

PATENT SPECIFICATION

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(54) A DIAL FOR A TIMEPIECE

(71) We, KABUSHIKI KAISHA SUWA SEIKOSHA, a Japanese company, of 3—4, 4-chome, Ginza, Chuo-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 dials for timepieces and to timepieces provided therewith.

According to one aspect of the present invention there is provided a dial for a timepiece having photoelectric means provided thereon, and having at least one window therein through which an indication of time (as herein defined) may be displayed. The term "time" is used in this specification in a broad sense as relating not only to hours, minutes and seconds, but also to days of the week, months, and date indications.

The photoelectric means may comprise a plurality of radially extending photoelectric elements.

The dial may include opposing recesses in at least two adjacent photoelectric elements, the recesses bounding the or a window.

In one embodiment, the photoelectric element adjacent the or each window is of a different shape but of substantially the same area as the or another photoelectric element.

Said photoelectric means may be provided on only one part of the dial. In this case, the or a window may be provided in the other part of the dial. Alternatively, said photoelectric means may comprise a plurality of photoelectric elements, opposing recesses in at least two adjacent photoelectric elements bounding the or a window.

Said photoelectric means may comprise a plurality of photoelectric elements, two or more of which are smaller in area than the other photoelectric elements, said two or more photoelectric elements being electrically connected in parallel with respect to one another and in series with respect to said other photoelectric elements, said other photoelectric elements being electrically connected in series.

According to a further aspect of the pre-

sent invention there is provided a timepiece having a dial as recited above.

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

Figures 1 to 6 are plan views of different embodiments of dials according to the present invention,

Figures 7 and 9 show plan views of two further embodiments of dials according to the present invention, and

Figures 8 and 10 shows the reverse sides of the dials of Figures 7 and 9 respectively.

Hitherto, in a timepiece having a dial provided with photoelectric elements or a solar battery thereon, the time has been indicated by conventional hours, minutes and seconds hands positioned above the surface of the dial. However, the shadows cast by the hands on the dial reduce the output current of the battery. Furthermore, when the dial has a solar battery it is difficult to provide the timepiece with means for indicating the day and/or date.

Referring to the drawings, and in particular to Figure 1, there is shown a first embodiment of a dial 1 according to the present invention for a timepiece. The dial 1 is circular in shape and is provided with a plurality (twelve shown) of radially extending spaced apart sector-shaped photoelectric elements or solar cells 2 which are connected in series to form a solar battery. Indicia 9 are provided between the radial boundaries of the solar cells to indicate the hours. In order to provide sufficient power to drive the timepiece, especially when the latter is a small-sized watch such as a wristwatch, the solar battery extends over substantially the whole of the dial. A window 3 is provided in the dial through which window an indication of time may be displayed. A pair of opposing recesses 4', 5' are provided in adjacent solar cells 4, 5 and these recesses bound the window. It is difficult, if not impossible, to form the recesses 4', 5' by a conventional process, for example, a scribe process but they can be formed by an ultrasonic process and this pro-

[Price 25p]

SPECIFICATION AMENDED - SEE ATTACHED SLIP

cess enables windows of even more complex shapes than those shown in the drawings to be formed. In Figure 1 an indication of date and day is displayed in the window 3, and the indicia 9 indicate the hours, minutes and seconds being displayed by conventional hands (not shown). The window 3 is disposed at the 3 o'clock position in Figure 1, although, of course, it could be disposed at any convenient position in the dial, for example the 6 o'clock, 9 o'clock or 12 o'clock position. Whilst the dial shown in Figure 1 has twelve solar cells, it may have any number of solar cells, although six or twelve is the most convenient number to achieve a desired output current to drive the timepiece. Two or more windows may be provided in the dial so that any one or more of date, day, hours, minutes and seconds may be indicated separately.

Referring to Figure 2 there is shown a second embodiment of a dial 1' according to the present invention for a timepiece. Again, the dial 1' is circular in shape and is provided with a plurality (eleven shown) of radially extending spaced apart sector-shaped photoelectric elements or solar cells 2' which are connected in series to form a solar battery. A window 3' is formed in the dial at the 9 o'clock position and in a segment of the dial not provided in with a solar cell. An indication of hours and minutes is displayed in the window.

In the conventional timepiece having a dial on which a solar battery is provided, hours and minutes hands pass above the dial and, as the gap between the hands and the dial is designed to be as little as possible, they cast strong shadows on the solar battery. Since it is desirable that each solar cell of the solar battery should receive substantially the same intensity of radiation, in the present invention a time indication of hours and minutes may be displayed through the window in the dial, thus avoiding the casting of shadows on the dial since it is no longer necessary to provide hours and minutes hands. However, it is possible still to provide a relatively fast moving hand whilst replacing the relatively slow moving hands with a window in the dial.

In the case where the timepiece is a watch and is designed to be worn on the left hand, the left-hand half of the dial is often obscured by clothing, e.g. a sleeve, and so this half of the dial does not receive as much radiation as the right-hand half. Thus, the solar battery may be provided on the right-hand half of the dial whilst the window or windows for displaying a time indication are provided in the left-hand half, for example at the 9 o'clock position. In this case it may be more convenient to display hours and minutes through the window than date and/or day. This construction will, of course, be reversed in the case where the watch is designed to be worn on the right hand.

In Figure 3 there is shown a square-shaped dial 6 according to the present invention for a watch. In this case a plurality (eight shown) of rectangular photoelectric elements or solar cells 7 are provided on the right-hand half of the dial and adjacent cells 7a, 7b, 7c and 7d have opposed recesses therein which bound a window 8 through which an indication of time may be displayed.

In Figure 4 there is shown another embodiment of a dial 6' according to the present invention for a watch, this embodiment being similar to that shown in Figure 3. A plurality (seven shown) of rectangular photoelectric elements or solar cells 7' are provided in the right-hand half of the dial. A window 8' is provided at a position in the right-hand half of the dial where this is no solar cell. In both Figures 3 and 4 the solar cells are connected in series to form a solar battery.

Next, Figure 5 shows another embodiment of a dial 11 according to the present invention for a timepiece. The dial 11 is circular in shape and is provided with a plurality (eleven shown) of radially extending spaced apart sector-shaped photoelectric elements or solar cells 12 which are connected in series to form a solar battery. A window 13 is provided in the dial through which window an indication of time is displayed. A solar cell 14 adjacent the window is of a different shape to the other solar cells 12, but has substantially the same radiation receiving area. The solar cell 14 and the window 13 may be disposed at any convenient position on the dial and not necessarily the 3 o'clock position as shown. This arrangement has the advantage that if all the solar cells receive the same intensity of radiation they each produce substantially the same output current whereas, for example, in the arrangement shown in Figure 1 the solar cells 4, 5 produce a slightly lower output current than the other solar cells.

A further embodiment of a dial according to the present invention for a timepiece is shown in Figure 6. This embodiment is very similar to that shown in Figure 2 and so like parts have been designated by the same reference numerals. In this embodiment, the window 3' is disposed centrally in the segment of the dial 1' which is not provided with a solar cell 2'.

The embodiments of the present invention described above have the advantage that an indication of time, for example, of any one or more of date, day, month, hours, minutes and seconds is displayed in a window or windows and, when no hands are provided, shadows are not cast on the solar battery. The window or windows can be disposed in any convenient position without affecting the high efficiency of the solar battery.

In the conventional timepiece the energy produced from the solar battery is stored in a

secondary battery which, in turn, drives the timepiece. In order to increase efficiency it is necessary to maximise the output current of the solar battery.

Referring now to Figures 7 and 8 there is shown a dial 21 according to the present invention for a timepiece. The dial is circular in shape and is provided with a plurality (twelve shown) of radially extending spaced apart sector-shaped photoelectric elements or solar cells 22, the solar cells being connected to form a solar battery. A window 23 is formed in the dial and two adjacent solar cells 22' are recessed to bound the window. As described in connection with the previous embodiments an indication of time is displayed in the window 23.

The output current of the solar battery is proportional to the radiation or light-receiving area of all the solar cells. However, the output current of each solar cell 22' is smaller than that of each of the solar cells 22. If all the cells are connected in series, the output current of the solar battery is limited by the solar cells 22' and, in fact, the output current is only equal to the output current of the solar cells 22'.

If $(n-1)$ solar cells of area A are connected in series, the current output will be greater than the current output of n solar cells of area A' if

$$\frac{A-A'}{A} > \frac{1}{n}$$

Therefore, in the present embodiment the solar cells 22' are electrically connected in parallel with respect to one another by connecting wires 24' and in series with respect to the solar cells 22 which are themselves electrically connected in series by connecting wires 24, the connecting wires 24, 24' being on the reverse side of the dial as shown in Figure 8. Thus, the output current from the solar cells 22' is proportional to $2A'$ and, as long as, $2A' > A$, the solar cells 22' do not limit the output current of the solar battery which is, therefore, independent of the size of the window.

Figures 9 and 10 show an embodiment of a dial 31 according to the present invention for a timepiece. Again, the dial 31 is circular in shape and is provided with a plurality of radially extending spaced apart sector-shaped photoelectric elements or solar cells 32, the cells being connected so as to form a solar battery. A window 33 is formed in the dial

so that a solar cell 32' adjacent the window has a radiation or light-receiving area which is less than that of the solar cells 32. As in the previous embodiment, the solar cells 32 are connected in series by connecting wires 34, 34' and the cell 32' is merely a "dummy" not being connected to the circuit of the solar cells 32.

WHAT WE CLAIM IS:—

1. A dial for a timepiece having photoelectric means provided thereon, and having at least one window therein through which an indication of time (as herein defined) may be displayed.

2. A dial as claimed in claim 1 in which the photoelectric means comprises a plurality of radially extending photoelectric elements.

3. A dial as claimed in claim 2 including opposing recesses in at least two adjacent photoelectric elements, the recesses bounding the or a window.

4. A dial as claimed in claim 2 in which the photoelectric element adjacent the or each window is of a different shape but of substantially the same area as the or another photoelectric element.

5. A dial as claimed in claim 1 in which said photoelectric means is provided on only one part of the dial.

6. A dial as claimed in claim 5 in which the or a window is provided in the other part of the dial.

7. A dial as claimed in claim 5 in which said photoelectric means comprises a plurality of photoelectric elements, opposing recesses in at least two adjacent photoelectric elements bounding the or a window.

8. A dial as claimed in claim 1 in which said photoelectric means comprises a plurality of photoelectric elements, two or more of which are smaller in area than the other photoelectric elements, said two or more photoelectric elements being electrically connected in parallel with respect to one another and in series with respect to said other photoelectric elements, said other photoelectric elements being electrically connected in series.

9. A dial for a timepiece substantially as herein described with reference to and as shown in the accompanying drawings.

10. A timepiece having a dial as claimed in any preceding claim.

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secondary battery which, in turn, drives the timepiece. In order to increase efficiency it is necessary to maximise the output current of the solar battery.

5 Referring now to Figures 7 and 8 there is shown a dial 21 according to the present invention for a timepiece. The dial is circular in shape and is provided with a plurality (twelve shown) of radially extending spaced
10 apart sector-shaped photoelectric elements or solar cells 22, the solar cells being connected to form a solar battery. A window 23 is formed in the dial and two adjacent solar cells 22' are recessed to bound the window. As described
15 in connection with the previous embodiments an indication of time is displayed in the window 23.

The output current of the solar battery is proportional to the radiation or light-receiving area of all the solar cells. However, the
20 output current of each solar cell 22' is smaller than that of each of the solar cells 22. If all the cells are connected in series, the output current of the solar battery is limited by the solar cells 22' and, in fact, the output current
25 is only equal to the output current of the solar cells 22'.

If $(n-1)$ solar cells of area A are connected in series, the current output will be greater
30 than the current output of n solar cells of area A' if

$$\frac{A-A'}{A} > \frac{1}{n}$$

Therefore, in the present embodiment the solar cells 22' are electrically connected in
35 parallel with respect to one another by connecting wires 24' and in series with respect to the solar cells 22 which are themselves electrically connected in series by connecting wires 24, the connecting wires 24, 24' being on
40 the reverse side of the dial as shown in Figure 8. Thus, the output current from the solar cells 22' is proportional to $2A'$ and, as long as, $2A' > A$, the solar cells 22' do not limit the output current of the solar battery which
45 is, therefore, independent of the size of the window.

Figures 9 and 10 show an embodiment of a dial 31 according to the present invention
50 for a timepiece. Again, the dial 31 is circular in shape and is provided with a plurality of radially extending spaced apart sector-shaped photoelectric elements or solar cells 32, the cells being connected so as to form a solar battery. A window 33 is formed in the dial

so that a solar cell 32' adjacent the window
55 has a radiation or light-receiving area which is less than that of the solar cells 32. As in the previous embodiment, the solar cells 32 are connected in series by connecting wires 34, 34' and the cell 32' is merely a "dummy"
60 not being connected to the circuit of the solar cells 32.

WHAT WE CLAIM IS:—

1. A dial for a timepiece having photoelectric means provided thereon, and having
65 at least one window therein through which an indication of time (as herein defined) may be displayed.

2. A dial as claimed in claim 1 in which the photoelectric means comprises a plurality
70 of radially extending photoelectric elements.

3. A dial as claimed in claim 2 including opposing recesses in at least two adjacent photoelectric elements, the recesses bounding
75 the or a window.

4. A dial as claimed in claim 2 in which the photoelectric element adjacent the or each window is of a different shape but of substantially the same area as the or another
80 photoelectric element.

5. A dial as claimed in claim 1 in which said photoelectric means is provided on only one part of the dial.

6. A dial as claimed in claim 5 in which the or a window is provided in the other part
85 of the dial.

7. A dial as claimed in claim 5 in which said photoelectric means comprises a plurality of photoelectric elements, opposing recesses in at least two adjacent photoelectric
90 elements bounding the or a window.

8. A dial as claimed in claim 1 in which said photoelectric means comprises a plurality of photoelectric elements, two or more of which are smaller in area than the other
95 photoelectric elements, said two or more photoelectric elements being electrically connected in parallel with respect to one another and in series with respect to said other photoelectric elements being electrically connected in series.
100

9. A dial for a timepiece substantially as herein described with reference to and as shown in the accompanying drawings.

10. A timepiece having a dial as claimed
105 in any preceding claim.

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