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(54) IMPROVEMENTS IN OR RELATING TO ELECTRIC TIME-PIECES

(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 electric time-pieces, and, though not limited thereto, is particularly advantageous for use in electric watches. More specifically the invention relates to electric watches and other time-pieces of the kind having a dial structure (by which expression is meant a structure incorporating the time display means of the time-piece) which incorporates or carries an electrical device which is required to be electrically connected to time measuring electrical circuitry provided in the main structure of the time-piece. Such an electrical device may be, for example, a solar cell or battery or a time displaying device of the liquid crystal type or of the luminous diode type, or, generally, any photo-electric or electric light emitting device.

Normal present day practice in electric watches of the kind referred to is to provide the necessary connections between the electrical device and the time measuring circuitry in the main structure of the watch by means of soldered or welded connection wires. This practice is expensive in manufacture and generally inconvenient, especially if the electrical device is one which may have to be removed and replaced from time to time. The present invention seeks to provide improved connection arrangements for the electrical devices of electric watches of the kind referred to which shall be considerably better, from the viewpoint of ease of manufacture, assembly and de-assembly, more convenient and better suited for use in electric watches of small size (such as small wrist-watches) than comparable electric watches with connection arrangements in accordance with present day customary practice.

According to this invention an electric time-piece comprises an electrical device

which forms part of or is carried by the dial structure of said time-piece and has terminal contacts which are connected electrically to required points in time measuring circuitry provided in the main structure of said time-piece through direct contact with associated correspondingly positioned contacts carried by said main structure, firm electrical contact between each such terminal contact and its associated contact being maintained by resilient or springy means which are under strain when said dial structure is in its assembled position in the time-piece.

In one way of carrying out the invention, the electrical device has, on one face thereof, metal film or like thin metal terminal contacts each of which contacts, face to face, an associated thin metal contact on the adjacent face of a base plate member, said device and base plate member, together with a resilient or springy member being held together by a flanged member which holds them together with said resilient or springy member under strain. The base plate member may be seated on a ridge or step on the inner surface of the flanged member or it may be fixed thereto. The resilient or springy member may be between the electrical device and the adjacent face of the flange of the flanged member.

In another way of carrying out the invention the terminal contacts of the electrical device are constituted by metal film or like thin metal contacts on a surface of the dial structure which is held in spaced relationship with respect to a base plate member carrying associated spring contacts adapted each to contact with one of the said terminal contacts, the spaced relationship being such that said spring contacts are under strain.

The dial structure may be carried by plugs fixed thereto and entering holes in the base plate member and arranged to be held, in entered position, by screws in said base plate member.

Where the electrical device is a multi-cell solar battery, the cells thereof are interconnected in the desired manner by deposited thin metal or film conductors on a

surface of the dial structure and thin metal or film conductors on a surface of the dial structure are provided connected to the battery end terminals to constitute the terminal contacts of the device.

Alternatively, where the electrical device is a multi-cell solar battery, the cell terminals may constitute the terminal contacts of the device and the cells may be interconnected in the desired manner by the associated contacts which are suitably shaped and positioned.

The invention is illustrated in and further explained in connection with the accompanying drawings in which Figures 1 and 4, which are provided for purposes of comparison, illustrate usual present day practice, and Figures 2, 3, 5 and 6 illustrate embodiments of this invention.

Figure 1 shows the at present customary way of providing electrical connections between the terminals of an electrical device forming part of or carried by the dial structure of an electric watch and the main body of the watch structure or a part thereof. Such a device may be a solar battery or cell constituting the electrical power supply source of the watch or a photo-electric diode or a light emission diode or an electric lamp bulb used in the electrical circuitry of the watch or a liquid crystal display device which displays the time kept by the watch. For brevity of description of Figure 1, it will be assumed that the said electrical device is a solar battery.

Referring to Figure 1, the solar battery 1 has, on its underface (i.e. its lower face when incorporated in the watch) terminals 2. Necessary connections to other parts (not shown) of the watch, are made by means of wires 3 which are welded or soldered as at 4 to the terminals, the other ends (not shown) of the wires are similarly welded or soldered to the points to which they are to be connected.

This method of making connection is time consuming and therefore expensive. Moreover, it is especially difficult and costly to carry into practice if the electrical device 1 has a considerable number of terminals to be connected, as is often the case, e.g. when the device 1 is a multi-cell solar battery. In addition, if or when the device 1 has to be removed, e.g. for replacement, the soldered or welded connections have to be freed and remade on re-assembly. This is very time consuming and therefore costly.

Figure 2 is a cross-sectional view of one construction in accordance with this invention and which avoids the foregoing defects. As will be seen later, it achieves this end by eliminating soldered or welded wire connections altogether and substituting direct contact connections which are held to one another by springy pressure.

Referring to Figure 2, reference 1 again indicates the electrical device to be connected, e.g. a time-displaying liquid crystal display device or a photo-electric element or a solar battery, and 2 are again terminals thereof. These terminals 2 are in direct contact with conductive metal films 5 which are provided in appropriate positions on the adjacent surface of a non-conductive base plate 6. A resilient or springy member 7 made, for example, of synthetic rubber or constituted by a wavy spring, is provided between the outer part of the upper face of the electrical device 1 and the under face of a flanged rim frame member 8 forming part of the general structure (not otherwise shown) of the watch. The interior surface of the member 8 is provided with a ridge or step as at 9 to provide a seat for the base plate 6. The arrangement is such that, when the parts are in the assembled position as shown in Figure 2, the member 7 is compressed and thus provides spring pressure to hold the terminals 2 in good contact with the metal film contacts 5. The base plate 6 may be fixed relative to the rim frame member otherwise than by being seated on a step therein as shown, e.g. it may be fixed thereto by one or more small screws (not shown).

The construction illustrated by Figure 2 is particularly advantageous when the device 1 has a considerable number of terminals, e.g. if it is a solar battery having a number of cells to be connected in series or in parallel. In such a case, by suitably shaping and positioning the contacts 5, required connections, though numerous, may be made quickly and easily, thus resulting in a very neat, simple and easily manufactured arrangement without any wires or soldered or welded points. A case of this nature is illustrated by Figure 3 which is a broken away view of the upper face of a base plate 6 having shaped contacts 5 arranged in two concentric rings for co-operation with terminals provided on the underface of an electrical device 1 (not shown in Figure 3).

As will now be appreciated, the absence of soldered or welded wire connections between a device 1 and the base plate 6 results in a substantial reduction of time and therefore cost required in manufacture and assembly and when a device 1 has to be removed and replaced, as may well happen, especially if the device 1 is a liquid crystal display device, for the useful life of such a device is comparatively short.

The disadvantages of the at present customary method of making connections by means of soldered or welded wire connections will be even more apparent from Figure 4, which is an under face (or reverse side) view of a known arrangement in which the method is used for connecting up the

cells 10 of a multi-cell solar battery provided as the electrical power supply of an electric watch and incorporated in the dial structure thereof. The cells 10 are mounted
 5 on the surface of a non-conductive dial member 11. In the case illustrated the cells are connected in series on the under face (or reverse side) by wires 3 welded or soldered at their ends to cell terminals 2, the
 10 wires 33, soldered or welded to the end terminals 22 of the series of cells, being taken off and soldered or welded to appropriate terminals (not shown) of the electrical circuitry of the watch. The time consuming
 15 difficulties of assembly and/or of removing and replacing the battery or substituting another will be obvious.

The embodiment of the invention shown in broken away cross-section in Figure 5
 20 and (to a smaller scale) in the broken away underside view in Figure 6, avoids these disadvantages and results in a much neater and better arrangement.

Referring to Figures 5 and 6, the watch
 25 has a non-conductive dial member 11 on the surface of which are mounted the cells 10 of the solar battery. These cells are connected in series by thin metal or metallic film connections 55 deposited on the under
 30 face of the dial member and making connection between cell terminals 2 to connect the cells in series. The end terminals of the battery are referenced 22 and references 555 indicate thin metal or metallic film deposits electrically corresponding with these.
 35 19 is a metal base plate and spring contacts 12 and 13 carried thereby make contact with the film contacts 555. Contact 12 is held by a screw 14 screwed directly into the base
 40 plate 19 while contact 13 is held by a screw 15 screwed into an insulating bush 16 in said base plate. Pins or plugs such as 17, fixed to the dial member 11, are entered into holes as shown, being forced in until
 45 the spring contacts 12 and 13 are strained to the desired extent, and are then locked in position by tightening grub screws such as 18. The contacts 12 and 13 need not be held by screws screwed into the base plate
 50 as shown, but may be held in some other way, e.g. by being fixed to a bridge member or the like fixed mechanically to the main body of the watch.

55 WHAT WE CLAIM IS:—

1. An electric time-piece comprising an electrical device which forms part of or is carried by the dial structure (as herein defined) of said time-piece and has terminal
 60 contacts which are connected electrically to

required points in time measuring circuitry provided in the main structure of said time-piece through direct contact with associated correspondingly positioned contacts carried
 65 by said main structure, firm electrical contact between each such terminal contact and its associated contact being maintained by resilient or springy means which are under strain when said dial structure is in its assembled position in the timepiece. 70

2. A time-piece as claimed in claim 1 wherein the electrical device has, on one face thereof, metal film or like thin metal terminal contacts each of which contacts, face to face, an associated thin metal contact on the adjacent face of a base plate member, said device and base plate member, together with a resilient or springy member being held together by a flanged member which holds them together with said resilient or springy member under strain. 80

3. A time-piece as claimed in claim 2 wherein the base plate member is seated on a ridge or step on the inner surface of the flanged member. 85

4. A time-piece as claimed in claim 2 wherein the base plate member is fixed to the flanged member.

5. A time-piece as claimed in claim 1 wherein the terminal contacts of the electrical device are constituted by metal film or like thin metal contacts on a surface of the dial structure which is held in spaced relationship with respect to a base plate member carrying associated spring contacts adapted each to contact with one of the said terminal contacts, the spaced relationship being such that said spring contacts are under strain. 90

6. A time-piece as claimed in claim 5 wherein the dial structure is carried by plugs fixed thereto and entering holes in the base plate member and arranged to be held, in entered position, by screws in said base plate member. 100

7. A time-piece as claimed in any of claims 1 to 6 wherein the electrical device is a multi-cell solar battery and the cells thereof are interconnected in the desired manner by deposited thin metal or film conductors on a surface of the dial structure, further thin metal or film conductors deposited on a surface of the dial structure being connected to the battery end terminals to constitute the terminal contacts of the device. 110

8. A time-piece as claimed in any of claims 1 to 6 wherein the electrical device is a multi-cell solar battery and the cell terminals constitute the terminal contacts of the 120

cells 10 of a multi-cell solar battery provided as the electrical power supply of an electric watch and incorporated in the dial structure thereof. The cells 10 are mounted on the surface of a non-conductive dial member 11. In the case illustrated the cells are connected in series on the under face (or reverse side) by wires 3 welded or soldered at their ends to cell terminals 2, the wires 33, soldered or welded to the end terminals 22 of the series of cells, being taken off and soldered or welded to appropriate terminals (not shown) of the electrical circuitry of the watch. The time consuming difficulties of assembly and/or of removing and replacing the battery or substituting another will be obvious.

The embodiment of the invention shown in broken away cross-section in Figure 5 and (to a smaller scale) in the broken away underside view in Figure 6, avoids these disadvantages and results in a much neater and better arrangement.

Referring to Figures 5 and 6, the watch has a non-conductive dial member 11 on the surface of which are mounted the cells 10 of the solar battery. These cells are connected in series by thin metal or metallic film connections 55 deposited on the under face of the dial member and making connection between cell terminals 2 to connect the cells in series. The end terminals of the battery are referenced 22 and references 555 indicate thin metal or metallic film deposits electrically corresponding with these. 19 is a metal base plate and spring contacts 12 and 13 carried thereby make contact with the film contacts 555. Contact 12 is held by a screw 14 screwed directly into the base plate 19 while contact 13 is held by a screw 15 screwed into an insulating bush 16 in said base plate. Pins or plugs such as 17, fixed to the dial member 11, are entered into holes as shown, being forced in until the spring contacts 12 and 13 are strained to the desired extent, and are then locked in position by tightening grub screws such as 18. The contacts 12 and 13 need not be held by screws screwed into the base plate as shown, but may be held in some other way, e.g. by being fixed to a bridge member or the like fixed mechanically to the main body of the watch.

WHAT WE CLAIM IS:—

1. An electric time-piece comprising an electrical device which forms part of or is carried by the dial structure (as herein defined) of said time-piece and has terminal contacts which are connected electrically to

required points in time measuring circuitry provided in the main structure of said time-piece through direct contact with associated correspondingly positioned contacts carried by said main structure, firm electrical contact between each such terminal contact and its associated contact being maintained by resilient or springy means which are under strain when said dial structure is in its assembled position in the timepiece.

2. A time-piece as claimed in claim 1 wherein the electrical device has, on one face thereof, metal film or like thin metal terminal contacts each of which contacts, face to face, an associated thin metal contact on the adjacent face of a base plate member, said device and base plate member, together with a resilient or springy member being held together by a flanged member which holds them together with said resilient or springy member under strain.

3. A time-piece as claimed in claim 2 wherein the base plate member is seated on a ridge or step on the inner surface of the flanged member.

4. A time-piece as claimed in claim 2 wherein the base plate member is fixed to the flanged member.

5. A time-piece as claimed in claim 1 wherein the terminal contacts of the electrical device are constituted by metal film or like thin metal contacts on a surface of the dial structure which is held in spaced relationship with respect to a base plate member carrying associated spring contacts adapted each to contact with one of the said terminal contacts, the spaced relationship being such that said spring contacts are under strain.

6. A time-piece as claimed in claim 5 wherein the dial structure is carried by plugs fixed thereto and entering holes in the base plate member and arranged to be held, in entered position, by screws in said base plate member.

7. A time-piece as claimed in any of claims 1 to 6 wherein the electrical device is a multi-cell solar battery and the cells thereof are interconnected in the desired manner by deposited thin metal or film conductors on a surface of the dial structure, further thin metal or film conductors deposited on a surface of the dial structure being connected to the battery end terminals to constitute the terminal contacts of the device.

8. A time-piece as claimed in any of claims 1 to 6 wherein the electrical device is a multi-cell solar battery and the cell terminals constitute the terminal contacts of the



device and the cells are interconnected in the desired manner by the associated contacts which are suitably shaped and positioned.

- 5 9. Electric watches and other time-pieces having electrical devices connected substantially as herein described with

reference to Figures 2, 3 or 5 and 6 of the accompanying drawings.

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