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The present invention relates to a control device for a watch, comprising a crown with a central cavity surrounded by an annular cavity, a watertight seal arranged in the said annular cavity, a sleeve fixed at its end in the said central cavity, a control rod of the watch arranged inside the sleeve, this rod and this sleeve having complementary coupling means allowing the rod to be driven in rotational and translational movement, a spring arranged in the sleeve between the end thereof and that of the control rod for engaging the said coupling means and a tube which is integral with the watch body, inside which the sleeve is free to move, and has a projecting part adapted to be screwed into the annular cavity of the crown and, when in the screwed-in position, to compress the watertight seal by means of its end.

A control device of this type is described in Swiss Patent No. 308,031.

The watertight seal arranged in the annular cavity is a seal with a rectangular section, obtained by cutting out from a sheet of elastomer of the desired thickness. The side of the seal adjacent the bottom of the annular cavity is fastened by adhesion to prevent the seal from turning the cavity during screwing on of the crown.

The fact that the seal is cut out from a sheet means that it has to have a rectangular cross section. The space available at that base of the annular cavity means that the small side of the rectangle ends up corresponding to the thickness of the seal, such that a flat seal is attained. As a result, when the crown is screwed on, the compression ration for the seal is large in view of its small thickness (in the order of 0.3 mm).

When the crown is connected to a rewinding and time-setting rod of an automatically winding watch, it can remain screwed on for several days, or possibly several consecutive weeks.

Given these constraints, it has been observed that a slight residual deformation can be induced in the long term in the thickness of the seal, which does not confer on it optimal efficiency.

Besides, given the very small dimensions of such a seal (its diameter is in the order of 3.5 mm and the width of its cross section of 0.6 mm), its fastening by adhesion and placement constitute an extremely delicate operation.

Indeed, it has already been proposed in FR-A-2,002,866 to form seals not by cutting, but by moulding. Nevertheless, such seals can only be obtained one at a time. A precise amount of moulding material must be introduced in the mould before closing the latter, which, given the aforementioned dimensions, created problems which are difficult to resolve. The production output of such seals is obviously very much less than that of cut-out seals. It is for this reason that moulding of seals is not used in practice, above all for seals as small as those for winder crowns. Furthermore, moulding does not allow sufficient accuracy to be guaranteed for the dimensions, such that this manufacturing technique does not satisfy any of the demands required to manufacture seals for watertight watch control devices. Besides, since the elastomers employed, whether natural or synthetic are incidentally not injectable, only cut-out seals exist on the market.

The object of the present invention is to provide an improved watertight watch control device, as described in Claim 1.

The principal advantage of this device comes from the fact that one is no longer limited to the seal of rectangular cross-section, as is the case for cut-out joints. The elastomer used also has mechanical properties that satisfy the requirements and the quality of which is perfectly constant from one production run to another. The volume of the seal can be substantially increased without adversely affecting the rigidity of the crown, which permits the compression ratio of the material to be reduced. The surface contact between the seal and its recess in the crown can also be greatly increased. As a result, the water-tightness between the seal and the crown is improved. The same applies to the frictional force between the seal and the crown. This frictional force resists the rotation of the seal in its groove and reduces the scissoring force exerted on the adhesive surface of the seal during the screwing and unscrewing of the crown.

Other advantages will be clear from the description which follows and the attached drawings which illustrate, schematically and by way of example, one embodiment of the control device according to the present invention.

Figure 1 is a partial sectional view of a watch casing body provided with a control device illustrated with the crown unscrewed;

Figure 2 is a sectional view similar to that of Figure 1, illustrated with the crown screwed on.

Figures 1 and 2 show very partially the part of a casing body 1 traversed by the control device according to the invention. This body 1 has a passage 2 provided with a thread 3 into which a tube 4 is screwed. A metallic watertight seal 5 is located between a projection 6 of the tube 4 and a clearance 7 surrounding the entrance to the passage 2.

The part of the tube 4 situated outside the body is flared and its lateral external face 8 is threaded, while an annular groove 9 is formed in the lateral internal face of this flared part of the tube 4. An O-ring seal 10 is arranged in this groove and is compressed between the latter and a sleeve 11 whose end 11a is screwed into a thread formed in a central cavity 12 of a crown 13. A disc-shaped metallic seal 14 is placed at the bottom of the central cavity 12, and the end 11a of the sleeve 11 engages against the periphery of this seal 14 to guarantee water-tightness between the crown 13 and the sleeve 11.

An annular cavity 15 surrounds the central cavity 12, and a tubular wall 16 separates these two cavities. The lateral external wall of the annular cavity 15 is provided with a thread 17, which is complementary to the thread of the lateral external face 8 of the flared part of the tube 4.

The bottom of the annular cavity 15 has a groove 18 that extends the lateral external face of the annular cavity. This groove 18 is narrower than the annular cavity so as not to weaken that base of the tubular wall 16, which is stressed by the screwing on of the sleeve 11 against the metallic seal 14.

Part of the annular cavity 15 and the groove 18 are occupied by a watertight seal 19 of complementary shape, that is to say which comprises two annular portions of the same external diameter, but having different internal diameters. The portion of greatest internal diameter 19a is that which is engaged in the groove 18, that of least internal diameter 19b occupies the bottom of the annular cavity 15. It is against its free face that the end of the tube 4 is applied in the screwed-on position of the crown 13 (Figure 2).

The lower part of the sleeve 11 encloses a coupling mechanism comprising a coupling member 20 having at one end thereof a threaded bore 21 for receiving the end of a control rod, in particular a control rod for winding up the watch and setting the time, and possibly also for setting the date. The coupling member 20 therefore forms an integral part of the control rod. On the external face of this coupling member is located a part of polygonal section 22. This cross section is complementary to that 23 which is formed at the end 11b of sleeve 11. A thin cylindrical section 24 is formed on the coupling member adjacent the part of polygonal cross section 22 and on the side opposite thereto in relation to the threaded

bore 21. The diameter of the truncated section 24 is chosen so as to permit it to slide freely inside the sleeve 11 and but the end of the polygonal cross section 23 of the sleeve 11. A cylindrical part 25 of smaller diameter than the cylindrical section 24 terminates this coupling member 20.

A coil spring 26 is arranged in the sleeve 11 around the cylindrical part 25. It abuts, on one side, the metallic seal 14 and on the other side, the projection formed between the cylindrical section 24 and the cylindrical part 25.

As can be seen in Figure 2, when the crown 13 is screwed onto the tube 4, the rod integral with the coupling member 20 prevents the latter from being displaced axially with the crown 13, so that the spring 26 is compressed, and at the same time, the parts 22 and 23 of the complementary polygonal cross sections become axially separated, so that the coupling member 20 is not driven in rotation during the screwing and unscrewing of the crown 13.

On the contrary, as soon as the crown 13 is unscrewed, the spring 26 urges the projection formed between the cylindrical section 24 and the part of polygonal cross section 22 against the projection formed at the end 11b of the sleeve 11 by the polygonal cross section 23, so that this sleeve 11, which is integral with the crown 13, and the coupling member 20, are integral while rotating. The respective adjacent projections of the polygonal cross section 23 and the cylindrical section 24 additionally permit the axial displacement of the coupling member 20 and thus the rod, which is integral therewith, towards the outside, in one of several positions, to allow setting of the time and possibly the date.

Given its shape, the seal 19 cannot be obtained by conventional techniques, that is to say by cutting out from a sheet material or by the moulding technique employed for the fabrication of O-ring seals. As is known, the elastomers utilised for manufacturing such aforementioned seals are not made of injectable material. This without doubt explains why, at least in the field of watch-making which is of interest here, the seals are either of rectangular section or circular section. As for the rare exceptions, they are only found in the literature.

The seal 19 is made by injection. To this end, a thermoplastic elastomer is employed, which is an intermediate between rubber and plastic, that is to say that at room temperature it has the properties of vulcanised rubber, while at a high temperature it melts like a thermoplastic. As a result, such an elastomer can be easily treated with conventional equipment used for thermoplastic material and can particularly be moulded by injection. No final treatment is necessary since this elastomer does not vulcanise.

Preferably, a polyester type thermoplastic elastomer is employed and, more particularly the one which is sold under the trade mark Hytrel ® by DuPont and is preferably a high performance Hytrel ® which has additional advantages relating to mechanical resistance and operating life for the most demanding applications. Hytrel ® 7246 can be selected from among this type of thermoplastic elastomer, but preferably Hytrel ® 5526 which has better properties for the present application.

Hytrel ® is the registered trade mark of DuPont de Nemours for the range of its technical thermoplastic elastomers. These are block copolymers, constituted of hard segments (crystalline) of polybutylene terephthalate and of soft segments (amorphous) based on long chain polyether glycols. Their properties are determined by the value of the ratio between the hard and soft segments and their arrangement.

Hytrel ® is a technical thermoplastic elastomer bringing together a number of the most desirable characteristics associated with high performance elastomers and soft plastics. It has in particular the following properties: exceptional resilience and tenacity; high flow resistance; flexibility at low temperatures and good maintenance of its properties at high temperatures.

Further, it resists derogation caused by numerous industrial chemical products, oils and solvents.

That being so, the fact of making an injected seal 19 of the shape illustrated in the drawings increases considerable the surface contact between the seal and its recess relative to a flat seal having the shape only of the part 19b, such that the frictional force is substantially increased, which is important in the case of a screwed crown. Nevertheless, preferably, the seal 19 is fastened by adhesion to ensure a mounting rendering impossible any attempt at removal without destruction. For matters of safety, as to the water-tightness of the crown, it is in effect necessary, if need be, to change the entire crown and not replace the seal. In effect, its mounting and its fastening by adhesion constitute a delicate operation which can only be ensured correctly at the time of manufacture. Furthermore, the adhesive surface must be perfectly smooth and clean, which cannot be guaranteed if the seal is changed.

As previously indicated, Hytrel ® is a thermoplastic elastomer, which is very difficult to fasten by adhesion. To this must be added the very small dimensions of the seal and the fact that the adhesive must in no case come into contact with the free face of the seal. It must be sufficiently fluid so as not to form a local excess thickness capable of deforming the flatness of the free face. It must finally not set too rapidly so as to allow wording under industrial

conditions.

Two solutions have been found: one consists in using, on the one hand, a two-part adhesive with a polyurethane base sold under the mark Thixon® 412/413 which allows optimum fastening by adhesion between 10 and 20 minutes after application on the seal, an application which can be carried out with precision and evenly by grinding, and on the other hand, Thixon® 403/404 which is a single-layer dual component adhesive agent that is placed on the metallic surfaces of the bottom of the cavity 15 and of the bottom of the groove 18. Thixon® 403/404 is used for fastening by adhesion onto metal of various polyurethane elastomers. The metal is degreased in advance with trichlorethylene vapour and allowed to dry for 30 minutes at room temperature. The separate equal components of the Thixon® mixture 403/404 can be applied with a gun (volumetric dilution 60 parts with a mixture 403/404, 40 parts xylene). The mixture is allowed to dry for 30 to 40 minutes at room temperature. The thickness of the dry film of Thixon® to be applied should be in the order of 25 to 30 µm.

The surfaces of the seal to be fastened by adhesion are cleaned and degreased by means of a solvent such as methyl ethyl ketone. They are left to dry from 30 minutes to one hour before the application of Thixon® 412/413 mixed in equal parts and allowed to dry for 10 to 20 minutes.

The other solution consists in applying an activator to the surfaces of the seal to be fastened by adhesion. This activator has a base of ethanol/ethyl acetate sold under the mark Pascoprime®. Finally, an adhesive sold under the mark Pascopepp® is applied onto this activator.

Claims

1. A watertight control device for watches comprising:
 - a crown (13) with a central cavity (12) surrounded by an annular cavity (15);
 - a watertight seal (19) positioned in the said annular cavity (15);
 - a sleeve (11) fixed at one end (11a) thereof in the said central cavity (12);
 - a watch control rod (20) arranged inside the sleeve;
 - the said rod (20) and the other end of the said sleeve (11) having complementary coupling means (22, 23) for driving the said rod in rotation and translational movement;
 - a spring (26) located in the sleeve (11) between the end thereof fixed in the said central cavity (12) and the end of the control rod for engaging the said coupling means;
 - a tube (4) integral with the body (1) of the watch, in the interior of which tube the sleeve (11) is free to move and having a projecting part adapted to be screwed into the annular cavity (15) of the crown and, in the screwed-on position, to compress the said watertight seal by means of its end;
 - characterised in that the said seal (19) is an injected part made of thermoplastic elastomer having a cross section complementary to that of the said annular cavity.
2. A device according to Claim 1, **characterised in that** the said annular cavity comprises a groove (18) formed in its bottom and the said seal (19) comprises two annular portions (19a, 19b) of the same external diameter, but different internal diameter, the annular portion (19a) of greater inner diameter engaging in the said groove (18) and the portion (19b) of smaller diameter being that on which the tube (14) acts in the screwed-on position of the crown.
3. A device according to Claim 1, **characterised in that** the said thermoplastic elastomer has a base of 55% by weight of soft segments of PTHF glycol with a molecular weight of about 1000 and 45% by weight of hard segments derived from 1,4-butane diol and methyl terephthalate.
4. A device according to Claim 4, **characterised in that** the thermoplastic elastomer is Hytrel® 5526.
5. A device according to Claim 1, **characterised in that** the seal is fastened by adhesion with the aid of a dual-component single layer adhesive system with a polyurethane base resistant to oil and solvent abrasion, deposited on the elastomer and a dual-component single layer adhesive agent that is placed on the bottom of the metallic surface of the said annular cavity (15, 18) of the crown against which it is desired to fasten the said seal by adhesion.

