

PATENT SPECIFICATION

(11)

1 566 543 (4)

1 566 543

- (21) Application No. 15167/78 (22) Filed 18 April 1978
 (31) Convention Application No. 52/048 232 (32) Filed 26 April 1977 in
 (33) Japan (JP)
 (44) Complete Specification published 8 May 1980
 (51) INT. CL.³ G04B 39/02
 (52) Index at acceptance
 G3T A2B A2C A2D



(54) ARRANGEMENT FOR HOLDING A WATCH GLASS ON A WATCH CASE

(71) We, CITIZEN WATCH COMPANY LIMITED, a Japanese corporate body of 2-1-1, Nishishinjuku, Shinjuku-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 an arrangement for holding an organic watch glass in position on the case of a water-tight wristwatch.

There have been proposed and employed in practice a great variety of arrangements for holding a glass in position on the case of a water-tight wristwatch. Three examples of prior art arrangements for holding a glass in position on the case of a water-tight wristwatch are shown respectively, in Figures 1, 2 and 3 of the accompanying drawings, which are fragmentary cross-sectional views.

In Figure 1, reference numeral 1 denotes a watch glass, reference numeral 2 denotes a metal tension ring and reference numeral 3 denotes the metal case of a water-tight wristwatch. The organic glass 1 is made in the form of a dome-shaped cap and has an annular recess 1a in the inner surface of the periphery 1b of the cap for receiving the metal tension ring 2 therein so that the periphery of the organic glass 2 is pinched between the case 3 and tension ring 2 whereby a sufficient contact pressure can be maintained between the periphery 1b of the glass 1 and the inner surface 3a of the periphery of the metal case 3 for a long period of time so as to provide a water-tight seal therebetween and at the same time to firmly hold the glass 1 in position on the case 3. When the glass is formed of a dome-shaped cap of organic glass, it is generally essential to employ a metal tension ring 2 as above described to assist the holding of the glass in position on the case. The reason is that organic glass itself has a coefficient of linear expansion several times as

great as that of metals and as a result, when the organic glass 1 is held in position on the metal case 3 without the employment of the tension ring 2, the organic glass 1 contracts its dimensions by a greater degree than the metal case does under low temperature conditions, resulting in an insufficient water-tight seal of the wristwatch and/or coming off of the glass. Further when the organic glass is subjected to an external force for a long time, an internal stress develops in the organic glass corresponding to the applied external force. However, the internal stress tends to be released gradually as time elapses which may cause a permanent strain, generally referred to as "stress release phenomenon", and the force holding the glass in the case is reduced. Therefore, as mentioned hereinabove, the holding of the organic glass in position on the metal case without the employment of any tension ring cannot provide any reliable water-tight seal and holding force.

For the reasons mentioned above, the arrangement for holding the organic glass in position on the case of a wristwatch by the employment of the metal tension ring 2 as shown in Figure 1 has been quite commonly accepted. However, the arrangement of Figure 1 has the disadvantages that the metal tension ring 2 requires a watch glass having a circular profile; also that since the watch glass is formed at the periphery of its undersurface with concavo-convex up-standing rim, the watch glass undersurface printing process which is frequently applied to digital timepieces cannot be applied to such a glass.

For digital timepieces in which the glass employed has a non-circular profile and the undersurface of the glass is required to be printed, in order to attain production cost reduction, the arrangements shown in Figures 2 and 3 are usually employed. In Figure 2, reference numeral 1 denotes an organic

glass, reference numeral 3 denotes the metal case of a wristwatch and reference numeral 4 denotes adhesive which secures the glass and case together. In Figure 3, reference numeral 1 denotes an organic glass and reference numeral 3 denotes the metal case of a wristwatch and the glass and case are secured together by directly press-fitting the glass in the case.

- 10 In the arrangement shown in Figure 2, because of the difference in coefficients of linear expansion between the glass and metal case, the adhesive 4 is subjected to a high stress each time the environmental temperature varies and the adhesive deteriorates gradually which may lead to an improper water-tight seal and in an extreme case, the organic glass 1 may come off the case 3. Also, in the arrangement of Figure 3, for the same reason as mentioned in connection with the arrangement of Figure 2, the glass may come off the case at cold temperatures or the glass may come off the case even at normal temperature due to stress release.

Therefore, although the arrangements of Figures 2 and 3 may satisfy the requirement of low production cost, the arrangements cannot satisfy the essential requirements called for in a watertight timepiece.

Therefore, the present invention has as an object to eliminate the limitations and disadvantages referred to hereinabove when an organic watch glass is employed, by making it possible to use glasses of various profiles and to substantially improve the reliability of water-tightness in water-tight wristwatches between the watch glass and watch case.

40 In accordance with the invention there is provided an arrangement, for holding a watch glass of organic material on a water-tight wrist watch case, comprising:

a) an outwardly-facing projection on the peripheral surface of the glass;

b) an inwardly-facing recess surrounding the glass and provided in either the case or an intermediate member interposed between the case and the glass; and

50 c) a packing of a thermoplastic elastomeric material interposed between either the glass and the case or the glass and said intermediate member,

the arrangement functioning such that said packing is compressed between either the glass and the case or the glass and said intermediate member so that said projection enters into the packing and material of the packing enters into said recess whereby the watch glass is held on the watch case in a water-tight manner.

Arrangements in accordance with the invention for holding a watch glass of organic material on a water-tight wrist watch case, are hereinafter described, by way of

example, with reference to Figures 4 to 7 of the accompanying drawings which are fragmentary cross-sectional views of the various embodiments.

Referring now to Figure 4 which shows a preferred embodiment of the present invention, reference numeral 6 denotes an organic glass having an outwardly-facing annular projection 6a formed on the peripheral surface of the glass, reference numeral 7 denotes a packing having an L-shaped cross-section formed of an thermoplastic elastomer for receiving the annular projection 6a of the glass and reference numeral 8 denotes the metal case of a wristwatch having an inwardly-facing annular recess 8a formed in the inner surface of the periphery of the case. The maximum outer diameter of the glass 6 is smaller than the inner diameter of the periphery of the case 8 thereby define an annular space 8b therebetween for the purpose to be described hereinafter. In assembling the organic glass 6 in position on the watch case 8, the L-shaped packing 7 is mounted on the outer surface of the glass 6 and the glass and packing assembly 6, 7 are press-fitted in the case 8 with the packing 7 filling up the annular space 8b whereby the annular projection 6a on the glass 6 intrudes deep into the packing 7 and the material of the packing 7 intrudes into the annular recess 8a in the inner surface of the periphery of the case 8.

The material of the packing 7 is a thermoplastic elastomer having a nature intermediate between elasticity and plasticity such as the thermoplastic elastomer sold under the tradename "PELPRENE" and having a permanent strain between 30% and 70%. A portion of the thermoplastic elastomer employed as the packing 7 plastically deforms about the annular projection 6a on the glass 6 and another portion of the packing material plastically deforms to intrude into the annular recess 8a in the case 8 to thereby increase the axial holding force on the glass and maintain elastic restoration ability even after the plastic deformation to thereby urge the glass in the radial direction thereof to provide a water-tight seal between the glass and case.

Although organic glass exhibits a substantial contraction in dimensions at low temperatures, in the arrangement for holding the glass in position on the case of a wristwatch according to the present invention, the combined effect of the physical properties of "PELPRENE" employed for the packing 7 and the annular projection 6a on the outer surface of the glass 6 provides reliable water-tightness and holding force.

When a resilient material such as synthetic rubber or the like is employed as the material for the packing 7, a portion of the packing

9

material which sealably surrounds the annular projection 6a on the glass 6 and a portion of the material which sealably intrudes into the annular recess 8a in the case 8, respectively, will scarcely plastically deform and as a result, a substantial holding force cannot be expected. And when a resin such as nylon or a fluorine containing resin such as Teflon (registered Trade Mark) is employed for the packing, although the packing material plastically deforms at the annular projection 6a and annular groove 8a to thereby substantially increase the holding force on the organic glass 6, the elastic restoration force of the packing material in the plastically deformed portions thereof is relatively low and the packing cannot contract in proportion to the contraction in dimensions of the organic glass at low temperatures, which makes it difficult to provide a sufficient glass holding force.

The annular projection 6a formed on the peripheral surface of the glass 6 may alternatively have any one of the forms shown, respectively, in Figures 5, 6 and 7.

In general, organic glass exhibits a substantial contraction in dimensions at low temperatures. Thus, in the prior art shown in Figure 2, the water-tightness becomes insufficient due to the separation of the adhesive 4 and in the arrangement as shown in Figure 3, the contraction of the organic glass in the diametrical direction thereof is such that the holding force on the glass in the axial direction and the water-tightness between the glass and wristwatch case decrease substantially, respectively. However, in the arrangement according to the present invention, the packing 7 of thermoplastic elastomer surrounding the annular projection 6a on the glass 6 plastically deforms in accordance with the contraction of the organic glass caused by decrease in temperature to maintain a radially-directed elastic biasing force on the glass to thereby maintain a desired holding force on the glass and also water-tightness between the glass and case and thus, the present invention provides improvements over the prior art glass holding arrangements in which the glass is directly held in position on the metal case or the glass is held in position on the metal case with the metal tension ring.

By the utilization of the plastic deformation of the thermoplastic elastomer packing in accordance with the contraction of the organic glass in the arrangement according to the present invention, less expensive organic glass can be employed as the glass for a digital timepiece. Such a glass generally has a non-circular profile and requires printing on the undersurface thereof and the present invention enables a highly reliable water-tightness and an adequate glass

holding force, to be realized using such a glass.

As shown in Figure 4, when the annular projection 6a is formed on the lower portion of the outer surface of the organic glass 6, the remaining upper portion 6b of the glass outer surface principally serves to maintain a desired water-tightness whilst the annular projection 6a on the outer surface principally serves to maintain a desired glass holding force. In general, organic glass is produced by the so-called injection molding process which requires the formation of a fin about the periphery of the glass product and the fin on the injected organic glass often tends to be subjected to deformation to become out of shape. Since importance is placed on the external appearance and function of the organic glass for a wristwatch, after the injection molding, the fin on the periphery of the molded organic glass is usually removed by grinding. However, in the embodiments of the present invention, since the fin is formed at the annular projection 6a below the top of the outer surface of the glass 6 the remaining upper portion of the glass outer surface can provide water-tightness even if the fin of the molded glass becomes out of shape after the molding thereof; also the fin is not required to be ground off to thereby substantially simplify the production of the molded glass product. In the embodiment of Figure 6, an annular glass intermediate support member 9 is interposed between the packing 7 and case 8 and another packing 10 is interposed between the member 9 and case 8.

As is clear from the foregoing description of the present invention, the arrangement of holding the glass can be applied not only for holding the glass in position directly on the case, but also for holding the glass in position on the case with the annular glass support member interposed therebetween.

While embodiments of the invention have been shown and described in detail with reference to the drawings, it will be understood that these are for illustration of examples only of the invention and are not to be taken as a definition of the scope of the invention, reference being had for this purpose to the appended claims.

WHAT WE CLAIM IS:—

1. An arrangement, for holding a watch glass of organic material on a water-tight wrist watch case, comprising:
 - a) an outwardly-facing projection on the peripheral surface of the glass;
 - b) an inwardly-facing recess surrounding the glass and provided in either the case or an intermediate member interposed between the case and the glass; and
 - c) a packing of a thermoplastic elastomeric material interposed between either the

9

material which sealably surrounds the annular projection 6a on the glass 6 and a portion of the material which sealably intrudes into the annular recess 8a in the case 8, respectively, will scarcely plastically deform and as a result, a substantial holding force cannot be expected. And when a resin such as nylon or a fluorine containing resin such as Teflon (registered Trade Mark) is employed for the packing, although the packing material plastically deforms at the annular projection 6a and annular groove 8a to thereby substantially increase the holding force on the organic glass 6, the elastic restoration force of the packing material in the plastically deformed portions thereof is relatively low and the packing cannot contract in proportion to the contraction in dimensions of the organic glass at low temperatures, which makes it difficult to provide a sufficient glass holding force.

The annular projection 6a formed on the peripheral surface of the glass 6 may alternatively have any one of the forms shown, respectively, in Figures 5, 6 and 7.

In general, organic glass exhibits a substantial contraction in dimensions at low temperatures. Thus, in the prior art shown in Figure 2, the water-tightness becomes insufficient due to the separation of the adhesive 4 and in the arrangement as shown in Figure 3, the contraction of the organic glass in the diametrical direction thereof is such that the holding force on the glass in the axial direction and the water-tightness between the glass and wristwatch case decrease substantially, respectively. However, in the arrangement according to the present invention, the packing 7 of thermoplastic elastomer surrounding the annular projection 6a on the glass 6 plastically deforms in accordance with the contraction of the organic glass caused by decrease in temperature to maintain a radially-directed elastic biasing force on the glass to thereby maintain a desired holding force on the glass and also water-tightness between the glass and case and thus, the present invention provides improvements over the prior art glass holding arrangements in which the glass is directly held in position on the metal case or the glass is held in position on the metal case with the metal tension ring.

By the utilization of the plastic deformation of the thermoplastic elastomer packing in accordance with the contraction of the organic glass in the arrangement according to the present invention, less expensive organic glass can be employed as the glass for a digital timepiece. Such a glass generally has a non-circular profile and requires printing on the undersurface thereof and the present invention enables a highly reliable water-tightness and an adequate glass

holding force, to be realized using such a glass.

As shown in Figure 4, when the annular projection 6a is formed on the lower portion of the outer surface of the organic glass 6, the remaining upper portion 6b of the glass outer surface principally serves to maintain a desired water-tightness whilst the annular projection 6a on the outer surface principally serves to maintain a desired glass holding force. In general, organic glass is produced by the so-called injection molding process which requires the formation of a fin about the periphery of the glass product and the fin on the injected organic glass often tends to be subjected to deformation to become out of shape. Since importance is placed on the external appearance and function of the organic glass for a wristwatch, after the injection molding, the fin on the periphery of the molded organic glass is usually removed by grinding. However, in the embodiments of the present invention, since the fin is formed at the annular projection 6a below the top of the outer surface of the glass 6 the remaining upper portion of the glass outer surface can provide water-tightness even if the fin of the molded glass becomes out of shape after the molding thereof; also the fin is not required to be ground off to thereby substantially simplify the production of the molded glass product. In the embodiment of Figure 6, an annular glass intermediate support member 9 is interposed between the packing 7 and case 8 and another packing 10 is interposed between the member 9 and case 8.

As is clear from the foregoing description of the present invention, the arrangement of holding the glass can be applied not only for holding the glass in position directly on the case, but also for holding the glass in position on the case with the annular glass support member interposed therebetween.

While embodiments of the invention have been shown and described in detail with reference to the drawings, it will be understood that these are for illustration of examples only of the invention and are not to be taken as a definition of the scope of the invention, reference being had for this purpose to the appended claims.

WHAT WE CLAIM IS:—

1. An arrangement, for holding a watch glass of organic material on a water-tight wrist watch case, comprising:
 - a) an outwardly-facing projection on the peripheral surface of the glass;
 - b) an inwardly-facing recess surrounding the glass and provided in either the case or an intermediate member interposed between the case and the glass; and
 - c) a packing of a thermoplastic elastomeric material interposed between either the





1 566 543

- 4
- glass and the case or the glass and said intermediate member,
the arrangement functioning such that said packing is compressed either the glass and
- 5 the case or the glass and said intermediate member so that said projection enters into the packing and material of the packing enters into said recess whereby the watch glass is held on the watch case in a water-
- 10 tight manner.
2. An arrangement, as set forth in Claim 1, in which said projection on the peripheral surface of the glass is in the form of an annular flange.
- 15 3. An arrangement, as set forth in Claim 2, in which the undersurface of said flange is co-planar with the undersurface of said glass.
4. An arrangement, as set forth in Claim
- 20 1, in which said projection on the glass is

defined by a face at right angles to the peripheral surface of the glass and a face inclined to the peripheral surface of the glass.

5. An arrangement, as set forth in Claim 25 1, in which said projection on the glass is defined by two faces each inclined with respect to the peripheral surface of the glass.

6. An arrangement for holding a watch glass in position on a water-tight wristwatch 30 case substantially as hereinbefore described with reference to any one of Figures 4 to 7 of the accompanying drawings.

BATCHELLOR, KIRK & EYLES,
Chartered Patent Agents,
2 Pear Tree Court,
Farringdon Road,
London, EC1R 0DS.
For the Applicants.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1980.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.