(No Model.)

W. B. VANSIZE & T. D. LOCKWOOD.

AUTOMATIC CIRCUIT CHANGER AND ALARM.

No. 313,841. Patented Mar. 10, 1885.

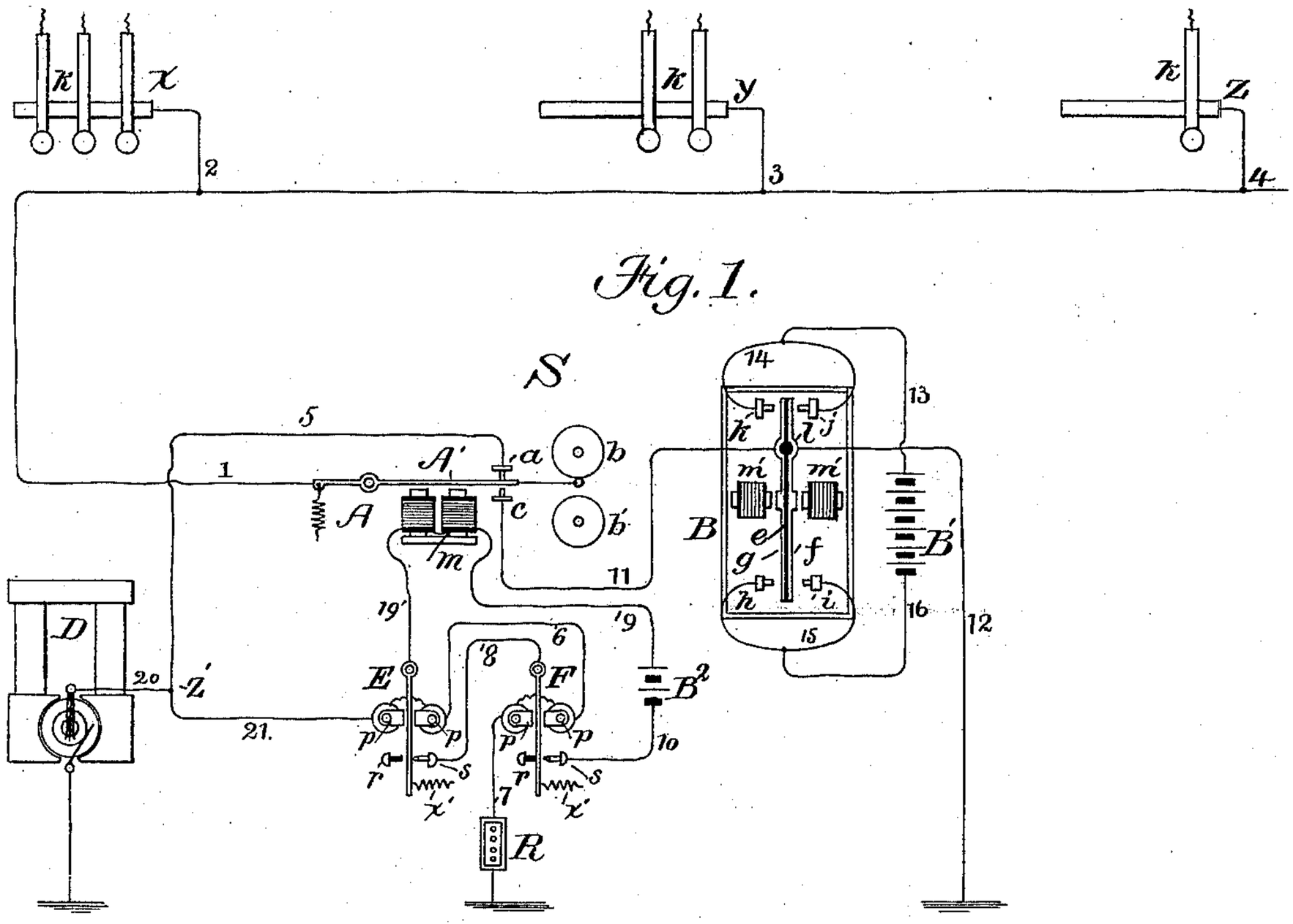

Fig. 1.

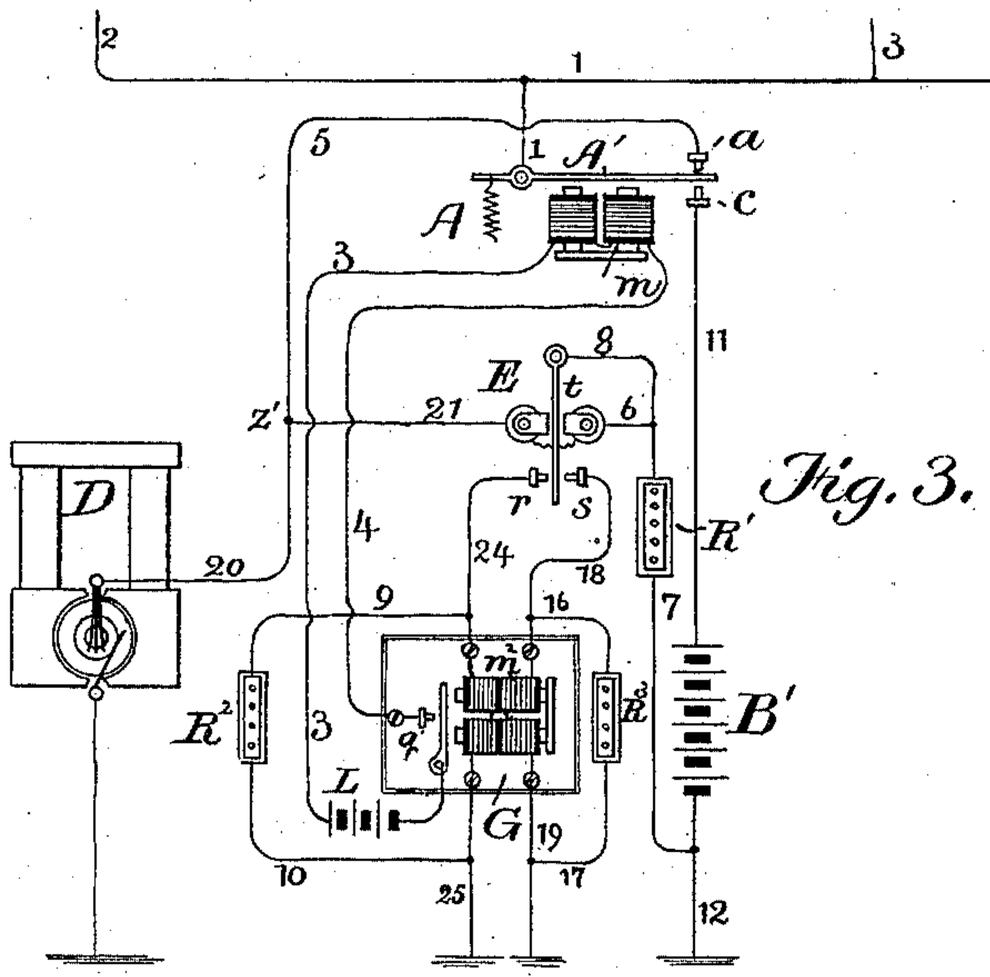

Fig. 3.

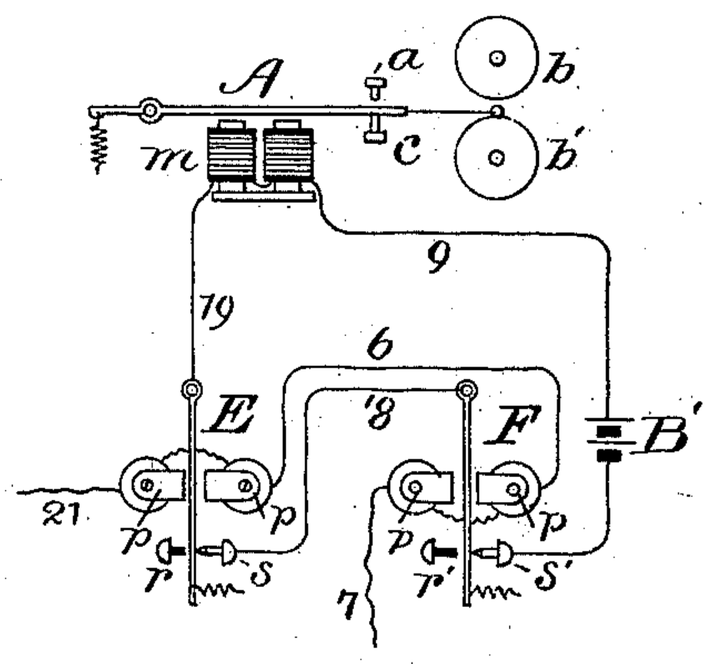

Fig. 2.

Witnesses.
Alfred M. Allen.
Geo. Willis Pierce

Inventors.
Wm. B. Vansize
Thos. D. Lockwood

UNITED STATES PATENT OFFICE.

WILLIAM B. VANSIZE, OF BOSTON, AND THOMAS D. LOCKWOOD, OF MALDEN, MASSACHUSETTS.

AUTOMATIC CIRCUIT-CHANGER AND ALARM.

SPECIFICATION forming part of Letters Patent No. 313,841, dated March 10, 1885.

Application filed September 6, 1884. (No model.)

To all whom it may concern:

Be it known that we, WM. B. VANSIZE, of Boston, in Suffolk county and State of Massachusetts, and THOMAS D. LOCKWOOD, of Malden, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Automatic Circuit-Changers and Alarms, of which the following is a specification.

Our invention relates to the transmission and controlment of electric signals, and especially to that class of signaling employed in central-office systems of electrical communication wherein a number of sub-stations are connected by wire with a central station, and may be signaled therefrom for the purpose of attracting their attention. Such an organization is the well-known telephone-exchange system. On the score of economy and increased efficiency and speed of operation, as well as to reduce the manual work of the operation, it has long been customary to use, in lieu of a separate calling electrical generator for each operator, a single magneto-generator sufficiently large to furnish dynamic electricity for the entire exchange, and provided with a normally-open main circuit and a series of branch circuits leading therefrom to the several switch-boards of the system, where, by suitable directing-keys and switching devices, the current developed by the generator may be directed to any desired line-circuit, and over said line to ring the electro-magnetic bells connected thereon. The generator, being necessarily in continuous or constant operation, is driven by power of any convenient character, such as a water-motor or steam or gas engine, and inasmuch as it is often difficult to find such source of power at or near the central station it has been found very convenient to set up the generator at the location of the power, irrespective of its distance from the central station, and to connect it with the said central station by a main wire of comparatively large size. The call-bells of telephone-stations are polarized—that is, they are constructed to respond to currents of rapidly-alternating direction—such bells being found to be more generally serviceable under the varying conditions than bells operated simply by the charge and discharge of electro-magnets due to the alternate presence or absence of the current, and it thus becomes requisite to provide a generator adapted to produce alternating currents. A constantly-operating pole-changer and a strong main battery may of course, if preferred, be substituted for the generator, and in this case the external source of power may be dispensed with; but experience has demonstrated that a magneto-generator is more efficient. It frequently happens, however, that when a generator is dependent upon an external source of power for its moving force the said external source temporarily fails, and that without giving any notice to the operators who are utilizing the currents developed for signaling purposes. For example, the steam-engine may be suddenly stopped for repairs, or a gas-engine supply may be turned off, and in either case the operators have no means of ascertaining the futility of their efforts to call until complaint is made. To obviate the annoyance due to such a casualty, and at the same time to furnish an automatic circuit-changing device actuated by the generator itself, so that the normally-open signaling branches may be transferred to another supply of electricity when the engine stops and may be restored to the normal connection when the engine again recommences its work, is the object of our invention. This is somewhat complicated by the fact that the outgoing main circuit is normally open, and it is thus rendered impossible to place an electro magnet therein which shall assume different states or conditions depending upon the activity or quiescence of the engine. We have, however, invented certain arrangements of circuits and devices by which an electro-magnetic switch is controlled by the generator itself to direct the current of said generator to any desired point when it is working efficiently, and to substitute a second source of electricity therefor when from any reason the said generator fails to perform its functions.

In the drawings which illustrate and constitute a part of this specification, Fig. 1 is a diagram explanatory of one arrangement of circuits and instrumentalities whereby our invention may be carried out. Fig. 3 is a modification of the same, and Fig. 2 a detail of Fig. 1, showing a second condition of the local circuit.

In Fig. 1, D represents a magneto-generator adapted to develop electrical currents of rapidly-alternating direction, which may be driven by any suitable source of power, (not shown,) and which may be located near to said source, at any distance from the central or signaling station, to which it is connected by the wire 20. Entering the station S, the circuit bifurcates the main or signaling branch leading from the main wire by wire 5, contact-pin *a*, and then normally through the armature-lever A′ of the electro-magnet *m* to service-wire 1, and by branch wires 2, 3, and 4 to the different operators' tables or switch-boards *x*, *y*, and *z*. At these boards each wire terminates in a contact-bar, and by the pressure of the keys *k*, or by any equivalent device, the current of the generator may in a manner well understood by those skilled in the art be directed to any of the telephone or electric lines so as to ring the call-bells connected in circuit therewith. It will be observed that all the branch circuits are open or incomplete until connected to one or more of the line-circuits connected with the keys.

From any suitable point, *z′*, on the main wire 20, a branch wire, 21, leads through the magnet of the polarized relays E and F and a resistance, R, and the connecting-wires 6 and 7 to the ground or return. The polarized relays E and F are, as shown, connected reversely to one another in the circuit, so that a current of given direction passing through both electro-magnets will tend to deflect one of the armatures to the left and the other to the right. The resistance or rheostat R must preferably be higher than that of the longest line to be served, so that whenever the main circuit is closed upon any line the greater part of the current will pass that way. The pole-pieces *p* of the relays should be adjustable, and each of the right-hand pole-pieces should be adjusted a little closer than the opposite ones to the armatures, so that when the relays are at rest the armature will always settle on the right side. This may be assisted by the retracting-springs *x′*, which, though useful to aid the adjustment, are not indispensable.

The relay-armatures are fitted on each side with a limit-screw, one of which, *r*, is made of some non-conducting material, while the other, *s*, is of metal, and constitutes also a contact-point in the circuit of a local battery, as hereinafter described. The armatures are adjusted so that both will come to rest on the side which has the metal contact-stop.

The electro-magnetic circuit-changer A is set in any convenient place, and its electro-magnet *m* is included in the circuit of the local battery B^2, which circuit may be traced as follows: From one pole of the battery by wire 9 to electro-magnet *m*, thence by wire 19 to the armature of the polarized relay E. From the other pole of the battery B^2 a wire, 10, leads to the contact-stop *s′* of relay F. The armature of relay F is then united by wire 8 to the contact-stop *s* of relay E. Thus a local circuit is formed which is open at all times, except when both armatures rest upon the contact-stops simultaneously. When such a condition is effected, the local circuit is closed and the electro-magnet *m* is energized, attracting its armature, which is normally held back by a retracting-spring, breaking the contact of said armature with its upper limit or contact-stop, *a*, and bringing it into contact with the lower contact-stop, *c*.

B is a pole-changing apparatus kept in constant motion by means of the alternating attraction of the actuating electro-magnet *m′*, which is charged by a separate battery. (Not shown.) The rocking bar *e* of the pole-changer oscillates from side to side on the pivot *l* under the influence of the magnets *m′*, and makes contact at one terminal point of its swing with the points *k* and *i*, and on the other side with *j* and *h*. The main battery B′ has extending from one of its poles a wire, 13, leading by the two wires 14 to the two upper contact-screws, *k* and *j*, and from its other pole a wire, 16, leads by the wire 15 to the lower contact screws, *h* and *i*. The two metal sides of the rocking bar are insulated from one another, and one side, *f*, is permanently connected with the ground by wire 12, while the other side, *g*, is electrically united by wire 11 to the lower contact or limit stop, *c*, of the electric switch A. It is evident, therefore, that when the said electric switch is actuated by its electro-magnet and brought into contact with the lower stop, *c*, the wire 1 and its branches 2, 3, and 4 become the virtual terminal of the pole-changer and battery-wire 11, and the current alternations proceeding from the said battery may be directed to line, the change from the magneto-machine to the battery pole-changer having been made without the volition or knowledge of the operators, and solely by the action of the generator itself.

We are not restricted to the mode of connecting the polarized relays which have been described, as it is evident that they may be connected so that both armatures will by the same pulsation of electricity deflect in the same direction. This may be done by uniting the right terminal of the relay E to the left terminal of the relay F, and connecting the ground and rheostat wire 7 to the right terminal of F. In this case it will of course be requisite to transpose the limit-screws of one of the relays, so that when both armatures simultaneously deflect to either side one of them will uniformly strike the conducting limit-screw at the same moment the other strikes the non-conducting screw, the precaution being taken to bias both armatures as hereinbefore described, so that when the armatures cease to vibrate they will both rest on their conducting limit-screw.

A pair of bells, *b b′*, are provided, whereby the electro-magnetic switch-armature, lengthened and provided with a hammer for the purpose, may strike an audible signal, if de-

sired, at the moment of its change in either direction.

We will here describe the operation of our invention. The magneto-generator D being by means of power in a state of continuous revolution, generates an electrical current, which is constantly reversed in direction. The main wire leading from the generator divides, one branch leading to the switch-boards or keys, whereby the current is to be utilized for signaling, and ending there in normally-open sub-branches. The other branch leads through the two polarized relays and a resistance to ground, and is a permanently closed or complete circuit. The alternating current therefore flows in this circuit, and, passing through the relays, causes the armatures to vibrate from one side to the other at a rate of speed corresponding to the changes in direction of the current; but as each current (irrespective of its direction) always holds one of the armatures against one of the non-conducting limit-stops so long as any current at all is generated, the armatures are kept in a state of continual motion and the local circuit is not closed; but should the power fail or the generator become disabled, or from any reason the currents cease, the polarized relays become inert and the armatures yield to their bias, and both fall back on the conducting limit-stop, closing the local circuit, as clearly shown in Fig. 2. The electro-magnet of the circuit-changer is thus energized, and its armature drawn down to the lower limit-stop, whereby the bell is struck and a supply of electricity is at once provided from the relief-battery and pole-changer. This condition continues until the generator D once more becomes active, when the polarized relays resume the vibration of the armatures, the electro-magnetic switch releases its armature, which once more is retracted to the back contact, reconnecting the switch-board branches to the generator, and giving a single stroke on the bell-alarm.

It may not always be necessary to employ a pole changer in the relief branch, as in some cases the bells to be rung may be adapted to ring by a steady or intermittent but reversed battery-current, and in such cases the battery may be dispensed with, as in the modification we show in Fig. 3. In that modification we employ a somewhat different arrangement of circuits to accomplish the same end. The same electro-magnetic switch may be employed, and so far as the main wire 20 and the supply-wire 5 are concerned the arrangement differs in no way from that shown in Fig. 1, the wire 5 leading to the upper contact-screw, *a*, of the switch. A wire, 1, leads from the armature to the service-line 1 and the service branches 2, 3, and 4. The pole-changer B is omitted, the wire 11 running directly from the battery B′ to the lower contact-screw, *c*, of the switch A′. It may, however, be connected, if required.

The controlling branch may be connected with the main generator-wire at the point *z*′, and continue by wire 21 through the polarized relay E, wire 6, resistance-coil R′, wire 7, and ground-wire 12 to earth. By a shunt-wire, 8, the wire 6 is united with the armature-lever *t*, which vibrates, when influenced by the alternating currents of the generator, between the two limit-stops *r* and *s*. These are both contact-stops, as shown, and both connect with the neutral double-coil relay G. The contact-screw *s* connects with the hinder coil by wire 18, and the out-wire of the coil m^2 leads to earth. Similarly a wire leads from the contact-screw *r* by wire 24 to the front coil, the out-wire 25 of said coil leading to earth.

It will be observed that the two coils of the neutral relay G are wound oppositely, and are traversed alternately by the currents developed by the generator for each of the neutral relay-coils in turn by means of their connecting-wires and the contact-screws *r* and *s*. The armature *t* of the polarized relay and the wire 8 constitute a shunt round the resistance R′, which, as before indicated, must be of comparatively high resistance. When, now, an electrical impulse of positive direction passes through the polarized relay-coils, it tends to attract the armature in a given direction, say to the right. When its traverse is stopped by the contact-screw *s*, it is clear that a short circuit is completed through the hinder helix, and the positive impulse passing through this shunt magnetizes the neutral relay-core, attracting the armature away from its local contact or back limit-screw, *q*. This impulse lasts, however, but for an instant, and is rapidly succeeded by an impulse of negative character. The polarized relay-armature is drawn at once to the opposite side, making contact with the stop *r* and completing the shunt-circuit through the front coil of the neutral relay, the circuit of the hinder coil being previously broken. If the coils were wound in the same direction, there would be a moment of neutrality in the core while the polarity of the magnetism was changing, inasmuch as the second impulse being opposite in character to the first tends, also, under the same conditions, to produce the opposite magnetism. The coils, however, being wound reversely, as described, compensate for such change in the nature of the passing impulse, and consequently the same magnetism is practically maintained intact, and the armature remains attracted and away from the contact-point *q*. This result is also aided by the rapidity of the vibrations of the polarized relay-armatures and the close adjustment of the screws *r* and *s*, which in practice are screwed up very close, so as to reduce the travel of the armature *t* to a minimum.

The tendency to a zero of magnetism at the moment of change is also opposed by making the neutral relay-cores sluggish to magnetic changes. This can be done by shunting the two neutral relay-coils, the hinder one by the wires 16 and 17 and the resistance-coil R^3, and

the front one by the wires 9 and 10 and the coil R^2. These coils may be made adjustable and varied until the best results are secured. When the generator is in action, the armature of the neutral relay will now remain in its forward position, and the local circuit will remain open. When the generator stops, the cores of the relay G lose their magnetism and the armature falls back on the point *q*, closing the circuit of the local battery L through the wire 3, the electric switch-magnet *m*, the wire 4, contact-screw *q*, and relay-armature. The switch-armature is attracted and the service lines 1, 2, 3, and 4 and thus transferred from the generator-contact *a* to the battery-contact *c*, to be restored when the generator resumes its functions.

We do not restrict ourselves to the method we have described of making the relay-cores sluggish with respect to magnetic changes by shunting the cores thereof, as other modes may be employed. We may, for example, lengthen the cores, or we may incase them in brass or copper tubes, or construct them of hard or cast iron. Neither do we restrict ourselves to the use of a generator with permanent field-magnets, as it is evident that we may use with equal facility a generator having electro-magnets to excite its field of force.

It is also obvious that we are not in any way restricted to the use of a battery as an alternate source of electric energy, and that we may, without departing from the spirit of our invention, use a second generator actuated from a separate source of power.

Having now fully and succinctly set forth our invention, we claim—

1. In a system of electric signaling, the combination of a generator, a main circuit therefor, a separate source of electrical energy, a circuit-changer controlled by a local circuit for transferring the main line from one source of energy to the other, and means, as indicated, for automatically opening and closing said local circuit, substantially as described.

2. The combination of a magneto or dynamo electric generator, a main circuit therefor, a separate and alternate source of electrical energy, an electro-magnetic switch or circuit-changer in a local-battery circuit, and means, substantially as described, actuated by the magneto-electric generator for opening and closing said local circuit.

3. The combination of a generator, a main circuit with a number of normally-open branches, a separate source of electrical energy, a circuit-changer in a local circuit for transferring the main line from one source of energy to the other, and devices, as indicated, in a closed branch of said main circuit adapted to open and close said local circuit, and thereby to actuate said circuit-changer, substantially as described.

4. In a signaling system, the combination of two generators of electricity, an automatic circuit-changing device operated by one of said generators, circuit-connections, substantially as described, and a series of normally-open branches.

5. In combination with a closed circuit and two reversely-connected polarized relays included therein and adapted to vibrate their armatures under the influence of alternating currents, a local circuit governed by said relays, an electro-magnetic switch or circuit-changer actuated in one direction by the closure and in the other direction by the opening of said local circuit, and a bell-alarm actuated by said circuit-changer to give an audible signal upon a change in either direction, substantially as described.

6. In a signaling system, the combination of two separate sources of electrical energy, a main circuit, an electric switch or circuit-changer comprising a magnet and armature adapted to transfer the main circuit from one source of electrical energy to the other, a bell-hammer constituting an extension of the armature-lever, and a bell for giving an audible alarm when a change of the circuit-connections takes place, substantially as described.

7. The combination, substantially as hereinbefore set forth, in a system of electric signaling, of a magneto-electric machine, a main circuit therefor, a battery adapted to act alternatively with said magneto-machine, an electro-magnetic switch or circuit-changer controlled by a local circuit and adapted to transfer the said main circuit from the magneto-machine to the battery or oppositely, a branch circuit from the magneto-generator to earth including electro-magnetic devices controlling the switch local-circuit and adapted to actuate the said switch by closing or opening the said local circuit, for the purposes specified.

8. The combination, substantially as hereinbefore set forth, in a system of electric signaling, of a magneto-electric machine, a battery adapted to act as an alternative to said machine, a main circuit capable of being connected with either source of electricity, an electro-magnetic switch or circuit-changer controlled by a local circuit and adapted to transfer the said main circuit from the magneto-machine to the battery or oppositely, a bell-alarm actuated by the movement of said switch in either direction, a branch circuit from the magneto-generator to earth including electro-magnetic devices controlling the switch local-circuit and adapted to actuate the said switch by closing or opening the said local circuit, for the purposes specified.

9. The combination, in an electrical-signaling system, of a magneto-electric generator and a normally-open main circuit therefor, with a normally-closed branch circuit including one or more relays and a resistance, a battery or other electrical source capable of acting as a relief for the magneto-generator, a local circuit controlled by the branch-circuit relays, and an electro-magnetic switch included in said local circuit and adapted to transfer the main circuit to the battery when the generator ceases to move or to emit elec-

tricity and to restore the same to the generator upon the resumption of the functions thereof, as hereinbefore specified.

10. The combination, substantially as hereinbefore described, of a normally-closed circuit, two polarized relays included therein but connected reversely with respect to one another and provided with armatures biased to deflect in a given direction when the relays are quiescent, a source of electricity connected with the said circuit and adapted to transmit electrical pulsations of successively-alternating direction through said relays, a local circuit passing through the contact-points of said relays and controlled thereby, whereby it may be maintained open so long as the armatures under the influence of the alternate currents vibrate oppositely to one another and caused to close when the said armatures come to rest, and an electro-magnetic switch included in said local circuit and actuated in one direction by the closure and in the opposite direction by the opening thereof.

11. In combination with a magneto-electric generator adapted for continuous operation, a battery, and a normally-open main circuit capable of being connected to either, a branch circuit from said generator to earth including a suitable resistance, two polarized relays connected reversely with respect to one another in said branch circuit, a local circuit passing through the contact-points of both relays, whereby it is maintained open during the passage of currents through the relays and is closed when such current ceases, and a switch or circuit-changer included in and controlled by said local circuit and adapted to maintain the main circuit in contact with the magneto-generator when the said generator is furnishing a current, and transfer the main circuit to the battery upon the failure of the generator so to do, as and for the purposes specified.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, this 4th day of September, 1884.

WM. B. VANSIZE.
THOS. D. LOCKWOOD.

Witnesses:
ALFRED M. ALLEN,
GEO. WILLIS PIERCE.