

PATENT SPECIFICATION (11)

1 378 400

1 378 400

- (21) Application No. 55297/72 (22) Filed 30 Nov. 1972 (19)
 (31) Convention Application Nos. 116 112 (32) Filed 9 Dec. 1971
 101 887 17 Dec. 1971 in
 (33) Japan (JA)
 (44) Complete Specification published 27 Dec. 1974
 (51) International Classification G04C 21/18 G04B 23/12
 G04C 21/02 21/20
 (52) Index at acceptance
 G3T A1



(54) WATCH WITH PIEZO-ELECTRIC BUZZER

- (71) We, KABUSHIKI KAISHA DAINI SEIKOSHA, a Japanese company of 31-1, 6-chome, Kameido, Koto-ku, Tokyo, Japan, 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:—
- This invention relates to a watch with a piezo-electric buzzer.
- According to the present invention there is provided a watch provided with a buzzer having a piezo-electric vibratory means adapted to produce a buzzing sound, and an electrical driving circuit for actuating the vibratory means.
- Preferably the watch comprises a housing, a back cover separate from but mounted on said housing, the said vibratory means being mounted on the said back cover, and the electrical driving circuit being disposed in said housing, and connecting means for electrically connecting said driving circuit to said back cover and said vibratory means.
- Conventional buzzer apparatus for a watch has comprised an electromagnetically driven vibrating member such as a hammer, which hits against a glass or against the back cover of the watch. However, a buzzer of this kind requires one large space for the stroke of the vibrator member, and requires another space in which to locate an electromagnet for driving the vibrating member. The use of the conventional buzzers therefore makes the watch large; it is difficult to adjust the distance between the glass or back cover and the hammer which is positioned in a narrow space, after all the parts of the watch have been assembled; and the mounting of the buzzer in a water-tight enclosure has made it difficult to hear the buzzer.
- The above-mentioned disadvantages may, however, be avoided by the use of the said piezo-electric element, which enables the watch to be made small.
- Preferably said back cover comprises an inner back cover and an outer back cover,
- [Price 25p]
- said vibratory means being mounted on said inner back cover.
- Moreover, said outer back cover is preferably provided with at least one hole therein for increasing the audibility of the buzzing. Such a construction makes it possible to achieve water-tightness while allowing the sound of the buzzer to be easily heard.
- The said connecting means preferably comprises a resilient member insulatedly mounted on a frame, one end of the resilient member being electrically connected to said driving circuit and the other end thereof being held in contact with means electrically connected to said vibratory means.
- The driving circuit preferably comprises a transistor switching device for effecting intermittent vibration of the vibratory means. Thus the driving circuit may comprise a transistor having its collector connected in series with both a power supply and a switch arranged to be actuated by a timing mechanism; a diode connected to the base of the transistor; a resistor connected between the input terminal of the diode and the collector of the transistors; a first capacitor connected between the input terminal of the diode and earth; and an oscillatory circuit including a second capacitor, connected to the base of said transistor, and a coil having one end connected to said second capacitor and the other end connected to said power supply, said coil having a centre-tapped portion to which the emitter of said transistor is connected, said vibratory means being connected across said coil.
- The invention is illustrated, merely by way of example, in the accompanying drawings, in which:—
- Figure 1 is a plan view showing a back cover of a watch according to the present invention, the watch being provided with buzzer apparatus,
- Figure 2 is a cross-sectional view taken on line A—A of Figure 1,
- Figure 3 is an external view of the back cover of the watch of Figure 1,
- Figure 4 is a schematic sectional view of

SPECIFICATION AMENDED - SEE ATTACHED SLIP

8.1.75

the said watch together with a circuit diagram, and

Figure 5 is an enlarged view showing means for connecting vibrating means of the buzzer apparatus to a driving circuit thereof.

Referring to the drawings, a watch has a back cover which includes an outer back cover 1 on an inclined surface portion 1a of which are provided a plurality of small holes 1b to 1i in equi-angularly spaced relationship. The watch has also an inner back cover 2 whose peripheral portion is secured to and sealed to that of the outer back cover 1. On the central portion of the inner back cover 2 there is attached a piezo-electric vibrating element 3 by means of an electrically conductive adhesive. The piezo-electric vibrating element 3, which constitutes a buzzer, is provided on its back surface with two electrodes, one of which is electrically connected through the inner and outer back covers 2, 1 to a frame plate 10, and the other of which is connected through a lead wire 6 to a terminal pin 5 mounted on a support 4. The support 4 is electrically insulated from the inner back cover 2 and therefore from the outer back cover 1 and the frame plate 10 (as best shown in Figure 5).

Figure 4 shows both the mechanical details of the watch and a circuit diagram of a driving circuit 9 for actuating the piezo-electric vibrating element 3. The driving circuit 9 is disposed in an internal space of the watch case defined by the inner surface of the inner back cover 2, the frame plate 10, and an annular case member or housing 7 mounted on and sealed to the outer back cover 1. The frame plate 10 carries the watch movement (not shown). A watch glass 11, of a natural or synthetic glass is mounted on and sealed to the case member 7.

When the back cover 1, 2 is mounted on the case member 7, the end of the terminal pin 5, as shown in Figure 5, is releasably held in contact with a spring 13 secured to an insulating member 12, the insulating member 12 being mounted on the back surface of the frame plate 10. It will therefore be understood that the piezo-electric vibrating element 3 is connected to the driving circuit 9 through the lead wire 6, the terminal pin 5, and the spring 13, on the one hand, and through the inner back cover 2, the case member 7 and the frame plate 10 (serving as the earth), on the other hand.

The driving circuit 9 for actuating the buzzer comprises a transistor Tr the collector of which is connected in series to a switch SW and a battery B, the switch SW being adapted to be actuated in response to a timer mechanism (not shown), and the battery B having a voltage value of 1.5. The negative electrode of the battery is earthed by being

connected to the frame plate 10. On the other hand, a diode D is connected to the base of the transistor Tr, and a resistor R is connected between the input terminal of the diode D and the collector of the transistor Tr. Further, a capacitor C_1 is connected between the input terminal of the diode D and earth (i.e. the frame plate 10). Thus, the diode D, resistor R and capacitor C_1 constitute a time constant circuit.

Another capacitor C_2 is connected to the base of the transistor Tr. To one terminal of the capacitor C_2 is connected a coil L which is divided into two portions La and Lb. The emitter of the transistor Tr is connected to the centre-tapped portion Lc of the coil L. Further, the capacitor C_2 is connected through the spring 13, the terminal pin 5 and the lead wire 6 to one electrode of the piezo-electric vibrating element 3. Thus it will be understood that the piezo-electric vibrating element 3 is connected across the coil L.

With this arrangement, the capacitor C_1 is charged with a current flowing from the battery B through the resistor R when the switch SW is closed at the predetermined time associated with the timer mechanism. The charging time of the capacitor C_1 is determined by the time constant of the capacitor C_1 and the resistor R. When the voltage across the capacitor C_1 exceeds a predetermined value, for instance 0.6V when a silicon diode is employed, the voltage is applied to the base of the transistor Tr to bias the transistor Tr, whereby the current flows through the collector/emitter circuit of the transistor Tr. Since the coil L is divided into two parts La and Lb and connected to the emitter of the transistor Tr, a current change in the collector/emitter circuit causes a voltage change in the coil La. Thus an induced voltage is produced in the coil Lb and then fed back through the capacitor C_2 to the base of the transistor Tr. Therefore, the circuit begins to oscillate at the resonant frequency determined by the coil L and capacitor C_2 .

The oscillation continues until the condenser C_1 is completely discharged. When the discharge is completed, the transistor Tr is turned off to stop the oscillation. When the capacitor C_1 is charged again, the circuit begins to oscillate in the same way as mentioned above, so that intermittent oscillation occurs with repeated charge and discharge of the capacitor C_1 . The piezo-electric vibrating element 3 connected across the coil L vibrates intermittently in response to the oscillation of the circuit. In order to obtain the maximum sound effect, the oscillatory frequency of the circuit should conform to the resonant frequency of the piezo-electric vibrating element 3.

The driving circuit 9 described above has

many advantages. Thus the consumption of electric power is reduced due to the use of transistor-switching. Moreover, the maximum sound effect of the piezo-electric vibrating element 3 may be obtained with only a small consumption of electric power because the piezo-electric vibrating element resonates at the oscillating frequency of the circuit. The circuit has a very long life because the circuit is contactless except for the switch actuated by the timing mechanism. No re-adjustment of the frequency is required, so that maintenance can easily be performed. The circuit is, moreover, particularly suitable for use in portable mechanisms such as watches where space is extremely limited.

Furthermore, a watch as shown herein has many advantages. Thus the watertightness of the watch case is assured by the fact that the inner back cover 2, case member 7, and glass 11 are sealed to each other. The sound of the piezo-electric vibrating element 3 can be clearly heard since it is transmitted through the holes 1a to 1i provided in the outer back cover 1. The piezo-electric element 3 employed as the vibrating means has no mechanical parts and therefore requires no re-adjustment of difficult adjustment of the frequency. The vibrating piezo-electric element 3 is comparatively thin so that it is particularly suitable for use in a small watch. The back cover of the watch case is easily assembled or disassembled because the piezo-electric element adhesively fixed to the inner back cover is releasably electrically connected to the driving circuit 9 by means of the terminal pin 5 provided on the inner back cover 2 and the spring 13.

WHAT WE CLAIM IS:—

1. A watch provided with a buzzer having a piezo-electric vibratory means adapted to produce a buzzing sound, and an electrical driving circuit for actuating the vibratory means.

2. A watch as claimed in claim 1 comprising a housing, a back cover separate from but mounted on said housing, the said vibratory means being mounted on the said back cover, and the electrical driving circuit being disposed in said housing, and

connecting means for electrically connecting said driving circuit to said back cover and said vibratory means.

3. A watch according to claim 2, wherein said back cover comprises an inner back cover and an outer back cover, said vibratory means being mounted on said inner back cover.

4. A watch according to claim 3, wherein said outer back cover is provided with at least one hole therein for increasing the audibility of the buzzing.

5. A watch according to any of claims 2 to 4 wherein said connecting means comprises a resilient member insulatedly mounted on a frame, one end of the resilient member being electrically connected to said driving circuit and the other end thereof being held in contact with means electrically connected to said vibratory means.

6. A watch according to any preceding claim in which the driving circuit comprises a transistor switching device for effecting intermittent vibration of the vibratory means.

7. A watch according to any preceding claim wherein said driving circuit comprises a transistor having its collector connected in series with both a power supply and a switch arranged to be actuated by a timing mechanism; a diode connected to the base of the transistor; a resistor connected between the input terminal of the diode and the collector of the transistor; a first capacitor connected between the input terminal of the diode and earth; and an oscillatory circuit including a second capacitor, connected to the base of said transistor, and a coil having one end connected to said second capacitor and the other end connected to said power supply, said coil having a centre-tapped portion to which the emitter of said transistor is connected, said vibratory means being connected across said coil.

8. A watch substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

J. MILLER & CO.,
Agents for the Applicants,
Chartered Patent Agents,
262 High Holborn,
London, WC1V 7EF.



many advantages. Thus the consumption of electric power is reduced due to the use of transistor-switching. Moreover, the maximum sound effect of the piezo-electric vibrating element 3 may be obtained with only a small consumption of electric power because the piezo-electric vibrating element resonates at the oscillating frequency of the circuit. The circuit has a very long life because the circuit is contactless except for the switch actuated by the timing mechanism. No re-adjustment of the frequency is required, so that maintenance can easily be performed. The circuit is, moreover, particularly suitable for use in portable mechanisms such as watches where space is extremely limited.

Furthermore, a watch as shown herein has many advantages. Thus the watertightness of the watch case is assured by the fact that the inner back cover 2, case member 7, and glass 11 are sealed to each other. The sound of the piezo-electric vibrating element 3 can be clearly heard since it is transmitted through the holes 1a to 1i provided in the outer back cover 1. The piezo-electric element 3 employed as the vibrating means has no mechanical parts and therefore requires no re-adjustment of difficult adjustment of the frequency. The vibrating piezo-electric element 3 is comparatively thin so that it is particularly suitable for use in a small watch. The back cover of the watch case is easily assembled or disassembled because the piezo-electric element adhesively fixed to the inner back cover is releasably electrically connected to the driving circuit 9 by means of the terminal pin 5 provided on the inner back cover 2 and the spring 13.

WHAT WE CLAIM IS:—

1. A watch provided with a buzzer having a piezo-electric vibratory means adapted to produce a buzzing sound, and an electrical driving circuit for actuating the vibratory means.

2. A watch as claimed in claim 1 comprising a housing, a back cover separate from but mounted on said housing, the said vibratory means being mounted on the said back cover, and the electrical driving circuit being disposed in said housing, and

connecting means for electrically connecting said driving circuit to said back cover and said vibratory means.

3. A watch according to claim 2, wherein said back cover comprises an inner back cover and an outer back cover, said vibratory means being mounted on said inner back cover.

4. A watch according to claim 3, wherein said outer back cover is provided with at least one hole therein for increasing the audibility of the buzzing.

5. A watch according to any of claims 2 to 4 wherein said connecting means comprises a resilient member insulatedly mounted on a frame, one end of the resilient member being electrically connected to said driving circuit and the other end thereof being held in contact with means electrically connected to said vibratory means.

6. A watch according to any preceding claim in which the driving circuit comprises a transistor switching device for effecting intermittent vibration of the vibratory means.

7. A watch according to any preceding claim wherein said driving circuit comprises a transistor having its collector connected in series with both a power supply and a switch arranged to be actuated by a timing mechanism; a diode connected to the base of the transistor; a resistor connected between the input terminal of the diode and the collector of the transistor; a first capacitor connected between the input terminal of the diode and earth; and an oscillatory circuit including a second capacitor, connected to the base of said transistor, and a coil having one end connected to said second capacitor and the other end connected to said power supply, said coil having a centre-tapped portion to which the emitter of said transistor is connected, said vibratory means being connected across said coil.

8. A watch substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

J. MILLER & CO.,
Agents for the Applicants,
Chartered Patent Agents,
262 High Holborn,
London, WC1V 7EF.