(No Model.) 2 Sheets—Sheet 1.

A. G. WATERHOUSE.

SYSTEM OF GENERATORS.

No. 420,924. Patented Feb. 4, 1890.

Fig. 1.

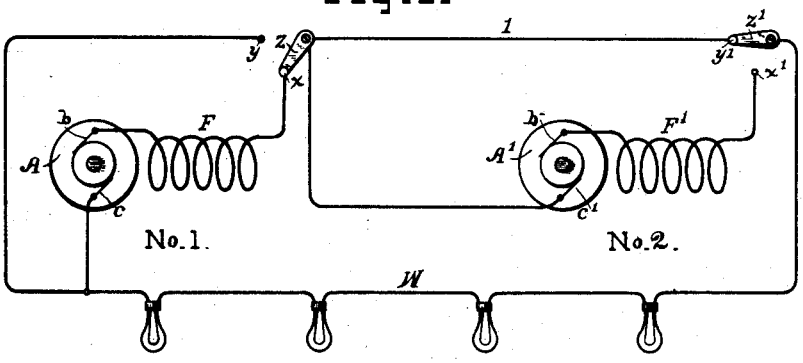


Fig. 2.

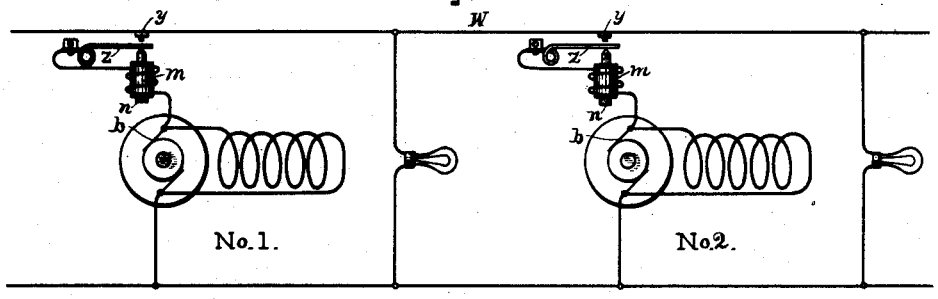
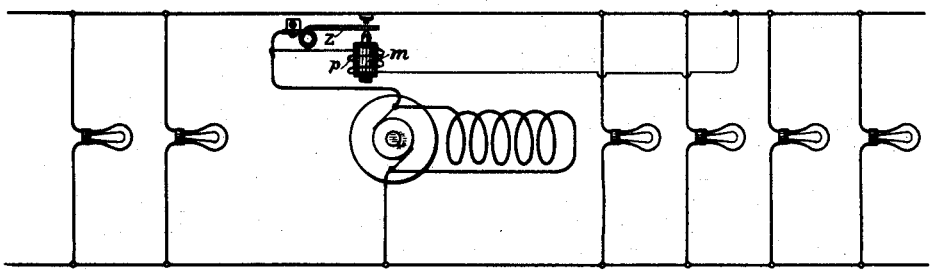


Fig. 3.



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(No Model.) 2 Sheets—Sheet 2.

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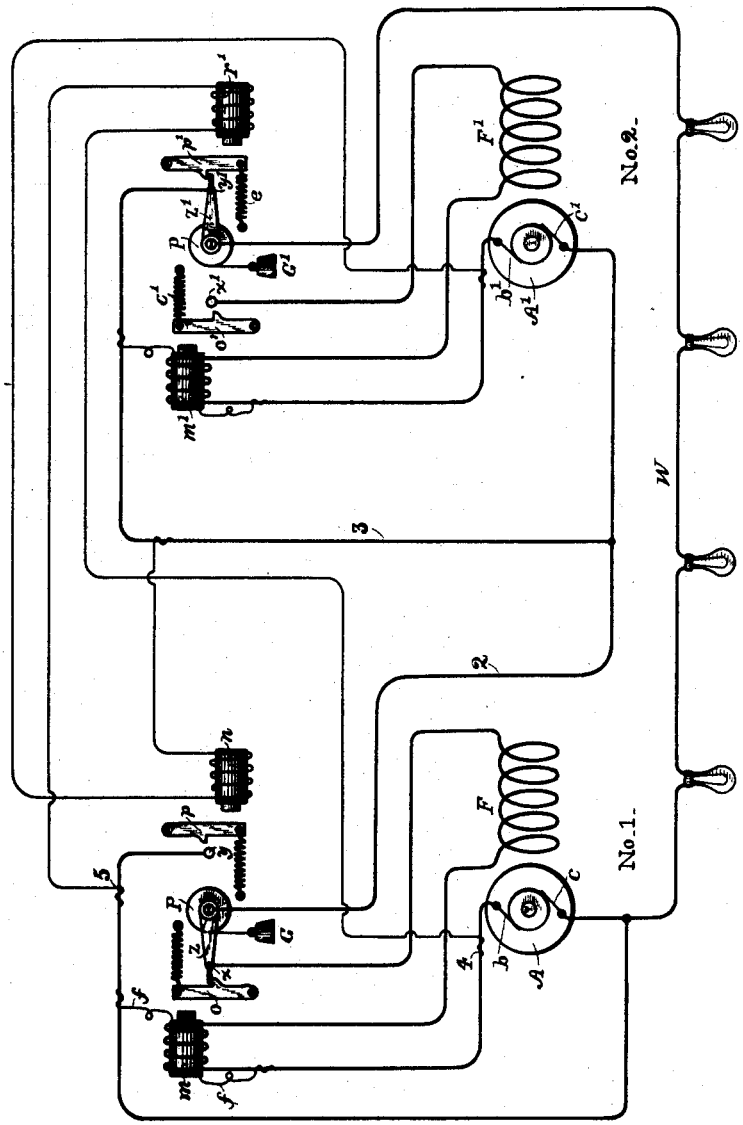
Fig. 4.



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UNITED STATES PATENT OFFICE.

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SYSTEM OF GENERATORS.

SPECIFICATION forming part of Letters Patent No. 420,924, dated February 4, 1890.

Application filed May 3, 1889. Serial No. 309,449. (No model.)

To all whom it may concern:

Be it known that I, ADDISON G. WATERHOUSE, a citizen of the United States, now residing at Hartford, in the county of Hartford and State of Connecticut, have invented a certain new and useful Improvement in Systems of Generators, of which the following is a specification.

My invention relates to a method of employing two or more dynamo-electric machines for supplying the same work-circuit, whether connected in series or multiple arc.

The invention consists in automatically cutting one or more such machines into or out of the working-circuit, accordingly as changes in the load or amount of work to be done requires their united services or can be performed by a portion of the machines.

The invention involves the construction of the cut-out devices or automatic switches by which the connections of the dynamos are controlled.

The invention will be described in detail in connection with the accompanying drawings, in which—

Figure 1 represents diagrammatically two dynamo-electric machines connected in series upon a work-circuit, and Fig. 2 illustrates in diagram two machines which may be connected with a work-circuit in multiple arc or singly. Fig. 3 illustrates a modification. Fig. 4 illustrates two machines connected in series and provided with means for automatically switching them into and out of the circuit as required.

Referring to the figures, the machines will be designated as "No. 1" and "No. 2." No. 1 consists of an armature A, field-magnets F, and collecting-brushes b and c, and No. 2 consists of an armature A′, fields F′, and brushes b' and c'. The conductors forming each field-magnet F and F′ lead from their respective brushes b and b', and after forming the field-coils F and F′ terminate at the contact-points x and x'. Each dynamo is provided with two contact-points x and y and x' and y', respectively, and corresponding switches z and z'. The points x and x' are connected with the terminals of the field-coils, as already indicated, and the points y and y' with the brushes c and c'. The switch z of dynamo No. 1 is connected with the brush c' of No. 2, and also with its contact-point y', while the switch z' of No. 2 is connected to the working-circuit W, which returns to the brush c of No. 1.

In the arrangement as shown in Fig. 1 it is evident that the current from the armature A of No. 1 will pass from the brush b through the field-magnet F to the contact-point x and through the switch z and conductor 1 to the point y', and through the switch z' to the working-circuit W, and back to the armature of No. 1, thus leaving No. 2 out of the circuit, as its switch z' is away from the point x'; but if the switch z' were moved from the point y' to the point x', then the two machines would be connected in series. If, on the other hand, the switch z were moved from the point x to y, then No. 1 would be cut out of the circuit and No. 2 would be doing all the work.

Now, the leading feature of my invention is the employment of devices, to be hereinafter described, which will automatically switch these machines into or out of the work-circuit, accordingly as the work to be performed may require both machines or only one.

Referring now to Fig. 2, the two machines here shown are of the shunt-wound type and arranged in multiple arc. Each machine is provided with a switching mechanism consisting of an electro-magnet m, which is energized by the main current passing from the brush b. The core n is drawn upward by reason of the current traversing the coil m, and it presses a spring or switch z into contact with the point y, thus forming a connection with the main line W. If the current delivered by the two dynamos decreases below a given value by reason of a decrease in the load, the strength of the magnet m will be insufficient to hold the spring z against the point y, and the circuit of the corresponding machine will be broken, so that all of the work will fall upon the other machine. By making the contact mechanism of several machines of varying sensitiveness the machines will be successively cut out of circuit as the work decreases.

In Fig. 3 a modification in the form shown

in Fig. 2 is illustrated. In this instance the contact-magnet m is energized by a shunt p around the switch z, including a certain length of the main conductor. This is so organized that the energy in the magnet m will correspond to the amount of current being taken from that part of the main conductor included in the shunt, so that the dynamo will be connected with or disconnected from the main line, according to the amount of work being done on the part of the main line shunted.

In Fig. 4 two machines are shown as connected in series and arranged to be automatically cut in and out, according to the requirements of the work-circuit. The machines are represented as Nos. 1 and 2, having armatures A and A′, field-magnets F and F′ respectively, and collecting-brushes b b' and c c'. The respective machines have switching mechanisms consisting of revolving switches z and z', made to rotate by means of the pulleys P and weights G and G′, or in some other convenient manner. The switches z and z' are made to form a contact with either of their points x y and x' y', and if arrested in contact with either of these points will form an electrical connection with the same. As shown in Fig. 4, dynamo No. 1 is in circuit with the work-circuit W, while No. 2 is cut out of circuit. If the current is delivered by the armature A of dynamo No. 1, it passes through the brush b to the line and through the coils of the magnet m to the field-magnet F, then to the point x, upon which the switch z rests, thence to the pivot of the switch, and by way of the conductor 2 to the brush c' of the dynamo No. 2. Circuit-connections are continued from this conductor through the armature A′ to the brush b', thence through the main coils of the magnet m' to the field-magnet F′, and to contact-point x'. The circuit-connections are, however, open at this point on account of the switch z' being moved away. The conductor 2, leading to the brush c' of dynamo No. 2, is, however, also connected by a conductor 3 with the point y', upon which the switch z' now rests, so that the current produced by No. 1 finds the circuit complete to the switch z'. This switch is connected with one terminal of the work-circuit W, the other terminal of which is connected with the brush c and armature A of the dynamo No. 1.

In the position shown in the drawings dynamo No. 1 is doing all the work. If now the work is increased beyond the capacity of this machine and it becomes necessary that No. 2 should be connected in the line, the following operation takes place: The switch z' is on the point y', and is held there by a detent on the armature p' of the magnet r', which armature is held by a retraction-spring e. The electro-magnet r' is energized by a high-resistance shunt led from points 4 and 5 upon the opposite sides of the armature A of the generator No. 1, or, in other words, from the brushes b and c. If the amount of work being done by or the load upon this armature increases, the difference of potential at the terminals of the shunt is proportionately increased until the magnet r' draws the armature p' forward, releasing the switch z'. The weight G′ then acts to rotate the said switch z' until it passes into contact with the point x', where it is arrested by a notch or step in a similar armature o', held back from its magnet m' by a spring c'. The dynamo No. 2 is thereby placed in the work-circuit in series with the dynamo No. 1.

If now both dynamos are connected with the work-circuit, and the work being done is reduced so that only one dynamo is necessary, or, in other words, each dynamo has been regulated or reduced down so that its output is only equal to one-half its normal capacity, then one of the machines will be cut out of circuit in the following manner: If the current passing from dynamo No. 1 out on brush b is up to the full standard or quantity—say ten ampères—this passing through the main coils of the magnet m would energize it to its full force were it not for an opposing shunt-coil f of high resistance. This shunt is a derived circuit extending from the brush b to the brush c of dynamo No. 1. While this machine is performing work amounting to over fifty per cent. of its normal capacity, the effect of this shunt-coil is sufficient to neutralize the effect of the main coil; but when the energy given out by this machine falls below, say, fifty per cent. or any predetermined proportion of its normal capacity, the effect of the shunt-coil is reduced in the same proportion and the relative magnetizing value of the main coil increases until the magnet draws forward the armature o and liberates the switch z, which swings around until caught and held in contact with the point y by the armature p of the magnet n, thus open-circuiting dynamo No. 1 and closing a circuit around it from the brush c, through the point y and switch z to the brush c' of the dynamo No. 2. The switch z' might operate in the same way to cut the dynamo No. 2 out of circuit, provided the coils of the corresponding magnet m' be so proportioned that it will respond more quickly than the magnet m. The construction, circuit-connections, and operation of the magnets m and m' will be evident without further description.

I claim as my invention—

1. The combination, with two or more dynamo-electric generators and a single work-circuit supplied thereby, of an automatic cut-out controlled by currents delivered by one of the generators for automatically removing the same from the circuit when the current delivered thereby falls below a predetermined amount.

2. The combination, with two or more dynamo-electric generators and a single work-circuit supplied thereby, of a circuit-controlling apparatus applied to one or more of the

generators and serving to disconnect the corresponding generator from the circuit when the current from that generator falls below a predetermined value, and to automatically reintroduce the generator into the circuit when the current delivered by any other generator rises above a predetermined value.

3. The combination of a series of generators, a single work-circuit supplied thereby, a circuit-controlling apparatus for two or more of the generators, consisting of a switch device normally connecting said generators with the work-circuit and removing a given generator from said circuit upon the decrease of the current delivered thereby below a predetermined value, the said circuit-controlling devices being organized to operate in succession.

4. Two or more dynamo-electric generators normally connected with the same work-circuit, switching mechanism for one or more of said generators, composed of a cut-out switch responding to changes in current strength to cut the dynamo out of circuit when the amount of electrical energy at any time produced by the dynamo falls below a fixed proportion of the normal capacity of such dynamo, substantially as and for the purposes as set forth above.

5. Two or more dynamos normally connected in multiple arc with a work-circuit, one or more of said dynamos having a switching mechanism composed of the following instrumentalities: a cut-out switch responding to the action of the current, which will cut the dynamo out of circuit whenever the current delivered thereby falls below a fixed proportion of its normal capacity, and a switching mechanism acting in response to current changes to cut into the circuit an inactive dynamo when the work being performed upon the circuit exceeds the capacity of the dynamos in action, substantially as and for the purposes set forth.

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