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Driving coil assembly for electronic transducer

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Fig. 1

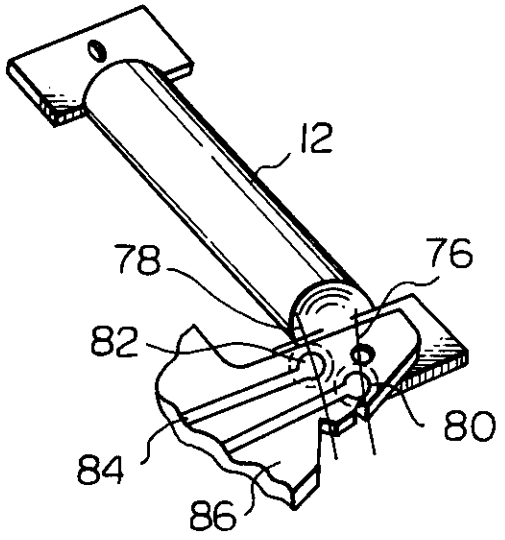


Fig. 2

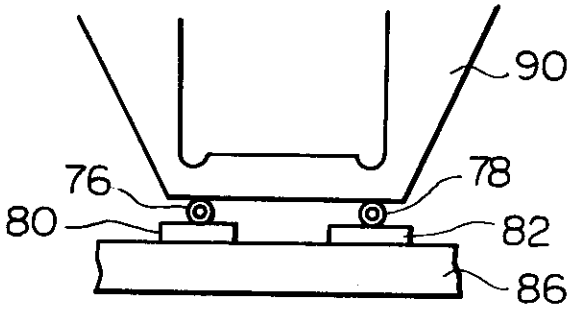
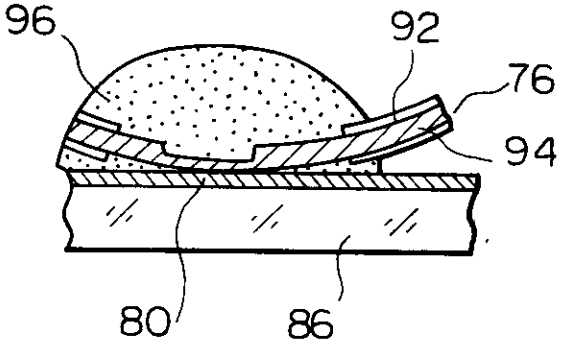


Fig. 3



SPECIFICATION

Driving coil assembly for electronic timepiece

This invention relates to an improvement in the protection of the driving coils used in electronic timepieces.

According to one aspect of the present invention there is provided a method of preparing a driving coil assembly for an electronic timepiece, comprising the steps of:

attaching a coil terminal sheet on at least one end plate of a core having end plate portions on both ends formed integrally with said core, said coil terminal sheet including one surface with printed wiring thereon forming connection portions on said one surface;

placing end leads from the coil on said connection portions of said coil terminal sheet;

applying heat and pressure to bond said end leads and said connection portions to one another by means of a heating element;

forming a layer of ultra violet radiation (UV) hardening type resin over portions of the leads where they are bonded to connection portions of the printed circuit to provide mechanical protection for the bonds; and hardening said layer of UV-hardening type resin by exposing it to ultra violet radiation.

In another aspect, the invention provides a driving coil assembly for a stepping motor of an electronic timepiece, comprising:

an elongated bar core having end plate portions on both ends formed integrally with said core;

a driving coil wound on said core and having end leads;

a coil terminal sheet attached on at least one of said end plates and including a printed wiring having connection portions bonded to said end leads of said driving coil by an application of combined heat and pressure and

protective layers of ultraviolet radiation hardening type resin formed over portions of said end leads of said driving coil where they are bonded to the connecting portions of the printed circuit.

The invention will now be described further, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 shows a method for securing coil end leads in accordance with the invention;

Fig. 2 shows a method of achieving electrical contact between the coil end leads of the coil assembly and adjacent terminals and

Fig. 3 shows a cross sectional view of the coil end lead contact for the coil assembly shown in Fig. 1.

Referring to Fig. 1, a type of coil assembly is shown which is often used in electronic timepieces. End leads 76 and 78 of coil 12 are bonded to connection portions 80 and 82 of printed wiring 84, formed on a printed circuit board 86. Bonding is performed by the application of combined heat and pressure, and establishes electrical contact between the coil end leads 76 and 78 and the connection portions 80 and 82. Fig. 2 illustrates the way in which this bonding is performed. Coil end leads 76 and 78 are compressed between a heating element 90 and connection portions 80 and 82 on circuit board 86.

Fig. 3 is an enlarged view of the bond which is established in this way. The coil end lead 76 is composed of a conducting core 94 and an insulating layer of polyurethane 92. When heat and pressure are applied as shown in Fig. 2, this insulating layer is removed, so that conductor 94 is laid bare and becomes electrically connected to connection portion 80 of printed wiring 84. A layer of ultraviolet hardening resin 96 is then formed over the bonded portion, to provide mechanical protection for the bond. This resin can be applied by means of a suitable dispenser, and then hardened *in situ* by subjecting it to ultraviolet radiation, as will be described in more detail later.

Coils for electronic timepieces generally incorporate extremely fine wire, and therefore in order to prevent breakages of the conductor in the coil itself, it is desirable to protect the outer periphery of the coil itself with a layer of resin.

The primary wavelength range of the ultraviolet radiation used to harden the resin should be in the range 200 to 400 nm, and the temperature should be in the range of room temperature to 70°C.

The duration of the ultraviolet illumination in this step can be within the range 1 second to 90 seconds, depending upon the intensity of the ultraviolet radiation and upon the particular type of ultraviolet radiation hardening resin which is used.

A protective layer formed around the coil can be as thin as 20 to 50 μm, depending upon the viscosity of the resin which is used. The setting time can be made extremely short, i.e. from 1 second to 90 seconds, so that very little flow of the resin occurs due to gravity. Thus, the thickness of the layer is almost the same at the top and bottom of the coil. In addition, this method is particularly suitable for production line manufacture of coil assemblies, since the setting time of the resin can be selected to match the rate of progress of the line.

From the above description, it will be apparent that a thin layer of ultraviolet radiation hardening resin applied to a coil offers various advantages. The difficulties inherent in the more conventional method of passing a heat shrinking type tube over end portions of the assembly, which may be of much larger diameter than that of the coil itself, are avoided. Since only a thin protective layer offers satisfactory protection, the overall diameter of the coil, and so the size of the coil assembly, can be reduced significantly. In addition, since no heat is applied in forming the protective layer, it is not necessary to utilize heat-resistant materials in the coil assembly, which can result in reduced cost of the assembly. Production is also facilitated due to the fact that the setting time of the resin is short, so that a large number of coil assemblies do not accumulate which are in a partially set condition. The short setting time of the resin also makes the method of the present inventions suitable for production line manufacture of such coil assemblies.

The ultraviolet hardening type resin suitably has a pot life of the order of 2 months. Setting of the resin is caused to occur very rapidly by the application of

ultraviolet radiation, so that very little flow of the resin occurs before setting. Devices for supplying a constant rate of flow of resin can therefore be utilized in the manufacture of the coil assemblies, so that the resin can be applied by untrained workers. With the resin layer in accordance with the present invention, greater uniformity of the layer is achieved on a mass production basis, and the level of productivity is greatly enhanced.

Since it is not necessary to heat the coil assembly in order to accelerate the setting of the resin, it is possible to utilize low cost materials such as ABS in the construction of the assemblies. Examples of ultraviolet radiation hardening resin which may be used include acrylate-base resins such as polyol acrylates, polyester acrylates, polyepoxy acrylate, polyurethane acrylate, and polyamide acrylates, and photo polymerization initiators such as benzoin derivative, benzil, acetophenone derivative, and benzophenone.

CLAIMS

1. A method of preparing a driving coil assembly for an electronic timepiece, comprising the steps of:

attaching a coil terminal sheet on at least one end plate of a core having end plate portions on both ends formed integrally with said core, said coil terminal sheet including one surface with printed wiring thereon forming connection portions on said one surface;

placing end leads from the coil on said connection portions of said coil terminal sheet;

applying heat and pressure to bond said end leads and said connection portions to one another by means of a heating element;

forming a layer of ultra violet radiation (UV) hardening type resin over portions of the leads where they are bonded to connection portions of the printed circuit to provide mechanical protection for the bonds; and hardening said layer of UV-hardening type resin by exposing it to ultraviolet radiation.

2. A method of preparing a driving coil assembly for an electronic timepiece according to Claim 1, wherein each of said end leads is composed of a conducting core and an insulating outer layer.

3. A method of preparing a driving coil assembly for an electronic timepiece according to Claim 2, wherein a portion of said insulating layer is removed by the application of heat and pressure, whereby said conducting core is laid bare for electrical connection to said connection portions.

4. A method of preparing a driving coil assembly for an electronic timepiece according to any preceding Claim, wherein a protective layer of ultraviolet radiation hardening type resin is formed on the outer periphery of said coil.

5. A method of preparing a driving coil assembly for an electronic timepiece according to any preceding Claim, wherein said ultraviolet radiation hardening type resin is selected from epoxy resin, polyol acrylate, polyester acrylate, polyepoxy acrylate, and polyurethane acrylate, and includes as a photo-polymerization initiator, a diazonium type solution, benzoin derivative, benzil acetophenone derivative, or benzophenone.

6. A driving coil assembly for a stepping motor of an electronic timepiece, comprising:

an elongated bar core having end plate portions on both ends formed integrally with said core;

a driving coil wound on said core and having end leads;

a coil terminal sheet attached on at least one of said end plates and including a printed circuit having connection portions bonded to said end leads of said driving coil by an application of combined heat and pressure and

protective layers of ultraviolet radiation hardening type resin formed over portions of said end leads of said driving coil where they are bonded to the connecting portions of the printed circuit.

7. A method according to Claim 1 substantially as herein described with reference to the accompanying drawings.

8. A driving coil assembly for a stepping motor of an electronic timepiece, substantially as herein described with reference to the accompanying drawings.

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DRIVING COIL ASSEMBLY FOR ELECTRONIC TRANSDUCER:

~~Coil assembly for electro-mechanical transducers~~

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