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"A CIRCUIT UNIT FOR A TIMEPIECE AND A METHOD OF MAKING THE SAME"

The present invention relates to a circuit unit for a timepiece and to a method for making the same.

A circuit unit for a timepiece has previously been made by the method disclosed in Japanese Patent Publication No. 27952/60(1985) entitled "Drive circuit unit for a timepiece.", and assigned to the present Applicants. In this circuit unit, there is sandwiched between two sheet-like insulating frames a lead frame having a predetermined pattern which incorporates a circuit element such as an integrated circuit.

The term "lead" as used herein is to be understood to refer to electrical conduction and not to the metal lead.

Since the two sheet-like insulating frames are required for sandwiching the lead frame, the construction disclosed in the prior art involves the use of large numbers of parts and large numbers of manufacturing steps and is troublesome to assemble. Moreover, this circuit unit is difficult to handle so that its mounting in a timepiece cannot be effected by an automatic assembly process. Furthermore, the circuit unit has to be coupled to contact members of a battery or motor, and this increases the number of working steps and thus increases the production costs.

According, therefore, to the present invention, there is provided a circuit unit for a timepiece comprising a

lead frame; a plurality of lead members which are separate from the lead frame and each of which is electrically connected at one of its ends to a circuit element; and a mass of insulating material within which the circuit element is encapsulated, the said mass being backed by an insulating plate and mechanically holding together the lead frame, the lead members and the circuit elements, the opposite end of each of the lead members extending outwardly of the said mass and being free of support by said insulating plate so as to provide an electrical contact for connection to a circuit component.

The circuit unit of the present invention can thus be fabricated without difficulty and at a reasonable cost since the number of parts of the circuit unit are fewer than in the prior art.

The said mass of insulating material preferably also encapsulates portions of the lead frame and of the lead members.

The mass of insulating material may be disposed on one surface only of the lead frame, the insulating plate being disposed on the opposite surface of the lead frame and being secured thereto, the mass of insulating material being aligned with and secured to the insulating plate.

The circuit element may be an integrated circuit.

The lead frame may be an H-shaped member having a pair of parallel side portions which are connected together by a connecting portion.

The circuit element may be die-bonded to the connecting portion.

The side portions may be fixed to a common holding member. Moreover, the holding member may form part of a coil bobbin on which is wound a driving coil of a driving motor.

The lead frame may have jointing members which interconnect respective end portions of the said side portions and which define therewith a space within which the lead members are disposed.

One of the jointing members may be arranged to be connected to a contact of a battery.

Preferably, each of the lead members has an end portion which is spaced from the circuit element and is electrically connected thereto by a bonding wire.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:-

Figure 1 is a top plan view showing a circuit unit according to one embodiment of the present invention;

Figure 2 is a front elevation showing the circuit unit of Figure 1 mounted on a holding member; and

Figure 3 is a front elevation showing a lead frame adapted to form part of the circuit unit of Figures 1 and 2, the said lead frame being shown in the form which it has immediately after it has been pressed out of an electrically conductive sheet from which it is formed.

In Figure 1 there is shown a circuit unit for a timepiece which comprises a lead frame 1 made of a metal sheet. The lead frame 1 comprises a die-bonding lead member 2, which is die-bonded to an integrated circuit 4, and other lead members 3. The die-bonding lead member 2 is shaped generally in the form of a letter "H" and comprises a pair of parallel side portions 21, 22 and a connecting portion 23 which interconnects the side portions 21, 22. An integrated circuit 4 is die-bonded to the connecting portion 23.

The other lead members 3, which are constituted by lead members 31, 32, 33, 34 and 35, i.e. the lead members other than the die-bonding lead member 2, are separated from the lead member 2 and have respective end portions positioned

in the vicinity of the integrated circuit 4. These end portions of the lead members 3 are electrically connected to the integrated circuit 4 through bonding wires 4a. Alternatively, the said end portions may be connected to the integrated circuit 4 not by wire bonding but by a face-down bonding method such as the flip chip or beam lead method.

The die-bonding lead member 2 and the other lead members 3 are mechanically integrated by a potting resin 5 which forms a mass of insulating material which encapsulates and thus protects both the integrated circuit 4 and the adjacent portions of the die-bonding lead member 2 and other lead members 3 so that they are mechanically held together. This integration of the parts 2, 3, 4 is effected in the present embodiment both by the potting resin 5 and by an insulating plate 9 which backs the potting resin 5. That is to say, the potting resin 5 is, as shown in Figure 2, disposed on one surface of the lead frame 1, the insulating plate 9 being disposed on the opposite surface of the latter and being secured thereto, the potting resin 5 being aligned with and secured to the insulating plate 9.

The generally H-shaped die-bonding lead member 2 has jointing members 24, 25 connecting the respective end portions of the side portions 21, 22. The lead members 31

to 35 are arranged in a compartment or space A which is bounded by the side members 21, 22 and the jointing members 24, 25. A quartz oscillator 6 together with capacitors and resistors which are required in a watch driving circuit are directly connected electrically to the lead members 31-35. The jointing member 24 is arranged to be connected to one contact of a battery (not shown) which may be done by a simpler technique than is employed in the prior art.

The lead frame 1, which is mechanically integrated with both the potting resin 5 and the insulating plate 9, is held in position by fixing the two side portions 21, 22 to a holding member. In the present embodiment, this holding member is constituted by a coil bobbin 8 (as shown in Figure 2), which is fitted on one stator member of a stator (not shown) of a driving motor, a driving coil 7 being wound on the coil bobbin. The coil bobbin 8 is integrally formed with two support members 81 each of which is formed with projections 81a and 81b. The projections 81a are inserted into and are thermally welded in connecting holes 21a and 22a which are formed in advance in the side portions 21, 22 of the lead member 2. The projections 81b are used for anchoring lead wires 7a coming from the coil 7. The projections 81b are arranged

at points a, a, in the compartment A of the lead frame 1. The lead wires 7a which are anchored to the projections 81b extend across the lead members 34 and 35 and are electrically connected to the lead members 34 and 35. This makes it remarkably easy to provide an electrical connection between the motor coil 7 and the circuit unit shown in Figure 1.

The lead frame 1 is formed by stamping an original electrically conductive sheet P of a metal such as stainless steel. At this stage, the individual lead members 3 are integrally connected to the lead frame 1 only through bridges b, as shown in Figure 3. After each of the lead members 3 has been electrically connected to the integrated circuit 4 and the potting resin 5 and the insulating plate 9 have been used to mechanically hold together the lead frame 1, the lead members 3 and the integrated circuit 4, the bridges b are cut so that the lead members 3 are separated from the lead frame 1 but are mechanically held by both the potting resin and the insulating plate 9 (as shown in Figures 1 and 2) and as described above.

After this, electrical parts such as the quartz oscillator 6 of Figures 1 and 2 and the capacitors (not shown) are connected in position.

As has been described hereinbefore, the individual

lead members 3 are integrally held by the potting resin 5 covering the integrated cirucit 4. As a result, no special holding part is required to reduce the number of parts, so that the circuit unit can be fabricated compactly with remarkable ease. Since, moreover, this circuit unit is integrated with the battery contacts, automatic assembly of the circuit unit in a timepiece may be achieved . The circuit unit, moreover, is fixed in position through the side portions 21, 22 which therefore provide sufficient mounting strength.



C L A I M S

1. A circuit unit for a timepiece comprising a lead frame; a plurality of lead members which are separate from the lead frame and each of which is electrically connected at one of its ends to a circuit element; and a mass of insulating material within which the circuit element is encapsulated, the said mass being backed by an insulating plate and mechanically holding together the lead frame, the lead members and the circuit element, the opposite end of each of the lead members extending outwardly of the said mass and being free of support by said insulating plate so as to provide an electrical contact for connection to a circuit component.

2. A circuit unit as claimed in claim 1 in which the said mass of insulating material also encapsulates portions of the lead frame and of the lead members.

3. A circuit unit as claimed in claim 1 or 2 in which the mass of insulating material is disposed on one surface only of the lead frame, the insulating plate being disposed on the opposite surface of the lead frame and being secured thereto, the mass of insulating material being aligned with and secured to the insulating plate.

* C L M S *

4. A circuit unit as claimed in any preceding claim in which the circuit element is an integrated circuit.

5. A circuit unit as claimed in any preceding claim in which the lead frame is an H-shaped member having a pair of parallel side portions which are connected together by a connecting portion.

6. A circuit unit as claimed in claim 5 in which the circuit element is die-bonded to the connecting portion.

7. A circuit unit as claimed in claim 5 or 6 in which the side portions are fixed to a common holding member.

8. A circuit as claimed in claim 7 in which the holding member forms part of a coil bobbin on which is wound a driving coil of a driving motor.

9. A circuit unit as claimed in any of claims 5-8 in which the lead frame has jointing members which interconnect respective end portions of the said side portions and which define therewith a space within which the lead members are disposed.

10. A circuit unit as claimed in claim 9 in which one of the jointing members is arranged to be connected to a contact of a battery.

11. A circuit unit as claimed in any preceding claim in which each of the lead members has an end portion which is spaced from the circuit element and is electrically connected thereto by a bonding wire.



12. A circuit unit for a timepiece substantially as hereinbefore described with reference to and as shown in the accompanying drawings.