No. 671,270. Patented Apr. 2, 1901.

W. L. R. EMMET.

MEANS FOR EQUALIZING THE SPEED OF SHAFTS.

(Application filed Jan. 9, 1900.)

(No Model.)

Fig. 1.

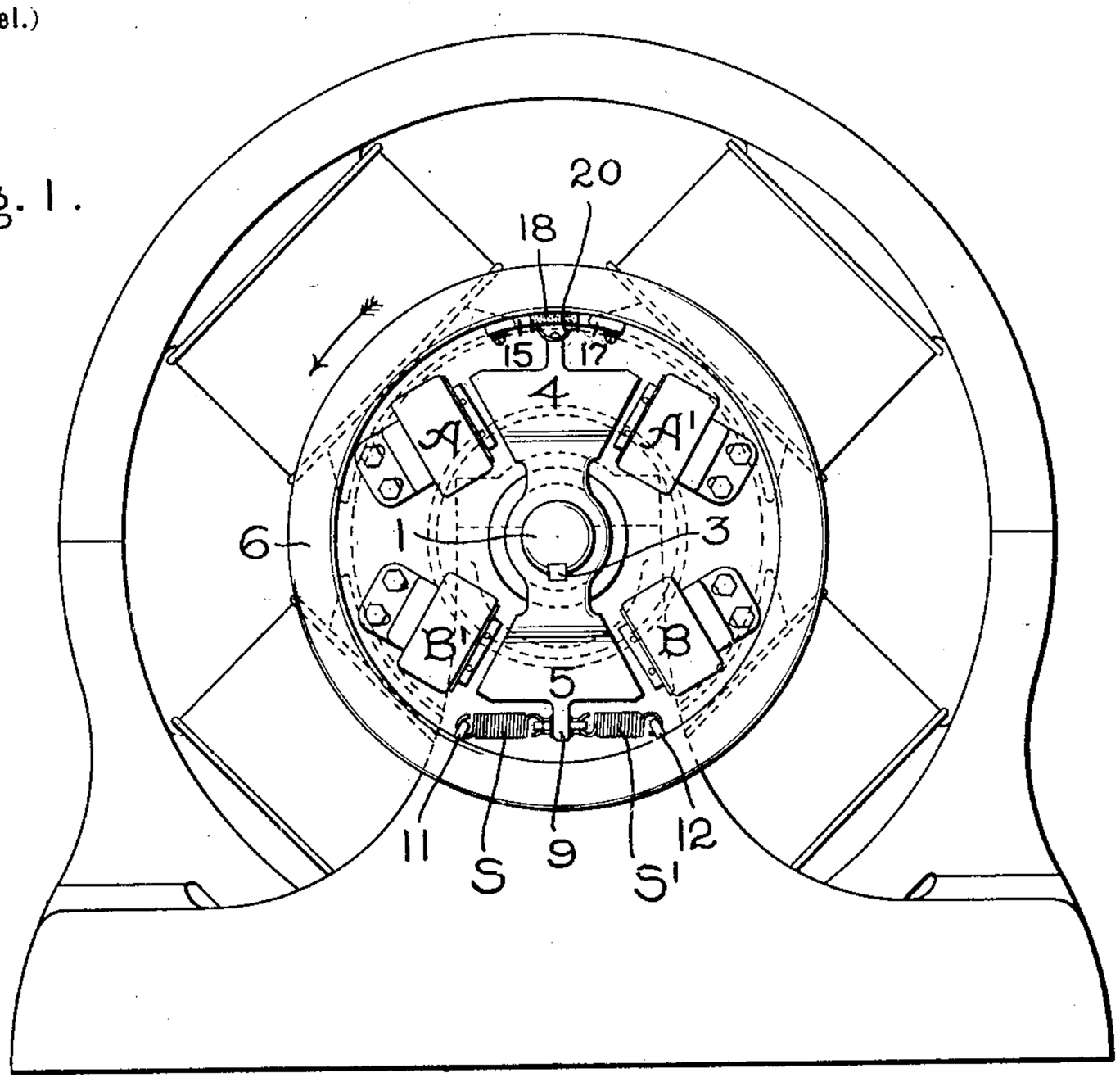


Fig. 2.

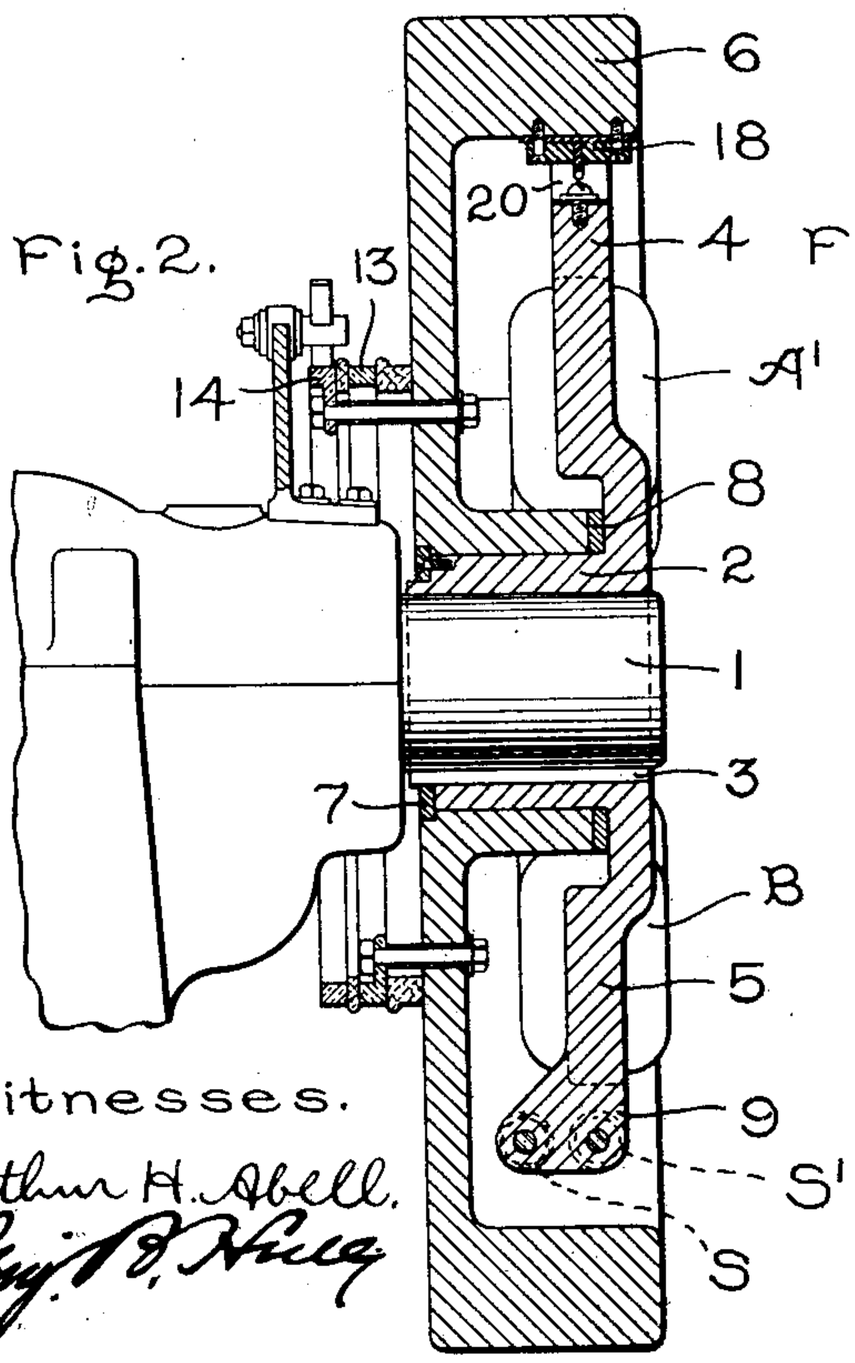
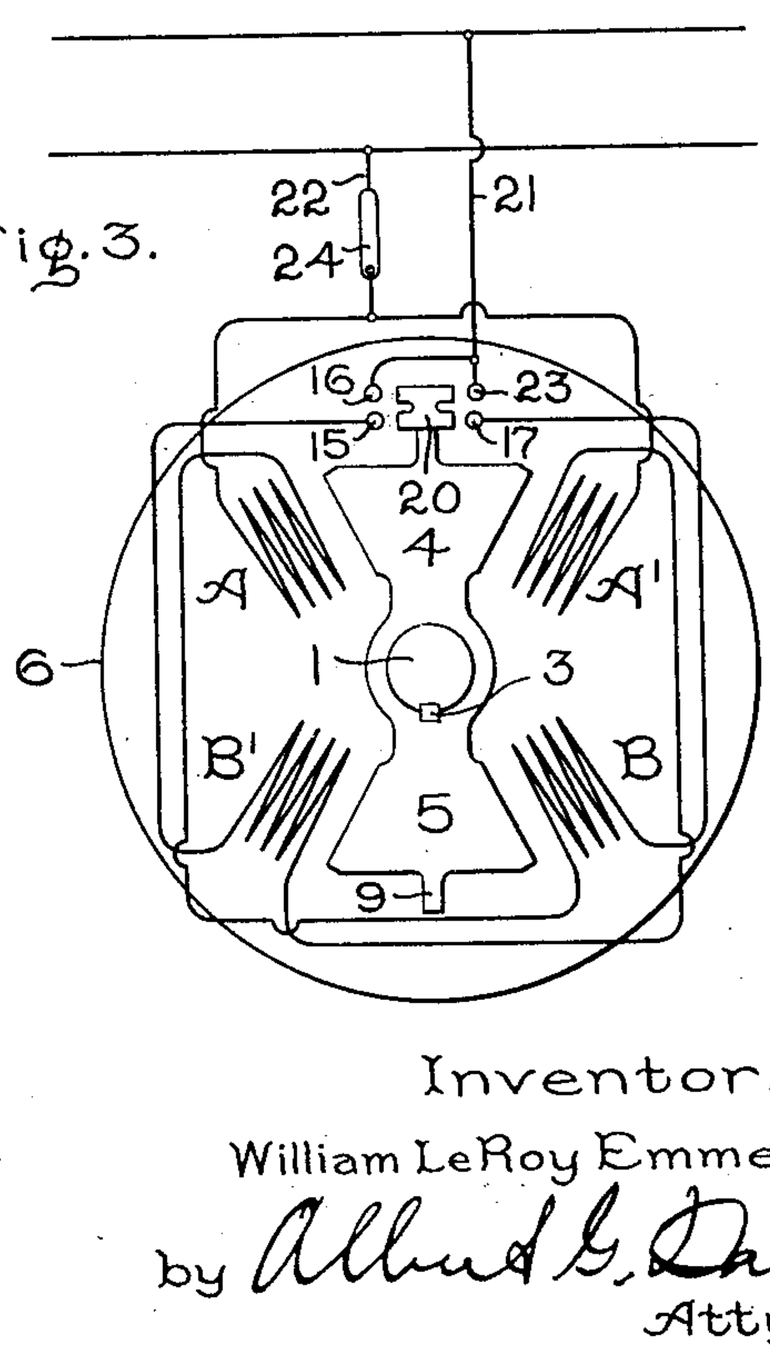


Fig. 3.



Witnesses.

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UNITED STATES PATENT OFFICE.

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MEANS FOR EQUALIZING THE SPEED OF SHAFTS.

SPECIFICATION forming part of Letters Patent No. 671,270, dated April 2, 1901.

Application filed January 9, 1900. Serial No. 884. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM L. R. EMMET, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Means for Equalizing the Speed of Shafts, (Case No. 1,256,) of which the following is a specification.

In the practical operation of synchronous motors and rotary converters it frequently happens that the speed of rotation varies or fluctuates periodically and with a period which from experience has been found to depend both upon the construction of the machine and upon the conditions of operation. This phenomenon is commonly known to engineers as "hunting" and is obviously very objectionable.

The details of my invention, which aims to obviate these difficulties, as well as its mode of operation, will be better understood by reference to the following description, taken in connection with the accompanying drawings, in which—

Figure 1 represents an application of my invention to a dynamo-electric machine. Fig. 2 is an enlarged sectional view of the device, while Fig. 3 is a diagram of circuits.

Referring to Figs. 1 and 2, I have indicated at 1 the shaft of a rotary converter or synchronous motor to which my invention is to be applied, since it is in connection with these machines that I have found my invention to be of particular value; but it will of course be evident that application of the invention may be made to shafts of any other nature in which a necessity for speed equalization exists. A sleeve 2 is secured to the shaft by means of a key 3 or any other suitable mode of connection. This sleeve carries two oppositely-projecting arms 4 and 5. A fly-wheel 6 is mounted so as to be rotatable upon the sleeve 2, means being provided, however, for preventing longitudinal motion of the same upon the sleeve. The means which I have here shown consists of a ring 7, secured to the sleeve 2 after the fly-wheel has been put in place and with its outer edge projecting outwardly from the sleeve 2, so as to engage and prevent a longitudinal displacement of the fly-wheel. The opposite end of the hub of the fly-wheel bears against a ring 8, mounted upon the sleeve 2. The fly-wheel is thus confined between the two rings 7 and 8, but is allowed a movement of rotation about the sleeve 2. This rotation is, however, restrained by means of springs connected to the fly-wheel and to one of the arms carried by the sleeve 2. In the particular construction shown the arm 5 is provided with a projecting ear 9, to which one end of each of two springs S S′ is attached, the other ends being secured to the fly-wheel 6, as shown at 11 and 12.

Two pairs of electromagnets A B and A′ B′ are adjustably secured to the fly-wheel 6, each magnet being located in proximity to one of the arms 4 5, so as to allow the arms to act as armatures to the magnets. Thus the magnet A is located in close proximity to the arm 4, while the magnet B is located in operative relation to the arm 5, but on the side opposite from that of the magnet A. The magnets A′ B′ are similarly located, but act upon the arms 4 5 in a direction opposite to that of the other pair of magnets. The magnets A′ and B′ are arranged in series, with one terminal connected to one of the collector-rings 13 14, carried by the fly-wheel 6, while the other is connected to a fixed contact 15, carried on the inner side of the rim of the fly-wheel. Another contact 16 is located beside the contact 15, but separated therefrom by insulation, and is connected with the other collector-ring. The magnets A B are likewise in series with each other, with one of the terminals connected to one of the collector-rings and the other to a fixed contact 17, which, as in the first instance, is separated by an insulating-partition from a coöperating contact connected with the other collecting-ring. These two sets of contacts are shown in end view in Fig. 1, the sets being separated from each other by a block of insulating material 18, flush with the surfaces of the contacts.

A bridging contact 20 is carried by an ear formed on the arm 4. Normally when no tension is exerted on the springs S and S′ the bridging contact rests upon the block of insulating material 18. As soon, however, as any relative motion takes place between the

fly-wheel 6 and the arm 4 the contact 20 moves off of the insulating material and onto one of the sets of contacts located on either side thereof, thus connecting the contacts of that set together. An opposite relative movement between the fly-wheel and the arm 4 causes the other set of contacts to be connected together.

Fig. 3 shows diagrammatically the connections made by the bridging contact 20. For example, when the contact 20 connects the contacts 15 and 16 the circuit is made from the supply-wire 21 through the magnet B′ and then through the magnet A′ to the other supply-wire 22. In a similar manner when the contact 17 is connected with its coöperating contact 23 the supply-wire 21 is connected through the magnet B and then through the magnet A to the supply-wire 22. When one set of connections is made, it is evident that the pull exerted by one of the sets of electromagnets tends to move the arms 4 and 5 in one direction relatively to the fly-wheel, while when the other set of connections is made a tendency to an opposite relative movement is produced.

The effectiveness of the invention is dependent upon the inertia of the fly-wheel 6. Thus, for example, let it be supposed that the shaft 1 of the rotary converter or other machine receives an impulse forward in a direction indicated by the arrow in Fig. 1. Owing to the inertia of the fly-wheel 6 the arms 4 and 5 rotate forward and stretch the spring S, at the same time moving the bridging contact 20 into operative relation with the contacts 15 and 16, thus closing the circuit of the magnets A′ B′, which being energized act in conjunction with the spring S, tending to restore the arms 4 5 and the fly-wheel 6 to their normal relative position. The pull thus exerted upon the arms 4 5 thus checks the forward impulse of the shaft 1 and tends to bring it back to its normal speed. If the shaft be momentarily retarded in speed, a similar mode of action takes place between the magnets A B and the arms 4 5, as will readily be understood. The fly-wheel 6 and springs connecting the same to the arm 5 should be selected so as to give the fly-wheel a natural period of oscillation about the shaft different from the period of oscillation which the shaft possesses by virtue of the tendency to "hunt."

In starting up the shaft to which my speed-equalizing device is attached I prefer to open the circuit used for energizing the electromagnets, and thus prevent the latter from being thrown into action. For this purpose a switch 24 may be employed.

While the employment of electromagnetic means such as described possesses advantages for carrying out my invention, its use is not a necessity, since the objects of my invention may be attained by the operation of means entirely mechanical. In this latter mode of operation the hunting of the shaft is prevented by impulsively transferring energy between the shaft and a fly-wheel carried thereby, this transfer of energy taking place through impacts between parts carried by the shaft and fly-wheel, respectively. Thus in Fig. 1 let it be supposed that the supply of energy to the electromagnets therein shown be withdrawn. If under these conditions the shaft 1 commences to hunt, it will be moved backward or forward against the tension of the centering-springs S S′, and the arms 4 5, carried by the shaft, will impinge upon the cores of the magnets A B and A′ B′, the cores in this instance serving the purely mechanical function of stops. The resultant impacts oppose the hunting of the shaft 1, provided the period of vibration of the fly-wheel 6 is different from that of the period of hunting. This relation between the periods of oscillation of the shaft and fly-wheel may be readily secured in practice, thereby causing the fly-wheel to act, in the manner described, as a speed-equalizer for the shaft by which it is carried.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination with a shaft of a dynamo-electric machine, of a fly-wheel loosely mounted on the shaft, a spring connecting the shaft and the fly-wheel, and electromagnetically-actuated means for resisting any relative movement between the shaft and the fly-wheel.

2. The combination of a shaft, a fly-wheel loosely mounted on the shaft and electromagnetically-actuated means for opposing any relative movement betweeen the shaft and the fly-wheel.

3. The combination of a shaft, a fly-wheel loosely mounted on the shaft and carrying an electromagnet, and an armature fixed to the shaft and in operative relation to said electromagnet.

4. The combination of a shaft, a fly-wheel loosely mounted on the shaft but spring-connected thereto, an armature fixed to the shaft and an electromagnet carried by the fly-wheel and in operative relation to said armature.

5. The combination of a shaft, a fly-wheel loosely mounted on the shaft but spring-connected thereto and an electromagnet for opposing a relative movement between the shaft and the fly-wheel.

6. The combination of a shaft, a fly-wheel loosely mounted on the shaft, an elastic connection between the fly-wheel and shaft, an electromagnet for opposing a relative movement between the fly-wheel and shaft, and means for energizing said electromagnet when such relative movement takes place.

7. The combination of a shaft, a fly-wheel loosely mounted on the shaft, an elastic connection between the fly-wheel and shaft, two electromagnets one of which acts to oppose a relative motion between the fly-wheel and shaft in one direction and the other electromagnet a relative motion in the opposite direction, and means for non-simultaneously energizing said electromagnets.

8. The combination of a shaft, a fly-wheel loosely mounted on the shaft, and means for exchanging kinetic energy between the fly-wheel and shaft by impact between parts carried respectively by the fly-wheel and shaft, the parts between which the impact takes place being normally held out of contact.

9. The combination with the shaft of a dynamo-electric machine of a fly-wheel loosely mounted on the shaft, and means operating by impact for transferring kinetic energy between the shaft and the fly-wheel when the shaft tends either to advance from or fall behind a position corresponding to uniform rotation.

In witness whereof I have hereunto set my hand this 8th day of January, 1900.

WILLIAM L. R. EMMET.

Witnesses:
BENJAMIN B. HULL,
MABEL E. JACOBSON.