

No. 682,152.

A. B. STETSON.

Patented Sept. 3, 1901.

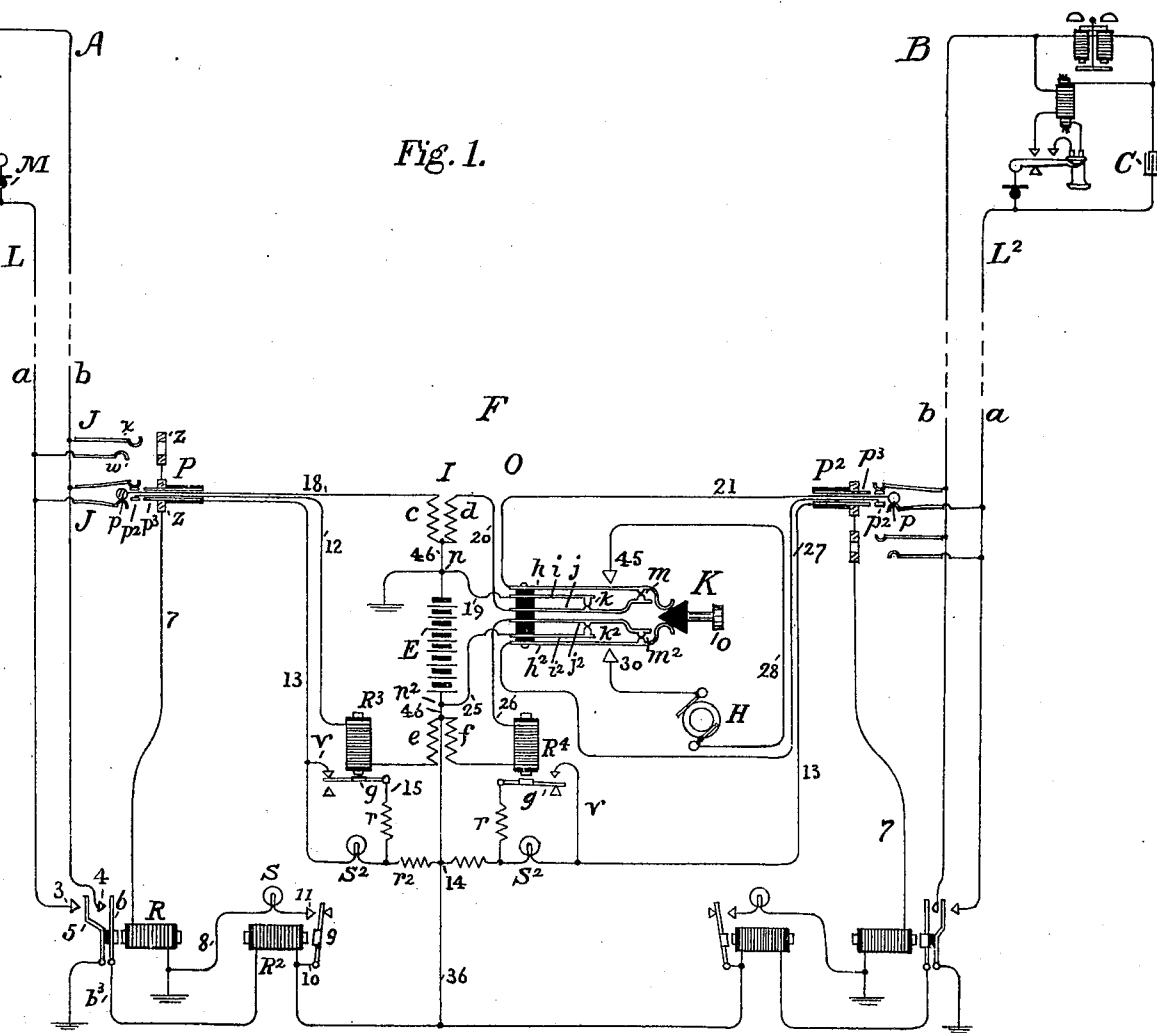
TELEPHONE EXCHANGE APPARATUS.

(Application filed May 24, 1901.)

(No Model.)

2 Sheets—Sheet 1.

Fig. 1.



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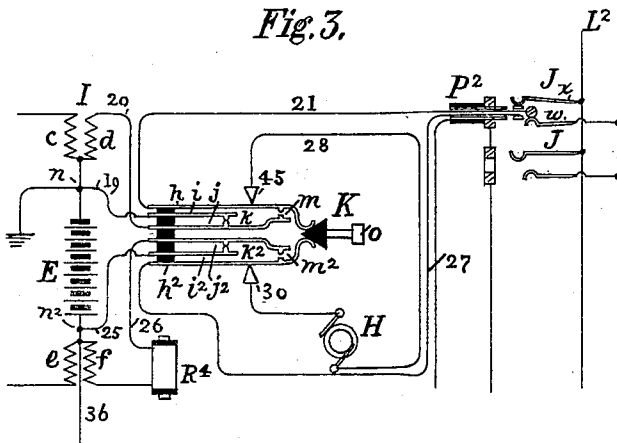
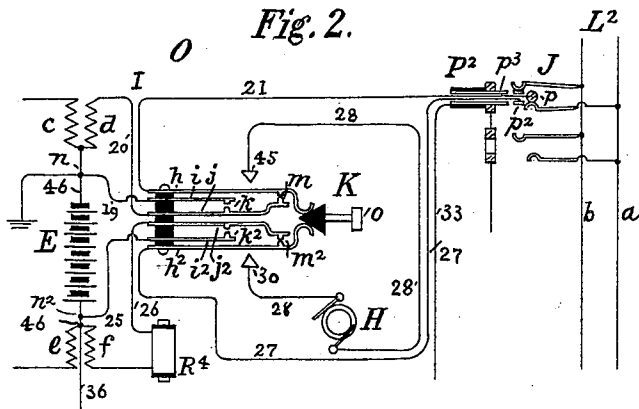
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(Application filed May 24, 1901.)

(No Model.)

2 Sheets—Sheet 2.



WITNESSES:

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TELEPHONE-EXCHANGE APPARATUS.

SPECIFICATION forming part of Letters Patent No. 682,152, dated September 3, 1901.

Application filed May 24, 1901. Serial No. 61,777. (No model.)

To all whom it may concern:

Be it known that I, ALMON B. STETSON, residing at Malden, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Telephone-Exchange Apparatus, of which the following is a specification.

In telephone-exchange systems constructed and operated on the central-battery plan, wherein the requisite current for the transmitters or signals, or both, is supplied from a central and common source, disagreeable "clicks" or harsh rasping sounds or noises are frequently produced by and heard in the receiving-telephones at subscribers' stations, such sounds being especially noticeable and annoying in the receiver of a subscriber who has initiated the call and who pursuant to such call is awaiting the outcome thereof with the receiver at his ear. The said clicks or noises are attributable to a variety of causes; but the special disturbance to which this invention particularly addresses itself occurs after the call of the subscriber has been responded to and the order for the desired number given, but before the substation called for has answered, and is due to a phenomenon attending the operation of the ringing-key when the operator "rings up" the wanted station. It is therefore quite distinct from such clicks or noises as are manifested when in response to the original call the operator inserts the answering-plug or when the called station responds by taking the receiving-telephone from its switch, thereby conductively closing the circuit at said station.

In the normal manipulation of the ringing-key by the central-station operator to call the second or wanted station, the circuit-conductors within the switch-cord extending from the station giving the call are severed, the circuit in that direction being thus opened, and the ringing-current from the call-generator traverses the line conductors of the wanted substation only, which in virtue of their electrostatic capacity become charged by the said ringing-current. When the ringing operation ceases and the ringing-key is released, the line discharges through the cord-circuit repeating-coil winding, which

is again conductively connected with said line, and this discharge acting inductively through the other winding of the said coil, the same being in the circuit of the calling-line, reaches the telephone of the calling subscriber and produces therein the sharp objectionable noise which has been mentioned herein. It has been found that this reaction is especially pronounced when the called-subscriber's line has a considerable electrostatic capacity—as, for example, when the said line passes through a cable.

The object of my invention is to prevent the manifestation of disagreeable and annoying sounds of this class in the receiving-telephone of the substation making the call; and to this end the said invention consists in providing the switch-cord and its associated ringing-key with means for preventing the discharge or return current from acting upon the repeating induction-coil by diverting the said discharge through an alternative channel of lesser resistance; also, in combining the said switch-cord and ringing-key with a circuit-closing device actuated by said key and adapted to short-circuit the repeating-coil winding and establish an alternative conductive channel for the discharge-current of the called line of resistance low relatively to that of the said winding during the application of the ringing-current to the line of the station wanted and momentarily thereafter, thus preventing the annoying click otherwise manifested in the receiver of the calling-station; also, in the combination of two substation telephone-circuits, switching devices adapted to unite them for the formation of a through talking-circuit, a central-station battery or source bridged across said through-circuit and furnishing a supply of current for both of the elemental circuits thereof, a repeating induction-coil associated with said switch devices and having its windings connected in the said two component circuits, respectively, a ringing-key associated with said switch devices and arranged between said repeating coil and the wanted line to send call-signals thereover to the substation thereof, and means controlled by the operation of said ringing-key

for short-circuiting the repeating-coil winding of said wanted line during the operation of said key and for a brief interval of time thereafter, whereby a channel or path around
 5 said coil-winding and of lower resistance is constituted for the passage of a discharge-current from the called line and whereby the said current is prevented from producing disturbing noises or clicks in the receiving-tele-
 10 phone at the substation of the calling-line.

In the accompanying drawings, whereby the invention and this specification are illustrated, Figure 1 is a diagram showing two substation-circuits united by switchboard
 15 devices with which are associated the ringing-key and my means for preventing the manifestation in the substation-receiver of one of the circuits of disturbance produced by the discharge-current from the other circuit. Figs. 2 and 3 are diagrams of the call-
 20 ing-key and a portion of the switchboard connections, showing the ringing-key and the shunting or short-circuiting devices for diverting the said discharge-current from the
 25 repeating induction-coil under the diverse conditions assumed at different periods of operation.

In Fig. 2 the ringing-key is represented as being in its quiescent normal or resting condition, while Fig. 3 represents the said key
 30 in the act of being manipulated, the spindle thereof having been pressed to send a ringing-current to the station which is to be signaled; but in Fig. 1 the key is represented
 35 in the condition it assumes when subsequent to the operation thereof to send the ringing-current it has been released and been allowed to return and resume its position of rest, but
 40 before the key-springs have had time to reach such normal condition or position of rest. Fig. 1 of the said drawings shows two main-
 45 telephone substation-circuits L L^2 , indicating any two circuits of a standard central-battery exchange system, the said circuits extending from the substations A and B , respectively, to the central or switchboard station
 50 F , where they are represented as being united to form a compound circuit for through communication between the said substations
 55 by means of switchboard devices comprising spring-jacks or sockets J ; permanently connected with the circuit-conductors, and switch-cords O , having main and local conductors and terminal plugs P P^2 , adapted
 60 for insertion within said sockets in a manner well understood. At both central station and substations the line connections and appliances are of usual and standard character. At the former the conductors a and b end in the contact-stops 3 and 4 of a cut-off relay R
 65 and by the armature-contacts 5 and 6 of the relay are, when the line is at rest, continued, respectively, to earth and through the winding of the line or call-relay R^2 to the ungrounded pole of the central source of current E by conductors b^3 and 36. The said call-relay R^2 controls a local circuit,

which may be formed of a branch 10, extending from conductor 36, and an earth
 70 conductor 8 and which contains the lamp-signal S , and passes through the line-relay armature-lever 9 and its contact-stop 11. The switch-sockets J of the main circuits
 75 are provided with the ordinary connection-springs w and x , representing the main conductors a and b , and with the test-rings or frame-piece contacts z , all of the said rings
 80 of each line being joined to one another conductively by the conductor 7, grounded after passing through the coil of the cut-off relay R . At the substations when the receiver t is in place on the switch-hook the
 85 circuit leads through the condenser C and the magnet-coils of call-bell D ; but when the receiver t is taken from the hook a conductive path is established between conductors
 90 a and b by way of the switch s and conductor 1, the said path including the secondary helix of the transmitter induction-coil I^2 , while the primary winding of the said
 95 coil, the receiving-telephone t , and the microphone M are brought into a short circuit, which contains also the condenser C . The central-station switchboard comprises, of
 100 course, as many of the switch-cords O as are necessary for the proper conduct of the business. Each cord, with its terminal plugs, may be regarded as having two sections separated
 105 conductively but united inductively for the through transmission of voice-currents by the induction-coil I . The common battery E supplies current to both sections, and consequently to the main circuits to
 110 which they are respectively switched, and forms a portion of conductor through which both sections are completed, being for the section of the answering-plug P placed between the two halves c and e of one winding
 115 of the induction-coil and for the section of the companion plug P^2 between the corresponding halves d and f of the other winding of said coil. The pole of the battery nearest to the c and d halves of the plug is grounded. The section or loop of plug P extends from the tip contact-surface p of said
 120 plug to the ring contact-piece p^2 thereof by way of the cord conductor 18, winding c e , and the interposed battery and conductor 12, and the other section is similarly provided
 125 with cord conductors 21 and 27, connecting with the two poles of the source, respectively, through the two half-windings d and f . The local-circuit conductors 13 branch in the usual way at point 14 from the battery-wire 36 and lead through the supervisory signals
 130 S^2 and their regulating resistances to the third plug contact-surfaces p^3 , the circuit being completed through the socket-frame z and its earth-wire extension-conductor 7, the said signal being (also in the usual manner) actuated by a shunt-circuit v , containing a suitable resistance r and leading through the armature g and its front contact-stop of the supervisory relay R^3 or R^4 , which relays

have their magnet-coils in the main-conductor plug-sections, respectively. The ringing-key K is shown as being associated with the cord-section of the companion plug P² only, since ordinarily it is the wanted station only which has to be rung or called for. H is the call-generator and is preferably an alternating-current magneto-generator. The said key (so far as its operative features in sending the call-signal are concerned) comprises two principal springs *h* and *h*², having back-stops 30 and 45, with which they may be brought into contact when they are caused to diverge from their normal position by pressing the button *o* to operate the key, and two inner springs *j* and *j*², which normally make contact at *m* and *m*² with the said principal springs, respectively. The principal springs *h* *h*² are united by conductors 21 and 27 with the tip and ring contact-pieces *pp*² of the calling-plug P². (Shown as being inserted in socket J.) The back-stops 30 and 45 are the terminals of the call-generator and are united thereto by conductors 28, and the internal springs *j* *j*² connect by conductors 20 and 26 with the outer ends of the induction-coil half-windings *d* and *f*. The effect of this arrangement is that when the key is out of operation or quiescent, as shown in Fig. 2, the source of current E and the split induction-coil winding *d* *f* are serially connected in the substation-circuit L², and the current from said source can flow out thereover through the said split winding. The circuit starting from the plus pole of the battery may be thus traced: through the half-winding *f*, supervisory relay R¹, conductor 26, inner key-spring *j*², contact *m*², outer spring *h*², conductor 27, plug-contact *p*², main conductor *b* of substation-circuit, and back from main conductor *a* by plug-tip contact *p*, cord conductor 21, key-spring *h*, contact *m*, inner spring *j*, conductor 20, and the half-winding *d* to the negative-battery pole. When the key is being operated to send the signal, the springs assume the position shown in Fig. 3. The contacts at *m* *m*² between the principal and inner springs are broken, the battery and induction coil being thus severed from the substation-circuit, and the said principal springs *h* *h*² are forced into contact with their back-stops 45 and 30. The call-generator H is thereby brought into the substation-circuit and the ringing-current is permitted to flow over circuit L² to actuate the call-bell at the substation thereof. When the ringing has been performed, the pressure upon the key-button *o* may be relaxed, or, in other words, the key may be released and the springs resume their normal position. In pursuance, however, of this invention two auxiliary springs *i* *i*² are incorporated in the key K and placed between the springs *h* *j* and *h*² *j*². These extra springs are permanently united by conductors 19 and 25 with the conductor 46, which includes the source of current E at points *n* and *n*² between the two poles of said source and their associated

induction-coil sections. During the quiescence of the key the springs *i* *i*² are free from contact with any of the other key-springs and may therefore, together with their connecting-conductors 19 and 25 and the battery E, be regarded as a normally discontinuous shunt or alternative branch path, which under certain possible conditions may be brought into connection with the line-circuit in parallel with the relatively high resistance path to the battery-poles through the windings *d* *f* of the induction-coil. While the key is being manipulated, as in Fig. 3, to send the call-signal, the inner springs *j* *j*², freed from the pressure of the principal springs *h* *h*², move by their own resiliency into contact at *k* *k*² with the shunt-springs *i* *i*², and when the call having been made the key button is released the springs before resuming their respective normal relation temporarily assume the position shown in Fig. 1, wherein the two sets of contacts *m* *m*² and *k* *k*² are both for an instant closed, thus restoring the connection of the main-line conductors with the battery and induction-coil, but also establishing momentarily for the said line a short circuit through the battery and around the induction-coil windings, the resistance thereof being of course low relatively to that of the normal path of the circuit through said windings. Immediately subsequent to the establishment of the said short circuit the contacts *k* *k*² are again separated and the key reassumes its normal condition, as shown in Fig. 2. When the ringing-key K is operated and its springs *h* *h*² forced by pressure of the button *o* into contact with the terminals 45 30 of the call-generator, the alternating current from said generator flows over the line L² for the operation of the bell at the substation B. Owing to the capacity of the main conductors the line becomes statically charged. The subsequent release of the key disconnecting the call-generator and reconnecting the points *m* *m*² enables the line to discharge, or in other words, to deliver a return-current impulse, which unless prevented passes through the induction-coil windings *d* and *f*. This discharge impulse inductively develops a similar current in the other winding *c* *e* of the induction-coil, which passing through the cord conductors of the answering-plug section and over the substation-circuit connected therewith, including the substation-receiver *t*, produces the objectionable click in the latter; but when pursuant to my invention the key is provided with the auxiliary springs *i* *i*², serving, in cooperation with the springs *j* *j*², as a circuit-closer for the normally discontinuous alternative path around the coil-winding comprising the conductors 19 and 25 and the battery E and adapted on the release of the key to short-circuit the said coil-windings *d* and *f*, the induction-coil remains unaffected by the discharge and the disturbing noise is not manifested in the receiver *t*

at station A, for under such improved conditions the key is obviously arranged in such a manner that its release first severs the call-generator connection at the contacts 45 30, next closes the connection at $m m^2$ between the springs $h h^2$ and $j j^2$, and lastly severs the connection at $k k^2$ between the springs $j j^2$ and $i i^2$.

At the moment when the two sets of contacts $m m^2$ and $k k^2$ are both closed, as shown in Fig. 1, it will be seen that at the points $k k^2$ two parallel routes present themselves to the discharge or return current of the line, one composed of the induction-coil helices d and f and the battery E and the latter short-circuiting the said helices and substantially containing the said battery alone. Since the resistance of the latter is extremely low relatively to that of the former, practically all of the said discharge-current passes that way, being thereby diverted from the induction-coil, which remains unaffected. As a consequence the annoying click or noise in the receiver at the calling-station is prevented.

Having thus described my invention and its operation, I claim—

1. In a central-battery telephone-exchange system, the combination with a switchboard having two conductive plug-sections; an interposed induction-coil uniting the said sections inductively; a ringing-key associated with one of said plug-sections; and a telephone-circuit connected with said plug-section and arranged to receive calling-current by the operation of the ringing-key associated therewith; of a path extraneous to the induction-coil through which the discharge or return current of said circuit is discharged at the close of said ringing operation, thereby preventing said current from acting upon the induction-coil.

2. In a central-battery telephone-exchange system, the combination with a switchboard having two conductive plug-sections; an interposed induction-coil uniting the said sections inductively; a ringing-key associated with one of said plug-sections; and a telephone-circuit connected with said plug-section and arranged to receive calling-current by the operation of the ringing-key associated therewith; of means for preventing the discharge or return current of said circuit at the close of said ringing operation from acting upon the said induction-coil, by diverting the same through an alternative channel of lesser resistance; substantially as set forth.

3. In a central-battery telephone-switchboard apparatus the combination of a switchboard having answering and companion terminal plugs; an induction-coil having its windings in circuit with the main-line contacts of the said plugs respectively; a main-telephone circuit connected with said companion plug and including a winding of said induction-coil; and a ringing-key associated with said cord and companion plug, and adapted when operated to send calling-cur-

rent over said main circuit; with a normally discontinuous or incomplete short circuit around the said induction-coil winding, of low resistance relatively thereto; and a circuit-closing device actuated by said ringing-key on its release, to momentarily complete the said short circuit, and establish thereby a transient alternative conductive channel for the return-current or discharge of said main circuit; substantially as and for the purposes set forth.

4. In a central-battery telephone system, the combination of two substation telephone-circuits: switching devices organized to unite them for the formation of a through talking-circuit; a central-station battery bridged across said through-circuit and furnishing a supply of current for both of the component circuits thereof; a repeating induction-coil associated with said switch devices, and having its windings connected in the said two component circuits respectively; a receiving-telephone in one of the said component circuits; a ringing-key associated with said switch devices and arranged between said repeating induction-coil and the other of said component circuits, to send signaling-currents over the latter to the substation thereof; a normally discontinuous short circuit including said battery arranged around the induction-coil winding of said called-for line; and means as indicated, controlled by said ringing-key, for closing the said short circuit around the said coil-winding during and for a brief period of time after the operation of said ringing-key; substantially as and for the purposes described.

5. In the central-station switchboard apparatus of a central-battery telephone-exchange the combination with the switch-cord circuit O, having answering and companion switch-plugs; the common battery E bridged between the main conductors of said cord; the induction-coil I, having its windings associated with the said plugs respectively, and having one-half of both windings on each side of said battery; and the ringing-key K, having two sets of terminal springs $h h^2$ and $j j^2$ normally in contact with each other to maintain normal continuity between the companion-plug contacts, and the two halves of its induction-coil winding, and a set of auxiliary springs $i i^2$ united electrically to points on the battery-bridge between the poles of said battery and the half-windings of said induction-coil, the said auxiliary springs being normally disconnected in said key, but adjusted to cooperate as a circuit-closer with the springs $j j^2$ during the operation of said key and momentarily thereafter, and thereby during the pendency of said contact to short-circuit the said induction-coil winding; substantially as and for the purposes described.

6. The combination of a telephone-circuit composed of two substation-circuits united in a central-station switchboard by a switch-cord connection comprising an answering-

plug section and a companion-plug section, a repeating induction-coil inductively uniting the said plug-sections and having a centrally-divided winding in each; a central battery in a bridge between the two half-windings of both sections, having its poles connected with the inner terminals of said windings; and an independent generator at said central station supplying currents for the transmission of outgoing call-signals; with a ringing-key in the companion-plug cord-section normally maintaining the continuity of the conductors thereof between the battery, induction-coil winding and plug-contacts, but adapted when operated to sever the said conductors, to connect the portion leading to the

plug with the terminals of said independent generator, and on the cessation of such operation to restore the continuity of said conductors, and to momentarily provide them with a short circuit for their discharge around the said induction-coil windings, and through said battery, substantially as described. 20

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 9th day of May, 1901. 25

ALMON B. STETSON.

Witnesses:

GEO. WILLIS PIERCE,
FRANK C. LOCKWOOD.

It is hereby certified that in Letters Patent No. 682,152, granted September 3, 1901, upon the application of Almon B. Stetson, of Malden, Massachusetts, for an improvement in "Telephone-Exchange Apparatus," errors appears in the printed specification requiring correction, as follows: In lines 43 and 58-59, page 4, the word "switch-board" should read *switchcord*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 17th day of September, A. D., 1901.

[SEAL.]

F. L. CAMPBELL,
Assistant Secretary of the Interior.

Countersigned:

F. I. ALLEN,
Commissioner of Patents.