

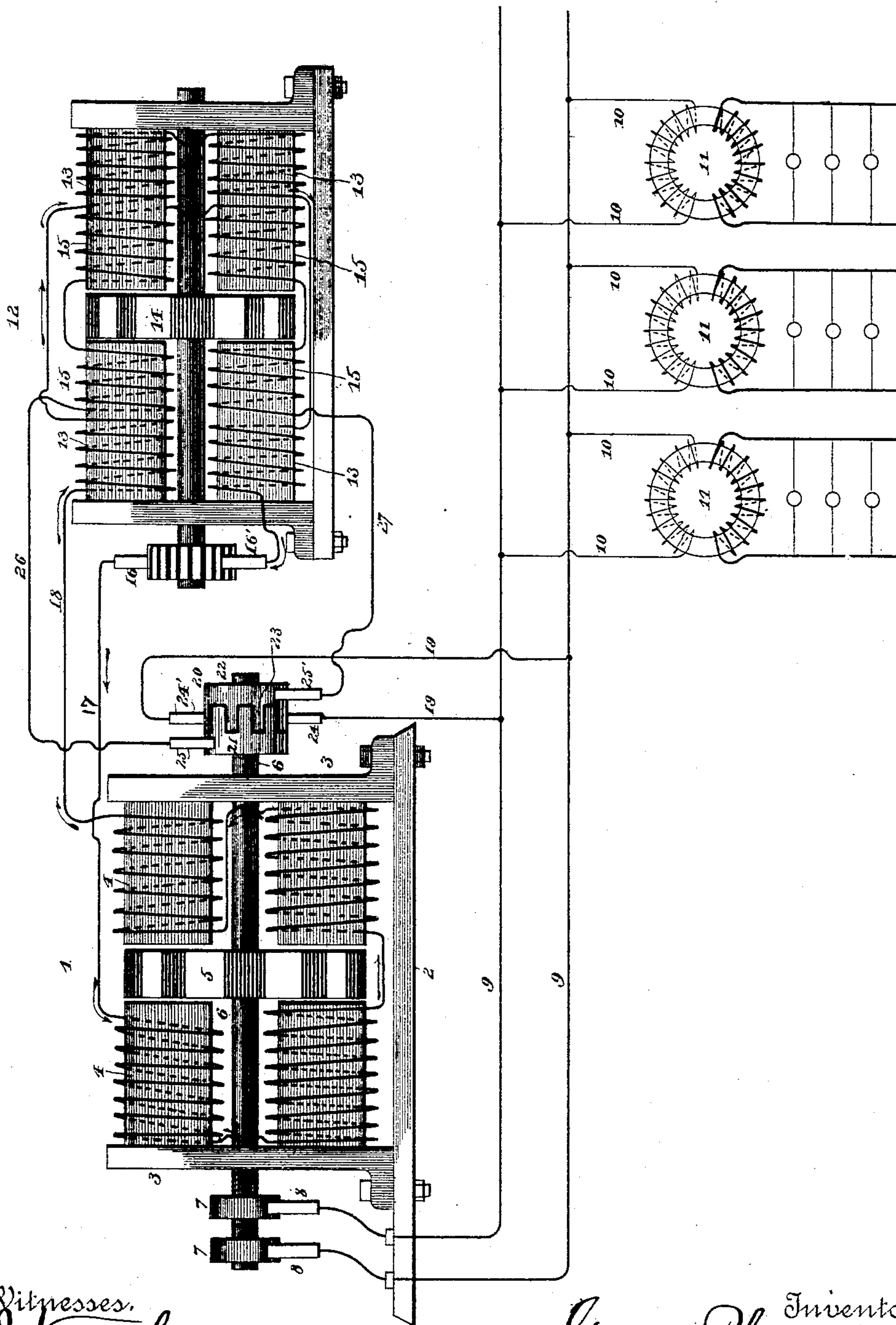
(No Model.)

G. PFANNKUCHE.

REGULATION OF ALTERNATE CURRENT GENERATORS.

No. 396,422.

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2 Witnesses.
At Nottingham.
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UNITED STATES PATENT OFFICE.

GUSTAV PFANNKUCHE, OF CLEVELAND, OHIO, ASSIGNOR TO THE BRUSH ELECTRIC COMPANY, OF SAME PLACE.

REGULATION OF ALTERNATE-CURRENT GENERATORS.

SPECIFICATION forming part of Letters Patent No. 396,422, dated January 22, 1889.

Application filed November 5, 1887. Serial No. 254,415. (No model.)

To all whom it may concern:

Be it known that I, GUSTAV PFANNKUCHE, of Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and
5 useful Improvements in the Regulation of Alternating Electric-Current Generators; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to
10 which it appertains to make and use the same.

My invention has reference to improvements in the regulation of alternating electric-current generators, whereby the latter become adapted for use in general systems of
15 distribution in which the number of translating devices is variable. It is more especially designed for use in connection with such systems of distribution in which the translating devices are in multiple-arc branches derived
20 from a main or trunk line, and in which it is desired to maintain a constant difference of potential at the terminals of the derived branches or working-circuits, which are frequently at great distances from the gener-
25 ator. In such systems, as in all other systems of distribution, the difference of potential at the brushes of the generator is dependent upon the relation of the external resistance to the total resistance in such manner that
30 when the external resistance increases the difference of potential at the brushes also increases, while at the same time less current is generated in the armature, and when the external resistance decreases the difference
35 of potential at the brushes also decreases and more current is at the same time generated in the armature. From this it becomes clear that in a multiple-arc system of distribution, whenever one or more working-branches are
40 opened provision should be made to decrease the strength of the field-magnets, and whenever additional working-circuits are closed the strength of the field-magnets should be increased, in order to maintain a constant dif-
45 ference of potential, substantially as in constant-potential dynamos for incandescent electric lighting.

The object of my invention is to accomplish this result automatically and effectively
50 in a separately-excited alternating-current generator, and provide for this purpose an ex-

citer which furnishes currents of one direction to the field-magnet coils of the alternating-current generator, and the arrangement is such that the strength of the current fur-
55 nished by the exciter is controlled by the difference of potential at the brushes of the alternating-current generator. For this purpose the field-magnets of the exciting-dynamo are provided with auxiliary energizing-coils
60 in addition to the ordinary coils, which auxiliary coils are wound in opposition to the normal coils and are in a branch of the main line near the brushes—i. e., in a shunt around
65 these brushes.

Since the currents derived from the main line are alternating, the branch to the auxiliary coils of the exciter must be provided with a commutator for straightening these currents
70 before they reach the auxiliary coils, all of which will more fully appear from the following detailed description, in which reference is made to the accompanying drawing, in which I have illustrated, mainly in diagram,
75 one of the numerous forms which my invention may assume.

The alternating-current generator 1 may be of any ordinary or improved construction. It is represented in the drawing as mounted
80 upon a base or platform, 2, upon which standards 3 3, of iron, are bolted, and which standards constitute the yokes of the field-magnets 4 4.

The armature 5, which is preferably of the Brush type, is mounted upon a shaft, 6, which
85 may be journaled in the standards and is driven in any suitable manner.

The alternating currents generated in this machine are collected by brushes 8 8, bearing upon collecting-disks 7 7, secured to but in-
90 sulated from the shaft and having the terminals of the armature-coils connected therewith. All these parts may be of ordinary construction, well understood by those skilled in the art, and need not be specifically described.
95 With the collecting-brushes 8 8 the main or trunk line 9 9 is connected, and at distant points 10 10, &c., this line is tapped by multiple-arc branches in which suitable translating devices are included.
100

The translating devices 11 11, &c., shown in the drawing are in effect inductoriums de-

signed to convert currents of a given tension into currents of a different tension, substantially as set forth in patent to Charles F. Brush, No. 219,209. The alternating-current generator used in the system here shown is constructed to furnish currents of comparatively very high tension, and the inductoriums or secondary generators are therefore arranged with their fine-wire coils in the multiple-arc branches 10 10, &c., while their coarse-wire coils include translating devices adapted to be operated by currents of comparatively low tension, like incandescent-electric lamps, &c. It will be understood, however, that while my system is eminently adapted for the operation of secondary transformers, it is by no means confined to the feeding of such transformers. Any other suitable translating devices may be substituted for the secondary transformers 11 11.

The field-coils of generator 1 are charged by an exciter, 12, which is preferably a series-dynamo of the Brush type. The field-magnets of this exciter are provided with two sets of coils, one set, 13 13, &c., being the normal field-coils, connected in series with the armature 14, as usual, and the other set, 15 15, &c., being wound in opposition to the normal coils, are in a shunt around the collecting-brushes 8 8 of the alternating-current generator, as will presently appear. From commutator-brush 16 of the exciter the circuit of the latter may be traced by arrows from wire 17 to and through the coils of field-magnets 4 4 of generator 1, and by wire 18 to and through the normal coils 13 13, &c., of the exciter, and back to the commutator and armature 14 by brush 16'. Thus it is seen that the field-coils of the alternating-current generator are in the external circuit of the exciting-dynamo and will receive a normal charge from the same so long as the field of force of the exciter remains unchanged.

Upon the armature-shaft of generator 1 is mounted, but insulated therefrom, a commutator, 20, composed of two hollow cylindrical blocks, 21 and 22, each provided at one end with a number of segmental teeth, 23, alternating with segmental spaces; and these two blocks are so mounted upon the armature-shaft that the teeth of each block engage the corresponding spaces in the other with insulating material, indicated by heavy lines intervening between the two blocks.

Two commutator-brushes, 24 24', bearing upon the segments of the commutator, are connected with wires 19 19, branched from the main line, and two other brushes, 25 25', bearing upon the undivided cylindrical portions of blocks 21 and 22, respectively, are connected by wires 26 and 27 with the terminals of the auxiliary coils 15 15, &c., of the field-magnets of the exciter. The total number of segments of commutator 20 is equal to the number of alternations of current in generator 1, and they are so located upon shaft 6 relative to the coils of armature 5 that one of

the brushes 24 24' will bear upon a segment of one of the blocks 21 22, while the other of these brushes will bear upon a segment of the other of these blocks during the prevalence of one electrical impulse.

It will now be easily understood that the alternating currents reaching the commutator by branch wires 19 19 will be straightened out by said commutator and will leave the same by one of the brushes 25 25' and return by the other, after having traversed the auxiliary field-coils 15 15 of the exciter in the inverse direction to the current in the normal coils 13 13, generated by the exciter itself. The auxiliary field-coils 15 15 are thus in a shunt around the brush-terminals of generator 1, and, as the difference of potential at those terminals varies, the auxiliary coils will be variably charged, and they will therefore variably modify the strength of the field-magnets of the exciter.

The automatic regulation to a constant difference of potential at the terminals of working-circuits in a system of distribution provided with my apparatus can now be explained.

The prime generator and the exciting-dynamo are started simultaneously. The current from the latter energizes the field-magnets of the former, and the strength of said field depends upon the strength of current from the exciter. This exciter, in so far as it is an ordinary self-exciting dynamo, will furnish a current depending upon its construction and speed; but in so far as its auxiliary field-coils are fed by a shunt across the brush-terminals of the alternating-current generator, the strength of its field, and, consequently, the strength of current generated by it, will also depend upon the relation of the external resistance to the total resistance of the prime generator. Supposing, then, that both machines are started when a given number of translating devices, like the secondary transformers 11 11, are at distant points included in multiple-arc branches from the main line, and that in that condition of the system the alternating-current generator furnishes the required current to the line and produces the required difference of potential. If, now, additional multiple-arc branches 10 10 are introduced, the external resistance of the prime generator will be reduced, and in consequence thereof, as stated above, the difference of potential at the brush-terminals of generator 1 will at once decrease, while at the same time more current will be generated, as required by the increased number of translating devices. In consequence of the decrease of difference of potential, less current than before will be diverted through the shunt 19 19 into the auxiliary field-coils 15 15 of the exciting-dynamo. These coils will therefore less oppose the magnetizing action of the normal coils 13 13, and the field of force of the exciter will consequently become stronger. The exciter will now furnish a stronger current to the field-

coils 4 4, &c., of the alternating-current generator, and the difference of potential at the brush-terminals of the latter will therefore be increased. Thus it is seen that such
 5 change in the external resistance as will tend to decrease the difference of potential at the brush-terminals will automatically operate to re-establish or maintain the original difference of potential. If, on the contrary, some
 10 of the multiple - arc branches 10 10, &c., are opened and the external resistance of the line increased, less current will be generated in armature 5, and the difference of potential at the brush-terminals will be increased. As a
 15 consequence of this, more current will be diverted into shunt 19 19 and auxiliary coils 15 15 of the exciter. These coils will more oppose the action of normal coils 13 13, as before, and the field of the exciter will be
 20 weakened. The exciter will therefore furnish a weaker current to the field-coils 4 4 of the prime generator, and the difference of potential at the terminals of the latter will decrease, thus re-establishing the normal difference of
 25 potential.

It is clear that my system will operate to maintain a constant difference of potential, whether the changes of external resistance are caused by the closing or opening of working-
 30 branches or by any other cause, for it responds to and reacts upon variations of differences of potential irrespective of the causes which produced or tend to produce the same. No artificially - introduced resistances and no
 35 manipulations of any kind are necessary to the effective operation of my invention, which is absolutely automatic.

I desire it to be understood that I do not limit myself to the identical details of construction herein shown and described. These
 40 details may be varied and modified at will, so long as the fundamental rules laid down in this specification are adhered to, without departing from the principle of my invention.
 45 tion.

I claim and desire to secure by Letters Patent—

1. The combination, with an alternating-

current dynamo, of a separate exciting-dynamo having its field-magnets provided with
 50 two sets of coils, one set being included in the circuit of the field-magnet coils of the alternating-current dynamo, and the other set being included in a shunt across the brush-
 55 terminals of the alternating-current dynamo.

2. The combination, with an alternating-current dynamo, of a separate-exciting dynamo having its field-magnets provided with two sets of coils, one set being included in the circuit of the field-magnet coils
 60 of the alternating current dynamo, and the other set being included in a shunt across the working-circuit, and a commutator included in the shunt for straightening the current to the set of field-coils therein, substantially as
 65 set forth.

3. In a system of electrical distribution, the combination of a separately-excited alternating-current generator having its field-coils charged by a self-exciting dynamo, with auxiliary differential coils upon the field-magnets of the exciter in a shunt across the
 70 brush-terminals of the alternating-current generator, and a commutator for straightening the currents in the shunt, substantially as described.
 75

4. The combination, with an alternating-current dynamo, inductoriums in multiple-arc branches of the main line from the alternating-current dynamo, and translating devices included in the secondary circuits of the inductoriums, of a separate exciting-dynamo having two sets of field-magnet coils, one set being included in circuit with the
 80 field-magnet coils of the alternating-current dynamo, and the other set included in a shunt from the main line, substantially as set forth.
 85

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.
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GUSTAV PFANNKUCHE.

Witnesses:

H. BATTES,
 S. M. HAMMILL, Jr.