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## (54) ACOUSTICAL SOUND PRODUCER FOR TIMEPIECES

(71) We, TIMEX CORPORATION, a Corporation organised under the Laws of the State of Delaware, United States of America of Waterbury 20, Connecticut, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 The present invention relates to an acoustical sound producer for timepieces, more particularly for wristwatches.

15 A known type of sound producer generally comprises a pin attached to the gears or crystal of the timepiece, said pin being able to be oscillated by means of an electromagnetic system excited by an oscillator.

20 A wristwatch with an electrically driven acoustical sound producer of this general type in which a plastics pin is formed on a plastics watch crystal is described in United States Patent Specification No. 3,462,943. The electromagnetic system, which is excited by a common, self-starting oscillator circuit, has an electro-magnet arranged on a support between two permanent magnets as well as a tongue which is firmly clamped on one side and capable of oscillating, which projects beyond the poles of the permanent magnets and the electro-magnet, and extends roughly at right angles to the pin formed on the watch crystal. If the oscillator excites the electromagnetic system, the oscillating tongue strikes the pin, thus exciting the watch crystal which serves as a resonator.

25 This known design has various disadvantages: To provide sufficient volume of the acoustical signal, it is not only necessary to adjust the tongue of the electromagnetic system relative to the magnets, but the tongue, and thus the entire electromagnetic system, must also be adjusted relative to the pin. In addition, the watch crystal must naturally be excited with its natural frequency. Since, as a result of striking the pin, the tongue does not oscillate sinusoidally, the watch crystal is excited with a frequency spectrum whose composition depends to an extremely great degree on the amplitude of

oscillation of the tongue. Adjustment of the electromagnetic system relative to the pin, temperature, and the charge of a driving battery thus significantly influence the exciting frequencies, so that there is great danger of the watch crystal no longer being excited with its natural frequency.

It is an object of the invention to create an acoustical sound producer in which the watch crystal is more likely to be excited with its natural frequency than with the known designs. For this purpose, it is now proposed according to the invention to provide an acoustical sound producer for a timepiece especially a wristwatch, comprising a crystal, an electromagnet system adapted to be excited by an oscillator, and a pin attached to the crystal, said pin being at least partially of magnetic material and extending into the alternating magnetic field of the electro-magnet system for direct excitation so as to cause vibration of the crystal and to produce a sound.

Thus, in a design according to the invention only the electromagnetic system as a whole need be adjusted relative to the pin of the watch crystal. Moreover, this pin can be excited so as to produce sinusoidal oscillations, as the excitation is not produced by striking. Thus, in a sound producer according to the invention it is much simpler to excite the watch crystal with its natural frequency.

In the above described known sound producer, there is an air gap both between the tongue and one of the poles of the permanent magnets and one of the poles of the electro-magnet. A preferred feature of the invention makes it possible to achieve even better efficiency by attaching pole shoes on the poles of the permanent magnets facing the pin, and locating the free end of the pin between said pole shoes and in front of one pole of the electro-magnet.

Further features and advantages of the invention can be seen from the following description and the accompanying drawings of a preferred embodiment of a sound producer according to the invention, in which:—

Figure 1 shows a vertical cross-section

through the watch crystal and the other members of the sound producer, with the exception of the excited oscillator circuit;

Figure 2 shows a cross-section along line 2—2 in Figure 1; and

Figure 3 shows a cross-section along line 3—3 in Figure 1.

The drawings show a watch crystal 10 of plastics. Attached in a projection 12 formed on the watch crystal is a pin 14 which, as can be seen from Figures 1 and 3, has the shape of a strip of sheet metal and is of magnetic material, e.g. ferromagnetic.

Attached on a plate 16 of the watch, which is otherwise not illustrated, by means of a mounting angle bracket 18 is an electromagnetic system, consisting primarily of an electromagnet 20 and two permanent magnets 22. The electro-magnet has a coil 20a surrounding a core 20b, whose free end forms one of the poles of the electro-magnet. The magnets 20 and 22 are attached to mounting bracket 18, with pole shoes 24 being attached to the poles of permanent magnets 22 which face away from the bracket 18 and pin 14 extends into the electromagnetic field between said pole shoes 24 in front of the core pole of the electromagnet.

A conventional self-starting oscillator (not shown) which is switched on by the watch at the selected time, excites electro-magnet 20; with the aid of mounting bracket 18 the electromagnetic system 20, 22 is adjusted relative to pin 14 in such a manner that pin 14 does not adhere to core 20b, whereby watch crystal 10 is excited with its resonance frequency, to which, of course, the unillustrated oscillator circuit must also be matched.

A significant advantage of the sound producer according to the invention is also to be viewed in the fact that with it good feedback of the natural frequency of watch crystal 10 to the exciting oscillator circuit can be achieved.

It is also practical to excite with a multiple of the resonance frequency of watch crystal

10, and a ratio of 2 : 1 (3000 : 1500) is especially recommended.

Experiments by the Applicants have shown that the current consumption of the sound producer according to the invention can be reduced to 2.5—3 mA while still generating a signal tone of sufficient intensity.

#### WHAT WE CLAIM IS:—

1. An acoustical sound producer for a timepiece especially a wristwatch, comprising a crystal, an electromagnet system adapted to be excited by an oscillator, and a pin attached to the crystal, said pin being at least partially of magnetic material and extending into the alternating magnetic field of the electromagnet system for direct excitation so as to cause vibration of the crystal and to produce a sound.

2. A sound producer according to Claim 1, wherein said electromagnetic system includes an electro-magnet arranged between two permanent magnets, pole shoes attached on the poles of the permanent magnets facing said pin with the free end of the pin being located between said pole shoes and in front of one pole of the electromagnet.

3. A sound producer according to Claim 1 or Claim 2, wherein the entire electromagnetic system is adjustable as a unit relative to said pin.

4. A sound producer according to any one of the preceding claims, wherein the pin is ferromagnetic.

5. An acoustical sound producer for a timepiece, substantially as hereinbefore described with reference to the accompanying drawings.

6. A timepiece including the acoustical sound producer as claimed in any one of the preceding claims.

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