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J. J. WALDMAN
WATERPROOF WATCH CROWN

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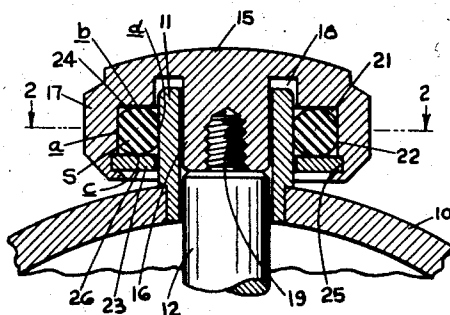


FIG. 1

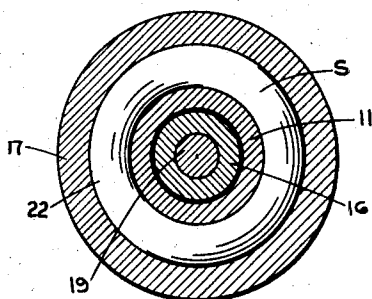


FIG. 2

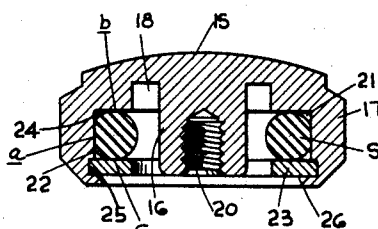


FIG. 3

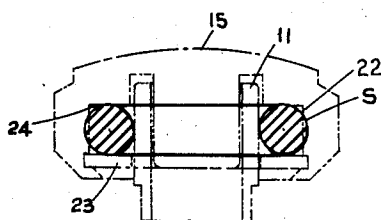


FIG. 4

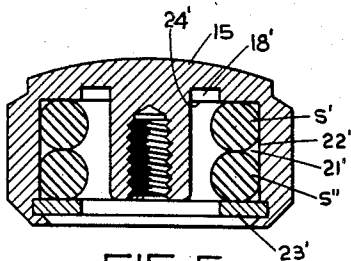


FIG. 5

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2,912,819

WATERPROOF WATCH CROWN

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7 Claims. (Cl. 58—90)

This invention relates to watch crowns, and has reference, more particularly, to a crown having improved means to provide a waterproof seal between the crown and the watch case in connection with which it is mounted.

The present invention is also directed to improvements upon the invention disclosed in my pending application, Serial Number 476,785, filed December 21, 1954, now abandoned, of which this application is a continuation-in-part.

Means, as heretofore proposed, for rendering a watch crown waterproof, when said crown is operatively assembled with a watch case and the watch works contained therein, i.e. sealed against admission of moisture between the crown and the neck of the watch case about which the crown can be rotated to actuate a winding and setting stem to which the crown is attached, has generally comprised a compressible and usually solid resilient packing which fills an annular cavity within the crown body so as to hold said packing in opposition to and in movable contact with the neck of the watch case when the crown is rotated about the latter. Such compressed resilient packings have not been found to be entirely satisfactory since, under compression strong enough to assure tight sealing effect considerable friction is developed between the seal body and the watch case neck, which friction offers considerable resistance to operative rotation of the crown relative to the watch case neck, and thereby not only renders manual winding and setting rotation of the crown unduly difficult, but is likely to cause rapid wear of the packing material with risk of impairment of its sealing effect. To avoid such undesirable effects, it has also been attempted to provide means for adjusting or regulating the amount of compression, or tensioning spring means have been provided to permit more scope to yielding reaction of the packing under stress. Such additional means add considerably to the cost and complication of the crown structure, and have not been found to be altogether satisfactory, since, if compression of the packing is reduced to substantially lessen friction, risk of loss of sealing effect is involved.

Actually, a suitable seal or barrier to the passage of dust, moisture or water at the area where the crown engages the watch case neck is not difficult to obtain. The problem has been complicated by the necessity to also provide a suitable seal between the sealing means itself and the crown body within which the sealing means is mounted, and to couple effective sealing at both of these areas with a very low measure of resistance to rotation, or torque required to rotate the crown. If the seal between the sealing means and the crown body is inadequate, an effective seal between the sealing means and the neck of the watch case is of no purpose to prevent the passage of fluid into the watch case. Also, effective seals between crown and case and between sealing means and crown body are of no utility, if substantial torque is required to rotate the crown.

Having the above in view, it is an object of this inven-

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tion to provide a watch crown or crown body with a sealing element to be carried thereby as a part thereof, wherein a high measure of resistance to the passage of dust, moisture or water is provided both between the sealing element and the crown body and between the crown body-sealing element assembly and the neck of a watch case, while affording minimal torque to rotate the crown body-sealing element assembly with respect to the watch case neck.

In accordance with the invention, the sealing element comprises an annular or ring shaped body of resilient material and of circular cross-section, which is adapted to be laterally or radially compressed between a wall of the crown body and the neck of a watch case to which the crown is rotatably related, and in such manner as to contact but a small area of the circumferential surface of the watch case neck, thus reducing to a minimum frictional resistance to rotation of the crown relative to the watch case neck, while nevertheless assuring an effective seal against entrance of both moisture and dust through the crown to the watch case interior and the watch works contained therein.

The invention has for a further object to provide a watch crown with a resilient O-ring sealing element, and means to retain said element in assembled relation therewith so as to be carried thereby as a part thereof, whereby the crown is adapted to be easily applied to and removed from its sealing attached relation to a watch case, and is therefore readily replaceable by another in case of loss thereof or injury thereto.

In addition, to assure that the seal will be effective throughout the vicinity of the crown, while affording minimal resistance to rotation, the sealing element is mounted within the crown body so that the sealing element is at all times maintained under compression, or even when the crown body-sealing element assembly is separated from the watch case, thereby providing an effective, independent seal within the crown itself.

Still a further object of the invention is to provide a watch crown with a resilient sealing element secured therein for assembly with standard or conventional waterproof watch cases, thereby enabling simple operative assembly with ordinary straight-walled watch case necks or tubes without necessitating modification of such necks.

An illustrative embodiment of this invention is shown in the accompanying drawings, the figures being greatly enlarged for clarity in illustration, in which:

Fig. 1 is a transverse vertical sectional view of a watch crown provided with a waterproofing sealing element according to this invention as assembled with a watch case so as to be operative to seal against the neck of said watch case;

Fig. 2 is a horizontal sectional view of the same, taken on line 2—2 in Fig. 1, the sealing element being shown in elevation;

Fig. 3 is a transverse vertical sectional view of the watch crown and contained sealing element removed from the watch case;

Fig. 4 shows a preferred dimensional relationship of the sealing element with respect to the crown body and to the watch case neck prior to mounting of the sealing element within the crown body, the crown body and neck being shown in phantom to more clearly illustrate such relationship; and

Fig. 5 is a view similar to Fig. 3 showing another form of the invention.

Referring to the drawings, in which like characters of reference denote corresponding parts, the reference character 10 indicates a watch case having a tubular neck 11 projecting exteriorly from its periphery, and into the interior of which extends the winding and setting stem 12 of the watch works contained in such watch case.

The watch crown structure, according to this invention, comprises a hollow crown body 15 having a downwardly projecting axial shank 16 dependent from its top wall, and an annular external side wall 17 which is outwardly spaced from and concentric to said shank, thus forming a downwardly open annular passage 18 intermediate the side wall 17 and said shank 16. Said passage 18 receives the tubular neck 11 of the watch case, when the crown is engaged over the latter in its operative assembled relation to the watch case; in which relation, the crown is coupled to the winding and setting stem 12 by means of its threaded coupling portion 19 which is entered in an internally threaded socket 20 with which shank 16 is provided. Formed in the side wall 17 of the crown body 15 is an annular chamber 21 which is inwardly open toward the passage 18, and which provides the housing for the sealing element with which the crown is provided. Said sealing element, indicated by the reference character S, comprises an annular or ring shaped body of circular cross section, made of a suitable resilient and moisture impervious material, such as natural or synthetic rubber or like plastic material. The sealing element S is lodged within the housing chamber 21, so that its external periphery abuts the circumferential side wall 22 of the latter. The bottom of the housing chamber 21 is closed against displacement of the sealing element S therefrom by a flat retainer ring 23 which is disposed in downwardly spaced relation to the top wall 24 of said housing chamber. The external marginal portion of the retainer ring 23 is engaged in an annular mortise or recess 25 which indents the circumferential side wall 22 of the housing chamber within the bottom portion of the crown body. The retainer ring 23 is retained in affixed relation to the crown body by an inwardly peened over or staking lip 26 with which the bottom portion of the crown body is provided.

In greater detail, and in accordance with a preferred embodiment of the invention, as shown in Fig. 4, the annular sealing element or O-ring S, in its initial or relaxed condition, or prior to mounting thereof within the housing chamber 21, has an external or outer diameter which is larger than the diameter of the chamber or its circumferential side wall 22. When the O-ring is lodged within the housing chamber, its external periphery firmly abuts the circumferential side wall 22 so that the sealing ring is maintained in compression in a direction radially toward the axially extending passage 18, or the axial shank 16. An effective seal is thereby provided at the area designated *a*, as shown in Fig. 3.

As shown in Fig. 4, the diametric cross-section of the sealing ring S in its initial or relaxed condition is substantially equal to the height of the chamber 21, or the distance between the longitudinally spaced sides provided at the top by the wall 24 and at the bottom by the retainer ring 23. When the oversize sealing ring is radially compressed within the circumferential side wall 22, the ring is expanded in a direction normal to the direction of the compressive forces, or in a direction parallel to the length of the axial shank 16. As a result, after securing the retainer washer 23 to the crown body, as above described, the ring is also maintained in compression at the areas designated *b* and *c*, as shown in Fig. 3. The diametric cross-section of the sealing ring may be initially more or less than the height of the chamber. Essentially, it is desired that the ring be in compression at the points or areas *b* and *c*, and this may be accomplished by correlating a given diametric cross-section with the particular hardness of the ring.

As also shown in Fig. 4, the internal or inside diameter of the sealing ring initially, or before the mounting thereof within the chamber 21, has a diameter which preferably is substantially equal to the diameter of the watch case neck 11 which the sealing ring is intended to engage. Due to the compressive forces applied to the ring in a direction radially inward at *a*, and also normal thereto,

at *b* and *c*, the inside diameter of the ring is decreased to a diameter which is less than the diameter of the watch case neck. In rotative operative assembly with the watch case, as shown in Fig. 1, the neck is compressively engaged by the sealing ring at *d*. The inside diameter of the sealing ring initially may be more or less than the diameter of the neck which the ring is to engage. The particular initial inside diameter is selected for a ring of given hardness to finally provide firm engagement with the neck when the sealing ring is compressed within the crown body as above described.

To facilitate assembly of the O-ring with the crown body, and to enable easy assembly of the sealing element containing crown with the watch case neck, and additionally, to afford minimal rotating friction between the sealing element containing crown and the watch case neck, it is preferred to coat the ring with a suitable inert lubricant. Silicon oil No. 200, as manufactured by Dow-Corning Corp., is an example of a suitable lubricant, which also will not exert any appreciable solvent action upon the composition of the rubber or rubber-like sealing ring.

The foregoing described relationships of sealing ring with respect to crown body, and of crown body-sealing ring assembly with respect to watch case neck, involve comparatively small areas of engagement between the sealing ring and adjacent surfaces. Nevertheless, an unusually high measure of sealability is obtained, because of the comparatively large compressive forces which are imparted to the sealing ring in a direction normal to the surfaces where fluid would tend to pass. Water under pressure would enter the watch case through the areas *c* and *d*. With increase of fluid pressure at these areas, the compressively loaded ring provides increased back pressure resisting passage of any entrant fluid. Such back pressure is directed radially outward in all directions from the diametric center of the sealing ring. Thus, the back pressure in the directions normal to the directions of the fluid flow tending to separate the sealing ring from the adjacent engaging surfaces at *c* and *d*, have added thereto the back pressure or energy stored within the ring itself, which is compressively loaded on all sides.

The frictional grip of the crown body upon the sealing element is greater than the frictional grip of the sealing element upon the watch case neck 11, because the sealing ring is firmly gripped at *a*, *b* and *c*, and the total pressure at these areas is greater than the force of friction at *d* when rotating the crown. Consequently the sealing element will rotate with the crown, but will readily slip or slide around the watch case neck.

Examples of preferred dimensional relationships of watch crown bodies and O-rings for variously sized standard watch case necks or tubes, together with the test results obtained of sealing resistance to water pressure and the torque required to rotate the crowns, are set forth in the following tabulation, the O-rings used being of a composition having a hardness of approximately 70 durometer:

	Chamber Dia.; Ring- Initial O.D. (±.001)	Chamber Height; Ring Init. Dia. Cross- section (±.001)	Neck Dia.; Ring- Init. I.D.; Ring Com- pressed I.D. (±.001)	Resistance to Water Pressure (lbs./sq. in.)	Average Torque (gm.- cms.)
A.....	.118; .127..	.028; .026..	.080; .079; .073..	70-72	5
B.....	.128; .137..	.028; .026..	.090; .089; .080..	70-72	5
C.....	.138; .145..	.030; .028..	.098; .097; .090..	70-72	5
D.....	.183; .195..	.042; .041..	.118; .117; .111..	70-72	5

The foregoing values of resistance to water pressure between the crowns and watch case necks were obtained under the test conditions set forth in Test No. 1, Federal Trade Commission, Trade Practice Rules, Respecting the Terms "Waterproof," "Shockproof," "Nonmagnetic," and

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Related Designations, as Applied to Watches, Watch-cases, and Watch Movements, as promulgated April 24, 1947. The described crowns in engagement with watch case necks were completely immersed for not less than 5 minutes in water under atmospheric pressure of 15 lbs./square inch, and for not less than an additional 5 minutes in the water under the pressures above indicated, without admitting or showing any evidence or capacity to admit water.

In another form of the invention, as shown in Fig. 5, the housing chamber, designated 21', is made of a height to receive a pair of annular sealing rings, designated S' and S''. The rings are arranged to lie within the housing chamber in parallel, abutting relationship, and are axially aligned. Crown bodies and sealing rings having the same dimensional relationship as set forth in the foregoing tabulation were used, except that the chamber height, or distance between 24' and the retainer ring 23', was doubled to receive a pair of the parallel, axially aligned sealing rings.

Upon test, crowns of this form furnished resistance to water pressure in excess of 110 lbs./square inch for the periods and under the conditions set forth in Test No. 1, Federal Trade Commission, Trade Practice Rules. The exact upper limits were not determined, because testing facilities which would furnish water pressure in excess of 110 lbs./square inch were not available. The average torque required to rotate these multiple sealing ring crowns proved to be as low as 6 gram-centimeters.

From the above it will now be obvious that not only does the instant invention provide an effective water-proof sealed watch crown, which can be easily rotatively manipulated without undue resistance, but also a sealed crown wherein the sealing element is carried by the crown so as to be easily removable therewith from assembled relation to a conventional watch case, and consequently the crown and its seal is readily removable for replacement by another if occasion requires. Also, the minimal friction between the water-proof crown and the watch case neck affords low resistance to sliding friction when the crown is moved from winding to setting position, and vice-versa.

The crown carries the sealing element in compressively loaded condition to afford a seal between the crown body and the sealing element in readiness for sealing with the watch case neck so that upon rotative assembly with the case, an unusually high measure of resistance to the passage of dust, moisture and water, coupled with extremely low torque to rotate the crown, are attained.

It is believed that the advantages of my novel crown structure will be apparent from the foregoing detailed description. It will also be apparent that while the invention has been described and illustrated in a preferred form, changes may be made to obtain equivalent structures with the accomplishment of the described improved results without departing from the spirit or scope of the invention as sought to be defined in the following claims.

I claim:

1. A waterproof crown adapted for rotation about a projecting neck of a watch case, said crown comprising a body having an axial shank adapted to be attached to a winding stem, a side wall dependent from said body in outwardly spaced concentric relation to said shank providing an intermediate passage for reception of the watch case neck, said side wall providing a circumferential side of an annular housing chamber open toward said axial shank, said chamber being further defined by fixed sides spaced from each other in a direction parallel to the length of said axially extending shank, and an annular sealing element of resilient, moisture-impervious material mounted in said housing chamber, said sealing element initially having a substantially circular cross-section and initially having an outside diameter larger than the diameter of said housing chamber, said sealing element being

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maintained in said housing chamber in compression in a direction radially toward said shank, and in a direction parallel to the length of said shank, the inside diameter of said compressed sealing element being less than the diameter of the neck which it is adapted to engage, the compressively loaded sealing element providing a seal resisting the passage of fluid between the sealing element and the sides of the housing chamber, the exposed side of the compressively loaded sealing element being adapted to provide a seal resisting the passage of fluid when in engagement with a watch case neck.

2. A crown as set forth in claim 1, wherein the sealing element initially has an inside diameter substantially equal to the diameter of the watch case neck which it is adapted to engage.

3. A crown as set forth in claim 1, wherein the sealing element is coated with an inert lubricant.

4. A waterproof crown adapted for rotation about a projecting neck of a watch case, said crown comprising a body having an axial shank adapted to be attached to a winding stem, a side wall dependent from said body in outwardly spaced concentric relation to said shank providing an intermediate passage for reception of the watch case neck, said side wall providing a circumferential side of an annular housing chamber open toward said axial shank, said chamber being further defined by sides longitudinally spaced from each other in fixed relation in a direction parallel to the length of said axially extending shank, and an annular sealing element of resilient, moisture-impervious material mounted in said housing chamber, said sealing element initially having a substantially circular cross-section, initially having an outside diameter larger than the diameter of said housing chamber, initially having an inside diameter substantially equal to the diameter of the watch case neck which it is adapted to engage, and initially having a diametric cross-section substantially equal to the distance between said longitudinally spaced sides, said sealing element being maintained in compression in a direction radially toward said shank and being maintained in compression between said longitudinally spaced sides, the inside diameter of the compressed sealing element thereby being less than the diameter of the watch case neck which it is adapted to engage.

5. A waterproof crown adapted for rotation about a projecting neck of a watch case, said crown comprising a body having an axial shank adapted to be attached to a winding stem, a side wall dependent from said body in outwardly spaced concentric relation to said shank providing an intermediate passage for reception of the watch case neck, said side wall providing a circumferential side of an annular housing chamber open toward said axial shank, and a pair of annular sealing elements of resilient, moisture-impervious material mounted in said housing chamber in parallel, abutting, axially aligned relationship, said sealing elements each initially having a substantially circular cross-section and initially having an outside diameter larger than the diameter of said housing chamber, said sealing elements being maintained in said housing chamber in compression in a direction radially toward said shank and in a direction parallel to the length of said shank, the inside diameter of said compressed sealing elements each being less than the diameter of the neck which they are adapted to engage.

6. A crown as set forth in claim 5, wherein the sealing elements are coated with an inert lubricant.

7. A waterproof crown adapted for rotation about a projecting neck of a watch case, said crown comprising a body having an axial shank adapted to be attached to a winding stem, a side wall dependent from said body in outwardly spaced concentric relation to said shank providing an intermediate passage for reception of the watch case neck, said side wall providing a circumferential side of an annular housing chamber open toward said axial shank, said chamber being further defined by sides longi-

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tudinally spaced from each other in fixed relation, in a direction parallel to the length of said axially extending shank, and a pair of annular sealing elements of resilient moisture-impervious material mounted in said housing chamber in parallel abutting, axially aligned relationship, said sealing elements each initially having a substantially circular cross-section, initially having an outside diameter larger than the diameter of said housing chamber, and initially having an inside diameter substantially equal to the diameter of the watch case neck which they are adapted to engage, said rings initially having diametric cross-sections, the total of which is substantially equal to the distance between said longitudinally spaced sides, said sealing elements being maintained in compression in a direction radially towards said shank and being maintained in compression between said longitudinally spaced sides, the inside diameter of each of said compressed sealing elements thereby being less than the diameter of the watch case neck which they are adapted to engage.

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