March 16, 1948. A. E. ADAMS ET AL 2,437,904

ALTERNATING CURRENT OR LIKE MOTOR WITH GYRATORY ARMATURE

Filed April 24, 1946

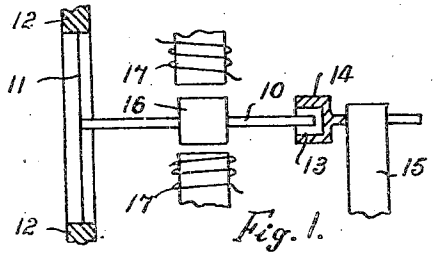


Fig. 1.

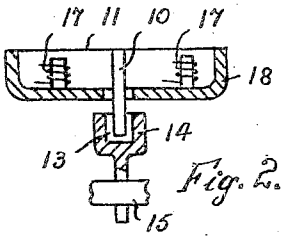


Fig. 2.

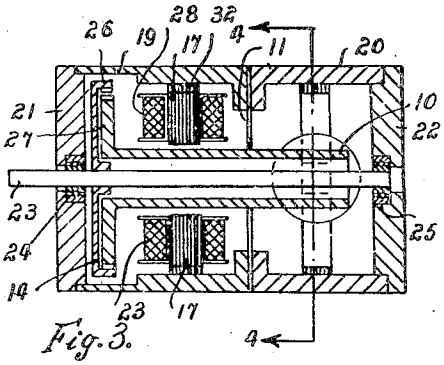


Fig. 3.

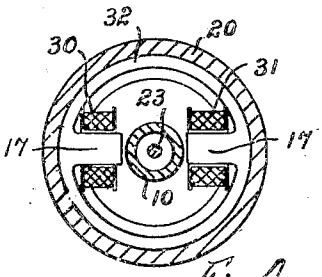


Fig. 4.

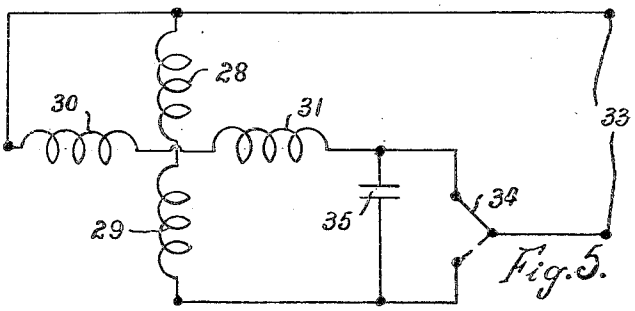


Fig. 5.

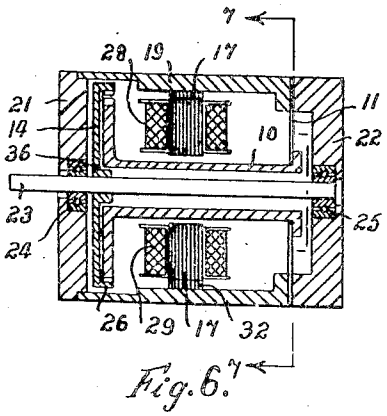


Fig. 6.

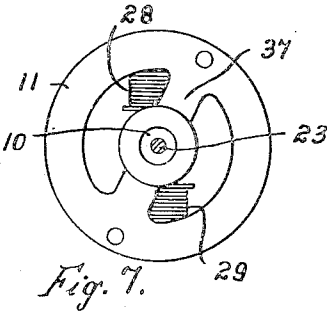


Fig. 7.

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By [signature] their ATTY.

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ALTERNATING CURRENT OR LIKE MOTOR WITH GYRATORY ARMATURE

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11 Claims. (Cl. 172—278)

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The present invention relates to dynamo-electric devices and particularly to small electric motors adapted to operate from alternating or pulsating current.

The present invention has amongst its objects to provide a small motor having relatively high efficiency and a high torque for a given size. A further object is to provide a motor adapted to run synchronously from an alternating or pulsating supply in which relatively low speeds of rotation can be obtained without the need for parts rotating in bearings at relatively high speeds.

According to the present invention a dynamo-electric device comprises a first member mounted for gyratory motion, a second member mounted for rotation relatively to said first member and in rolling engagement with said first member and electromagnetic means for imparting gyratory motion to said first member to produce relative rotation between said first and second members.

In a preferred form of the present invention, the said first member is mounted for gyratory motion in a conical path but is prevented from rotation, the said second member is mounted for rotation and is in frictional or toothed engagement with a part of the said first member which moves in a circular path. The point on the said first member which lies at the apex of the cone is preferably mounted upon a flexible support which permits limited gyration but prevents rotation.

The invention will be described by way of example with reference to the accompanying drawing in which

Figs. 1 and 2 show diagrammatically and in part sectional elevation two embodiments of the invention,

Fig. 3 is a view in sectional elevation of a preferred embodiment of the invention,

Fig. 4 is a view in section on the line 4—4 of Fig. 3,

Fig. 5 shows a wiring diagram for the coils of Figs. 3 and 4,

Fig. 6 is a view in sectional elevation of a further preferred embodiment of the invention, and

Fig. 7 is a view in section along the line 6—6 in Fig. 5, that is to say an end view of the device with the right hand end portion removed.

Like parts in the several figures are given the same references.

Referring to Fig. 1, a first member constituted by a cylindrical rod 10 is fixed at one end to the centre of a diaphragm 11 and projects perpendicularly therefrom. The edge of the diaphragm is fixed to a support 12. The external surface at the free end of the rod 10 rests upon a corresponding internal surface within a cylindrical recess 13 in a member 14 mounted for rotation in a bearing in a support 15. The diameter of the recess 13 is greater than that of the rod 10. Intermediate the ends of the rod is fixed an armature 16 co-operating with an electromagnet system 17 adapted to produce, when fed with alternating or pulsating current, a magnetic field which rotates about the armature. The armature may be provided with polarising windings or it may be a permanent magnet.

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When the rotating magnetic field is set up, the armature 16 is caused to move in a circular path limited by the engagement of the rod 10 in the recess 13. The rod 10 thus moves in a conical path, the diaphragm 11 being at the apex of the cone and preventing rotation of the rod about its axis. This gyratory motion of the rod 10 causes the rotatably mounted member to rotate owing to friction between the rod and the cylindrical wall of the recess 13. The gear ratio between the rotation of the rotatable member and the gyrations of the rod will thus be equal to

$$\frac{D-d}{D}$$

where D and d are the diameters of the recess 13 and the rod 10 respectively. The free end of the rod may be provided with teeth engaging internal teeth on the rotatably mounted member.

In the embodiment shown in Fig. 2 a diaphragm 11 of magnetic material is fixedly mounted above a number of pole pieces 17 provided with energising coils. The diaphragm 11 is supported by a cup-shaped member 18 of magnetic material which acts as a yoke for the pole pieces 17. There may for example be four pole pieces and coils and suitable air gaps are provided between the diaphragm 11 and the pole pieces 17. A rod 10 is fixed to the centre of the diaphragm 11 and projects perpendicularly therefrom, downwards between the pole pieces 17. Its free end engages loosely in a cylindrical recess 13 in a member 14 mounted for rotation in a bearing in a support 15 relatively to the pole pieces and diaphragm.

The energising coils are so connected to a source of alternating or pulsating current that they reach their maxima in succession so that a ripple is caused to pass around the diaphragm thus causing the rod 10 to move in a conical path

and drive the rotatable member 14 as in the first example.

Referring to Figs. 3 and 4, a casing comprises two cylindrical portions 19 and 20 having between them the edge of a diaphragm 11, and two end plates 21 and 22 in which a shaft 23 is mounted in ball bearings 24 and 25. The casing is held together and clamps the diaphragm 10 in position by suitable means not shown. On the shaft 23 is fixed a rotatable member 14 having a backwardly turned flange 26. Fixed through the centre of the diaphragm 11 is a gyratory member 10, in this case in the form of a tube of suitable magnetic material, permanently magnetised to north polarity at one end and south polarity at the other end. At one end of the member 10 is a flange 27 of diameter slightly less than that of the inside of the flange 26. On each side of the diaphragm 11 is provided a pair of laminated pole pieces 17 having windings 28 and 29 and 30 and 31 respectively. Each pair of diametrically opposite pole pieces has a laminated annular yoke 32. The windings may be connected as shown in Fig. 5 to terminals 33 for connection to a single phase alternating current supply. A switch 34 and condenser 35 are provided whereby in one setting of the switch shown in full lines the windings 30 and 31 are placed directly across the terminals 33 and the windings 28 and 29 are in series with the condenser 35 across these terminals, whilst in the dotted setting of the switch 34 the condenser 35 is in series with the windings 30 and 31 and the windings 28 and 29 are connected directly across the terminals 33. In both settings of the switch 34 the current in the two pairs of windings are phase displaced by approximately 90° relatively to one another and by operating the switch the direction of gyration of the member 10 and hence that of rotation of the shaft 23 can be changed.

Owing to the relatively large diameters D and *d* of the contacting surfaces of the members 26 and 27 compared with the difference between their diameters, the ratio between the speed of gyration of the member 10 and the speed of rotation of the shaft 23 is high. Where it is desired that the gear ratio should be exactly maintained, teeth are provided upon the engaging surfaces of the members 26 and 27. In order to prevent excessively deep meshing of the teeth and nevertheless to limit the radius of gyratory movement of the member 10, the member 14 may be provided with a boss 36 engaging in the hollow end of the member 10 with sufficient play to provide the desired radius of rotation. Alternatively, in order to reduce frictional losses, the flange 26 of the member 14 may be provided with a rolling surface of radius equal to that of the pitch circle of the teeth and the member 27 may be provided with a corresponding surface adapted to roll on the first named surface, the difference in radii of these surfaces being such as to give the desired radius of gyratory motion.

In order to avoid the need for phase-splitting, as shown in Fig. 5, and to simplify the construction, the arrangement shown in Figs. 6 and 7 may be used. Only one pair of windings 28 and 29 is used and the diaphragm 11 is cut away as shown in Fig. 7 to form a diametral bridge portion 37 which is inclined relatively to the axis of the windings 28 and 29. These windings when energised by single phase alternating current serve to impart to the member 10 alternating force in the direction of their axis. The shape of the diaphragm 11 is such as to convert the resulting motion of the member 10 to a gyratory one in an approximately conical path.

We claim:

1. A dynamo-electric device comprising a first member mounted upon a flexible support which permits gyration but prevents rotation of said first member relatively thereto, a second member mounted for rotation relatively to said first member and in rolling engagement with a part of said first member which moves in a circular path, and electromagnetic means for imparting gyratory motion to said first member to produce relative rotation between said first and second members.

2. A dynamo-electric device comprising a first member mounted upon a flexible support which permits gyration but prevents rotation of said first member relatively thereto, a first frictional driving surface in the form of a surface of revolution on said first member, a second member mounted for rotation relatively to said first member and having a second frictional driving surface in rolling engagement with said first frictional driving surface, and electromagnetic means for imparting gyratory motion to said first member to produce relative rotation between said first and second members.

3. A dynamo-electric device comprising a first member mounted upon a flexible support which permits gyration but prevents rotation of said first member relatively thereto, an external frictional driving surface in the form of a surface of revolution on said first member, a second member mounted for rotation relatively to said first member and having an internal frictional driving surface in rolling engagement with said external frictional driving surface, and electromagnetic means for imparting gyratory motion to said first member to produce relative rotation between said first and second members.

4. A dynamo-electric device comprising a first member mounted upon a flexible support which permits gyration but prevents rotation of said first member relatively thereto, a toothed portion on said first member, a second member mounted for rotation relatively to said first member and having a toothed portion in rolling engagement with the toothed portion of said first member, and electromagnetic means for imparting gyratory motion to said first member to produce relative rotation between said first and second members.

5. A dynamo-electric device comprising a frame, a diaphragm having its periphery fixed to said frame, a first member fixed to substantially the centre of said diaphragm whereby said first member is free to gyrate in a conical path but prevented from rotation relatively to said frame, a second member mounted on said frame for rotation relatively thereto and having a surface which is in rolling engagement with said first member, and electromagnetic means for imparting gyratory motion to said first member to produce relative rotation between said first and second members.

6. A dynamo-electric machine according to claim 5, wherein said electromagnetic means are arranged to apply pulsating force to said first member in a direction substantially perpendicular to the axis of said gyration and wherein said diaphragm is so constituted as to cause said first member to move in a substantially conical path in response to said pulsating force.

7. A dynamo-electric device comprising a first member mounted for gyratory motion, a second member mounted for rotation relatively to said

first member and in rolling engagement with said first member and electromagnetic means for imparting gyratory motion to said first member to produce relative rotation between said first and second members, characterised in that said electromagnetic means comprise a magnetic circuit of magnetic material constituted in part by said first member, a winding upon a part of said magnetic circuit for generating a pulsating magnetic flux in said magnetic circuit, and means for generating a unidirectional magnetic flux in said magnetic circuit including said part.

8. A dynamo-electric device comprising a first member mounted for gyratory motion, a second member mounted for rotation relatively to said first member and in rolling engagement with said first member and electromagnetic means for imparting gyratory motion to said first member to produce relative rotation between said first and second members, characterised in that said electromagnetic means comprise a magnetic circuit of magnetic material constituted in part by said first member, means for generating a unidirectional magnetic flux in said magnetic circuit and a winding for generating a pulsating magnetic flux in said magnetic circuit and positioned to be traversed by at least a substantial part of said unidirectional flux.

9. A dynamo-electric device comprising a first member mounted for gyratory motion, a second member mounted for rotation relatively to said first member and in rolling engagement with said first member and electromagnetic means for imparting gyratory motion to said first member to produce relative rotation between said first and second members, characterised in that said electromagnetic means comprise a magnetic circuit of magnetic material constituted in part by said first member, a permanent magnet for generating a unidirectional magnetic flux in said magnetic circuit and a winding for generating a pulsating magnetic flux in said magnetic circuit and positioned to be traversed by at least a substantial part of said unidirectional flux.

10. A dynamo-electric device according to claim 9, wherein said first member constitutes said permanent magnet.

11. A dynamo-electric device comprising a first member mounted for gyratory motion, a second member mounted for rotation relatively to said first member and in rolling engagement with said first member and electromagnetic means for imparting gyratory motion to said first member to produce relative rotation between said first and second members, said electromagnetic means comprising a yoke of magnetic material at least partly surrounding said first member, a plurality of pole pieces of magnetic material projecting inwardly from said yoke towards said first member, a winding upon at least one of said pole pieces for generating a pulsating magnetic field in said yoke and pole pieces and a permanent magnet for causing unidirectional magnetic flux to traverse, in series, said first member, said pole pieces and said yoke.

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