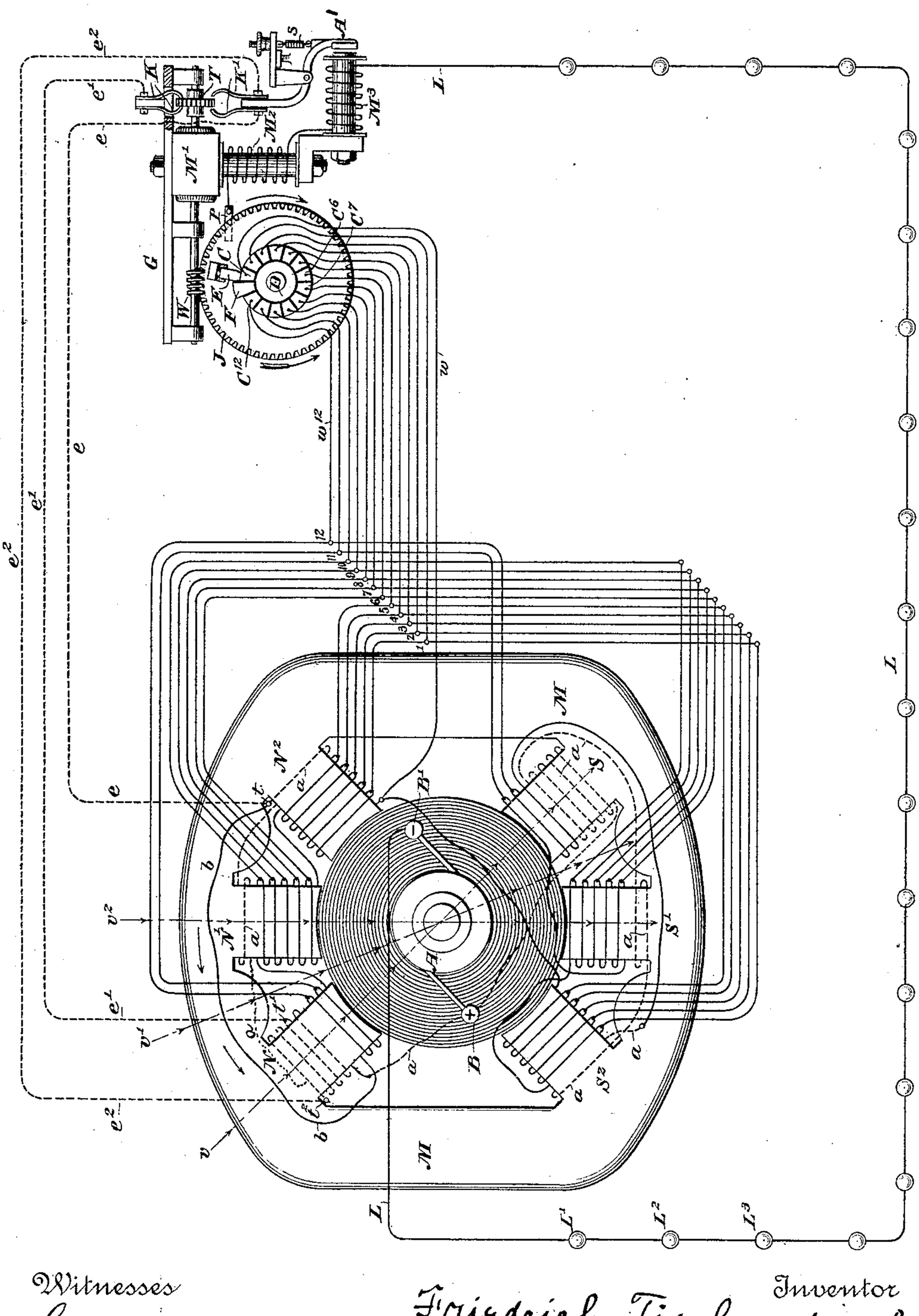
(No Model.)

F. TISCHENDOERFER.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 451,312. Patented Apr. 28, 1891.



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REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

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To all whom it may concern:

Be it known that I, FRIEDRICH TISCHENDOERFER, a subject of the King of Bavaria, residing at Brooklyn, county of Kings, and State of New York, have made a new and useful Improvement in Dynamo-Electric Machines and Regulators Therefor, of which the following is a specification.

My invention is directed particularly to improvements in dynamo-electric machines for use in connection with arc-light circuits and novel methods and means for regulating the same automatically in accordance with the demands of the lights or translating devices loacted in the exterior or working circuit.

My invention will be understood by referring to the accompanying drawing, and to the description thereof, and the novel features thereof will be particularly pointed out in the claims which follow this specification.

The drawing represents a diagrammatic view of my apparatus as applied to arc-light circuits where the lamps are arranged in series.

L represents the line-circuit, connected at one end to one of the commutator brushes B′ of the dynamo-machine M, and including a series of arc lamps L′ L² L³, &c., the return-circuit or other end of the line being connected through the magnet M³ and field-magnets M² of a regulating electric motor M′, and ultimately through the regulator G, and one of the circuits *w* to w^{12} and auxiliary field-magnets N to N² and S to S² to the other commutator-brush B.

The field-magnets are constructed with reentrant auxiliary poles N N′ N² S S′ S², the former indicating north polarity and the latter south polarity, the armature A being of any preferred type. Each of the auxiliary field-magnet coils N N′ N² and S S′ S² is divided into sections connected in sequence at the points 1 2 3, &c., to 12, with branch conductors *w* to w^{12}, running to insulated conducting-segments C to C^{12}, arranged in circular order around a shaft D, which carries also a geared regulating-wheel J, adapted to mesh with a worm W on the armature-shaft of the regulating-motor M′, the commutator T of which is connected on one side by stationary brushes K through a conductor *e*′ with one of the coils of the auxiliary field-magnet coil N at a point *t*′.

K′ represents a pair of movable commutator-brushes carried by a pivoted armature-lever A′, provided with an adjusting-spring *s*, this armature being located in the magnetic field of the regulating-magnets M³, the coils of which are connected directly to the exterior or working circuit and in series with the field-coils M² of the regulating-motor M′. These two brushes K′, which are insulated from each other, are connected, respectively, by wires *e* and e^2 with the coils of the auxiliary field-magnets N² and N at points *t* and t^2, the former being connected to the auxiliary field-coil N at the point of greatest potential of the machine—that is to say, near the plus commutator-brush B—while the latter is connected to the auxiliary field-coil N² at a point *t* of very much lower potential, the conductor *e*′ being connected to the coil N at a point *t*′ of intermediate potential, as clearly shown.

The operation of the apparatus is as follows: Suppose the lamps to be all in circuit and the machine to be working with a full load. Under this condition of affairs the retractile spring *s* of the armature A′ is so adjusted that the brushes K′ are held out of contact with the ends of the commutator-strips of the commutator T, and the motor, therefore, is inert. The current then flowing magnetizes all of the auxiliary field-magnets N to N² to the necessary point of saturation, and S to S² to a similar point of saturation, the former giving north polarity and the latter south polarity, and circuit may be traced as follows, said circuit being in parallel from the plus commutator-brush through the coils of the north and south field-magnet poles respectively. Passing by the dotted lines *a* from the brush B to auxiliary field-magnets N and S around the several coils of dotted windings, thence to auxiliary field-magnets N′ and S′, (shown each as one coil of dotted winding,) thence to auxiliary field-magnets N² and S², (shown each as one coil of dotted winding,) and thence by the full-line conductors *b* to the first auxiliary field-magnets N and S through two sections, giving the same polarities as before, thence to auxiliary field-magnets N′ and S′ through five sections, giv-

ing the same polarities as before, thence to auxiliary field-magnets N^2 and S^2 through five sections, giving the same polarities as before, said conductors being connected ultimately to the wires *w* to w^{12}, running to the conducting-segments C to C^{12} on the regulator G. As long as this state of affairs continues the field-magnets will be energized to the desired point of saturation. Suppose, now, one or more of the lamps are removed from the circuit, or short-circuited. The armature A is immediately drawn forward by the increase of current, thereby causing the left-hand brush K′ to come into contact wih the commutator T, carried by the armature of the motor M′, thereby connecting said brush with the field-magnet circuit at the point *t*. Immediately, therefore, a derived circuit is formed from the field-magnets through the conductors *e* and *e′*, the current passing from the point *t′* of higher to the point *t* of lower potential through the armature of motor M′ in such direction as to impart to the gear-wheel J, through the worm W, a motion in the direction of the tailless arrow, shown on the right of the wheel J, causing the sliding contact E to pass from the segment C to the succeeding segment C′, whereby the first coil or section of the auxiliary field-magnet N^2 is cut out of circuit, and the corresponding coil or section of the south auxiliary field-magnet S^2 is similarly cut out of circuit, thereby diminishing the magnetic effect of the field-magnets upon the armature without, however, decreasing or in any manner affecting the magnetic effect of the remaining auxiliary field-magnets N N′ and S S′. As soon, therefore, as this decrease in the magnetic condition of the auxiliary field-magnets N^2 and S^2 is effected a decrease of the current on the line will result and the armature A′ will assume its normal position, which it will maintain for a given quantity of current in neutral position, as shown by the drawing. As this action is repeated, therefore, and lamps are successively removed from the circuit successive sections of the auxiliary field-magnet coils N^2 and S^2 will be cut out until finally all of the sections indicated in heavy lines will be removed from the circuit, and so on in succession the various sections of the auxiliary field-coils N′ S′ will be continuously removed until all of the sections indicated by heavy lines have been cut out. In like manner, also, the two successive sections in the auxiliary field-coils N and S will be removed when the current required upon the line is a minimum. It will be noticed, however, that those coils indicated upon the field-magnets in dotted lines are never removed from the circuit, and that this dotted-line circuit is made to include a greater proportion of the field-coils in the magnets N and S and only one section in each of the coils N′ and S′ and N^2 S^2. This arrangement of coils is designed for the purpose of always leaving the machine in such a condition that it will act upon the regenerative principle, no matter what may be the resistance or condition of the exterior circuit, and also with diminished effect upon the auxiliary field-cores N′ S′ and N^2 S^2 under all conditions of resistance in the exterior circuit, it being necessary to always maintain a certain proportion of north magnetism in the cores N′ N^2 and south magnetism in the cores S′ S^2 in order to prevent a magnetic short-circuit through the inner-end field-poles and the armature.

With this method of regulation I am enabled to maintain the commutator-brushes always in a fixed position and to avoid sparking under all conditions of load, inasmuch as I make no change in what is known as the "magnetic lead," by virtue of the fact that I maintain the magnetic lines of force always at the proper degree in the various field-cores in proportion to the demands of the exterior circuit. In other words, when the machine is working with a full load the resultant of all of the magnetic lines of force will be through the center of the auxiliary field-magnet cores N′ S′, as shown by the line of arrows v^2.

When the magnetism of the auxiliary field-cores N^2 S^2 is reduced to a minimum by the cutting out of all of the sections of its winding, the resultant effect of the lines of force remaining will be felt at a point midway between the auxiliary field-cores N N′ and S S′, as shown by the tailless arrows *v′*, and in like manner when the magnetic effect of the two sets of coils N′ S′ N^2 S^2 is removed the resultant of the lines of force remaining will be found in the direction of the arrows *v* through the auxiliary field-cores N and S. It will be understood, therefore, that for each decrease in the load in the working-circuit I shift the lines of force in a reverse direction to the direction of rotation of the armature, and vice versa, on increasing the load in the circuit.

I lay especial stress upon this novel mode of regulating the rotation of the magnetic field in accordance with the load in the working-circuit, and the method claims hereinafter made are directed, broadly, to the application of this principle without regard to any special form of mechanism for applying the principle.

I wish it understood that the method claims hereinafter made are directed also to the prevention of sparking at the commutator-brushes as well as to regulation, the application of the generic principle herein described being of especial utility in this particular.

I do not limit myself to the specific apparatus herein disclosed for regulating by varying the intensity of the lines of force in the various auxiliary portions of the magnetic field, as I believe it is broadly new with me to utilize this principle of regulation, and I desire it understood that my claims are to be construed as of such scope as to include any means of varying the intensity of the lines of force in one portion of the magnetic field caused by the influence of auxiliary field-

magnet poles and in retaining the intensity constant in another portion of the field in direct proportion to the demands of the exterior or working circuit.

It is obvious to those skilled in the art that many modified forms of winding might be devised which would bring about this result in a dynamo having its field-magnet composed of a series of auxiliary or helping field-magnet poles; and I desire it understood that my claims shall include generically all devices which accomplish the methods hereinafter particularly claimed.

I am aware that it is broadly old in the art to regulate a dynamo-electric machine by the differential action of two coils wound in reverse direction upon the core thereof and in such manner as to cause the lines of force to vary their influence in accordance with the load and at the same time prevent sparking at the brushes without any additional regulating devices, and my claims hereinafter made are not designed to include either such a method of operation or a mechanism for practicing such method.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. The described method of regulating a dynamo-electric machine having auxiliary field-magnet poles in accordance with the current demands of the exterior or working circuit, consisting in increasing the magnetic effect in those auxiliary field-magnet cores lying next the brushes in the direction of the armature's rotation in sequence and in similarly decreasing said effects in a reverse direction, substantially as described.

2. The described method of regulating a dynamo having auxiliary field-magnet poles, consisting in increasing the area of the magnetic field in the direction of the armature's rotation by cutting into circuit additional auxiliary field-magnet coils as the current demands increase and in diminishing this area by cutting out of circuit auxiliary field-magnet coils as the current demands diminish, substantially as described.

3. The described method of regulating a dynamo having auxiliary field magnet poles in accordance with the current demands of the working-circuit, consisting in increasing or decreasing the intensity of the magnetic field of the field-poles by cutting in and cutting out auxiliary field-magnets coils in pairs until the desired saturation is obtained and in successively bringing these pairs of poles into effective service until the machine assumes a magnetic field of maximum area and intensity, substantially as described and shown.

4. A dynamo-electric machine having auxiliary field-magnet poles, all of the north auxiliary poles being arranged on one side of the armature and all of the south auxiliary poles on the other side thereof, the field-magnet coils on said poles being divided into sections and provided with multiple series connections, whereby the magnetic area and intensity are increased in accordance with increased current demands, substantially as described.

5. A dynamo-electric machine having a series of north field-magnet poles and a similar series of south field-magnet poles on opposite sides of the armature, the field-magnet windings being in multiple series through the two sets of field-magnet coils and provided with branch conductors running from sections of each field-magnet coil to electro-magnetic cut-out mechanism for regulating the magnetic effect in accordance with the number of lamps in circuit, said electro-magnetic cut-out mechanism having circuit-connections with the machine at three points of differing potential, substantially as described.

6. A dynamo-electric machine having auxiliary field-magnet coils provided with independent sections, in combination with an automatic electro-magnetic regulator adapted to vary the magnetic effect of the machine by varying the number of sections in circuit, substantially as described.

7. In a dynamo-electric machine, a series of auxiliary field-magnet cores wound with coils which are tapped at various points by branch wires connected to an electro-magnetic regulator which automatically varies the number of sections in circuit, substantially as described.

8. A dynamo having sectional auxiliary field-magnet coils connected in multiple series with an automatic electro-magnetic regulator having one member, as its field-magnet coil, located in the working-circuit and the other member, as its armature, connected through circuit-connections with the dynamo at points of different potential, substantially as described.

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