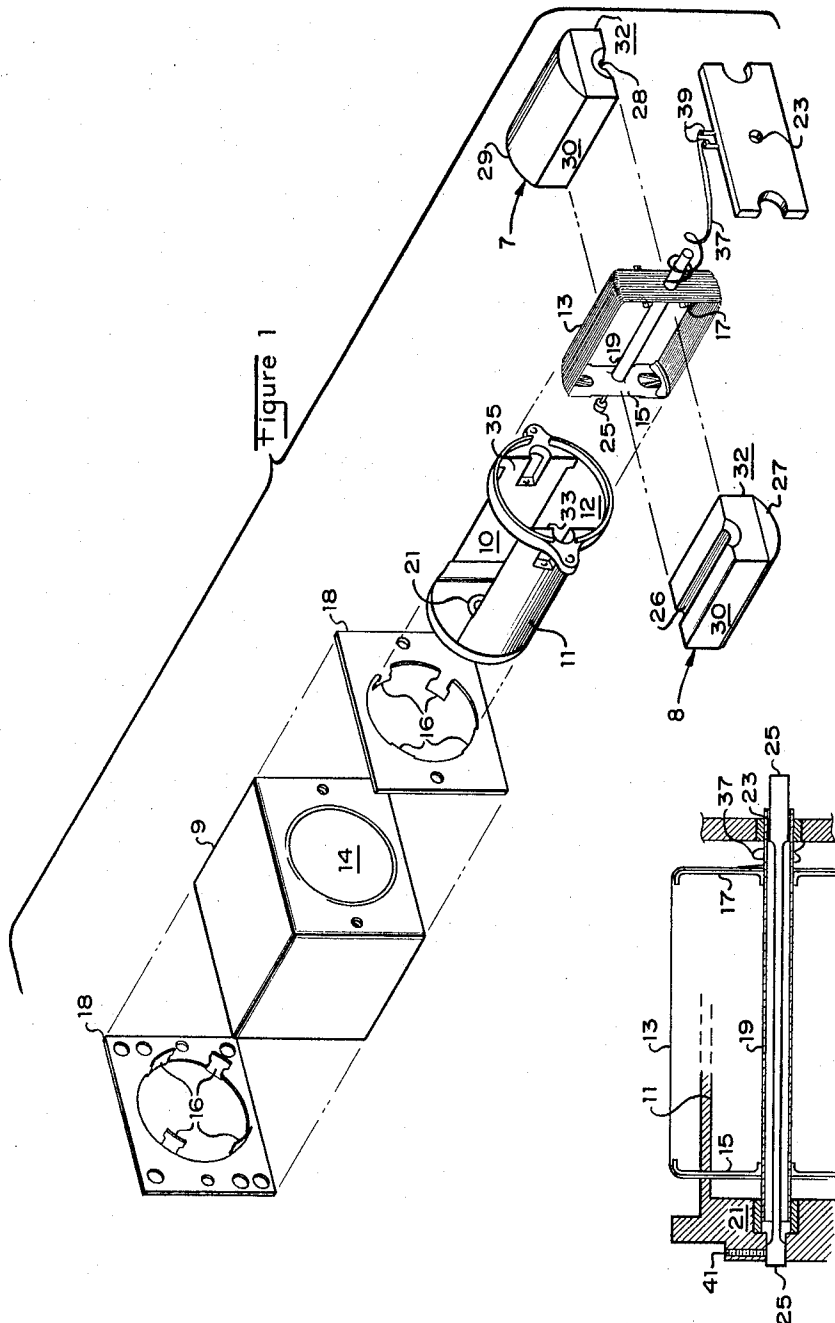


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ELECTROMECHANICAL TRANSDUCER HAVING A
TORSIONALLY MOUNTED ARMATURE
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ELECTROMECHANICAL TRANSDUCER HAVING A TORSIONALLY MOUNTED ARMATURE

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This invention relates to fractional-turn torque motors.

It is an object of the present invention to provide an electromechanical transducer which provides an angular shaft position that is related to the amplitude of an applied signal.

It is another object of the present invention to provide apparatus for rotatably supporting and axially positioning the rotatable armature of a torque motor.

In accordance with the illustrated embodiment of the present invention, an armature including an electromagnet is formed on supports attached to a shaft which is rotatably supported. An axially rigid torsion spring is disposed within a hollow portion of the shaft with one end of the spring attached to the shaft and the other end of the spring protruding beyond an end of the shaft. The protruding end of the spring is rigidly fixed in position so that the armature is resiliently biased for angular rotation and is held in fixed axial position by the axially rigid torsion spring. A radial flux field is produced in the region through which the conductors of the electromagnet rotate by a permanent magnet including two sections positioned between the shaft and the conductors of the electromagnet and by an outer case of magnetic material positioned about the armature.

Other and incidental objects of the present invention will be apparent from a reading of this specification and an inspection of the accompanying drawing in which:

FIGURE 1 shows a pictorial diagram of the torque motor of the present invention, and

FIGURE 2 shows a sectional view of the shaft and bearing detail.

Referring now to FIGURE 1, there is shown an outer case 9 of low reluctance material such as soft iron which supports the inner shell 11. This case 9 provides a return path for magnetic flux between the pole regions 10 and 12 and also provides shielding against the interaction of leakage flux between adjacent units. The shell 11 is positioned concentrically within the cavity 14 of case 9 by the protrusions 16 on the end spacers 18. The edges of protrusions 16 also lock the two permanent magnets 7 and 8 in concentric position. The armature includes a number of turns of wire 13 wound about upper and lower coil forms 15, 17 attached to the hollow rigid shaft 19 which is rotatably supported in the bearing 21, 23 carried by the inner shell 11. A longitudinally rigid, rotationally resilient torsion bar 25 within the hollow shaft 19 has one end attached to the shaft and has another end which protrudes from the shaft and which is clamped in the rear bearing 21, as shown in FIGURE 2. The two permanent magnets 7 and 8, each having a cylindrical section pole piece 27 and 29, respectively, on one surface and a groove 26, 28 in the opposite surface, are positioned about the shaft 19 between it and the turns of wire 13. The magnet is formed from two sections 7, 8 to facilitate construction and winding of the armature separately. The completed armature can then be positioned about the magnet pieces 27, 29 (by first orienting the armature one quarter turn from the position shown) with the armature shaft 19 located within the aperture formed by the grooves 26 and 28. The armature and magnet assembly may then be inserted within the shell 11 with the flat portions 30, 32 of the magnet pieces contiguous with the flat inner walls 33, 35 of the shell

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11. The front bearing 23 is attached to the shell 11 and the entire assembly may be inserted in the case 9. The ends of the wire 13 forming the electromagnet are brought out through flexible leads 37 to terminals 39 on the upper bearing support.

The sectional view of the rear bearing 21 is shown in FIGURE 2. The shaft 19 is freely rotatable in the upper part of bearing 21. Axial and normal rotational positions of the armature are adjusted and held in place by clamping the lower end of the torsion bar 25 with a set screw 41 in the lower part of bearing 21. This obviates the need for axially adjustable bearings to take up end play in the armature shaft.

This assembly process must be carried out before the magnet pieces 27, 29 are magnetized because the magnet and armature within the shell 11 must be inserted as a unit into the case 9 with only small clearances between the turns of wire 13, the magnet pieces 27, 29 and the case 9. This feature prevents undetectable tampering with the device for if once disassembled after being magnetized, the magnet and armature cannot readily be reassembled into the case 9 with the small clearances provided without causing considerable abrasion of the wire 13 and magnet pole surfaces.

I claim:

1. In an electromechanical transducer:

an armature which is rotatable about a longitudinal axis and which includes an electrical conductor having a portion thereof disposed away from said axis and parallel therewith;

rigid hollow shaft means disposed along said axis, said armature being attached thereto and supported thereby;

a torsionally resilient and axially rigid bar means coaxially disposed within said hollow shaft means and attached at one end thereof to said shaft means;

at least one bearing disposed about said shaft means for rotatably supporting said shaft means and hence said armature about said axis; and

means securing said bar means rigidly at a point along the length thereof, whereby rotation of said armature about said axis twists only said bar about said axis.

2. The transducer as set forth in claim 1 which also includes a pair of permanent magnets fixedly disposed between said conductor and said shaft means on opposite sides thereof.

3. In an electromechanical transducer:

an armature which is rotatable about a longitudinal axis and which includes an electrical conductor having a portion thereof disposed away from said axis and parallel therewith;

a rigid shaft disposed along said axis and having said armature attached thereto, at least a terminal portion of said shaft being hollow;

means fixedly attached to said shaft for supporting said conductor in fixed positional relationship with respect to said shaft;

a torsionally resilient and axially rigid member coaxially disposed within the hollow portion of said shaft with one end of the member extending beyond the shaft;

means attaching the other end of said member to said shaft;

at least one bearing disposed about said shaft for rotatably supporting said shaft; and

means rigidly securing said one end of said member against rotational and axial movement.

4. In an electromechanical transducer:

an armature which is rotatable about a longitudinal axis and which includes an electrical conductor hav-

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ing portions thereof disposed away from said axis on opposite sides thereof and parallel therewith;
a rigid shaft disposed along said axis and having said armature attached thereto, at least a terminal portion of said shaft being hollow;
means fixedly attached to said shaft for supporting said conductor in fixed positional relationship with respect to said shaft;
a source of magnetic flux disposed between said shaft and said conductor and having cylindrical section pole faces disposed near said portions of the conductor;
a torsionally resilient and axially rigid member coaxially disposed within the hollow portion of said shaft with one end of the member extending beyond the shaft;
means attaching the other end of said member to said shaft;
at least one bearing disposed about said shaft for rotatably supporting said shaft; and

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means rigidly securing said one end of said member against rotational and axial movement.
5. Apparatus as in claim 4 wherein said source of flux comprises:
a pair of permanent magnets having mating faces remote from said cylindrical section pole faces; and a groove in at least one of said mating faces for receiving said shaft therein when the magnets are engaged along said mating faces.

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