(No Model.)

J. S. STONE.

TELEPHONE SIGNALING CIRCUIT.

No. 563,692. Patented July 7, 1896.

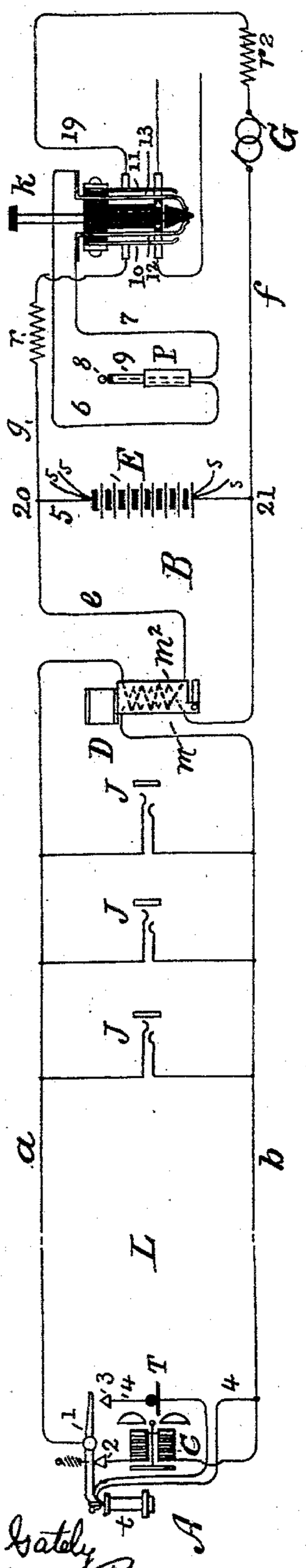

Fig. 1.

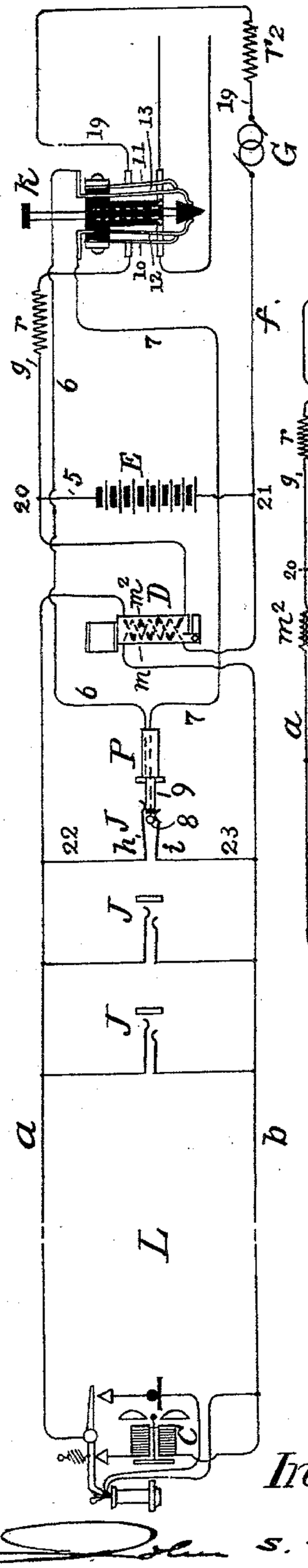

Fig. 2.

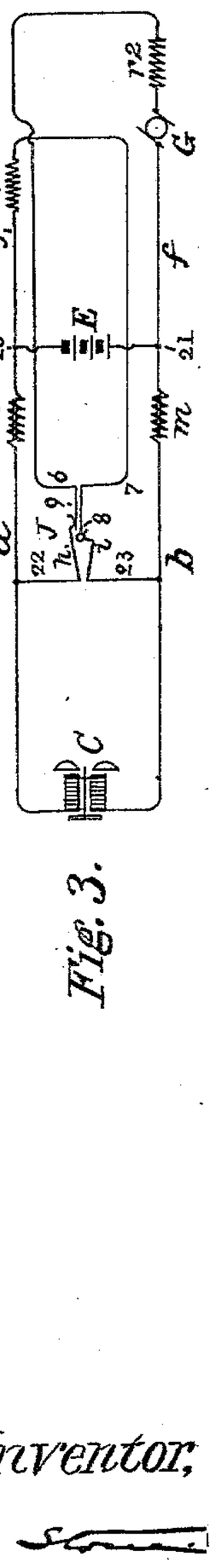

Fig. 3.

Attest.
Joseph A. Gately
Evan Ellis Pierce

Inventor,
J. S. Stone

UNITED STATES PATENT OFFICE.

JOHN S. STONE, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO THE AMERICAN BELL TELEPHONE COMPANY, OF SAME PLACE.

TELEPHONE SIGNALING-CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 563,692, dated July 7, 1896.

Application filed March 18, 1896. Serial No. 583,794. (No model.)

To all whom it may concern:

Be it known that I, JOHN S. STONE, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Telephone Signaling-Circuits, of which the following is a specification.

In branch terminal telephone-exchange systems employing automatic calling apparatus a common centralized battery is normally connected with the substation-circuits through the line-signal, and the circuit being through the call-bell at the substation when the telephone is upon the hook-switch the armature of the bell is constantly attracted to the core of one of the bell-helices and acquires a tendency to adhere thereto, so that it is technically said to become "locked" or "biased," and when a substation calling-current is sent through the circuit from the central station the bell-armature fails to respond and the bell does not ring.

The object of the present invention is to provide means whereby this fault is overcome, and the bell-armature made free to respond to the signaling-current.

In such substation-circuits as those to which I refer the circuit-conductors are provided with normally open branch terminal switch connections upon each switchboard-section, and each conductor passes through a coil or winding in the line-signal to the poles of a common battery, and ordinarily in grounded circuits to prevent the substation-call-bell armature from thus becoming biased the bell-magnet is placed in series with a condenser, while in metallic circuits it is placed either in series with a condenser or in a branch to ground. There are objections to these devices, which need not be described here.

This invention permits the substation call-bell to be placed directly in the circuit when the telephone is on its hook-switch support, while the line-signal has a portion of its windings placed in series with each conductor, and the common battery for signaling the central station is connected directly with the said conductors, and it comprises the arrangement of the operator's plug-and-cord circuits in such manner that when a plug is inserted in a socket and the ringing-key is depressed the common central battery which furnishes current for incoming call-signals is introduced or placed across the circuit in a second branch in a direction opposite to that in which it is already connected through the line-signal, whose coils also serve as impedances and resistances, so that the biasing effect of the battery is neutralized, and the call-bell armature is made free to respond to current from the special generator which provides current for outgoing calls and which is automatically switched to the circuit by the depression of the ringing-key. Of course the same object would be attained in substantially the same way if the insertion of the plug and the concurrent operation of the key were made to connect the circuit in question with the opposite poles of an independent battery of like power, and since such a construction would clearly embody the spirit of the invention.

In the drawings, Figure 1 is a diagram of a substation-circuit and a portion of the operator's cord-circuit, both in a normal or quiescent condition. Fig. 2 is a similar diagram, the operator's apparatus being arranged for calling the substation; and Fig. 3 is a schematic drawing illustrating the operation of the circuits shown in Fig. 2.

L is the substation-circuit, whose conductors *a* and *b* extend from the substation A to the central station B. The conductor *a* connects the hook-switch 1 with one coil or winding section *m* of the line-signal or annunciator D, and to the negative pole of the common signaling-battery, which has a low internal resistance, and conductor *b* connects the contact 2 and the bell C with the second coil-section m^2 of the winding of the signal appliance D to the positive pole of the battery E. Branch terminal jacks or plug-sockets J represent the circuit upon the respective sections of the switchboard. As much of the operator's cord-circuit as is necessary to illustrate the invention is shown, and consists of a plug P, whose tip 8 is connected by wire 7 with spring 12 of the ringing-key *k*, and whose sleeve 9 connects by wire 6 with the opposite spring 13. The spring 10 of the key is united by wire *g*, including resistance *r*, to point 20, and the complementary spring 11 is united by wire 19, through resistance r^2,

to one terminal of the substation calling-generator G, the other terminal of which is connected by wire *f* with point 21.

In the operation of the invention, when a substation is to be called, the plug P is inserted in a socket J, its tip 8 making contact with the spring *i* and its sleeve 9 with the spring *h*. This does not affect the relation of the battery E and the substation-bell C as long as the key *k* remains unoperated, because, as clearly indicated in Fig. 1, the cord-conductors 6 and 7 terminate in the springs 12 and 13, at both of which the circuit is open. When, however, the said key is depressed, as shown in Fig. 2, a new relation is brought about, for the said springs 12 and 13 are thereby forced into contact with their associate springs 10 and 11, the former of which, by wire *g* and resistance *r*, connects with the negative pole, and the latter, through wire 19, resistance r^2, and the calling-generator G, with the positive pole of the battery E. The result of this is that while the battery E still maintains its normal connection with the substation call-bell C (its positive pole being connected therewith through main conductor *b*, and its negative pole through main conductor *a*) a second connection is also established between the said battery and call-bell, in which the polar arrangement of the former is reversed, the positive pole now being also connected with the bell through conductor *a* and the negative pole through conductor *b*. This second route for the battery-current is traceable from its positive pole through point 21, conductor *f*, generator G, wire 19, resistance r^2, key-springs 11 and 13, conductor 6, plug-sleeve 9, socket-spring *h*, branch 22, main conductor *a*, bell C, main conductor *b*, branch 23, socket-spring *i*, plug-tip 8, conductor 7, key-springs 12 and 10, wire *g*, resistance *r*, and point 20 to the negative battery-pole.

It is evident that during the operation of the key other branch circuits for the battery-current are likewise formed, which divert a portion of the said current in any case from the main line. One of these leads from the positive to the negative pole of the battery through point 21, section m^2 of the annunciator, branch 23, socket-spring *i*, plug-tip 8, conductor 7, key-springs 12 and 10, wire *g*, resistance *r*, and point 20; and another unites the said poles through conductor *f*, generator G, wire 19, resistance r^2, key-springs 11 and 13, conductor 6, plug-sleeve 9, socket-spring *h*, branch 22, conductor *a*, section *m* of annunciator-winding, and point 20. All of these several circuits are more easily traceable in the diagram, Fig. 3. By this arrangement, as already stated, a portion of the battery-current is diverted from the substation-line and through the said derived circuits; and such portion of current as would remain to otherwise pass through the main circuit in a given direction, and which would therefore tend to maintain the undesired quiescence of the bell-armature, is neutralized by a substantially equal current which in virtue of my invention passes through the main circuit and substation call-bell oppositely when the key is depressed to send the outgoing call; or, more properly speaking, the operation of said key impresses upon the main circuit by means of the original source of current an electromotive force substantially equal in strength but opposed in direction to the electromotive force already impressed upon such circuit by the same source in its normal connection, and a zero of unidirectional current through the bell is thereby produced as long as the key remains depressed, though the battery connection is maintained. When the key *k* is pressed, the calling-generator G is also introduced and an alternating current is sent through the circuit as follows: starting from the right side of the generator by wire 19, resistance r^2, springs 11 and 13, wire 6, sleeve 9 of plug P, spring *h* of socket, branch wire 22, conductor *a*, bell C, conductor *b*, branch wire 23, spring *i* of socket, tip 8 of plug P, wire 7, springs 12 and 10 of key, wire *g*, and resistance *r* to point 20, bridge 5, and battery E to point 21, and by wire *f* to the other side of the calling-generator; and the bell C, being untrammeled by current from the battery E, responds readily and promptly to current from generator G.

When the plug is inserted and the key is depressed, the entire organization may be regarded as a signaling-circuit, constituted of the original substation-circuit, and the operator's keyboard circuit or loop.

The alternating currents of the call-generator traverse this circuit, as already explained, while for the time and as long as the key is depressed the annunciator-coil m^2 is brought into a bridge or shunt circuit between the points 22 and 20, and the annunciator-coil *m* into a similar circuit between the points 23 and 21.

The coils $m\ m^2$ of the line-signal D are made to offer a considerable impedance to the alternating currents from the calling-generator, which therefore is not appreciably diverted through them.

The function of the resistances $r\ r^2$ is to balance the calling-circuit, as when the fall of potential from battery E through $r\ r^2$ and generator G is equal to the fall of potential from battery E through the coils $m\ m^2$ there will be no potential from generator E impressed upon the circuit *a b*.

Having now fully described the invention, I claim—

1. The combination of a telephone-circuit extended between a substation and a central station, and containing a polarized bell at the former and switch connections at the latter station; and a battery at the central station normally and constantly connected directly with the conductors of said circuit and impressing thereon an electromotive force of constant direction; with means for connecting the poles of the same or an equal battery

reversely with the said circuit-conductors, through the switch connections thereof, and for thereby impressing an equal and opposite electromotive force upon said circuit; substantially as, and for the purposes described herein.

2. In combination with a telephone-circuit extended between two stations, a polarized call-bell connected therewith at one station, switch connections at the other station, and a battery constantly connected with the two conductors of said circuit directly, and normally maintaining a current of given direction through said bell; a normally open loop extending to the said circuit-conductors from the opposite poles respectively of the said battery through the said switch connections, and a circuit-closing key in the said loop controlling the continuity thereof, and adapted when operated to neutralize the normal line-current, by an opposed current of like strength from the same source, substantially as described.

3. The combination of a polarized call-bell at a substation, and switch connections, a battery and a circuit-closing call-key at a central station, with a main telephone-circuit extending between the said stations, the two conductors of such circuit having a direct permanently-closed connection with the two poles respectively of the said battery, and a normally open connection through the said switch connections and key, each with an opposite pole thereof; whereby when the said key is operated the said battery is enabled to impress equal and opposite electromotive forces upon the circuit, and to produce therein a zero of battery-current.

4. A telephone-circuit extended between a substation and a central station, a polarized call-bell connected therewith at the former station, and switch connections, and a battery whose poles are constantly connected with the main-circuit conductors direct, at the latter station, normally maintaining a current in the said circuit; combined with a normally open loop or operator's circuit extending to the said circuit-conductors from the opposite poles respectively of the said battery, through the said switch connections, an alternating-current call-generator in the said operator's circuit adapted to furnish current for the operation of said bell, and a circuit-closing call-key also contained therein controlling the continuity thereof, the reverse current of the battery, and the operation of the call-generator, substantially as specified.

5. The combination substantially as hereinbefore described of a telephone-exchange metallic circuit extended between a central station and a substation, an electric bell responsive to alternating currents at the substation in the said circuit, a signal-receiving instrument having half of its winding in one and half in the other conductor of said circuit, a battery connected directly with the conductors of said circuit and supplying current in a definite direction thereto, and switch connections for said circuit all at the central station, with a normally open operator's keyboard circuit or loop adapted for connection with the said keyboard-circuit at its switch connections, an alternating-current call-generator, the said battery, and a call-sending key controlling the battery-terminals, and the continuity of the call-generator circuit, all included in said loop; the said battery having its poles connected with the key so that when the said key is operated to transmit call-currents to line, it is enabled simultaneously to supply a battery-current to line in a direction opposite to that supplied to the line by the same battery direct.

6. In a telephone-exchange system, a signaling-circuit formed of a substation-circuit provided with branch terminal switch-socket connections in discontinuous bridges at the central station, and an operator's keyboard circuit or loop terminating in a switch-plug inserted in one of the said sockets, a polarized call-bell in said circuit at the substation an alternating call-generator at the central station to actuate the same; a circuit-closing and signal-sending key controlling the said generator; a battery having two independent connections with the said circuit, one in which its poles are permanently united to the conductors thereof to supply a normal current of definite direction thereto, and the other through the call-key and plug and socket, in which the polar connection is reversed with respect to the said conductors to supply an equal and neutralizing current to the said circuit, when the said key is operated to actuate the call-generator; and a call-annunciator in the said circuit having a portion of its winding in each main conductor thereof at points between the permanent battery connections, and the switch-socket connections to constitute impedance-coils, operating to prevent the short-circuiting of the alternating generator call-currents all substantially as specified and for the purposes set forth.

7. In a telephone-exchange, a signaling-circuit consisting of a telephone substation-circuit, and an operator's normally open keyboard circuit or loop; the former provided at the substation with a call-bell, and at the central station with discontinuous bridges including branch terminal spring-jacks, a low-resistance battery having its poles in permanent connection with the ends of its conductors, and with a call-receiving annunciator having coils of high impedance, one of which is located in each of the said conductors, between the spring-jacks, and the battery; and the latter comprising a plug inserted in one of the said spring-jacks, a ringing-key, an alternating-current generator to send outgoing calls, and equalizing or balancing resistances; the key connections being such, that when the said key is depressed the call-generator, a reversed battery, the equalizing resistances and the substation call-bell are all placed in

series in the signaling-circuit, and the high-impedance annunciator-coils placed in shunt-circuits extending respectively one from the plug and spring-jack connection to one pole of the battery, and the other around the said battery substantially as specified.

8. The combination with a metallic calling-circuit provided at one terminal with a call-bell and at its other terminal with a spring-jack in a bridge, an impedance-coil in series with each conductor, and a normally-connected battery in a bridge supplying current for incoming signals; of a plug inserted in said spring-jack having in series with its tip and sleeve conductors the said battery reversed, a calling-generator, and two balancing resistances, as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 13th day of March, 1896.

JOHN S. STONE.

Witnesses:
GEO. WILLIS PIERCE,
JOSEPH A. GATELY.