

DEVICE FOR ASSEMBLING A TOUCH-TYPE CRYSTAL ON A CASE

FIELD OF THE INVENTION

The present invention concerns a device for assembling a tactile or touch type crystal on a case, wherein contact zones, located close to one edge of the crystal, for connecting electrodes structured on the inner face of the crystal, to an electronic module contained in the case, are hidden and electrically insulated.

The invention will be more specifically illustrated by a wristwatch having a tactile crystal extending to the outer edge of the middle part.

BACKGROUND OF THE INVENTION

The most common way of assembling a tactile crystal, generally made of sapphire, on a wristwatch case is explained hereinafter with reference to Figure 1 and to the schematic cross-section of Figure 2, in which the contrasts and thicknesses have been greatly exaggerated for better comprehension.

The wristwatch shown includes, in a known manner, a case 1 formed of a middle part 3 closes on its bottom part by a back cover 5 and on its top part by a crystal 10 delimiting a compartment 7. Compartment 7 is for housing a watch movement 8 for the display of timer data on a dial 6. In the example shown, the display is an analogue display by means of hands for the hours 6a, minutes 6b and seconds 6c.

It can also be seen that the bottom face 11 of crystal 10 includes five electrodes 15 forming, for example, capacitive sensors, said electrodes 15 each being connected via conductive paths 16 to contact zones 17 made close to the edge 12 of crystal 10. The conductive network 15, 16, 17 is made in a known manner by structuring a transparent conductive oxide, such as indium and tin oxide (ITO), deposited for example by vapour deposition and having a thickness comprised between 25 and 75 nm. Electrodes 15 and conductive paths 16 can be made practically invisible by depositing dielectric layers in the spaces comprised between said electrodes 15 and paths 16, as disclosed for example in EP Patent No. 1 457 865. However, contact zones 17, which are placed in contact with a connector 19 passing through an insulating connector ring 2 and connecting an electronic module 9, capable of detecting the presence of a finger above one electrode 15 and of sending a control signal to movement 8, are much more visible.

When crystal 10 is assembled on case 1 by means of a bezel 13 secured to the middle part, bezel 13 need only be given sufficient width to conceal contact zones 17.

However, there exist cases, particularly for wristwatches, wherein crystal 10 extends to the outer edge of middle part 3. Crystal 10 is assembled for example via bonding on the shoulder of said middle part 3 or on an insulating connector ring 2. In order to conceal the adhesive joint, metallising has to be carried out by depositing at least one very thin anchorage layer, generally by chromium evaporation, and possibly other metals or alloys, close to the edge of the crystal, in order to try to harmonise the hue of the middle part shoulder seen through the crystal with that of the rest of the middle part. For tactile crystals, there is thus a significant risk of short-circuiting two neighbouring contact zones 17, or of creating stray capacitance.

SUMMARY OF THE INVENTION

It is thus an object of the present invention to overcome the drawbacks of the aforecited prior art by providing a tactile crystal that can be assembled, for example by bonding, to the shoulder of the aperture of a case while concealing the contact zones, without any risk of causing short-circuits

The invention therefore concerns a device for assembling a tactile crystal, made of a transparent material, resistant to temperatures higher than 500°C, to the shoulder of the aperture of a case, such as a wristwatch case. The tactile crystal includes on its inner face, in a known manner, a conductive network comprising transparent electrodes connected by conductive paths to generally grouped contact zones to form a connection area, opposite the ends of connectors connected to an electronic module housed in a compartment of the case. The tactile crystal is characterized in that it includes, close to its edge, a deposition of enamel of which at least one part of the surface conceals the electrode connection area.

The transparent material resistant to temperatures higher than 500°C can be a mono or polycrystalline material, for example quartz, spinelle or corundum, particularly sapphire. An amorphous material may also be used, such as a mineral glass, provided its softening point is higher than the temperature necessary to carry out the enamel deposition.

According to a first embodiment, the enamel deposition has the shape of a tape following the inner contour of the crystal and whose width is at least equal to the width of the connection area.

It is also desirable for the conductive network to be structured on a surface that has no discontinuities.

For this purpose a hollow is machined in the inner face of the crystal, the contour of which at least substantially corresponds to that of the connection area, enamel is deposited in one or several steps until a thickness, slightly greater than the depth of the hollow is achieved, then polishing is carried out to make the surface level of the enamel the same as that of the crystal in order to structure the conductive network.

According to a second embodiment, the enamel deposition is carried out in a groove formed in the thickness of the crystal, the depth of said groove being at least equal to the width of the connection area.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the present invention will appear in the following description illustrated by a wristwatch given by way of illustrative and non-limiting example, with reference to the annexed drawings, in which:

- Figure 1 shows a top view of a wristwatch with a tactile crystal;
- Figure 2 corresponds to a semi-cross-section along the line II-II of Figure 1 for a wristwatch according to the prior art;
- Figure 3 shows a semi-cross-section along the line II-II of Figure 1 for a wristwatch according to the invention;
- Figures 4 to 6 show the various steps of a method for making a tactile crystal according to the invention, according to a first embodiment, and
- Figure 7 shows a tactile crystal according to a second embodiment.

DETAILED DESCRIPTION OF THE INVENTION

Figures 1 and 2 have already been described for indicating the closest prior art, and only Figures 4 and the following Figures will be described hereinafter, in which the same references are used to designate the same elements of the wristwatch.

Figure 3, which is a semi-cross-section along line II-II of Figure 1 passing through two sensors 15, a conductive path 16 and a contact zone 17, shows that edge 12 of crystal 10 extends to the outer surface of middle part 3 and that said crystal 10 is not held by means of a bezel secured to the middle part 3. The inner face 11 of crystal 10 includes, close to its edge, an enamel deposition 20 which extends above the entire connection area 18 (shown in dotted lines in Figure 1) where the five contact zones 17 of the five electrodes 15 are grouped.

It is possible to carry out this enamel deposition solely in said connection area 18 and to metallise the remaining part of the shoulder of the case where there is no risk of short-circuiting, then to assemble the crystal, for example by bonding. This

method requires an additional step, which increases the costs, and it can be difficult, or impossible to find the same hue and the same tone for the enamel and the metallising, which is inconvenient when aesthetic appearance is also important. This is why it is preferable to carry out the enamel deposition in the form of a continuous tape that goes all around crystal 10 and whose width is at least equal to the width of connection area 18, such that the same hue is observed over the entire periphery of the case.

Depending upon the type of case, it is also possible to mount crystal 10 by snap fitting with the insertion of a synthetic sealing gasket between the crystal and the case.

With reference now to Figures 4 and 6, a method will be described hereinafter for making a tactile crystal according to the invention, the material forming said crystal being sapphire by way of example.

In a first step shown in Figure 4, a hollow 14 is made close to edge 12 of crystal 10 by means of a diamond grinding-wheel over a depth comprised between 0.1 mm and 0.5 mm, depending upon the thickness of crystal 10.

In a second step shown in Figure 5, an enamel deposition 20 is carried out, in one or several steps, via known soaking, spraying, buffing or silk printing techniques, each step being followed by baking, until the enamel slightly projects above the inner face of the crystal.

According to a step that is not shown, the entire inner surface of the crystal is polished so as to remove any discontinuities between the enamel layer and the rest of the crystal.

In a last step, shown in Figure 6, the conductive network 15, 16, 17 is structured with a transparent conductive oxide, such as indium and tin oxide (ITO). This step will not be described further since it is well known to those skilled in the art. Crystal 10 can then be assembled on shoulder 4 of the middle part with the insertion of an adhesive joint, then pressed.

With reference now to Figure 7, a second embodiment is shown. As can be seen, edge 12 of crystal 10 is machined to obtain a groove 25 in which the enamel layer 20 is formed. This embodiment has the advantage of making the porosities in the enamel mass invisible, facilitating the machining and polishing operations including at the aperture of groove 5. This embodiment also allows much easier polishing of the surface where contact zones 17 have to be structured, without any risk of creating zones of discontinuity able to have a detrimental effect on conductive paths 16 connecting sensors 15 and contact zones 17.

In the preceding description, the invention was illustrated by a flat tactile crystal, but it is clear that the invention also applies to any convex crystal.

CLAIMS

1. Device including a tactile crystal (10), assembled on the aperture (4) of a case (1), said crystal being made of a transparent material resistant to temperatures higher than 500°C, and including on the inner face (11) thereof electrodes (15) forming sensors, connected by conductive paths (16) to contact zones (17) located in
5 a connection area (18) close to the edge (12) of the crystal (10) opposite the ends of the connectors (19) of an electronic module (9) contained in a compartment (7) of the case (1), the edge (12) of the crystal (10) including a deposition of enamel (20) at least one part of the surface of which conceals the connection area (18), characterized in that the enamel deposition (20) is carried out in a hollow (14)
10 machined in the inner face (11) of the crystal (10) at least at the connection area (18).

2. Device including a tactile crystal (10), assembled on the aperture (4) of a case (1), said crystal being made of a transparent material resistant to temperatures higher than 500°C, and including on the inner face (11) thereof electrodes (15) forming sensors, connected by conductive paths (16) to contact zones (17) located in
15 a connection area (18) close to the edge (12) of the crystal (10) opposite the ends of the connectors (19) of an electronic module (9) contained in a compartment (7) of the case (1), the edge (12) of the crystal (10) including a deposition of enamel (20) at least one part of the surface of which conceals the connection area (18), characterized in that the enamel deposition (20) is carried out in a groove (25)
20 machined in the thickness of the crystal (10) at least at the connection area (18).

3. Device according to any of claims 1 or 2, characterized in that the transparent material forming the crystal is a mono or polycrystalline material for example a quartz, spinelle or corundum.

4. Device according to claim 3, characterized in that the material forming
25 the crystal is sapphire.

5. Device according to any of the claims 1 or 2, characterized in that the transparent material forming the crystal is an amorphous material, such as a mineral glass.

6. Device according to any of the claims 1 to 5, characterized in that the
30 hue of the enamel layer (20) matches that of the case (1).

7. Device according to any of the claims 1 to 6, characterized in that the tactile crystal (10) is assembled on the shoulder (4) of the case (1) by bonding.

8. Device according to any of the preceding claims, characterized in that the compartment (7) of the case (1) further includes a watch movement (8) and a dial (6) to form a timepiece with at least partially tactile control.

9. Method of manufacturing a tactile crystal (10) of a transparent material
- 5 resistant to temperatures higher than 500°C including on the inner face (11) thereof a conductive network (15, 16, 17) including electrodes (15), conductive paths (16) and contact zones (17) forming a connection area (18) including the steps of:
- machining a hollow (14) in the inner face (11) of the crystal (10), or a groove (25) in the thickness thereof whose contour at least substantially corresponds to that
 - 10 of the connection area (18);
 - forming an enamel deposition (20) in the hollow (14) or in the groove (25);
 - polishing the enamel surface and the non-enamelled surface of the crystal to place them at the same level, and
 - structuring the conductive network (15, 16, 17) on the inner enamelled
 - 15 surface and non-enamelled surface of the crystal (10).