

ELECTRIC MOTOR ASSEMBLY

This invention relates to electric motor assemblies.

So-called "miniature" electric motors are commonly employed in motor driven device such as tape recorders, for example. Often such motors comprise a motor proper within a shielding case and a control circuit for controlling motor revolution. Control circuits for such electric motors are being made increasingly compact as a result of miniaturizing of circuit elements by the use of integrated circuits and like techniques and by mounting the control circuit on a printed circuit board. As a result of such miniaturization, a problem arises in how effectively to dissipate heat generated in the integrated circuit.

It has previously been suggested to overcome the heat dissipation problem by installing a printed circuit board incorporating integrated circuits outside the shielding case, or alternatively by employing a metallic board having a high heat dissipating effect as the printed circuit board. Provision of a printed circuit board externally of the shielding case may require that additional space be provided for the motor and related parts. Use of a metallic printed circuit board, on the other hand, may give rise to increased material costs.

The present invention has arisen from our work in seeking to overcome these problems.

In accordance with the present invention, there is provided an electric motor^{assembly} having a motor proper and a printed circuit board, on which a control circuit for controlling the motor is mounted, both installed in a shielding case, and including an elastic member providing a heat conductive path between an integrated circuit heat dissipator in the control circuit and the shielding case so that heat generated

in said integrated circuit is dissipated to said shielding case via said elastic member.

The invention is hereinafter more particularly described by way of example only with reference to the accompanying drawings, in which:-

Fig. 1 is a longitudinal cross-sectional view of a miniature electric motor constructed in accordance with this invention;

Fig. 2(A) is an end elevational view of the motor of Fig. 1 as seen in the direction A-A with the shielding case cover and damper omitted and the side wall of the case in section;

Fig. 2(B) is an enlarged sectional view through the motor of Figs. 1 and 2(A) taken along the line B-B in Fig. 2(A); and

Fig. 3 is a view similar to Fig. 2(B) for an alternative embodiment.

Fig. 1 shows the general construction of one embodiment of miniature motor in accordance with this invention. The motor proper 1 is installed in a shielding case 2 which includes a shielding case cover 2' for closing its open mouth. To make the motor size compact, a printed circuit board 3 incorporating a control circuit comprising capacitors, integrated circuits (ICs) 5, etc. is installed in a space between the motor proper 1 and the shielding case cover 2'. Elastomeric vibration dampers 4 and 4' are used to prevent the motor proper 1 and the printed circuit board 3 from moving within the shielding case 2.

This invention permits the printed circuit board 3 to be installed in the shielding case 2 as shown in Fig. 1, and for the heat in the IC 5 to be effectively dissipated.

In the first embodiment shown in Figs. 2(A) and 2(B), a housing 9 in which an elastic member in the form of a metallic spring 8 is installed is provided by forming a through-hole on the printed circuit board 3 and the vibration damper 4'. The location of the housing 9

corresponds to the location of the heat dissipator 6 of the IC 5. The metallic spring 8 is made of an electrically conductive metal having good heat conductivity. The outside diameter of the metallic spring 8 in its unbiased state is chosen to be larger than the separation P between the shielding case cover 2' and the heat dissipator 6. Consequently, with the metallic spring 8 installed, it makes elastic contact with both the shielding case cover 2' and the heat dissipator 6. It will preferably also make elastic contact with the vibration damper 4'. As a result, the heat generated in the IC 5 is transmitted from the heat dissipator 6 to the shielding case cover 2' and further to the shielding case 2 proper via the metallic spring 8, and thus effectively dissipated by the shielding case cover 2' and the shielding case 2 proper, both having larger heat dissipating areas. The metallic spring 8 not only plays a role in heat conduction but also serves as a grounding means because of its electrical conductivity. Where there is a particular need to electrically insulate the metallic spring 8 and the shielding case cover 2', an electrically insulating sheet, such as a plastic sheet, may be interposed between the metallic spring 8 and the shielding case cover 2'.

The second embodiment of this invention shown in Figure 3 has a similar construction to the first embodiment shown in Figures 2(A) and 2(B). Whereas the outer periphery of the metallic spring 8 makes contact with the shielding case cover 2' and the heat dissipator 6 in the first embodiment shown in Figures 2(A) and 2(B), the spring of the second embodiment shown in Figure 3 is a coil or compression spring with its respective axial end faces making elastic contact with the shielding case cover 2' and the heat dissipator 6.

In the foregoing embodiments shown in Figures 2(A) and 2(B), and Figure 3 the elastic member was a spring 8.

This invention, however, is not limited to this arrangement: any elastic member having good thermal conductivity, for example, made of electrically conductive elastomeric

material, may be used, in place of the metallic spring, as a means for transmitting the heat generated in the IC 5.

As will be seen from the above description, this invention enables the production of embodiments of
5 miniature electric motor of a compact size in which a printed circuit board incorporating a control circuit is installed inside a shielding case, heat generated in an IC being transmitted to a shielding case having a larger heat
10 dissipating area via an elastic member having good thermal (and optionally electrical) conductivity. The elastic member, if electrically conductive, has a grounding effect which is beneficial. The elastic member contributes
significantly to cost reduction since an inexpensive printed circuit board made of phenol and other synthetic resins can
15 be used as the printed circuit board itself need not dissipate heat generated in the IC.

CLAIMS:

assembly

1. An electric motor/having a motor proper and a printed circuit board, on which a control circuit for controlling the motor is mounted, both installed in a shielding case, and including an elastic member providing a heat conductive path between an integrated circuit heat dissipator in the control circuit and the shielding case so that heat generated in the integrated circuit is dissipated to the shielding case via the elastic member.
2. A motor assembly according to Claim 1 including an elastomeric vibration damper disposed between the circuit board and the shielding case.
3. A motor assembly according to Claim 2 wherein the elastic member is formed of an electrically and thermally conductive elastomeric material and is constructed so as to make elastic contact with the shielding case, with the heat dissipator and with the elastomeric vibration damper.
4. A motor assembly according to Claim 2 or Claim 3 wherein the elastic member comprises a metallic spring; a housing for said metallic spring being provided by forming a through-hole in the printed circuit board and the damper, disposed at a location corresponding to the location of the integrated circuit heat dissipator, and constructed so that the outer periphery of the metallic spring makes contact with the shielding case cover and with the heat dissipator.
5. A motor assembly according to Claim 4 wherein the metallic spring is a coil spring positioned with its respective axial end faces in elastic contact with the shielding case and the heat dissipator.



6. A motor assembly according to any preceding Claim wherein the shielding case includes a shielding case cover, the elastic member being disposed to provide said heat conductive path between the heat dissipator and the shielding case cover.

7. A motor assembly according to claim 6 wherein the elastic member is electrically as well as thermally conductive, and an electrically insulating sheet is interposed between the elastic member and the shielding case cover to provide electrical insulation.

8. An electric motor assembly substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

