(No Model.)

S. D. FIELD.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 391,954. Patented Oct. 30, 1888.

Fig. 1.

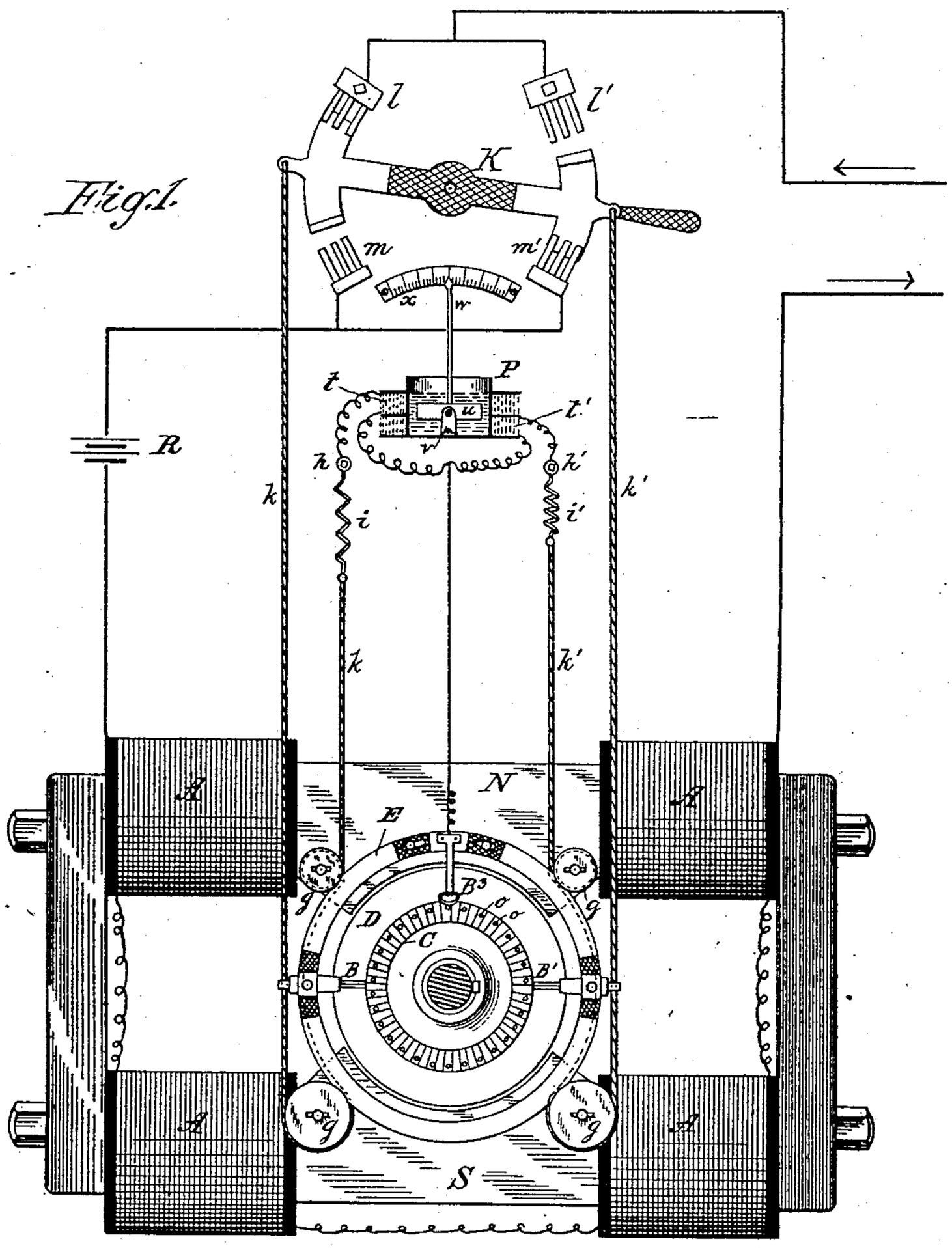


Fig. 3.

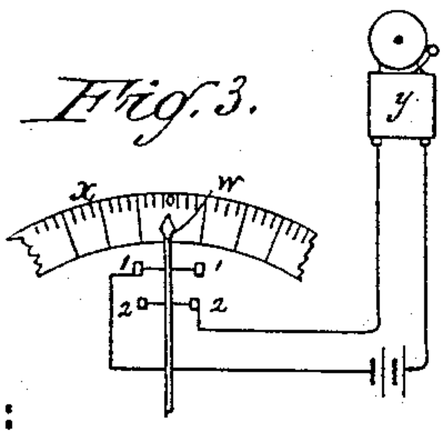
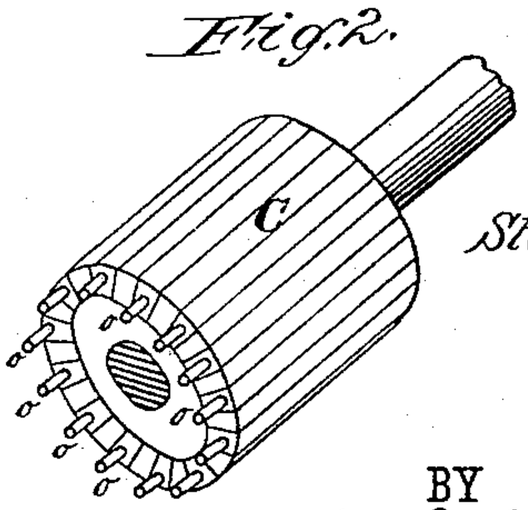


Fig. 2.



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REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 391,954, dated October 30, 1888.

Application filed October 21, 1887. Serial No. 252,986. (No model.)

To all whom it may concern:

Be it known that I, STEPHEN DUDLEY FIELD, a citizen of the United States, and a resident of Yonkers, in the State of New York, have invented certain new and useful Improvements in Dynamo-Electric Machines and Electric Motors, of which the following is a specification.

In every dynamo or electric motor there will be found a certain position for the brushes where the spark is least or entirely absent; but any departure from such position will cause more or less sparking and consequent wear of both brushes and commutator. On the other hand, when the brushes are normally in sparkless position and the electrical output from the dynamo or the electrical energy absorbed by the motor is subject to sudden and considerable changes, the position of least or no spark changes accordingly, and unless the brushes are moved to compensate for the change they and the commutator will suffer in proportion.

The object of the present invention is to provide a sensitive automatic visual indicator which will at all times show whether the brushes are at the position of least spark or away from it, and, if the latter, will show the direction of movement required to restore them and the distance to be moved.

The invention is more particularly intended for application to electric locomotives and cars, where an attendant is always present and will have the indicator constantly in view and the adjusting-lever under his hand ready for instant manipulation in response to the conditions of actual performance.

To this and other ends accordingly my invention consists in the arrangement of circuits and combination and construction of devices, substantially as hereinafter more fully described and claimed.

In the drawings herewith, Figure 1 is an end view of an electric motor, which in this instance is shown with the armature and field-magnets in series and an adjustable liquid rheostat in the circuit, the figure also showing the reversing-lever as combined with brush-shifting devices and visual indicator with its peculiar arrangement of circuits. Fig. 2 is a perspective of the commutator as constructed in practice. Fig. 3 is a detail showing the addition of an audible alarm.

In all dynamos and motors whose armature is a closed circuit touched at two points by collecting-brushes, a point can be found on the commutator which equally divides the rise of potential if a dynamo, and the fall of potential if a motor, between the positive and negative brushes. Whether this point is midway between the brushes depends on various circumstances—such as the relative strength of magnetism between the field and armature core, the character of distribution of the lines of force, and the amount of distortion, &c.

A is the field-magnet circuit; B B′, the main brushes; C, the commutator, and D the armature, the front bearing being removed for the sake of clearness. The brushes B B′ are carried by a ring, E, (but insulated therefrom,) which is freely rotatable between the friction-wheels *g*, set on the poles N and S of the motor. Wheels *g* are made of or covered with an insulating material or otherwise insulated. Ring E is grooved peripherally, and should be covered with an insulating material.

From two fixed points, *h h′*, through the tension-springs *i i′*, I pass two flexible wire cables, *k k′*, which respectively pass down under the upper friction-wheels around the grooved periphery of the ring E till they reach the lower wheels, *g*, whence they pass up to the respective ends of the pivoted reversing-lever K, whose ends are insulated from each other. The cables *k k* are electrically connected to their respective springs *i i′* and to their respective brushes B B′, and their friction on the ring E is sufficient to rotate it when they are moved by the lever K. One side of the main or supply circuit leads to the two contacts *l l′* of the switch, and the other two contacts, *m m′*, of the switch are connected through the rheostat R and the field-magnets A to the other side of the supply-circuit.

The lever K is made so that in either of its positions it has a considerable range of movement to impart to the brushes B B′ without breaking or reversing the circuit through the armature.

The arrangement of the visual indicator is as follows: Having found the point on the

commutator which bisects the fall of potential, I mark it for the location of the extra brush B^3. As this will be always at a position of strong induction, I prefer to take current only from every second or third bar. For this purpose every second or third bar of the commutator C is fitted with a metal pin, *o*, or other projection from its end. The extra brush B^3 is carried by the ring E, and is insulated therefrom. The brush is made in the form of a spring-wiper and stands in the line of travel of the pins *o*, so as to make contact with them successively but one at a time.

I construct a bobbin, P, with closed bottom and wind it with two high-resistance coils, *t t'*. Coil *t* is included in the circuit between extra brush B^3 and brush B, while coil *t'* is included in the circuit between extra brush B^3 and brush B'. Coils *t t'* are balanced as to magnetic effect and resistance, but are connected differentially, so as to neutralize each other when the currents flowing through them are equal. In the cup of the bobbin I mount a magnetized needle, *u*, (preferably in the form of a hollow cylinder,) pivoted in bearings *v* and provided with pointer *w*, extending upwardly, as shown. The bobbin-cup is then filled with oil to decrease the gravity of the needle and lubricate its bearings. The coils *t t'* are of so high a resistance that the additional current in the corresponding portions of the armature will be too trifling to disturb the magnetic equilibrium subsisting between the armature and field magnetism.

As long as the two currents in coils *t t'* are exactly equal the pointer *w* will stand vertical; but the slightest excess in either coil due to a preponderating fall of potential between its terminals arising from a change of density in the lines of force at its corresponding portion of the armature will instantly deflect the pointer *w* to one side or the other. The polarities are so arranged that the pointer will move in the direction in which the brushes B B' are displaced. This at once not only indicates the fact that brushes B B' need adjustment, but shows the direction in which they should be moved to restore them to sparkless position. A scale, *x*, is placed behind the pointer, and is preferably calibrated and marked to indicate in small fractions of an inch or meter the amount of displacement, or the arc of movement to be given the adjusting-lever to restore the brushes B B' to their proper position.

The operation of moving the brushes is purely manual. The attendant watches the pointer, and the instant it varies from zero he moves his brush-lever in the required direction and to the precise extent needed to restore the brushes to the zero or non-sparking position. I have described a particular arrangement of devices for this purpose; but obviously a great variety of arrangements are open to the selection of the builder. I therefore do not confine the scope of this invention to any particular form or construction of parts. As stated, the invention is applicable to both motors and generators wherever used. Evidently when two or more motors are used in electric-railway service, each could have its own pole-changing switch and indicating-galvanometer. It may be well to state also that so sensitive can this arrangement be made that a displacement of the brushes of one hundredth of an inch can be easily discerned and corrected.

Obviously the galvanometer may be utilized also to produce an audible alarm, if desired. In Fig. 3 the metallic pointer *w* will, on a deflection of, say, one-sixteenth of an inch in either direction, lightly touch contacts 1 2 and close the circuit of a vibrating bell, *y*. In the application of my invention to generators at supply-stations this audible alarm may be of considerable importance, and where several machines are in use the bell of each may easily be given a distinguishing tone.

I claim as my invention—

1. In a dynamo-electric machine or electric motor, the combination, with the armature, of a differential galvanometer whose respective coils are differentially included in two circuits derived from portions of the armature-circuit selected to normally balance each other in electric energy only when the brushes are at the position of least spark, substantially as described, whereby displacement of the brushes from such position is visually made known.

2. In a dynamo-electric machine or electric motor, the combination, with the armature, of a differential galvanometer whose respective coils are differentially included in two circuits derived from portions of the armature-circuit selected to normally balance each other in electric energy only when the brushes are at the position of least spark, and a pointer and scale for such galvanometer adapted to indicate the direction of displacement of brushes from their normal position, substantially as described.

3. In a dynamo-electric machine or electric motor, the combination, with the armature, of a differential galvanometer whose respective coils are differentially included in two circuits derived from the main brushes, and one or two supplementary brushes, and adapted to visually indicate abnormal conditions of the potential in said circuit, substantially as described.

4. In a dynamo-electric machine or electric motor, the combination, with the armature, of a differential galvanometer included in two circuits derived from portions of the armature normally balancing each other when the pointer of a galvanometer is at zero, and an alarm-circuit including an audible alarm, a source of current, and contacts for the alarm-circuit adapted to be closed by the pointer when it departs from its zero position, substantially as described.

5. In a dynamo-electric machine or electric motor, the combination of the armature, the

brushes, a movable holder therefor, a pole-changing switch mechanically connected to said brush-holder and having a range of adjusting motion in each direction, and an electrical indicating device connected by one terminal with one or both said brushes, and by the other terminal with an intermediate point of the commutator, substantially as described, whereby the brushes may be adjusted in either position by the switch-lever without preventing the operation of the indicating device.

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