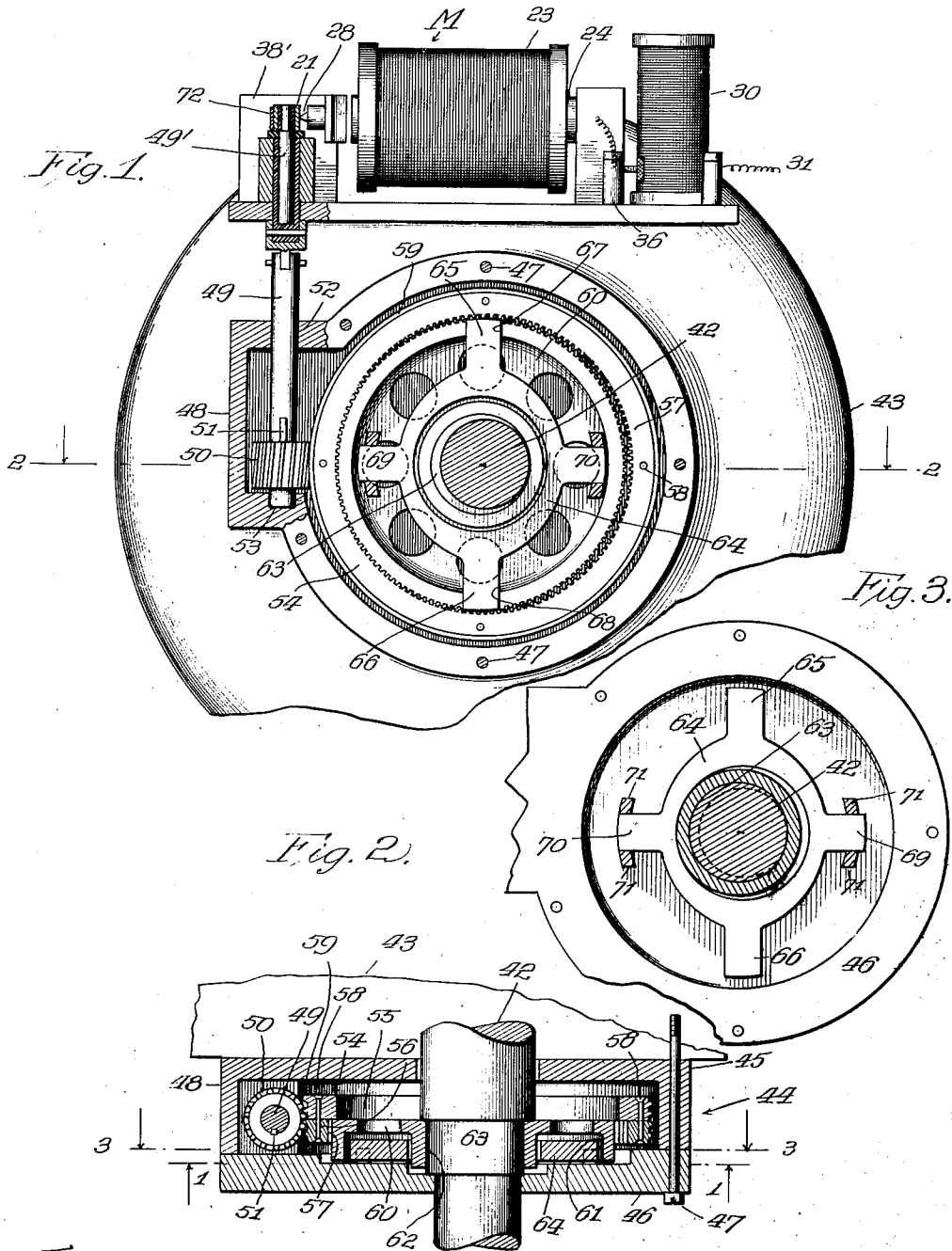


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REGULATOR FOR DYNAMO ELECTRIC MACHINES.
APPLICATION FILED OCT. 2, 1911.

1,062,380.

Patented May 20, 1913.

2 SHEETS—SHEET 1.



Witnesses:
Robert Weir
A. H. Rabag

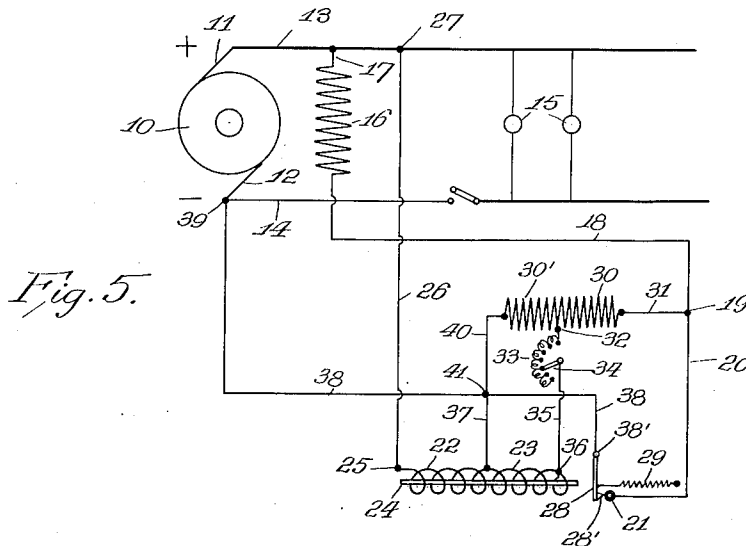
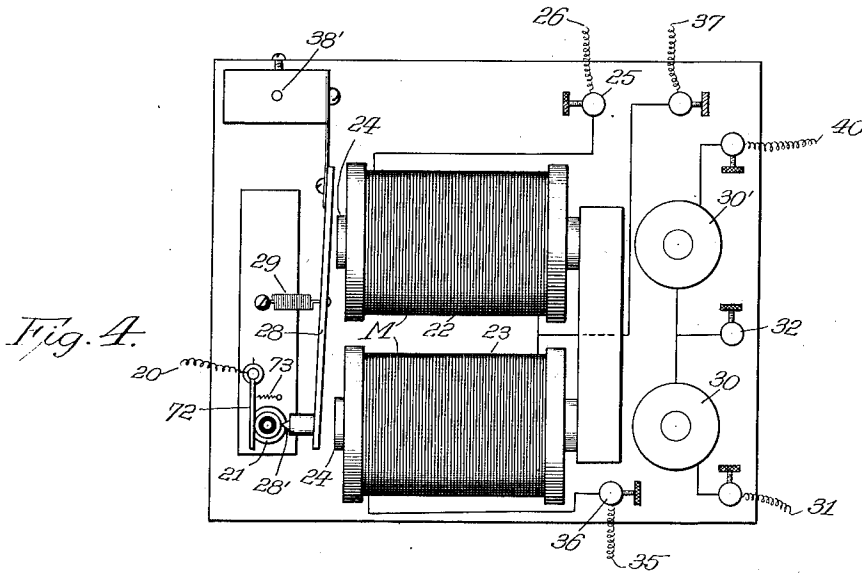
Inventor:
Vincent G Apple
by *Forre Bain May*
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UNITED STATES PATENT OFFICE.

VINCENT G. APPLE, OF DAYTON, OHIO, ASSIGNOR TO THE APPLE ELECTRIC COMPANY,
OF DAYTON, OHIO, A CORPORATION OF OHIO.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

1,062,380.

Specification of Letters Patent.

Patented May 20, 1913.

Application filed October 2, 1911. Serial No. 652,381.

To all whom it may concern:

Be it known that I, VINCENT G. APPLE, a citizen of the United States, residing at Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Regulators for Dynamo-Electric Machines, of which the following is a specification.

My invention relates to improvements in regulators for dynamo electric machines, and has for one of its objects to provide a regulator that will automatically maintain substantially constant the difference of potential between the terminals of a dynamo-electric machine, irrespective of the varying changes of load or speed, or both load and speed, of the machine.

Another object of my invention is to provide a circuit controlling switch in association with said regulator and said dynamo, by which the circuit is frequently interrupted and wherein a revolving contact member of said switch, rotated by the dynamo, presents constantly changing surfaces for the other member of said switch, thereby to insure infallibility of operation by preventing sticking or freezing of the switch members.

Still another object of my invention is to provide a power-transmitting means whereby the speed of the dynamo is greatly reduced in the motion imparted thereby to said rotated terminal, and whereby the dimensions of said transmitting means is reduced to a minimum.

Other and further objects of my invention will be readily understood by persons skilled in the art from a consideration of the following description, taken in conjunction with the drawings, wherein—

Figure 1 is a broken away portion of a dynamo showing the switch and power transmitting means therefor; Fig. 2 is a central section of the driving or speed reducing means, taken on line 2—2 of Fig. 1; Fig. 3 is a section taken on line 3—3 of Fig. 2; Fig. 4 is a plan view of the circuit controlling electro-magnet, coöperating with the rotating switch element; Fig. 5 is a diagram of circuits embodied in my regulator.

In all of the views the same reference characters indicate similar parts.

Dynamo electric machines, of the shunt type, that produce substantially constant difference of potential when driven at sub-

stantially constant speed will not maintain that constancy of potential when the speed at which they are driven is caused to vary and thus when generators of this type are driven by a source of power, such as an engine that affords the propelling power for an automobile, or from the axle of a train, operated at varying speed, it becomes necessary to provide an extraneous means to regulate the dynamo when constancy of potential is required, as when said dynamo is employed to furnish current for constant potential lamps, or for charging storage batteries, or the like, when placed in parallel circuit.

In carrying my invention into effect it becomes necessary to open and close an electric circuit, associated with the field windings quite frequently, and to prevent failure of operation I cause one of the contacts, where the circuit is so closed and opened, to be revolved thereby to present new surfaces to the vibrating contact at each period of its movement, and for convenience of structure I provide a speed reducing means whereby power for revolving said contact at a relatively low velocity may be taken from the dynamo with which the regulator is associated, although it is obvious that any other available driving means may be employed.

I will first describe the circuits whereby the regulation is accomplished, and then I will describe specifically the apparatus which may be employed in connection therewith.

The dynamo electric machine armature is represented by 10 provided with a + brush 11 and a — brush 12, connected to mains 13 and 14 respectively. Between these mains lamps 15, and other translating devices, such as storage batteries and the like may be connected.

16 is the shunt field windings of the dynamo, connected by wire 17 to the main 13 and by wire 18 to a point 19. A wire 20 extends to the revolving contact 21.

M is an electro-magnet having windings 22 and 23 and core 24. It will be observed that the windings are in the same direction. The terminal 25 is connected by wire 26 to the main 13, as at 27. A pivoted armature 28 confronts the end of the magnet 24. It is normally held against the revoluble contact

21 by the spring 29. The contact 21 and armature 28 normally short circuit the field resistance coil 30. When the circuit is open between these two points, current will pass from wire 20 over wire 31, through resistance coil 30 to point 32 through adjustable resistance 33, that is controlled by arm 34, and thence by wire 35, to the terminal 36 of the magnet coil 23, and thence by wire 37 to main 14, by wire 38, as at 39. Armature 28 is connected to wire 38. The remaining portion 30' of the field resistance 30 is connected to wire 38 by wire 40, as at 41. The adjustable resistance 33 may be set to change the critical voltage at which the system is to be maintained.

The operation of the regulator is as follows: The armature 28 of the electro-magnet M carries a contact 28' which is separated from the rotary contact 21 when the magnet 24 is sufficiently energized to attract its armature 28 against the tension of the retractile spring 29. The contacts 21 and 28' close the field circuit direct through the circuit heretofore described, thereby connecting the shunt field windings 16 directly with the mains 13 and 14. The dynamo now "builds up its voltage" so to speak, energizing its field windings to maximum. Current then passes from the positive main through wire 26 to winding 22 of the electro-magnet M and over wire 37 to the negative main 14. When the difference of potential has reached the desired, or predetermined, voltage the armature 28 is attracted against the resisting tension of the spring 29 thereby separating the contacts 21 and 28. Circuit over wire 38 is now broken and, therefore, current will pass through the field windings 16 from main 13, through wires 18 and 31 to resistance 30—30' and through wires 40 and 38 to the main 14 and in shunt from point 32 through the adjustable resistance 33 over wire 35 to point 36 and through coil 23 over wire 37 to the negative main 14. The current passing through coil 23 magnetically opposes the effect of the current passing through coil 22, thereby weakening the strength of the magnet 24 causing retraction of the armature by the spring 29 again establishing connection between contacts 21 and 28', and cutting out the resistance 30, 30' from the field windings. The insertion of the resistance in the field windings causes the lowering of the electromotive force of the dynamo and removing the resistance causes the converse effect. The rapidity with which this result is accomplished has further modifying effect upon undue rise of potential and the tendency toward excessive rise of potential tends to increase the rapidity and thus the difference of potential may be maintained constant against effects that tend to cause its increase. Where a circuit is frequently

interrupted I have found it of great advantage to relatively rotate one of the contacts to prevent "sticking" or "freezing" of the contacts together, and in a system, such as that illustrated, wherein current is produced for lighting and sparking an engine, to be used for automobile propulsion, for instance, it is of great advantage to so arrange the parts that power for rotating one of the contacts may be taken directly from the dynamo shaft, and that the vibrating member be mounted on the dynamo frame in close proximity to the rotating member. The speed of the dynamo shaft is, however, very much greater than that required for the rotating contact. I, therefore, have devised a means for transmitting the power to the rotatable contact, wherein the speed ratio may be as great as 2000 to 1, which I find sufficient for all practical purposes.

In the exemplification 42 is the dynamo shaft and 43 is the dynamo frame. A gear casing 44 is composed of two parts 45 and 46 secured together by screws 47. The casing is circular in form except for the off-set 48 wherein is contained a vertical shaft 49 upon which is fixed a worm wheel 50, as by a key 51. The shaft has bearing in the wall of the casing, as at 52, and a step bearing as at 53. The screws 47, that secure the two parts of the casing together, may also be employed to secure the casing to the dynamo frame. A worm wheel, or annulus, 54, is preferably made of two parts 55 and 56, the former annulus being preferably made of brass, and having a somewhat smaller bore to provide a shoulder between it and the preferably steel annulus 56. The latter is provided with internal gear teeth, as at 57. The two parts are united as by rivets 58, and both parts have upon their exterior peripheral surfaces a continuous worm 59, that has driving engagement with worm wheel 50. The wheel 54 lies in a bore in the part 48 of the casing, and it is rotated therein by the mechanism now to be referred to. Lying inside of the steel internal gear wheel part 56, and resting on the shoulder provided by the brass wheel part 55, is an exteriorly geared wheel 60, counter-bored as at 61, and centrally perforated as at 62, to receive an eccentric 63 on the dynamo shaft 42. Inside of the counter-bore, and flush with the exterior surface of the wheel 60, lies a four arm spider or universal guide 64, having two relatively long arms, 65 and 66, that lie in the notches 67 and 68, respectively, provided in the flange of the wheel 60. The relatively short arms 69 and 70 lie between guiding lugs 71—71, which project from the inner surface of the cover plate 46. The spider 64 moves freely in the respective guides. It permits vertical and horizontal movement of the wheel 60 with-

out permitting its rotation, such motion being imparted to the wheel 60 by the eccentric 63.

The outer gear, 54, has one more gear 5 tooth than has the inner gear 60 and, therefore, after one revolution of the shaft all of the spaces, except one, between the teeth of the outer wheel have been filled by the teeth of the inner wheel in successive order, and 10 the outer gear, which can be rotated freely, has been driven one tooth, or $\frac{1}{N}$ th part of a revolution at every revolution of the shaft, or in other words, the reduction in speed 15 $= 1 \div N$. The speed rotation, between the worm wheel and the worm that is cut on the peripheral surface of the outer gear $= 1 \div N_2$. This brings the total reduction in speed to

$$\frac{1}{N} \times \frac{1}{N_2}$$

In the present exemplification the speed 25 of the dynamo used for producing current for lighting and sparking an automobile and engine is two thousand revolutions per minute while the rotary contact is turned one revolution per minute, which I have found in practice to be sufficient. The vertical shaft 49 carries upon its upper end an 30 insulated section 49' which carries upon its upper end an insulated annulus preferably of platinum, which is the rotated contact member, to which current is conducted by 35 contact brush 72, held in contact therewith by the spring 73.

While I have herein shown a single embodiment of my invention for purposes of 40 clear disclosure, it is evident that many changes can be made in the structure within the scope of the appended claims, without departure from the spirit thereof.

What I claim is:

1. The combination of a dynamo having 45 a longitudinal shaft, a casing, reduction

gearing therein comprising a cam on the shaft, an annular member loose on the cam, a surrounding annular member co-acting therewith for rotation at reduced speed, the exterior of said surrounding member being 50 formed into a worm, a rotatable vertical shaft supported in said casing, a worm at one end of said vertical shaft coöperating with the worm provided by said surrounding annular member, an electrical contact on 55 the other end of said vertical shaft for rotation thereby at greatly reduced speed, and suitable coöperating electrical contacts for purposes described.

2. The combination of a dynamo having 60 a longitudinal shaft, a casing, reduction gearing therein including a slowly rotating worm, a vertical shaft mounted in the casing, a co-acting worm wheel on one end thereof, a contact on the other end rotatable 65 by the dynamo at greatly reduced speed through the medium of said reduction gearing and worm, and coöperating contacts vibratable into and out of electrical connection with said rotating contact. 70

3. The combination with a dynamo having a shaft and a dynamo-energized circuit, a vibratable contact, means responsive to a predetermined condition in said dynamo-energized circuit to vibrate said contact, a 75 vertical shaft, a rotatable contact on one end of said shaft, the other end extending down into horizontal alinement with said dynamo shaft, and connections between the other end and the dynamo shaft for rotation of the 80 rotatable contact at a speed slower than but in proportion to the speed of the dynamo shaft.

In testimony whereof I hereunto set my hand in the presence of two witnesses.

VINCENT G. APPLE.

In the presence of—

E. V. MARTIN,
N. M. O'CONNOR.