March 7, 1933. E. B. KRAMER 1,900,881

SCREW CAP

Filed July 22, 1931

Fig. 1.

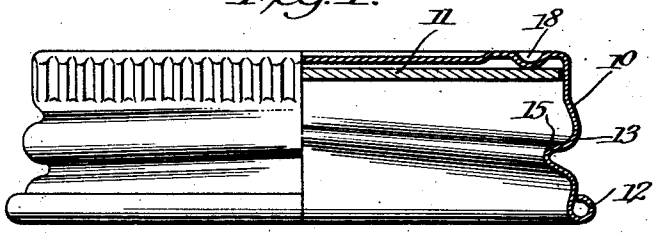


Fig. 3.

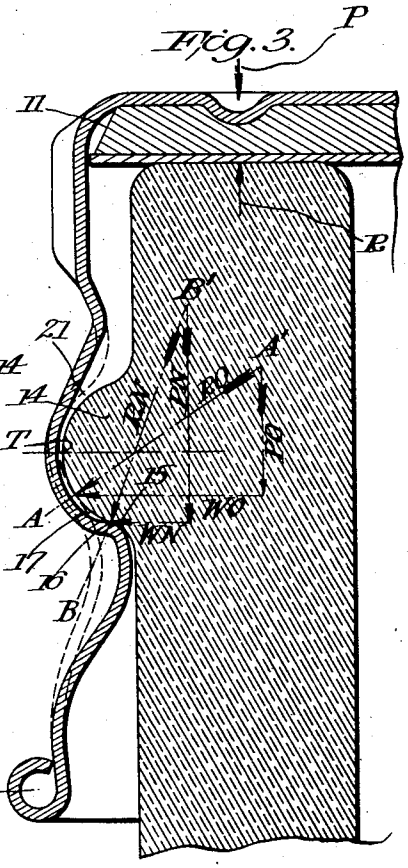


Fig. 2.

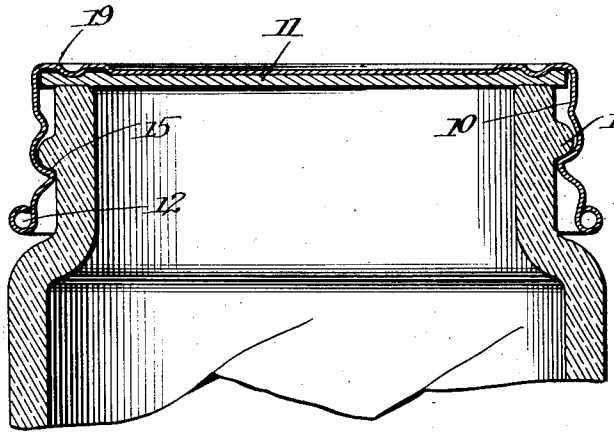
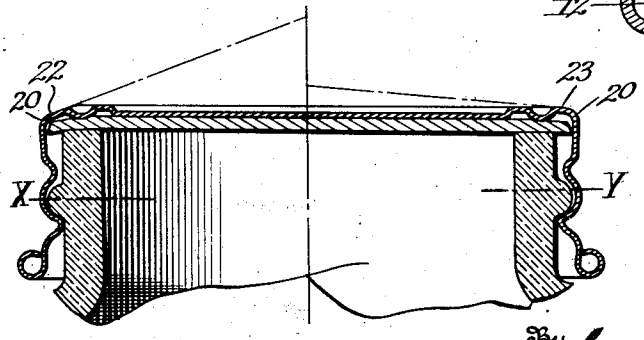


Fig. 4.



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UNITED STATES PATENT OFFICE

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SCREW CAP

Application filed July 22, 1931. Serial No. 552,494.

The present invention relates to screw or threaded metal caps which are formed from relatively thin metal blanks. Caps which are fastened after more or less rotation fall into three classes, as illustrated by the prior art: first, the continuous thread or screw cap typified by the well known Mason cover and exhibiting correlative threads (continuous or multiple) on cap and jar; second, the lug cap, exhibiting lugs or projections on inner side of cap flange, passing between and/or underneath separated ribs on jar; third, caps having lugs adapted to function with jars threaded substantially as in the first class. The present invention relates to the first class of caps. This type of cap has certain well known and obvious advantages, particularly simplicity and security. The cap merely "screws on", with as many revolutions as the length of flange, height of jar, top and pitch of thread permit. But this type of cap also has many objections, among which may be mentioned difficulty of removal, and tendency of the cap to rise at one side and distort when screwed tightly on a container.

An object of the present invention is to provide a screw cap which eliminates or minimizes to a substantial degree the defects heretofore present in the screw type of cap.

I have discovered that many of the objections to screw caps of conventional design may be overcome by constructing the screw thread in such a way as to establish a predetermined relationship between the cap thread and the container thread. More particularly, I have found that a number of the defects in screw caps of conventional design are due to the relation of the outward wedging pressure to the sealing pressure. I have further discovered that these defects may be overcome in the present invention by the provision of a thread upon the cap so formed in relation to the thread upon the container that the sealing pressure exerted is substantially in excess of the outward wedging pressure.

This is accomplished by providing a cap of thin metal having a screw thread formed with a shelf adapted to make a substantially line or point contact with the thread of the container. This line of contact is disposed near the inner edge of the cap thread shelf in a plane sufficiently approaching the perpendicular to the axis of rotation of the cap that there is produced a downward sealing pressure substantially in excess of the outward wedging pressure. That is to say, the surface of the thread shelf and of the container thread engage well beneath the container thread and along substantially a line and the common tangent through said line is sufficiently close to the perpendicular to the axis of cap rotation that the downward sealing pressure is substantially in excess of the outward wedging pressure.

The primary object of the invention is to produce a cap having a relatively deep thread providing a shelf which will engage sufficiently beneath the under surface of the thread of a glass or other conventional threaded container to enable the downward sealing pressure to be greatly increased over that available with present articles of this character and sufficiently to produce a sealing pressure substantially in excess of the outward wedging pressure.

A further object of the invention is to reduce to a minimum the effect of the outward wedging pressure which in conventional constructions results in distortion of the cap and particularly the thread portion, thereby seriously affecting the sealing pressure.

In applying a conventional cap to a container, it is frequently observed that one side of the cap raises perceptibly, thereby destroying its sealing value, and it is this objection which the hook-shaped or more nearly horizontal shelf characteristic of the deep thread of the present invention eliminates.

The cap of the present invention wherein the deep hook-shaped shelf engages well under the glass thread and, in effect, actually hooks to i. e., makes a line or point contact with, the under surface thereof, reduces to a minimum the possibility of the cap thread riding or climbing on the glass thread and thus eliminates any such deformation as would cause the top of the cap to raise on one side or the thread to distort.

The cap of the present invention has a threaded skirt which in cross section presents

a contour in which the shelf has near its inner edge a portion which is adapted to engage well beneath the container thread along a narrow line of contact and in a plane sufficiently close to perpendicularity to the axis of the cap to exert a sealing pressure substantially in excess of the outward wedging pressure. By reason of this construction the shelf of the thread is adapted to engage the ledge or under surface of the container thread at a point close to the wall of the container and is remote from the surface of the container thread outwardly and upwardly from the line of contact to a diametrical point on the container thread when such diameter is drawn substantially parallel to the top or bottom of the container. In other words, the line contact between the respective surfaces of the cap and container threads takes place at a point sufficiently close to perpendicularity to the axis of the cap and the container to insure a downward sealing pressure in excess of the outward wedging pressure. Such a construction insures complete freedom from excessive outward wedging pressure which in present screw closures causes an objectionable jamming or wedging of the threads.

A further feature of the cap of this invention resides in its flexibility enabling equally high sealing pressures to be obtained on both the low and high points of the sealing surface of the container. Most glass containers have at least two high and two low points found variously on the sealing surface.

The usual cap has a circumferential bead which in conventional closures is forced into the gasket or liner when the cap is turned and reliance is placed on the resiliency and compressibility of this liner to effectively seal the container at the low points.

With the present invention there is a hooking of the respective threads at a point, as viewed in cross-section or, as viewed circumferentially, on substantially a line, well under the glass thread and there is a clearance or freedom from outward wedging action between the cap body and the container from this point outwardly and upwardly around the surface of the container thread and preferably this clearance continues entirely to the sealing surface.

Therefore, when my cap is screwed down, the bead in the cap top presses into the liner, but since the cap body or thread cannot ride or climb due to the line engagement of the shelf of the metal thread with the container thread along a narrow line of contact disposed so that a common tangent through said line is sufficiently close to the perpendicular to the cap axis to reduce the outward wedging pressure to a minimum and substantially increase the sealing pressure, the top peripheral portion of the cap outside of the bead is drawn or flexed downwardly from the bead as a pivot. This is possible through the resiliency of the metal forming the rim defined by the bead, and the lack of friction or contact between the cap body and the neck of the container as provided by the clearance between these portions. This flexing is more on the high points than on the low points of the sealing surface and with the high points contacting first, flex the rim portion beyond the elastic limit of the metal creating a permanently deformed portion having a different resiliency. Further turning, therefore, puts this deformed portion under tension, and this deforming and tensioning continues until the tension at the low points and high points is equal, producing an equal sealing pressure throughout the sealing surface. As a result the cap does not rise to break the seal, but on the contrary is flexed to give an actual sealing pressure on the low points which is not dependent on the resilience or compressibility of the gasket or liner, and moreover this sealing pressure at the low points is equal to that at the high points.

Referring to the drawing:

Figure 1 is a view partly in section of the improved cap.

Figure 2 is a sectional view showing the cap applied.

Figure 3 is a view showing the present conventional cap in dotted lines and the cap of the invention, the view being made in section to illustrate clearly the relationship and the departure from the conventional construction, and

Figure 4 is a view in section showing the cap in position and portions thereof at the high and low points of a sealing surface.

It is to be understood that the cap forming the subject matter of this application is adapted for use with threaded containers in accordance with accepted standards, and particularly with threads which are in general contour curved in cross section and adopted as standard by the Glass Container Ass'n of America.

Numeral 10 indicates the cap of the invention which is preferably formed of sheet metal and fashioned from a blank in accordance with my copending application. There is usually interposed a liner of resilient material such as paper, rubber, paper pulp or cork 11 and the cap is provided with the customary wire edge 12.

The spiral thread 13 is formed in the skirt of the cap in accordance with my copending application, which enables a much deeper thread to be produced and which also permits of the formation of a hook-shaped shelf. That is to say, the shelf hooks under the thread or engages the thread along a line contact, the contacting portions being disposed in a plane sufficiently close to the perpendicular, or so that the common tangent through the line is sufficiently close to the

perpendicular, to the axis of the cap that the sealing pressure produced is greatly in excess of the outward wedging pressure. When referring to the shelf as "hook-shaped" or as "approaching the horizontal" or "approaching the perpendicular", I do not mean that it has a portion which ascends or rises, since this is not an essential characteristic of a hook. I means merely that the thread is so formed in relation to the container thread that it engages the latter along a narrow line of contact and in a plane sufficiently close to the perpendicular to the cap axis, or with the surfaces having a common tangent sufficiently close to perpendicularity to the cap axis, that there will be exerted a sealing pressure substantially in excess of the outward wedging pressure.

Upon referring to the several views, it will be observed that the threaded skirt presents in cross section substantially the contour of the conventional fish hook and the shelf of the thread, by reason of the depth thereof will hook under the glass thread which facilitate the attainment of the high sealing pressure, possible with this invention.

By following the process and apparatus of my copending application, it is possible to produce the cap of the present invention from a shell without further distending the metal of the skirt and thread, so that they are of substantially the thickness of the original shell.

Referring to Figure 3, the dotted line disclosure indicates a screw cap of conventional design wherein the thread contacts with the glass thread 14 at A. This area of contact may vary a little either up or down on the glass, depending upon the nicety with which the glass thread is made and in accordance with the glass diameters, that is, whether such diameters are to the maximum or minimum specifications of the standard finishes. It will be noted, however, that the area of contact is relatively close to a diametrical point T on the surface of the glass thread when the diameter is drawn substantially parallel to either the top or bottom of the container. Referring to the drawing, it will be observed that the contact portion of the shelf engages the undersurface of the container thread to establish a line contact and that the opposed contact portions, i. e. surfaces of the cap thread and container thread at said line of contact approach sufficiently close to perpendicularity to the axis of the cap and the container to insure a downward sealing pressure in excess of the outward wedging pressure. The objection to such an area of engagement will be later brought out, but it can here be stated that the outward wedging pressure or the pressure which is exerted on the cap thread tending to cause it to ride or climb over the glass thread is excessive at the point A, which not only causes the distortion of the cap but very seriously interferes with and reduces the sealing value, by causing one side of the cap to raise up perceptibly.

The cap of the present invention, on the other hand, engages the glass thread at B, a point relatively close to the wall of the container and quite removed from the diametrical point T. In this manner the outward wedging force is extremely small and the sealing value is correspondingly augmented.

It will be understood that when the cap is turned, the turning effort applied to the cap results in a down pressure which will be denoted as P and which is resisted by an equal pressure R in the glass.

It is quite evident that this resistance is transferred to the glass thread and the cap thread in the conventional construction at the point A. With the present invention this resistance is transferred to the point B.

To analyze the forces at these points, assume that the line AA′, which is drawn through the center of curvature of the glass thread contour represents the magnitude and direction of the force or resistance, and is designated RO. From this line a parallelogram of forces may be constructed by drawing a vertical line through A′ and a horizontal line through A. Since RO is the resistance, the down pressure will be represented by a component in the direction and magnitude of the line PO and the outward wedging pressure will be indicated by a component in the direction and magnitude of the line WO.

It will be observed, therefore, that in the conventional cap when applied to a container, there is an excessive outward wedging pressure which is greater than the downward sealing pressure, and it is true with conventional constructions that this excessive wedging pressure tends to make the cap rise upwardly and at times over the glass thread. It, likewise, as will be apparent, causes distortion of the top as well as the threaded skirt and causes the cap to lose its original shape. That is to say, the climbing or riding of the cap thread on the glass thread results in raising or forcing the top up on one side to destroy the seal and permit leakage. Furthermore, in conventional caps, because of this excessive outward wedging pressure, and since such caps are relatively thinner at the threaded portions than the cap of the present invention, it is frequently necessary to discard large numbers of caps, because the caps do not properly seal.

It will be clear from the diagram that the outward wedging force increases rapidly as the contact point A is advanced upwardly to the danger point of slipping entirely off at T.

From this it will be seen that the nearer the contact point A approaches the high spot of the glass thread at T, the smaller the downward pressure or sealing pressure of

the cap, and to a corresponding extent, the greater becomes the outward wedging pressure which will be exerted to release and raise the cap and distort it, causing the cap thread to ride or climb and raise the cap at one side to destroy the seal.

It is this condition in conventional constructions which causes jamming or wedging of the threads in a manner which is known in the machine industry as "cross threads". With this objection present, it is extremely hard to remove the cap and the sealing pressure is not only very slight, but also unreliable.

From a full appreciation of all of the objectionable conditions surrounding the usual caps as described, the present invention employs a cap having a thread provided with a shelf which will contact under the glass thread a sufficient distance to assure a sealing pressure higher than the outward wedging pressure between the cap and container and wherein the outward wedging pressure is reduced to a minimum.

As stated, the cap of this invention is adapted to contact with the thread of the container at the point B and to analyze the forces when the improved cap is so applied to a container, the line BB′ will be described through the same center and of the same magnitude and direction as the line AA′, to represent the resistance. If now the line BB′, which will be denoted RN be resolved into its components in the same manner as was accomplished above in connection with the conventional structure, a line will be drawn through B′ and indicated in magnitude and direction as PN, being parallel to PO, and a line will be drawn to WO. In other words, applying the parallelogram of forces principle to the line RN, there is presented the line PN as the magnitude of the downward sealing pressure and the line WN as the magnitude of the outward wedging force. These two forces, it will be observed, are greater than and less, respectively, than the same forces in the conventional construction, from which it will be clear that while the sealing force PN is greatly increased the outward wedging force WN is greatly decreased. In this manner, the cap of the present invention exerts a sealing pressure which is far greater than that of the conventional cap since the outward wedging pressure is so materially decreased, and the diagrams have been employed as the most simple and convenient method of illustrating the improvements represented by the invention.

In the ordinary method of rolling a thread in a cap it was not possible to produce a deep thread of hook-shape construction since the metal would crack in the rolling operation. In order to get the deeper thread with the hook-shaped contour as shown in the drawing, the new method of bending and folding and machine for producing the cap was invented as described in the copending application. This copending application discloses the method and machine by which a deeper thread is obtained by allowing the shell to shrink in height during the thread forming operation without causing any stretch or distension of the metal, such as would produce weak points and result in cracking or breaking. In other words, the copending application describes a method and machine in which the metal is folded, as distinguished from the conventional rolling method of stretching or distension, and in this manner strain is minimized, if not practically eliminated, to such an extent that threads may be produced safely to any depth desired.

Thus upon reference to the drawing it will be perceived that the point or line B, which is the point or narrow line of contact of my improved cap with the glass thread affords a much greater sealing pressure than with the conventional cap where the point of contact with the thread of the glass is at A. This is due to the deep hook-shaped thread construction of the present cap and to the provision of a thread having a shelf, in effect forming a hook which enables the thread to engage a greater distance beneath the glass thread of the container and closer to the wall thereof.

Referring to the drawing, the end or radially inner edge of the hook-shaped shelf will be indicated by the numeral 15 and will preferably be a flattened portion or a slightly curved portion or possess a configuration such that the thread of the cap will hook under the glass thread of the container. Such point of engagement of the respective threads may be stated, in effect, to be the engagement of the shelf of the cap thread with the under surface or ledge of the container thread at a point sufficiently beneath the glass thread to provide a frictional sealing contact characterized by a pressure exerted by the cap on the container in excess of the outward wedging pressure and more specifically a pressure exerted by the cap on the container through the threads at a point close to the wall of the container and remote from a diametrical point described by a diameter drawn through the curved container thread parallel to the top or bottom of the container.

The shelf of the cap thread is indicated generally at 16, and the under surface of the glass thread is indicated as a whole at 17, from which it will be clear from the previous description that the shelf and the glass thread under surface engage each other at a point remote from that which is now common in the conventional structures.

It will be quite obvious that the new cap of this invention gives a much greater sealing pressure, and in tests this sealing pressure has been found to be from 50 to 75 per cent

more with the new caps than with those now available.

It has, furthermore, been proven that caps made with the new deep hook-shaped thread can be applied and removed with greater ease, notwithstanding the tremendous increase obtained in sealing pressure. The sealing pressure afforded by the cap of the present construction not only produces a more effective cap closure, but there is a substantially complete elimination of the causes of jamming or wedging of the threads since the outward wedging pressure is reduced to a minimum.

Referring to Figures 2 and 3, it will be noted that from the point of engagement of the threads at 15 outwardly around the container thread surface, and in the preferred form entirely to the sealing surface of the container, there is a freedom of wedging pressure and clearance between the cap body and the container neck.

This lack of contact or avoiding of any substantial friction not only enables easy application and removal of the cap, but has a further function which will hereinafter be described.

The cap is provided with a bead 18 defining a circular metal portion or rim 19 between it and the peripheral edge. This bead may take a variety of forms, it being used primarily to compress the liner 11, but can be omitted from my cap, although I prefer it.

It will be understood that by reason of the line or point engagement between the threads beneath the container thread, the top of the cap cannot rise, but on the contrary is drawn downward by the force PN exerting a very high sealing pressure.

However, due to imperfections and difficulties in glass manufacture, the sealing surface of a container customarily has high and low points or irregularities which are to be variously found on the sealing surface.

Heretofore, reliance has been placed on the cushion or liner 11 to provide a sealing contact at the low points. With my invention, this objectionable factor is superseded by applying an actual and equal direct sealing pressure at both the high and low points.

This is accomplished by permitting and causing the portion 19 to flex downwardly and deform from the bead, as shown at 20.

To be more specific, the hooking engagement not allowing the cap to ride up, on the contrary at the high points actually compels the portion 19 to flex downward as shown in Figure 4. This is possibly due to the resiliency of the metal which flexes downwardly about the bead as a pivot or in other words is drawn downwardly from the bead; and also is obtained by reason of the clearance 21 between the cap body and container neck, these portions being substantially out of contact between the point or line contact 15 of the threads and the sealing surface, providing a non-frictional or spaced relation of these parts.

Referring to Figure 4, X is a section through a high point of the sealing surface, and Y a section through a low point thereof.

As the cap is applied the high point or points contacting first draws or flexes the rim 19 down about the bead as a pivot, as shown at 22. This flexing exceeds the elastic limit of the metal at this point producing a permanent deformation of the metal and creating a new degree of resilience or tension therein. This continues with the screwing of the cap until the tension at the high point equals that at the low point when a uniformly equal sealing pressure will be exerted over the entire sealing surface. This sealing pressure is very high and is actual and direct throughout the sealing surface. Thus reliance upon the liner 11 is only necessary from the standpoint of the usual gasket and not to primarily make the seal at the low points, as is now customary.

As shown in Figure 4, the portion 22 is flexed downwardly more than at the low point portion 23, but the tension and sealing pressure at both points is equal since the portion 22 has its metal flexed past its elastic limit and possesses a new limit or tension equal to that of the metal at 23.

Thus an equal sealing pressure is obtained throughout the sealing surface, direct and actual upon both low and high points. The deformation caused by the flexing does not impair the cap, but rather equalizes the resilience or tension of the metal throughout the rim portion 19, so that the cap may be used over and over.

I claim:

1. In combination with a glass container having a neck formed with a continuous external thread, a screw cap of thin metal having a skirt formed with a continuous thread having a shelf provided near its inner edge with a contact portion which is formed to provide a narrow line contact with the underside of the container thread, the shelf surface and the container thread surface along said line approaching sufficiently close to perpendicularity to the cap axis to produce a downward sealing pressure substantially in excess of the outward wedging pressure, said shelf having a clearance outwardly and upwardly from said line contact about the container thread.

2. In combination with a glass container having a neck formed with a continuous external thread, a screw cap of thin metal having a skirt formed with a continuous thread having a shelf provided near its inner edge with a contact portion which is formed to provide a narrow line contact with the underside of the container thread, the shelf surface and the container thread surface along said line approaching sufficiently close

to perpendicularity to the cap axis to produce a downward sealing pressure substantially in excess of the outward wedging pressure, said skirt having a clearance outwardly and upwardly from said line of contact substantially to the sealing surface of the container.

3. A screw cap having a top and a skirt provided with a continuous spiral thread and adapted for application to a container having a neck and a continuous thread formed with an undersurface having a portion approaching perpendicularity to the container axis, said cap being formed of thin metal and the thread thereof having a shelf provided near its inner edge with a contact portion which is formed to provide a narrow line contact with the underside of the container thread, the contact portion of the shelf surface approaching sufficiently close to perpendicularity to the cap axis to produce a downward sealing pressure in excess of the outward wedging pressure, said shelf being formed to have a clearance outwardly and upwardly from said line contact about the container thread.

4. A screw cap having a top and a skirt provided with a continuous spiral thread and adapted for application to a container having a neck and a continuous thread formed with an undersurface having a portion approaching perpendicularity to the container axis, said cap being formed of thin metal and the thread thereof having a shelf provided near its inner edge with a contact portion which is formed to provide a narrow line contact with the underside of the container thread, the contact portion of the shelf surface approaching sufficiently close to perpendicularity to the cap axis to produce a downward sealing pressure in excess of the outward wedging pressure, said shelf and skirt being formed to have a clearance outwardly and upwardly from said line of contact substantially to the sealing surface of the container.

In testimony whereof I have hereunto set my hand.

ERIC B. KRAMER.