

## DESCRIPTION

According to a first aspect, the invention provides a watch middle cum plate made of brass; this middle cum plate comprises top and bottom faces, at least one of them being formed with recesses for receiving components of a watch movement and side faces. The middle cum plate is provided with a coating made of a material that is chemically more inert than brass and overlaying at least the side faces.

Watches fitted with middles cum plates of the above kind have been described in many published patent specifications, e.g. Swiss patent specifications 296, 6502 and 250700, and French patent specification 2085292. So far, however, the number of such middles cum plates actually to have been produced has at best been extremely small.

As is known, brass is very often used in watch-making, in particular for making watch plates and watch cases. One advantage of this material is that it can readily be machined. On the other hand it is very subject to oxidation.

To overcome this drawback, the plates are generally coated with a layer of nickel which in turn may be clad with gold. The thickness of this layer does not usually exceed 2  $\mu\text{m}$ . This suffices to protect the brass while affecting to the minimum the dimensions of the plates.

In the manufacture of watch cases, the brass is coated with a layer of chromium, gold or any other suitable protective material. The protective layer on the cases must be much more resistant than that on the plates as it is subject to many kinds of attack, both physical and chemical. A layer of 2  $\mu\text{m}$  is therefore not enough. In practice, the thickness is generally of at least 5  $\mu\text{m}$  and may exceed 20  $\mu\text{m}$ . Such added thickness on the plates would considerably increase the spread in value of the dimensions and the resulting plates would be unfit for automated assembly of the components.

Thus, the production of a watch having a middle cum plate made of brass gives rise to the following dilemma: either an effective protection is provided in which case the brass needs a thick protective coating thus making assembly difficult, or a coat is provided that is sufficiently thin so as not to affect assembly, in which case the exposed surfaces of the watch are not adequately protected.

Swiss patent specifications 296 and 6502 do not discuss the problem set by this dilemma.

Swiss patent specification 250700 does, and proposes making the plate-forming portion out of brass and the middle-forming portion out of steel, these two portions being then assembled by welding or by force-fitting. If at first this idea might seem attractive, it should be borne in mind that the considerable stresses that may be generated in so doing are likely to deform the plate-forming portion thereby making it unfit for automated assembly.

French patent specification 2 085 292 suggests using aluminium, copper, metal alloys and synthetic materials to produce a middle cum plate and not to apply a protective layer. None of these materials would it is believed enable sufficient accuracy to be achieved for the plate-forming portions to enable automated assembly, unless it is an alloy such as brass which, because of its propensity for oxidation, must be provided with a protective coating.

Patent specification US-A-360477 describes a watch provided with a middle cum plate, a glass and a back cover. The middle cum plate is for example made of brass. It comprises lateral faces forming the middle edge and by this way exposed to chemical and physical attacks when the watch is worn. For protecting these lateral faces, it is suggested to coat them either with a gold or silver ring, soldered on the brass, or with a metal coating deposited by electroplating. In this case, the plate-forming portion is not at all protected.

An object of the invention is to provide a middle cum plate of the kind set forth, but in which the middle-forming portion affords a good resistance to chemical and physical attack, without however the assembly of the components of the watch movement being made more complicated.

This object is attained by the fact that the middle cum plate presents the features as defined in claim 1.

In so doing a watch middle cum plate can be produced in which the plate-forming portion may readily be made with sufficient accuracy while providing a middle-forming portion that is particularly resistant to both chemical and physical attack.

According to a second aspect, the invention also provides a method of making middles cum plates.

In known methods of applying a protective coating, a large part of the cost is attributable to the machines they require, to the space occupied by the machines and to the multiple handling operations.

Another object of the present invention is to reduce this cost.

This object is attained by the method as defined in claim 13.

With known manufacturing methods, middles, and more particularly the surfaces thereof that are visible in a finished watch, are machined one after another, thereby increasing the cost of production. Moreover, when machining the periphery of middles cum plates after having applied a protective layer to the recesses, chips and lubricant are liable to damage the surface of this layer.

Another object of the present invention is to reduce the manufacturing costs, and moreover to permit a machining after deposition of this layer, without damage.

This object is attained by the method as defined in claim 15.

The present invention also provides a watch with a middle cum plate as defined in one of claims 1 to 12.

As pointed out earlier, the manufacture on an industrial scale of watches fitted with middles cum plates has not so far been possible because of the difficulty in resolving the above indicated dilemma, i.e. the very divergent conditions required for automating assembly and for resisting the various kinds of attack to which a watch is subjected in use.

Another object of the present invention is to solve this problem.

This object is attained thanks to the features of the watch as stated in claim 17.

The invention will be better understood from the following description and from the drawings in which :

Figure 1 is a plan view partly broken away of a watch having a middle cum plate according to a first embodiment of the invention;

Figure 2 is a cross-section along line II-II of the watch of Figure 1;

Figure 3 shows on an enlarged scale a detail of Figure 2;

Figures 4 and 5 illustrate in cross-section two other embodiments of watches according to the invention; and

Figures 6 and 7 illustrate a stack of middle cum plates in the course of manufacturing.

In the Figures, the same reference numerals have been used to designate corresponding parts. Moreover, the thickness of the protective coatings has been increased to make the understanding easier.

The watch shown in Figures 1 to 3 comprises a middle cum plate 10 bearing various components of a watch movement, a glass 12 and a back cover 14 that protect these components, and a wristlet 16.

More exactly, middle cum plate 10 comprises a first, middle-forming, portion 18 of annular shape and a second, plate-forming, portion 20 surrounded by portion 18.

Middle-forming portion 18 has a top face 22, a bottom face 24 on which bear glass 12 and back 14 respectively, and side faces 26.

Top face 22 is formed with a peripheral groove 28 for receiving a gasket 30 to ensure fluidtightness between the middle cum plate 10 and glass 12. Bottom face 24 is formed with a peripheral groove 32 for receiving a gasket 34 to ensure fluidtightness between the middle cum plate 10 and back 14.

Side faces 26 are each formed with a pair of lugs 36 in opposed relationship, each lug having a bearing surface 38 and

being formed with a groove 40. Bearing surfaces 38 are parallel to faces 22 and 24. They carry dogs 42 for securing glass 12, each formed with a beak 42a cooperating with a bevel 12a on glass 12 (see Figure 2). Dogs 42 are secured to lugs 36 by screws 44 extending through smooth holes 46 in lugs 36 and tightened in tapped holes 48 in dogs 42.

Bar 50 for attaching wristlet 16 is housed in each groove 40 and kept there by dog 42.

Plate-forming portion 20 is formed with recesses 52 in which are housed various components of the watch movement. Among these illustrated components, it may be noted display means defined with hands 54 and certain parts of the means for driving, controlling and correcting the display means, diagrammatically shown at 58.

Some recesses require relatively little accuracy, but others, such as recess 52a (Figure 3), which has a hole 52b, require much greater accuracy. This is because hole 52b, which acts as a bearing for a wheel 58a, must have a well defined diameter and position to ensure proper meshing of the wheels and pinions of the watch movement.

Thus, to produce a brass plate in which even the closest tolerances are respected and whose surface is protected, the latter is coated with a layer 60 of a noble or passivable material, such as gold or nickel, having a thickness varying from 0.5 to 3  $\mu\text{m}$ , typically 2  $\mu\text{m}$ .

Such a protective layer 60 amply suffices to preserve the appearance of plate-forming portion 20 which is protected from outside attack by glass 12 and 14. But it is not at all suited to protect side faces 26 which are subjected to physical attack, such as from abrasion or shock, or to chemical attack, such as from sweat. To overcome this problem, side faces 26 and those portions of bottom face 24 that are not covered by back 14, are coated with a layer 62 of a material that is chemically more inert than brass and more resistant than layer 60 to chemical and physical attack.

When layer 62 is made of one of these metals or metal components, its thickness best ranges from 5 to 30  $\mu$ m, and is typically 10  $\mu$ m. It imparts to the exposed regions a much better resistance than that afforded by a brass component even if it is protected by a layer 60 of nickel or gold, as is the case with the plate-forming portion.

When the layer is of gold its thickness generally exceeds 8  $\mu$ m so as to qualify as "gold plated".

When the layer is of aluminium applied by galvanization, its thickness ranges from 20 to 30  $\mu$ m. This layer is then hardened and coloured by anodic treatment.

The aluminium layer may be applied by the method described by U. Landau in pages 317 to 324 of the report on the conference "Interfinish Europe" held in Berlin in 1985.

When layer 62 is of rubber, its thickness best ranges from 0.5 to 1mm. In this case, the gaskets 30 and 34 are best moulded integrally with the protective layer 62.

It is also possible for layer 62 to consist of paint, generally enamel paint and best deposited by electrophoresis.

In the modification of Figure 4, middle-forming portion 18 of middle cum plate 10 protrudes beyond glass 12 and back 14 and is formed with peripheral bevels. In this embodiment, the protruding part of portion 18 is entirely coated with protective layer 62, represented by a thick line. As will become apparent hereinafter, glass and back are best aligned vertically one with the other.

In the modification of Figure 5, the part of portion 18 protruding beyond glass 12 and back 14 is also entirely coated with protective layer 62. In this embodiment, side face 26 is rounded as at 63 to provide smooth merging with top and bottom faces 22 and 24.

Portion 18 can take many forms. In each case however the brass must be provided with protective coating 62 where it is not overlaid. If desired the layer may extend on to the faces overlaid by back or glass; but the layer must not extend on to the surfaces of recesses 52 for the reasons given earlier.

Middles cum plates such as shown in Figures 1 to 5 are made from a strip of brass that is cut up into blanks of any shape, e.g. round or rectangular, and of a size larger than that of the finished middles cum plates. These blanks are first machined to the required thickness and are then machined to form the recesses 52 for accommodating movement components and to form holes such as locating holes for positioning the blanks during subsequent manufacturing operations, or such as bearing holes for receiving the pivots of wheels and pinions.

The machining of plate-forming portion 20 and of the top and bottom faces 22 and 24 being complete, the middles cum plates are first cleaned and then coated with protective layer 60, generally galvanically. This completes the surface conditioning of portion 20 and of faces 22 and 24. Side faces 26, however, are still in a raw state. They need to be machined to define the outline of the middle-forming portion 18 and to produce the wristlet fixing means. These operations differ notably from those required to machine plate-forming portion 20. Although less accuracy is required, the state of the surfaces should on the other hand be flawless. Further, the shape must be readily modifiable from one blank to another so as to increase scope for creative design.

For this machining work, in so far as side faces 26 are perpendicular to top and bottom faces 22 and 24, it is possible to stack the middles cum plates on a support such as that shown in Figure 6. This support comprises a base 64, positioning rods 66, only one of them being visible on the drawing, an upper clamping plate 68 and screws 70. Base 64 and plate 68 each have protuding from the outer face a cylindrical boss 71, visible only on plate 68, arranged for locating the stack of middles cum plates on the machine-tool.

Base 64 and plate 68 preferably are made of brass and have the same size as the middles cum plates 10 before machining. The middles cum plates are slipped on to rods 66, whose positions correspond to locating holes in the middles cum plates. The top ends of rods 66 are formed with tapped holes for receiving screws 70.

Once firmed up by tightening screws 70 in rods 66, the assembly is mounted on a machine-tool, e.g. a numerical control milling machine. The outline is then milled. The state of the surface may be fined down by, for instance, brushing, sanding or polishing. The stack is then cleaned. It is then placed in a chamber enabling coating material to be applied by chemical vapour deposition (CVD), or by physical vapour deposition (PVD). All necessary precautions will of course be taken by the man skilled in the art to ensure maximum adherence of the coating material and hence good resistance to abrasion. Such maximum adherence may in some cases be achieved by applying several layers. For instance a sub-jacent layer of nickel will often be applied.

When the layer coating middle-forming portion 18 is for instance of gold, aluminium or chromium, it may be deposited galvanically, the middles cum plates 10 being stacked as described above.

This enables the outer configuration of the middle-forming portions of a large number of middles cum plates to be machined collectively and the protective coating to be applied to these blanks collectively also, the adjacent faces of adjoining middles cum plates masking each other and the outer faces of the outermost middles cum plates being overlaid by back 64 and plate 68.

If a more elaborate outer shape is required for middle-forming portion 18, e.g. as shown in Figures 4 and 5, the middles cum plates 10 will need to be machined successively. During this operation, chips are projected on to plate-forming portions 20 and are liable to damage layer 60. The machining operations should therefore be completed before applying layer 60. In so doing, side faces 26 are also coated. Depending on the material used for layer 62, it may be desirable to remove layer 60, e.g. by chemical attack, to improve the adherence of layer 62. This operation is performed after the blanks have been stacked, thereby sparing plate-forming portions 20.

When top and bottom faces 22 and 24 also need to be partly coated by layer 62 over their periphery, the blanks are no longer simply stacked

directly on top of each other, but spacers 72 are inserted between them as shown in Figure 7. Spacers 72 cover the regions that are protected by the glass 12 and the back 14. Thus, if a glass 12 and a back 14 are in alignment with each other, spacers 72 only need to have an area identical to those of glass and back.

When the area that is covered by a glass is larger or smaller than that covered by a back, two kinds of spacers 72 may be provided, one having the same area as glass, the other having the same area as back. The middle cum plates 10 would then be arranged with top face facing top face and bottom face facing bottom face, and with between them a correspondingly sized spacer.

Spacers 72 should be as thin as possible but sufficiently thick for material to be properly applied at the bottom of the groove between a pair of superposed middle cum plates 10. This will be the case if the depth of the groove is roughly equal to the thickness of the spacer.

Layer 62 may extend under the glass 12 or the back 14 without affecting the operation of the resulting watch. In this case, the layer should not extend to plate-forming portion 20 of middle cum plate 10.

In Figures 1 to 5, the glass is fixed directly to middle cum plate 10. It could also cooperate with a bezel, with the latter being fixed to middle cum plate 10.

It will be noted that as the top and bottom faces of middle cum plate 10 are flat, the contacting faces of glass and of back may also be flat. The cost is thus minimal.

In an embodiment not shown in the drawing, the top and bottom faces could be of any shape, adapted to receive a glass and a back of more complex design. In this case, the spacers should be so shaped as to be complementary to the surfaces with which they are intended to cooperate.

As exposed hereinabove, it is possible to manufacture a watch with a middle cum plate in which all of the parts that form the frame and case are suitably protected. The cost price of the finished watch can also be appreciably reduced, without affecting its quality.



## CLAIMS

1. A watch middle cum plate (10) made of brass comprising bottom (24) and top (22) faces with at least one formed with recesses (52) for receiving components (58) of the watch, and side faces (26), and provided with a coating (60, 62) made of a material that is chemically more inert than brass and which protects the latter at least on said faces (26), characterized in that said coating includes two parts, a first part (60) that protects the brass in the regions of the middle cum plate that are formed with said recesses (52) and a second part (62) that protects the brass at least over said side faces (26) and in that the thickness and the resistance to chemical and physical attacks of the second part (62) are better than the ones of the first part (60).

2. A middle cum plate according to claim 1, characterized in that the periphery of at least one of said bottom (24) and top (22) faces is covered by the second part (62) of said coating.

3. A middle cum plate according to one of claims 1 and 2, characterized in that the first part (60) of said coating consists of a layer of metal selected from the group consisting of gold and nickel.

4. A middle cum plate according to claim 3, characterized in that the thickness of said layer ranges from 0.5 to 3  $\mu\text{m}$ .

5. A middle cum plate according to any one of claims 1 to 4, characterized in that the second part (62) of said coating consists of a layer of metal selected from the group consisting of gold, chromium, titanium and aluminium.

6. A middle cum plate according to claim 5, characterized in that the thickness of the metal layer of coating in its second part (62) exceeds 8  $\mu\text{m}$ .

7. A middle cum plate according to any one of claims 1 to 4, characterized in that the second part (62) of said



coating consists of a layer of carbide or nitride of a metal selected from the group consisting of tungsten, vanadium and titanium.

8. A middle cum plate according to claim 7, characterized in that the thickness of the coating layer in its second part (62) exceeds 5  $\mu\text{m}$ .

9. A middle cum plate according to any one of claims 1 to 4, characterized in that the second part (62) of said coating consists of a layer of organic material.

10. A middle cum plate according to claim 9, characterized in that said organic material is an organic paint.

11. A middle cum plate according to claim 9, characterized in that said organic material is rubber.

12. A middle cum plate according to any one of claims 1 to 11, characterized in that at least one bonding sublayer is provided between said brass defining the middle cum plate (10) and said coating (60, 62).

13. A method of making watch middles cum plates (10) according to claim 1, from flat brass blanks, each having bottom (24), top (22) and side (26) faces, wherein the central portion of at least one of said top and bottom faces comprises recesses (52) for receiving components of a watch movement (58), characterized in that the middles cum plates are coated with a layer of metal that is chemically more inert than brass to form a first part (60) of a protective coating, the middles cum plates are stacked and assembled such that at least the central portions with the recesses (52) are masked and in that the visible regions of the middles cum plates are coated with a protective layer forming a second part (62) of said coating.

14. A method according to claim 13, characterized in that the adjacent top and bottom faces of a pair of contiguous middles cum plates mask each other.

15. A method according to claim 14, characterized in that the side faces (26) of the middles cum plates once stacked and assembled are machined collectively to define the outer



shape of their middle-forming portions before applying the second part (62) of the coating.

16. A method according to claim 13, characterized in that a spacer (72) is provided between each of the middles cum plates while being stacked, said spacer only partly covering the top and/or bottom adjacent faces.

17. A watch having a middle cum plate according to any one of claims 1 to 12, a glass (12) and a back (14), characterized in that the first part (60) of the coating is completely covered particularly with the glass (12) or the back (14).

18. A watch according to claim 17, characterized in that the bottom (24) and top (22) faces of the middle cum plate are flat and parallel around their peripheral portion and in that said glass (12) and back (14) have flat parallel faces and overlay said top (22) and bottom (24) faces of the middle cum plate (10).