



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
09.10.2019 Bulletin 2019/41

(51) Int Cl.:
G04B 37/22 (2006.01) G04B 37/11 (2006.01)

(21) Application number: **17875698.7**

(86) International application number:
PCT/JP2017/042815

(22) Date of filing: **29.11.2017**

(87) International publication number:
WO 2018/101332 (07.06.2018 Gazette 2018/23)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

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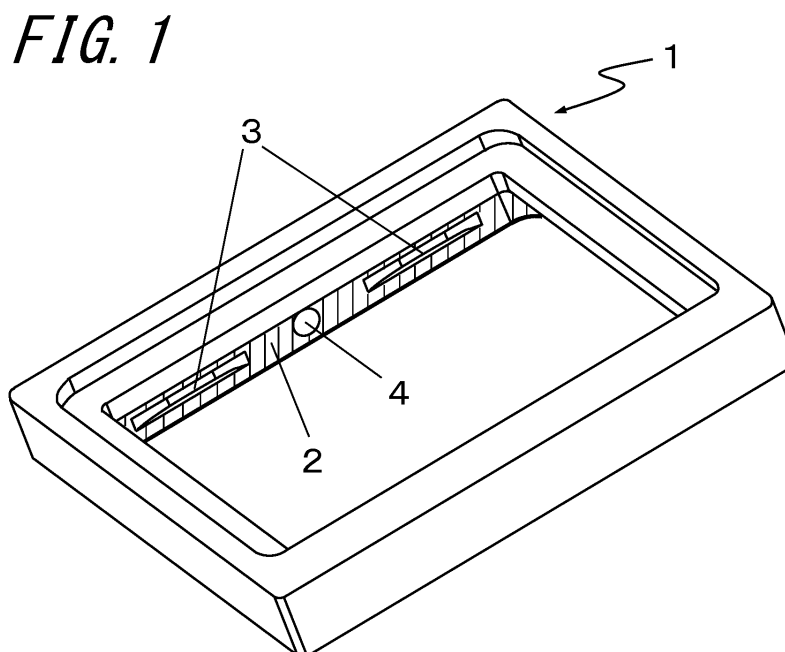
(30) Priority: **29.11.2016 JP 2016231463**

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(54) **TIMEPIECE CASE**

(57) A timepiece case according to the present disclosure is formed of ceramics. Further, the timepiece case includes a fitting surface facing a lid member when the lid member is fitted to the timepiece case. An arith-

metic mean roughness Ra of the fitting surface which is obtained from a roughness profile, is 0.6 μm or less, and a reduced peak height Rpk of the fitting surface which is obtained from the roughness profile, is 0.9 μm or less.



Description

Technical Field

5 **[0001]** The present disclosure relates to a timepiece case.

Background Art

10 **[0002]** In order to make a wrist watch have a sense of high quality, it has been suggested that a timepiece case, which is an external component used to accommodate movements, etc., is to be formed of ceramics.

[0003] For example, Patent Literature 1 discloses a timepiece case, wherein a shell and a back cover of the case are wholly or partially formed of ceramics or artificial gems.

Citation List

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Patent Literature

[0004] Patent Literature 1: Japanese Unexamined Patent Publication JP-A 63-249085 (1988)

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Summary of Invention

[0005] A timepiece case according to the disclosure is formed of ceramics. Further, the timepiece case includes a fitting surface facing a lid member when the lid member is fitted to the timepiece case. An arithmetic mean roughness Ra of the fitting surface which is obtained from a roughness profile, is 0.6 μm or less, and a reduced peak height Rpk of the fitting surface which is obtained from the roughness profile, is 0.9 μm or less.

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Brief Description of Drawings

[0006] FIG. 1 is a schematic view of a timepiece case according to the disclosure.

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Description of Embodiments

[0007] A timepiece case for a wrist watch is configured so that a lid member may be installed or detached (hereinafter, referred to as 'attached/detached'). This lid member is an element for preventing moisture, dust, etc. from infiltrating into the timepiece case. Here, when a battery of the wrist watch is replaced, the lid member needs to be detached from the timepiece case. In a case where the timepiece case is formed of ceramics, when the lid member is repeatedly attached/detached in order to replace the battery, a fitting surface of the timepiece case facing the lid member when fitting with the lid member (hereinafter, may be simply referred to as the fitting surface) may be easily worn out. When the fitting surface in the timepiece case is worn out, moisture, dust, etc. may easily intrude from a gap between the lid member and the timepiece case, and waterproof and dustproof properties of the timepiece case degrade. In addition, dust generated when the fitting surface is worn out penetrates into movements, which becomes a cause of malfunction.

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[0008] According to the timepiece case of the disclosure, even when the lid member is repeatedly attached/detached, the fitting surface is less prone to be worn out, and thus, waterproof and dustproof properties may be retained for a long period of time. Hereinafter, the timepiece case according to the disclosure will be described in detail with reference to FIG. 1. In a timepiece case 1 shown in FIG. 1, the lid member is fitted from a lower portion in the drawing, and a surface which is hatched is a fitting surface 2.

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[0009] The timepiece case 1 according to the disclosure is formed of ceramics. Here, the ceramics may include aluminum oxide-based ceramics, zirconium oxide-based ceramics, silicon nitride-based ceramics, and silicon carbide-based ceramics. Among the ceramics, when the timepiece case 1 of the disclosure is formed of zirconium oxide-based ceramics, the timepiece case 1 is less prone to be damaged even when being used for a long period of time and does not destroy the beauty.

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[0010] Here, the zirconium oxide-based ceramics is ceramics containing zirconium oxide as a main component, and contains 70 mass% or greater of zirconium oxide in 100 mass% of all the components constituting the ceramics. In addition, the content of the main component may be calculated by a method below. First, the timepiece case 1 is measured by using an X-ray diffraction device (XRD), and a value of obtained 2θ (2θ is a diffraction angle) is identified as a JCPDS card. At this time, when the timepiece case 1 includes the zirconium oxide-based ceramics, presence of the zirconium oxide is found.

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[0011] Next, quantitative analysis of metal components (other than oxygen, carbon, and nitrogen) in the identified

components is performed by using an inductively coupled plasma (ICP) emission spectrophotometer (ICP). In addition, a content of the component (compound) identified by the XRD is calculated from a result of the quantitative analysis. For example, when the component identified by the XRD is zirconium oxide, the content of zirconium (Zr) obtained through the measurement performed by the ICP is converted into zirconium oxide (ZrO_2). Here, when the converted content is 70 mass% or greater, the ceramics is zirconium oxide-based ceramics. Note that, other ceramics may be identified by the same method.

[0012] In addition, the timepiece case 1 of the disclosure includes the fitting surface 2 facing the lid member when the lid member is fitted to the timepiece case 1. An arithmetic mean roughness R_a of the fitting surface 2 which is obtained from a roughness profile, is $0.6\ \mu\text{m}$ or less, and a reduced peak height R_{pk} of the fitting surface 2 which is obtained from the roughness profile, is $0.9\ \mu\text{m}$ or less.

[0013] Here, the arithmetic mean roughness R_a is a value defined in JIS B 0601 (2013). The reduced peak height R_{pk} is defined in JIS B 0671-2 (2002), and has a definition as follows. First, in a central portion of a material ratio curve including 40% of measurement points in the roughness profile, a straight line that makes a split line of the material ratio curve drawn to set a material ratio difference to be 40% the gentlest slope is assumed to be an equivalent straight line. Next, a space between two height positions where the equivalent straight line crosses a vertical axis at locations where the material ratio of 0% and 100% is assumed as a core. Then, in the roughness profile, a mean height of a peak above the core is the reduced peak height R_{pk} .

[0014] In addition, since the timepiece case 1 of the disclosure satisfies the above configuration, irregularities of the fitting surface 2 are small and the peaks are small, and thus, even when the lid member is repeatedly attached/detached, the peak is less prone to be worn out. Accordingly, according to the timepiece case 1 of the disclosure, even when the lid member is repeatedly attached/detached, the waterproof and dustproof properties can be retained for a long period of time. Note that, in the fitting surface 2, when the arithmetic mean roughness R_a is $0.1\ \mu\text{m}$ or greater and the reduced peak height R_{pk} is $0.06\ \mu\text{m}$ or greater, not a few peaks exist, and thus, the lid member can be easily attached and detached.

[0015] In addition, in the timepiece case 1 of the disclosure, a core roughness depth R_k of the fitting surface 2 which is obtained from the roughness profile, may be $0.8\ \mu\text{m}$ or less. Here, the core roughness depth R_k is defined in JIS B 0671-2 (2002), and in the roughness profile, is an index indicating a level difference between an upper side and a lower side of the core described above.

[0016] When the above configuration is satisfied, according to the fitting surface 2 of the timepiece case 1 of the disclosure, since the variation in core height is small, even when the lid member contacts a portion corresponding to the core in the fitting surface 2, the portion may be less prone to be worn out. Accordingly, even when the lid member is repeatedly attached and detached, the waterproof and dustproof properties may be retained for a long period of time. Note that, in the fitting surface 2, when the core roughness depth R_k is $0.11\ \mu\text{m}$ or greater, the lid member may be easily attached/detached while retaining excellent waterproof and dustproof properties.

[0017] In the timepiece case 1 according to the disclosure, a ratio R_{pk}/R_k between the core roughness depth R_k and the reduced peak height R_{pk} of the fitting surface 2 may be 0.7 or less. When such a configuration is satisfied, the fitting surface 2 of the timepiece case 1 according to the disclosure may have the surface texture, in which the peaks are small and the variation in core height is small, and thus, even when the lid member is repeatedly attached/detached, the waterproof and dustproof properties may be retained for a long period of time. Note that, in the fitting surface 2, when the ratio R_{pk}/R_k is 0.5 or greater, the lid member may be easily attached/detached while retaining excellent waterproof and dustproof properties.

[0018] In addition, in the timepiece case 1 of the disclosure, a skewness R_{sk} of the fitting surface 2 which is obtained from the roughness profile, may be negative. Here, the skewness R_{sk} is defined in JIS B 0601 (2013), and is an index indicating a ratio between the peak and a valley when a mean height of the roughness is assumed as a center line. When the skewness R_{sk} is negative, it may be indicated that a region that corresponds to the peak is greater than that of the valley. When such a configuration is satisfied, even when the lid member is repeatedly attached/detached, the peak itself in the fitting surface 2 is not likely to be chipped, and thus, the waterproof and dustproof properties may be retained for longer period of time.

[0019] Further, in the timepiece case 1 of the disclosure, a mean peak height R_{pm} of the fitting surface 2 which is obtained from the roughness profile, may be $0.5\ \mu\text{m}$ or less. Here, in sections where a reference length in a direction of the average line of the roughness profile is divided into five equal parts, when a height from a mean height of the highest peak in each section to a peak is assumed as R_{pi} , the mean profile peak height R_{pm} means a mean value of the R_{pi} in the five sections. When such a configuration is satisfied, the fitting surface 2 in the timepiece case 1 of the disclosure has a small peak, and thus, even when the lid member is repeatedly attached and detached, abrasion of the fitting surface 2 is reduced, and the waterproof and dustproof properties may be retained for longer period of time. Note that, in the fitting surface 2, when the mean profile peak height R_{pm} is $0.2\ \mu\text{m}$ or greater, the lid member may be easily attached/detached while retaining excellent waterproof and dustproof properties.

[0020] In addition, in the timepiece case 1 of the disclosure, a root mean square slope $R_{\Delta q}$ of the fitting surface 2 may be 10° or less. Here, the root mean square slope $R_{\Delta q}$ is defined in JIS B 0601 (2013), and is an index indicating a

gentleness of the slope of the peak. When such a configuration is satisfied, the slope of the peak in the fitting surface 2 of the timepiece case 1 according to the disclosure is gentle, and thus, even when the lid member is repeatedly attached/detached, the peak is less prone to be worn out and the waterproof and dustproof properties may be pertained for longer period of time. Note that, in the fitting surface 2, when the root mean square slope $R\Delta q$ is 3° or greater, the lid member may be easily attached/detached while retaining excellent waterproof and dustproof properties.

[0021] In addition, in the timepiece case 1 according to the disclosure, an average interval S between the vertexes at the peaks of the fitting surface 2 which is obtained from the roughness, profile may be $15\text{ }\mu\text{m}$ or less. Here, the average interval S of the peak vertex is defined in JIS B 0601 (1994), and is an index indicating an average of intervals among the vertexes of the adjacent peaks. When such a configuration is satisfied, in the fitting surface 2 of the timepiece case 1 according to the disclosure, the interval between the peaks, through which the moisture, dust, etc. is likely to infiltrate, is small, and thus, the waterproof and dustproof properties may be improved. Note that, in the fitting surface 2, when the average interval s between the peak vertexes is $3\text{ }\mu\text{m}$ or greater, the lid member may be easily attached/detached while retaining the excellent waterproof and dustproof properties.

[0022] Here, in the fitting surface 2 of the timepiece case 1 according to the disclosure, the arithmetic mean roughness R_a , the skewness R_{sk} , the mean profile peak height R_{pm} , and the root mean square slope $R\Delta q$ can be measured in accordance with JIS B 0601 (2013). In addition, in the fitting surface 2 of the timepiece case 1 according to the disclosure, the average interval S between the peak vertexes can be measured in accordance with JIS B 0601 (1994). On the other hand, in the fitting surface 2 of the timepiece case 1 according to the disclosure, the reduced peak height R_{pk} and the core roughness depth R_k can be measured in accordance with JIS B 0671-2 (2002). Measurement conditions may include, for example, a measurement length of 0.8 mm , a cut-off value of 1.0 mm , and a scanning speed of 1 mm/sec . with a needle having a needle radius of $2\text{ }\mu\text{m}$. Then, in the fitting surface 2, at least three points are measured and a mean value thereof may be obtained.

[0023] As shown in FIG. 1, the timepiece case 1 of the disclosure may include a groove 3. When the lid member has a projection, the groove 3 is a part fitted to the projection. As described above, when the timepiece case 1 of the disclosure includes the groove 3 and the projection of the lid member and the groove 3 are fitted to each other, the lid member may be firmly fixed to the timepiece case 1.

[0024] As shown in FIG. 1, the timepiece case 1 of the disclosure may include a through hole 4 which is a hole to which a winding crown is inserted in the fitting surface 2. The winding crown is provided to perform a time correction operation and the like of the timepiece from outside.

[0025] Hereinafter, a method of manufacturing the timepiece case 1 according to the disclosure will be described. Here, the timepiece case 1 formed of zirconium oxide-based ceramics will be described as an example.

[0026] First, zirconium oxide (ZrO_2) powder which is a main raw material is put into a mill with a solvent and a ball, and is ground to a predetermined particle size to prepare a slurry. Next, after adding a binder to the obtained slurry, a spray-drying is performed by using a spray dryer to obtain granules.

[0027] Next, these granules, a thermoplastic resin, wax, etc. are put into a kneader and are kneaded while being heated to obtain a green body. Then, the obtained green body is put into a pelletizer, and then, a pellet that becomes a raw material for injection molding is obtained. Next, the obtained pellet is put into an injection molding machine to be injection molded, and thus a molded body of a timepiece case shape is obtained.

[0028] In order to obtain the molded body of the timepiece case shape as described above, a shaping mold for obtaining the timepiece case shape is manufactured based on a general injection molding method, and may be installed in an injection molding machine to perform injection molding. Here, a surface texture on an inner surface of the shaping mold is transferred to a surface of the molded body. Accordingly, in order to obtain the fitting surface 2 having the arithmetic mean roughness R_a of $0.6\text{ }\mu\text{m}$ or less and the reduced peak height R_{pk} of $0.9\text{ }\mu\text{m}$ or less, the molded body is preferably manufactured by using the shaping mold, whose inner surface has the surface texture which is obtained taking into account a polishing amount due to a surface treatment such as a barrel polishing, etc. after a firing process. Note that the same as above is applied to cases in which the core roughness depth R_k is $0.8\text{ }\mu\text{m}$ or less, a value of R_{pk}/R_k is 0.7 or less, the skewness R_{sk} is negative, the mean profile peak height R_{pm} is $0.5\text{ }\mu\text{m}$ or less, the root mean square slope $R\Delta q$ is 10° or less, and the average interval S between the peak vertexes is $15\text{ }\mu\text{m}$ or less, in the fitting surface 2.

[0029] Next, in a case where, for example, the zirconium oxide is the main raw material, the obtained molded body of the timepiece case shape is fired at a maximum temperature of 1350°C or more and 1550°C or less under the atmosphere to obtain a sintered body. Then, the obtained sintered body is barrel-polished to obtain the timepiece case 1 of the disclosure. In addition, since the firing condition varies depending on a shape and size of a product, the firing condition may be adjusted according to necessity.

[0030] Hereinafter, examples of the disclosure will be described in detail, but the disclosure is not limited to the examples.

Example 1

[0031] Samples (timepiece cases) having different arithmetic mean roughness Ra, reduced peak heights Rpk, and core roughness depths Rk in a fitting surface were manufactured, and attachment/detachment tests of the lid member were performed.

[0032] First, raw material powder was obtained by weighing and mixing 94.8 mass% of zirconium oxide (ZrO_2) and 5.2 mass% of yttrium oxide (Y_2O_3) as a stabilizer. Then, with respect to 100 mass% of the raw material powder, total 4 mass% of chromium oxide (Cr_2O_3), iron oxide (Fe_2O_3), and cobalt oxide (Co_3O_4) were added as pigment components. Moreover, water was added thereto, and ground and mixed by a ball mill to obtain a slurry.

[0033] Next, after adding a binder to the slurry, a spray-drying was performed by using a spray dryer to obtain granules. Then, a thermoplastic resin and wax were added to the obtained granules, and then, the mixture were put into a kneader to be kneaded while being heated to obtain a green body. Next, the obtained green body was put into a pelletizer to obtain a pellet which is to be a raw material for injection molding. Then, the pellet was put into an injection molding machine to obtain a molded body of a timepiece case shape.

[0034] Here, the surface texture on the inner surface of a shipping mold provided in the injection molding machine was set in consideration of the polishing amount due to the barrel polishing after the firing process, so that the fitting surface of each sample may have the arithmetic mean roughness Ra, the reduced peak height Rpk, and the core roughness depth Rk as shown in Table 1.

[0035] Next, the molded body of the timepiece case shape was fired at the maximum temperature of 1500°C in the atmosphere to obtain the sintered body of the timepiece case shape. Then, the obtained sintered body is barrel-polished to obtain each sample.

[0036] Then, for each of obtained samples, the arithmetic mean roughness Ra, the reduced peak height Rpk, and the core roughness depth Rk in the fitting surface were measured by using a contact type surface roughness meter based on JIS B 0601 (2001) and JIS B 0671-2 (2002). The measurement conditions were set to be the measurement length of 0.8 mm, the cut-off value of 1.0 mm, and the scanning speed of 1 mm/sec. by using a needle having a needle radius of 2 μm , and three points in the fitting surface were measured and a mean value thereof was calculated.

[0037] Next, an attachment/detachment test of the lid member was performed by using each sample. First, a lid member which is formed of stainless steel and that can be fitted to the fitting surface of each sample was used as the lid member. Next, the attachment/detachment of the lid member was performed 10 times for each sample by using a commercially available lid member closure machine. At this time, a load σ_0 required when the lid member is attached for the first time and a load σ_1 required when the lid member is attached for the tenth time were measured by using a push-pull gauge. Then, a decrease rate of the required load $\Delta\sigma(\%) = (\sigma_0 - \sigma_1)/\sigma_0 \times 100$ was calculated from the load σ_0 and the load σ_1 . Then, the samples were ranked in a descending order of the decrease rate $\Delta\sigma$ of the required load. That is, the sample having the lowest decrease rate $\Delta\sigma$ of the required load was ranked first, and the sample having the highest decrease rate $\Delta\sigma$ of the required load was ranked as the lowest. In addition, as the rank of the decrease rate $\Delta\sigma$ of the required load is higher, even when the lid member is repeatedly attached/detached, the fitting surface was less prone to be worn out, and it is shown that the adhesion between the fitting surface and the lid member may be maintained.

[0038] Results are shown in Table 1.

[Table 1]

Sample No.	$\bar{Ra} (\mu\text{m})$	$\bar{Rpk} (\mu\text{m})$	$\bar{Rk} (\mu\text{m})$	$\bar{Rpk/Rk}$	$\bar{\text{Rank of decrease rate } \Delta\sigma \text{ of required load}}$
1	0.7	1.12	0.95	1.2	6
2	0.6	1.00	0.92	1.1	5
3	0.6	0.90	0.85	1.1	4
4	0.4	0.60	0.80	0.8	3
5	0.2	0.30	0.43	0.7	2
6	0.1	0.06	0.11	0.5	1

[0039] As shown in Table 1 above, the decrease rates $\Delta\sigma$ of the required loads in sample Nos. 3 to 6 were highly ranked. From the above results, it was shown that, when the arithmetic mean roughness Ra was 0.6 μm or less and the reduced peak height Rpk was 0.9 μm or less in the fitting surface, even if the attachment/detachment of the lid

member were repeatedly performed, the waterproof and dustproof properties were maintained for a long period of time.

[0040] In addition, sample Nos. 4 to 6 had higher ranks in the decrease rates $\Delta\sigma$ of the required loads as compared with the sample No. 3. From the above result, it was shown that, when the core roughness depth R_k is 0.8 μm or less in the fitting surface, the waterproof and dustproof properties were maintained for longer period of time.

[0041] Further, sample Nos. 5 and 6 had higher ranks in the decrease rates $\Delta\sigma$ of the required load as compared with sample No. 4. From the above result, it was shown that, when a ratio R_{pk}/R_k between the core roughness depth R_k and the reduced peak height R_{pk} is 0.7 or less in the fitting surface, the waterproof and dustproof properties can be further maintained for a long period of time.

Example 2

[0042] Next, samples in which the skewness R_{sk} in the fitting surface was differently set to be positive or negative were manufactured, and attachment/detachment tests of the lid member were performed.

[0043] The manufacturing method was the same as the method of manufacturing the sample No. 6 according to Example 1, except that the surface texture on an inner surface of a shaping mold installed in an injection molding machine was changed in consideration of a polishing amount due to a barrel polishing after a firing process so that the fitting surface of each sample had the skewness R_{sk} as shown in Table 2. Note that sample No. 7 is the same as the sample No. 6 according to Example 1.

[0044] In addition, for each obtained sample, the skewness R_{sk} in the fitting surface was measured, and the measurement condition was the same as that of Example 1. In addition, the attachment/detachment test of the lid member was performed in the same manner as in Example 1.

[0045] Results are shown in Table 2. In addition, ranking of the decrease rates $\Delta\sigma$ of the required load is performed by only comparing the samples shown in Table 2.

[Table 2]

Sample No.	R_{sk}	Rank of decrease rate $\Delta\sigma$ of required load
7	positive	2
8	negative	1

[0046] As shown in Table 2, the decrease rate $\Delta\sigma$ of the required load in the sample No. 8 was lower as compared with the sample No. 7. From the above result, it was shown that when the skewness R_{sk} is negative, the waterproof and dustproof properties can be further maintained for longer period of time.

Example 3

[0047] Next, samples having different mean profile peak heights R_{pm} in fitting surfaces were manufactured, and attachment/detachment tests of a lid member were performed.

[0048] The manufacturing method was the same as the method of manufacturing the sample No. 8 according to Example 2, except that the surface texture on an inner surface of a shaping mold installed was changed in an injection molding machine in consideration of a polishing amount due to a barrel polishing after a firing process so that the fitting surface of each sample had the mean profile peak height R_{pm} as shown in Table 3. Note that sample No. 9 is the same as the sample No. 8 according to Example 2.

[0049] In addition, for each obtained sample, the mean profile peak height R_{pm} in the fitting surface was measured, and the measurement condition was the same as that of Example 1. In addition, the attachment/detachment test of the lid member was performed in the same manner as in Example 1.

[0050] Results are shown in Table 3. In addition, ranking of the decrease rates $\Delta\sigma$ of the required load was performed by only comparing the samples shown in Table 3.

[Table 3]

Sample No.	R_{pm} (μm)	Rank of decrease rate $\Delta\sigma$ of required load
9	0.6	3
10	0.5	2
11	0.2	1

[0051] As shown in Table 3, the decrease rates $\Delta\sigma$ of the required load in the sample Nos. 10 and 11 were lower as compared with the sample No. 9. From the above result, it was shown that when the mean profile peak height R_{pm} is $0.5\ \mu\text{m}$ or less, the waterproof and dustproof properties can be maintained for longer period of time.

Example 4

[0052] Next, samples having different root mean square slopes $R\Delta q$ in fitting surfaces were manufactured, and attachment/detachment tests of a lid member were performed.

[0053] The manufacturing method was the same as the method of manufacturing the sample No. 11 according to Example 3, except that the surface texture on an inner surface of a shaping mold installed in an injection molding machine was changed in consideration of a polishing amount due to a barrel polishing after a firing process so that the fitting surface of each sample had the root mean square slope $R\Delta q$ as shown in Table 4. Note that sample No. 15 is the same as the sample No. 11 in Example 3.

[0054] In addition, for each obtained sample, the root mean square slope $R\Delta q$ in the fitting surface was measured, and the measurement condition was the same as that of Example 1. In addition, the attachment/detachment test of the lid member was performed in the same manner as in Example 1.

[0055] Results are shown in Table 4. In addition, ranking of the decrease rates $\Delta\sigma$ of the required load was performed by only comparing the samples shown in Table 4.

[Table 4]

Sample No.	$R\Delta q$ (°)	Rank of decrease rate $\Delta\sigma$ of required load
12	3	1
13	7	2
14	10	3
15	12	4

[0056] As shown in Table 4, the decrease rates $\Delta\sigma$ of the required load in the sample Nos. 12 to 14 were lower as compared with the sample No. 15. From the above result, it was shown that when the root mean square slope $R\Delta q$ is 10° or less, the waterproof and dustproof properties can be maintained for longer period of time.

Example 5

[0057] Next, samples having different average intervals S between peak vertexes in fitting surfaces were manufactured, and attachment/detachment tests of a lid member were performed.

[0058] The manufacturing method was the same as the method of manufacturing the sample No. 12 according to Example 4, except that the surface texture on an inner surface of a shaping mold installed was changed in an injection molding machine in consideration of a polishing amount due to a barrel polishing after a firing process so that the fitting surface of each sample had the average interval S between the peak vertexes, as shown in Table 5. Note that, sample No. 19 is the same as the sample No. 12 in Example 4.

[0059] Then, for each obtained sample, the average interval S between the peak vertexes in the fitting surface was measured based on JIS B 0601 (1994), and the measurement condition was the same as that of Example 1. In addition, the attachment/detachment tests of the lid member were performed in the same manner as in Example 1.

[0060] Results are shown in Table 5. In addition, ranking of the decrease rates $\Delta\sigma$ of the required load was performed by only comparing the samples shown in Table 5.

[Table 5]

Sample No.	S (μm)	Rank of decrease rate $\Delta\sigma$ of required load
16	3	1
17	5	2
18	15	3
19	18	4

[0061] As shown in Table 5, the decrease rates $\Delta\sigma$ of the required load in the sample Nos. 16 to 18 were lower as compared with the sample No. 19. From the above result, it was shown that when the average interval S between the peak vertexes is 15 μm or less, the waterproof and dustproof properties can be maintained for longer period of time.

5 Reference Signs List

[0062]

10 1: Timepiece case
2: Fitting surface
3: Groove
4: Through hole

15 **Claims**

1. A timepiece case, comprising:

20 a fitting surface facing a lid member when the lid member is fitted to the timepiece case, the timepiece case being formed of ceramics, an arithmetic mean roughness Ra of the fitting surface which is obtained from a roughness profile, being 0.6 μm or less, a reduced peak height Rpk of the fitting surface which is obtained from the roughness profile, being 0.9 μm or less.

25 2. The timepiece case according to claim 1, wherein a core roughness depth Rk of the fitting surface which is obtained from the roughness profile, is 0.8 μm or less.

30 3. The timepiece case according to claim 1 or 2, wherein a ratio Rpk/Rk between the core roughness depth Rk and the reduced peak height Rpk of the fitting surface which is obtained from the roughness curvature, is 0.7 or less.

4. The timepiece case according to any one of claims 1 to 3, wherein a skewness of the fitting surface which is obtained from the roughness profile, is negative.

35 5. The timepiece case according to any one of claims 1 to 4, wherein a mean profile peak height Rpm of the fitting surface which is obtained from the roughness profile, is 0.5 μm or less.

6. The timepiece case according to any one of claims 1 to 5, wherein a root mean square slope RΔq of the fitting surface is 10° or less.

40 7. The timepiece case according to any one of claims 1 to 6, wherein an average interval S between peak vertexes of the fitting surface which is obtained from the roughness profile, is 15 μm or less.

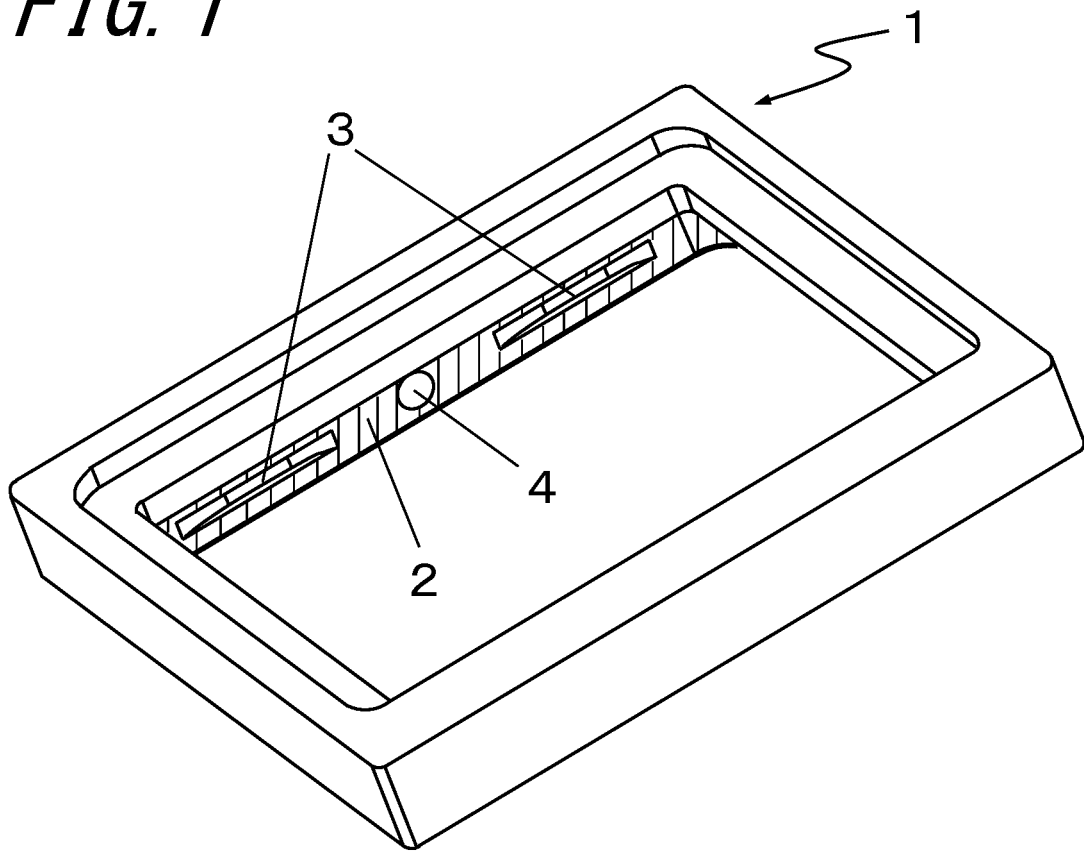
8. The timepiece case according to any one of claims 1 to 7, wherein the ceramics is zirconium oxide-based ceramics.

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FIG. 1



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2017/042815

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. G04B37/22 (2006.01) i, G04B37/11 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl. G04B37/22, G04B37/11, G12B9/00, G01D11/24, H05K5/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996

Published unexamined utility model applications of Japan 1971-2018

Registered utility model specifications of Japan 1996-2018

Published registered utility model applications of Japan 1994-2018

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 56-110071 A (CITIZEN WATCH CO., LTD.) 01 September 1981, page 3, upper right column, line 13 to lower left column, line 12, page 4, lower right column, line 17 to page 5, upper left column, line 8 (Family: none)	1-8
A	JP 2001-147280 A (KYOCERA CORP.) 29 May 2001, paragraphs [0002]-[0005], fig. 3, 4 (Family: none)	1-8
A	JP 2016-182763 A (KYOCERA CORP.) 20 October 2016, paragraphs [0002]-[0009] (Family: none)	1-8
A	JP 2014-095392 A (TOYOTA MOTOR CORP.) 22 May 2014, claim 1 & US 2015/0192195 A1, claim 1 & CN 104520069 A & KR 10-2015-0046783 A	1-8

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Further documents are listed in the continuation of Box C.

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See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

01 February 2018 (01.02.2018)

Date of mailing of the international search report

13 February 2018 (13.02.2018)

Name and mailing address of the ISA/

Japan Patent Office

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Form PCT/ISA/210 (second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 63249085 A [0004]