

"ELECTROMAGNETIC BUZZER"

The present invention relates to an electromagnetic buzzer, e.g. for use in an alarm electronic timepiece.

In a conventional electromagnetic buzzer, the terminal portions of the coil of the buzzer are welded or soldered to a lead-in substrate or lead-carrying frame which is attached to the bottom of the electro-magnetic buzzer, so that the electrical contact between the coil terminal portions and the lead-carrying frame is made outside of the electromagnetic buzzer.

It is, however, the object of the present invention to simplify connection of the coil terminal portions to the lead-carrying frame and to reduce the thickness of the buzzer.

According to the present invention there is provided an electromagnetic buzzer comprising a magnetic core; a coil surrounding said magnetic core; permanent magnet means; a base plate which magnetically couples the magnetic core to the permanent magnet means, the coil being mounted to one side of the base plate; a support frame; and a vibratable plate which is supported by the support frame and which is disposed adjacent to the magnetic core with a space therebetween; the coil being connected to at least one conductor member which is mounted to the said one side of the base plate and which extends externally of the buzzer.

At least one said conductor member is preferably mounted on a lead-carrying or lead-in plate.

The lead-carrying plate may be secured to the base plate by a plurality of pins extending from the latter.

The lead-carrying plate may have means for positioning the permanent magnet means.

There may be two said conductor members mounted on the lead-carrying plate, the two said conductor members being respectively
5 connected to spaced terminal portions of the coil.

Alternatively, one terminal portion of the coil may be connected to a said conductor member on the lead-carrying plate, and the other terminal portion of the coil may be connected to the base plate.

10 The lead-carrying plate may be a flexible plate.

The lead-carrying plate may be electrically connected to a circuit block by a screw or screws or may be electrically connected to the circuit block by a spring secured to the latter.

The invention also comprises an electronic wrist watch
15 provided with a buzzer as set forth above.

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

Figures 1 and 2 respectively show a sectional view and an underneath plan view of a conventional electromagnetic buzzer,

20 Figure 3 shows a conventional electromagnetic buzzer mounted in a wrist watch,

Figures 4 and 5 respectively show a sectional view and a plan view of a driver portion of a first embodiment of an electromagnetic buzzer according to the present invention,

25 Figure 6 shows a plan view of a second embodiment of an

electromagnetic buzzer according to the present invention,

Figure 7 shows a sectional view of a third embodiment of an electromagnetic buzzer according to the present invention,

Figure 8 shows a partial sectional view of a fourth embodiment
5 of an electromagnetic buzzer according to the present invention mounted in a wrist watch,

Figure 9 shows a partial sectional view of a fifth embodiment of an electromagnetic buzzer according to the present invention mounted in a wrist watch, and

10 Figure 10 shows a partial sectional view of a sixth embodiment of an electromagnetic buzzer according to the present invention mounted in a wrist watch.

Terms such as "upper" and "lower", as used in the description below, are to be understood to refer to directions as seen in the
15 accompanying drawings.

Like reference numerals in the various embodiments indicate like parts.

In Figures 1 and 2 there is shown a conventional electromagnetic buzzer in which a coil 2, which is wound around a magnetic core 1, has terminal portions 2a, 2b respectively which are welded or
20 soldered to annular terminals or leads 4a, 4b of a lead-in substrate or lead-carrying plate 4. The latter is secured to the lower surface of a base plate 3, the terminal portions 2a, 2b extending through a cut away portion 3a of the base plate 3. Accordingly, when the
25 buzzer of Figures 1 and 2 is, for example, incorporated in an alarm

wrist watch as shown in Figure 3, the required electrical connection between the buzzer and means for driving the latter is made by connecting the terminals 4a, 4b to lead-in plates 7, 8 respectively which are themselves connected to a circuit block 6.

5 However, the electromagnetic buzzer of this construction has various drawbacks. For one thing, the production of such a buzzer is exceedingly inefficient since the coil terminal portions 2a, 2b are welded by leading them through the cut away portion 3a to the back of the base plate 3 and considerable time is expended
10 on a molding process which is used to protect the welding portions. For another thing, permanent magnets 5 are fixed to the upper surface of the base plate 3 by an adhesive without any appropriate positioning means but largely depending on the worker's intuition. The magnetic attraction power of the magnets 5 therefore varies
15 with their position and there is therefore a corresponding variation in the buzzer performance. Moreover, if the buzzer is mounted in an alarm wrist watch as shown in Figure 3, the thickness of the wrist watch is increased since the coil terminal portions 2a, 2b are led to the circuit block 6 from the lead-carrying plate 4, which is
20 mounted beneath the lower surface of the base plate 3, by way of the lead-in plates 7, 8.

Figure 4 therefore shows a sectional view of a driver portion of a first embodiment of an electromagnetic buzzer according to the present invention, and Figure 5 shows a top plan view thereof.
25 The buzzer of Figures 4 and 5 comprises a magnetic core 11 and a

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coil 12 wound around the magnetic core 11. The coil 12 has terminal portions 12a, 12b which are respectively welded to patterns or conductors 14a, 14b on a lead-in substrate or a lead-carrying plate 14 positioned on a base plate 13, the conductors 14a, 14b extending externally of the buzzer. It will be noted that both the coil 12 and the lead-carrying plate 14 are mounted to the same side, i.e. the upper side, of the base plate 13 and that consequently the terminal portions 12a, 12b do not have to be taken through a cut-away portion to the back of the base plate 13.

A plurality of pins 18 are formed by press extrusion so as to extend from the base plate 13. The lead-carrying plate 14 is secured on the base plate 13 by reason of being mounted on the pins 18. The lead-carrying plate 14 and the base plate 13 are fixed together by upsetting the pins 18. The lead-carrying plate 14 has recesses 14c to house and thereby position three equi-angularly spaced apart permanent magnets 15. The latter are therefore retained in exactly predetermined positions with respect to the magnetic core member 11. The base plate 13 magnetically couples the magnetic core 11 to the permanent magnets 15.

Figure 6 is a top plan view of a driver portion of a second embodiment of an electromagnetic buzzer according to the present invention. The Figure 6 embodiment differs from the Figure 4 embodiment with respect to the coil terminal portions. In the Figure 6 embodiment, the coil 12 has a terminal portion 12c which is connected to a pattern 14c on the lead-carrying plate 14 and

and has a terminal portion 12d which is connected to the upper surface of the base plate 13.

Figure 7 shows a sectional view of a third embodiment of an electromagnetic buzzer according to the present invention.

5 The Figure 7 embodiment comprises a support frame 16 which supports a vibratable plate 17, the buzzer of Figure 7 having a driver portion as shown in Figure 4. The vibratable plate 17 is disposed adjacent to the magnetic core 11 with a space therebetween. The support frame 16 is provided with a partially concave recess
10 16a through which extends an externally projecting portion of the lead-carrying plate 14 by means of which the coil 12 is connected electrically to the exterior.

Figure 8 shows a partial sectional view of a fourth embodiment of an electromagnetic buzzer according to the present invention
15 mounted in a wrist watch. In order to increase the sound volume, the electromagnetic buzzer of Figure 8 is secured to a buzzer frame 21 which serves as a resonator, and the buzzer frame 21 is secured to a part of a tubular case 23 by way of a gasket 22 for establishing fluid-tightness.

20 In the Figure 8 construction, moreover, the support frame 16, in addition to supporting the vibratable plate 17, also supports a sound plate 24 which is spaced from the vibratable plate 17 by an air space 28. This arrangement, which is a known arrangement called a "double vibrating plate structure", improves the temper-
25 ature characteristic of the electromagnetic buzzer, i.e. it reduces

the effect which temperature has on the resonant frequency of the buzzer.

The coil terminal portions of the electromagnetic buzzer of Figure 8 are led out from a side of the buzzer by way of the lead-carrying frame 14 and an electrical connection is made by fixing the lead-carrying frame 14 with its conductors to a circuit block 25 by means of at least one screw 29. Accordingly, since members for providing the coil terminal portions with external connections (such as a lead substrate, a lead plate and the like) are not needed between the base plate 13 and a back cover 26 of the watch case, the overall thickness of the watch case is considerably reduced.

Figure 9 shows a fifth embodiment of the present invention wherein the lead-carrying plate is constituted by a flexible printed circuit board 14d to provide greater flexibility for layout of each unit of the watch.

Figure 10 shows a sixth embodiment of the present invention wherein a lead-carrying plate 14e is fixed to the circuit block 25 by means of a spring member 27 which may cooperate with another mechanical element (not shown).

The embodiments of the present invention described above have the following advantages:-

(1) Positioning is simplified by fixing a lead-carrying plate by a plurality of pins, and productivity is considerably improved since the use of an adhesive is eliminated.

(2) A stable performance of a buzzer is obtained by using a

lead-carrying plate as a means for positioning permanent magnets.

(3) A moulding process for securing terminals is not needed since the coil terminal portions are connected inside the buzzer to the conductors on the lead-carrying plate.

- 5 (4) An electrical connection between the buzzer and the circuit block of the watch is made at the side of the buzzer, so that the thickness of the watch is reduced.



C L A I M S

1. An electromagnetic buzzer comprising a magnetic core; a coil surrounding said magnetic core; permanent magnet means; a base plate which magnetically couples the magnetic core to the permanent magnet means, the coil being mounted to one side of the base plate; a support frame; and a vibratable plate which is supported by the support frame and which is disposed adjacent to the magnetic core with a space therebetween; the coil being connected to at least one conductor member which is mounted to the said one side of the base plate and which extends externally of the buzzer.
2. A buzzer as claimed in claim 1 in which at least one said conductor member is mounted on a lead-carrying plate.
3. A buzzer as claimed in claim 2 in which the lead-carrying plate is secured to the base plate by a plurality of pins extending from the latter.
4. A buzzer as claimed in claims 2 or 3 in which the lead-carrying plate has means for positioning the permanent magnet means.
5. A buzzer as claimed in any of claims 2-4 in which there are two said conductor members mounted on the lead-carrying plate, the two said conductor members being respectively connected to spaced terminal portions of the coil.
6. A buzzer as claimed in any of claims 2-4 in which one terminal portion of the coil is connected to a said conductor member on the lead-carrying plate, and the other terminal portion of the coil is connected to the base plate.



7. A buzzer as claimed in any of claims 2-6 in which the lead-carrying plate is a flexible plate.
8. A buzzer as claimed in any of claims 2-7 in which the lead-carrying plate is electrically connected to a circuit block by a screw or screws.
9. A buzzer as claimed in any of claims 2-7 in which the lead-carrying plate is electrically connected to a circuit block by a spring secured to the latter.
10. An electromagnetic buzzer substantially as hereinbefore described with reference to and as shown in Figures 4 and 5, or in any of Figures 6-10 of the accompanying drawings.
11. An electronic wrist watch provided with a buzzer as claimed in any preceding claim.

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