United States Patent

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[73] Assignee **Bulova Watch Company Inc. New York, N.Y.**
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[33] **Switzerland**
[31] **1798/69**

[54] **MINIATURIZED ELECTRONIC WATCH**
5 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** ..... **58/23 BA,** 58/23 TF
[51] **Int. Cl.** **G04c 3/00**
[50] **Field of Search** 58/23, 50, 88, 90

[56] **References Cited**
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ABSTRACT: A miniaturized electronic watch in which a tuning fork resonator is sustained in vibration by a transistorized drive circuit energized by a single power cell, the vibratory action being converted into rotary motion to operate a dial train which turns the hands of the watch. The watch movement includes a pillar plate below which the power cell is so positioned that its periphery coincides at one point with the border of the plate, the body of the cell extending to or beyond the geometrical axis of the hands, which axis is normal to the plate. The tuning fork is disposed to one side of the cell below the plate, whereas the dial train is mounted above the cell to provide a highly compact layout.

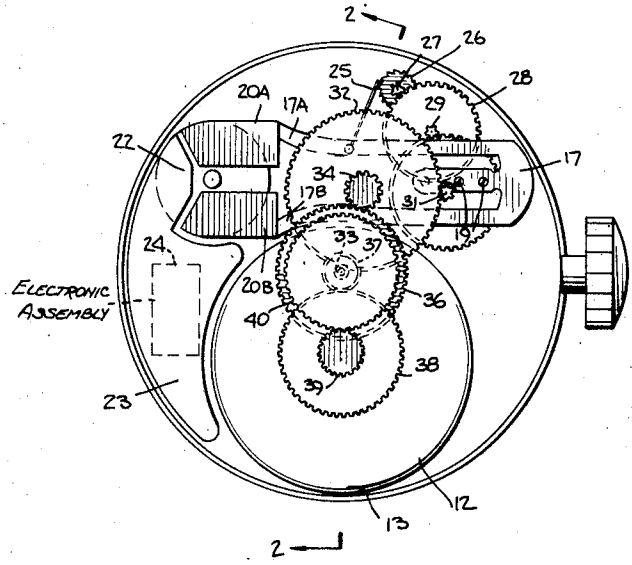

Fig. 1.

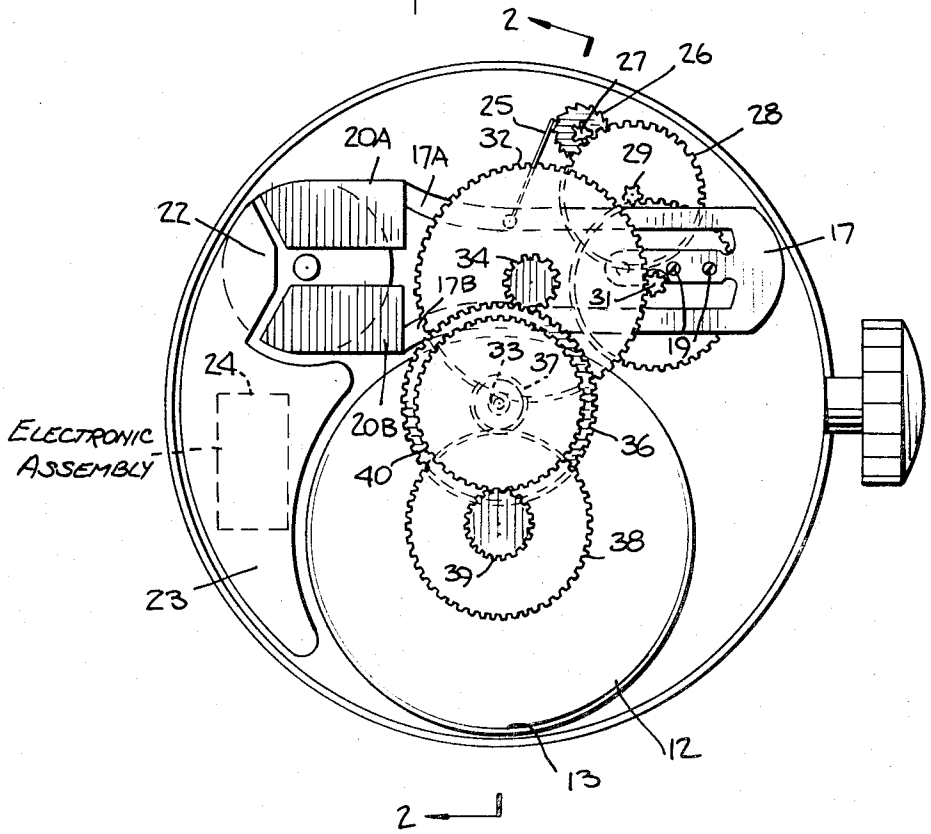

Fig. 2.

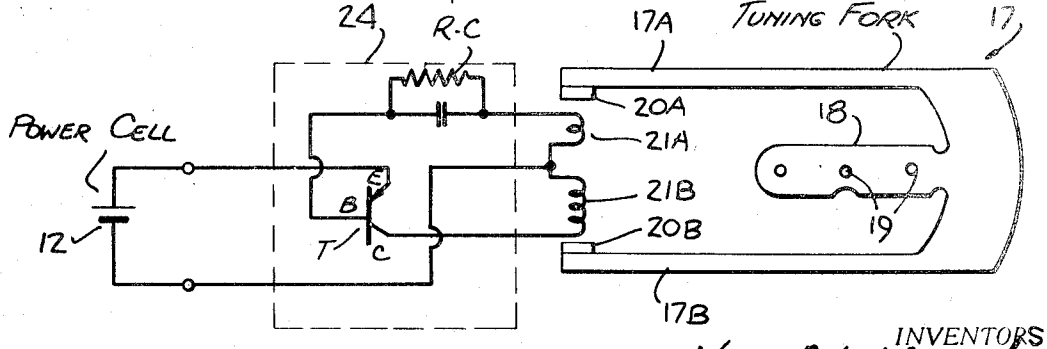

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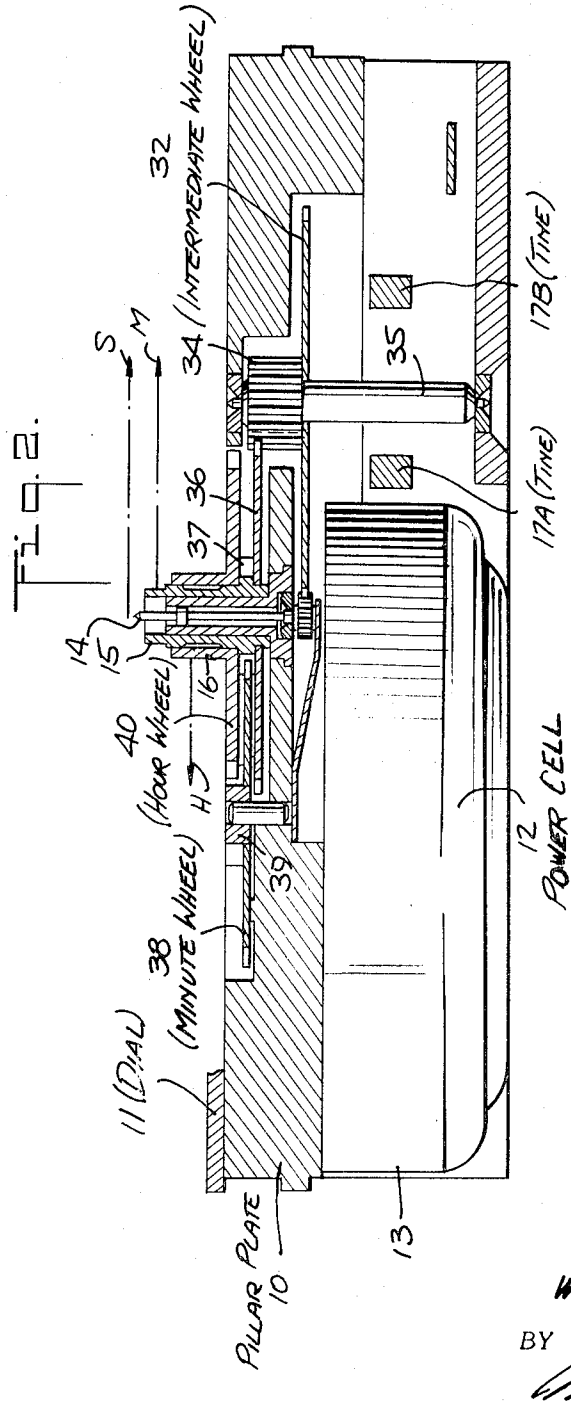
Fig. 2.



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MINIATURIZED ELECTRONIC WATCH

BACKGROUND OF INVENTION

This invention relates generally to battery-operated electronic timepieces, and more particularly to a miniaturized electronic watch including a tuning fork resonator whose vibrations are converted into rotary motion for operating dial pointers.

In electronic timepieces of the type disclosed in U.S. Pat. No. Re.26,322, a battery-energized transistor drive circuit acts to sustain the vibratory motion of a tuning fork. This motion is transferred by a pawl and ratchet mechanism to a rotary movement including a gear train and dial pointers or hands.

In tuning fork electronic watches of the type heretofore known, the structural arrangement has been such as to preclude a reduction in the diameter and other dimensions of the watch movement to a degree making it possible to house the movement within a ladies' watch case. Though such watches have been made in relatively large models having masculine appeal, it has not hitherto been feasible to miniaturize the dimensions to a point rendering the watch acceptable to ladies.

The main obstacle to a further reduction in the dimensions of an electronic timepiece of the tuning fork type, is the power cell. This single-cell battery, which is round and buttonlike, occupies a relatively large portion of the useful volume of a watch movement. In the conventional layout, the power cell is laterally displaced from the dial train, as a consequence of which a watch movement with a commercially available type of power cell has a diameter of at least 25 millimeters. This diameter is beyond the limits acceptable in ladies-model watches.

SUMMARY OF INVENTION

In view of the foregoing, it is the main object of this invention to provide a miniaturized electronic watch movement which may be housed in a relatively small case and is, therefore, acceptable in lades' models or for other applications in which small size is a desideratum.

More specifically, it is an object of the invention to provide a layout for an electronic watch of the tuning fork type, in which the single power cell is disposed below the pillar plate with its periphery coincident to the border of the plate at at least one point, the fork being also disposed below the plate in side-by-side relation to the cell, whereas the dial train for turning the hands is mounted above the cell, to afford a highly compact structure.

A significant feature of the invention is that the layout of the dial train, power cell, tuning fork, and the associated electronic assembly, is such as to make possible a movement whose diameter is less than 20 millimeters, such dimensions being suitable for ladies' models.

Briefly stated, these objects are accomplished in a tuning fork electronic watch movement in which the single buttonlike power cell for energizing the electronic drive circuit is placed below the pillar plate with at least one point on its periphery coincident with the border of the plate, the body of the cell extending beyond the geometrical center of the hands. The tuning fork is disposed in side-by-side relationship to the cell below the plate and is operatively coupled to the dial train for turning the hands, which dial train is mounted above the cell.

OUTLINE OF DRAWING

For a better understanding of the invention, as well as other objects and further features thereof, reference is made to the following detailed description to be read in conjunction with the accompanying drawing, wherein:

FIG. 1 is a schematic view of an electronic watch in accordance with the invention as viewed from the dial side, with the dial, pillar plate, and case omitted to facilitate an understanding of the invention;

FIG. 2 is a transverse section taken in the plane indicated by line 2—2 in FIG. 1; and

FIG. 3 is a schematic diagram of the electronic circuit of the watch.

DETAILED DESCRIPTION OF INVENTION

Referring now to the drawing, a miniaturized watch movement in accordance with the invention includes a circular pillar plate **10**, above which is mounted a watch dial **11**. The movement fits within a case (not shown). The purpose of the invention is to provide a movement of small diameter adapted to fit within a ladies' model case of 20 millimeters or less.

Disposed below pillar plate **10** is a buttonlike, round power cell **12** whose flat top and bottom surfaces are parallel to the plane of pillar plate **10**. Cell **12** is tangentially disposed with respect to the border of pillar plate **11**, so that point **13** on the circumference of the cell is substantially in line with the border. Depending on the shape of the power cell relative to the pillar plate, more than one coincidence point is possible.

The seconds, minute and hour hands indicated diagrammatically by lines S, M and H, are mounted respectively on arbor **14**, cannon **15**, and tube **16**, respectively, which are coaxially arranged. The axis of arbor **14**, which is the geometrical axis X of the hands, coincides with the center of pillar plate **10**. The diameter of cell **12** is somewhat greater than the radius of the pillar plate; hence the body of the cell extends well beyond the geometrical axis X of the hands. Therefore, in the embodiment illustrated, the axis X passes through the power cell. In other instances, the cell may come quite close to the axis, or go only slightly beyond it.

The electronic watch includes a tuning fork, generally designated by numeral **17**, having two tines **17A** and **17B**, and a reentrant mounting stem **18** which is attached to the underside of the pillar plate by screws **19**. The fork is positioned in side-by-side relationship to cell **12**, the tines lying in a common plane which is parallel to the top and bottom surfaces of the cell.

At the free ends of tines **17A** and **17B** are attached permanent magnets **20A** and **20B** which cooperate with a stationary pancake-shaped coil **21** having sensing and drive windings **21A** and **21B** (FIG. 3), the magnetic flux in the air-gap of the magnets being perpendicular to the plane of the coil. Coil **21** is supported from a projection **22** formed on a plastic module **23** which houses the electronic assembly, generally designated by numeral **24**.

This assembly, as best seen in FIG. 3, is constituted by a transistor T and a resistance capacitance network RC which is associated with the sensing and drive windings **21A** and **21B**. The manner in which the circuit acts to sustain the tuning fork in vibration is explained in U.S. Pat. No. 2,971,323, and will, therefore, not be repeated herein.

It will be seen that the outer side of module **23** is convex to conform to the corresponding curvature of the border of the pillar plate on which it is mounted, whereas the inner side is concave to conform to the curvature of cell **12**, while the profile of the upper side follows that of the tuning fork. Thus the shape of module **23** permits optimum use of the space between the fork, the cell, and the periphery of the movement.

An index finger **25** is attached to tine **17A**, the finger **25** having a jewelled tip which engages the teeth of an index wheel **26**. A pawl (not shown) cooperates with the wheel to prevent retrograde motion thereof. The pinion **27** of index wheel **26** meshes with the teeth of a wheel **28** whose pinion **29** drives a wheel **30**. The pinion **31** of wheel **30** drives an intermediate wheel **32**, which in turn drives a pinion **33** mounted on the lower end of the arbor **14** for turning the seconds hand S.

On the arbor **35** of intermediate wheel **32**, is attached a pinion **34** which drives wheel **36**. A friction clutch (not shown) is interposed between wheel **36** and cannon **15**. Cannon **15** is provided with a pinion **37** which meshes with minute wheel **38**, which, by means of pinion **39**, drives hour wheel **40** mounted on tube **16**.

It will be seen that all dial train elements supporting hands S, M and H, are disposed above power cell **12**. As seen from

the backside of the movement, all of these parts, including minute wheel **38**, are hidden by cell **12**. Thus the cell, instead of being laterally displaced from the dial train elements, as in the conventional electronic watch arrangement, are disposed thereover, making possible a substantial reduction in the diameter of the movement.

While there has been shown a preferred embodiment of a miniaturized electronic watch in accordance with the invention, it will be appreciated that changes and modifications may be made within the scope of the invention.

For example, other parts of the wheel train may be placed on top of the cell in addition to those shown. This depends on the shape of the resonator, which is not limited to the tuning fork shown, and on the arrangement of the other electronic and mechanical components.

What we claim is:

1. A miniaturized electronic timepiece comprising:

A. a pillar plate having a dial thereover;

B. timing hands turnable on said dial with respect to a geometrical axis passing through the center of said plate,

C. a button-shaped, single power cell disposed below said plate at a position in which one point on the periphery of said cell substantially coincides with the border of said plate, the body of the cell extending at least to said axis, the flat top surface of said cell being parallel to said plate,

D. a mechanical resonator serving as a frequency standard, said resonator being constituted by a tuning fork sustained in vibration by an electronic drive circuit energized by said cell, the fork being disposed below said plate to one side of said cell and having a pair of tines which lie in a plane parallel to the top and bottom surfaces of said cell, and

E. means to convert the vibrations of said resonator to rotary motion for turning said hands, said means including a dial train operatively coupled to said hands and disposed above the plane defined by the top surface of said cell.

2. A timepiece as set forth in claim **1**, wherein said timing hands are constituted by seconds, minute and hour hands, the seconds hand being supported on an arbor lying along said geometrical axis, the minute hand being supported on a cannon coaxially disposed with respect to said arbor, said hour hand being supported on a tube concentric with said cannon, said arbor being operated by a pinion attached to the end thereof, which pinion is hidden by the cell when looking at the movement from the side opposing the dial.

3. A timepiece as set forth in claim **2**, wherein said cannon and tube are also hidden by the cell.

4. A timepiece as set forth in claim **3**, wherein said cannon is engaged by a minute wheel which is disposed above the plane defined by the top surface of said cell and is hidden by said cell when the movement is viewed from the side opposing the dial.

5. A timepiece as set forth in claim **3**, wherein the components forming said electronic drive circuit are contained in a plastic module disposed between the border of said plate, the periphery of the cell, and one tine of the fork, the outer side of the module being curved to conform to the curvature of said border, the inner side of the module being curved to conform to the curvature of said cell.

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