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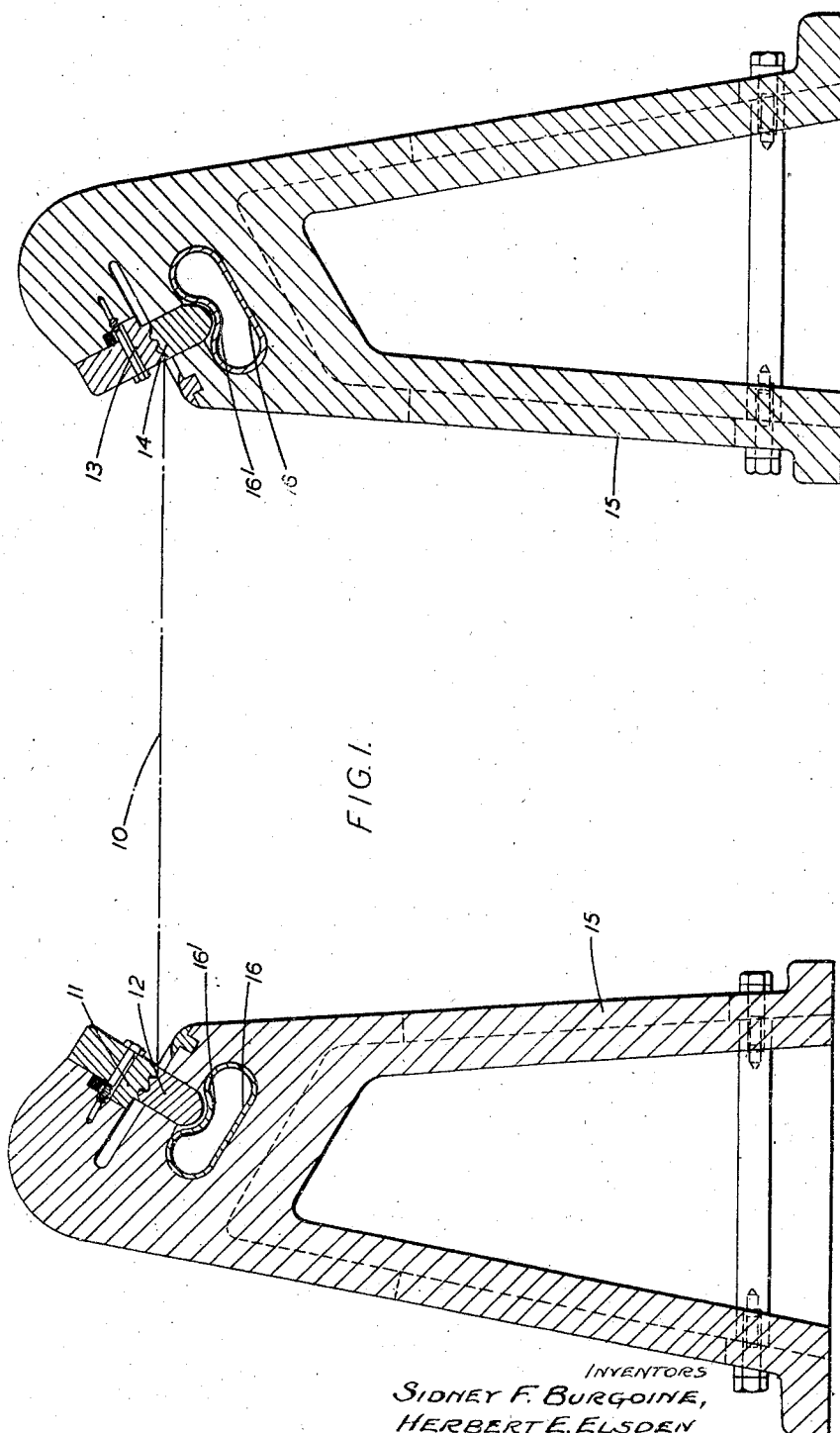
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2,382,958

FLUID-OPERATED WORKHOLDING VISE

Filed March 14, 1944

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

FIG. 2.

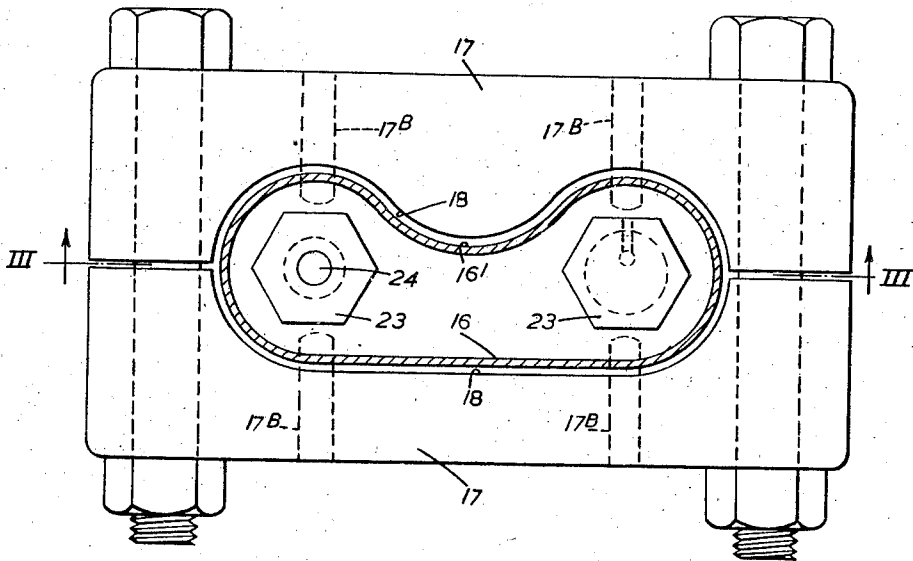
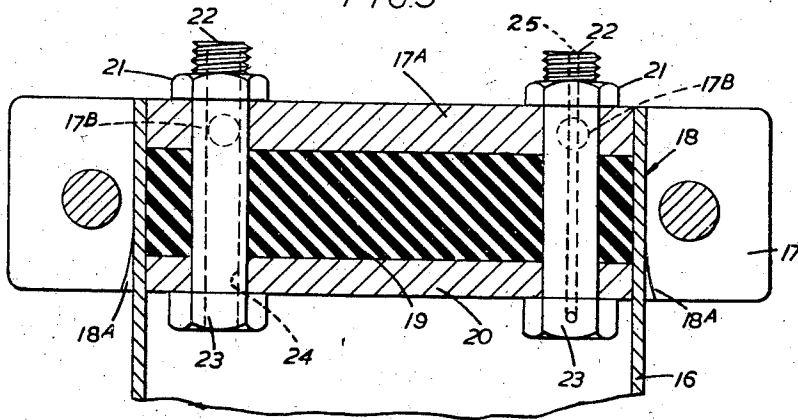


FIG. 3



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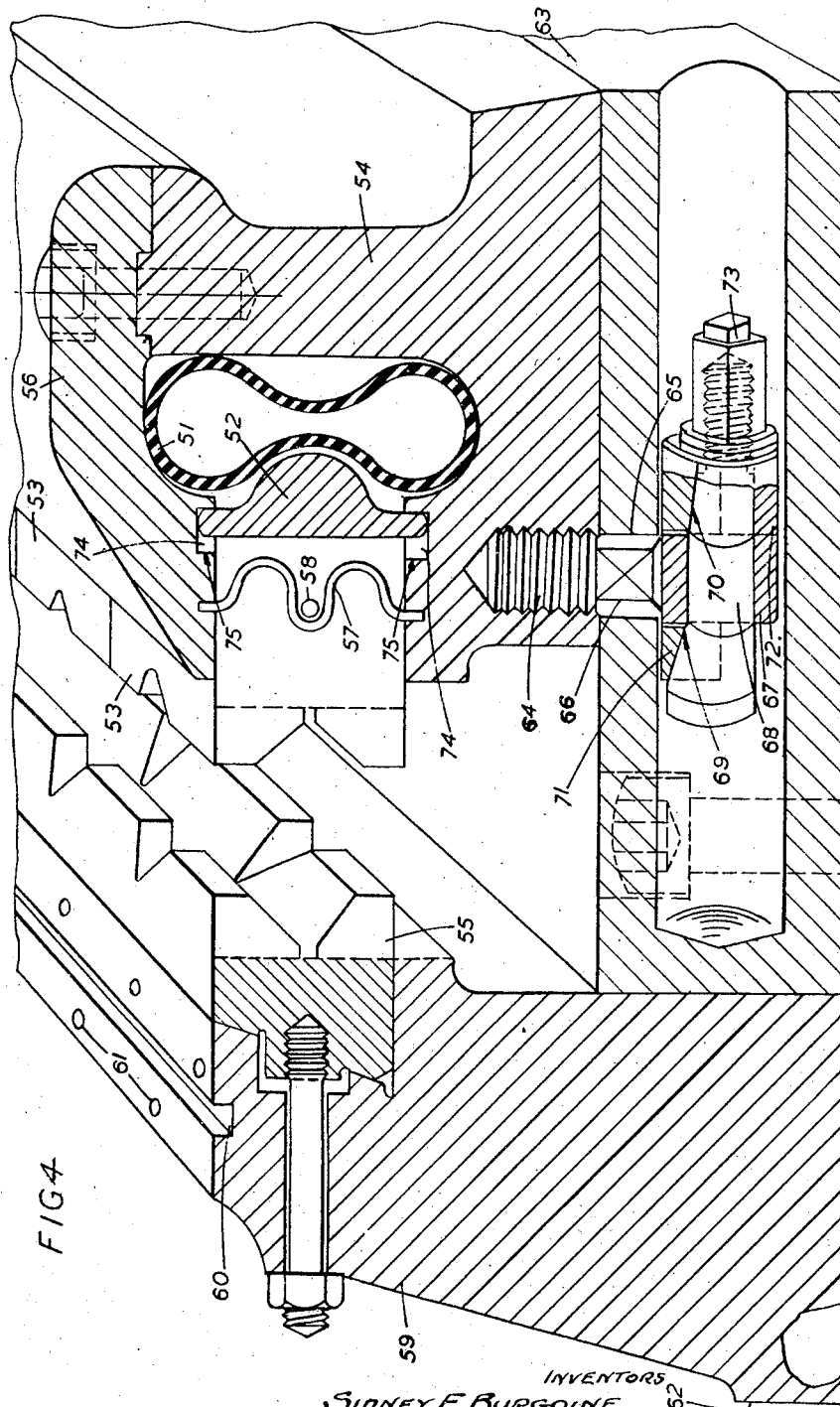
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FLUID-OPERATED WORK-HOLDING VISE

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Cheltenham, EnglandApplication March 14, 1944, Serial No. 526,448
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14 Claims. (Cl. 24-243)

The present invention is a work-holding device in which gripping or clamping of the work is effected by fluid pressure operating in an expandable capsule.

It is an object of the invention to provide a work-holding device in which a long or complicated piece of work can be clamped or gripped by a simple and preferably by a single operation.

It is a further object of the invention to provide a work-holding device in which a plurality of clamping members can be effectually actuated at a simple and preferably at a single operation.

Yet a further object of the invention is the provision of a fluid actuated clamp which enables work to be effectually clamped despite irregularities of contour.

Another object of the invention is the provision of a clamping device which, being dependent for clamping operation upon fluid pressure, enables the clamping pressure to be considerably varied according to the fragility or otherwise of the work, and having due regard to the operation to be performed.

Yet a further object of the invention is the provision of a vice or other clamping device to accommodate a plurality of articles of work and to grip them effectually despite the fact that one or more of the individual articles of work may be somewhat under size in relation to another.

Further objects of the invention are made apparent in the ensuing description with reference to the accompanying drawings in which like reference numerals are employed to indicate like parts, and in which—

Figure 1 illustrates two laterally opposed hydraulically operated work-clamping devices, suitable for such a purpose as gripping the edges of sheet metal for a shaping operation to be performed thereon, the sheet metal being diagrammatically indicated by the chain line.

Figure 2 is a detailed side elevation, partly in section, showing end clamping mechanism and end sealing of a tubular capsule as shown in the clamping devices illustrated in Figure 1.

Figure 3 is a section on the line III—III of Figure 2.

Figure 4 illustrates a modification of the invention in which the gripping action at one side of the clamp or vice is provided by a plurality of separate clamping jaws actuated by a common capsule in elongated tubular form, similar to those shown with reference to Figures 1, 2 and 3.

Referring now to Figure 1 of the drawings, the sheet metal, or other material to be subjected to a shaping operation, is indicated by the ref-

erence numeral 10, and is seen in chain line. The sheet material is gripped between the laterally spaced pairs of jaws 11 and 12, and 13 and 14. The fixed jaws 11 and 13 can be regarded as fixtures on the base mountings 15, but are readily removable for servicing or replacement to suit different work. The movable jaw members 12 and 14 operate as a sliding fit in suitably disposed slots provided in the base mountings 15. To actuate the movable jaws 12 and 14 for clamping the work, fluid pressure is delivered to the interior of the elongated tubular capsules 16. The tubular capsules 16 are in this case preferably of thin flexible steel, and are completely sealed, and may be operated for expansion under control of a single valve, or there may be a valve individual to each capsule.

As shown in Figures 1 and 2, the steel capsules, for the greater part of their periphery, conform to the shape of a housing provided therefor in each of the base castings 15, but with sufficient clearance to allow for movement of the capsule under pressure and the upper face of each capsule, against which the co-operating end of the respective movable jaw element 12 or 14 bears, as the case may be, is recessed as indicated at 16'. The arrangement is such that on application of fluid pressure from an appropriate source of supply, internal pressure within the capsule 16 forces the depression outwardly and actuates the associated movable clamping element 12 or 14 appropriately.

The arrangements for sealing the ends of the elongated tubular capsules will best be understood with reference to Figures 2 and 3. Figures 2 and 3 serve to illustrate one particularly suitable form of end fitting, one such end fitting being provided at each end of each elongated tubular capsule such as those represented by the reference numeral 16 in Figure 1, and for convenience again used in Figures 2 and 3. The end fitting 17 is formed of two complementary clamping blocks shaped to define the recess 18. Each end of the capsule 16 is closed by a gland backing plate 17A, normally of metal, against which a resiliently deformable sealing member 19 of natural or synthetic rubber is compressed subject to axial pressure by load applied through the metal pressure plate 20, thus to deform the resiliently deformable sealing member 19 radially outwards, to press the capsule 16 into engagement with the walls of the recess 18 to provide an effective fluid tight closure for the end of the capsule 16. The pressure plates 20 are pulled up against the resiliently deformable sealing member 19 by tight-

ening up a nut 21 on the threaded outer end 22 of each of the tubular bolts 23. The reference numeral 24 indicates a bore through one of the tubular bolts 23 which may receive at its outer end a pipe connection or inflation valve through which fluid pressure may be introduced for expanding the capsule. The other bolt 22 may be provided with a fine bore 25 to serve as a bleed hole closed at its outer end by a bleeder plug or valve.

It will be noted that at its inwardly directed end the recess 18 is flared as indicated at 18A in order to provide for an adequate measure of capsule flexure. It should be noted that the sealing effect of the resiliently deformable member 19 tends to increase as pressure increases internally of the capsule 16, for the simple reason that pressure in the capsule 16 is effective over the entire face of the pressure member 20, which is greater in area than the cross-sectional area of the resiliently deformable sealing member 19, because of the unsupported area effect introduced by the bolts 23 passing through the resiliently deformable member 19. In most cases the friction introduced by radial expansion of the resiliently deformable sealing member 19 against the inner periphery of the capsule 16 is sufficient to prevent the composite gland so constituted from being blown out of the capsule and end fitting, but if desired dowels may extend between the clamping blocks and gland backing member 17a, as indicated at 17b.

In the form seen with reference to Figures 2 and 3, the end fitting may be wholly external of the housing for the tubular capsule 16, but in some cases, at least one portion of the clamp may be formed integrally with the housing.

In the construction shown with reference to Figure 4, the capsule 51 bears on the pressure member 52 for transmission of actuating load to the laterally contiguous but separate gripping jaws 53, which are slidably located in the carrier or housing 54. On the introduction of actuating fluid pressure to the interior of the capsule 51, the jaw members 53 are loaded to travel towards the reaction jaw 55. The reaction jaw 55 may be formed in one piece, although there may be cases in which a stationary reaction jaw will preferably be replaced by separate movable jaws under control of a pressure capsule similar to the pressure capsule 51.

Certain additional features are introduced into Figure 4, which may find useful application in the forms of the invention described with reference to Figures 1, 2 and 3. Thus, it will be noted that the housing 54 as seen in Figure 4 is constituted of two parts, the main lower part indicated by the reference numeral 54, and the bolted on upper part indicated by the reference numeral 56. The parts 54 and 56 co-operate to define a recess in which the individual movable gripping jaws 53 are slidable. To ensure return of the individual movable gripping jaw members 53, on relief of internal pressure in the capsule 51, so as to provide for release of the gripping action, a wire spring 57 is disposed in a space between each pair of adjacent individual movable clamping members 53, to co-operate each with a transverse pin 58. The spring 57 is distorted from its natural form on application of pressure internally of the elongated capsule 51, and naturally returns to its original form on release of such internal pressure.

Another feature which is clearly illustrated in Figure 4, and is applicable to the construction

shown in Figures 1, 2, and 3, is the fact that the upper edge of the housing 59 which mounts the reaction member is accurately ground and is provided not only with a slide groove as indicated at 60, but also with jig mounting holes as indicated at 61. The arrangement is thus such that a jig for a drilling or a like operation can be installed and operated with the work clamped in position. The edge 62 can also be ground or milled to provide a working guide face to co-operate with an indexing member for running parallel with respect to the face of the reaction member.

In regard to the reaction member 55 that, like the individual gripping jaws 53, is preferably readily detachable to suit different types of work.

It is an important feature, particularly of the construction shown in Figure 4, that the pressure member 52 is sufficiently flexible longitudinally to accommodate slight variation in dimensions of a plurality of clamped items of work engaged between the reaction member 55 and the individual pressure jaws 53. To some extent advantage may be taken of the use of similarly flexible pressure members to accommodate irregularities or taper of the work to be clamped.

Another feature which is illustrated in Figure 4 is the provision of adjustment for the housing 54. A limited degree of adjustment may be provided for both in the longitudinal sense and the transverse sense, and for that purpose the housing 54 is connected to the base plate 63 by bolts 64, which pass through clearance slots 65 in the base plate. The slots 65 can be elongated to any predetermined extent, and the reduced squared portions 66 provide for clearance in the transverse or lateral sense also. The bolts 64 terminate in a squared eye end 67, and co-operate with the straight centre portions 68 of a double taper cotter pin, the double taper surfaces 69 and 70 of which lie at each side of the centre straight portion, and co-operate with the wedge members 71 and 72 respectively. The cotter pin is accessible through a suitable slot in the base of the machine for adjustment by first unscrewing the locking nut 73 to free the housing 54 for adjustment, and when the housing has been set to the required position, the nut 73 is tightened up again so that the wedges 71 and 72 ride up their respective tapers to draw the bolt 64, and therefore, the housing, tightly down on to the bed 63.

It will be noted that, in regard to Figure 4 the pressure member 52 rides in the slot 74 of the housing 54, and that the face 75 of that slot provides a positive abutment stop beyond which the pressure member 52 cannot move forward under the influence of pressure applied internally of the capsule 51. The advantage of that arrangement is that movement of the individual jaw members 53 is essentially limited, so that the clamp can still be operated without danger of damage to the capsules even if some of the individual jaws have no work to clamp. Advantage may be taken of that feature to limit the travel of the pressure member in any of the constructions so far described, and where it is likely that excessive distortion of the capsule might otherwise occur.

As has been stated, the flow of actuating fluid at pressure to the interior of a plurality of capsules can be under control of a single valve, or a plurality of valves, according to requirements.

The use of fluid pressure, which may be provided by compressed air or other gas, or by a pump controlled liquid supply, or liquid supplied at pressure delivered from a hydraulic accumu-

lator, enables clamping pressure to be applied gradually, and exactly to the extent required, which end is simply achieved by the provision of suitable manual control valve means, operable with reference to a visual pressure gauge. Such an arrangement enables the clamping pressure to be adapted to suit various kinds of work irrespective of whether a light clamping action is required for fragile work, or a heavy clamping action for more substantial work.

In cases where a movable clamping element is required to make such movement in operation as would involve excessive distortion of a capsule, a plurality of capsules can be disposed contiguously, or with pressure members between them, so that the distortion of one operates additively to the other or others.

We claim:

1. In a work-clamping member, embodying at least two clamping jaws, at least one of which is movable toward and away from the other for clamping work engaged between them; a hollow capsule having a recessed flexible face for engagement with a pressure member operatively associated with the movable jaw means, and a pressure fluid flow connection communicating with the interior of said capsule for flexure of said flexible face outwardly, to urge said movable jaw means toward the co-operating clamping jaw means.

2. In a work-clamping device, embodying at least two clamping jaws, at least one of which is movable toward and away from the other for clamping work engaged between them; an elongated distortable hollow capsule open at its ends, a resiliently deformable sealing member within each end of said capsule, a backing plate and a pressure plate at opposite sides of the sealing member, and also disposed within said capsule, means embracing the ends of said capsule externally, bolt means acting to draw the backing plate and the pressure plate together to expand said sealing member radially outwards against said embracing means by application of pressure axially of the capsule, and means for supplying actuating fluid pressure internally of said capsule to flex it expansibly.

3. The combination as set forth in claim 2, in which the bolt means incorporate passage for actuating fluid flow to the interior of the capsule.

4. The combination as set forth in claim 2, in which the bolt means incorporate a bleed port to permit escape of air from the interior of the capsule.

5. A work-clamping device comprising movable clamping means, reaction means co-operating therewith for work clamping, capsule means operatively associated with said movable clamping means and having an inwardly flexed wall distortable outwardly by internal pressure, and means to apply pressure internally of said capsule means for outward flexure of said flexible wall effectually to expand said capsule means and load said movable clamping means toward said reaction means.

6. A work-clamping device as set forth in claim 5, embodying a pressure member intermediate

said capsule means and said movable clamping means.

7. A work-clamping device as set forth in claim 5, embodying a flexible pressure member intermediate said capsule means and said movable clamping means, and wherein said movable clamping means is formed of adjoining separate segments.

8. A work-clamping device comprising movable clamping means constituted by a plurality of separate elements, reaction means co-operating therewith for work clamping, a capsule embodying a flexible wall operatively associated with, and common to, a plurality of said separate elements of said movable clamping means, said capsule being distortable by flexure of a flexible wall of said capsule for outward flexure of said flexible wall effectually to expand said capsule means and load said movable clamping means toward said reaction means.

9. A work-clamping device comprising a movable clamping element and a fixed reaction member, a sealed, flexible-walled, inflatable capsule operatively interposed therebetween, said capsule having its wall adjacent the movable element recessed, and a projection operatively associated with the movable element received in such recess of the capsule, for receiving and transmitting pressure from the capsule upon its inflation and distortion to the movable element to move the latter.

10. A work-clamping device as in claim 9, wherein the capsule's flexible wall is formed of sheet metal.

11. A work-clamping device as in claim 9, wherein the movable clamping element is divided lengthwise into a plurality of individually movable elements, and wherein the flexible capsule extends lengthwise in common operative relationship to the several individual elements.

12. A work-clamping device as in claim 9, wherein the fixed reaction member is formed with limit stops, and the movable clamping element is formed with cooperating stops limiting its pressure-induced movement.

13. A work-clamping device as in claim 9, wherein the capsule walls are open at each end, and the seal therefor comprises a resilient packing member sandwiched between an external backing plate and an internal pressure plate, the resilient packing member being thereby pressed outwardly against the walls of the capsule.

14. A work-clamping device as in claim 9, wherein the capsule walls are open at each end, and the seal therefor comprises a resilient packing member sandwiched between an external backing plate and an internal pressure plate, the resilient packing member being thereby pressed outwardly against the walls of the capsule, and bolt means extending through the two plates and the resilient packing member, and accessible externally of the capsule to draw the plates together and thereby to squeeze the resilient packing member against the capsule's walls.

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