No. 750,009. PATENTED JAN. 19, 1904.

E. THORDON.

ELECTROMAGNETIC GEARING.

APPLICATION FILED FEB. 6, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

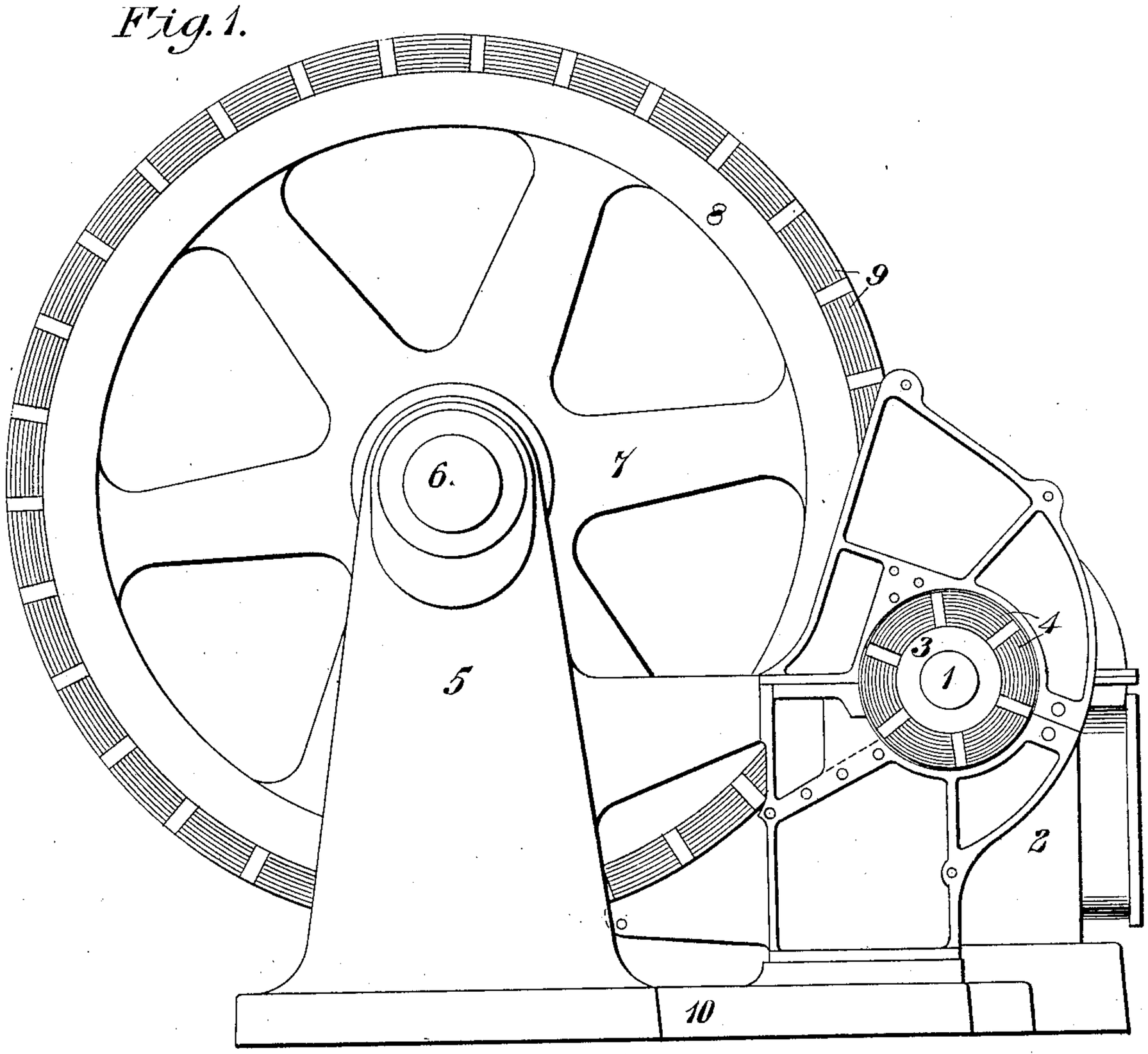


Fig. 2.

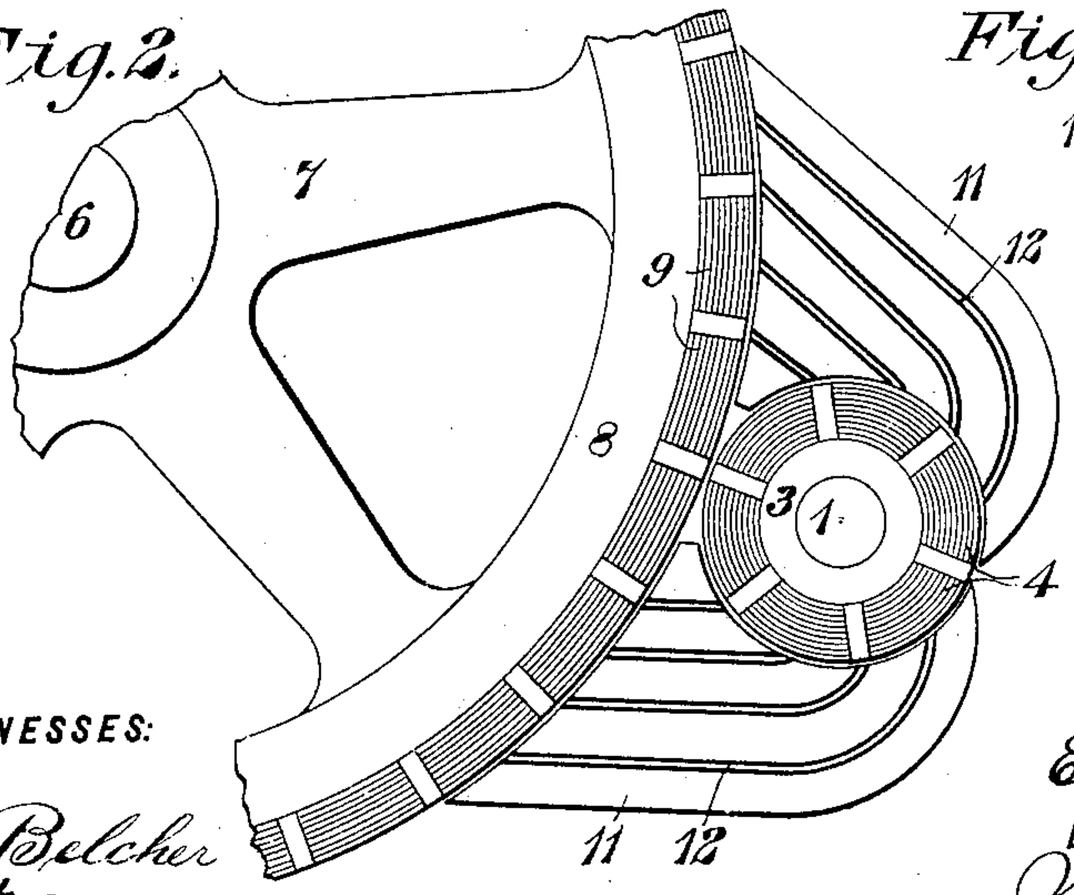
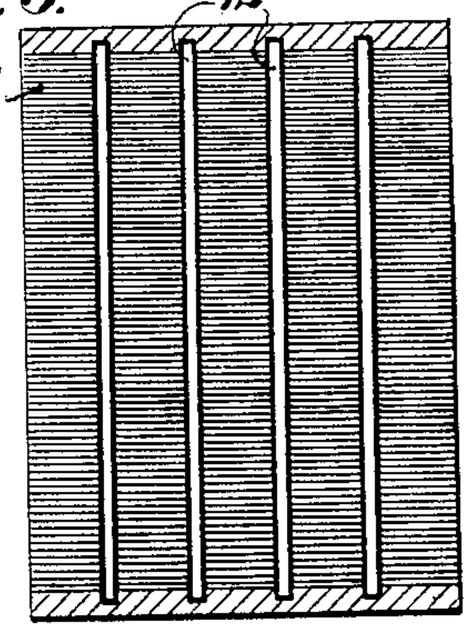


Fig. 3.



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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 4.

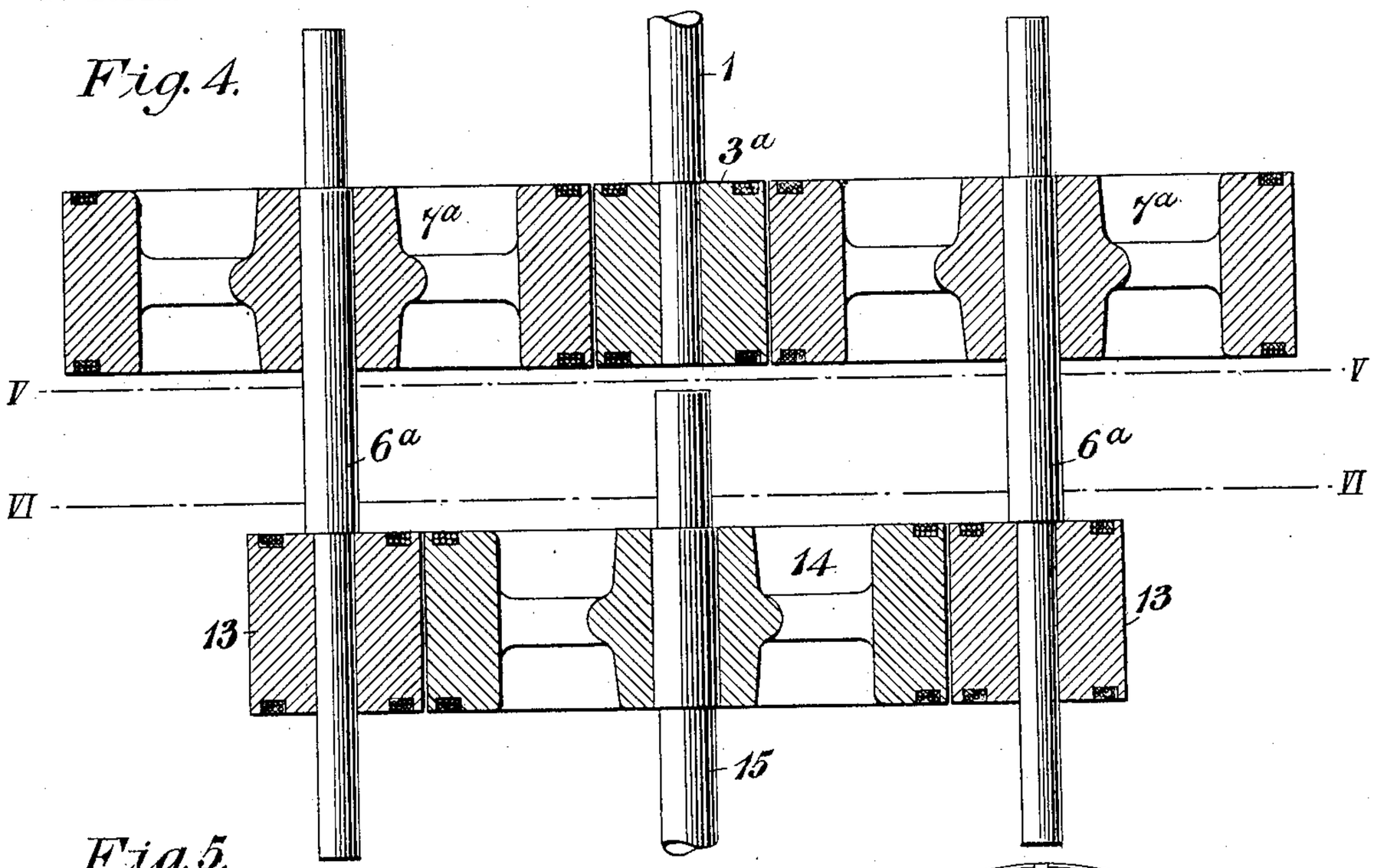
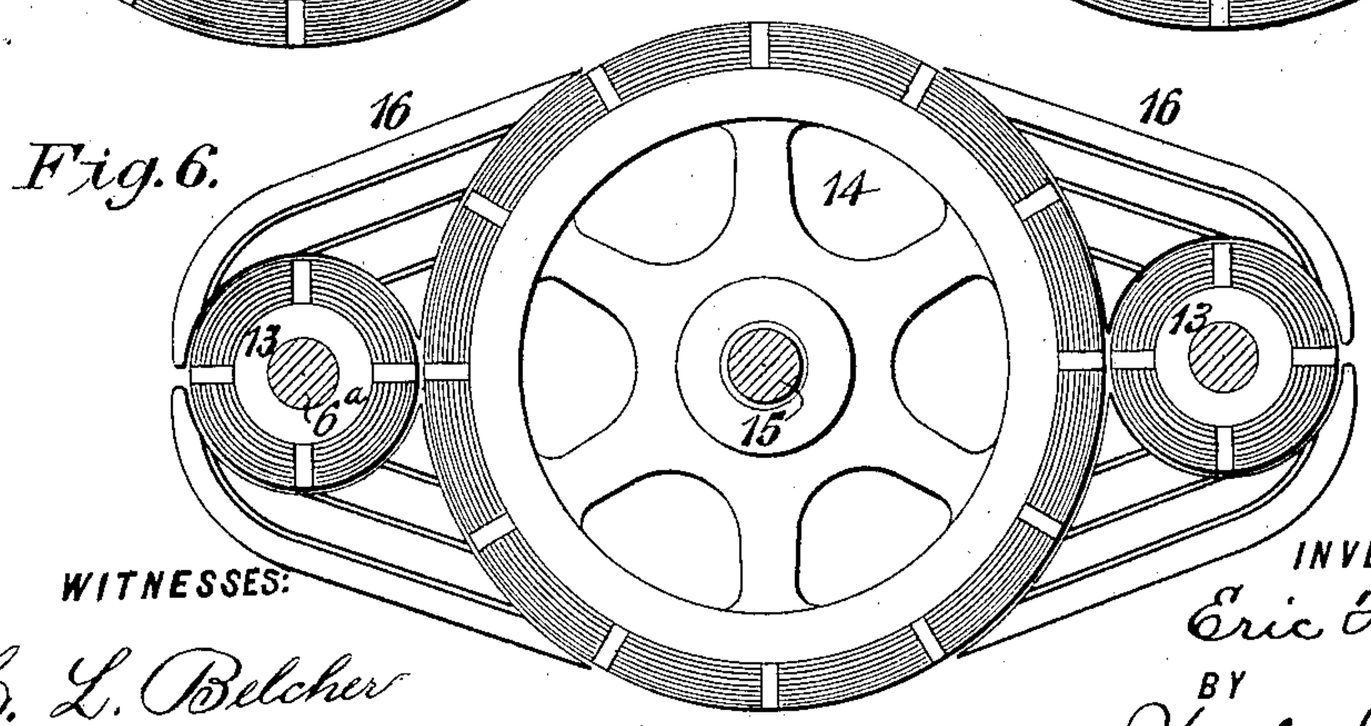


Fig. 5.

Fig. 6.



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APPLICATION FILED FEB. 6, 1903.

NO MODEL. 3 SHEETS—SHEET 3.

Fig. 7.

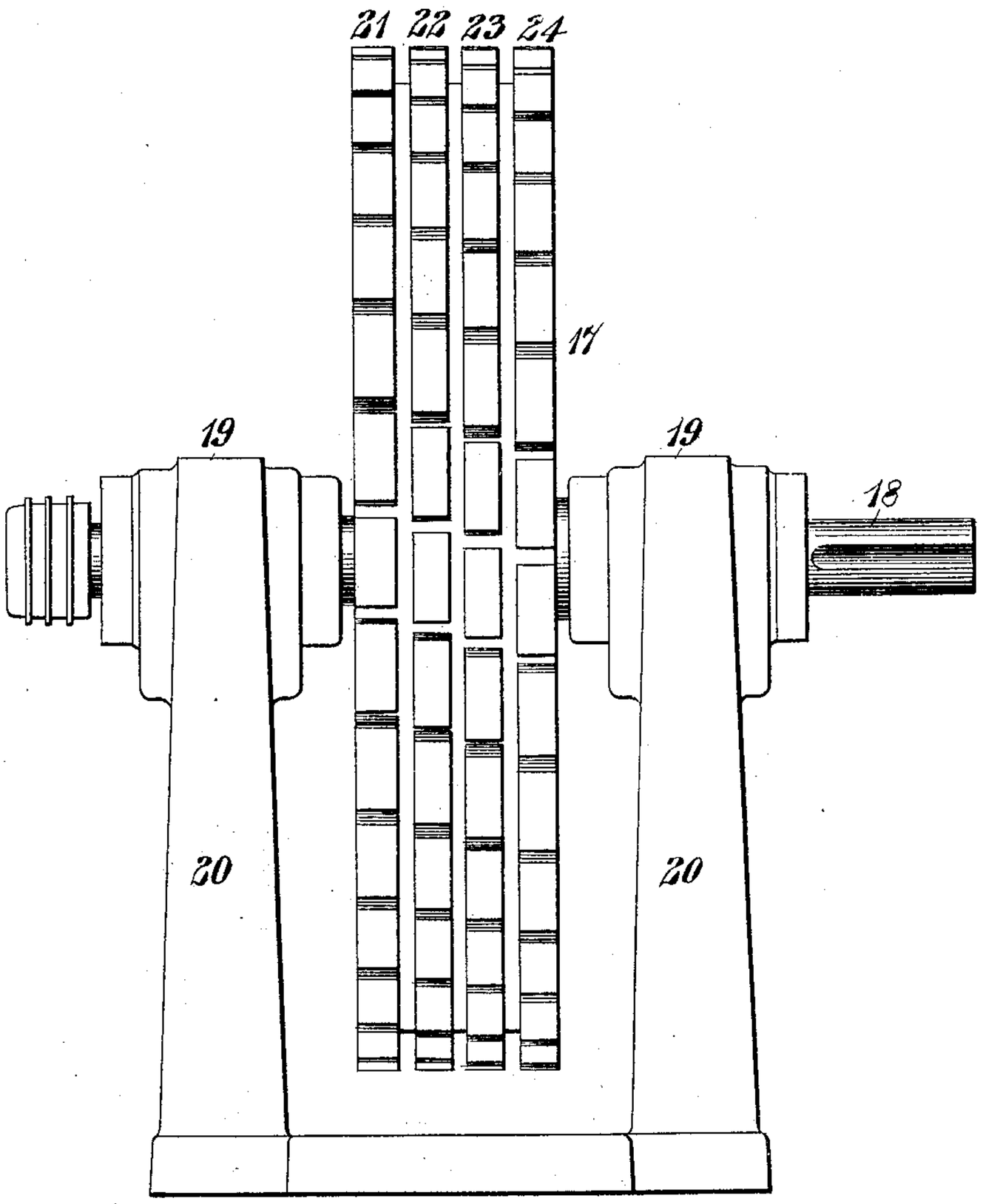
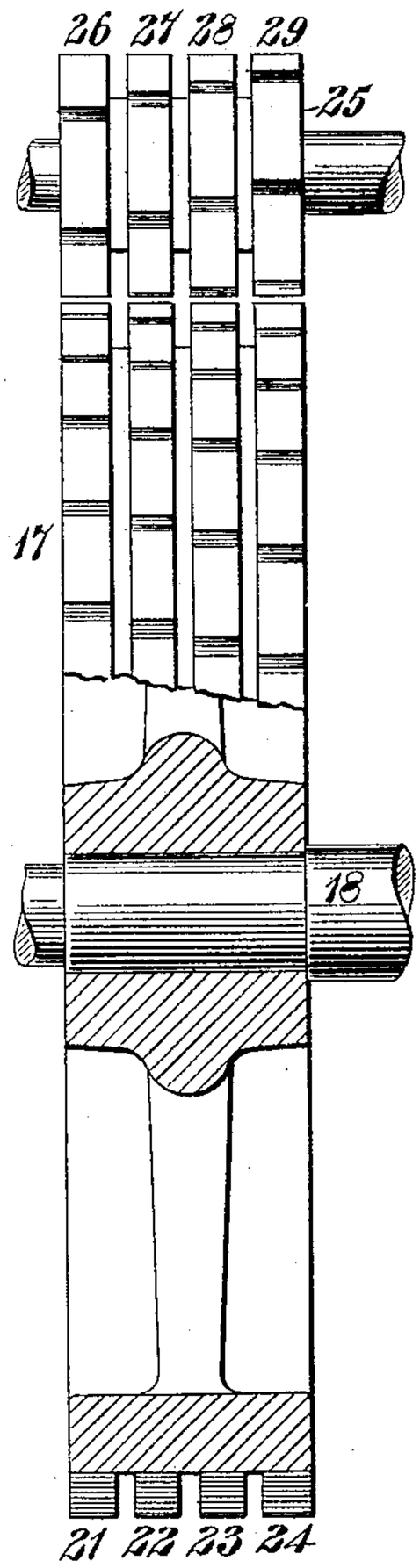


Fig. 8.



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No. 750,009. Patented January 19, 1904.

UNITED STATES PATENT OFFICE.

ERIC THORDON, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO THE WESTINGHOUSE MACHINE COMPANY, A CORPORATION OF PENNSYLVANIA.

ELECTROMAGNETIC GEARING.

SPECIFICATION forming part of Letters Patent No. 750,009, dated January 19, 1904.

Application filed February 6, 1903. Serial No. 142,242. (No model.)

To all whom it may concern:

Be it known that I, ERIC THORDON, a citizen of the United States, and a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Electromagnetic Gearing, of which the following is a specification.

My invention relates to electromagnetic gearing employed for transferring power from one rotating shaft to another either at the same or at a different speed; and it has for its object to provide gearing of this character which shall be comparatively simple and inexpensive in construction, substantially free from liability to disarrangement or injury, and which shall be smooth and substantially noiseless in operation.

The various forms of gearing which are generally employed for transferring energy from one shaft to another—such as belts, cog-wheels and pinions, friction-wheels, and sprocket-wheels and chains—are in many cases noisy, particularly when operated at high speeds, are subject to excessive wear, and are liable to disarrangement and breakage in service.

My invention is substantially free from all of the objectionable features pertaining to other forms of gearing and is illustrated in the accompanying drawings, in which—

Figure 1 is a view in end elevation of one embodiment. Fig. 2 is a detail view of a portion of the mechanism shown in Fig. 1. Fig. 3 is a sectional view of a portion of the apparatus shown in Fig. 2. Fig. 4 is a longitudinal sectional view of a modified construction. Figs. 5 and 6 are transverse sectional views taken, respectively, on lines V V and VI VI of Fig. 4. Fig. 7 is a side elevation of one member of another form of my invention; and Fig. 8 is a view, partially in side elevation and partially in section, of both members constructed in accordance with what is shown in Fig. 7, portions of the shaft and the supporting-framework being omitted.

Referring particularly to Figs. 1, 2, and 3, which illustrate my invention as embodied in a speed-reducing gearing, the driving-shaft 1 is illustrated as the shaft of a steam-turbine 2, and on this shaft is mounted a wheel 3, having an annular set of electromagnets 4, the coils of which may be supplied with energizing-current in accordance with the usual practice where it is necessary to supply the coils of rotating members of machines with energizing-currents. These coils may obviously be supplied in series, in parallel, or in parallel series, provided the circuit arrangements are such as to provide poles or sets of poles of alternating polarity. As indicated, the poles alternate in polarity, and this will be the simplest and generally the most desirable arrangement, though in some cases it might be feasible to have two or more adjacent poles of the same polarity.

Mounted in suitable bearings in standards or pillars 5 is a shaft 6, having a wheel 7, the rim 8 of the wheel being provided with an annular set of electromagnets 9, the outer faces of which move in close proximity to the outer faces of the electromagnets 4 of the wheel 3 when the two wheels rotate.

The coils of the magnets 9 may be supplied with energizing-current in the usual manner and preferably so that the pole-pieces alternate in polarity, as indicated in Fig. 2, though they may be arranged in groups or sets if those of the wheel 3 are so arranged.

A single base-plate 10 may be provided for the entire mechanism, or the two members of the gearing may be mounted upon separate bases, if for any reason such arrangement is desired.

In order to insure the passage of the magnetic lines of force between the two sets of magnets 4 and 9, I provide conducting-paths therefor, which, as shown in Figs. 2 and 3, consist of masses of curved iron plates 11, subdivided into groups of any desired or suitable number, the groups being separated by non-magnetic plates 12, of insulated copper or other suitable material. These groups 11 of laminated iron might be separated by air-spaces or by non-conducting material, and it is my desire and intention to include such a construction within the scope of my invention. I prefer, however, to employ electric conduct-

ing-strips 12, as above stated, since any magnetic lines having tendency to jump across those spaces will serve to set up electrical currents in the non-magnetic strips or plates, which in turn tend to choke down the magnetic leakage in the laminated iron plates, and thus insure a constant passage of the magnetic flux between the two members of the gear in the manner desired for the purpose of securing the maximum rotative effect. Since only a portion of the poles of the member 7 are active at any one time as magnetic elements of the gearing, it would be feasible, and perhaps desirable in some cases, to cut the inactive coils out of circuit by some convenient means; but in general it will probably be found more advantageous to simplify the apparatus by supplying the energizing-current to all of the coils continuously, even though only a portion of them are at any one time active in connection with the propelling member 3.

The speed reduction here indicated is from five to one; but of course any other ratio may be provided, the relative size of the members and the number of poles and coils being made in accordance with the speed ratio desired.

As the shaft 1 is rotated, by any suitable means, the magnetic flux between the poles 4 and the poles 9 of opposite sign will obviously, through the magnetic passages 11, exert a certain pull upon the member 7 and effect rotation of its shaft 6 at a speed corresponding to the ratio of speed reduction determined by the diameters of the two members and the number of magnetic poles.

As indicated in Figs. 1 and 2, the mechanism is shown as operating without load. Obviously if the member 7 is driving a load its poles will lag behind those of the member 3 in accordance with the amount of such load, and the driving or pulling torque will increase with this lag until a maximum pull is reached.

Referring now to Figs. 4, 5, and 6, the driving-shaft 1 is provided with a propelling member 3^a, which may be the same in construction and arrangement as the member 3, (shown in Figs. 1 and 2;) but it is here indicated as having four poles and coils 4^a, which act in conjunction with two sets of flux-conductors 11 and two wheels 7^a, which are mounted upon corresponding shafts 6^a and have annular sets of coils 9^a, (here indicated as twelve in number,) and therefore as providing a speed reduction of from three to one. The shafts 6^a are in turn provided with wheels or magnetic pinions 13 corresponding to the wheel or pinion 3^a, and these wheels or pinions act in the manner already described to drive a wheel 14, mounted on a shaft 15, a flux-conductor 16 being provided between the wheels 13 and the wheel 14 and the ratio of poles and coils being such as to provide a further reduction from three to one.

Referring now to Figs. 7 and 8, the driving-wheel 17 has a shaft 18 mounted in bearings 19 in standards 20 in substantially the same manner as is indicated in Fig. 1, and the wheel is shown as provided with four annular sets of magnets 21, 22, 23, and 24, which are arranged in an offset or step relation, and the driving-pinion 25 is similarly provided with four sets 26, 27, 28, and 29, which are offset or arranged in a step relation in the opposite direction to those of the sets 22, 23, and 24, so as to provide a more continuous rotative pull upon the shaft 18 of the driving member. The number of sets may of course be more or less than four, this number being merely illustrative and not intended to restrict the invention to specific numbers or dimensions of parts.

While I have shown the driving and the driven wheels as out of actual physical contact, I desire it to be understood that such physical engagement may exist either incidentally or by intentional design, and whenever the said wheels are referred to in the claims as "in proximity" to each other such descriptive terms are to be construed as meaning either physical contact or any operative relation that falls short of such contact.

Other variations in dimensions and relations of the elements employed may of course be made without departing from my invention, and I therefore desire it to be understood that the invention is not to be limited except as limitations may be imposed by the prior art.

I claim as my invention—

1. An electromagnetic gear comprising a wheel having an annular set of electromagnet-coils, in combination with an adjacent wheel having an annular set of electromagnet-coils and means for conducting the magnetic flux between adjacent, unlike poles of the two wheels.

2. The combination with a driving-shaft having an annular set of electromagnet-coils, of a shaft having an annular set of electromagnet-coils arranged to move in proximity to the electromagnet-coils of the first set and means for conducting the magnetic flux between adjacent poles of the two sets of magnet-coils.

3. The combination with a shaft and a pinion or wheel thereon which is provided with an annular set of electromagnet-coils the poles of which alternate in sign, of an adjacent wheel having an annular set of electromagnet-coils the poles of which alternate in sign and masses of laminated iron located between the two sets of magnets and terminating in proximity to both sets.

4. The combination with a driving-shaft and a wheel or pinion thereon which is provided with an annular set of electromagnet-coils, of a driven shaft, a wheel thereon which is provided with an annular set of electromagnet-coils arranged to move in proximity to those of the first set and masses of laminated iron

and interspersed plates of non-magnetic metal located between the two sets of electromagnets and terminating in proximity to both.

5. The combination with a driving-shaft and a pinion having an annular set of electromagnet-coils and pole-pieces, of a second shaft, a wheel mounted thereon and provided with an annular set of electromagnet-coils and pole-pieces movable in proximity to the first-named set, masses of curved iron laminæ located between the two sets of electromagnets so as to conduct the magnetic flux between the same and non-magnetic plates separating said iron laminæ into groups.

6. The combination with a driving-wheel having one or more annular sets of electromagnet-coils and pole-pieces, of an adjacent wheel differing in size from said driving-wheel and also having one or more annular sets of electromagnet-coils and pole-pieces and a curved flux-conductor which substantially surrounds the smaller wheel and projects into proximity to the adjacent portion of the larger wheel.

7. The combination with a driving-shaft and a wheel thereon which is provided with a plurality of annular sets of electromagnet-coils and pole-pieces, of an adjacent shaft, a wheel thereon which differs in size from the driving-wheel and is provided with a plurality of annular sets of electromagnet-coils and pole-pieces that are moved magnetically by the driving-wheel magnets and a flux-conductor which substantially surrounds the smaller wheel and projects into proximity to the adjacent portion of the larger wheel.

8. The combination with a driving-shaft, a wheel thereon which is provided with a plurality of annular sets of electromagnet-coils having pole-pieces disposed in a stepped or offset relation, of an adjacent shaft, and a wheel thereon which is provided with a plurality of annular sets of electromagnet-coils having pole-pieces that are oppositely disposed in a stepped or offset relation so as to magnetically intermesh with the magnets on the wheel of the driving-shaft.

9. The combination with a wheel having a peripheral set of radial pole-pieces and magnetizing-coils thereon, of an adjacent wheel having a peripheral set of radial pole-pieces and magnetizing-coils thereon and magnetic flux-conductors disposed between the two wheels.

10. The combination with two adjacent wheels of different size, each having a peripheral set of radial pole-pieces and magnetizing-coils thereon, of magnetic flux-conductors disposed between the two wheels.

In testimony whereof I have hereunto subscribed my name this 2d day of February, 1903.

ERIC THORDON.

Witnesses:
JAMES B. YOUNG,
BIRNEY HINES.