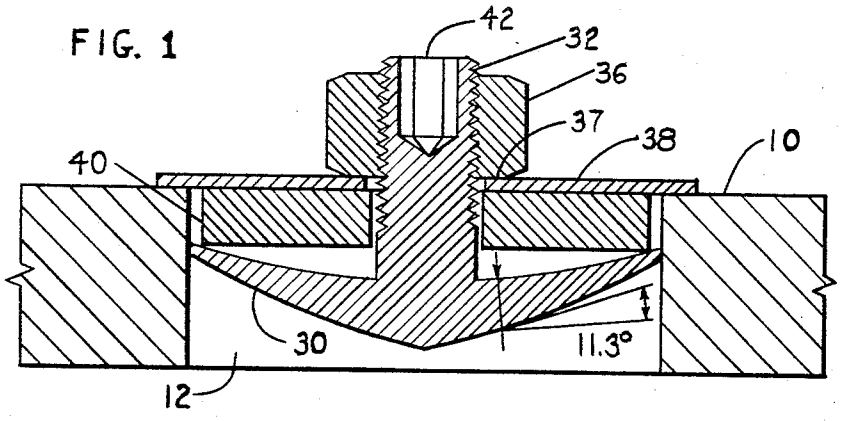
Aug. 1, 1967 F. O. WISMAN 3,333,723

EXPANSIBLE CLOSURE PLUGS

Filed March 25, 1965

FIG. 1



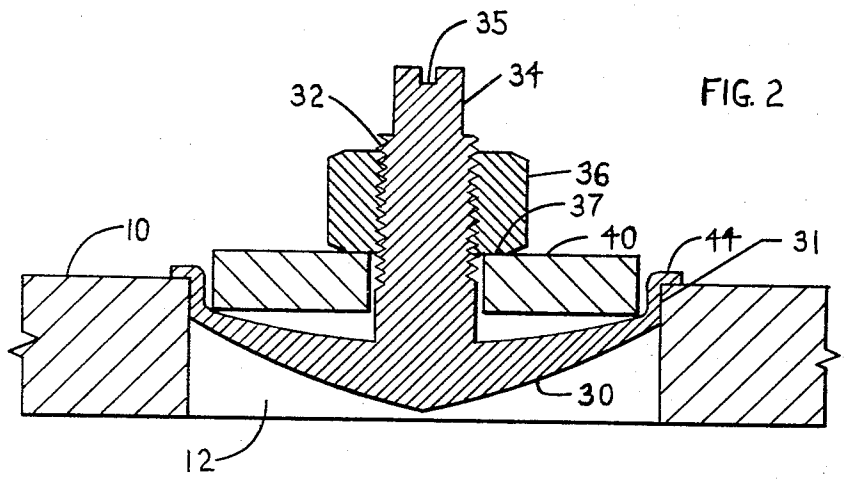


FIG. 2

FIG. 3

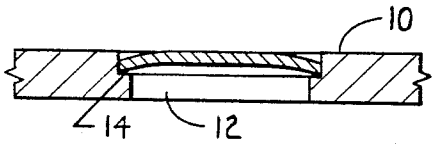
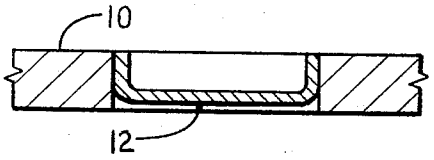


FIG. 4



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EXPANSIBLE CLOSURE PLUGS

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ABSTRACT OF THE DISCLOSURE

A self positioning all metallic closure for fluid vessels, affording low wrenching effort installation in limited access locations without special tools. The deformable head element is contoured to attain progressive and complete expansion.

This invention relates to expansible plugs for closing openings in structures or vessels, more particularly the water jacket core holes in internal combustion engine cylinder blocks. Two species of plugs are in common usage. The familiar welch plug is initially domed and is seated against a shoulder so that a heavy hammer blow flattens the central portion and effects closure by expanding the diameter. The other skirted type has a flat head with an axially extending cylindrical portion allowing use in a plain through bore. It is dimensioned to be an interference fit and likewise must be driven home with substantial force if it is to effect certain closure without leakage. Either species is easily installed if working space is not cramped, but if the engine is mounted in an automobile chassis it is frequently impossible to replace a leaking plug for lack of room to swing the hammer. A device installed differently is needed if heavy dismantling expense is to be avoided.

Some prior art appliances designed to be installed by wrenching a screw or nut are limited in application to shouldered openings and often resilient gasket washers are required to seal the opening for a drawbolt. Another prior art type lacks provision for aligning squarely in the opening during installation and further requires a high wrench effort to install by reason of turning contact at a large diameter between the parts. In many instances the special wrench needed is no easier accommodated than the swing of the hammer.

The object of the present invention is the provision of a device which shall be easily and perfectly installed in a confined location with ordinary mechanics' wrenches. A further object is improvement in reliability through the complete elimination of gasketing washers. A further important object is to provide a single device adaptable to replacing either species of original plug, thereby simplifying the parts inventory needed by service garages. Yet another objective shall be more economical manufacture than the prior devices. These and the other objects of the invention will be readily understood by the following description and reference to the accompanying drawings in which: FIGURE 1 is a cross sectional view of the present invention in place just prior to expansion; FIGURE 2 is another embodiment of the invention more particularly adaptable to manufacture by forging or impact extrusion; FIGURES 3 and 4 illustrate typical openings to be closed and the closures used therein originally.

In each figure the numeral **10** designates the cylinder block or other structure with an opening **12** to be closed. The shouldered type opening, FIGURE 3 has an abutment **14** against which the plug seats.

Referring to FIG. 1 the present invention employs a domed head **30** with threaded shank or drawbolt shaft **32** cooperating with an ordinary nut **36** thrusting against washers **38** and **40**. Washer **38** has a major diameter

larger than the opening to be closed and serves to align the appliance squarely in a plain opening by seating against the opening face. Washer **38** may be discarded when closing a shouldered opening since the shoulder **14** will provide alignment. The washer **40** is relatively stiff and positions the domed head **30** at a predetermined depth in the opening while applying the drawbolt thrust reaction to the domed head near its perimeter. For lack of a more definitive term I use the word "domed" broadly. While the head sections illustrated are arcuate, they may equally well be more intricate curved forms or conical.

Tightening of the nut **36** causes the domed head **30** to be flattened, thereby expanding its diameter to tightly fit the opening **12**. As is evident from FIGURE 1, abutment of the head **30** against the washer **40** will cause the wrenching effort to increase abruptly when complete expansion has been attained. This eliminates any need for visual inspection, which may be impractical by reason of poor access, and precludes drawing head beyond flat into a reverse domed and loosened condition. The plain nut **36** may be operated by any convenient standard wrench and the torsional friction is effective at no greater radius than the nut face **37** in contradistinction to prior art devices where torsional friction is developed at substantially the perimeter of the domed head. This is of particular importance because the nut torque needed to initiate deformation of the head must be resisted by means of the necessarily small wrenching provision in the end of the shaft **32**. While a screwdriver slot **35** may be used in some instances, I find the wrench flats **34** or a polygonal key socket **42** more conducive to the basic objectives of the invention.

Referring to FIG. 2, washer **38** has been replaced by a flange **44** positioned in spaced relation to domed head **30** by a cylindrical extension **31**. This embodiment is particularly attractive if the part is to be manufactured by forging or extrusion from easily worked material such as brass.

I find that the thickness of the head **30** should taper from a thin periphery to a thickened central portion for the best results. To develop complete flattening and the maximum expansion, it is desirable for deformation to begin at the periphery and progress toward the center. It can be demonstrated that the critical taper angle to insure this action is 11.3° as dimensioned on FIG. 1. Smaller angles result in head **30** contacting washer **40** at the minor diameter without achieving total flattening against the washer and larger angles needlessly stiffen the central portion, increasing the force required of the nut. While the angle specified is optimum, I find that a tolerance of a few degrees either way may be allowed without grossly impairing performance or departing from the spirit of my invention.

Either embodiment as described attains the objectives as set forth and is applicable to either type opening, the positioning element being redundant when used in a shouldered hole. No gasketing elements are required and either embodiment presents a smooth surface to the interior of the vessel or structure.

Having described my invention, I claim:

1. An expansible closure plug comprising a convex domed head to be expanded; threaded drawbolt means extending opposite said convex domed head, a second threaded element cooperating with said threaded drawbolt and including a thrust face, and means for transmitting the thrust of said second threaded element to said domed convex head at a greater diameter than the effective thrust face diameter of said second threaded element.

2. An expansible closure plug comprising a convex domed head to be expanded; threaded drawbolt means

permanently affixed to and extending opposite said convex domed head, a second threaded element cooperating with said threaded drawbolt and including a thrust face, and means for transmitting the thrust of said second threaded element to said domed convex head at a greater diameter than the effective thrust face diameter of said second threaded element.

3. An expansible closure plug comprising a convex domed head to be expanded; threaded drawbolt means integral with and extending opposite said convex domed head, a second threaded element cooperating with said threaded drawbolt and including a thrust face, and means for transmitting the thrust of said second threaded element to said domed convex head at a greater diameter than the effective thrust face diameter of said second threaded element.

4. An expansible closure plug comprising an imperforate convex-faced head to be expanded, a threaded shaft integral with and extending opposite said imperforate convex head face, a nut for cooperating with said threaded shaft means and means for transmitting the thrust force exerted by said nut to said imperforate convex faced head at a diameter greater than the face diameter of said nut.

5. The device of claim **1** wherein the thrust transmitting means is a relatively stiff cylindrical washer.

6. An expansible closure plug comprising a convex domed head to be expanded, a threaded shaft extending oppositely therefrom, a second threaded element arranged for cooperating with said threaded shaft and including a thrust face, means for transmitting the thrust force to said convex domed head at a diameter greater than the thrust face of said second threaded element and means formed on the end of said shaft for opposing the wrenching effort applied to said second threaded element.

7. The device of claim **6** in which the wrenching effort opposing means comprises flats formed on the side of said shaft.

8. The device of claim **6** in which the wrenching effort opposing means comprises a socket cavity formed to accommodate a key in the end of said threaded shaft.

9. The device of claim **6** in which the wrenching effort opposing means comprises a screwdriver slot transverse of the end of said threaded shaft.

10. An expansible closure plug device for stopping an opening comprising a convex domed head to be expanded, a threaded shaft extending opposite said domed head, nut means for cooperating with said threaded shaft, means for transmitting the thrust force of said nut to the domed head at a diameter larger than the nut face diameter and means associated with the device for positioning said domed head at a predetermined location and attitude within said opening.

11. The device of claim **10** in which the positioning means comprises a washed interposed between said nut means and said thrust transmitting means, said washer being of a major diameter larger than said opening.

12. The device of claim **10** in which the positioning means comprises a flange positioned in predetermined relation to said domed head, said flange being formed integral with said domed head and adapted to abut the face of said opening.

13. An expansible closure plug device comprising a convex domed head to be expanded whose thickness tapers from a thin periphery to a thicker central portion, threaded drawbolt means extending opposite said convex domed head, nut means for cooperating with said drawbolt means and means for applying the thrust of said nut means to said convex domed head.

14. The device of claim **13** in which the angle of thickness taper is greater than 8 degrees but less than 14 degrees.

15. The device of claim **13** in which the angle of thickness taper is substantially 11.3 degrees.

16. The device of claim **4** wherein said convex-faced head tapers in thickness from a thin outer portion to a thicker central region.

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