(No Model.) 3 Sheets—Sheet 1.

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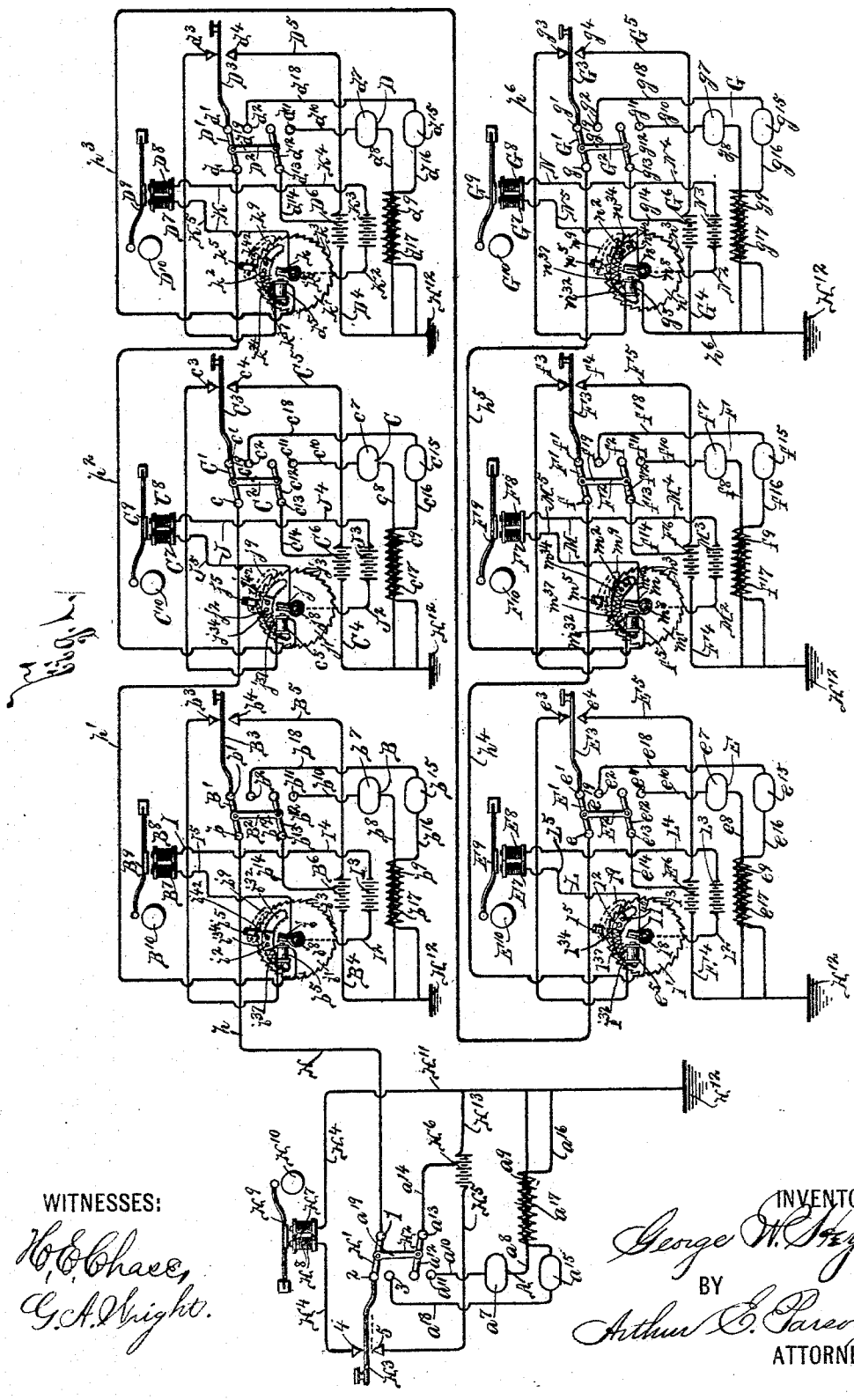
ELECTRICAL SIGNAL APPARATUS.

No. 514,461. Patented Feb. 13, 1894.



WITNESSES:

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ATTORNEY

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Fig. 2.

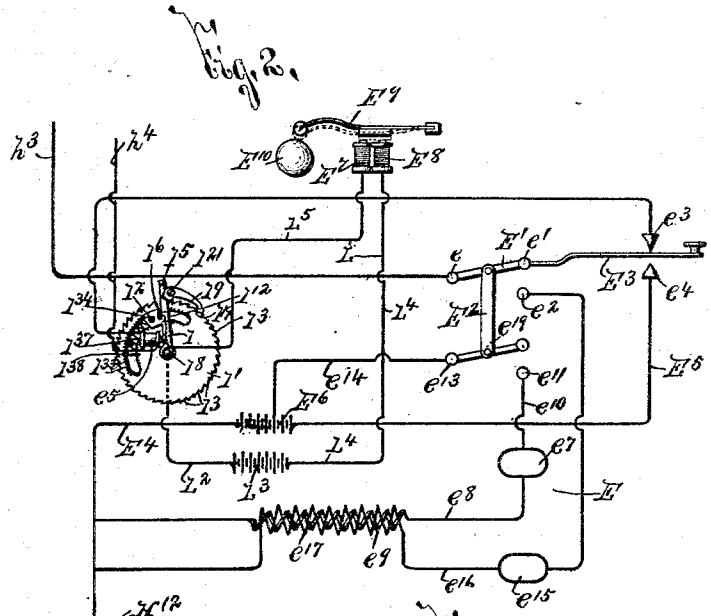

Fig. 3.

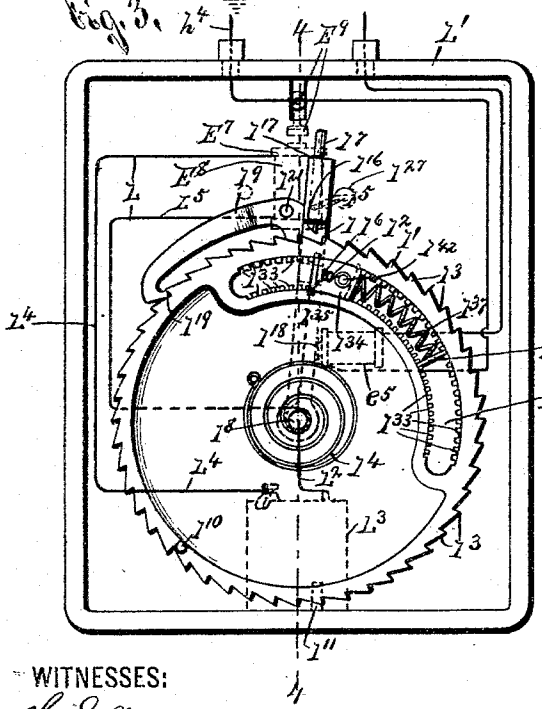

Fig. 4.

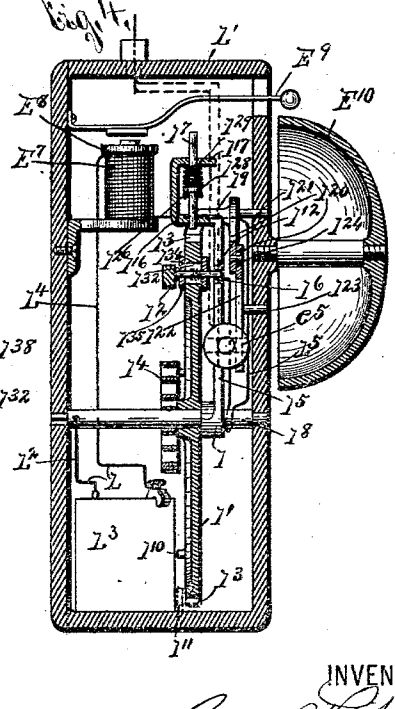

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Fig. 5.

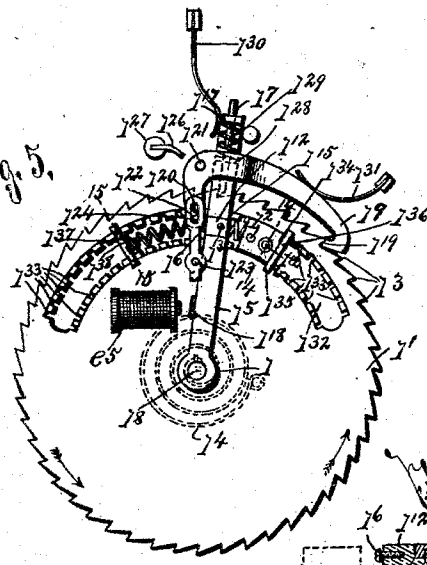


Fig. 6.

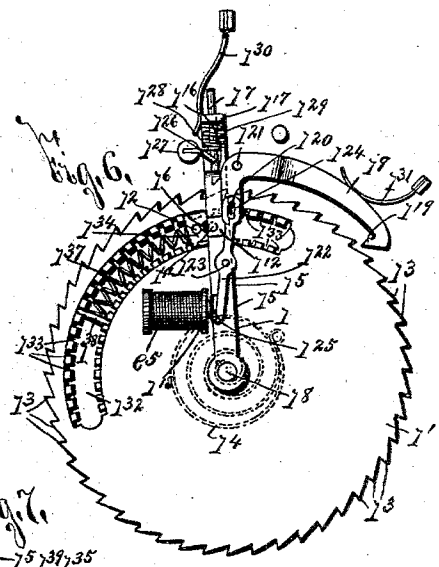


Fig. 7.

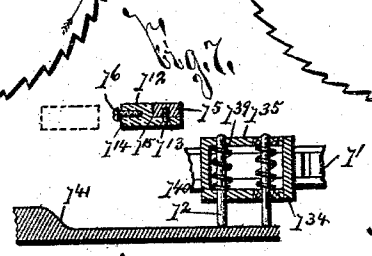


Fig. 8.

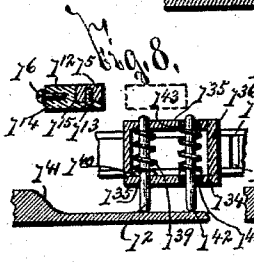


Fig. 9.

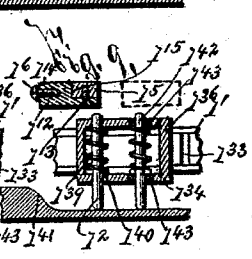


Fig. 10.

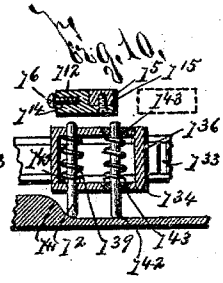


Fig. 11.

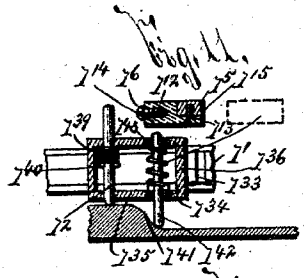


Fig. 12.

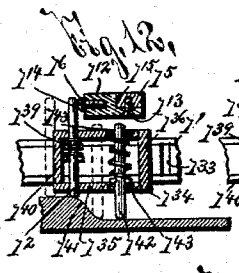


Fig. 13.

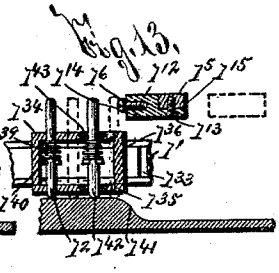


Fig. 14.

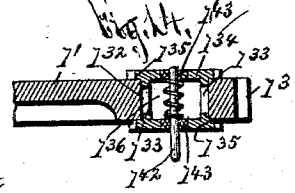
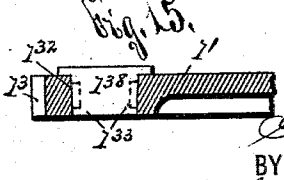


Fig. 15.



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UNITED STATES PATENT OFFICE.

GEORGE W. HEY, OF SYRACUSE, NEW YORK.

ELECTRICAL SIGNAL APPARATUS.

SPECIFICATION forming part of Letters Patent No. 514,461, dated February 13, 1894.

Application filed April 22, 1892. Serial No. 430,274. (No model.)

To all whom it may concern:

Be it known that I, GEORGE W. HEY, of Syracuse, in the county of Onondaga, in the State of New York, have invented new and useful Improvements in Methods of and Apparatus for Transmitting Signals, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

My invention relates to improvements in an apparatus for electrically transmitting signals, which is particularly designed for use in telephone and telegraphic service; and to this end it consists, essentially, in a circuit or line conductor, a series of stations connected to said conductor by normally open circuit-closers each having its terminals normally separated from each other, separate supports for the terminals of the stations, an independent signal operating circuit at the stations connected to said terminals, and actuating mechanisms at the stations connected to the line conductor and to the terminals at the stations for bringing the terminals of the circuit-closers at one station into contact with each other for closing the signal operating circuit at said station and simultaneously returning to their normal position the normally separated terminals of the circuit-closers at the other stations.

The invention furthermore consists in the detail construction and arrangement of the parts, all as hereinafter more particularly described and pointed out in the claims.

In describing this invention, reference is had to the accompanying drawings, forming a part of this specification, in which, like letters and figures indicate corresponding parts in all the views.

Figure 1 is a diagrammatic view illustrating the general construction and arrangement of one form of apparatus for carrying out my invention. Fig. 2 is a diagrammatic view, representing the parts of a simple form of telephone, a simple telephone signal, the independent circuit for bringing said signal into action, and the circuit closer for opening and breaking the independent circuit. Fig. 3 is a rear face view, partly in section, of the enlarged circuit closer shown at Fig. 2 illustrated as inclosed within a portion of an outer case. Fig. 4 is a vertical sectional view, taken on line —4—4— Fig. 3. Fig. 5 is a front face view of the detached circuit closer shown at Figs. 3 and 4, illustrating the same as in said figures in its normal position. Fig. 6 is a front face view similar to Fig. 5, representing the terminals of the circuit closer as just on the point of contact one with the other for permitting the passage of the current through the independent circuit for ringing the signal. Figs. 7, 8, 9, 10, 11, 12, and 13 are vertical sectional detail views representing the terminals of one of the circuit closers in various positions for clearly illustrating the action of said circuit closer, and Figs. 14 and 15 are detail sectional views, taken on lines —14—14— —15—15—, Fig. 5.

It is well known that, at present, it is customary to connect several telephones to a single main wire or circuit and call the required one from the main or central station on the main wire by means of a peculiar call consisting of a particular number or duration of vibrations of the signal bell. In this case the signal for each telephone is transmitted throughout the whole number, and is rung simultaneously by all of the signal bells, thus occasioning considerable inconvenience and annoyance, owing to the continued ringing of the bells and the liability of mistaking the telephone call. I am aware, however, that certain telephone call bell systems have been devised for calling a predetermined station of a series at a single line, but, as usually constructed, these systems are dependent for operation either upon complicated mechanism, wiring, electric motors, current of different quality or strength, and non-automatic resetters, or are so constructed and arranged as to momentarily close the signal-operating circuits in stations other than the one to which the predetermined call is addressed. My present signaling system is entirely differentiated from devices of this character, in that, it is extremely simple in construction, practical in operation, and does not, to effect its operation, require complicated mechanism or wiring, electric motors or currents of different quality or strength. Moreover, it is so constructed and arranged that the switches at each station are automatically reset as soon as one of the signal-operating circuits is closed by the switch at any station of the series on the cir-

cuit wire, and that the signal operating circuit of the station to which the call is addressed is positively and effectually closed without requiring momentary closing of the signal-operating circuits of the other stations connected to said line conductor.

My invention is also designed for use in telegraphy, and for transmitting signals for other purposes and also for bringing into action for any purpose by means of a main wire a predetermined one of a number of independent circuits, and, in order that it may be readily understood, I have here illustrated one of the simple forms of mechanism embodying the same, although, as will be evident and hereinafter reiterated, my invention is not limited to this particular form of mechanism.

—A— represents the main or central station, and —B—C—D—E—F— and —G— telephone branch stations connected to the main station by the sections —*h*—*h'*—*h*^{2}—*h*^{3}—*h*^{4}— and —*h*^{5}— of the main wire —H— forming part of the main circuit. One extremity of the section —*h*— of the wire —H— is provided with a terminal —1— connected to one end of a lever —H'— of a switch —H^2—. The other end of the lever —H'— is alternately movable upon terminals —2— and —3—; the terminal —2— being connected to one end of a movable switch or key —H^3— having its opposite ends interposed between the terminals —4— and —5— of the wires —H^4— and —H^5—. The wire —H^4— is connected to a suitable signal as an electric bell —H^7— of the usual construction consisting of magnets —H^8—, movable clapper —H^9— and vibrating shell —H^{10}— of the same construction as the shell —E^{10}— shown in cross section at Fig. 4, and is connected to the ground —H^{12}— by a wire —H^{11}—. The wire —H^5— is connected to the positive pole of a suitable battery or other electrical generator —H^6—, and the negative pole of said battery or generator is connected by a wire —H^{13}— to the ground wire —H^{11}—. The opposite end of the section —*h*— of the main wire —H— is connected to a terminal —*b*— of the first telephone station —B,— upon which swings one end of a lever —B'— of a switch —B^2—. The outer end of the switch lever —B'— is movable between terminals —*b'*— and —*b*^{2}—, the terminal —*b'*— being connected to one end of a switch or key —B^3— having its opposite end movable between terminals —*b*^{3}— and —*b*^{4}— connected respectively to the section —*h'*— of the main wire —H— and to the wire —B^5— connected to the positive pole of a battery —B^6—.

The section —*h'*— of the main wire —H— extends from the terminal —*b*^{3}— through or in proximity to a suitable magnet —*b*^{5}— for operating the normally open switch —*i*— of an independent circuit —I— connected thereto, and extends to the terminal —*c*— of the second telephone station —C— corresponding to the terminal —*b*— of the first station —B—. This second telephone station is provided with a switch lever —C'—, switch —C^2—, terminals —*c'*—*c*^{2}—, switch or key —C^3—, terminals —*c*^{3}—*c*^{4}—, magnet —*c*^{5}—, circuit closer —*j*—, independent circuit —J—, and wire —C^5— and battery —B^6— corresponding to the similar parts —B'—B^2—, —*b'*—*b*^{2}—, —B^3—, —*b*^{3}—*b*^{4}—, —*b*^{5}—, —*i*—, —I—, —B^5— and —B^6—, of the first telephone station, and the third, fourth, fifth, and sixth telephone stations are each provided with corresponding parts —D'—, —D^2—, —*d'*—*d*^{2}—, —D^3—, —*d*^{3}—*d*^{4}—, —*d*^{5}—, —*k*—, —K—, —D^5— and —D^6—; —E'—, —E^2—, —*e'*—*e*^{2}—, —E^3—, —*e*^{3}—*e*^{4}—, —*e*^{5}—, —*l*—, —L—, —E^5— and —E^6—; —F'—, —F^2—, —*f'*—*f*^{2}—, —F^3—, —*f*^{3}—*f*^{4}—, —*f*^{5}—, —*m*—, —M—, —F^5— and —F^6—; and —G'—, —G^2—, —*g'*—*g*^{2}—, —G^3—, —*g*^{3}—*g*^{4}—, —*g*^{5}—, —*n*—, —N—, —G^5— and —G^6—; the sections —*h*^{2}—*h*^{3}—*h*^{4}— and —*h*^{5}— of the main wire —H— being connected respectively to the terminals —*c*^{3}—*d*,—*d*^{3}—*e*,—*e*^{3}—*f*,—*f*^{3}—*g*—, and to the magnets —*c*^{5}—*d*^{5}—*e*^{5}—*f*^{5}—. The extreme end section —*h*^{6}— of the main wire —H— extends from the terminal —*g*^{3}— of the sixth telephone station through the magnet —*g*^{5}— and to the ground —H^{12}—. It will thus be seen that the main circuit consists, essentially, of the battery —H^6—, negative wire —H^{13}—, ground wire —H^{11}—, the positive wire —H^5—, switch or key —H^3—, terminal —2—, switch lever —H'—, terminal —1—, the sections —*h*—*h'*—*h*^{2}—*h*^{3}—*h*^{4}—*h*^{5}— and —*h*^{6}— of the main wire —H—, the terminals —*b*—*c*—*d*—*e*—*f*—*g*—, switch levers —B'—C'—D'—E'—F'—G'—, terminals —*b'*—*c'*—*d'*—*e'*—*f'*—*g'*—, switches or keys —B^3—C^3—D^3—E^3—F^3—G^3—, and the magnets —*b*^{5}—*c*^{5}—*d*^{5}—*e*^{5}—*f*^{5}—*g*^{5}—.

When desired to call any of the stations connected to the main wire —H— the switch or key —H^3— is depressed into contact with the terminal —5—, and the current passes through the wire —H^5—, terminal —5—, switch or key —H^3—, terminal —2—, switch lever —H'—, terminal —1— and main wire section —*h*—, to the first telephone station —B—, and through the terminal —*b*—, switch lever —B'—, terminal —*b'*—, switch or key —B^3—, and terminal —*b*^{3}— of said station, to the second main wire section —*h'*—, thence through the main wire sections —*h*^{2}—*h*^{3}—*h*^{4}— and —*h*^{5}— to the second, third, fourth, fifth, and sixth stations through their corresponding parts —*c*—C'—*c'*—C^3—*c*^{3}—; —*d*—D'—*d'*—D^3—*d*^{3}; —*e*—E'—*e'*—E^3—*e*^{3}; —*f*—F'—*f'*—F^3—*f*^{3}—, and —*g*—G'—*g'*—G^3—*g*^{3},— and finally through the section —*h*^{5}— to the ground —H^{12}—. If desired the section —*h*^{6}—, instead of running to the ground, may return to the negative pole of the battery —H^6— of the main or central telephone station. The battery —H^6— may consist of any other desired form of electric generator, the switches —H^2—H^3,—B^2—B^3,—C^2—C^3,—D^2—D^3,—E^2—E^3,—F^2—F^3,— and —G^2—G^3— may be suitably varied, and the magnets —*b*^{5}—*c*^{5}—*d*^{5}—

e^5—f^5— and —g^5— may be of any suitable construction capable of being energized or brought into action by the passing current, and the particular form of wiring connecting the aforesaid parts may be varied at will.

The operating parts of the main or central station —A— consist of the transmitter —a^7— connected by a wire —a^8— having a primary coil —a^9—, to the negative pole of the battery —H^6— by a portion of the ground wire —H^{11}— and the wire —H^{13}— and is connected by a wire —a^{10}— to a terminal —a^{11}— with which is registered one end of the switch lever —a^{12}— of the switch —H^2— having its opposite end hinged to a terminal —a^{13}— connected by a wire —a^{14}— with a positive pole of the battery —H^6—, and said parts consist also of the receiver —a^{15}— connected to the ground wire —H^{11}— by a wire —a^{16}— provided with a secondary coil —a^{17}— surrounding the primary coil —a^9— and connected by the wire —a^{18}— to the terminal —3— with which the switch lever —H′— is registered when desired to change the course of the electric current and cause the same to flow through the operating parts of the telephone instead of to the electric bell —H^7—. The switch lever —a^{12}— is connected by an insulating bar —a^{19}— to the lever —H′—, previously described, in order that both levers may be moved simultaneously without communicating to one, the current passed through the other. The wires —B^5—C^5—D^5—E^5—F^5— and —G^5— are connected respectively to the positive poles of the batteries —B^6—C^6—D^6—E^6—F^6—G^6— and the negative poles of these batteries are connected to the ground —H^{12}— by the wires —B^4—C^4—D^4—E^4—F^4—G^4—, the wire —G^4— being connected to the main wire section —h^6— instead of to the ground as said section —h^6— is grounded.

The operating parts of the first telephone station —B—, are similar to the corresponding parts of the main or central station —A—, and consist of the transmitter —b^7— connected by a wire —b^8— having a primary coil —b^9—, to the ground wire —B^4— and by a wire —b^{10}— to a terminal —b^{11}— with which is registered one end of the switch lever —b^{12}— of the switch —B^2— having its opposite end hinged to a terminal —b^{13}— connected by a wire —b^{14}— with a positive pole of the battery —B^6—; and said parts consist also of the receiver —b^{15}— connected to the ground wire —B^4— by a wire —b^{16}— provided with a secondary coil —b^{17}— surrounding the primary coil —b^9—, and connected by the wire —b^{18}— to a terminal —b^2— with which the switch lever —B′— is registered when desired to pass the electric current through the operating parts of the telephone station —B—. The switch levers —b^{12}— and —B′— are also connected by an insulating bar —b^{19}— corresponding to the bar —a^{19}— of the switch —H^2—.

The operating parts of the second, third, fourth, fifth, and sixth stations —C—D—E—F— and —G— consist of the transmitters —c^7—d^7—e^7—f^7—g^7—, wires —c^8—d^8—e^8—f^8—g^8—, primary coils —c^9—d^9—e^9—f^9—g^9—, wires —c^{10}—d^{10}—e^{10}—f^{10}—g^{10}—, terminals —c^{11}—d^{11}—e^{11}—f^{11}—g^{11}—, switch levers —c^{12}—d^{12}—e^{12}—f^{12}—g^{12}—, terminals —c^{13}—d^{13}—e^{13}—f^{13}—g^{13}—, wires —c^{14}—d^{14}—e^{14}—f^{14}—g^{14}—, receivers —c^{15}—d^{15}—e^{15}—f^{15}—g^{15}—, wires —c^{16}—d^{16}—e^{16}—f^{16}—g^{16}—, secondary coils, —c^{17}—d^{17}—e^{17}—f^{17}—g^{17}—, wires —c^{18}—d^{18}—e^{18}—f^{18}—g^{18}—, and insulating bars —c^{19}—d^{19}—e^{19}—f^{19}—g^{19}—of similar construction and arrangement to the corresponding parts —b^7— b^8—b^9—b^{10}—b^{11}—b^{12}—b^{13}—b^{14}—b^{15}—b^{16}—b^{17}—b^{18}— and —b^{19}— of the first telephone station —B—.

When desired to call the main or central station from the first telephone station —B— the switch or key —B^3— is depressed into contact with the terminal —b^4—, and the electric current passes from the battery —B^6— through said switch —B^3—, the terminal —b'—, the switch lever —B′—, the terminal —b—, the main wire section —h—, terminal —1—, switch lever —H′—, terminal —2—, switch or key —H^3—, terminal —4—, wire —H^4—, magnet —H^8— of the bell —H^7—, and ground wire —H^{11}—. The ringing of the bell —H^7— gives the signal to the main or central office, and immediately the attendant moves the switch levers —H′—a^{12}—, into contact with the terminals —3— and —a^{11}—, and the user of the telephone at the first station moves the switch levers —B′—b^{12}— into contact with the terminals —b^2—b^{11}—, whereupon the current from the battery —H^6— passes through the wire —a^{14}—, terminal —a^{13}—, switch bar —a^{12}—, terminal —a^{11}—, wire —a^{10}—, transmitter —a^7—, wire —a^8—, primary coil —a^9—, and wires —H^{11}—H^{13}—, to the negative pole of the battery —H^6—. An induced current is then generated in the secondary coil —a^{17}— which is connected to the ground —H^{12}— by the wire —H^{11}— and the portion of the wire —a^{16}— interposed between the coil —a^{17}— and the wire —H^{11}—, and said current is passed from the coil —a^{17}— through the opposite portion of the wire —a^{16}—, the receiver —a^{15}—, wire —a^{18}—, terminal —3—, switch lever —H′—, terminal —1—, main wire section —h—, terminal —b—, switch lever —B′—, terminal —b^2—, wire —b^{18}—, receiver —b^{15}—, and through the wire —b^{16}— to the ground wire —B^4—.

It will be noted that, when the switches —H^3—B^2— are shifted as just described for transmitting speech over the line so that the free ends of the levers —H′—B′— rest respectively upon the terminals —3—b^2—, the bell —H^7— and the magnet —b^5— are cut out from the wire —H—. The main or central station —A— is called in like manner from the second, third, fourth, fifth and sixth stations, and the line wire is used for the transmission of speech, it being understood that the sections of the main wire between the central station and the station in circuit with the

main wire are utilized for the transmission of the current, and that the sections of the main wire on the opposite side of said station remain cut out.

The described operating parts of the stations —A—B—C—D—E—F— and —G— may be of any desirable construction and arrangement, and I have described only a simple form thereof, it being understood that any construction and arrangement of electric generators and wires may be used that are capable of transmitting and reproducing sound.

Connected in the circuits —I—J—K—L—M— and —N— are signals or bells —B^7—C^7—D^7—E^7—F^7—G^7—, here illustrated as composed of magnets —B^8—C^8—D^8—E^8—F^8—G^8—, clappers —B^9—C^9—D^9—E^9—F^9—G^9—, and bell gongs —B^{10}—C^{10}—D^{10}—E^{10}—F^{10}—G^{10}— of similar construction to the like parts —H^8—H^9— and —H^{10}— of the bell —H^7— previously described, but it will be evident that these signals or bells may be of any desired construction capable of being set in motion through the medium of an electric current.

As the bells —B^7—C^7—D^7—E^7—F^7—G^7— may be of any desirable form, size, and construction to attract the attention of the operator at the stations provided therewith, it is unnecessary to fully illustrate and to further describe said parts, especially as at Fig. 4, I have, in illustrating the switch —*l*— presently described, clearly shown the parts —E^8—E^9—E^{10}— of the bell —E— in enlarged section as operatively mounted within the casing —L'— inclosing the switch —*l*—.

The switches or circuit closers —*i*—*j*—*k*—*l*—*m*— and —*n*— are all preferably of similar construction and arrangement, and I have here illustrated at Figs. 3 to 15 inclusive the circuit closer —*l*— of the fourth telephone station —E—. This circuit closer consists of a movable disk —*l'*— forming a support for a terminal —l^2—, and provided with ratchet teeth —l^3— upon its periphery; a resetter or spring —l^4— for returning the disk or terminal support to its normal position; a lever or support —l^5— carrying a terminal —l^6— adapted to be brought into registration with the terminal —l^2— for closing the circuit —L—, and carrying a dog —l^7— for engaging the teeth —l^3— of the disk —*l'*— and partially rotating said disk on its pivot —l^8—; and a stop or dog —l^9— for holding the disk or terminal support —*l'*— in its adjusted position.

The circuit closer —*l*— is preferably mounted in a suitable inclosing box —L'—, which may be arranged in suitable proximity to the ordinary box, not necessary to herein illustrate, adapted to support the working parts of the adjacent telephone, and may, if desired, be a part of said box.

The pivot —l^8— for the disk —*l'*— is, as best seen at Fig. 4, journaled in the walls of the case —L'— and one end of the spring —l^4— is rigidly secured to said pivot and the other to the disk —*l'*— for automatically forcing said disk to its normal position with a stop —l^{10}— thereon in contact with a stop —l^{11}— provided upon the frame —L'—. The lever —l^5— is hinged upon the pivot —l^8—, and extends outwardly beyond the periphery of the disk —*l'*—, and the terminal —l^6— on said lever is arranged midway between its extremities at a point directly above the outer portion of the disk —*l'*—. This terminal —l^6— consists preferably of a screw inserted into the side of an insulating block —l^{12}— secured by screws —l^{13}— to the under face of the lever —l^5— and formed with a head —l^{14}— projecting upwardly in a side cut-out —l^{15}— in the lever. The outer end of the lever —l^5— is deflected downwardly and formed with the upright shoulder —l^{16}—, and the dog —l^7— is movable through an upwardly extending ear —l^{17}— on said outer end of the lever —l^5— and through the shoulder —l^{16}— into engagement with the ratchet teeth —l^3—.

The magnet —e^5— is in proximity to the inner end of the lever —l^5—, which is provided with an armature —l^{18}— opposite to the pole thereof, and, when the magnet is energized by the current passed therethrough in calling the fourth station —E—, the lever —l^5— is drawn forwardly, as shown by arrows at Fig. 5 and the disk —*l'*— is thereby partially rotated. The dog —l^9— for holding the disk from return movement consists of a bell crank lever having one arm provided with a tooth —l^{19}— adapted to engage the teeth —l^3— of the disk —*l'*— and the other with a projecting lug —l^{20}— and is supported upon a pivot —l^{21}— projecting from the wall of the outer case —L'—. A lever —l^{22}— is pivoted on a post —l^{23}— projecting from the case —L'—, and is provided at one end with a slot —l^{24}— registered with the lug —l^{20}— and at the other with an armature —l^{25}— adapted to be drawn toward the magnet —e^5— when the same is energized, thus disengaging the tooth —l^{19}— from the teeth —l^3— to permit retraction of the disk —*l'*— to its normal position by the spring —l^4—.

—l^{26}— represents a cam mounted on a post —l^{27}— and adapted to engage a shoulder —l^{28}— on the dog —l^7— and force the same as the lever —l^5— is drawn forwardly by the magnet —e^5—, out of engagement with the teeth —l^3— against the action of the spring —l^{29}— surrounding said dog for throwing the same into action. It will thus be noted that, when the armatures —l^{18}— and —l^{25}— are in engagement with the magnet —e^5— the dog —l^7— and the tooth —l^{19}— are out of engagement with the teeth —l^3— in order to permit the retraction of the disk —*l'*— by the spring —l^4—, and that when the main circuit is broken immediately after being closed, to effect the energization of the magnet —e^5—, the lever —l^5— is forced to its normal position by a spring —l^{30}— bearing against the same, the dog —l^7— is then engaged with the teeth —l^3— by the spring —l^{29}—, and rides over said

teeth against the action of said spring —l^{29}— and the tooth —l^{19}— of the dog —l^9— is forced into instant engagement with the teeth —l^3— by a spring —l^{31}— bearing against the dog —l^9—.

The movement of the lever —l^5— and the length of the teeth —l^3— are so proportioned with reference to each other that by each movement of the lever the disk —l'— is rotated forwardly a tooth and a half, and, when the main circuit is instantly broken and the tooth —l^{19}— forced against the teeth —l^3—, the spring —l^4— retracts said disk a half a tooth so that the actual advance of the disk is but a single tooth, although the same moves forwardly a tooth and a half, since the disk also moves backwardly a half a tooth with each forward movement. This peculiar construction of the parts insures positive and automatic return of the disk should the current passed through the main wire —H— and the magnet —e^5— be of considerable duration, since the dog —l^7— and tooth —l^{19}— are then held out of engagement with the teeth —l^3—, and the spring —l^4— instantly returns said disk to its normal position. On the contrary when said current is of short duration the dog —l^9— is instantly returned and engages the returning disk —l'— without permitting the retraction thereof for more than half a tooth. It is thus evident that, when a series of consecutive currents of short duration are passed through the magnet —e^5— by rapidly closing and breaking the main circuit —A— the disk —l'— rotates forwardly one tooth for every pulsation of current passed through the main wire, and, when a current of long duration is passed through said magnet, the disk is immediately retracted to its normal position.

The disk —l'— is formed with a concentric groove or slot —l^{32}— arranged directly beneath the terminal —l^6— and formed with serrations or notches —l^{33}— in its longitudinal edges. —l^{34}— represents a head or box supported in the groove —l^{32}— and formed with shoulders —l^{35}— resting upon the top and bottom faces of said disk, which is preferably reinforced along the edges of the slot —l^{32}—. The head is held from rearward lengthwise movement in the slot —l^{32}— by a plate —l^{36}— engaged with the serrations —l^{33}— in the edges of the slot —l^{32}— and from forward movement by a spring —l^{37}— having one end engaged with the forward face of the head —l^{34}— and the other with a plate —l^{38}— corresponding to the plate —l^{36}—. It will thus be noted that the terminals —l^5— and —l^2— are separated one from the other, and that, as the lever —l^5— rotates the disk —l'—, the terminals are approximated for closing the circuit —L— and bringing the bell —F'— into action to attract the attention of the user of station —E—.

In order that the approximation of the terminals may be readily perceived I have at Figs. 7 to 12 inclusive illustrated the movements of said terminals from their extreme separated position to their position assumed when in contact. At Fig. 7 the terminals are in their extreme separated position, and, as clearly seen in this view, the terminal —l^2— is forced downwardly by a coil spring —l^{39}— bearing against a shoulder —l^{40}— on said terminal. As the lever —l^5— moves forwardly from its position, shown at Fig. 7, it carries with it the disk —l'— and the terminal —l^2— until it assumes its position shown at Fig. 8, and upon reference to these figures it will be noted that the relative distance between the terminals —l^2— and —l^6— has not been changed. The main circuit is then broken and the lever —l^5— is retracted by the spring —l^{30}— to its position shown by dotted lines at Fig. 8 and full lines at Fig. 9, and the disk —l'— is retracted a half a tooth and is held from further backward movement by the dog —l^9—. This movement of the lever —l^5— and the disk —l'— brings the terminals —l^2—l^6— nearer together. The terminal —l^2— projects beneath the head —l^{34}— and directly in the path of the projecting end thereof is a cam —l^{41}— for raising said terminal upwardly against the action of the spring —l^{39}—. At Fig. 7 the projecting end of the terminal is shown at its greatest separation from this cam —l^{41}—; at Fig. 8 it has approached the cam —l^{41}—, a distance corresponding to the forward rotation of the disk —l'— a single tooth, and at Fig. 9, which represents the parts as in the position when the lever —l^5— has twice moved the disk forward, it has still further approached the cam —l^{41}—. The current being quickly broken when the lever —l^5— is in its position shown by full lines at Fig. 9, it moves backwardly to its position shown by dotted lines at Fig. 9, thus approximating the terminals —l^2— and —l^6— sufficiently so that the upper end of the terminal —l^2— is directly beneath the forward edge of the lever —l^5—, but, owing to the presence of the insulating block —l^{12}— directly above said terminal —l^2—, the passage of electricity between the terminal —l^2— and lever —l^5— is absolutely prevented.

At Fig. 10 I have shown the parts in the position assumed when the lever —l^5— has rotated the disk —l'— a third tooth, and, although the relative approximation of the terminals —l^2—l^6— has not been varied from that just described, the lower end of the terminal —l^2— is at the foot of the upward inclination of the cam —l^{41}—. The lever —l^5—, when retracted by the spring —l^{30}— from its position shown by full lines at Fig. 10 assumes its position shown by dotted lines at said figure and moves from above the terminal —l^2—. As the lever —l^5— moves the disk —l'— a fourth tooth the terminal —l^2— is forced upwardly by the cam —l^{41}—, against the action of its spring —l^{39}—, and, if the electric current is of duration sufficiently long to permit the return movement of the disk —l'—, the terminal —l^2— immediately contacts with the terminal —l^6— and the cir-

cuit —L— is closed. Owing to the contact of said terminals, the head —i^{34}— is held from retraction and the spring —l^{37}— is compressed by the return movement of the disk —l'—. When the main circuit is broken the lever —l^5— moves to its position shown by dotted lines at Fig. 11, the spring —l^{37}— forces the head —l^{34}— rearwardly, the spring —l^{39}— depresses the terminal —l^2— and the head —l^{34}— is forced into engagement with the stop plate —l^{36}—. It will thus be seen that, when three currents of short duration are passed through the main circuit and are followed by a fourth of longer duration the terminals —l^2— and —l^6— of the circuit —L— are brought into contact and said circuit is closed. Should the fourth current be of the same duration as the three preceding, the lever —l^5— returns to its normal position and moves from above a post —l^{42}— movable through insulating bushings —l^{43}— in the head —l^{34}—. If the fifth current is then of longer duration the disk is moved forwardly a tooth and a half from its previous position, the insulating post is elevated by the cam —l^{41}—, and, when the disk —l'— returns, the insulating post encounters the terminal —l^6—, as shown by dotted lines at Fig. 13, thus preventing the contact of the terminals —l^2—l^6— and the closing of the circuit —l—. It will thus be seen that the terminals —l^2— and —l^6— can only come into contact when three currents of short duration are passed through the main circuit —A—, and are followed by a fourth of longer duration, and that should but three consecutive currents of either equal or unequal duration be passed through the main circuit, the circuit closer —l— will be automatically reset and that should, as described, four currents of short duration be followed by one of either long or short duration, an insulating post intervenes between said terminals. The terminals —l^2— and —l^6— may, however, be so relatively arranged as to vary the number of currents of short duration required in connection with one of long duration to bring said terminals into contact, since the terminal —l^2— may be moved either forwardly or in advance of its position shown at Figs. 3, 5, and 6 by removing the stop plate —l^{36}—, forcing the head —l^{34}— to the desired position, and returning the plate —l^{36}— into engagement with the serrations —l^{33}— to form a stop for said head.

The circuit —L— consists of a positive wire —L^2— from a battery —L^3— to the pivot —l^8— of the disk —l'—, the negative wire —L^4— from the negative pole of the battery —L^3— to the magnet —E^8— of the bell —E^7— and the negative wire —L^5— from the magnet —E^8— to the terminal —l^6—.

As previously stated the terminal —l^6— is insulated from the lever —l^5—, and consequently there is no flow of electricity through the circuit closer —l— until the terminals —l^2— and —l^6— are in contact. As the lever —l^5— is continuously in movement when the current is passing, I obviate wear on the wire —L^5— to the greatest possible extent by winding the same around the pivotal pin —l^8— and running the same lengthwise of the lever —l^5— until the terminal —l^6— is reached.

As described a separate battery —L^3— is used for the circuit —L—, but it is evident that the battery —E^6— may be provided with an extra pair of positive and negative poles connected to the wires —L^2—L^4—L^5—, or that any other suitable electric generator may be used, and that the circuit —L— is not limited to any particular form of wiring.

The circuits —I—J—K—M— and —N— are each shown as composed of parts —I^2—I^3—I^4—I^5—, —J^2—J^3—J^4—J^5—, —K^2—K^3—K^4—K^5—, —M^2—M^3—M^4—M^5—, and —N^2—N^3—N^4——N^5— corresponding to the like parts —L^2—L^3—L^4— and —L^5— of the circuit —L—.

The circuit closers —i—j—k—m— and —n— are constructed in the same manner as the switch —l—, and are composed of movable disks —i'—j'—k'—m'—n'—, terminals —i^2—j^2—k^2—m^2—n^2—, levers —i^5—j^5—k^5—m^5—n^5—, terminals —i^6—j^6—k^6—m^6—n^6—, slots —i^{32}—j^{32}—k^{32}—m^{32}—n^{32}—, heads —i^{34}—j^{34}—k^{34}—m^{34}—n^{34}—, springs —i^{37}—j^{37}—k^{37}—m^{37}—n^{37}—, and insulating posts —i^{42}—j^{42}—k^{42}—m^{42}—n^{42}— corresponding in construction and operation to the like parts —l'—l^2—l^5—l^6—l^{32}—l^{34}—l^{37}— and —l^{42}—. It is, therefore, unnecessary to illustrate in enlarged views any of these switches —i—j—k—m—n—, it being understood that their respective terminals —i^2—i^6—, —j^2—j^6—, —k^2—k^6—, —m^2—m^6—, —n^2—n^6—, are of unequal separation, as, for instance, the terminals —i^2—i^6— are separated but slightly, so that they are approximated by the forward movement of the disk —i'— a tooth and a half, and the return movement of said disk a tooth and a half occasioned by the passage of a single current of long duration. The terminals —j^2—j^6— are separated twice as far as the terminals —i^2—i^6— so that they are approximated by the passage through the main circuit of a current of short duration and one of long duration. The terminals —k^2—k^6— are separated three times as far as the terminals —i^2—i^6—, and are approximated by two currents of short duration followed by one of long duration, and, as previously stated, the terminals —l^2—l^6— are approximated by the passage of three currents of short duration followed by one of long duration. The terminals —m^2—m^6— are separated a still greater distance so as to be approximated by the passage through the main circuit of four currents of short duration followed by one of long duration, and the terminals —n^2—n^6— are so separated as to be approximated by the passage of five currents of short duration followed by one of long duration. This unequal separation of the terminals of the respective circuit closers —i—j—k—l—m— and —n— is readily effected as the respective heads —i^{34}—j^{34}—k^{34}—

l^{34}—m^{34}— and —n^{34}— are adjustable in the slots —i^{37}—j^{37}—k^{37}—l^{37}—m^{37}— and —n^{37}— in the same manner that the head —l^{34}— is adjustable in the slot —l^{32}—. It will also be readily understood that the terminals of any of the circuit closers —i—j—k—m— and —n— are separated by the corresponding insulating post —i^{42}—j^{42}—k^{42}—m^{42}— and —n^{42}— when the currents of short duration passed through the main circuit —A— are in excess of the number designed to approximate said terminals when followed by a current of long duration, in the same manner that the terminals —l^2— and —l^6— are separated by the post —l^{42}— when five currents of short duration are followed by one of long duration. It will also be evident that the disks —i'—j'—k'—m'— and —n'— are automatically returned to position when a current of long duration is passed through the magnets —b^5—c^5—d^5—f^5— and —g^5— in the same manner that the disk —l'— is returned by the spring —l^4— when a current of long duration is passed through the magnet —e^5—.

The circuit closers —i—j—k—l—m— and —n— interposed between the main wire —H— and the signal bells —B^7—C^7—D^7—E^7—F^7— and —G^7— are a simple form of mechanism suitable for carrying out my invention, and may be of any desired construction to attain the desired end, which is the operating of any particular signal by a certain quantity or duration of currents passed through the main circuit without operating the remaining signals.

It will be readily noted upon examination of the foregoing description and accompanying drawings that the speaking current is not passed through the magnets for operating the circuit-closers, but is short circuited by proper switches directly into the "receiver of the telephone," and that consequently my invention may be connected to an electric conductor without in the least impairing its capability for transmitting speech. It will also be observed that in effecting the practical operation of the circuit-closers forming an essential feature of my invention that current pulsations are passed through the circuit conductor, and that these pulsations differ from one another only in their duration of time, thus corresponding to the dots and dashes of the "Morse telegraphic alphabet."

The operation of my invention will be readily understood from the foregoing description and upon reference to the drawings, and it will be particularly noted that several telephones may be connected by my invention upon a single main wire or circuit, and that the signal bell of the telephone required is the only one rung when desired to call that particular telephone; that all of the circuit closers between the main line and the signal bells return automatically to their normal position, and that my invention is not limited to any particular form of wiring or particular construction of circuit closer or wiring interposed between the signal bell and the main circuit.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination with one terminal of an electric circuit-closer; of a second terminal arranged to move step by step, a magnet and armature, suitable connections for moving the second terminal, and a supplemental armature connected to release the terminal actuating mechanism and make the circuit, substantially as and for the purpose set forth.

2. In combination, a main circuit conductor, a series of independent circuits, a series of independent circuit-closers connected to the main circuit conductor, each circuit-closer having a pair of movably adjustable terminals connected to one of the independent circuits, said terminals of any one of the circuit-closers being adjusted to a greater or less separation than the terminals of the other circuit-closers, and means, substantially as described, connected to said main circuit conductor for causing said terminals to make contact, substantially as and for the purpose described.

3. In combination, a main circuit conductor, a series of independent circuits, a series of independent circuit-closers connected to the main circuit conductor, each circuit-closer having a pair of movably adjustable terminals connected to one of the independent circuits, said terminals of any one of the circuit-closers being separated a greater or less distance than the terminals of the other circuit-closers, means, substantially as described, connected to said main circuit conductor for causing said terminals to make contact, and resetters for automatically returning said means to its normal position, substantially as and for the purpose specified.

4. In combination, a main circuit conductor, an independent circuit, a circuit-closer connected to the main circuit conductor and having a pair of movable terminals connected to said independent circuit, a movable support for one of the terminals for moving said terminal into contact with the other terminal, said support being movable independently of the terminal, whereby the support is permitted to assume its initial position without disturbing the contact of the terminals, and means, substantially as described, connected to the main circuit conductor for moving said support, substantially as and for the purpose set forth.

5. In combination, a main circuit conductor, an independent circuit, a circuit-closer connected to the main circuit conductor and having a pair of movably adjustable terminals connected to said independent circuit, a movable support for one of the terminals for moving said terminal into contact with the other terminal, said support being movable independently of the terminal, whereby the support is permitted to assume its initial position

without disturbing the contact of the terminals, means, substantially as described, connected to the main circuit conductor for moving said support, and a resetter connected to the movable terminal support for returning the same to its normal position, substantially as and for the purpose described.

6. The combination with a main circuit conductor and a series of independent circuits; of a series of circuit-closers each comprising a pair of movable terminals connected to one of said independent circuits, said terminals of any one of the circuit-closers being separated a greater or less distance than the terminals of the other circuit-closers, a movable support for one of the terminals for moving said terminal into contact with the other terminal, whereby the terminals of one circuit-closer are caused to make contact and the terminals of the other circuit-closers remain separated, said support being movable independently of the terminal moved thereby, whereby the terminal supports of the circuit-closers are permitted to assume their initial position without disturbing the contact of the terminals moved into contact, and a resetter for returning said support to its initial position, substantially as and for the purpose specified.

7. In combination, a main circuit conductor, a second circuit, a signal operated by the second circuit, the operating parts of a telephone, a circuit-closer connected to the circuit conductor and having a pair of terminals connected to the second circuit and having means, substantially as described, for passing current from said second circuit through said terminals and for breaking said current passing through said terminals, and a switch between the operating parts of the telephone and the main conductor for cutting out the portion of the main circuit conductor connected to operate the circuit-closer and passing said current through the operating parts of the telephone, substantially as and for the purpose set forth.

8. In combination, a main circuit conductor, a second circuit, a signal operated by the second circuit, the operating parts of a telephone, a circuit-closer connected to the circuit conductor and having a pair of terminals, and a movable part or support carrying one of said terminals, said circuit-closer being provided with means, substantially as described, for moving said support and causing the terminals to make contact, and a switch between the operating parts of the telephone and the main conductor for cutting out the portion of the main circuit conductor connected to operate the circuit-closer and passing said current through the operating parts of the telephone, substantially as and for the purpose described.

9. In combination, a main circuit conductor through which is passed predetermined current pulsations, a series of independent circuits, signals operated by the second circuits, the operating parts of a series of telephones, a series of circuit-closers connected to the circuit conductor, each of said circuit-closers being provided with a pair of terminals connected to one of the independent circuits and being provided with means, substantially as described, for passing a current from said independent circuit through said terminals and for breaking said current passing through said terminals, and with mechanism, substantially as described, for preventing the passage through said terminals of a current from said independent circuit when there is passed through said circuit conductor any combination of current pulsations other than that required to operate said means, and switches between the operating parts of said telephones and the main circuit conductor for cutting out the portion of said circuit conductor connected to operate the circuit-closers and for passing the current through the operating parts of the telephones, substantially as and for the purpose specified.

10. The combination with an electro magnet; of circuit-closing terminals normally separated, and a plurality of armatures operated by said electric magnet connected to make and break circuit through the terminals by the current passed through the magnet, substantially as and for the purpose set forth.

11. In combination, a main circuit conductor, a magnet connected to said conductor, an independent electric circuit, and the herein described circuit-closer connected to said independent circuit, the same comprising a pair of terminals, a movable support for one of the terminals for bringing the same into contact with the other terminal, an operating piece arranged in proximity to the magnet and connected to actuate the movable terminal support for closing the circuit closer, and an insulating post on the movable support for preventing contact of said terminals, substantially as and for the purpose set forth.

12. The combination with a main circuit conductor, and an independent circuit, of the herein described circuit closer, the same comprising a terminal connected to one pole of said circuit, a movable support, a head adjustably mounted on said support, a terminal carried by said head connected to the other pole of said circuit and adapted to make contact with the former terminal, and means, substantially as described, connected to the conductor and adapted to move said support, substantially as and for the purpose set forth.

13. The combination with the main circuit conductor and an independent circuit, of the herein described circuit closer, the same comprising a terminal connected to one pole of said circuit, a movable support, a head adjustably mounted on said support, a spring for forcing said head to its normal position, a terminal carried by said head connected to the other pole of said circuit and adapted to make contact with the former terminal, and

means, substantially as described, connected to the conductor and adapted to move said support, substantially as and for the purpose specified.

14. The combination with a main circuit conductor, and an independent circuit, of the herein described circuit closer, the same comprising a terminal connected to one pole of said circuit, a movable support formed with a guide, a head movable in said guide, a spring for forcing said head to its normal position, a terminal carried by said head connected to the other pole of said circuit and adapted to make contact with the former terminal, and means, substantially as described, connected to the conductor and adapted to move said support, substantially as and for the purpose set forth.

15. The combination with a main circuit conductor, and an independent circuit, of the herein described circuit closer, the same comprising a terminal connected to one pole of said circuit, a movable support formed with a guide, a head movable in said guide, an adjustable stop for the head, a spring for forcing said head against the stop, an adjustable stop for the spring, a terminal carried by said head connected to the other pole of said circuit and adapted to make contact with the former terminal, and means, substantially as described, connected to the conductor and adapted to move said support, substantially as and for the purpose specified.

16. The combination with a main circuit conductor, and an independent circuit, of the herein described circuit closer, the same comprising a terminal connected to one pole of said circuit, a reversible support formed with a curved guide, a head movable in said guide, a spring for forcing said head to its normal position, a terminal carried by said head connected to the other pole of said circuit and adapted to make contact with the former terminal, and means, substantially as described, connected to the conductor and adapted to move said support, substantially as and for the purpose set forth.

17. The combination with a main circuit conductor, and an independent circuit, of the herein described circuit closer, the same comprising a terminal connected to one pole of the independent circuit a movable terminal support, a terminal connected to the other pole of said circuit and moving lengthwisely in said support for engaging the former terminal, and means, substantially as described, connected to the conductor for moving said support, substantially as and for the purpose specified.

18. The combination with a main circuit conductor, and an independent circuit, of the herein described circuit closer, the same comprising a terminal connected to one pole of the independent circuit, a movable terminal support, a head adjustably mounted on said support, a terminal connected to the other pole of said circuit and movable lengthwisely in said head for engaging the former terminal, and means, substantially as described, connected to the conductor for moving said support, substantially as and for the purpose set forth.

19. The combination with a main circuit conductor and an independent circuit, of the herein described circuit closer, the same comprising a terminal connected to one pole of the independent circuit, a movable terminal support, a terminal connected to the other pole of said circuit carried by said support for engaging the former terminal, an insulator movable lengthwisely in said head for engaging the former terminal, and means, substantially as described, connected to the conductor for moving said support, substantially as and for the purpose specified.

20. The combination with a main circuit conductor and an independent circuit, of the herein described circuit closer, the same comprising a support, a lever above the support for moving the same, a terminal carried by the lever and connected to one pole of the circuit, a terminal connected to the other pole of the circuit movably mounted on said support for engaging the former terminal, and means, substantially as described, connected to the conductor and adapted to move said support, substantially as set forth.

21. The combination with a main circuit conductor and an independent circuit, of the herein described circuit closer, the same comprising a support, a lever above the support for moving the same, a terminal carried by the lever and connected to one pole of the circuit, a terminal connected to the other pole of the circuit movably mounted on said support for engaging the former terminal, an insulator movably mounted at one side of the latter terminal for preventing contact of said terminals, and means, substantially as described, connected to the conductor and adapted to move said support, substantially as and for the purpose specified.

22. The combination with a main circuit conductor, and an independent circuit, of the herein described circuit closer, the same comprising a movable support, a terminal carried by said support, means, substantially as described, for moving said support, a second terminal for engaging the former terminal, and a spring for engaging said terminals and retracting said support without separating said terminals, substantially as and for the purpose set forth.

23. The combination with a main circuit conductor and an independent circuit, of the herein described circuit closer, the same comprising a movable support, a terminal carried by said support, a lever for moving said support, a terminal carried by said lever, and a resetter engaging said terminals and for returning said movable support without separating said terminals, substantially as and for the purpose specified.

24. A circuit-closer comprising in its organi-

zation the terminals of an electric circuit, mechanism operated by electric current pulsations for passing an electric current through said terminals, said mechanism being automatically reset simultaneously to its initial or starting point without disturbing the passage of the electric current through said terminals, and means for breaking the current passing through said terminals, substantially as described.

25. A circuit-closer comprising in its organization the normally separated movable terminals of an electric circuit, mechanism operated by electric current pulsations for bringing the terminals into contact with each other, said mechanism being automatically reset to its initial or starting point without disturbing the contact of said terminals, and means for separating the terminals, substantially as specified.

26. A circuit-closer comprising in its organization the terminals of an electric circuit movable toward and from each other, mechanism operated by electric current pulsations for passing an electric current through said terminals, said mechanism being automatically reset simultaneously to its initial or starting point without disturbing the passage of the electric current through said terminals, and means for breaking the current passing through said terminals and for resetting the terminals, substantially as and for the purpose described.

In testimony whereof I have hereunto signed my name, in the presence of two attesting witnesses, at Syracuse, in the county of Onondaga, in the State of New York, this 9th day of April, 1892.

GEORGE W. HEY.

Witnesses:
CLARK H. NORTON,
E. A. WEISBURG.