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Kasai et al.

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[54] **BATTERY-POWERED TIMEPIECE WITH EXTERNALLY ACCESSIBLE CIRCUITRY**

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[21] Appl. No.: **509,156**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 296,410, Oct. 10, 1972, abandoned.

[30] **Foreign Application Priority Data**

Oct. 7, 1971 Japan 46-79043

[52] **U.S. Cl.** ..... **58/23 BA**

[51] **Int. Cl.** **G04c 3/00**

[58] **Field of Search** ..... 58/19 C, 23 BA, 127 R

[56] **References Cited**

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Primary Examiner—George H. Miller, Jr.

Attorney, Agent, or Firm—Blum, Moscovitz, Friedman & Kaplan

[57] **ABSTRACT**

A battery-powered timepiece has a transparent cover over the dial, said cover having thereon indicia, including decorative material, of a conductive metal. Conductive leads pass over the edge of the transparent cover and make pressure contacts with leads connected with selected points of the circuitry of said watch. The exposed metallic regions on the surface of the transparent cover make it possible to check out the circuitry, and, where a secondary battery is used, to recharge the battery.

10 Claims, 5 Drawing Figures

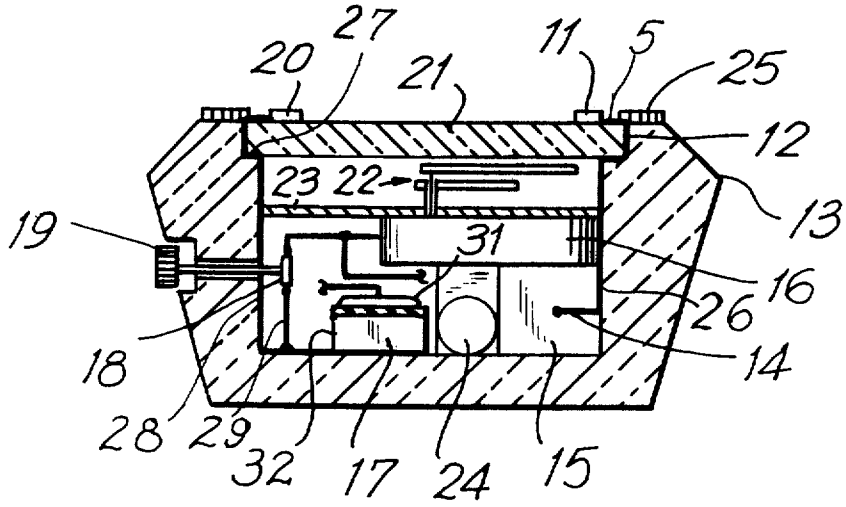


FIG. 1

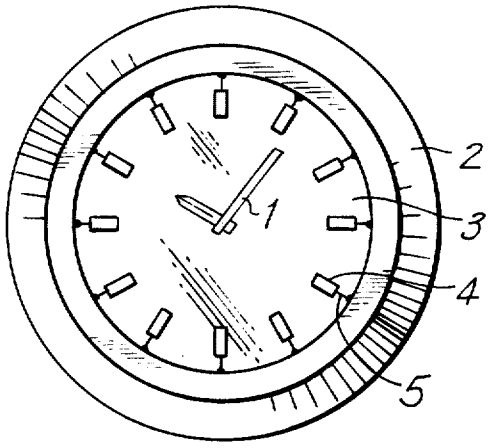


FIG. 2

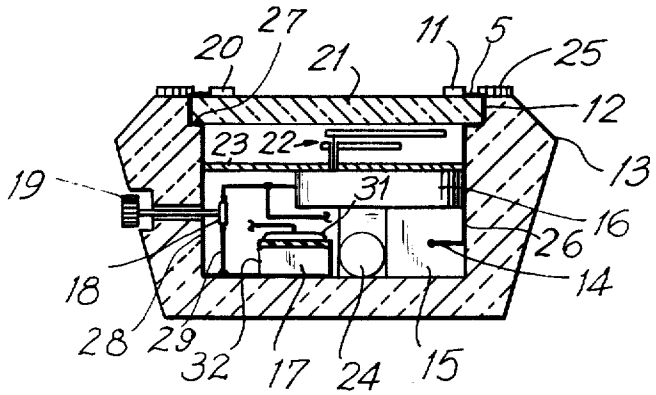


FIG. 3

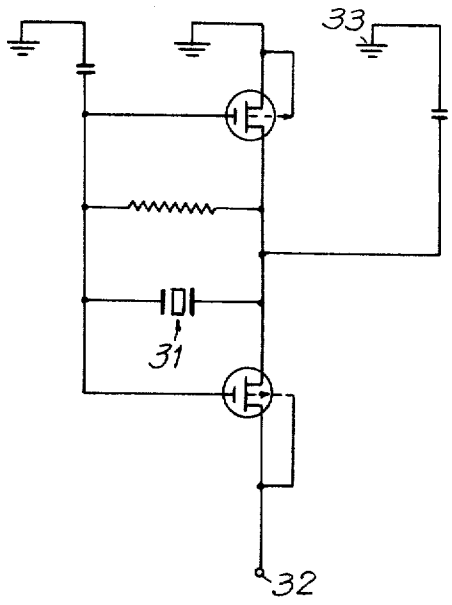
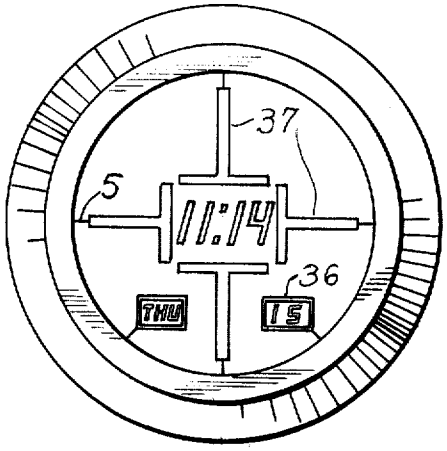


FIG. 4



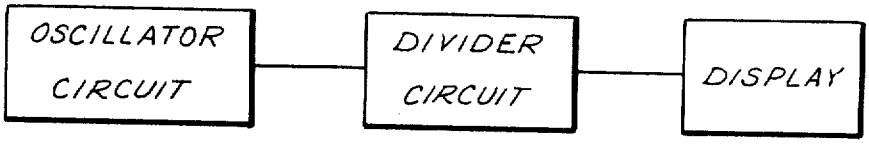


FIG. 5

BATTERY-POWERED TIMEPIECE WITH EXTERNALLY ACCESSIBLE CIRCUITRY

CROSS-REFERENCE TO RELATED APPLICATION

The present application is a continuation-in-part of parent application having the Ser. No. 296,410, filed Oct. 10, 1972. The parent application is now abandoned.

BACKGROUND OF THE INVENTION

As timepieces, and in particular, wrist-watches are used more and more as costume jewelry in addition to indicating the time, the search for novel methods of enhancing the appearance of timepieces is pursued intensively. In proceeding to decorate such a timepiece, the watch case itself, the band holding the watch case, the dial, the watch crystal and the bezel all serve as media to be decorated. Up to the present time, decoration has largely been limited to such processes as gold plating, chromium plating, alumite dyeing and the use of synthetic and semi-precious stones. More recently, both clear and colored, have been used as settings for an entire watch. As is evident, the search for new means and, in particular, creative means of ornamenting watches continues at a great rate.

In addition to considerations concerning the appearance of timepieces, it is noted that problems arise from the fact that battery-powered timepieces have become popular and appear likely to constitute a continually increasing fraction of the market. Such timepieces, up to the present time, have used primary batteries, i.e., batteries which cannot be recharged. Such batteries have a limited life, as is well known. Unfortunately, the life of the battery cannot be precisely predicted; accordingly, the imminence of failure of the battery, as timepieces are presently constructed, does not evidence itself in any way. As a result, the user of a battery-powered watch becomes aware of the failure of the battery only as the result of the timepiece ceasing to function. Obviously, such failure can occur at times when the lack of a functioning timepiece is extremely awkward. It is therefore evident that it would be most desirable to have a timepiece so constructed that imminence of failure of the battery could be detected. It would also be desirable to be able to examine the circuitry from the exterior of the timepiece without disassembling same. Specifically, where the timepiece is of the quartz-crystal type, it would be advantageous to be able to determine whether the crystal is oscillating at the desired rate. Up to this point, however, it has not been feasible to determine the condition of the battery, to recharge the battery, where a secondary is used, or to probe the circuitry of battery-powered watches without taking them apart.

SUMMARY OF THE INVENTION

A timepiece has a transparent cover either of plastic or of glass on which are formed indicia or decorative elements of a conductive material. Conductive leads are carried over the edge of the cover to a region where pressure-contacts can be made with corresponding leads connected with selected points in the circuitry of the watch. Two of the indicia or decorative elements may thereby be connected with the battery which powers the timepiece for the purpose of measuring the voltage of the battery, and thereby determining its condition. Where the battery is a secondary, i.e., a rechargeable battery, a switch is incorporated for disconnecting the battery from the circuitry so that the battery may be recharged. Conductive elements may also be connected to the oscillator portion of the circuitry so that a frequency meter may be connected through a synchroscope or an amplifier to said external elements for the purpose of determining the frequency at which the quartz-crystal oscillator is vibrating.

The timepiece may be of the digital or of the analogue type. Where the timepiece is of the analogue type, the conductive elements may be spaced about the periphery of the timepiece to serve as indications of the hour. Where the timepiece is of the digital display type, using light-emitting diodes or a liquid crystal display device, the conductive elements may be arranged to be decorative. The invention is particularly useful for wristwatches where components are small in size and disassembly is relatively difficult.

Accordingly, an object of the present invention is an improved battery-powered timepiece wherein conductive elements, positioned on the exterior surface of the transparent cover of the timepiece are electrically connected to selected portions of the electrical circuitry of said timepiece.

Another object of the present invention is an improved battery-powered timepiece in which it is possible to determine the voltage of the battery from the exterior of said timepiece.

A further object of the present invention is an improved battery-powered timepiece in which it is possible to determine the vibrational frequency of an oscillator in the electrical circuitry thereof.

Still another object of the present invention is an improved battery-powered timepiece in which conductive elements on the exterior surface of the transparent cover of said timepiece serve as indicia or to enhance the appearance of said timepiece.

Yet another object of the present invention is an improved battery-powered timepiece wherein said battery is a secondary battery and can be recharged from the exterior of said timepiece.

An important object of the present invention is a battery-powered wristwatch wherein the circuitry of said wristwatch can be examined without disassembling said wristwatch.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification.

The invention accordingly comprises an article of manufacture possessing the features, properties, and the relation of elements which will be exemplified in the article hereinafter described, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the invention, reference is had to the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a plan view of a timepiece in accordance with the present invention;

FIG. 2 is a cross-sectional view of an analog timepiece in accordance with the present invention;

FIG. 3 shows quartz-crystal oscillator circuitry including the points to which connection must be made for determining the vibrational frequency of the quartz-crystal;

FIG. 4 is a plan view of a digital timepiece wherein

contact elements are used as decorative elements; and

FIG. 5 shows the driving circuitry of a quartz-crystal timepiece in box-diagram form.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The timepiece of FIG. 1 is of the analog type as is shown by the presence of hands 1. Case 2 is of an insulating material, preferably ceramic or plastic. Alternatively, case 2 may be of metal with a liner of non-conductive material (not shown).

Mounted in case 2 is transparent cover 3 which may be of glass or of plastic. On the surface of transparent cover 3 are conductive elements 4, each of said conductive elements having a conductive lead 5 connected thereto. Where the transparent cover 3 is of plastic, conductive element 4 and lead 5 are of a conductive paint. Such paints are widely available, and, as sold, consist of a vehicle containing a high concentration of a metallic powder, usually in the form of flakes. On evaporation of solvent, or on curing, a relatively permanent, conductive residue remains. Where the transparent cover is of glass, conductive element 4 and lead 5 are applied in the form of a metal resinate by any convenient means such as screen-printing, transferring, brush painting or the like, after which the piece is fired at a temperature high enough to burn off the organic portion of the metal resinate. The residue is a highly-conductive, strongly-adherent metal. Preferred metals are gold, gold alloys, platinum and silver. Gold resinates are sold as liquid gold. However, such compositions are widely available.

In the embodiment of FIG. 1, the conductive elements 4 are deposited at spacings corresponding to those of the hours on the usual timepiece. Consequently, they may be termed indicia. The indicia may take a variety of forms, including actual numbers. Further, they may be so shaped as to be decorative as well as useful in making it feasible to read the time easily. Moreover, although a conductive lead 5 is shown attached to each of the elements 4, the number of leads may be limited in accordance with the intention of the designer as based on the number of connections to the circuitry which will be employed.

In FIG. 2 conductive elements 11 and 20 on the outer surface of transparent cover 21 are connected to conductive leads 5 which pass over the outer edge of transparent cover 21. Conductive lead 26 is connected at one end to a selected point in the circuitry. Lead 26 traverses the interior case up to the region 12 at which region lead 26 makes a pressure contact with that portion of lead 25 which passes over the outer edge of cover 21. Alternatively, pressure contact can be made between lead 5 and a lead from the circuitry at the region indicated by the reference numeral 27. For contact to be made between corresponding leads at region 27, it is necessary that lead 5 not only traverse the outer edge of cover 21 but also lie partly on the lower face of cover 21. Pressure contact between lead 5 on cover 21 and leads from the circuitry may be made easily through the use of a spring member of a material such as Be-Cu (not shown).

Lead 28 which is electrically continuous with conductive element 20 when cover 21 is in place, also is joined with the case of battery 17. The other terminal of battery 17 is also joined by a lead (not shown) to a conductive element (not shown) on the outer surface of cover 21. By means of these latter two conductive elements, it is possible to measure the voltage of battery 17 at any time without interrupting the operation of the timepiece, and thereby, to determine the voltage of the battery, from which voltage it will be known whether the end of the operating life of the battery is imminent.

Switch 18, operated by crown 19, when in the position shown in FIG. 2, permits battery 17 to power the circuitry of the timepiece. Characteristically, reference numeral 15 represents a C-MOS IC substrate, having a terminal 14. Battery 17, through the use of leads connected to its terminals 31 and 32 powers the circuitry as well as motor 16 driving hands 22. Where battery 17 is of the secondary type, movement of crown 19 inwardly opens lead 29 so that the battery 17 is disconnected from the motor in the circuitry. Under such circumstances battery 17 can be recharged through the use of outer conductive elements 20 and another conductive element (not shown) connected to terminal 31 of the battery.

As aforenoted, case 13 may be of ceramic or of plastic. Dial 23 is mounted in the case, and bezel 25 is used to hold cover 21 in place. Bezel 25 must be so designed that it does not short out any of the leads 5. One way of effecting this is to make bezel 25 of an insulator, such as a ceramic or a plastic.

Reference numeral 24 in FIG. 2 indicates a capsule of a quartz-crystal vibrator. In FIG. 3 which is a C-MOS IC of a quartz-crystal oscillating circuit, the quartz-crystal vibrator itself is indicated by the reference numeral 31. In order to determine the vibration frequency of quartz-crystal oscillator 31, a frequency meter may be connected to outer electrodes 32 and 33, such outer electrodes corresponding to conductive elements 4 of FIG. 1 and 36 and 37 of FIG. 4. FIG. 4 shows, in plan view, a timepiece of the digital type, where the display is either of the liquid crystal type or the light-emitting diode type.

The circuitry necessary for driving a battery-powered watch is shown schematically in FIG. 5. As shown in said Figure, it consists of an oscillator circuit which supplies a time standard frequency and a divider circuit which drives the display. Where the display is of the digital type, the divider circuit also includes decoder means.

As will be evident, the present invention is particularly suitable for use with wristwatches due to the fact that it is highly desirable that such timepieces be of minimum diameter and thickness. These requirements increase the difficulty of disassembling such timepieces to determine the condition of the battery or to examine the circuitry. Consequently, the present invention is particularly useful with respect to wristwatches.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above article without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description and shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention, which, as a matter of language, might be said to fall therebetween.

What is claimed is:

1. In a quartz-crystal oscillator timepiece driven by a battery, and having a transparent cover, the improvement comprising a plurality of adherent conductive elements on the exterior of said cover, said elements being electrically connected to the circuitry of said timepiece so that the voltage of said battery may be monitored by making contact with selected conductive elements.

2. The improvement as defined in claim 1, wherein said elements are so connected to said circuitry that the frequency of vibration of said oscillator may be measured by making contact with selected elements.

3. The improvement as defined in claim 1, wherein said cover is of an inorganic glass and said conductive elements are fired metal resinates.

4. The improvement as defined in claim 1, wherein said crystal is removably seated in an insulated case and each of said adherent conductive elements has electrically connected thereto a first continuous lead passing over the edge of said crystal to an interior region of said timepiece, and said circuitry has a plurality of second leads attached to selected portions thereof, said first and second leads being so disposed that seating said crystal in said case effects pressure contacts between pairs of said first and second leads.

5. The improvement as defined in claim 1, wherein said timepiece is of the analog type and said conductive elements are indicia.

6. The improvement as defined in claim 1, wherein said timepiece is of the digital type and said conductive elements are decorative.

7. The improvement as defined in claim 1, wherein said improvement further comprises a switch operable from the exterior of said timepiece for disconnecting said battery from said circuitry, thereby making it possible to recharge said battery without removing same from said timepiece.

8. The improvement as defined in claim 1, wherein said timepiece is a wristwatch.

9. The improvement as defined in claim 1, wherein said conductive elements are of a tarnish-resistant metal.

10. The improvement as defined in claim 9, wherein said conductive elements are of a member of the group consisting of gold, gold alloys, platinum and silver.

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