May 11, 1965 W. J. VAN ROSSEM 3,182,358

MOLD FORMING DEVICE

Filed Aug. 21, 1961

FIG. 1.

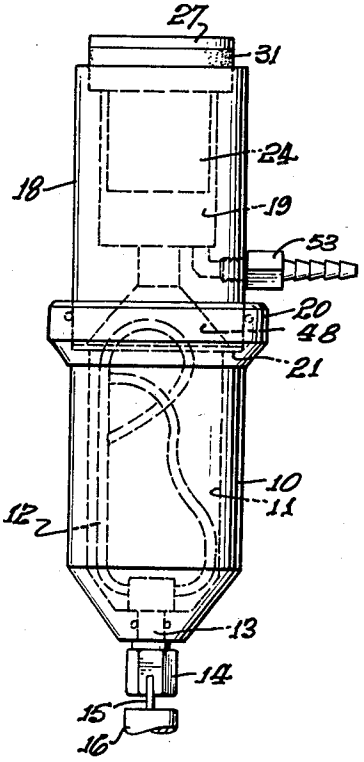


FIG. 2.

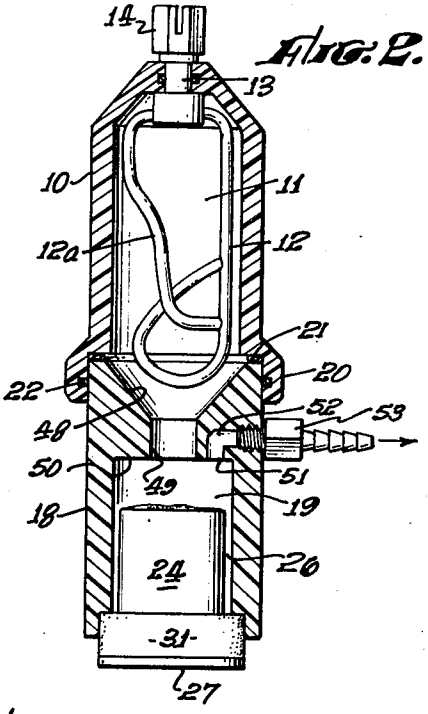


FIG. 3.

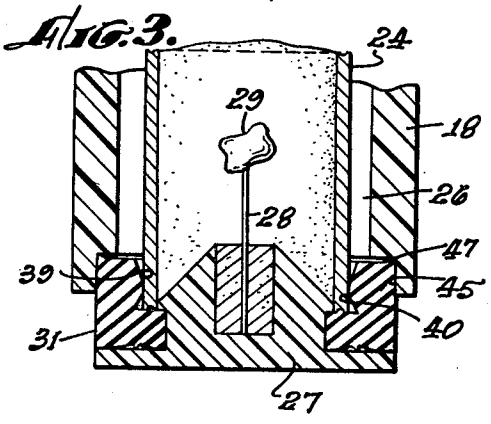
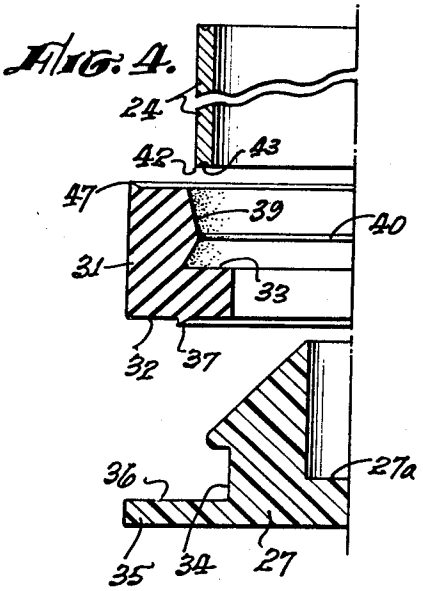


FIG. 4.



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MOLD FORMING DEVICE

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The present invention relates generally to the art of investing wax patterns; and more especially to molding apparatus for this type of work having a number of improved and advantageous features.

Apparatus of the type with which we are here concerned is used for investing a wax pattern, under vacuum, with a suitable composition which will harden and form a mold upon removal of the wax pattern. This process is used in making metal castings in various fields, for example dental work, the manufacture of jewelry, and the like; and it is generally known as the "lost wax technique" of casting.

It is advantageous to carry on the mixing of the powder and the water forming the plaster mix under vacuum as well as to pour the investment mixture under vacuum around the wax pattern. The vacuum is applied in order to eliminate any air bubbles that are liable to occur in the investment and which, by adhering to the outer surface of the wax pattern, result in a rough or imperfect casting. Such bubbles of air are a result of dissolved gases (largely air) in the water added to the investment powder; and by subjecting the investment mix to a high degree of vacuum the dissolved gases are boiled out of the water at a temperature below the melting point of the wax pattern. Elimination of air bubbles from the investment also aids the investment in entering all the small crevices of the pattern and thus aids in obtaining a faithful reproduction of the pattern. Maintenance of the vacuum within the device requires that the seals between the component parts of the device be air tight in order to prevent any leakage. It is obvious that it is advantageous to reduce the opportunity for leakage of outside air by reducing to a minimum the number of seals required as well as by designing them for maximum effectiveness.

The vacuum line preferably opens to the interior of the device at a point such that no material will enter the vacuum line, either during the mixing operation or the subsequent pouring of the plaster around the pattern. This can be avoided by proper location and shielding of the point of access of the vacuum line to the interior of the molding device.

As a further aid to elimination of air bubbles and obtaining an accurate pattern, the molding device is frequently placed upon a shaking or vibrating table to vibrate the fluid investment mixture while it is covering the wax pattern. In known types of molding devices it has frequently been the case that the vibration thus produced periodically breaks the seal around the casting ring and admits air into the device. Consequently, an improved type of seal between components of the device is desirable in order to permit vibration on a shaking table without destroying or decreasing the vacuum inside the molding device.

In general, it is desirable in a device of this character to be able to carry out all of the mixing and molding operations within a single piece of apparatus which is simple in design, economical to make and easy to maintain and care for.

Accordingly, it is a general object of the present invention to make a mold forming device for use in investment casting that is novel in design and has all of the advantageous features mentioned above.

This and other objects of my invention are obtained by providing a mold forming device comprising a cup-like shell which defines a mixing chamber open at one end, a tubular body member open at both ends and engageable with the shell at said open end, the tubular body forming a molding chamber, and a casting ring located within the molding chamber with one end open and facing the mixing chamber to receive therefrom the investment plaster or other mold forming material which falls out of the mixing chamber by gravity and for vibration into the casting ring. The other end of the ring is closed by a base upon which is mounted the pattern; and a gasket flange of novel design engages not only the base but the ring and the tubular body in air tight sealing relation.

In a preferred form, the gasket flange has a recess receiving one end of the casting ring. The recess in the gasket flange includes a substantially radial surface on the gasket which engages the surface at one end of the ring and also a surface of revolution disposed at an angle to the radial surface, said surface of revolution having a shape such that it engages the external cylindrical surface of the casting ring over only a narrow annular area. The end surface of the ring has an annular groove which cooperates with the radial surface on the gasket to form a more effective air tight seal therewith than can be obtained without the seal. The gasket flange and the base also have mutually engaging surfaces which lie substantially in radial planes parallel to each other, the gasket having an annular ridge, preferably of triangular cross-section, on its radial surface which engages the surface on the base to effect an air tight seal therewith.

How the above objects and advantages of my invention, as well as others not specifically mentioned herein, are attained will be more readily understood by reference to the following description and to the annexed drawing, in which:

FIG. 1 is a side elevation of a mold forming device embodying the present invention shown in the initial or mixing position in which the mixing chamber is at the lower end.

FIG. 2 is a vertical median section through the device of FIG. 1 showing the device in the second or investing position in which the molding chamber is at the lower end of the device.

FIG. 3 is an enlarged vertical median section through the lower end of the tubular body member and the casting ring showing the configuration of the gasket flange and the base members.

FIG. 4 is a further enlarged, fragmentary exploded view of the base, the gasket flange, and the casting ring.

Referring now to the drawing it will be seen that the mold forming device illustrated therein includes a cup-like shell 10 defining interiorly thereof mixing chamber 11. Shell 10 is open at one end, which is the upper end when the device is in the mixing position of FIG. 1. The other or lower end of the shell is then closed. At this end of the shell there is rotatively mounted stirring means 12 which includes a short shaft 13 that extends through the lower end of the shell where the stirring means carries a slotted nut 14. An O ring or other seal surrounds shaft 13 to prevent air leakage at this point when a vacuum is applied to the interior of the shell. This nut 14 is adapted for engagement with a rotating drive member to turn the stirring means. Within the mixing chamber the stirring means includes a bent wire 12*a* or other suitable member for the purpose of mixing the dry investment powder and water therein to form a fluid investment compound. As an example of drive means, the nut 14 is shown engaged with web 15 at the end of drive shaft 16 rotated by any suitable means, not shown, the web being engaged in the slot in nut 14 to rotate the latter.

The mold forming device also includes a tubular body member 18 which is open at both ends and which defines interiorly thereof molding chamber 19. The tubular body 18 is preferably cylindrical in external shape and is received at one end within a circular recess in flange 20 on the shell. The shell and the tubular member fit together with a telescopic type of joint. An air tight seal at this joint is obtained by interposing resilient gasket 21 between the end of the tubular member and the shoulder formed inside the shell at the base of flange 20 and placing O ring 22 inside flange 20 to engage the outer surface of body 18. When a partial vacuum is produced inside the device the exterior air pressure presses the members 10 and 18 toward each other, improving the seal at gasket 21. In the initial or mixing position shown in FIG. 1, the tubular body is above the shell but the parts are reversed in their relative positions when the device is inverted to bring it to the investing position of FIG. 2. In both positions shell 10 provides means for closing one end of the tubular body and in the inverted position of FIG. 2, means for delivering to the molding chamber a charge of plaster or other similar mold forming material which has been mixed within the shell. Body 18 is functionally a means for connecting to the mixing chamber the lower end assembly, including casting ring 24, as described below.

Within molding chamber 19 there is located casting ring 24, as may be seen in FIG. 2. The casting ring or flask, is usually a hollow cylindrical member having a relatively thin wall and an outside diameter that is somewhat smaller than the inside diameter of molding chamber 19. Thus the casting ring is annularly spaced, as indicated at 26 from the inner wall of tubular body member 18. The ring is open at one end, the upper end when the parts are in the position of FIG. 2. This open end of the ring faces toward mixing chamber 11 in order to receive the fluid mixture flowing by gravity and/or vibration from the chamber when the device is in the position of FIG. 2.

The other end of the ring, the lower end, when the parts are in the position of FIG. 2 is closed by base 27, in order to hold the casting material within the ring. To do this, base 27 has a central conical portion, commonly referred to as a crucible former, having a maximum diameter substantially equal to the inside diameter of the casting ring in order that the base and ring substantially fit together. Centrally of the base there may be located a socket adapted to receive wax or other soft material into which may be stuck sprue former 28 at the upper end of which is supported the wax pattern 29 which forms the mold cavity in the hardened body of the mold forming or investment material in the ring. The wax pattern is later removed by melting the wax which flows out the opening left by the sprue former.

At the end of tubular body 18 removed from shell 10, is gasket flange 31 of novel design. The gasket flange engages tubular body 18, base 27, and ring 24 in order to support the ring on the base and also to support the ring in position within molding chamber 19 inside the tubular body 18. Since gasket 31 spans the gap between the ring and tubular body member 18, the gasket closes annular space 26 at one end, as shown particularly in FIG. 3.

Gasket flange 31 is designed to engage the base, the ring, and the tubular body member in an air-tight manner in order to prevent entrance of air into the device while a vacuum is being applied thereto. For this purpose, the gasket is shaped as shown in detail in FIG. 4. The gasket has two surfaces lying in parallel, radial planes at 32 and 33. The portion of the gasket between these two parallel surfaces fits into a groove indicated at 34 in the base member formed by undercutting the conical portion of the base. This provides a means of having the casting ring 24 engage the gasket at a location away from the edge of the gasket where air leaks might and often do occur; and this advantage is gained because the undercut at 34 allows the gasket to extend radially inwardly of the wall of ring 24. At the outer end (or lower end in FIGS. 3 and 4), the base has a flange 35, one surface 36 of which lies in a substantially radial plane and is thus parallel and in engagement with surface 32 of the gasket. Base 27 with its flange 35 is of one-piece or integral design in order to avoid deformation under forces existing when vacuum is applied to the molding chamber 19. Projecting from gasket flange surface 32 is an annular ridge 37, which is preferably triangular in cross-section as shown in FIG. 4. This ridge presses against surface 36 on the base to form an air-tight seal therewith and to maintain the sealing relationship of the gasket with the base in spite of any vibration to which the device is subjected. A triangular shape with the vertical face on the outside or pressure side has been most effective as a seal; but ridge 37 is not necessarily limited to the exact shape illustrated.

Extending away from the outer margin of surface 33 on the gasket, is a surface of revolution, indicated generally at 39, this surface being convex radially inwardly; and more specifically it is designed to provide a narrow cylindrical surface 40 at a position between the two ends of surface 39 which is of minimum radius. This narrow surface 40 is concentric with the axis of gasket flange 31 and engages the exterior surface of the casting ring to maintain an air-tight seal therewith even when not under external air pressure and during vibration. The air-tight seal between the casting ring at the end surface 42 of the ring and the radial surface 33 is improved by providing a groove 43 in ring surface 42. Because of the resilient nature of the gasket 31, which is formed from rubber or other similar elastic material, the narrow edges on the ring at either side of groove 43 indent the elastic material, forcing some of the material up into groove 43. It has been found that this forms a particularly effective seal at this point in maintaining an air-tight relationship between the parts. The seal is obtained by an action somewhat in the nature of an O ring type of sealing action. The end of body member 18 removed from the mixing chamber is provided with a recess 45 of right-angular formation which receives one end of gasket 31 to effect sealing engagement between the gasket and tubular body member. The parts fit snugly together in an air-tight sealing relationship. This seal is maintained by adding a ridge 47 to the upper end of the gasket to obtain a sealing action similar to that provided by ridge 37. Again a triangular shape in cross-section is preferred.

It will be noticed that in general the resilient gasket 31 avoids forming sealing contact with one of the other members of the device over simple, flat surfaces. Experience has indicated that it is very difficult to maintain an air-tight seal between two flat surfaces in engagement when the device is being vibrated on a shaking table. When two flat surfaces are under vibration, one of them is apt to become intermittently separated from the other at one edge so that it is, at least in part, inclined with respect to the other, breaking the seal between them and allowing air to work across the width of the surfaces from one edge to the other. In other words, there is a tendency under the vibrating conditions for the surfaces to rock with respect to one another, breaking the seal at one edge and then at another but at the same time allowing air to intermittently pass between the surfaces. This possibility has been eliminated in the present construction by providing sealing elements of only limited area of contact. For example the annular area 40 is comparatively narrow in an axial direction, allowing casting ring 24 to tilt considerably with respect to the gasket without at any time causing the seal to break at the annular area 40. The narrow contact areas 42 at either side of groove 43 at the end of the ring maintain an effective seal at this point even with severe vibration. The triangular ridges 37 and 47, being resilient, maintain contact at all times with the opposing surface on the base member 27. Ridges 37 and

47 may alternatively have a semi-cylindrical or other advantageous shape in cross-section.

Another feature of advantage in this arrangement is that the critical sealing areas in the gasket are disposed as far as possible in such a manner that the gasket is held between two rigid members. For example, surface 36 on base 27 opposes the seal with the surface on the end of casting ring 24 and also with a portion of the contact between the gasket and tubular body 18 at notch 45. In a similar manner, the seal at the annular area 40 is opposed by contact of the gasket with the unyielding body 18 at the recess 45.

In operation, measured quantities of a suitable investment powder and water to be mixed therewith are placed in mixing cup 10 which is held with the open end upwardly, as in the position of FIG. 1. Body member 18 is then placed on the mixing shell in a manner to close the open upper end thereof and the stirring member is engaged with a drive as indicated at FIG. 1. After the investment powder or plaster has become thoroughly mixed and while the mix is still fluid, the device is then inverted to the position of FIG. 2, and the plaster flows by gravity with or without vibration out of mixing chamber 11 into casting ring 24. In order to guide the mix as it passes from one chamber to the other, there is preferably provided suitable funnel means. The funnel means herein comprises a frusto-conical surface 48 on the inner surface of body member 18, the walls of which converge centrally of the body member 18, thus directing all of the contents of the mixing chamber toward the center of casting ring 24 when the ring axis is vertical. The upper end of the casting ring faces the mixing chamber in order to receive the contents thereof and is preferably spaced a short distance below the discharge orifice 49 of the funnel means.

Among other advantages, this arrangement has the advantage that by tilting the axis of the device away from the vertical, the funnel may be used to direct the mix falling through the funnel into a desired portion of the casting ring where it does not fall on pattern 29 but to one side thereof. This is a well known technique in investment casting and avoids the possibility of knocking the wax pattern off of the sprue former support 28.

In order to observe directly the progress of the operations inside the device, and see the movement of the investment mix from the mixing chamber into the casting ring, it is preferred that both shell 10 and body 18 be made of a transparent material. For this purpose one of the synthetic resins or plastics may be chosen as several combine strength and transparency with the desired properties of molding or machining desired to produce these members. Preferably the orifice 49 is spaced a short distance from the converging walls 48, thus being located in a radial surface 50 at one end of molding chamber 19. Advantage is taken of the location of this surface 50 to place therein the orifice 51 which is the inner terminus of the vacuum duct. Angular passage 52 opens to the molding chamber at orifice 51 and also opens to a point at the outside of the body 18. At this external orifice there is attached a suitable fitting 53 to which may be attached a line, not shown, leading to a vacuum pump for evacuating air and water vapor from the interior of the casting device.

Experience has taught that during the process vacuum investing bubbles of water vapor form on the lower portions of the pattern, especially the under-surfaces. When the vacuum is broken and pressure inside the device returns to atmospheric, the water vapor bubbles condense leaving a film of water on the pattern. This film causes rough, imperfect surfaces on the final casting. Operators using this technique know that vibrating the casting ring and crucible former assembly mixes this water film into the surrounding investment, improving the final casting. Without the projection 40 on the gasket engaging the exterior of ring 24 air will pass between the gasket and ring, passing end surface 42 and groove 43, during vibration of the assembly. This air enters the still soft investment. The projection 40 giving a narrow annular contact with the ring and recess 34 extending gasket 31 into the groove around the crucible former are believed to be novel features and they cooperate to produce an advantageous design for the gasket and crucible former assembly even when removed from body 18 and used alone, as it usually is during the final vibration operation.

The lower end or casting ring assembly consisting of the casting ring itself, the crucible former and the gasket flange can be detached from the mixing shell and body 18 and has a separate utility. Investment material mixed in another container can be poured into the casting ring and the assembly placed on a vibrating table (not shown) to vibrate the investment as the final operation mentioned above. Also the body 18 can be modified in size or shape at its upper end, or replaced by another cylindrical body, to connect the lower assembly to a mixing chamber of different design.

Thus it becomes apparent that various changes in the design and shape of the elements of my improved mold forming device may be made without departing from the scope of my invention. Accordingly all such changes and modifications are considered to be within the scope of the invention defined by the appended claims.

I claim:

1. In a mold forming device of the character described, the combination comprising:
   - a cup-like shell open at one end and defining a mixing chamber;
   - a tubular body member engageable with the shell at said open end and forming a molding chamber, the tubular body member being open at both ends;
   - a casting ring open at both ends and disposed within the molding chamber with one open end facing the mixing chamber to receive the contents of the mixing chamber falling therefrom by gravity;
   - a separable base closing the open end of the ring remote from the mixing chamber;
   - and gasket means engaging the base, the ring, and the tubular member in air tight sealing relation, said gasket means having a portion frictionally engaging opposed spaced surfaces on the body member and casting ring to position the ring inside the body member and having another portion integral with the first mentioned portion engaging the base to hold the base in position closing the end of the ring.

2. In a mold forming device, the combination claimed in claim 1 that also includes funnel means formed integrally with the tubular member between the mixing and molding chambers and having centrally converging walls directing material into the ring.

3. In a mold forming device, the combination claimed in claim 1 in which the tubular member has an interior annular surface facing toward and spaced from the open end of the ring, said surface having an opening therein communicating with a passage terminating exteriorly of the tubular member.

4. In a mold forming device, the combination as claimed in claim 1 in which the tubular member and the ring are each circular in cross section and are annularly spaced from each other; and the gasket means closes the annular space at one end thereof.

5. In an invertable mold forming device of the character described, the combination of:
   - a cup-like shell defining a mixing chamber open at one end and closed at the other end;
   - stirring means within the mixing chamber mounted at the closed end thereof for operation form outside the device;
   - a tubular member telescopically engageable with the shell at said open end thereof and forming a molding chamber co-axial with the mixing chamber, said tubular member being open at both ends;
   - a casting ring open at both ends and disposed within

the molding chamber with its open end facing toward the mixing chamber to receive material therefrom;

funnel means having walls converging centrally of the device and directing into the ring the contents of the mixing chamber falling therefrom by gravity when the device is inverted to place the ring at the lower end;

a vacuum connection mounted on the tubular member and opening into the upper end of the molding chamber at a downwardly facing orifice spaced above the ring with the device in the inverted position;

a base closing the end of the ring remote from the shell and mounting the ring in the molding chamber;

and gasket means cooperating with the base, the ring, and the tubular member to form an air tight closure there between, said gasket means having a portion between and frictionally engaging opposed spaced surfaces on the body member and casting ring to position the ring inside the body member and having another portion engaging the base to hold the base in position closing the end of the ring.

6. In a mold forming device of the character described, the combination comprising:

a tubular member open at both ends and defining a molding chamber;

means for closing one end of the tubular member and delivering thereto a charge of mold forming material;

a casting ring within the molding chamber;

a base closing the outer end of the ring;

and a single annular gasket engaging the base, the ring, and the tubular member in air tight sealing relation, said gasket means having an annular portion inserted between and frictionally engaging opposed surfaces on the body member and the casting ring respectively, to position the casting ring inside the tubular member and to close the annular space therebetween, the gasket having surfaces in axially spaced substantially radial planes engaging opposing surfaces on the body member, the ring, and the base respectively.

7. In a mold forming device as claimed in claim 6, the combination in which the gasket and the base have engaging substantially radial surfaces and the gasket has an annular ridge of triangular cross-section on its radial surface engaging the base to effect an air tight seal therewith.

8. In a mold forming device as claimed in claim 6, the combination in which the gasket has a recess receiving one end of the ring, the recess including a substantially radial surface on the gasket engaging the end surface of the ring and a surface of revolution that is inwardly convex engaging the external cylindrical surface of the ring over a narrow annular area.

9. In a mold forming device as claimed in claim 8, the combination in which said end surface of the ring has an annular groove.

10. A casting ring assembly for investment casting comprising:

a cylindrical casting ring open at both ends and adapted to hold a quantity of investment material;

a base closing one end of said ring;

and gasket means engaging the base and the ring in air tight sealing relation to mount the ring on the base to prevent admission of air at the closed end of the ring to investment material in the ring, the gasket means comprising a resilient body having a generally

angular recess receiving one end of the ring, one wall of the recess being a substantially radial surface engaging the end surface of the ring and the other wall of the recess being a surface of revolution that is inwardly convex and engages the casting ring externally over a narrow annular area spaced from the end of the ring in engagement with the radial surface of the recess.

11. An assembly as claimed in claim 10, in which said end surface of the ring has an annular groove forming a sealing ridge in the gasket when in contact therewith.

12. An assembly as claimed in claim 10 in which the flat surface in the gasket means extends radially inwardly of the casting ring to limit engagement of the ring with said flat surface to an area removed from the free edge of the surface.

13. A casting ring assembly for investment casting under vacuum, comprising:

a cylindrical casting ring open at both ends and adapted to hold a quantity of investment material;

a rigid base having a central portion disposed within and closing one end of the ring, said base also having a flange extending radially outwardly from the central portion of the base to at least the outside diameter of the casting ring to provide a rigid external surface for resting the assembly on a vibrating table;

and resilient gasket means engaging the base and the ring in air-tight sealing relation to mount the ring on the base for vibration of the assembly without admitting air into the ring at said closed end thereof,

said gasket means surrounding the end portion of the casting ring and having a narrow, annular ridge engaging the exterior surface of the ring and the gasket means also having a radially inwardly extending portion with a substantially radial surface engaging the end of the ring.

14. A casting ring assembly as in claim 13 in which the casting ring has an annular groove in said end surface of the ring bearing against the gasket means forming a sealing ridge in the gasket when in contact therewith.

15. A casting ring assembly as in claim 13 in which the gasket means and the base have engaging, substantially radial surfaces and the gasket means has an annular ridge on its radial surface engaging the opposing radial surface on the base to effect an air-tight seal therewith.

References Cited by the Examiner

UNITED STATES PATENTS

1,133,320	3/15	Rockwood	277—207 XR
1,325,004	12/19	Davidson	22—196
1,535,017	4/25	Cline	22—190.1
2,274,186	2/42	Brace	22—113.1
2,319,727	5/43	Duggan.	
2,416,506	2/47	Vest	22—190.1 XR
2,457,756	12/48	Vest	22—113.1 XR
2,482,257	9/49	Frei	22—190.1
2,487,669	11/49	Pattullo et al.	277—207 XR
2,516,191	7/50	Englesson.	
2,660,768	12/53	Barr	22—113.1 XR
2,777,177	1/57	Steinbock et al.	22—113.1 XR
2,864,125	12/58	Kelley	18—5.7

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