

(No Model.)

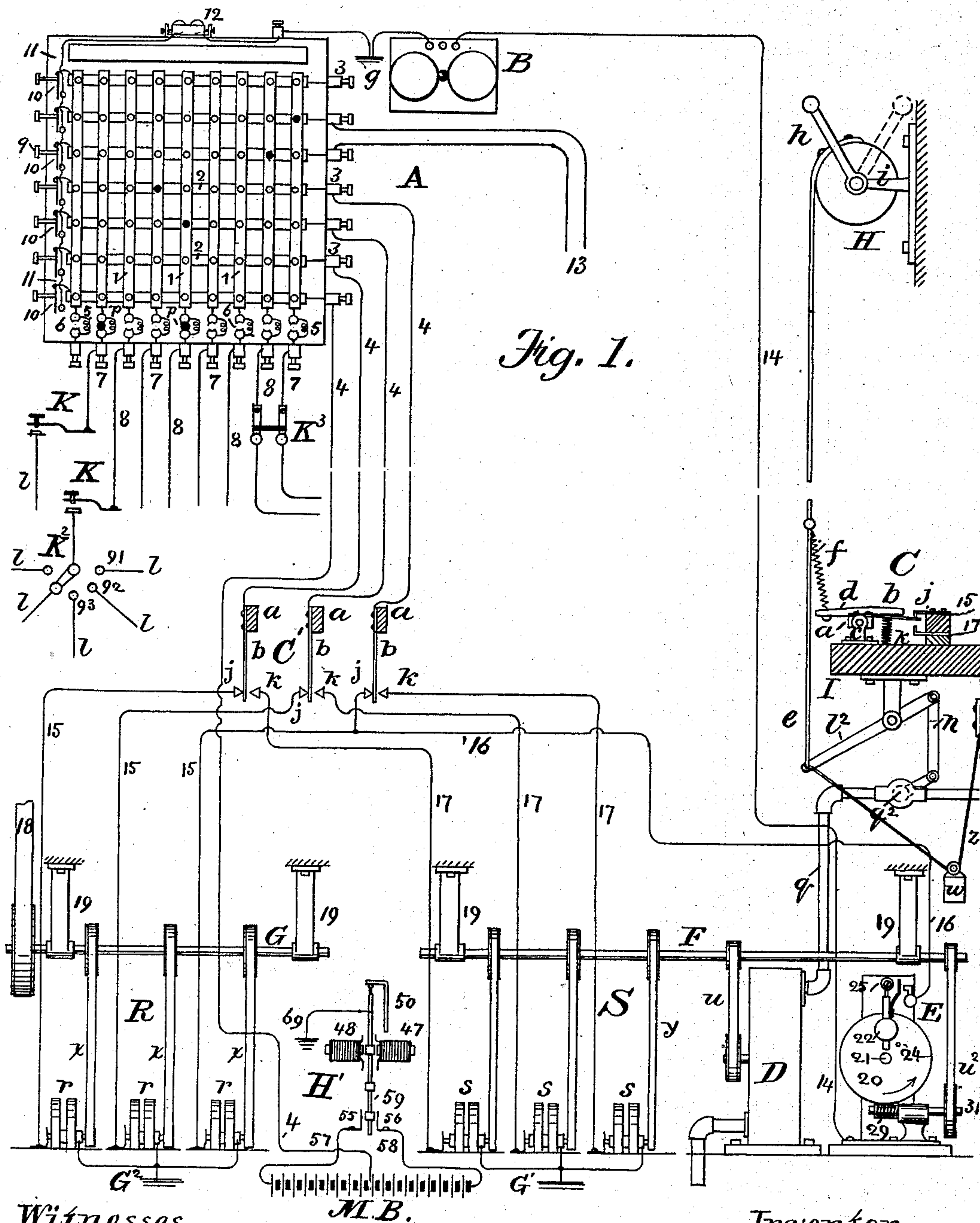
2 Sheets—Sheet 1.

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CENTRAL STATION CALLING APPARATUS.

No. 413,276.

Patented Oct. 22, 1889.



Witnesses.

Thomas Pierce

Frank C. Lockwood

M.B.

Inventor.

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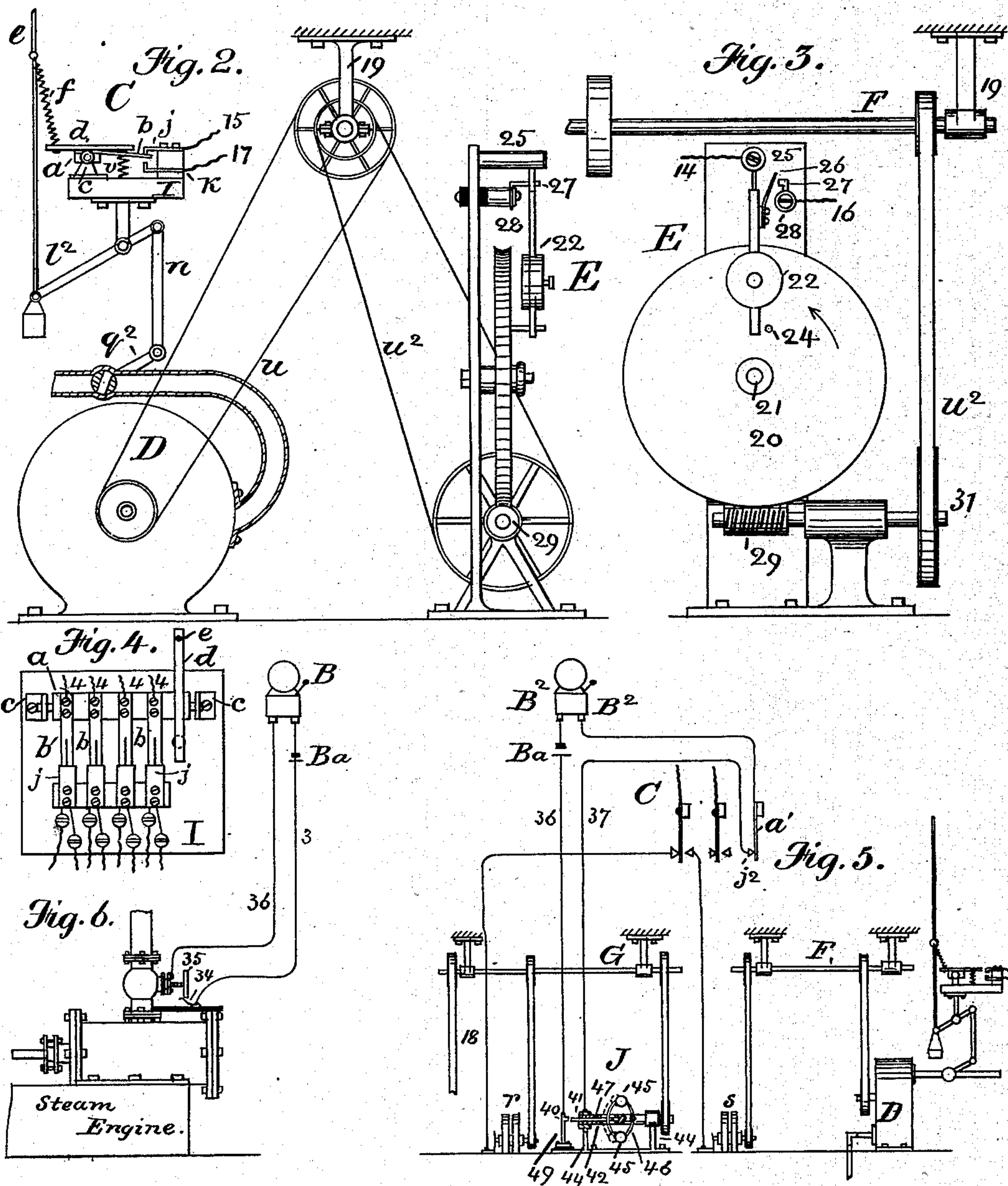
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UNITED STATES PATENT OFFICE.

ISALAH H. FARNHAM, OF MALDEN, MASSACHUSETTS, ASSIGNOR TO THE NEW ENGLAND TELEPHONE AND TELEGRAPH COMPANY, OF NEW YORK.

CENTRAL-STATION CALLING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 413,276, dated October 22, 1889.

Application filed April 20, 1889. Serial No. 307,946. (No model.)

To all whom it may concern:

Be it known that I, ISALAH H. FARNHAM, residing at Malden, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Central-Station Calling Apparatus, of which the following is a specification.

My invention relates to apparatus for providing at central telephone stations a constant supply of electricity for the purpose of sending outgoing call-signals.

Its object is to provide a completely satisfactory system of apparatus, allowing the employment of a number of power-generators in a single central station, and means for distributing to the several switch-boards the currents of such generators; to arrange for the substitution of a duplicate set of generators actuated by alternative power, in case the original generators and source of power should from any cause become temporarily unavailable, all necessary changes of the several circuits being likewise simultaneously and automatically effected; also, to prevent the contingency of operating the two sets of generators and the use of two sources of power unnecessarily or simultaneously and the consequent expense and waste of energy; and to provide that when the original power is temporarily interrupted notice of such interruption shall be given, to the end that proper action may be taken.

In brief, my object is to make the use of power-generators in telephone central stations as trustworthy and efficient and as perfectly under control, though located at a distance, as if each switch-board section were provided with a hand-generator, and to hedge such use round by every possible security, so that the chance or opportunity for failure is minimized to the fullest extent.

Formerly it was customary to provide the several switch-board sections each with a hand-generator, which the attendant of that section was required to operate manually in sending a call. It has now, in accordance with the patent of C. H. Haskins, No. 299,926, bearing date of June 3, 1884, become an almost uniform practice in large exchanges to provide one or more magneto-generators for

a central station, actuated by steam or other suitable power. These can be located wherever most convenient, either within or outside of the exchange-building. Where the power generators are employed for the development of calling-currents, the hand-generators can be totally dispensed with. The steam-power usually depended upon to drive the power-generators is derived, ordinarily, from some adjacent factory, mill, or printing establishment, and is therefore generally at rest during meal hours and at night, and of course is liable at all times to be temporarily interrupted. Unless, therefore, some plan be adopted to prevent such a contingency the central station is liable to be left entirely destitute of a supply of electricity for calling purposes. It is consequently of paramount importance in the organization of a central station that such a contingency should never occur. To prevent it I employ an alternative source of power and a duplicate set of generators.

Experience has demonstrated that in a large central station several medium-sized generators having conductors branching to different portions of the switch-board are preferable to one or two large generators connecting with and supplying all sections of the board. By providing a number of small generators, instead of relying upon one or two large ones, a greater degree of uniformity in the current supplied to each section can be maintained, and the danger of a too large supply at certain periods of the day is avoided. Moreover, in case of the temporary disablement of one or more generators, when a number are used, there is no danger of crippling the entire station.

In a central-station arrangement which has been actually constructed, and which constitutes an embodiment of this invention, one series of magneto-electric generators (six, for instance) are run by steam-power for the greater portion of the day, but are supplemented by an equal number of other like generators, forming an alternative and auxiliary series of sources of electricity for use at times when the steam is shut down. A small distributing switch-board is also provided, by

means of which different sections of the regular switch-board may be connected at will with either or all of the several generators, and this distributing switch-board is fitted with devices for determining whether or not the generators and their circuits are in perfect order, and for equalizing resistance and current of the several generator-circuits. Means are provided whereby upon any interruption of the steam-power the water-motor may instantly be set to work, and the said means are also enabled to simultaneously and by the same operation disconnect the circuits of the stopped steam-actuated generators and substitute for them the circuit-connections of those operated by the water-motor, which motor thereupon becomes active. Finally, I have provided and have now in operation an automatically-working alarm actuated only when the two sets of generators are working at the same time, and necessarily dependent upon their coaction, for the purpose of notifying the proper authority that the steam-power has resumed operation, and that it has therefore become his duty to throw the water-motor and the generators driven thereby out of use. A similar alarm may be added in the manner hereinafter described, which may also afford a like notification whenever the steam-power shuts down, so that there may be no loss of time in starting the water-motor and its generating appliances. To provide against the very remote contingency of the failure of both steam and water power, I find it convenient to add a calling-battery and pole-changer, which can be employed in an emergency.

In the drawings which accompany and form a part of this specification, Figure 1 is a diagram showing the general arrangement of circuits, the substituting-switch being, however, for clearness, shown in two places, as more fully described hereinafter. Fig. 2 is a representation, on an enlarged scale, of so much of Fig. 1 as relates to the water-motor, its starting apparatus, the switch also operated thereby, and the alarm apparatus designed to give notice of the coincident or contemporaneous operation of both sets of generators. Fig. 3 is a front view of the alarm-sending apparatus shown in Fig. 2. Fig. 4 is a detail view of the automatic substituting-switch shown diversely in Figs. 1 and 2. Figs. 5 and 6 are respectively diagrams showing an alarm adopted for automatic operation upon and to give notice of the interruption of the steam-power.

Referring first to Fig. 1, R represents a set of magneto-generators, *r* embracing any desired number, the revolving armatures whereof are driven through the agency of belts *x* and pulleys therefor by a counter-shaft G, supported in bearings 19, the said counter-shaft in turn being driven by a belt 18 from a steam-engine or other prime motor. (Not shown.) These generators are ordinarily in operation. A like but totally independent

series S of similar magneto-generators *s* are actuated by a water-motor D, this being enabled to act upon the rotating armatures and to operate them through the intermediation of the belt *u* and pulleys therefor, the counter-shaft F, and the individual generator-belts *y*. This counter-shaft also revolves in bearings 19, and the motor and its dependent generators are assumed to be ordinarily at rest and to come into action only when the steam-power and first series are stopped.

At the upper part of the drawings may be seen the distributing switch-board A, which is located in the central station. This may be of any desired form or principle, and in the present case a switch-board embodying the principle of the well-known so-called "Leviss commutator" is shown. It comprises vertical and horizontal metal bars crossing each other transversely. Each of both series is provided with a screw terminal for the attachment of wires, and the bars of one series do not touch those of the other. At the intersections holes are bored through both for the reception of connecting-plugs, and when any such plug is inserted it serves to unite the bars of the two series intersecting each other at that point, thus uniting the wires connecting with that particular horizontal and vertical bar.

In the drawings the horizontal bars 2 connect, by means of their screw terminals 3 and the wires 4, leading therefrom, with the generators of one series or the other or with the pole-changer and battery. The vertical bars 1, by means of their screw-terminals 7, connect with wires 8, and these wires are the conductors leading to the several main switch-boards, (not shown,) and by them the calling-currents developed by the generators are distributed to the said switch-boards, and can there by suitable and well-known appliances be directed over any line for the purpose of attracting the attention of the subscriber. For the purpose of indicating diagrammatically this final distribution of the calling-current feed-wires, I have shown in circuit with two of the said wires 8 keys K, which may be understood as representing two of the said sections of switch-board where the sub-station lines are connected, the main telephone-circuits being further indicated at one of the keys K by a small switch K², showing that at the said sections the calling-current brought to the switch-board by a single lead 8 may be directed over any of the lines *l* by turning the lever K² upon any of the studs 91 92 93, &c., or by using any well-known equivalent device.

By employing the switch-board A and varying the position of its plugs any desired generator can be connected with any particular section of switch-board, as the exigencies of the service may require, or several switch-board sections may be connected to one generator.

On the left of the switch-board A are shown

several keys 10, one for and corresponding to each horizontal or generator bar. These are adapted to be manually operated by buttons 9, and make contact when depressed with a common contact piece or wire 11, leading through a bell, buzzer, or other electro-magnetic alarm 12 to an earth-connection *g*. These keys are normally open or retracted from the said contact-piece, and their function is to test the several generator-circuits for the purpose of approximately locating faults. When any of the said keys are depressed, a current tends to be drawn from the particular generator represented by the said key and is directed through the test device 12.

If any switch-board should fail to obtain a calling-current from its own generator, it is easy to ascertain whether the trouble be between the switch-board A and generator or between the main telephone switch-board section K and the switch-board A, by withdrawing the pin or plug connecting the horizontal and vertical switch-bars at A and then by pressing the key 10. If the trouble be beyond, the current will pass at a normal strength and operate the testing device. If, on the contrary, the trouble be between this point and the generators, or if the generator be defective, the testing device will refuse to operate or will respond feebly.

At the base of each vertical bar I include a suitable resistance 5, in circuit between the said bar and its screw terminal. These resistances may be connected in the circuit of the generator leading to the switch-board or may be shunted therefrom, according as a plug *p* is inserted in or withdrawn from the sockets 6. In some of the said sockets the plugs are shown as being inserted, while in others they are withdrawn. I have found an ordinary resistance-coil having a magnitude of about five hundred ohms to answer well. The use of the said coils is based upon the following facts: Assuming each of the generators to develop a sufficient electro-motive force to supply a current on the longest lines with a suitable margin, as must be the case, it is evident that with five hundred ohms resistance added to the main wire from which a group of telephone-line circuits are supplied a greater proportion of the total current is given to the long circuits, or those having a normal high resistance when the current is being used on several lines at once, than would be the case were this extra resistance not added. In the latter case, for instance, if one line of a group has a resistance of one hundred ohms and another of one thousand ohms, and a call be sent upon both simultaneously, the shorter line will receive about nine-tenths of the current; but taking the same lines and adding five hundred ohms to that part of the generator-circuit which is common to both, the first line being now represented by six hundred ohms and the latter by fifteen hundred ohms, if we ring on the two lines at the same time the first line will receive less than

two-thirds of the whole current. It is therefore decidedly advantageous in practice, even on the regular switch-board lines, to add this five hundred ohms to the circuit of the generator when calling; but when both the local and long trunk-lines are for any reason connected with the same generator, as they often are temporarily arranged, this advantage is greatly emphasized.

Recurring to the generators, those of the series R all have one of their terminals grounded at G^2 , while their other poles are connected by wires 15 to the members of one series of contact-points *j* of a circuit-changing switch C, to be more fully hereinafter described. The movable members *b* of the said switch are shown as being in contact with the several points *j*, and the said members being themselves permanently connected with the main-generator wires 4, it follows that the generators *r* of the steam-power-driven series R are shown as being in operation for developing the switch-board supply. The substitute or motor-driven generators *s* of the series S all, also, have one of their poles grounded, and their other poles are connected by wires 17 with contact-pieces *k* of the same circuit-changing switch C.

It is to be observed, although I have here stated that one pole of each generator of both series is connected to earth and the remaining one only to the switch-boards, that I contemplate also the application of this organization to metallic circuits, in which case one or more of both series of generators would have both poles disconnected from the earth, and in lieu thereof connected by two wires—one from each pole—in a manner well understood, through the various instrumentalities to their final destination at the section of switch-board where the two wires of the metallic telephone-circuit terminate. This I have endeavored to indicate in the drawings by the pair of wires 13, which are attached to the horizontal bars 2, which are second and third from the upper edge of the switch-board A, these being wires leading from the two poles of a generator and by the paired wires 8 and the double key K^3 , attached to the two vertical bars of the said switch-board at the extreme right. As a matter of fact, any or all of the generators might be so adapted for metallic circuits without affecting the organization of devices herein described. The electrical connections of the said switch are shown at C', Fig. 1, and a vertical cross-section showing its mechanical operation is shown at C at the right of the said figure, two views in the same figure having been made necessary by the difficulty of showing the electrical and mechanical features together. Its manifest function is to change the connections of the generator-circuits when one set of generators ceases to work and when the other begins. Reference may also for this circuit-changing switch be made to Figs. 2 and 4. A bar of non-conducting material *a*, pivoted in bracket-

bearings *c*, serves as a movable support for a number of spring-tongues *b*, one for each of the main generator-circuits which lead to the distributing switch-board, and the said tongues constituting the movable part of the circuit-changing switch C are each connected with one of the horizontal bars of the said distributing switch-board by means of the wires 4. The free ends of the spring-tongues extend between upper and lower contact-pieces *j* and *k*, those of the upper set *j*, with which the spring-tongues are normally kept in contact by springs *v*, being, as already described, the terminals of the wires 15, leading from the power-generators of the set R, while those of the lower set *k* form in like manner the terminals of the alternate generators of the set S. The entire apparatus may be mounted upon a convenient shelf I, which may serve also as a support for a portion of the starting apparatus of the alternative generators.

In the operation of this entire system it is especially convenient that the said alternative generators shall be located at a point sufficiently near the central station to be absolutely under the control of the person there in charge. I have in practice placed both sets of generators near together in the cellar of the central-office building, where, also, is placed the circuit-changing switch C. The distributing-switch A, the test-instrument 12, and an alarm-bell B, the function whereof will presently appear, are, together of course with the main telephone-circuit switch-board, preferably placed in the operating-room, which may be and ordinarily is in an upper story of the same building. There is also located in the operating-room a lever *h* and drum H, operated thereby, supported on a wall-bracket *i*, and this lever, raised to the position shown in dotted lines or lowered to the position where it is shown in solid lines, serves to start or stop the water-motor. The water-motor D is fed by the pipe *q*, and its supply is contracted by the throttle-valve lever *q*², as in Figs. 1 and 2. Connected with the main starting-lever *l*², which acts upon the throttle-lever by means of a link *n*, is a rope, cord, or chain *e*, fastened to the periphery of the drum above, which rope conveys the motion of the said drum to the throttle-valve; or, if thought best, a short rope may be used near the drum, while a rod may be employed at the lower extremity of the rope, being articulated to the starting-lever *l*². A counterbalancing-weight *w* and cord *z* may be arranged to co-operate with the starting apparatus. A short bar or board *d* is rigidly affixed to the pivoted tongue-supporting bar *a* of the circuit-changing switch C, and projects forward over the said tongues, forming a bearing for the springs *v* and backward therefrom, constituting an appliance for moving the same. To the end of this is attached a spiral spring *f* of sufficient strength to overcome the springs *v*, but capable of yielding before any damage could

be done to the automatic circuit-changing switch C by reason of its spring-tongues being too forcibly pulled against the contact-pieces *k*, so that while the length of motion of the rod or rope *e* is properly set to operate the motor-valve the automatic switch C is also controlled by it without the necessity of giving it the same length of motion. Thus it will be seen that the act of starting and stopping the water-motor D, and the generators *s* actuated thereby, also makes the necessary change of circuits, transferring the main generator-conducting wires 4 from the generators *r* to those marked *s*, and vice versa.

In the majority of cases no signal is required to notify the attendant in charge of the operating-room of the stoppage of the regular power-generators *r*, since they usually stop at regular meal-hours and at night, and when so stopped it becomes the duty of the attendant to start the water-motor at once. Experience has, however, demonstrated that a signal is necessary whereby the attendant shall be apprised that the power-generators, after being stopped, have resumed operation, so that he shall promptly shut off the water-motor and the generators driven thereby; for it is obvious that it is useless for the two sets of generators to be working at the same time, and extravagant to use the water unnecessarily, and I have devised an apparatus E, which automatically announces that the regular power-generators have resumed operation. It depends upon the concurrent and simultaneous operation of the two sets of generators, or, more accurately, upon the operation of one set of generators and the motor mechanism of the other, and will now be described.

F is the counter-shaft of the water-motor D, and revolves at a comparatively high velocity, being driven by the belt *u*. From a small pulley on this shaft motion is communicated by the belt *u*² to a larger pulley fixed on the shaft 31. The said shaft carries a worm 29, which imparts a slow motion to a worm-wheel 20 in the direction of the arrow. This wheel is hung upon a stud 21, fixed to an upright standard, to which, also, other necessary working parts are secured. On the face of the wheel and extending outward is the operating-pin 24, and in front of the wheel a pendulum or weighted rod 22 is suspended from an overhanging post 25. This pendulum is so adjusted in relation to the wheel 20 and the pin 24 that on each revolution of the wheel it is forced to one side by the pin, and when released makes one or two vibrations. Near the top of the pendulum-rod is attached a flat and moderately stiff contact-spring 26, which normally stands just out of contact with a fixed contact-point 27, which, as shown in Figs. 2 and 3, is mounted on the standard 28, but insulated therefrom. The motion of the wheel, as indicated by the arrow, carries the pendulum and its contact still farther

away from point 27. By reference to Fig. 1 it will be seen that the said contact-point 27 is in permanent electrical union, by means of wire 16, with the wire 15 of some one of the steam-power generators *r*. The pendulum 22 is in like manner connected either directly or through the standard 28, by means of wire 14, with one terminal of the electric bell B in the operating-room, the other terminal of this bell being grounded.

It will be observed from the foregoing and from the drawings that the wheel 20 is in constant motion during the use of the water-motor, and it is therefore evident that if the water-motor and its generators are in motion while the steam-generators are at rest there will no signal be given upon the bell, though the alarm apparatus is moving, as no current can be supplied to the point 27. It is equally obvious that with the steam-generators in motion and the water-motor at rest no alarm will be given on the bell, for in this case, while the contact-piece 27 is connected with an active source of electricity, the pendulum is at rest, and therefore no circuit is completed between the generator and the bell; but with both steam and water power in operation at the same time the current is supplied to the contact-piece, and the pendulum periodically swings, closing the circuit through the alarm-bell, for a moment at a time, once in three or four minutes, depending upon the speed of the wheel 20. Thus an automatically-operated signal is provided which is so arranged that a constant loud or annoying alarm will not be given, while it is remarkably efficient, in that it is sounded not only once, but repeatedly at intervals until the superfluous power is shut off. Furthermore, the apparatus arranged as described effectively insures that the pendulum-contact can never be left in permanent contact with the fixed contact 27, as might easily happen were the pendulum forced by the wheel-pin toward instead of away from the fixed contact, and it thus becomes immaterial in what position the wheel 20 may stop.

As already stated, an alarm to indicate the stoppage of the regular generators *r* is not usually necessary. In some cases, however, it may be required, and to this end I have combined such an alarm with the foregoing devices, as shown in Figs. 5 and 6. The plan delineated in Fig. 5 is preferred by me, as being quite independent of manual control. It is not new *per se*, having been already described in Letters Patent issued to me September 30, 1884, No. 305,747; but its combination (as shown herein to produce a definite result) with other instrumentalities I believe to be quite new.

In Fig. 5 most of the details are, in view of what has gone before, self-explanatory.

F is the counter-shaft of the water-motor, and G the shaft operating the steam-driven generators, the power being conveyed thereto by the belt 18. I affix to the automatic

switch C an extra spring *a'* and fixed contact *j'*, and include these in a local alarm-circuit, including also a bell B², located in the operating-room, and a battery B^a. The switch-contact is normally closed. The wires 36 and 37 of this local circuit lead to a point near the power-generators, and the circuit is there held open during the operation of the said generators by a circuit-controller 40 41, actuated by a centrifugal governor J. This governor is operated by a pulley and belt driven by the counter-shaft G. Two fairly heavy balls 45 are fitted upon a flexible but strong hoop 46, one side of which is fixed, while the other is attached to a rod 47, sliding easily in one end of the hollow shaft 42, this being revolved in bearings 44. The end of the shaft 47 forms the contact-point 41, and is adapted, when the machinery stops, to come into contact with a second point 40, supported upon an insulated standard 49. When these two points touch, on the stoppage of the machinery, the circuit will be closed and the bell will ring, notifying the attendant in the operating-room to start the water-motor, and as the automatic switch C is operated by the same motion it is evident that the local alarm-circuit will be thereupon opened at the points *a'* and *j'*. The bell will then cease ringing. When, on the contrary, the machinery starts, the balls swing apart, retract the shaft 47 into the outer shaft 42, and open the circuit once more between 41 and 40.

Fig. 6 shows a modified arrangement. In this case the wire 37 of the local circuit terminates in a contact-spring 34, within range of the main-valve handle of the steam-engine. The metal of the said handle 35 is connected with the other wire 36 of the circuit, which is thus closed when the handle is turned inward to shut off the steam, and the alarm is thereupon given.

It will be evident that it is by no means essential that the main power or regular generators *r* shall be located in any particular position with reference to the operating-room, and that, if convenient, they may be some distance therefrom, all that is required being that their wires 15 must extend to the automatic switch C, that one of the said wires must branch by a wire 16 to the alarm device E, and that the automatic switch C must be so arranged that it can be operated, as shown, by the action of starting the water-motor. It is evident, also, that the connections of the wires 14 and 16 in Fig. 3 may be reversed with respect to the signal-sending apparatus without affecting the operation of the same. Moreover, though I have herein specified the motor of the substitute set to be a water-motor, it is obvious that I am not restricted thereto, as a gas-engine or an electromotor could be readily and without further invention substituted therefor. A water-motor is, however, for simplicity, preferred.

The pole-changer H' is simply provided for use, in connection with the double battery M

B, in case some accident should happen to both sets of generators. A wire 4 is run from the center of the battery to the lowest horizontal bar of the distributing-switch, and can
5 there be connected by plugs to any or all wires 8, leading to the main switch-board. The pendulum 59 of the pole-changer connects by wire 69 with the earth. Wires 57
10 and 58 run from the extreme and opposite poles of the battery to contact-springs 55 and 56, with which the lower end of the pendulum, which is polarized by the proximity of the magnet 50, comes in contact. The local
15 circuits of the electro-magnets 47 and 48 are not shown.

My invention, then, in accordance with the foregoing specification, comprehends the association of power-generators with a distributing-switch provided with testing and equalizing devices, the employment, in association
20 with said switch-board and with an automatic circuit-changing switch, of duplicate sets of generators actuated by independent sources of power, one of the said sources being entirely under the control of the central
25 station; also, in combining with duplicate sets of generators a signal-sending apparatus adapted to notify the proper person when at any time the two sets are in operation at the
30 same time, and also in providing, in connection with the foregoing, an independent signal adapted to announce the stoppage of the regular power-generators; and, in accordance with this statement of my invention,

35 I claim—

1. The combination, substantially as here-
inbefore described, in a call apparatus for
telephone-exchanges, of a series of magneto-
40 electric generators operated by power, connecting-wires extending therefrom to the signal-sending appliances of a series of telephone-switch-board sections, each of the said
45 wires being adapted to form part of a sub-station circuit for sending outgoing signals, a distributing switch-board placed in the circuit of said wires between the generators and
the telephone switch-board, and means, as indicated, for testing the said generators and
50 their connecting-wires, for the purposes specified.

2. In a call apparatus for telephone-exchanges, a series of magneto-electric generators operated by power, connecting-wires extending therefrom to the signal-sending
55 appliances of a series of telephone-switch-board sections, each of the said wires being adapted to form part of a sub-station circuit for sending outgoing signals, a distributing switch-board placed in the circuit of said
60 wires between the generators and the telephone switch-board, whereby the connection of the generators with the switch-board sections may be varied at will, and a testing device for the said generator-circuit, comprising
65 a series of test-keys located at the said switch-board, one in permanent connection with each generator-wire, and an electro-

magnetic alarm-instrument connected on one side to earth and on the other with the common front contact of the said keys, substantially as and for the purposes specified. 70

3. In a call apparatus for central telephone-stations, a series of magneto-electric generators operated by steam or other power, connecting-wires extending therefrom to the signal-sending appliances of a series of telephone switch-board sections, each of the said
75 wires being adapted to form part of a sub-station or trunk circuit for the purpose of sending outgoing signals, a series of equalizing resistances interposed in the generator-circuits—one for each—between the said generators and the said signal-sending appliances, and means for shunting or short-circuiting the said resistances, substantially as
80 described, and for the purposes specified herein. 85

4. The combination, substantially as hereinbefore described, of a series of constantly-operating electric generators, circuit-connections therefor extending therefrom, a distributing switch-board receiving the outer ends
90 of said circuit-connections, extension-wires leading from the said distributing switch-board to the signal-sending appliances of a series of telephone-switch-board sections, a series of equalizing resistance-coils interposed in the circuit of said extensions, one for each, and a shunt-circuit controlled by a manual
95 circuit-closer for each resistance. 100

5. The combination, in a telephone-exchange, of two sets of magneto-generators for sending outgoing call-signals, one of the said series of generators being regularly operated by steam or other power, the other series being adapted to be actuated by a water or other
105 motor under the control of the central station, an automatic circuit-changing switch interposed between the telephone switch-board and the two series of generators, and adapted, when operated, to disconnect one of the said series of generators from the said switch-board and to connect the other in lieu thereof, duplicate circuit-connections extending, respectively, from the two series of generators
110 to the said automatic switch, and a single set of circuit-connections extending therefrom to the telephone-switch-board sections, and in circuit with one or the other of the series of generator-connections, according to the position of said automatic switch, a mechanical
115 controlling device located in the central station acting upon the throttle of the water-motor, whereby the same can be started or stopped from the said station, and means, substantially as described, actuated by the said
120 motor-controlling device, whereby the automatic switch may be simultaneously operated by the action of starting or stopping the motor, and the circuit-connections thereupon
125 changed from the quiescent to the active generators. 130

6. In a central station of a telephone system, a regular series of magneto-generators for

furnishing currents for sending outgoing signals, adapted for practically constant operation and actuated by steam or other power, a supplementary or substitute series of similar
 5 generators actuated by a water-motor or like local power and adapted to be brought into action during the temporary stoppage of the regular series, an automatic switch controlling the circuit-connections of both generators
 10 and adapted to connect the series at any given moment in operation with the switch-board, and to disconnect therefrom those which are quiescent, and means, substantially as described, comprising, as shown, a link-and-lever
 15 mechanism extending from a manually-operated lever in the operating-room to the valve or throttle of the water-motor and also to the said automatic switch, whereby the said motor may be thrown into and out of operation as
 20 required, and whereby the said automatic switch may simultaneously and without independent action be moved in correspondence therewith.

7. The combination, substantially as hereinbefore described, of two series of call-generators operated by independent sources of power, one of the said series being intended for regular operation and being actuated by power uncontrolled by the central station,
 30 and the other being adapted for use in case of the temporary stoppage of the first and being actuated by power—such as a water-motor—controlled by means of suitable mechanism at the central station, an
 35 automatic circuit-changing switch actuated also by the said controlling mechanism and adapted to transfer the switch-board generator-wires from one series of generators to the other when the substitute generators are
 40 started and stopped, and an alarm-signal comprising a bell or other electro-magnetic device, an electric circuit, and an intermittent circuit-closer therefor, the said alarm being adapted to be actuated only by the
 45 simultaneous and concurrent action of both series of generators, whereby the central-station operator may be notified whenever the water-motor is being unnecessarily employed.

8. The combination of two series of magneto-electric generators driven by independent sources of power, with an automatic electro-magnetic alarm adapted to indicate the concurrent operation of both series, the said alarm having its actuating-magnet included
 55 in circuit with a generator of one of the said series and deriving its actuating-current therefrom, and an intermittent and periodic circuit closer and breaker included also in said alarm-circuit and operated by the
 60 driving mechanism of the other series, substantially as and for the purposes specified.

9. The combination of two series of magneto-electric generators driven by independent sources of power, with means for indicating at a given point that both series are
 65 working at the same time, said means comprising an electric circuit, an electro-mag-

netic alarm-instrument included therein, an intermittent vibratory circuit-closer operating at intervals to momentarily close the said
 70 circuit, said circuit-closer being actuated by the motor mechanism of one of the series of generators and one of the generators of the other series, the said generator being included in the said electric circuit with the circuit-closer and alarm, whereby attention may be
 75 called to the unnecessary simultaneous operation of both series by an alarm capable of being operated only when both series are at work, substantially as described. 80

10. The combination, with a regular series of power-driven magneto-generators, of a normally-open alarm-circuit including an electric bell and one of the said generators, an
 85 auxiliary or substitute series of generators driven by independent power and adapted for use when the first series are temporarily stopped, and an intermittent vibratory circuit-closer also included in the said normally-open circuit, actuated by the motor mechanism of the said substitute series of generators
 90 and adapted to close the alarm-circuit at intervals, whereby the simultaneous operation of both series of generators is automatically announced, as set forth. 95

11. The combination of an intermittent circuit-closer comprising the rotary disk 20 and the pin 24, carried thereon, the pendulum or rod 22, the spring-contact 26, supported thereby, and the insulated fixed contact-piece 27,
 100 the said wheel being arranged to rotate in such a direction that the pin will strike the pendulum away from said fixed contact, with an electric circuit and an alarm-instrument included therein, the said spring 26 and fixed
 105 contact 27 being, respectively, terminals of the said electric circuit, whereby a brief and intermittent and periodic signal may be given only when the rotary disk is in motion at the same time that an electro-motive force is connected with said circuit. 110

12. In a telephone central-office system, the combination, substantially as hereinbefore described, of a series of power-driven magneto-electric generators adapted for regular
 115 and constant use, a substitute series of generators driven by independent power under the control of the central station and adapted for use when the first series are from any reason at rest, for the purpose of maintaining at
 120 all times a supply of calling-currents, an automatic signal, substantially of the character indicated herein, comprising an electro-magnetic alarm, a normally-open electric circuit in which the same is included, and a circuit-closer
 125 actuated by the stoppage of the first series of generators for the purpose of calling attention to such stoppage, and an independent automatic alarm operated by the current of one of the generators of the first
 130 series flowing in an electric-bell circuit which is closed at intervals by the motor mechanism of the generators of the substitute series, whereby attention is called to the simultane-

ous operation of both series, substantially as described.

13. The combination, with two series of magneto-electric generators actuated by independent sources of power, of an electric alarm or signal adapted to become operative only when both series are working at the same time, the said alarm comprising an electric circuit, an electric signal-bell included therein, one of the generators of one of the series and a periodic circuit-breaker driven by the motor mechanism of the other series.

14. The combination, with two series of magneto-electric generators actuated independently by suitable power, of an electric signal or alarm adapted to indicate the simultaneous operation of both series and depend-

ing upon the concurrent action of a current developed by the generators of one series and the movement of the motor mechanism of the other series, the circuit of said signal being provided with an intermittent and periodic circuit-closer driven by the motor mechanism of one generator series and including one of the generators of the other series, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 15th day of April, 1889.

ISAIAH H. FARNHAM.

Witnesses:

GEO. WILLIS PIERCE,
FRANK C. LOCKWOOD.