Nov. 29, 1960 A. J. STARR ET AL 2,962,185

PLASTIC CLOSURE PLUG AND CONTAINER FLANGE PLUG ASSEMBLY

Filed March 5, 1958

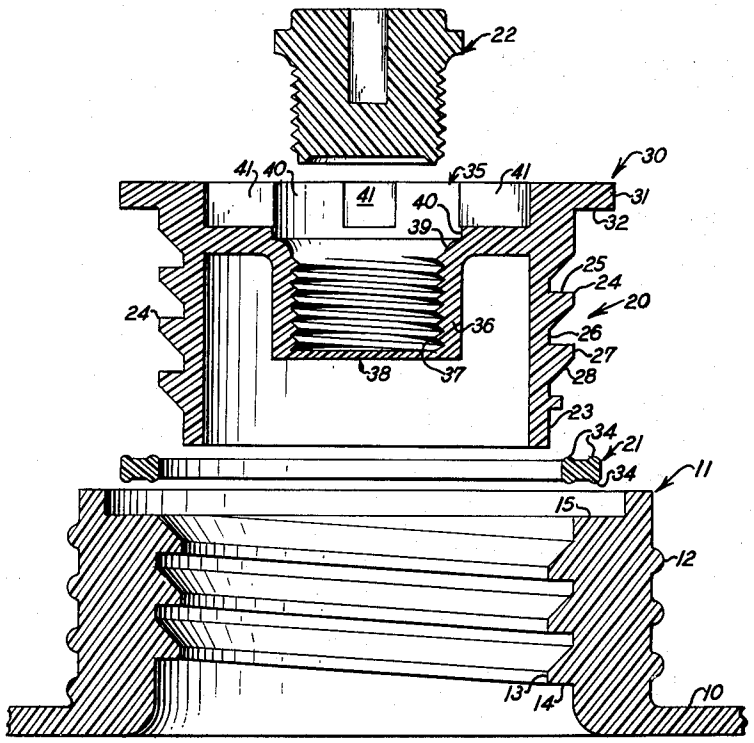


FIG. 1

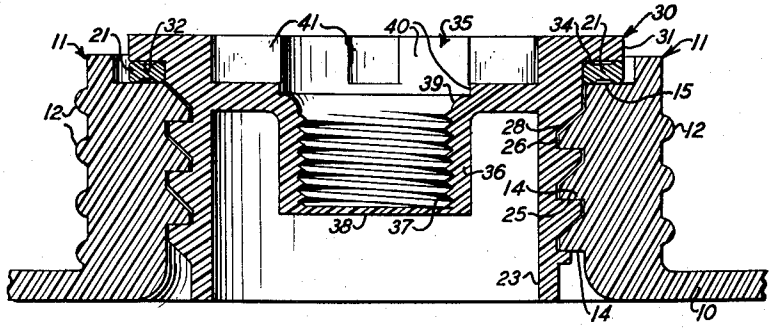


FIG. 2

INVENTOR

ANTHONY J. STARR
JEROME S. HEISLER
ALBERT HEISLER

BY Carey, Hart + Hemple

ATTORNEY

United States Patent Office 2,962,185
Patented Nov. 29, 1960

2,962,185

PLASTIC CLOSURE PLUG AND CONTAINER FLANGE PLUG ASSEMBLY

Anthony J. Starr, Jerome S. Heisler, 1234 Prospect Drive, and Albert Heisler, 117 W. 39th St., all of Wilmington, Del.; said Anthony J. Starr assignor to Jerome S. Heisler and Albert Heisler

Filed Mar. 5, 1958, Ser. No. 719,328

3 Claims. (Cl. 220—39)

This invention relates to a plastic closure plug for containers, and particularly for polyethylene drums provided with one or more flanged openings threaded to receive plugs of the same material.

Polyethylene possesses a number of desirable properties which commend it for use as a material of construction in the manufacture of containers and the like for the transportation and storage of various materials, particularly valuable fluids and chemicals which are corrosive or easily contaminated if brought into contact with a metal surface. Polyethylene has a relatively low density, is chemically inert, and in sheet or strip form is flexible, strong, practically unbreakable and possesses high tear resistance. Moreover, since polyethylene is thermoplastic it lends itself to fabrication into various shapes by procedures involving the application of heat.

Because of these and other desirable physical and chemical properties, polyethylene containers are becoming widely used in industry and commerce. As in the case of conventional containers such as steel drums and the like, polyethylene containers are usually provided with one or more openings for use in filling and emptying the container. These openings are defined by flanges cooperating with suitable closures, preferably of the screw threaded type. Usually the flanges are interiorly threaded to receive polyethylene plugs which are similarly impervious to the chemical to be deposited in the container. The flanges may be additionally threaded on their outer walls to accommodate standard metal or plastic screw caps which are economical enough to be expendable. The plugs, on the other hand, are of a more expensive construction because they are relied upon in major part to provide effective sealing closures for the drums and may be formed with a central internally threaded flange to support a pouring device. Consequently it is of advantage if such plugs can be used repeatedly with the containers for substantial periods of time.

The polyethylene plugs heretofore in use rely for their sealing qualities principally upon the conventional pipe thread with which such plugs are provided. The sealing effect of this type of thread is due to two factors: (1) the close fit of the apex of the thread on the plug with the bottom of the groove formed by the thread on the flange and (2) the fineness of the thread. As to the first factor, the seal becomes progressively less effective as the apex of the thread wears off through reuse. This deterioration of the seal is more rapid when the thread is made of a relatively soft material such as polyethylene. Also this type of material is more subject to damage in reuse than harder materials so that there is always the danger that in the handling of the plug the thread will incur such damage as to destroy entirely its effectiveness as a seal. With regard to the size of the thread, the seal is more effective the finer the thread size. To make the seal of these prior polyethylene plugs as effective as possible, the threads thereof have been made relatively

fine—of the order of approximately 11 threads per inch. Threads of such fineness, when made of a soft material like polyethylene, wear out rapidly and provide a poor seal after little usage of the same.

These prior polyethylene plugs also have been provided with sealing flanges. According to one type of construction, the sealing surface of the flange is curved in a transverse direction to enable it to seat snugly on a curved, annular sealing surface provided on the outer end of the drum flange. The effectiveness of the seal produced by such parts depends on the wiping wedging action of the sealing surface of the plug on the sealing surface of the flange as the plug is screwed tightly into place. Such a seal is difficult to obtain repeatedly when sealing parts having the aforesaid construction are made of polyethylene which is soft and therefore subject to rapid wear under stresses of this type. Polyethylene is also of such a compressible and yielding nature that rather than afford a more secure seal as the plug is so tightened on the drum flange, it will have a tendency to give to such an extent that two surfaces of the construction indicated will properly coact to produce the seal they were designed to effect. Further, under the pressures usually applied in fitting such a plug into closed position in the flange, the polyethylene material in the root portion of an outwardly extending sealing flange of the plug will tend to cold flow to cause a permanent deformation of the flange, thereby rendering the flange useless as a sealing device.

In another type of polyethylene plug, the flange thereof is provided on its underside with an annular bead which is located adjacently to the periphery of such flange and which is adapted to seat in a groove on the end of the drum flange. The sealing effect of this arrangement is dependent upon the close fitting of the bead within the groove and the close seating of the end of the bead on the inner wall of the groove. Because of the yielding nature of polyethylene, however, the peripheral edge portion of the flange containing the bead will give as the plug is screwed tightly into place, thereby destroying the sealing arrangement which the bead and groove are designed to effect. In this construction also, the cold flow of the polyethylene material in the flange under the applied pressure will tend to cause a permanent set of the flange in a tilted condition. Also because of the softness of polyethylene, the bead on the plug will enlarge the groove on the drum flange and itself will wear as the plug is reused, thus destroying the sealing effect of such two parts. Further, because of the relatively rapid wear of the fine conventional pipe threads provided on the plug and flange of this construction, it is difficult to maintain a positive, tight connection between the engaging surface portions of these threads such as to produce repeatedly good seals between the plug and the container flange at the outer end of the latter.

It is the primary object of this invention to provide a closure plug made of polyethylene, polyisobutylene and like materials that is capable of forming an effective seal on the flange of a polyethylene container and which is of such improved construction that it is not subject to the disadvantages of the above discussed plug constructions and, therefore, may be reused for considerable periods without deterioration of its sealing capabilities.

The novelty of the closure plug of this invention resides in part in the accomplishment of its sealing action primarily at the top of the container flange with the aid of a buttress type of thread provided on the exterior of the plug and adapted to interengage with a corresponding buttress type thread provided on the interior wall of the container flange. In accordance with one of the features of the invention, the under sealing surface of the plug flange is made flat and disposed at right angles to the

central axis of the plug and in opposed relation to a flat annular sealing surface provided on the top end wall of the container flange. The sealing surface of the plug coacts with the sealing surface of the flange either directly, or through an annular gasket made of any suitable plastic material such as polyethylene or rubber and preferably made of a softer material than the materials of the plug and the container flange. In accordance with another feature of the invention, the gasket is provided with the general shape of a flat ring and is provided adjacent its inner and outer peripheries, on both sides thereof, with small ring-shaped beads. Thus, when the plug is fitted into the container flange, the beads on the upper side of the gasket are in engagement with the sealing surface of the plug and the beads on the lower side of the gasket are in engagement with the sealing surface on the flange, such beads providing the seal between such sealing surfaces.

The seal between the plug and the container flange is further insured by the interaction of the spiralling surfaces of the buttress threads of the plug and flange which are disposed at right angles to the central axes of such members. Initially in seating the plug the gasket will rotate with the plug. When, however, the gasket is pressed into engagement with the container flange sealing surface to a degree that the frictional resistance therebetween becomes as great as the rotative component of the force that is applied to the outer edges of the beads of the gasket by the plug sealing surface, the gasket will stop its rotary movement as the plug is turned. Thereafter, the axial thrust component only of the forces resulting from the interaction of said thread surfaces will be transmitted to the flange sealing surface through the gasket. Thus, during the final turns of the plug to bring it to a sealed condition with relation to the container flange there is no rotational motion between the gasket and the container flange sealing surface, the sealed condition between such parts being attained by force applied longitudinally of the container flange. The combined effect of such interaction of the thread surfaces, the flange sealing surfaces and the gasket is a positive sealing action whereby wear of the flange sealing surface is minimized to such an extent that good sealing results can be attained repeatedly. The gasket being of softer material than the materials of the container flange and the plug will absorb the greatest wear and it is economical enough to be expendable. Further, as the beads on the gasket enable the forces that are applied by the plug flange to be distributed more uniformly to the gasket and to the container flange seating surface without any substantial levering effects on the plug flange, any tendency of the latter to tilt from normal position is minimized.

In accordance with another feature of the invention, the buttress threads of the plug and flange provide a secondary seal between the spiral surfaces thereof which are disposed perpendicularly to the longitudinal axis of the flange. The seal effected by such spiral surfaces of the buttress threads is not dependent upon the previously explained end of the thread engagement required with the conventional pipe thread to provide a good seal, nor is it dependent upon the fineness of the thread. The buttress thread, therefore, can be made substantially more rugged and heavier than the conventional pipe thread to bring it more into conformance from a practical standpoint with the polyethylene material of which the plug and flange are formed. With a more rugged thread, the spiral surfaces can be made substantially wider thus providing better sealing surfaces and enabling the provision of a better seal with a substantially lesser number of thread turns than is possible with the conventional pipe thread. It has been found satisfactory to use a buttress type thread having less than one half the number of threads per inch which would be required in a plug having the conventional pipe thread. Since the sealing effect of the buttress threads is not dependent on an end of the thread engagement as required in conventional pipe threads, wear of the thread ends does not destroy the seal. Further, while the camming surfaces of the heavier buttress threads will wear to some extent during usage, such wear will take place on the strongest part of the thread and will therefore be minimized. Such wear as will occur will not be sufficient to effect substantially either the seal of such camming surfaces, or the seal between the sealing surfaces of the plug and flange due to the gasket.

A more complete understanding of the invention will be obtained from the following description, when read in connection with the accompanying drawings, in which

Fig. 1 is an exploded view of a closure plug made in accordance with the invention and including the plug with its sealing gasket and a screw plug for the threaded opening to which a pouring device may be connected, each of said parts being shown in central vertical section.

Fig. 2 is a central vertical section through the flange portion of a container with the plug and gasket unit in seated relation thereto.

In the drawings, there is shown a fragmentary portion of the top end of a polyethylene drum type container **10** provided with the usual flange **11** defining the opening by which the drum may be filled or emptied. The flange is provided with an external screw thread **12** to which may be attached a standard metal or plastic screw cap (not shown) and is provided with an internal screw thread **13** into which is screwed the plug of this invention. The screw thread **13** is of the buttress type and has a downwardly spiralling thread surface **14** disposed at right angles to the central axis of flange **11** and facing downwardly in opposed relation to the interior of the container. The thread **13** is complemental to the exterior thread on the plug which will be described later in more detail. The flange is provided at its upper end with a flat annular sealing surface **15** which is disposed at right angles to the central axis thereof. The flange **11** is made of polyethylene and may be formed in the manner disclosed in pending U.S. application Serial No. 375,625, filed August 21, 1953, utilizing a similar mold assembly. In practicing the process disclosed in said application to mold flange **11**, it is contemplated using polyethylenes having a density within the range of approximately 0.92 to 0.95, such as the polyethylene known as "Super Dylan" manufactured by Koppers Co., to assure that the thread **13** and the sealing surface **15** have sufficient hardness to reduce wear thereof to the extent that such parts shall be enabled to properly perform their intended functions throughout the life of the drum.

The plug unit, as shown in Fig. 1, includes a plug which is indicated generally by the reference numeral **20**, a gasket **21** and a stopper **22**. The plug **20** may be formed in accordance with the process disclosed in said U.S. application Serial No. 375,625, utilizing a mold assembly permitting the practice of such process and employing a polyethylene having a density wtihin the range of approximately 0.92 to 0.95 to provide a molded polyethylene plug of suitable hardness. The plug **20** comprises a cylindrical shank **23** formed to provide an external screw thread **24** of the buttress type. The thread **24** includes a downwardly spiralling thread surface **25** disposed at right angles to the central axis of the plug and facing upwardly in opposed relation to the thread surface **14** of the thread **13** on flange **11** (note Fig. 2). The thread surface **25** extends outwardly from the bottom edge of a longitudinally disposed thread surface **26** which spirals about the central axis of the plug and forms the bottom of the groove between the thread turns. The outer periphery of the thread surface **25** forms a spirally-shaped line of juncture with the top edge of longitudinally disposed spiral thread surface **27** forming the outer edge of thread **24**. The bottom edge of thread surface **27** is joined to the upper edge of an inclined spiral thread surface **28** which at its lower edge is joined to the top

edge of thread surface 26. Buttress thread 24 therefore is rugged in construction and has a relatively blunt outer edge that can withstand substantial wear. Preferably in a plug of the type indicated, the thread 24 is made with approximately 5 turns per inch and with a thread surface 25 approximately ⅛ inch to provide a heavy thread with a wide working surface for engagement with the similarly constructed surface 14 of flange thread 13. When the plug 20 is in closed position on flange 11, the engaged thread surfaces 14 and 25 form a suitable sealing means. This seal, as has previously been indicated, is more effective when such surfaces 14 and 25 are relatively wide. Consequently, by making the said engaging surfaces approximately ⅛ inch wide, the number of thread turns necessary to provide an effective fluid-tight seal is considerably reduced. This in turn enables the threads to be made heavy enough to withstand wear without substantial loss of their sealing qualities for a long period of usage even when made of a relatively soft material such as polyethylene.

Integral with the top of the shank 23 is a flanged top 30 having an outwardly extending sealing flange 31. Provided on the underside of flange 31 is an annular sealing surface 32 which is flat and disposed at right angles to the central axis of the plug so as to be positioned in parallel opposed relation with the flat annular sealing surface 15 provided on the top end of flange 11. This sealing surface is not wide with relation to the thickness of the flange 31 being approximately 3/16 inch wide when the flange is approximately ⅛ inch thick. Thus, if the longitudinal stresses to which sealing surface 32 is likely to be subjected in the use of the plug, are effectively distributed with relation to such sealing surface, the chances of flange 31 becoming titled or deformed as a result of such use are not great and are within practical considerations. Such an effective distribution of the stresses may be accomplished by use of a gasket such as the gasket 21 shown in the drawings. Gasket 21 is formed of a resilient and compressible material such as rubber or a polyethylene having a density of approximately 0.92. Thus gasket 21 has a hardness substantially less than that of the materials of flange 11 and plug 20 and while it has a thickness approaching that of flange 31, approximately 3/32 inch, flange 11 is substantially rigid, whereas gasket 21 is relatively flexible. Gasket 21 has a width substantially the same as the width of flange surface 32, namely, 3/16 inch. Adjacent to each peripheral edge of gasket 21, and on both sides thereof, is a ring-shaped bead 34 having a width of approximately 1/32 inch and a thickness of approximately 1/64 inch. Thus any stresses applied to the flange 31, are transmitted through the more compressible material of the gasket by way of the beads 34, one pair of which is located adjacently to the root of such flange and the other pair of which is located adjacently to the outer edge of such flange. The upper concentrically arranged pair of beads in engagement with the sealing surface 32 of the flange and the lower concentrically arranged pair of beads in engagement with the sealing surface 15 of the container flange, become flattened under the stresses imparted in screwing the plug to seating relation to the flange and together with such surfaces form the primary liquid-tight seal between the plug and the container flange. Because of the compressible nature of the material of gasket 21 any irregularities or worn spots in the sealing surfaces 15 and 32 will be conformed to by such material without weakening the overall effectiveness of the seal. Further, this quality of the gasket will tend to maintain an effective sealing relation between the working thread surfaces 14 and 25 even when such surfaces have become substantially worn.

The flanged top 30 is provided with a central circular opening 35 which extends down into the upper end portion of the shank 23. Communicating with the bottom end of such opening is the upper end of a socket 36 provided with an internal thread 37 and closed at its lower end by a diaphragm 38. The diaphragm is of substantially reduced thickness to enable it to be readily severed from the body of the plug 20 when the contents of the container are to be dispensed. The socket 36 is provided at its upper, open end with a smooth, curved, outwardly extending sealing lip 39. The outer peripheral edge of the lip 39 is integrally connected with the lower end of the annular wall 40 forming the opening 35. Provided in the wall 40 above the sealing lip 39 are two opposed pairs of slots which are open at their upper ends and which provide openings through wall 40 into the tool engaging recesses 41 formed in the top portion of the plug in offset relation to the central opening 35 thereof.

While there is hereinabove described and illustrated in the accompanying drawings a preferred embodiment of the invention, it will be apparent to those skilled in the art that changes may be made therein without departing from the spirit of the invention or the scope of the appended claims.

We claim:

1. A closure plug for a drum made of polyethylene or the like and provided with an opening defined by a flange of similar material having an annular sealing surface at the top end and an internal screw thread, said plug being constituted of polyethylene or similar thermoplastic material having relatively soft and yielding qualities and a tendency to cold flow into a permanently deformed set under sustained pressure, said plug having a tubular shank with an external screw thread formed in the tubular body thereof and having at the top of such tubular shank a sealing flange extending outwardly from the outer cylindrical surface of said tubular shank and provided on its under side with an annular sealing surface coactable with the sealing surface at the top end of said drum flange to effect a seal therebetween, the annular projecting portion of said plug flange being of considerable thickness to prevent substantial deformation of the polyethylene material thereof under the pressures required to effect such seal, and the sealing surface on said plug flange being flat and disposed substantially at right angles to the central axis of the plug, an annular gasket in the form of a flat ring surrounding said plug shank adjacent to said flange sealing surface thereof, said gasket being made of a resilient, compressible material that is softer than the polyethylene materials of which said plug flange and drum flange are constituted so that pressures applied to said plug to form a seal are distributed to the drum flange with substantial uniformity and without any substantial levering effects on the plug flange so that a good seal is enabled to be made without exerting substantial distorting force on the plug flange, the screw thread on the plug being of the buttress type and being recessed in the tubular shank so that the outer edge of such thread lies in the outer cylindrical surface of said tubular shank, said thread in transverse cross-section having an upwardly disposed side positioned substantially at right angles to the central axis of the plug and in parallelism with said plug flange sealing surface and directed in opposed relation to the latter so that as said plug flange sealing surface compresses said gasket into sealing relation on said drum flange sealing surface, said upwardly disposed side of said screw thread moves into engagement with the associated downwardly disposed side of the internal screw thread on said container flange and under the pressures applied in effecting such seal the polyethylene materials of such sides are displaced to be locked together into tight substantially uniform contact affording equal distribution throughout the length of said thread outward forces acting thereon, said buttress thread being of relatively few turns and being relatively heavy and massive with a blunt substantially wide outer edge and with a thickness at its base at least as great as the thickness of said plug flange to give it sufficient ruggedness to prevent rupture of such seal by distortion of the polyethylene material of such thread under outward

forces acting on such plug and to prevent for a considerable period of repeated usage cold flow of the polyethylene material forming said upwardly disposed side thereof to the extent under the pressures required to effect said seal that resulting deformation of such thread side would substantially lessen the effectiveness of such seal.

2. A closure plug such as defined in claim 1, in which said gasket is provided on both the upper and lower surfaces thereof with two concentric substantially spaced beads arranged adjacently to the inner and outer peripheries of said gasket, said beads being of such height that they engage the sealing surfaces on said plug and drum flanges to form the seal therebetween, the beads on the upper surface of said gasket being paired with the beads on the lower surface of such gasket so that the forces applied to said plug in forming such seal are transmitted directly through such paired beads and without deformation of the body of such gasket between such paired beads in a direction at right angles to the axis of said plug.

3. A closure plug such as defined in claim 1, in which said plug has an internally threaded tubular passage to threadedly receive a stopper located within the tubular shank thereof and concentric thereto, said tubular passage being supported in spaced relation within said shank by a top flange integrally connected at its outer periphery with said plug sealing flange and integrally connected at its inner periphery with the outer end of said tubular passage by means of an annular stopper sealing lip which is curved downwardly in transverse cross-section, and in which said plug includes a stopper having an external thread to be threadedly received by said tubular passage and having a curved annular surface engageable with said sealing lip to effect a seal therebetween when said stopper is screwed into said tubular passage, the interior of said plug sealing flange above said top flange being configured to provide tool engaging means.

References Cited in the file of this patent

UNITED STATES PATENTS

1,408,944	Howard	Mar. 7, 1922
1,958,582	Kerr et al.	May 15, 1934
2,752,059	Schneider	June 26, 1956
2,814,418	Rieke	Nov. 26, 1957

FOREIGN PATENTS

764,102	Great Britain	Dec. 19, 1956
789,009	Great Britain	Jan. 15, 1958