(No Model.) 2 Sheets—Sheet 1.

A. H. LOW.

SIGNAL CALL FOR TELEPHONE OFFICES.

No. 322,835. Patented July 21, 1885.

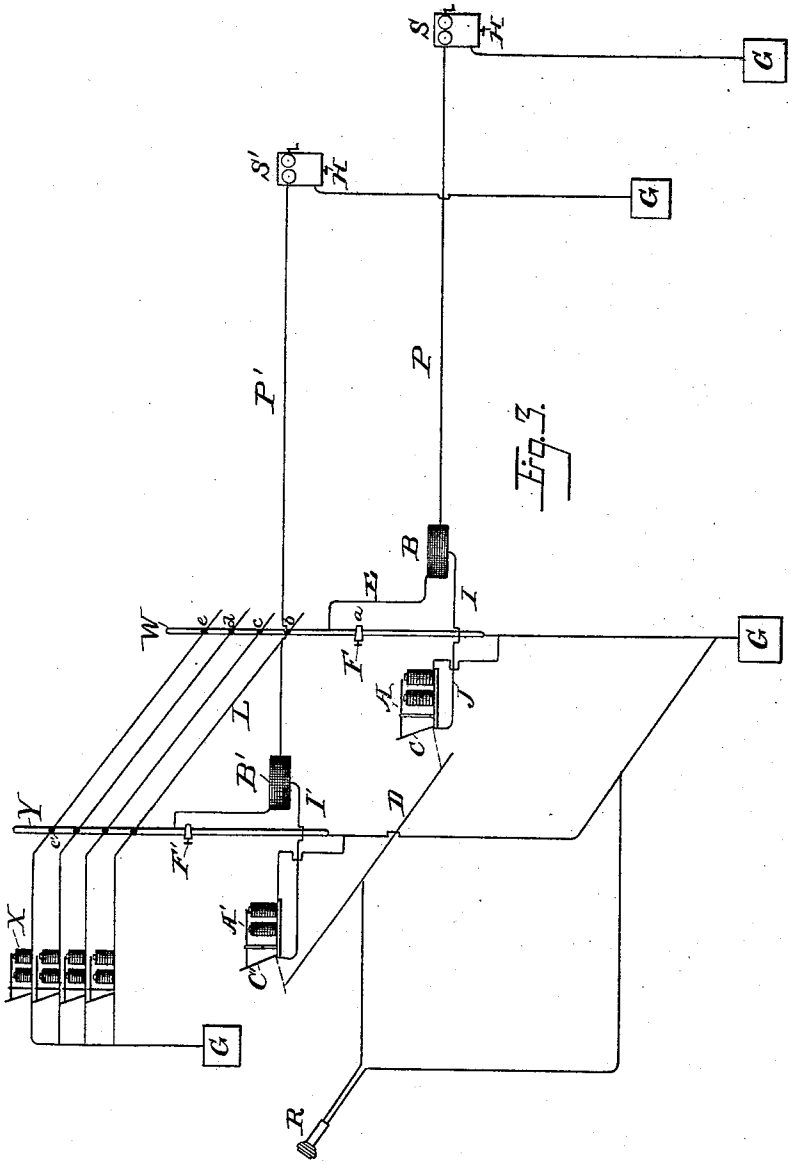

Fig. 3.

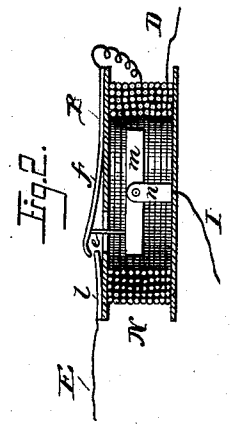

Fig. 2.

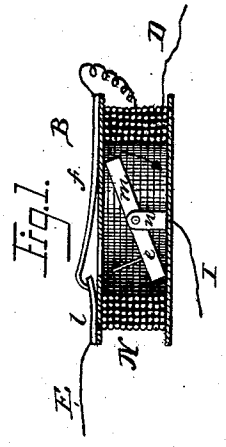

Fig. 1.

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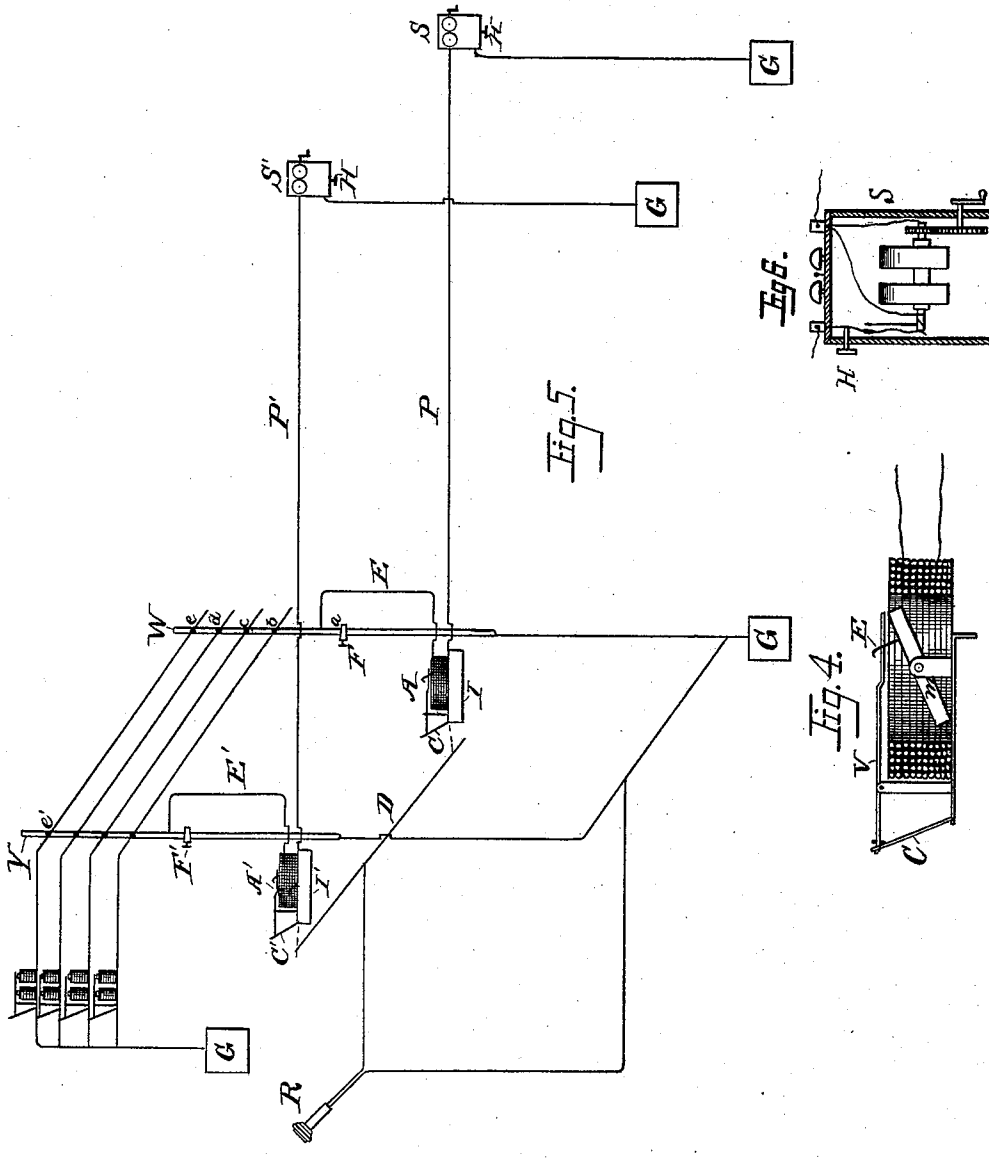

Fig. 5.

Fig. 6.

Fig. 4.

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UNITED STATES PATENT OFFICE.

ALBERT H. LOW, OF DENVER, COLORADO.

SIGNAL-CALL FOR TELEPHONE-OFFICES.

SPECIFICATION forming part of Letters Patent No. 322,835, dated July 21, 1885.

Application filed November 14, 1884. (No model.)

To all whom it may concern:

Be it known that I, ALBERT H. LOW, a citizen of the United States, and a resident of the city of Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Signal-Calls for Telephone-Offices, of which the following is a specification.

My invention relates to telephonic systems, and has for its object to signal to the exchange, whatever may be the arrangements of the circuits, without producing any signals at the subscribers' stations, and, furthermore, to signal to subscribers, when properly connected therewith, without producing any signal at the exchange, and this object I effect by the transmission of both alternating and non-alternating electric currents from the subscribers' stations, and by causing such currents to be automatically controlled at the central station, as fully set forth hereinafter.

In the drawings, Figure 1 is a diagram showing a sectional elevation of an automatic switch or drop controller which I employ in carrying out my invention. Fig. 2 is the same as Fig. 1, showing the parts in a different position. Fig. 3 illustrates a telephonic exchange system embodying the drop-controller form of my invention. Fig. 4 is a sectional elevation of an arrangement whereby the drop-controller is made to act mechanically directly on the lever of the drop. This combination of drop-controller and drop I call the "galvanometer-drop." Fig. 5 is a diagram illustrating a telephonic exchange using the galvanometer-drop. Fig. 6 shows one form of a generator arranged to send the different kinds of currents.

In carrying out my invention I make use of a device operating on the principle of a galvanometer, a drop operated directly or indirectly by said galvanometer, and the usual telephone and switch-board at the central station and the telephone-calls at the subscribers', said calls being constructed to send either alternating or non-alternating currents over the line at the will of the subscribers.

The construction and operation of the galvanometer when used to control the drop indirectly may be understood by special reference to Figs. 1 and 2. A permanent magnet, *m*, (preferably about three inches long, one-half an inch high, and one-fourth of an inch thick,) is mounted so as to swing freely in a standard, *n*, and is weighted so that it will normally take the inclined position shown in Fig. 1. This magnet is surrounded by a coil, N, of fine insulated wire, and the whole is mounted in a frame on the top of which are the contact springs or plates *f l*. These springs are fixed in hard rubber or other suitable insulating material, but make an electrical connection when in contact with each other. A pin, *e*, on the magnet is so arranged that when the magnet is moved to a horizontal position the said pin comes in contact with *f*, thus making an electrical connection, and at the same time breaking the connection between *f* and *l*. A current of electricity passing through the apparatus in the direction D E first enters the coil N, which it traverses, and goes to the spring *f*, thence through the spring *l*, and then off to E. If, however, the magnet is so tipped that the pin *e* comes in contact with the spring *f* and lifts it from contact with the plate *l*, then the current passes from *f* through the pin *e* to the magnet *m*, and thence to I.

Conformably to well-known physical laws, the magnet *m*, which, with the coil, constitutes a galvanometer, always tends to place itself at right angles to a non-alternating electric current traversing the coil, a given pole being elevated or depressed according as the electricity passes through the coil in one direction or the other. An alternating current tends to impart a vibratory motion to the magnet; but if the magnet is made sufficiently long and heavy this vibration is reduced to a minimum, since no single electrical impulse from the magneto-machine used is strong enough to impart much motion to the magnet, and as each succeeding impulse tends to destroy the effect of its immediate predecessor. Thus while a non-alternating electric current in the proper direction will cause the magnet to move in the direction of the arrow, an alternating current simply produces an insignificant vibration. The electric current may, therefore, be directed over the wires E or I at will, according as the alternating or non-alternating current (the latter in the proper direction) is sent through the coil.

One mode of arranging and using this instrument in connection with a drop in the central

office of a telephone-exchange will now be described, although the requirements of any given exchange may necessitate a different arrangement.

In the diagram Fig. 3, S and S′ represent any two subscribers. B is a galvanometer drop-controller in the central office of the exchange; L, the switch-board with plugs F F′. R is the operator's receiver, and A A′ represent drop-retaining magnets, C C′ being the drops and D a bar in electrical connection with the receiver R. If S sends the ordinary alternating current over the line, the circuit is from the magneto-machine over the line to B, thence over the wire E, through the plug F to the ground, and back to S. The drop A not being in the circuit, is not affected. Now, if S presses on the button H of his magneto and sends, as will be fully explained hereinafter, a non-alternating current in the proper direction over the line, the magnet in B is tipped to the position shown in Fig. 2, so as to break the circuit through E and establish one through the wire I. From I the circuit passes through the electro-magnet A of the drop and thence to the ground. The armature of the magnet being now attracted, the drop C is released and falls upon the bar D in the position shown by the dotted lines, thus completing a second electric circuit through the receiving-telephone of the operator at the central station to the ground. The current is thus divided at J, a portion still passing through the magnet of the drop and then to the ground, and the remainder reaching the ground through the receiving-telephone of the operator, who responds to the summons. If S now notifies the operator of his desire to talk with S′, the operator returns the drop of the annunciator C to its original position, and removes the plug F from the opening *a* in the vertical strip W and inserts it in any one of the openings, *b c d e*, of the switch-board L. By this insertion of the plug the vertical strip W is electrically connected with the horizontal cross-strip intersecting at the point of insertion. The corresponding plug, F′, of S′ is likewise removed and inserted at *e′*, in connection with the same horizontal strip as F. Now an alternating current sent from S will pass through the drop-controller B, then over E up to *e*, across to *e′*, down through the drop-controller B′, and thence out over the line to S′. The signal-bells of S and S′ are both rung by such a current, and S′ responds in a similar manner, ringing the bell of S. If S now desires to again call central office, he sends a non-alternating current over the line. This current passes at first through the drop-controller B′ of S′, and thence over his line and instruments to the ground. His drop-controller is, however, not affected by this non-alternating current, since the latter is not in the proper direction, and the signal-bells are likewise not rung, since they respond only to an alternating current. This first circuit is maintained only for an instant, and is quickly broken by the action of the drop-controller B, the magnet in which is lifted so as to switch the current from E to I and through the drop A again. If S′ should desire to call the central office after communication with S, he sends a non-alternating current over the line, when the magnet of the controller B′ will assume its elevated position, the current will pass through I′ to the magnet of the drop A′, and the armature of the latter will be drawn down and the drop released, falling into contact with the bar D and sending part of the current through the operator's telephone to ground. As a non-alternating current is employed to call the operator, the bell of S is not affected. Thus either S or S′ can, even when electrically connected, call the central office at will without ringing the signal-bells of the other. Each of the cross-strips on Y and W is permanently connected with the ground through a resistance-coil, X, in that department of the telephonic exchange known as the "clearing-out house," (not shown in detail in the drawings,) and accordingly S and S′ always have the proper ground-connections at central office, and can operate their respective drop-controllers regardless of the position of the plugs.

It is obvious that, instead of completing an electric circuit, the drop-controller may be a substitute for the electro-magnet of the drop itself, and may be connected to act mechanically on the lever which releases the annunciator, the general arrangement of the circuit being otherwise the same. To fully illustrate this mechanical action of the drop-controller on the lever of the drop, reference is made to Fig. 4. In this arrangement the drop-controller or galvanometer is substituted for the electro-magnet of the drop, and the magnet *m* is so weighted that the end carrying the wire E is lighter than the other, and the magnet consequently normally assumes the position shown in the figure. The upper end of the wire E is bent so as to overhang the lever V, and thereby form a catch which will act on the lever and release the annunciator C when the magnet is made to properly rotate or tip from its normal position. Supposing now an alternating current is sent through the coils, the magnet vibrates a little, but not enough to move the lever V. A non-alternating current, on the contrary, if in the proper direction, at once tips the magnet so that the catch E strikes the lever V and releases the annunciator C. I call this combination of galvanometer and drop the "galvanometer-drop."

Reference is made to Fig. 5 to show how the galvanometer-drop may be used in a telephonic exchange. Starting from S, the normal circuit is over the line P, through the galvanometer-drop A, up through E, and thence down to ground. An alternating current does not affect this arrangement. If, now, a non-alternating current is sent over the line in such a manner as to cause the magnet in A to tip, and thus release the annunciator C, the latter falls upon D and opens a second chan-

nel for the current through I to D, and thence to the operator and ground, the original circuit remaining meanwhile intact.

To connect S with S′, the annunciator C is first lifted back to its original position, and then the plug F is removed from *a* and placed on any one of the horizontal cross-strips at *b*, *c*, *d*, or *e*. The corresponding plug, F′, of S′ is similarly removed and placed on the same cross-strip. The circuit is now from S over P to A, up E to the cross-strip, then down through E′ and A′, and out over P′ to S′ and ground. Either S or S′ may now use an alternating current, and thus ring the signal-bells on the line, or a non-alternating current, and thus operate their respective drops in the central office.

Although I have shown drop-indicators, indicators of various different constructions may be employed, it only being necessary that they be of such character as to signal the operator at the central office when a current of the proper character is sent over the line from any station. It will also be apparent that any suitable switch mechanism or mechanical arrangement operated directly or indirectly by the indicator-controller may be employed to throw the operator's receiving-telephone into circuit when the subscriber signals to him. It will further be apparent that the general arrangement of the parts will vary in almost every case, according to the requirements of the exchange.

For the production of either alternating or non-alternating currents at will, I construct the magneto-machine with a suitable commutator and switching arrangement, so that with the switch in one position the machine will deliver the usual alternating currents, and with the switch in another position connection with the alternating circuit is broken and communication with the commutator furnishing non-alternating currents is established.

Without limiting myself to the precise construction and arrangement and mode of operating the parts above described, I claim—

1. The within-described improvement in telephonic systems, the same consisting in the combination, with the central office and stations, of a generator adapted to transmit both alternating and non-alternating electric currents between the stations and central office, and a circuit controller and connections, substantially as described, for automatically causing currents of one character to operate the office-indicators and currents of another character to operate the signals, substantially as set forth.

2. The combination, with generators at the various stations, constructed to produce both alternating and continuous currents, and provided with signal-bells arranged to be operated by alternating currents only, of indicators arranged at the central office, and automatic controlling devices constructed to be adjusted, when the character of the current is changed, to cause an annunciator-drop to fall in central office, either directly or with other stations in the circuit, whereby the signal-bells of the stations in electrical communication are operated only upon the transmission of signal-currents, substantially as set forth.

3. The combination, in telephone systems, of generators adapted to produce alternating and non-alternating electric currents located at the subscribers' stations, indicators located in the central office, and signal-bells at the subscribers' stations, and automatic circuit-controllers and circuits, substantially as described, whereby the indicators or signal-bells are operated according to the character of the current transmitted and at the will of the operator, substantially as set forth.

4. The combination, with generators at subscribers' stations constructed to produce both alternating and non-alternating currents, of a galvanometer and circuits and connections, substantially as described, whereby the current, according to its character, is made to effect different results, substantially as set forth.

5. The combination, with generators, for producing both alternating and non-alternating currents, of automatic switch devices for directing the currents to different circuits according to their character, one circuit including the switch-board and ground, the latter either directly or through another station, and another circuit including an indicator and the receiving-telephone at the central office through a different course to the ground, substantially as specified.

6. The combination, with generators for producing both alternating and non-alternating currents, of automatic switch devices, indicating devices, and switch-board arranged at the central office to form different circuits, according to the character of the current transmitted, substantially as specified.

7. The automatic switch device for telephonic systems, consisting of a coil and contact-plates in circuit with the main line, and a movable galvanometer-bar supported within the coil, and arranged in another circuit, and constructed to connect or disconnect the contact-plates according to its position, substantially as set forth.

8. The combination, with the annunciator-drops and generators for producing both alternating and non-alternating currents, of an automatic galvanometer device and circuits and connections, substantially as described, for mechanically operating the drop in central office or permitting it to remain unaffected, according to the character of the current sent and at the will of the operator, substantially as specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ALBERT H. LOW.

Witnesses:
E. A. REYNOLDS,
G. A. CORBIN.