

ELECTRICALLY CONNECTING CIRCUIT BOARDS TO MOTOR CASINGS

This invention relates to electric motors, and particularly to miniature motors controlled by an electric circuit on a circuit board mounted on the motor case. The motor case is typically metallic, and a terminal of the circuit is earthed thereto.

Miniature motors of the above type are known, in which an electric circuit on a printed circuit board controls for example the rotation speed of the motor. In such a miniature motor, the circuit has heretofore been earthed by connecting an earthing wire in advance to the earth terminal on the printed circuit board, and then connecting the earthing wire to the case using an appropriate joining mechanism such as spot welding or soldering after the printed circuit board has been fitted in the case. This type of assembly not only requires an earthing wire exclusively for earthing the electronic circuit but also two specific process steps in its installation; connecting the earthing wire in advance to the printed circuit board, and connecting the earthing wire to the case. These two steps are expensive in terms of time and efficiency of the production process.

The present invention seeks to provide a means by which the manufacturing process for motors of the above type can be made more efficient, particularly in the connection of an earth terminal of the circuit board to the motor case. To this end, an electric motor according to the invention comprises an electrically conductive case and an electronic circuit for controlling the operation thereof, the circuit being mounted on a printed circuit board and the circuit board being mounted in the case, wherein a lug protrudes from the case, and wherein the circuit includes a terminal on the circuit board for electrical connection to the case, the board being mounted on the case with said terminal engaging the lug. While the engagement of lug and terminal case can provide a sufficient electrical connection, the connection is

normally assured by soldering after the circuit board has been fitted in place.

In a typical embodiment of the invention, the terminal is disposed at the periphery of, and normally extends around an opening in the circuit board. In another, the terminal is disposed at the edge and along at least one side of a notch cut in the side of the circuit board. The lug can thus pass through the opening or notch, and for ease of assembly and subsequent soldering for example, is normally in any event of length greater than the thickness of the circuit board such that it extends beyond the surface thereof.

Motors of the kind to which the invention relates, and particularly miniature electric motors, are normally based on a case which has a closed end and an open end with the circuit board mounted at the open end and the lug extending from a side wall of the case at said open end. It is preferred that the side wall has a portion cut away at the open end of the case, the lug extending from the base of the cut away portion.

Motors according to this invention can also be provided with electromagnetic shielding ^{by using} a the metallic case ^{AND} covering the the open end thereof with an electrically conductive, normally metallic, electronic circuit cover.

The invention will now be described by way of example and with reference to the accompanying drawings wherein:

Figure 1 is a perspective view of the essential parts of an embodiment of the invention;

Figure 2 is an exploded perspective view of the embodiment shown in Figure 1; and

Figure 3 is a cross-sectional view of another embodiment of the invention.

Figure 1 shows the essential parts of a miniature motor embodying this invention, in the state where a printed circuit board 2 is installed on an electromagnetic

shielding metallic case 1. The motor itself is housed in the space defined within the metallic case 1 and beneath the printed circuit board 2. The open end of the metallic case 1 is normally covered by an electromagnetic shielding case cover (not shown). The circuit board shown has a major circular portion received within the case 1 with a projection therefrom which passes radially through a cut away portion of the case 1 and bears circuit terminals 4 and 5.

As shown in Figure 2, the metallic case 1 has a lug protruding from the cut away portion at the open end of the metallic case 1. The circuit board 2 has at a location corresponding to the lug portion 3 an engaging opening 6 through which the lug will pass as shown in Figure 1. The length of the lug 3 is at least equal to and normally greater than the thickness of the printed circuit board 2. The terminals 4 and 5 each consist of a metallic tab on the surface of the board 2, through which the opening 6 is cut. Thus, the terminal 4 extends around the entire periphery of and beyond the opening 6.

After installation of the circuit board 2, the earth terminal 4 thereof is electrically joined to the metallic case 1 by soldering at 7 the lug 3 and the earth terminal 4 as shown in Figure 1. In this way the earthing process of the metallic case 1 and the printed circuit board 2 in the embodiment shown in Figure 1 is completed merely by a single soldering step in the motor assembly process. This leads to a substantial reduction in the manhours required for the earthing process. It should be appreciated that a resilient or sufficiently tight fit between the lug 3 and opening 6 may preclude the need for the soldering step.

Although an opening 6 is shown in Figure 1 and 2 for receiving the lug 3, a notch extending from the side surface of the printed circuit board 2 to the location of the opening 6 shown in Figure 2 may also serve the same purpose.

Figure 3 illustrates another embodiment of the invention in which the entire motor is electromagnetically

shielded by covering the open end of the motor case 8 with a metallic electronic circuit cover 9. The embodiment shown in Figure 3 has basically the same construction as the embodiment shown in Figure 1 described above since the motor case 8 has the same shielding function as the metallic case in the embodiment shown in Figure 1.

Figure 3 also shows the motor components within the case; specifically an end bell cap 10 through which terminals 11 connect the circuit on the board 2 to brushes 12 which engage a commutator 13 on a motor shaft 15 in the usual way. The shaft 15 carries a rotor 17 and is supported for rotation in bearings 14 within stator magnets 16.

The embodiment shown in Figure 3 has a lug 3 protruding from the edge of the open end of the motor case 8 in the same manner as in the embodiment shown in Figure 1. An engaging portion 6 through which the lug 3 is passed is provided at a location corresponding to the lug 3 on the earth terminal (not shown) of the printed circuit board 2, again as in the embodiment shown in Figure 1. The earth terminal (not shown) of the printed circuit board 2 is electrically joined to the motor case 8 via by soldering at 7 the lug 3 to the earth terminal of the printed circuit board 2 after the circuit board 2 has been installed in the motor case 8 with the lug 3 inserted into the engaging portion 6.

As described above, this invention not only substantially reduces the manhours required for earthing the printed circuit board and the metallic case or motor case but also eliminates an earthing wire, contributing to cost reduction. Furthermore, the mounting of the printed circuit board is further strengthened since the circuit board is secured to the metallic case or motor case where the terminal engages the lug.

CLAIMS:

1. A miniature electric motor comprising an electrically conductive case and an electric circuit for controlling the operation thereof, the circuit being mounted on a printed circuit board and the circuit board being mounted in the case, wherein a lug protrudes from the case, and wherein the circuit includes a terminal on the circuit board for electrical connection to the case, the board being mounted on the case with said terminal engaging the lug.
2. A motor according to Claim 1 wherein the terminal is disposed ^{AROUND} the periphery of an opening in the circuit board, and wherein the lug passes through the opening.
3. A motor according to Claim 1 wherein the terminal is disposed at the edge of a notch cut in the side of the circuit board, and wherein the lug passes through the notch.
4. A motor according to any preceding Claim wherein the length of the lug is greater than the thickness of the circuit board.
5. A motor according to any preceding Claim wherein the case has a closed end and an open end with the circuit board mounted at the open end and the lug extending from an ^{END FACE OF A} side wall of the case at said open end.
6. A motor according to claim 5 wherein the side wall has a portion cut away at the open end of the case, the lug extending from the base of the cut away portion.
7. A motor according to any preceding Claim wherein the case has a closed end an open end with the circuit board mounted at the open end, the motor including an electrically conductive cover closing the open end of the case over the circuit board.
8. A motor according to any preceding Claim wherein the terminal is soldered to the lug to assure an electrical connection therebetween.
9. A miniature electric motor substantially as described herein with reference to Figures 1 and 2 or Figure 3 of the accompanying drawings.

