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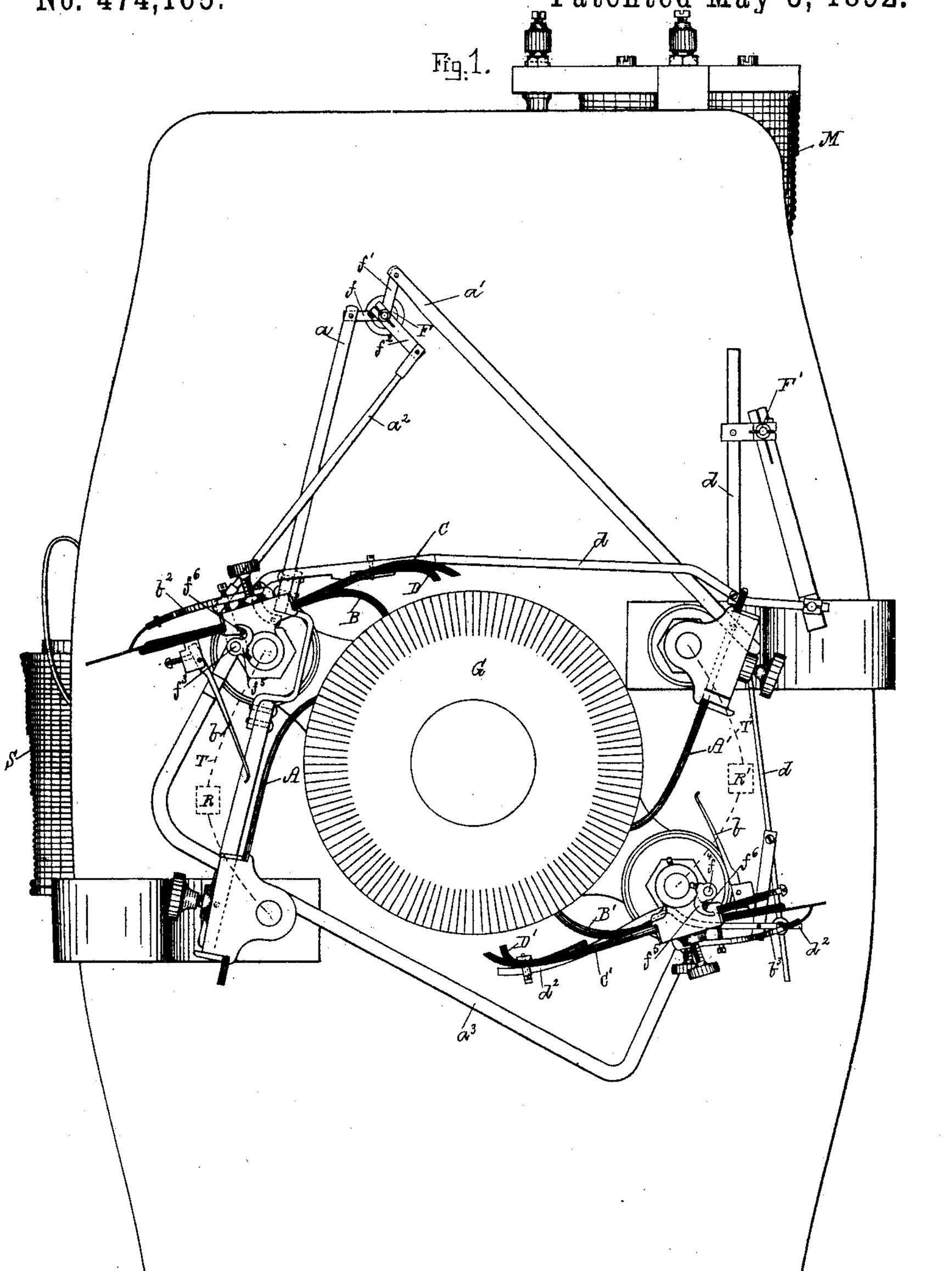
W. H. ELKINS.

REGULATOR FOR DYNAMOS AND MOTORS.

No. 474,165. Patented May 3, 1892.

Fig. 1.



Witnesses.
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(No Model.) 5 Sheets—Sheet 2.

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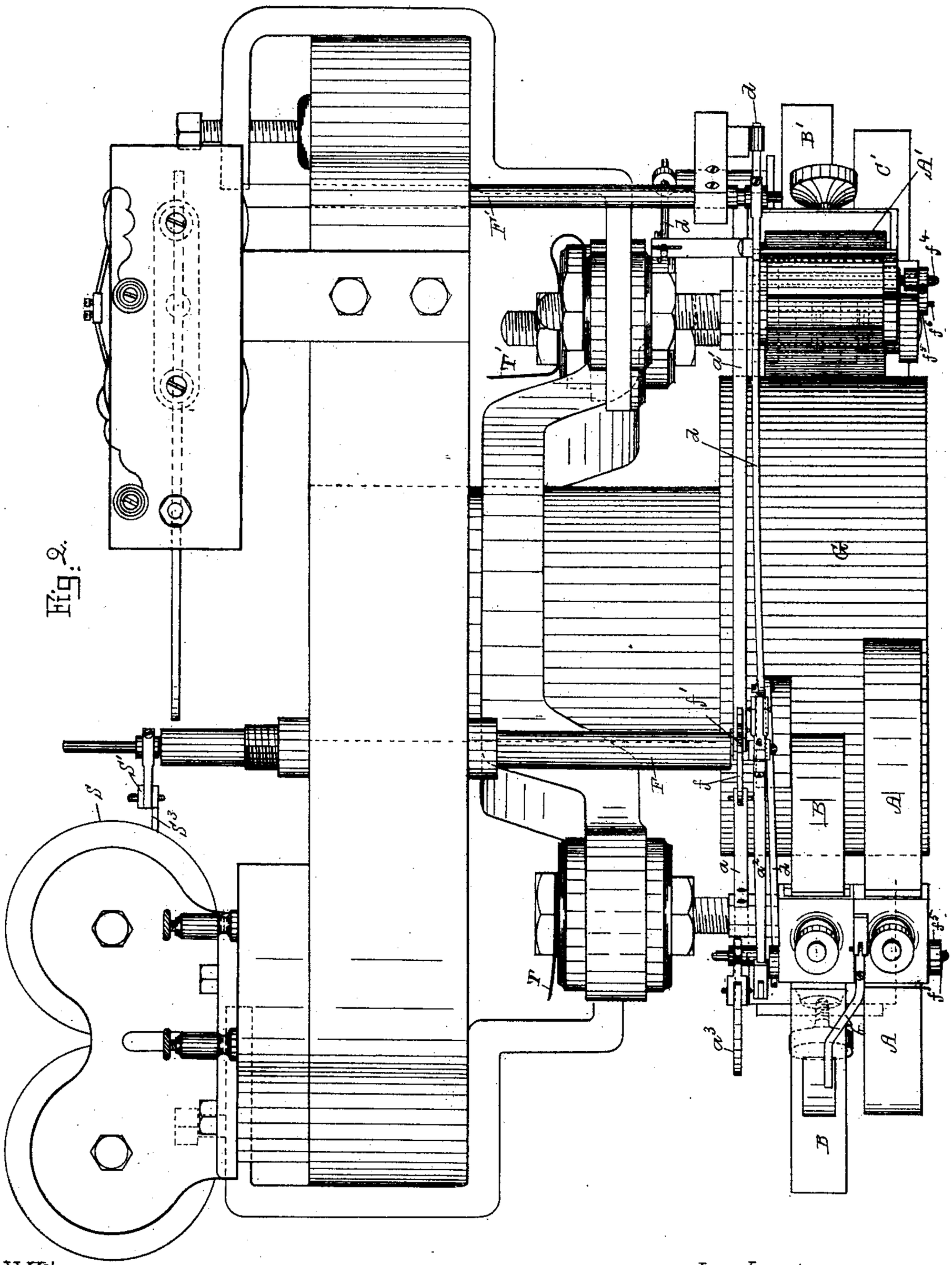

Fig. 2.

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W. H. ELKINS.

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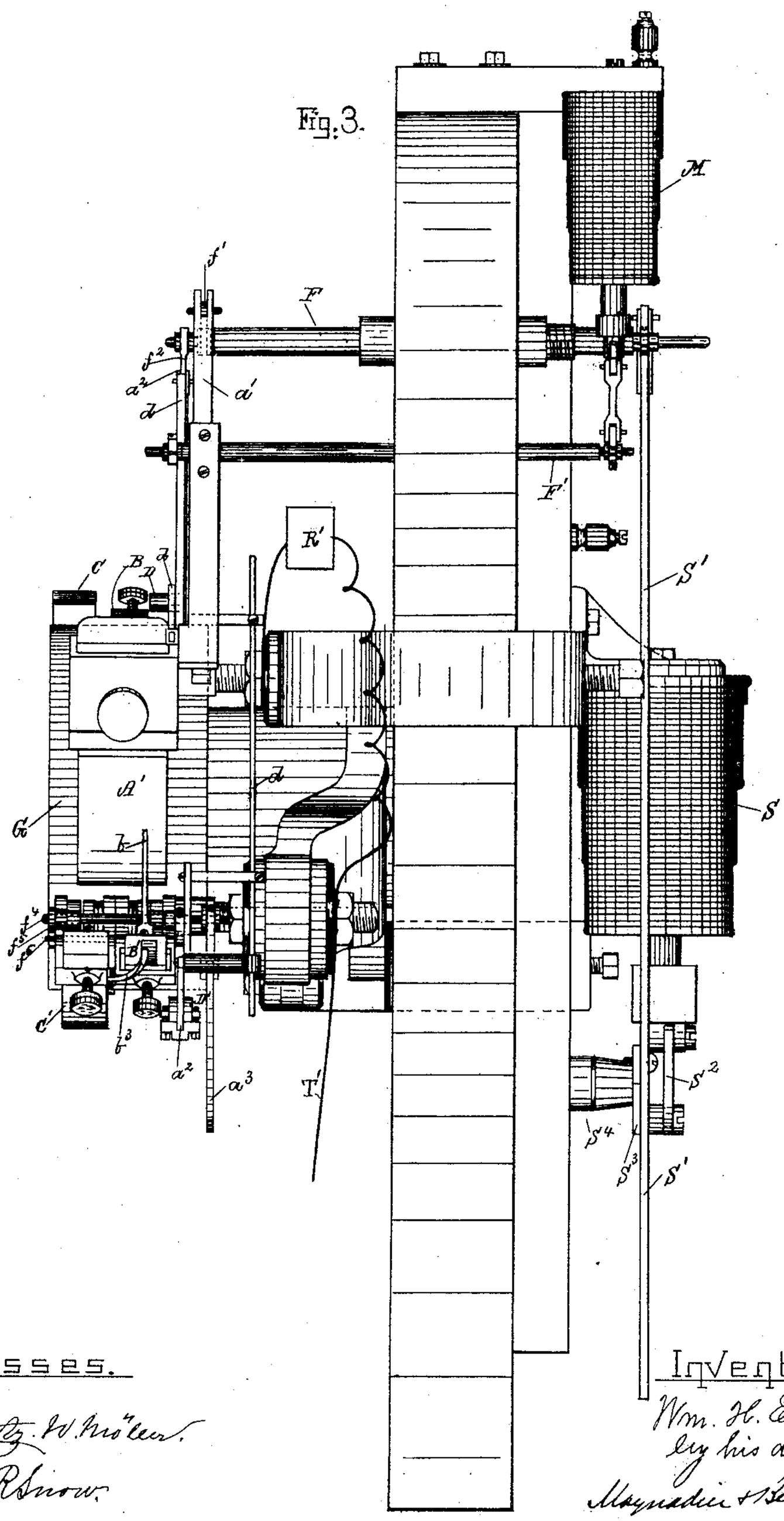
Fig. 3.



Witnesses.

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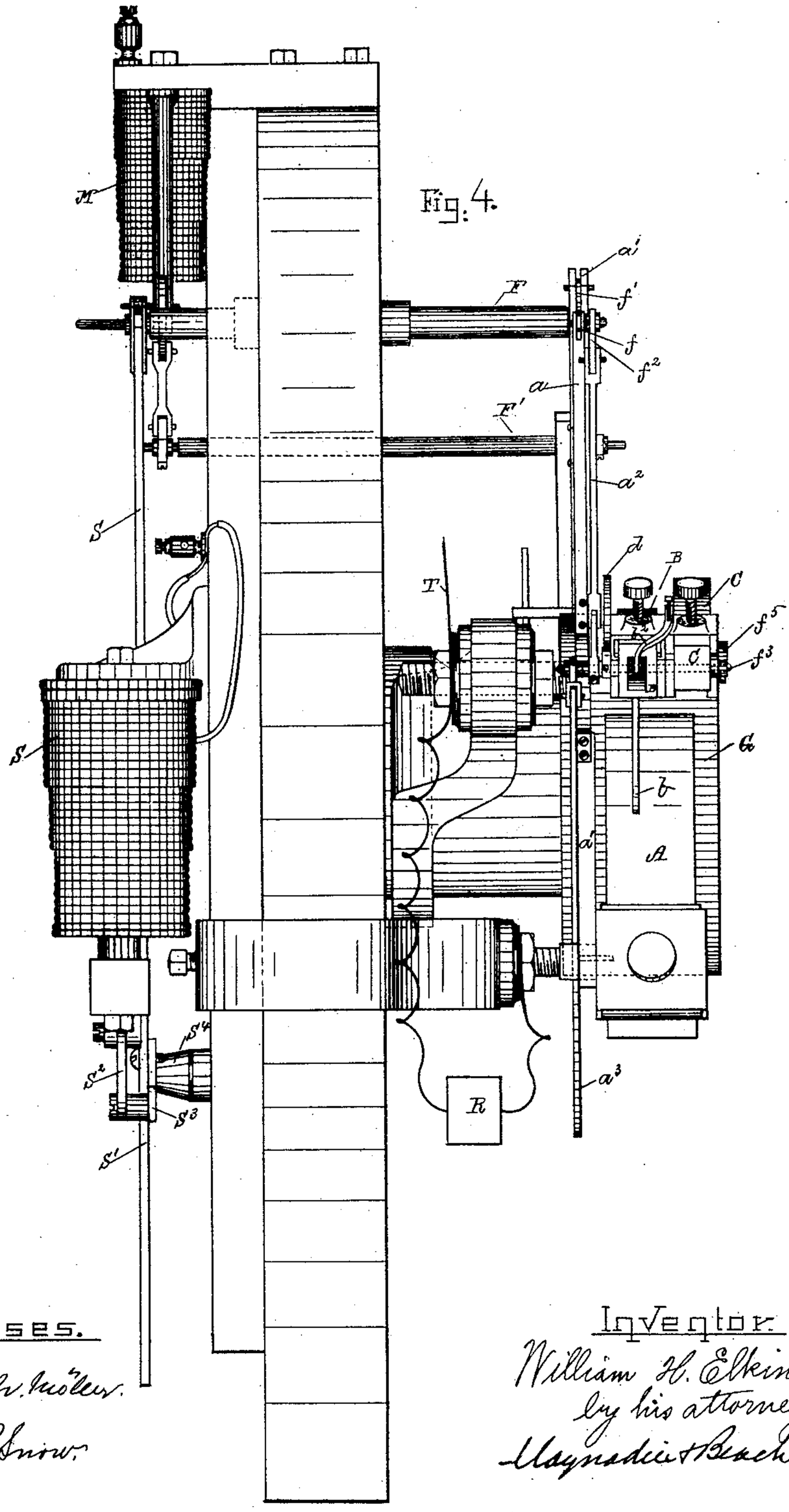
(No Model.) 5 Sheets—Sheet 4.

W. H. ELKINS.

REGULATOR FOR DYNAMOS AND MOTORS.

No. 474,165. Patented May 3, 1892.

Fig. 4.



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(No Model.) 5 Sheets—Sheet 5.

W. H. ELKINS.

REGULATOR FOR DYNAMOS AND MOTORS.

No. 474,165. Patented May 3, 1892.

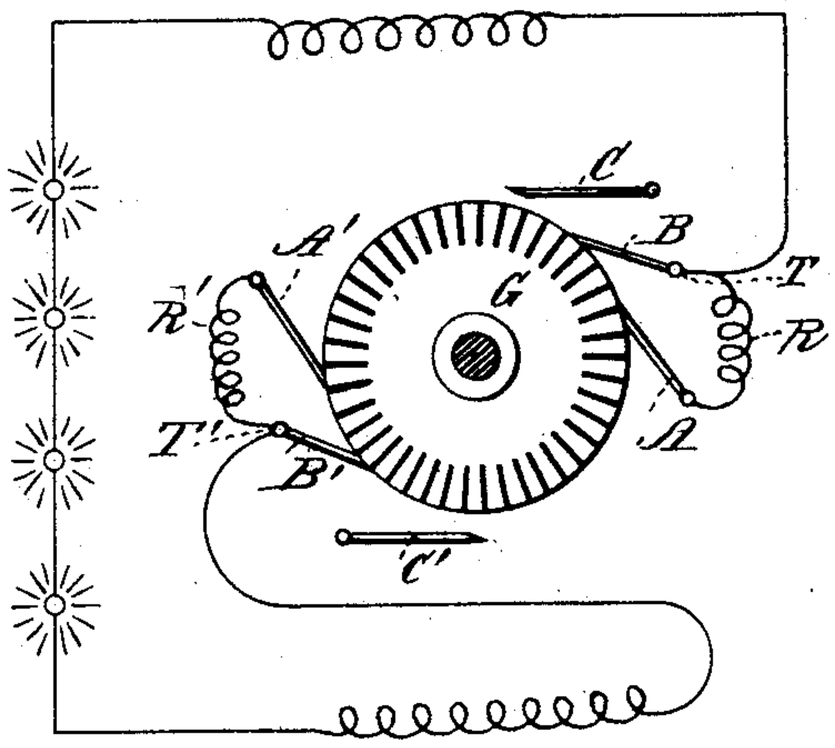

Fig. 5.

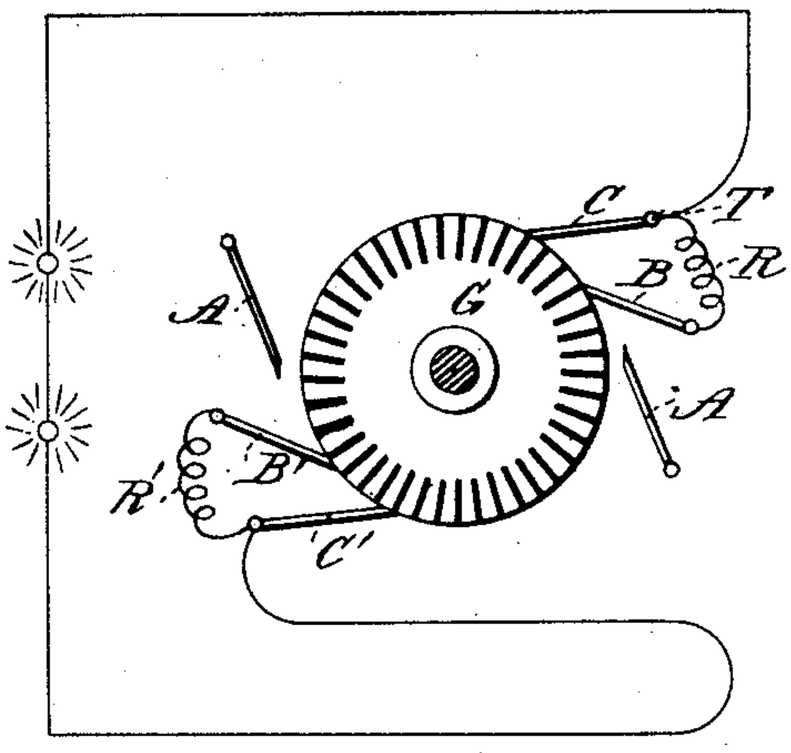

Fig. 6.

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Inventor:
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his Attorneys.

UNITED STATES PATENT OFFICE.

WILLIAM H. ELKINS, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO HENRY E. IRVINE, OF NEW YORK, N. Y.

REGULATOR FOR DYNAMOS AND MOTORS.

SPECIFICATION forming part of Letters Patent No. 474,165, dated May 3, 1892.

Application filed February 6, 1890. Serial No. 339,426. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM HENRY ELKINS, of Boston, in the county of Suffolk and State of Massachusetts, have invented an Improved Regulator for Dynamos and Motors, of which the following is a specification, reference being had to the accompanying drawings, making a part hereof, in which—

Figure 1 is an elevation looking endwise on the armature, showing a portion of a dynamo with my regulator attached. Fig. 2 is a plan view. Fig. 3 is an elevation looking at the armature from one side, and Fig. 4 is an elevation looking at the armature from the opposite side. Fig. 5 is a diagram illustrating the brushes and their connections when the dynamo is at half load or over. Fig. 6 is a like diagram when the dynamo is made half load.

My invention relates to controlling the difference of potential between the terminals; and it consists in a novel arrangement of three brushes on a side, so connected to the terminals that the electro-motive force of each terminal may correspond with the electro-motive force of either one of the three brushes on a side or by means of a variable resistance between two brushes on the same side of the commutator may be graduated at any electro-motive force desired between those of the two brushes then in contact with the commutator, as will now be fully explained by reference to that form of my regulator shown in the drawings.

When running at full load, the terminals T T′ are connected to the brushes A A′ and B B′, which are in contact with the commutator-segments, as in an ordinary dynamo—that is, by conductors of slight resistance. Consequently these brushes A B and A′ B′ are adjusted once for all and without resistance between them, as is usual in adjusting such brushes on an ordinary dynamo with two pairs of brushes, and at full load work in the usual way; but the variable resistance R between the brush A and terminal T and R′ between A′ and T′ enables me to practically neutralize the brushes A A′ by making the resistance R R′ practically infinite, and consequently the terminal T will have the same electro-motive force as the brush A when the resistance R is zero or very slight and the terminal T′ the electro-motive force of brush A′, R′ being zero. Any increase in resistance R lessens the electro-motive force of T and in R′ lessens that of T′ until R and R′ become very great, when the electro-motive force of T is that of brush B and of T′ that of brush B′. In this way a two-thousand-five-hundred-volt machine giving ten ampères can be practically run as a fifteen-hundred-volt ten-ampère machine, or in case of arc lighting, with fifty lamps as full load, any number not exceeding twenty-one can be cut out and the differences of potential between T and T′ varied so as to keep the current constant. After thus reducing the difference of potential between T and T′ the brushes C and C′ are brought into contact with the commutator and the brushes A A′ lifted, and the brushes B B′ are connected to the terminals T T′ through resistances R and R′. Then the terminals T T′ have the same electro-motive force as the brushes B B′, for the resistances R and R′ are then practically nothing, and the difference of potential between the terminals T T′ is, say, fifteen hundred volts, or adapted for thirty fifty-volt arc lamps. When any of these thirty lamps are cut out, the difference of potential between the terminals T T′ must be reduced, and this is done by increasing the resistances R and R′, so that the terminals T T′ first take the electro-motive force of the brushes B B′. Then as the resistances R and R′ are increased the electro-motive force of the terminals T T′ is decreased, until when the resistances R and R′ are practically infinite the electro-motive force of T and T′ is that of the brushes C C′.

The brushes A and B are so adjusted at the start that there is no objectionable sparking when the dynamo is run at full load; but in all large machines of the Gramme type the brushes B B′ will spark as the load is reduced. Consequently in a machine with my regulator running fifty arc lights the sparking will begin to be objectionable at brush B when the load is reduced to forty lights, and for that reason I apply the brushes D D′, which serve as lap-brushes for the brushes B B′, as soon as the sparking gets objectionable at the brushes B B′ and keep these brushes

D D′ applied so long as B B′ are doing the main work in connection with the brushes A A′; but when the brushes C C′ are applied and the brushes A A′ lifted I also lift the brushes D D′ and keep them lifted while the brushes B B′ and C C′ are applied, for, in fact, the brushes A and B and A′ and B′ work as pairs in the sense that B is a lap-brush for A, and B′ for A′, and so of the brushes B and C and B′ and C′, C being a lap-brush for B, and C′ for B′. These brushes D D′, while not essential, are yet highly desirable in a large class of dynamos. In practice I use them only when the load is about four-fifths of the maximum and keep them in use only while the load varies from four-fifths to three-fifths, or in the case of a fifty-light machine apply them when the load is about forty lights and lift them when the load is about thirty lights, or as soon as the brushes C C′ are applied and A A′ lifted.

It will now be clear that the principle of my invention consists in a peculiar arrangement of three brushes on each side of the commutator, the first and second (positive or negative) brushes making a pair for full load down to nearly half load and the second and third (positive or negative) brushes making a pair from a little over half load to minimum load, the difference of potential between the terminals T T′ being varied to suit the load by varying the resistances of the conductors which connect A with T and A′ with T′ while A B and A′ B′ work as pairs and by varying the resistance of the conductors which connect B with T and B′ with T′ while B C and B′ C′ work as pairs.

It will be clear that my invention, although I have described it as a current-regulator, in fact regulates the difference of potential, and that it is applicable to constant-potential as well as to constant-current machines, the only difference being that when automatic regulation is desired the resistances should be varied by variations of current where the current is to be kept constant and by variations of potential when the potential is to be kept constant.

The distance apart of the brushes A B and A′ B′—that is, the number of segments between them at full load and down to about three-fifths load—will vary on different machines, but is usually on a fifty-arc-light machine, or a machine giving twenty-five hundred volts and a constant current of about nine ampères at full load, eleven segments, and this statement is also true as to the distance between brushes B and C and B′ and C′, although this distance is ordinarily somewhat less than the distance between A and B or A′ and B′. In practice I have found it to be nine segments instead of eleven; but this is a matter depending wholly upon the details of construction of the machine, the rule being to set the brushes A and B and A′ and B′ to the best advantage under full load and the brushes B and C and B′ and C′ to the best advantage under about three-fifths load, both these adjustments being well understood by all persons competent to run dynamos.

The mechanism shown in the drawings for operating the brushes A B C and A′ B′ C′ consists of the links a a', which connect the brushes A A′ with the arms f f' of shaft F, so that when shaft F is turned in one direction the brushes A and A′ are rocked so as to cause them to make contact with the commutator G and when shaft F is turned in the other direction the brushes A A′ are rocked so as to lift them off from the commutator G. A third link a^2 connects arm f^2 of shaft F with the rock-shaft f^3, and rock-shaft f^3 is connected by link a^3 with rock-shaft f^4. Both rock-shafts f^3 and f^4 move together and each has cam-hooks f^5, which engage with pins f^6 on the brush-holders or brushes C and C′, so that when shaft F is turned to rock brushes A and A′ it also rocks the brushes C and C′, the latter rocking into contact with the commutator when the former rocks out of contact, and vice versa.

The brush-holders of brushes B and B′ are stationary, and the brushes B and B′ are insulated from their holders, but are electrically connected by the contacts b b', which are carried by the brushes B B′, with the brushes A A′ when they are out of contact with the commutator G, and are also electrically connected with the holders of the brushes C and C′ when they are out of contact with the commutator by contacts b^2 b^3, so that the current from the commutator G through brush B or B′ is through contact b^2 or b^3, the holder of brush C or C′, and through terminal T or T′ to line, this being the case so long as brushes A and B and A′ and B′ are working—that is, at full load and down to three-fifths load or less the current from the commutator G through brush B or B′ is through contact b or b^3, brush-holder of C or C′, and terminal T or T′ to line. This mechanism is for rocking the brush-holders and for connecting them electrically, so that the forward brushes (B B′ when A A′ are in contact with the commutator G, but C C′ when A A′ are out of contact with G) shall always connect with T T′ without resistance, and the rear brushes (A A′ when C C′ are out of contact, but B B′ when C C′ are in contact) shall always connect with T T′ through adjustable resistances R R′. It will be obvious that a great variety of means may be used for these purposes, and I have contemplated several other mechanisms and arrangements of conductors; but I prefer those shown, for the reason that a single shaft F gives all the motions and makes all the changes in connections required, and this shaft F is readily operated by solenoid S, by the links s s^2, and lever s^3, fulcrumed at s^4 upon the head of the machine.

The auxiliary brushes D D′ serve only as lap-brushes for B and B′. They are thrown into action in that form of my regulator shown

in the drawings by the magnet M, which oscillates shaft F′, and thereby actuates link *d*, which connects with link *d′*, which is jointed to the holder of brush D and also with lever d^2, which carries brush D′, so that when link *d* is moved upward the brushes D D′ are lifted from commutator G, and when link *d* is moved downward they are brought into contact with commutator G.

The rheostats R R′ may be adjusted by hand or automatically and may be of any approved construction.

What I claim as my invention is—

1. A dynamo-electric machine having two or more sets of brushes placed at successive points in the periphery of the commutator and provided with a resistance adapted to be shifted in circuit from one brush to the next, combined with a lifting mechanism for two or more of said brushes, by which a desired set may be brought into contact with the commutator and the other set lifted therefrom.

2. The combination, with a dynamo-electric machine, of three sets of commutator-brushes placed at successive points in the periphery of the commutator, lifting mechanism for two or more sets of said brushes, by which a desired set may be brought into contact with the commutator and the other lifted therefrom, and a resistance adapted to be shifted from the circuit of one brush to the circuit of the next.

3. The combination, in a dynamo-electric machine, of three sets of commutator-brushes placed at successive points around the periphery of the commutator, the intermediate sets being fixed and the other two sets being movable, and automatic mechanism for lifting the movable brushes into and out of contact with the commutator.

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Witnesses:
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