

CYLINDRICAL MOTOR

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention concerns a small-sized cylindrical motor which is incorporated in a portable communication device, for example, a movable telephone, personal handyphone system (PHS), pocket bell (trade mark of NTT Inc.), vibration-transmission type pager, and a signal receiver for blind persons and which is used, for example, as a vibration generator for causing cenesthetic vibrations as soundless reception informing signals.

Prior Art Statement

A cylindrical motor of the above-mentioned type is generally adapted to generate rotational vibrations by attaching an eccentric cam-type weight made of a metal having large specific gravity such as tungsten to a rotational shaft of a motor. Commutator segments are disposed in parallel with the axial direction of the rotational shaft, and brushes in sliding contact with the commutator segments are disposed in perpendicular to the axial direction of the rotational shaft.

As shown in a perspective view of Fig. 6 and a cross sectional view of Fig. 7, a cylindrical motor of the prior art comprises, as a whole, a stator

portion 1, a rotor portion 2 and a brush portion 3.

In the rotor portion 2, a hub 6 is attached to one end of the rotational shaft 4 of the motor for securing one end of cylindrical windings 5 disposed coaxially to the periphery of the rotational shaft 4.

The hub 6 has a columnar portion 6a protruded axially of the rotational shaft 4. Three or five commutator segments 7 are disposed by the number corresponding to the number of poles of the motor to the circumferential surface of the columnar portion 6a, in parallel with the axial direction of the rotational shaft 4 and arranged and bonded in a state each at an equal pitch along the rotating direction of the rotational shaft 4.

Since the commutator segments 7 have to be arranged so as to form a round circle along the circumferential surface of the columnar portion 6a and, further, have to be smoothed at the surface state, the segment is fabricated into an arcuate shape of a predetermined radius of curvature in an intimate contact with the circumferential surface of the cylindrical columnar portion 6a and curved smoothly at the surface.

Further, although not illustrated, a wiring lead led out of one end of the cylindrical windings 5 is connected to each of the commutator segments 7, for example, by means of soldering.

Then, the stator portion 1 comprises a housing 8 having an outer cylindrical portion constituting an outer shell of the motor and an inner cylindrical portion constituting a bearing 11 for the rotational shaft 4 which are integrally extrusion molded; a pair of front and rear metal bearings 9 and 10 press-fitted to both ends of the bearing 11 for rotatably pivoting the rotational shaft 4; and a magnet 12 secured to the outer circumferential surface of the bearing 11 while being kept at a predetermined gap to the inner circumferential surface of the cylindrical windings 5 of the rotator portion 2. The magnet 12 is magnetized such that magnetic poles are generated within a plane in perpendicular to the axial direction of the rotational shaft 4.

Then, in the brush portion 3, a brush base 13 is fitted to the outer cylindrical portion of the housing 8 of the stator portion 1, and a pair of right and left brushes 14 are attached to the brush base 13 such that they are on both right and left sides of the commutator segment 7 of the rotator portion 2 and brought into sliding contact with the commutator segment 7 in the direction perpendicular to the axial direction of the rotational shaft 4. A pair of lead wires 15 and 16 are attached as power feed lines for the brushes 14 respectively.

When the brush base 13 is tightly fitted to the

outer cylindrical portion of the housing 8, since it is necessary to enlarge the space between the brushes 14 for putting the commutator segment 7 between them by using a jig, the brush base 13 is perforated with an aperture for inserting the jig and an end cap 17 is disposed for closing the aperture.

The motor is assembled completely when the brush base 13 is tightly fitted to the outer cylindrical portion of the housing 8, by properly aligning a relative angle of the direction of the magnetic pole of the magnet 12 and the brush 14 in the stator portion 1.

Further, a vibration generation device is completed by securing a weight 18 to the other end of the rotational shaft 4 protruding from the housing 8 of the motor by means of caulking or adhesives.

By the way, as sales competition has become more and more violent for movable telephones or pocket bells popularized remarkably in recent years, manufactures have made effort furiously to minimize the size and reduce the cost of products.

Therefore, it has been demanded for miniaturization and reduction of cost, also for cylindrical motors to be used as the vibration generation device, by decreasing the number of parts and the number of assembling steps.

However, the existent cylindrical motor has a struc-

ture, as shown in Fig. 7, in which a plurality of commutator segments 7 are disposed to the circumferential surface of the columnar portion 6a of the hub 6 in parallel with the axial direction of the rotational shaft 4, and arranged and fixed along the rotational direction of the shaft 4 so as to form a round circle, and in which the commutator segment 7 is put between the brushes 14 which are disposed in perpendicular to the axial direction of the rotational shaft 4 for providing sliding contact between the brushes 14 and the commutator segment 7. Accordingly, fabrication at a high accuracy is required upon fabrication of the commutator segment 7 for attaining a roundness and, in addition, fabrication of securing the commutator segment 7 to the hub 6 is extremely troublesome.

Further, when the brushes 14 are brought into sliding contact with the commutator segment 7, the space between the brushes 14 has to be enlarged by using a jig and it needs a laborious procedure of closing the aperture in the brush base 13 perforated for using the jig with an end cap 17 after the use of the jig, which hinders the reduction of the cost.

OBJECT OF THE INVENTION

In view of the above, it is a technical object of the present invention to make an improvement for the

arrangement and the structure of commutator segments disposed to a rotor portion of a cylindrical motor, thereby eliminating a trouble of applying fabrication at a high accuracy for attaining the roundness to the commutator segments and capable of facilitating fabrication for securing the commutator segments to the hub and assembling for sliding contact of the brushes with the commutator segment.

SUMMARY OF THE INVENTION

The foregoing object can be attained in accordance with the present invention by a cylindrical motor having a rotator portion comprising,

- a rotational shaft of a motor,

- a hub (6) attached to one end of the rotational shaft (4) for securing one end of cylindrical windings disposed coaxially to the periphery of the rotational shaft,

- an insulating substrate attached over the end face of the hub in perpendicular to the axial direction of the rotational shaft, and

- a plurality of commutator segments formed within a plane of the substrate each at a predetermined pitch along the rotating direction of the rotational shaft, with a winding lead of the cylindrical windings being connected to each of the commutator segments.

According to the present invention, since the commu-

tator segments are formed previously within the plane of the insulating substrate, the commutator segments can be secured to the end face of the hub by a simple fabrication of merely attaching the substrate over the end face of the hub.

Further, it is not necessary that the brushes to be in sliding contact with the commutator segment are disposed so as to put the commutator segment between them as done in the prior art but it is only necessary that the brushes are disposed so as to urge the surface of the substrate on which the commutator segments are formed. Therefore, this facilitates the assembling operation for sliding contact of the brushes with the commutator segment and makes it unnecessary at all for fabrication at high accuracy for providing the roundness to the commutator segment.

BRIEF DESCRIPTION OF THE INVENTION

A preferred embodiment of the present invention will be explained specifically with reference to the drawings; wherein

Fig. 1 is a cross sectional view illustrating a preferred embodiment of a cylindrical motor according to the present invention;

Fig. 2 is a cross sectional view for a rotor portion of the cylindrical motor shown in Fig. 1;

Fig. 3 is a right side elevational view for the rotor portion of the cylindrical motor shown in Fig. 1;

Fig. 4 is a left side elevational view for the rotor portion of the cylindrical motor shown in Fig. 1;

Fig. 5 is a right side elevational view for a brush portion of the cylindrical motor shown in Fig. 1;

Fig. 6 is a perspective view illustrating the appearance of the cylindrical motor; and

Fig. 7 is a cross sectional view illustrating a cylindrical motor of the prior art.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 is a cross sectional view illustrating an preferred embodiment of a cylindrical motor according to the present invention, Fig. 2 and Fig. 3 are a cross sectional view and a right side elevational view of a rotor portion, Fig. 4 and Fig. 5 are a left side elevational view and a right side elevational view of a brush base that constitutes a brush portion.

In Fig. 1 to Fig. 7, components and parts corresponding to those in Fig. 6 and Fig. 7 carry the reference numerals.

In a cylindrical motor shown in Fig. 1, the constitution of a stator portion 1 is identical with the existent portion shown in Fig. 6 and Fig. 7.

The motor of this embodiment differs from the prior art motor for the constitution of a rotor portion 2 and a brush portion 3, in that the rotor portion 2 is different mainly in the arrangement and the structure of commutator segments 7, and the brush portion 3 is different mainly in the arrangement and the structure of a brush 14.

The rotator portion 2 according to the present invention is identical with the rotor portion of the prior art in that a hub 6 is attached to one end of a rotational shaft 4 of the motor for securing one end of cylindrical windings 5 disposed coaxially to the periphery of the rotational shaft 4, but has a distinct difference from the rotor portion of the prior art in that an insulating substrate 20 is attached over an end face of the hub 6 in perpendicular to the axial direction of the rotational shaft 4, and a plurality of commutator segments 7 are formed within a plain of the substrate 20 each at a predetermined pitch along a rotating direction of the rotational shaft 4.

The substrate 20 comprises a printed substrate molded from a thermosetting resin and, as shown in Fig. 3, having, three commutator segments 7 arranged each at a pitch of 120 degree and three lands 24 for connecting winding leads 21, 22 and 23 of the cylindrical windings 5, respectively, to the commutator segments 7 formed on the surface of

the substrate 20 as a pattern by photolithography. The substrate 20 has a circular aperture 25 perforated at a central portion corresponding to the axial center of the rotational shaft 4, and has a three-forked shape defined by forming a plurality of notches 26 to a circumferential edge each at a pitch of 120 degree while avoiding portions in which the commutator segments 7 are formed.

The hub 6 having the substrate 20 attached thereto is molded from a thermoplastic resin. The rotational shaft 4 and the substrate 20 are insert-molded during molding, in which the substrate 20 is secured to the end face of the hub 6 by fusion of the thermoplastic resin, and the cylindrical windings 5 and the hub 6 are integrally molded by the thermoplastic resin to improve the dimensional stability of the windings 5.

Further, a portion of the thermoplastic resin for molding the hub 6 intrudes into the aperture 25 perforated to the central portion of the substrate 20 and fused to the inside of the aperture 25, as well as fused also to the periphery of the notches 26 formed at the circumferential edge of the substrate 20 during insert molding, by which the substrate 20 is firmly secured to the end face of the hub 6.

Then, referring to the brush portion 3, a brush base 13 is tightly fitted to the housing 8 of the stator por-

tion 1 and opposed in parallel to the substrate 20 which is attached over the end face of the hub 6. A pair of brushes 14, 14 are protruded on one surface of the brush base 13 each at a pitch of 180 degree in the rotational direction of the commutator segment 7 such that the top ends of the brushes are in sliding contact with the commutator segments 7 formed within the plane of the substrate 20 being disposed in parallel with the surface of the substrate 20. Connection terminals 27, 28 for lead wires 15, 16 are disposed to the other surface of the brush base 13 for feeding electric power to each of the brushes 14.

Each of the brushes 14 is formed by a leaf spring having such a resiliency as causing the top end to be in resilient contact with the surface of the substrate 20.

As shown in Fig. 4, the top end of the brush 14 is bifurcated, and curved arcuately along the rotating direction of the substrate 20.

The cylindrical motor of this embodiment can be assembled such that the commutator segments 7 of the rotor portion 2 and the brushes 14 of the brush portion 3 can be brought into sliding contact by merely mounting the rotator portion 2 to the stator portion 1 and tightly fitting the brush base 13 of the brush portion 3 to the housing 8 of the stator portion 1, so that the number of parts and the number of assembling steps can be reduced

drastically.

Further, since the commutator segments 7 can be previously formed simply to the surface of the substrate 20, for example, by using photolithography and fabrication at high accuracy for attaining the roundness as in the prior art is no more required, the cost of the cylindrical motor can be reduced.

Further, when the substrate 20 comprises a printed substrate on which the commutator segments 7 are formed by the photolithography, the quality of products is made uniform and the rate of occurrence of rejected products is lowered remarkably.

Although the substrate 20 attached over the end face of the hub 6 is secured by means of fusion in this embodiment, the present invention is not restricted only thereto but the substrate may be secured by adhesives.

The present invention provides excellent advantageous effects capable of reducing the number of parts and the number of assembling steps and making it unnecessary for fabrication at high accuracy that needs increased cost thereby enabling to remarkably reduce the cost for the small-sized cylindrical motor, , as well as contributing to the reduction of commercial price, for example, of movable telephones or pocket bells using the motor as a vibration generation device information for signal recep-

tion information.



1. A cylindrical motor having a rotor portion comprising,
 - a rotational shaft (4) of a motor,
 - a hub (6) attached over one end of the rotational shaft (4) for securing one end of cylindrical windings (5) disposed coaxially to the periphery of the rotational shaft (4),
 - an insulating substrate (20) attached over the end face of the hub (6) in perpendicular to the axial direction of the rotational shaft (4) and
 - a plurality of commutator segments (7) formed within a plane of the substrate (20) each at a predetermined pitch along the rotating direction of the rotational shaft (4), with winding lead (21, 22, 23) of the cylindrical windings (5) being connected to each of the commutator segments (7).
2. A cylindrical motor as defined in claim 1, wherein the substrate (20) comprises a printed substrate on which the commutator segments (7) and lands (24) for connecting the winding leads to the commutator segments are formed as a pattern.
3. A cylindrical motor as defined in claim 1 or 2,



wherein the hub (6) is molded with a thermoplastic resin, and the substrate (20) is molded with a thermosetting resin, and in which the substrate (20) is attached over the end face of the hub (6) by fusion of the thermoplastic resin.

4. A cylindrical motor as defined in claim 3, wherein the substrate (20) has an aperture (25) perforated to a central portion thereof, and the thermoplastic resin is fused to the inside of the aperture (25).

5. A cylindrical motor as defined in claim 3 or 4, wherein the substrate (20) has a plurality of notches (26) formed each at an approximately equal pitch to the circumferential edge of the substrate (20), and the thermoplastic resin is fused to the periphery of the notches (26).

6. A cylindrical motor as defined in any one of claims 3 to 5, wherein the cylindrical wirings (5) are integrally molded with the hub (6) by the thermoplastic resin for molding the hub (6).

7. A cylindrical motor having a rotor portion (2) comprising,



a hub (6) attached to one end of a rotational shaft (4) of a motor for securing one end of cylindrical windings (5) disposed coaxially to the periphery of the rotational shaft (4),

an insulating substrate (20) attached over the end face of the hub (6) in perpendicular to the axial direction of the rotational shaft (4) and

a plurality of commutator segments (7) formed within a plane of the substrate (20) each at a predetermined pitch along the rotating direction of the rotational shaft (4), with the winding lead (21, 22, 23) of the cylindrical windings (5) being connected to each of the commutator segments (7) and

a brush portion (3) in which the top end portions of plate-shaped brushes (14) disposed in parallel with the surface of the substrate (20) are brought into sliding contact with the commutator segments (7).