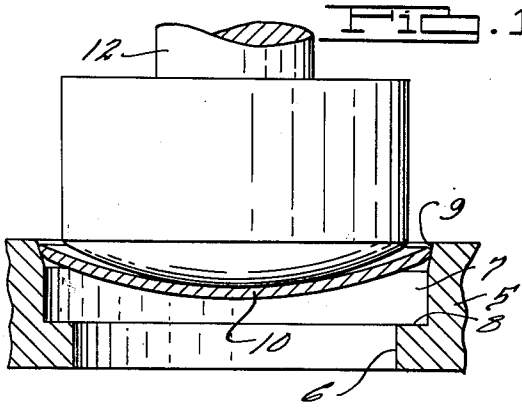
Aug. 24, 1954 L. T. KNOCKE 2,687,228

EXPANSIBLE CLOSURE PLUG

Filed Jan. 5, 1951

Fig. 1.



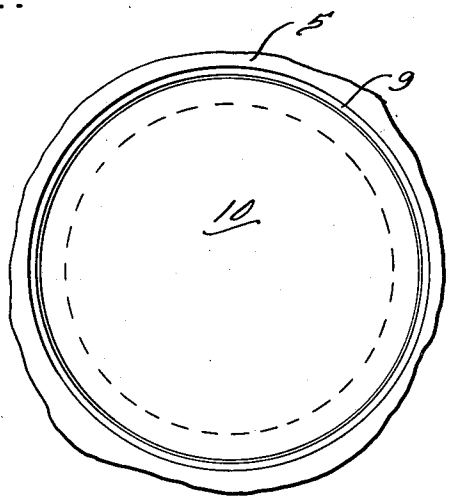


Fig. 4.

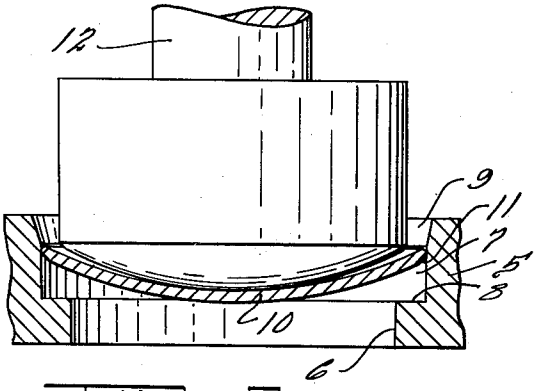
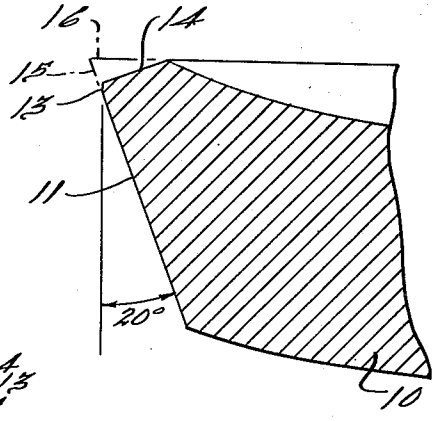


Fig. 2.

Fig. 5.



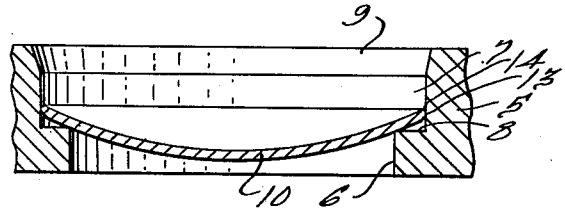


Fig. 3.

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EXPANSIBLE CLOSURE PLUG

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3 Claims. (Cl. 220—24.5)

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This invention relates to an improved closure for an opening and the method of applying the same.

An object of the invention is to provide a closure for an opening, for example in a pressure retaining body which will retain a high degree of pressure within the body without leakage or displacement of the closure; and to provide a closure which will exert a lateral pressure on the wall of the opening under application of pressure, and which will not produce a broaching action on the wall of the opening in response to pressure application.

In carrying out the objects of the invention, there is preferably provided a dished closure of resiliently springable material, for example sprung steel, which is inserted into the opening with the convex side or surface of the closure facing inwardly of the opening, the closure having a frusto-conical peripheral surface and a wall engaging edge, preferably flat. This wall engaging edge is so located that pressure against the closure will tend to expand the same radially and force the engaging edge against the wall of the opening and minimize the tendency of the closure to move bodily axially of the opening. Stated in another way, with a thin dished closure of resiliently springable material the pressure within the opening produces a form of toggle action on the dished closure tending to flatten it and the tendency of the closure is to expand radially.

The wall engaging edge of the closure is located in relatively close proximity, axially of the closure, to the concave side of the latter and the closure will retain a relatively high degree of pressure without flattening or reversing the dish.

A still further object of the invention is to provide a closure having a wall-engaging, sealing edge which will not be deformed, for example rolled inwardly of the closure, as an incident to forcibly pressing the closure into the opening. In carrying out this feature of the invention the aforesaid edge is so located that a substantial body of the closure resists deformation of the edge as the closure is pressed into the opening.

Other objects and advantages of the invention will be more apparent from the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is an enlarged fragmentary elevational view, partly in section, showing the closure initially seated in the opening of a pressure retaining body and a tool for forcing the closure into the opening.

Fig. 2 is a view similar to Fig. 1 but showing progression of the closure into the opening.

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Fig. 3 is a view similar to Fig. 1 showing the closure in its final position in the opening, with the tool omitted.

Fig. 4 is a top plan view of the Fig. 3 assembly.

Fig. 5 is a greatly enlarged, fragmentary elevational view, in section of the closure.

Referring to the drawings, the numeral 5 designates a pressure retaining body having an opening therein including a main body indicated at 6, a counterbore at 7, a ledge at 8, and a flared entrance at 9. By way of example, the body 5 may be an engine block with core openings as above, although the invention can be applied to a variety of bodies, particularly pressure retaining, having an opening therein to be closed.

The closure for the opening is a disc 10 initially centrally dished in one direction axially to provide a concavo-convex contour of curvature. The disc has a frusto-conical peripheral surface 11 inclined with respect to the axis of the cone of which it is a fragment. Preferably, the disc 10 is metallic and has a high yield strength permitting deformation thereof by exaggeration of its concavo-convex contour of curvature and resultant reduction in diameter as an incident to pressing it into the opening. For most uses the disc can be formed from spring steel which is a steel having a high carbon content and will retain a high yield strength following quenching and drawing. Materials other than spring steel may be utilized, particularly in instances where highly corrosive conditions exist, but the material should be so resiliently springable as to permit the above deformation thereof and provide lateral pressure for urging the edge of the disc against the wall of the opening when the disc is deformed.

A disc as above is initially assembled relative to the body 5 by seating the same with the frusto-conical surface 11 seated on the wall of the flared entrance 9, as shown in Fig. 1. The surface 11 and entrance wall 9 facilitate centering of the disc relative to the opening and by way of example but not limitation the angle of such surface and of the wall may be one of 20°. The disc 10 is forced into the opening by a tool 12, the head of which includes a surface having a spherical radius less than the spherical radius of the concave surface of the disc. As the tool is forced downwardly the concavo-convex contour of curvature of the disc is exaggerated, reducing the disc diameter as it progressively moves from the entrance 9, as shown in Fig. 2, and into the counterbore 7 to its final assembled position as shown in Fig. 3.

When the pressure of the tool is released, the resilient nature of the material of the disc in its

exaggerated contour provides lateral pressure on the wall at 7 by the edge of the disc adjacent its concave side. This pressure causes the disc edge to bite into the wall 7 as shown in exaggerated form in Fig. 3 and resists displacement of the disc.

The shoulder or ledge 8 serves as a stop for the disc although the length of travel of the tool 12 in its pressure stroke may be predetermined to define the final position of the disc in its opening without the pressure of the shoulder or ledge 8.

Referring to Fig. 5, the closure disc 10, which may be made from stock of $\frac{1}{16}$ inch thickness, is shown greatly enlarged to more clearly illustrate the frusto-conical surface 11, a wall-engaging edge surface 13, and a surface 14 extending between the surface 13 and the concave surface of the disc. The surface 14 circumscribes the disc surface of concave contour and extends outwardly from and at an inclination to the latter surface. The dot and dash lines 15 and 16 are respectively projections of the surface 11 and the uppermost portion of the surface at the concave side of the disc, the wall-engaging surface 13 being within the included angle defined by such projections.

As thus constructed, the edge 13 is reinforced by a substantial body of the disc and will not be subject to deformation during installation to the extent of an edge located at the intersection of the projections 15, 16. By way of further example, the surfaces 11 and 14 include an angle of 90°. The edge 13 is shown as flat and may have an axial dimension from .002 to .007 of an inch. A flat in this range for a disc of $\frac{1}{16}$ inch stock provides in effect a relatively dull edge which will have a minimum tendency to produce a broaching action on the wall by the force of pressure retained in the opening.

By locating the edge 13 as indicated, the force of the pressure retained in the opening tends to produce in effect a toggle action centered centrally of the disc and as a result there is a substantial radial force developed in the disc producing lateral pressure on the wall of the opening. While the edge 13 tends to bite into the wall of the opening under the influence of pressure to resist dislodging the disc, the relative dullness of the edge 13 minimizes a broaching action and thus further opposes bodily axial movement of the disc.

Although but one specific embodiment of the invention has herein been shown and described, it will be understood that various changes in the size, shape, and arrangement of parts may be made without departing from the spirit of the invention.

I claim:

1. A closure for an opening in a metallic pressure retaining body, including a disc of resiliently deformable metal centrally dished and having at one side thereof a surface of convex curvature and at the opposite side a surface of concave curvature, the disc including a peripheral edge substantially parallel with the longitudinal axis of the disc adapted to engage the wall of the opening, and first and second converging surfaces intersecting said peripheral edge, said first surface circumscribing said surface of concave curvature and extending outwardly therefrom and said second surface extending outwardly from said surface of convex curvature.

2. A closure for an opening in a pressure retaining metallic body, including a concavo-convex disc of resiliently deformable metal adapted to be inserted in the opening with its convex side facing inwardly of the opening, the disc having peripheral surfaces including first and second converging frusto-conical surfaces extending outwardly from said concave and covex sides, respectively, and a third peripheral surface intermediate the outermost extremities of said first and second surfaces adapted to engage the wall of the opening.

3. A closure for a circular opening including an annular disc of resiliently deformable metal adapted to be pressed into the opening, the disc having axially opposed surfaces respectively of concave and convex contours and a frusto-conical surface extending between said convex surface and said concave surface, said disc including a peripheral surface intersecting said frusto-concial surface and being spaced radially outwardly from the periphery of said concave surface, said peripheral surface being adapted to engage the wall of the opening when the disc is pressed therein.

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