No. 614,608. Patented Nov. 22, 1898.

E. CANTONO.

DYNAMO ELECTRIC MACHINE OR ELECTROMOTOR.

(Application filed Dec. 16, 1897.)

(No Model.) 3 Sheets—Sheet I.

Fig. 1.

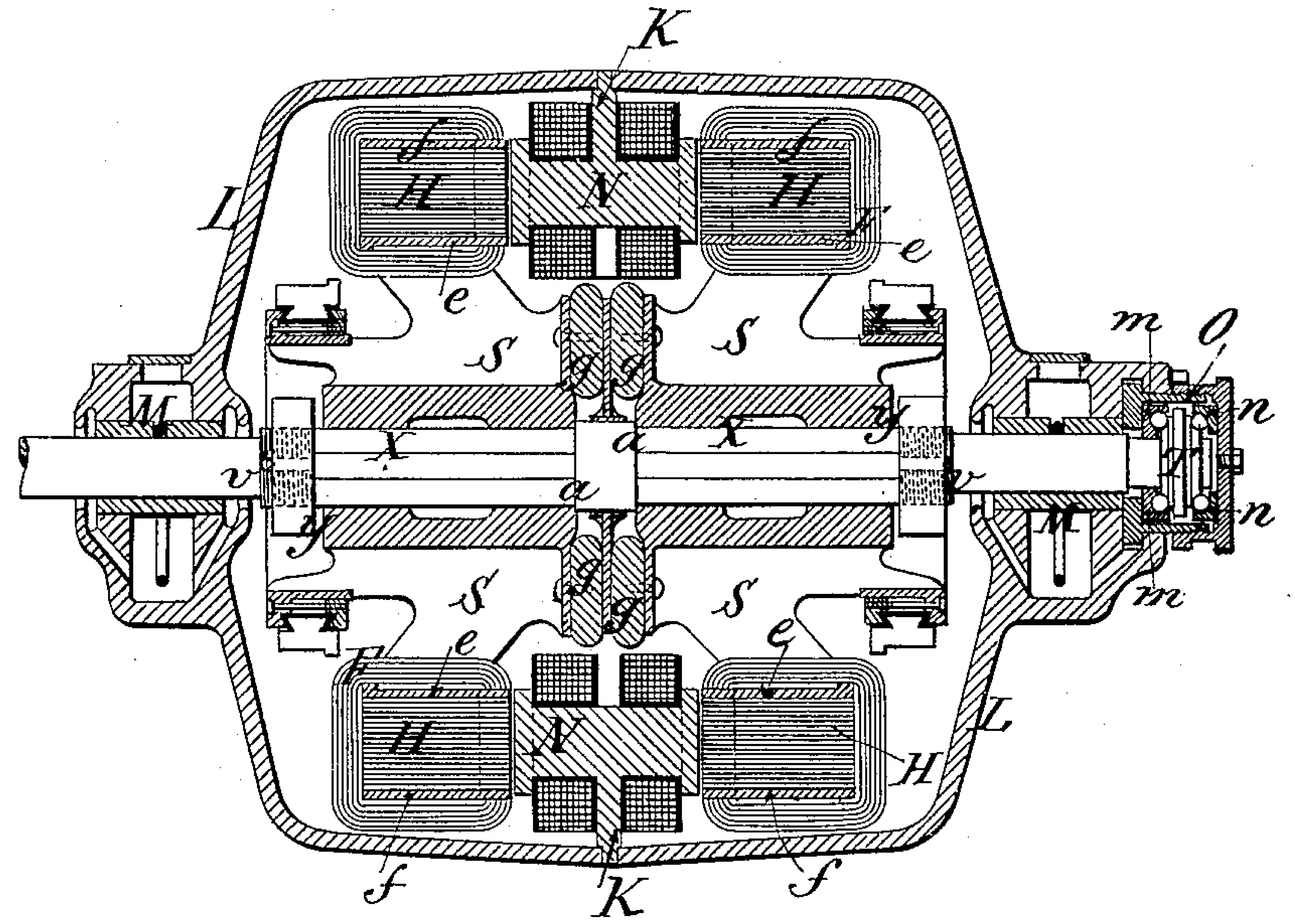

Fig. 2.

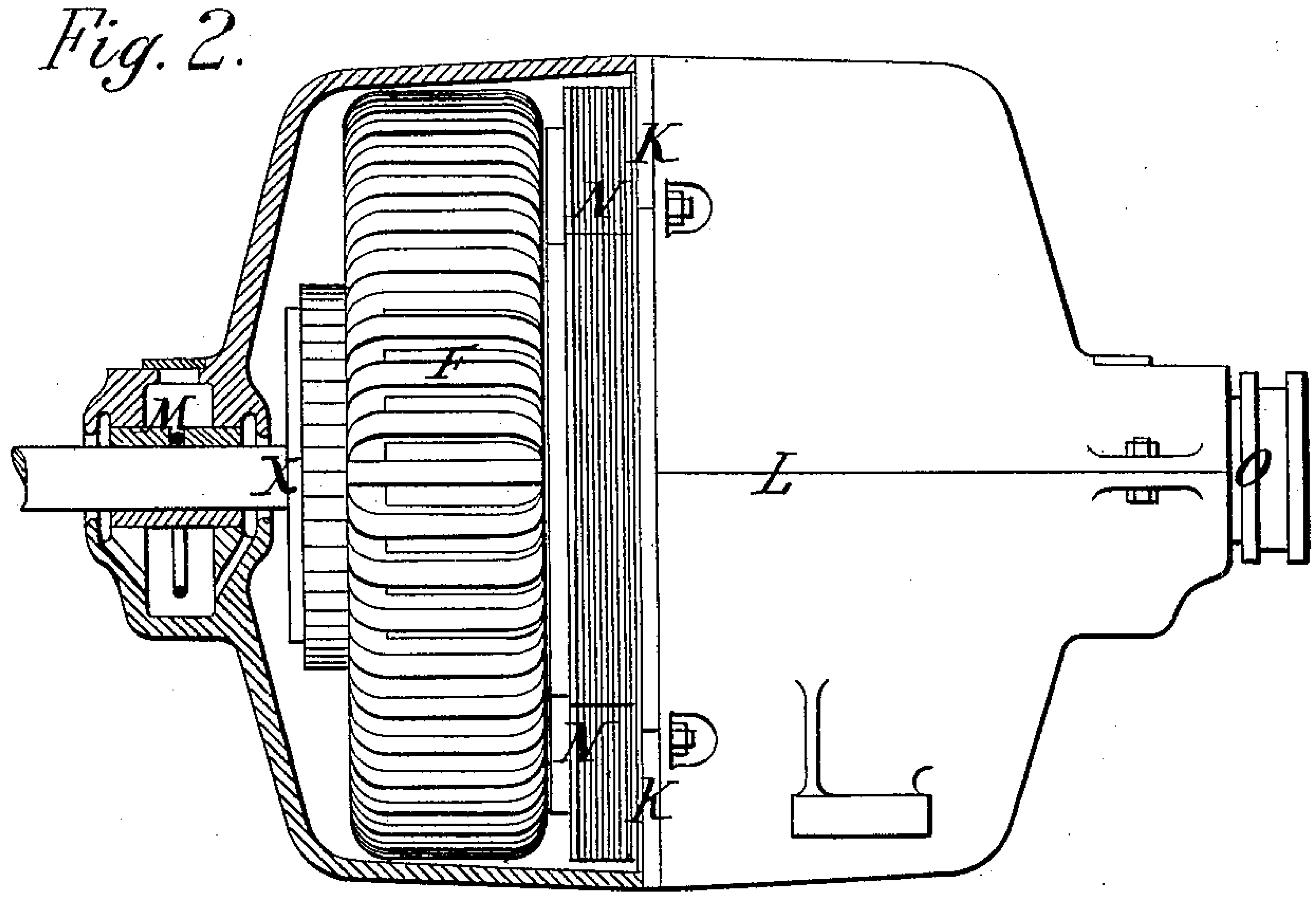

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Fig. 3.

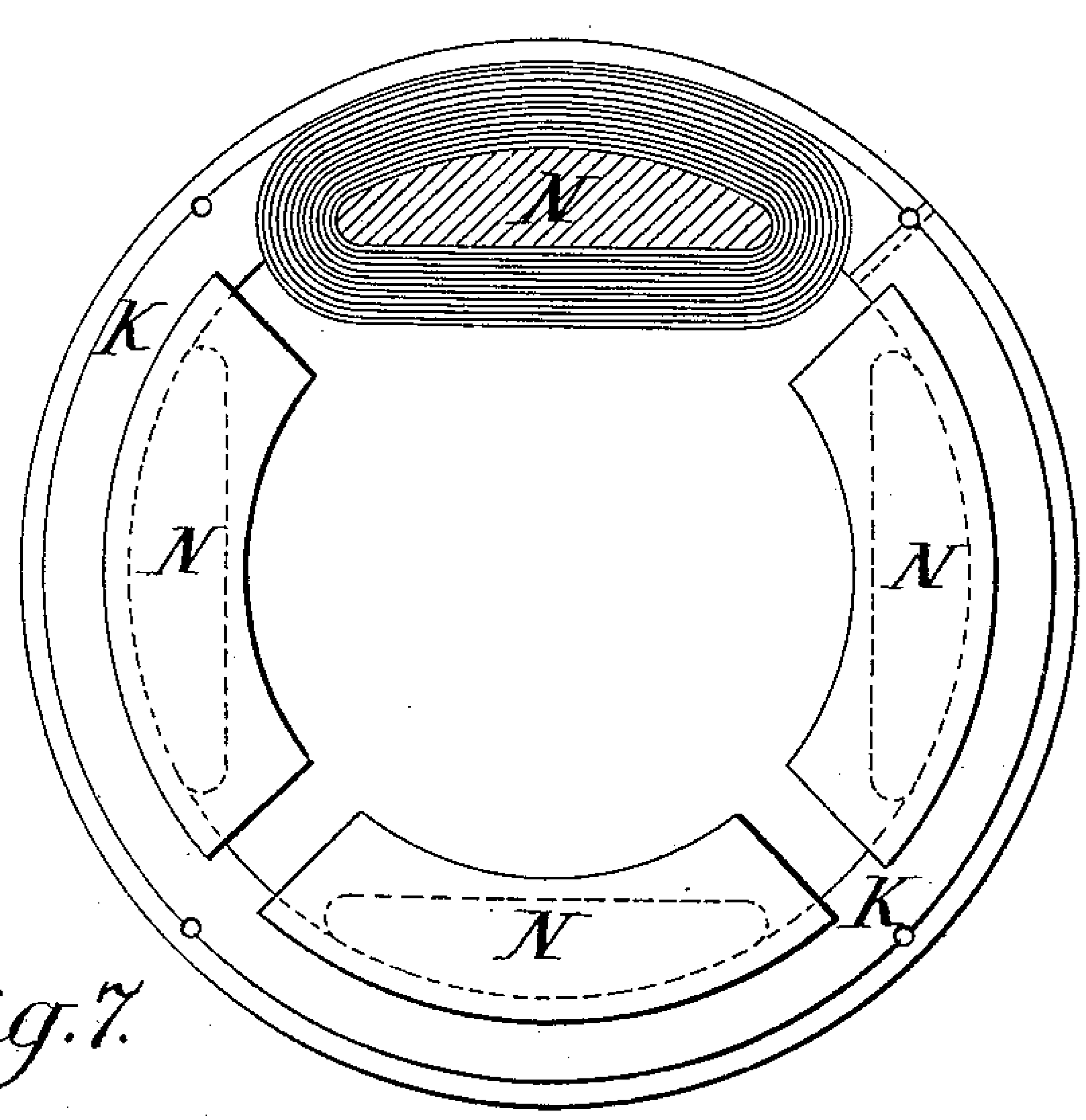


Fig. 4.

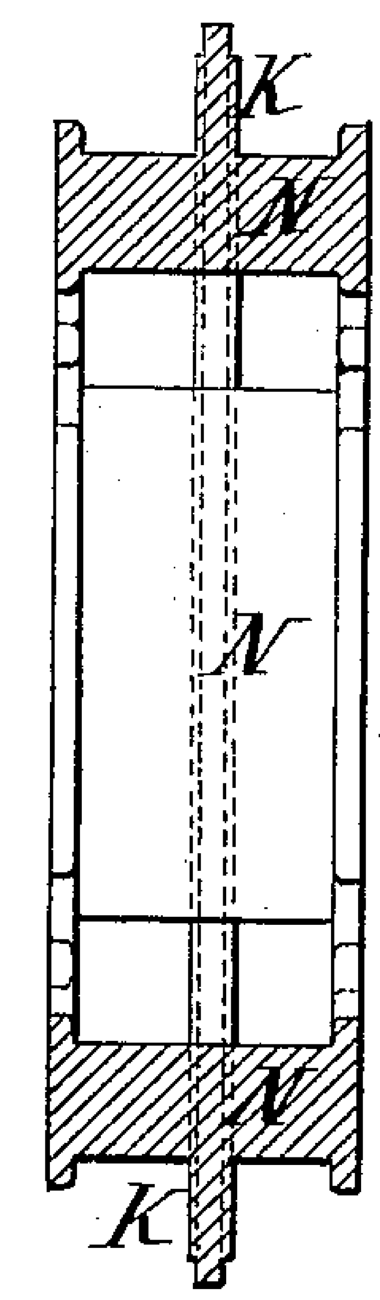
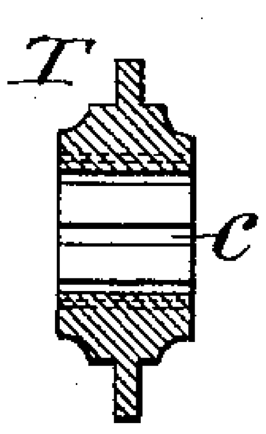


Fig. 7.



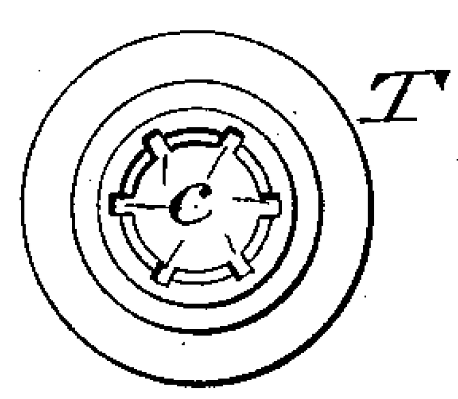


Fig. 8

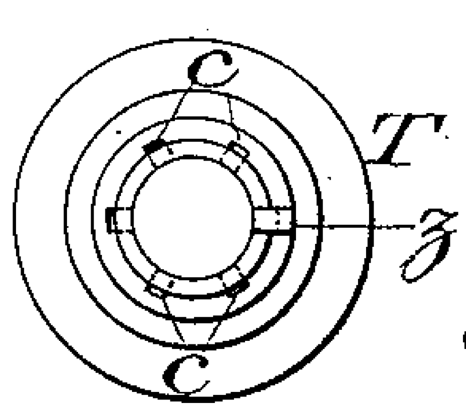


Fig. 9.

Fig. 5.

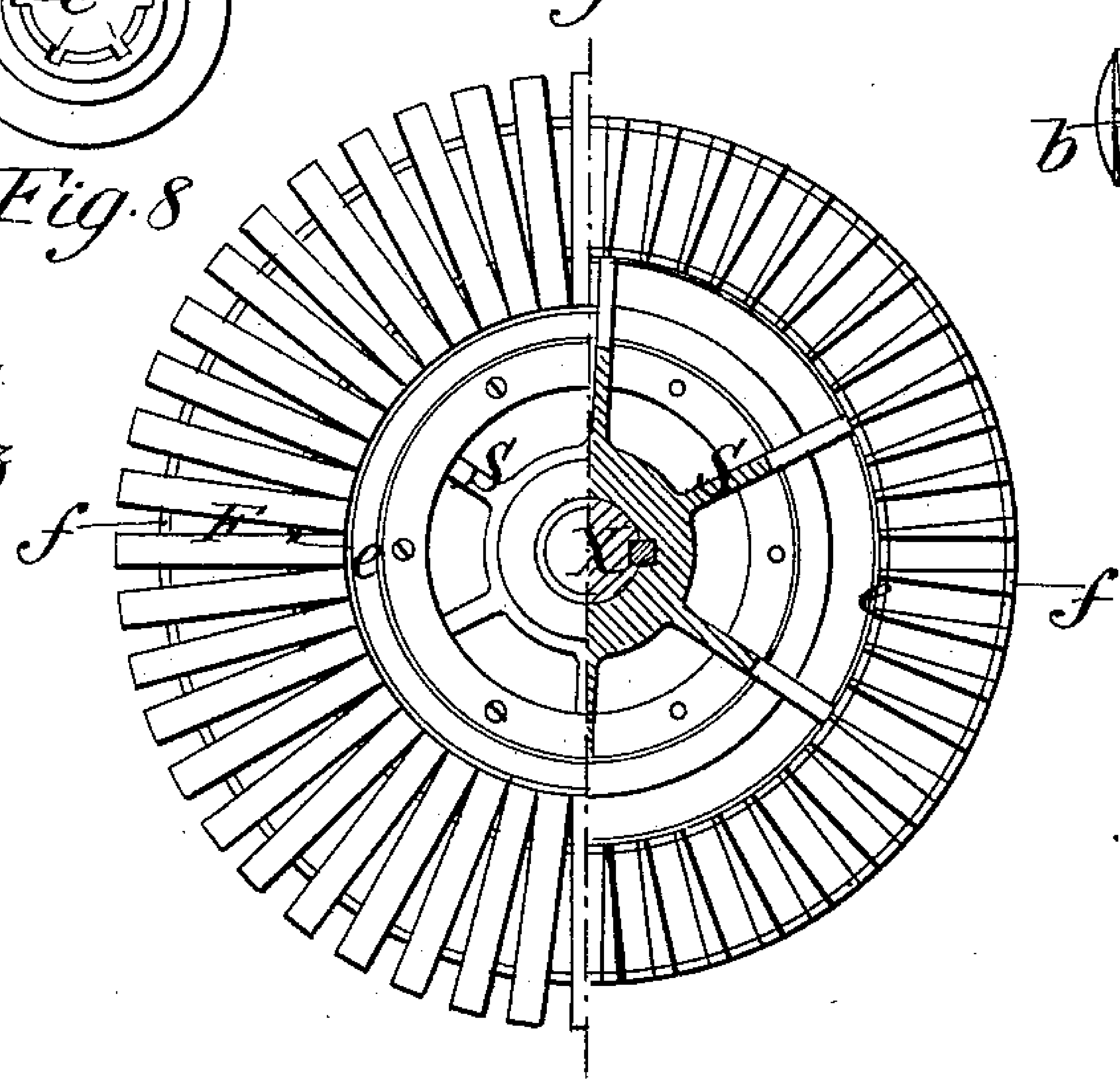
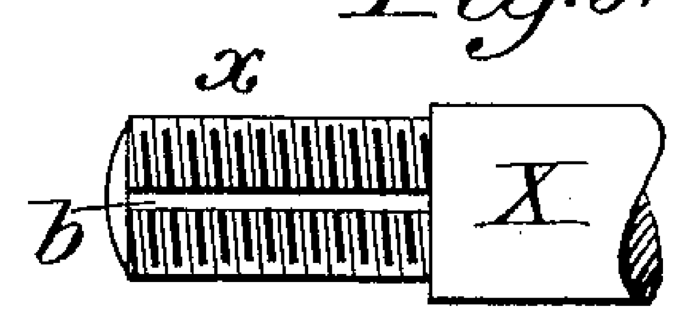


Fig. 6.



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3 Sheets—Sheet 3.

Fig. 10.

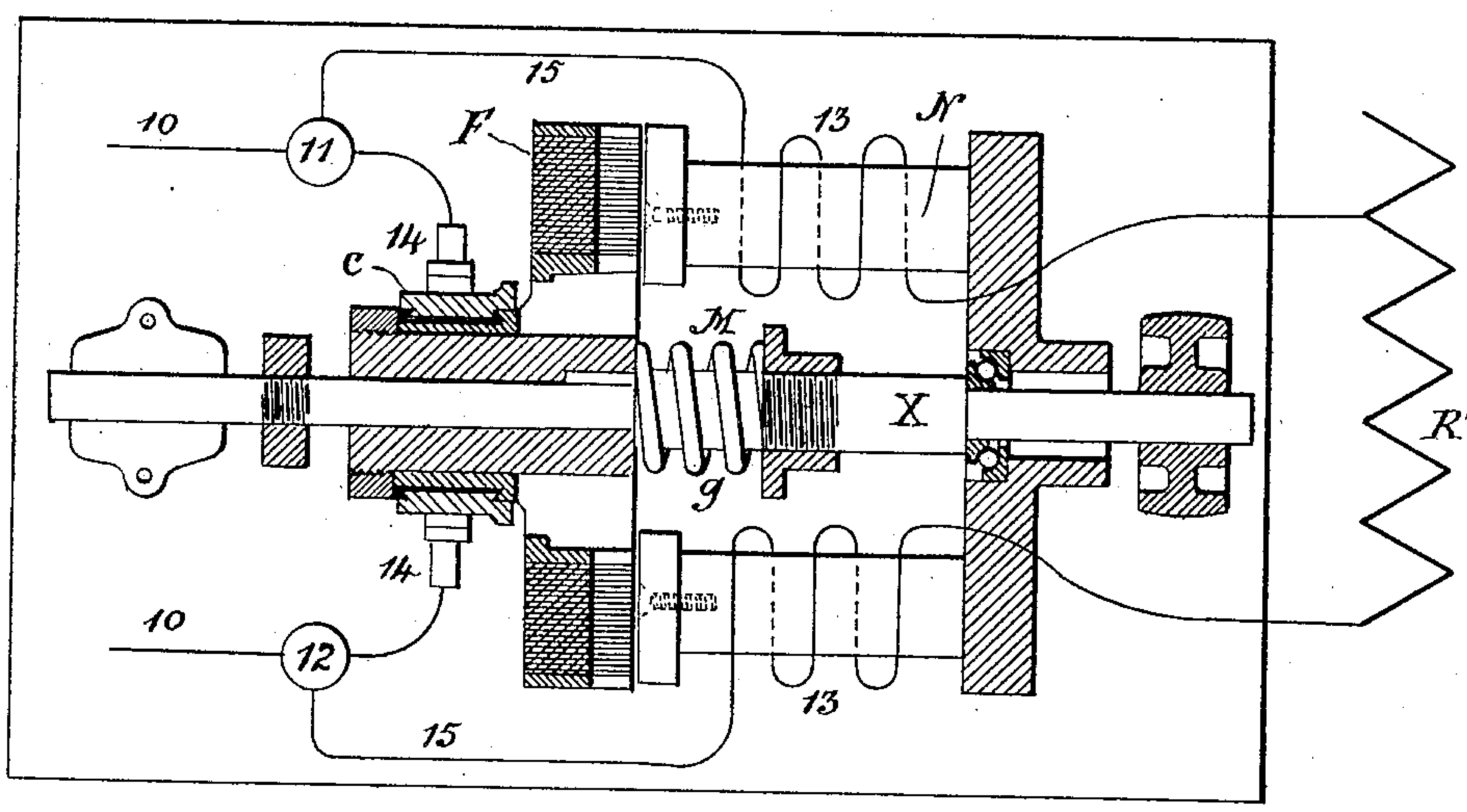
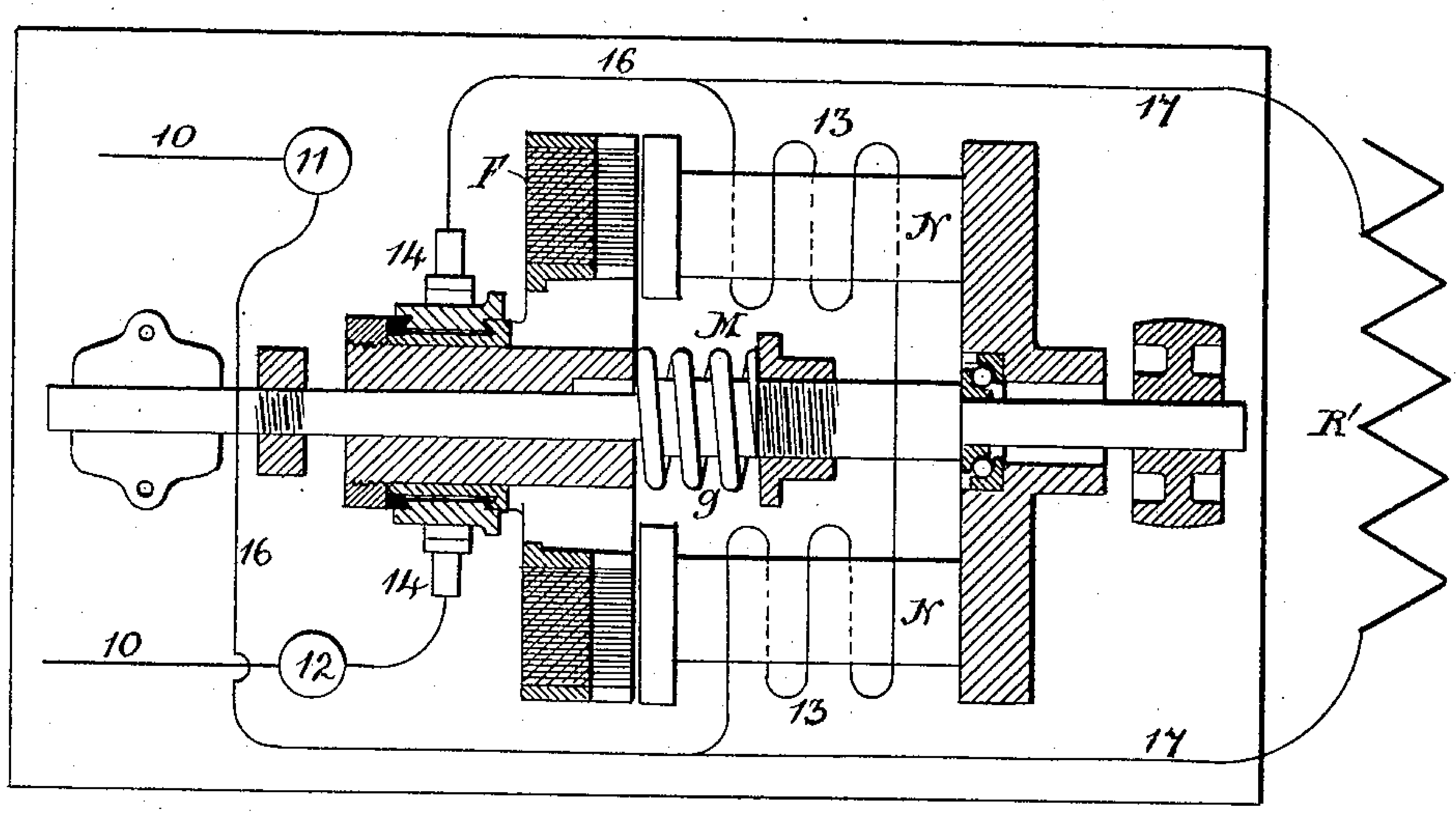


Fig. 11.



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UNITED STATES PATENT OFFICE.

EUGÈNE CANTONO, OF PAVIE, ITALY.

DYNAMO-ELECTRIC MACHINE OR ELECTROMOTOR.

SPECIFICATION forming part of Letters Patent No. 614,608, dated November 22, 1898.

Application filed December 16, 1897. Serial No. 662,102. (No model.)

To all whom it may concern:

Be it known that I, EUGÈNE CANTONO, a subject of the King of Italy, residing in Pavie, Italy, have invented certain new and useful Improvements in Dynamo-Electric Machines or Electromotors, (the same being the subject-matter of Letters Patent in Italy, dated the 29th day of April, 1897, Vol. 87, No. 166,) of which the following is a specification.

The problem the solution of which is the object of the present invention may be stated as follows: An electromotor should develop certain power at speeds variable within very wide limits, these speeds being assumed by the armature of the motor in such a way as to dispense with all kinds of complex mechanism hitherto employed to transmit motion to operating-machines, such as machine-tools, fabric-printing machines, and especially machines for electric traction. By some mechanical or electromechanical arrangement I vary the resistance of the magnetic circuit by modifying the interval between the circumference of the movable armature and the pole-pieces within which it revolves. If, for instance, I increase the air-space, other things remaining unchanged, the number of revolutions of the armature should increase in order that it may develop the desired counter electromotive force, notwithstanding the increase of the resistance of the magnetic circuit. If, on the other hand, I diminish the air-space, the armature will turn more slowly. The variation by small degrees of the air-space of the motor therefore completely solves the problem of modifying by insensible gradations and within very wide limits the speed of the armature, the power absorbed remaining sensibly constant. The limits of speed variation are much wider than can be attained by the use of ordinary rheostats, and, moreover, the loss of work which always attends the use of rheostats is avoided. The same method can be applied to generating-dynamos to vary the electromotive force at constant speed. Change of speed can also be produced by a slight variation of the excitation. The result of this is to modify the attraction of the armature or armatures by the inducing system, so that if there are armatures capable of being slightly shifted axially by means of opposing mechanism—such, for instance, as springs—the attraction of the inducing system will be balanced by the distance of the armature caused by the springs above mentioned. The equilibrium will establish itself for all the values of the attraction comprised within suitable limits, this attraction being itself produced by the inducing-current. Hence it results that for every value of the exciting-current there will be a certain air-space, which modifies the intensity of the speed. This arrangement can be employed to regulate motors at a distance, and it also permits the obtaining of automatic variation of the potential in charging accumulators from dynamos.

When motors at a distance have to be controlled and when it is not advantageous to use mechanical means for varying the air-space, the most practical solution of the problem is that attained by the type of motor now about to be described.

When motors are to be applied to electric traction, to working cranes, or generally machines on shipboard, cases in which the motors are not within reach of the persons who work them, this system is of great service.

In the accompanying drawings, Figures 1 to 9, inclusive, show the preferred construction of an electromotor according to this new system; and Figs. 10 and 11 are diagrammatic sectional plan views showing two different modes of electrically connecting the elements of the motor for carrying out the regulation. Fig. 1 is a longitudinal mid-section of the improved motor. Fig. 2 is an elevation thereof, of which the left-hand half shows the inclosing shell in vertical section. Fig. 3 is a front view of the magnet with one pole in section. Fig. 4 is a transverse section of the magnet without its winding. Fig. 5 shows the armature partly in end elevation and partly in vertical mid-section. Fig. 6 shows in detail the end of the armature-shaft X. Figs. 7 and 8 show in cross-section and elevation the double cone T which screws on this shaft. Fig. 9 shows the end elevation of the shaft with the cone T applied and locked thereon.

I will now describe the construction shown in Figs. 1 to 9, inclusive. Two opposite armatures F F close the magnetic circuit created by an even number of straight electro-magnets N. When the magnets act, they attract the two armatures, which would strike the faces of the magnets but for the two stops *a a* on the shaft X, which limit their movement. Between the armatures are provided two caoutchouc springs *g g*. By means of screws *v v* on the shaft X the play *y* of the armature-sleeves on the shaft is regulated so that they can slide longitudinally between the two limits of the air-space, the one for the highest and the other for the lowest speed required. Between these limits the armature can take a position of equilibrium between the attraction of the electromagnets and the repulsion of the elastic material *g*. Thus may be readily understood how to vary the air-space and the consequent speed. If the motor be supposed connected in series, which is generally the case in traction arrangements, a rheostat is applied in shunt at the two extremities of the exciting-circuit, the purpose of this rheostat being to weaken at will the magnetic field, a very small weakening of which serves to weaken the attraction and consequently to increase the air-space, causing a very considerable increase of speed. This principle of acting on the field to produce changes of speed becomes practical, these changes being kept within narrow and consequently practicable limits. As the tension of the magnetic field is only very slightly varied, the resultant of the two fields—the inducing and the induced—retains the same position, and consequently it is not necessary to vary the position of the brushes.

Figs. 10 and 11 show two modes of controlling the field excitation by means of a rheostat. In these figures, N designates the field-magnet; F, the armature; X, the armature-shaft; *g*, the spring or cushion tending to open the air-space. R′ is the rheostat. 10 10 is the line-circuit. 11 and 12 are the opposite terminals or binding-posts. 13 13 are the field-exciting coils, and 14 14 the commutator-brushes. In Fig 10 the motor is excited in derivation, a field-exciting circuit 15 15 being connected at one terminal to the binding-post 11 and at the opposite terminal to the post 12, and the rheostat R′ for controlling the flow of current through this branch is connected serially therein. Fig. 11 shows an arrangement which may be adopted where the motor is excited in series, the field-exciting coils 13 13 being connected in a circuit 16 serially with the commutator-brushes 14 14. In this case the field excitation is controlled by short-circuiting more or less current from the field-coils 13 through a shunt 17, the conductivity of which is controlled by the rheostat R′. This system also allows of modifications with all known kinds of springs or elastic material for moving the pole-pieces nearer to or farther from the armature, which remains stationary.

The double-armature type shown in Figs. 1 and 2 has the advantage, in the special applications above referred to, of not causing passive resistances, which have to be overcome and which are always caused in known machines by the magnetic adhesion between the pieces that are moved and the stationary organs of the machine. The arrangement adopted of the double armature with flat ring has only become practical after long studies. It has always been objected that ring armatures made with a band wound on did not have sufficient stability. This objection has especially been made when the armatures were subjected under both faces to an inducing flux in such a manner that the lateral attraction on the two sides in opposite directions was almost compensated. In the arrangement in question, the attraction being only on one face, these armatures could not be employed. It was therefore necessary to find some practical method of getting over this difficulty. These researches led to the adoption of the following arrangement: The ring is constructed by dividing it into three parts—first, a continuous internal ring *e* of the thickness of several millimeters; second, a winding on the said ring of a thin band H, of soft iron, insulated by means of varnish or other insulating material, this winding comprising almost all the radial thickness of the ring, and, third, a second continuous ring *f*, arranged upon the winding. The interior part of the ring is of truncated conical form. The bronze wing-supports S S should have the same conicity. These supports are intended to carry the ring. The dimensions of the two truncated cones ought to be such that the shoulders of the supports are strongly held in the hollow of the cone. The fixing of the ring upon the wing-supports is effected by hydraulic pressure, which gives the armature the same solidity as if it were made in a single piece. With this construction the employment of ring armatures, combined with the arrangement shown in Fig. 1, becomes quite practicable.

The cores of the magnet N are of cast-iron in one piece with their crown-support K, which forms a ring perpendicular to the cores and connects them all together. This crown should be sufficiently thin, so that the surface of its radial section should be small relatively to the section of the magnetic core. In this way the difference of magnetic flux from the two opposite pieces of the same core remains almost constant. This condition is indispensable, so that the pressure along the axis supporting the armature, which results from the two pressures exercised by the two armatures, shall be the least possible and without injurious effect in its practical applications. This system of magnet, most simple to construct, gives excellent results in respect of the facility of centering the whole of the armature, as well as the cores.

The whole of the field-magnet is kept in position by the framing of the motor, which consists of two cast-iron boxes L, Fig. 2, almost hemispherical, which meet upon the crown K of the magnet, and thus keep all the organs of the motor together. In the bottoms of the boxes is arranged an opening, in which is adjusted a bearing M for the shaft of the armature. A practical arrangement for this kind of motor consists in dividing each covering-box L into two parts, following the horizontal section in relation to the axis of the armature and to establish the field-magnet in two parts, dividing the crown above described radially in such a manner that the upper sector thus obtained shall contain one of the cores of the magnet made with four or several pairs of cores. In this manner it is extremely easy to dismount the armature when necessary. For that it only is needed to take away the upper parts of the cast-iron boxes forming the cover, then take away the upper magnet, part of the uncovered sector, and the armature can then be easily taken out.

In certain applications the upper parts of the boxes can be united to the lower parts by means of hinges, which facilitate inspection of the interior of the motor.

In order to regulate the position of the magnet after it is mounted and in order to get over the difficulty of heatings, which are frequently produced in other kinds of motors having flat rings, in consequence of the axial movement due to the different attractions of each of the sides of the polar pieces, recourse is had to the employment of a ball-bearing. In Fig. 1 O represents the box, in which are lodged two concave rings *m* and *n*, holding the balls. T represents a double intermediate cone screwed upon the shaft of the armature and secured to the desired position by means of a key. In order to facilitate the keying, the double cone T has on its interior part several notches *c*, Figs. 7, 8, and 9, which present themselves successively in front of a groove *b* of the threaded part *x* of the shaft X, Fig. 6, and when one screws up or unscrews this double cone T one can thus vary the position by a fraction of a turn, putting back the key *z* into its groove *b* and into that one of the notches *c* which corresponds to it. The advantages of this light motor with variations of speed are: The first advantage of this motor is its great lightness, since it allows the obtaining of power equal to that of the motors hitherto employed with a diminution of weight to the extent of thirty to forty per cent. The application of the two armatures and the variation of the air-space allow the obtaining from the motors all speeds which are to be desired without having recourse to the employment of passive resistances, as in the types hitherto known. There are therefore obtained by means of this new type of motor very appreciable advantages, which may be summed up as follows: first, reduction of weight; second, economy and simplicity of construction and installation; third, great power in consequence of suppression of the losses by passive resistances; fourth, suppression of shocks and great losses of current on putting the machine in action when these motors are applied to tramways or carriages, this suppression of shocks resulting really from the coupling in series of the two collectors on putting in action and from the automatic reduction of the air-space when use is made of exciting in series; fifth, absolute protection of all the organs, which are thus sheltered from dust and moisture, and, sixth, great facility in varying speed, which proceeds either from the employment of rheostats or from the automatic variation of the air-space of the motor resulting from the increasing force to be overcome.

Employment of accumulators: When a motor having speed changed by varying air-space is to be employed with accumulators, a considerable economy results, as much in regard to the constancy of the work done as in regard to the duration of the accumulators.

The arrangement of the motor previously studied may also be applied to generating-dynamos, an application which might render great services, particularly in charging accumulators. In effect, let us admit that the speed of the machine is constant and let us suppose that the dynamo is excited in shunt. If the output of the machine becomes lessened in consequence of the increase of the counter electromotive force of the battery, the difference of potential at the terminals of the machine will increase. From this results an increase of the excitement and consequently of the attraction, the separation of the air-space will diminish, and in consequence the electromotive force developed will increase and will reëstablish the output of the machine. The machine in this case should be studied, so as to concentrate in it the greatest part of the losses due to its operation in the interior resistance of the armature in order to render the self-regulating action more sensible. This mode of charging accumulators permits rheostats and other organs to be dispensed with and at the same time gives a greater economy in attendance and allows a constant current to be maintained for charging batteries.

In the case of compounding or hypercompounding dynamos controlled at a distance the arrangement previously studied may also be of great service.

I claim as my invention—

1. A dynamo-electric machine constructed with the fixed and rotative members of its magnetic field movable toward or from each other to vary the air-space, and with an elastic medium tending to widen said air-space, so that the width of said space varies with the field excitation.

2. A dynamo-electric machine constructed with the fixed and rotative members of its magnetic field movable toward or from each other to vary the air-space, and with an elastic medium tending to widen said air-space, combined with means for controlling the field excitation.

3. An electromotor constructed to vary the

air-space between the fixed and rotative members of its magnetic field, proportionally to the field excitation, combined with a rheostat connected to control its field excitation, whereby to control the speed of the motor.

4. An electromotor constructed to vary the air-space between the fixed and rotative members of its magnetic field, proportionally to the field excitation, and having its field excited in derivation, combined with a rheostat arranged in series with the exciting-circuit, whereby to vary the excitation of the motor, and consequently to determine the width of said air-space, whereby to control the speed of the motor.

5. An electric motor comprising two armatures and an intermediate field-magnet, the armatures movable toward and from each other to vary the air-space, and springs interposed between the armatures to counteract the attraction due to the magnets, whereby the speed varies in inverse ratio to the motor-couple to be furnished, and the output is maintained nearly constant.

6. The described construction of armatures consisting of a winding of iron ribbon confined between inner and outer hoops, and a spider S having radial arms forced into contact with the inner hoop.

7. The combination with an electromagnet consisting of cores N N and ring K, and a shell or casing consisting of opposite cups L L between which said ring is clamped.

8. The combination with central annularly-arranged field-magnets, annular armatures F F facing them on opposite sides, spiders S S for said armatures, springs *g g* between said spiders, armature-shaft X carrying said spiders and on which they are free to slide when approaching or receding from each other, and adjustable stops on said shaft for limiting the receding movement of the armature-spiders.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

EUGÈNE CANTONO.

Witnesses:
LORENZO FRETTE,
SANTO FIRREN.