Jan. 23, 1968 W. P. MALENKE 3,365,093

HOLE PLUGGING MEANS

Filed July 13, 1966

FIG. 1

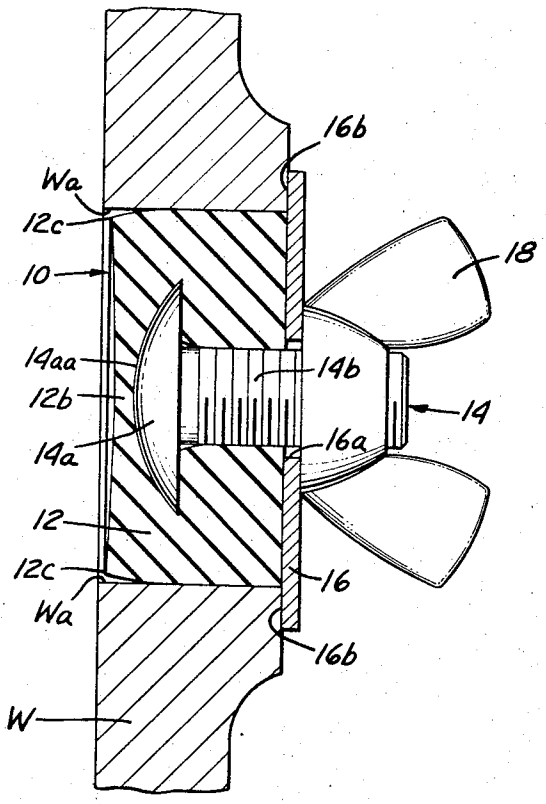


FIG. 2

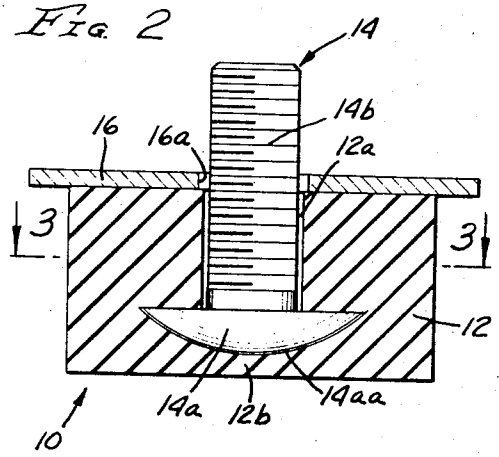


FIG. 3.

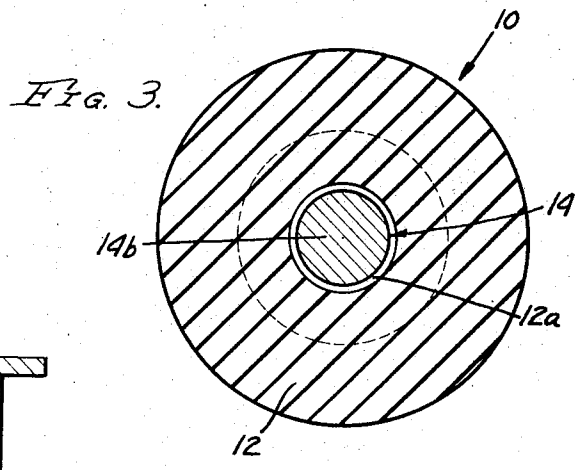
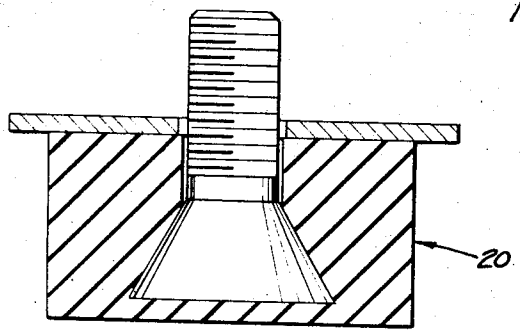


FIG. 4



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HOLE PLUGGING MEANS

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ABSTRACT OF THE DISCLOSURE

A neoprene plug expanded into sealing engagement with a smooth walled circular aperture in the wall of an internal combustion engine water jacket by the head of a bolt embedded in the plug and cooperating with a washer engaging a boss on the water jacket wall, the bolt shank extending through the outer face of the plug and threaded ly receiving a nut thereon engaging the washer.

Background and description

This invention relates to an easily installable device for the plugging of openings, and more particularly to such a device especially useful as a plug for freeze plug openings in the water jacket walls of water-cooled intrnal combustion engines.

Because of the presence of water jackets around their combustion cylinders, water-cooled internal combustion engines are subject to the risk of coolant freezing and expansion when exposd to sub-freezing temperatures for extended periods of time. When such coolant freezes it must expand in some direction, and unless a safety valve of some sort is provided the resulting strain on the engine block will cause it to crack. The prevent this result, modern automobile, and other water-cooled internal combustion engines, are fitted with so-called freeze plugs which are simply metal plugs cemented into openings appropriately provided in the water jacket walls of the engines. Theoretically, these plugs are supposed to yield before engine block cracking occurs and thereby prevent serious engine damage in the event of engine coolant freezing. In practice, however, as garage mechanics well know, the freeze plugs do not always so yield before such engine block cracking occurs.

Installed freeze plugs sometimes become defiective and must be replaced to prevent coolant loss and possible engine damage as a result of overheating. The removal and replacement of such a defective freeze plug is a dirty, tedious, and time-consuming job, often made even more onerous by the positioning of freeze plug openings in difficulty accessible places. Consequently, the removal and replacement of freeze plugs consitutes service of a sort which everyone would be happy to avoid, if possible, the mechanic because of the dirty and difficult nature of the involved work and the customer because of the seemingly high charges thereby necessitated.

I have now devised a novel plugging device, particularly suitable for freeze plug utility, which can be easily installed in a receptive opening in a few seconds time, often without the use of a hand tool of any sort. Furthermore, the device is designed and constructed to permit its removal from an installation site in a fraction of the time required for the removal of a conventional freeze plug of the type presently employed in water-cooled automobile engines, and with a fraction of the difficulty normally encountered in attempting the latter operation. Additional advantages of the novel plugging device of this invention over conventional freeze plugs of the above-indicated type are, as will be seen, relative inexpensiveness and rust or corrosion resistance (the conventional freeze plugs, being metal, are quite susceptible to corrosion in

the harsh enviromental condition to which they are exposed in use). Finally, my novel plugging device is designed and constructed to more effectively yields to freezing water pressures than do conventional freeze plugs, while holding substantially as firmly as the latter during periods of engine usage or storage, thereby affording greater protection against engine block damage in cold weather than do the conventional plugs.

It is thus a principal object of this invention to provide a freeze plug for water-cooled internal combustion engines which can be quickly and easily installed in freeze plug openings in engine block walls, often without the use of any hand tool.

It is still another object of the invention to provide such a freeze plug which can be more easily and rapidly removed from freeze plug openings in the engine block walls than can be presently conventional freeze plugs.

It is still another object of the invention to provide such a freeze plug with can be easily adjusted to a tighter fit within a receptive freeze plug opening in an installed position therein.

It is yet another object of the invention to provide such a freeze plug which is substantially resistant to corrosion under its enviromental conditions of use, as well as all other conditions it might normally be expected to encounter.

It is still a further object of the invention to provide such a freeze plug of relatively inexpensive material and manufacturing costs.

Other objects, features and advantages of the freeze plug will become apparent in the light of the detailed description of my invention to follow.

The physical character of the freeze plug of this invention, and its manner of use and functioning, will be more readily explainable by reference to the accompanying drawing, of which:

FIGURE 1 is a view, partly in section, of a preferred embodiment of a freeze plug in accordance with this invention, installed in tightened fit, with the aid of a lock-nut, within the freeze plug opening of the water jacket wall of a water-cooled internal combustion engine, the wall being shown fragmentarily.

FIGURE 2 is a view, partly in section, of the FIGURE 1 freeze plug in a free, or uninstalled position.

FIGURE 3 is a cross-sectional view of the freeze plug, taken along line 3—3 of FIGURE 2.

FIGURE 4 is a view similar to that of FIGURE 2 of an alternative form of the freeze plug.

Considering now the drawing in greater detail, there is shown generally at **10** the preferred freeze plug embodiment of above reference, hereinafter referred to as freeze plug **10**, the plug being shown in its installed position within a freeze plug opening in an engine block wall in FIGURE 1, and as it appears in its uninstalled position in FIGURES 2 and 3.

Freeze plug **10** comprises a neoprene plug member **12** of circular, disc-like shape; a bolt **14** having a wide, relatively flat head **14***a* and a relatively short shaft **14***b*; and a washer **16** with a central concentric opening **16***a* sufficiently large to freely admit shaft **14***b* of the bolt in the manner illustrated, in somewhat exaggerated fashion for graphic emphasis, in the drawing. As FIGURES 2 and 3 show, head **14***a* of bolt **14** is embedded within neoprene plug member **12** with the exception of a narrow annular ring around the underside of the bolt head. This ring marks the bottom limit of a narrow annular space **12***a* around bolt shaft **14***b* within the body of neoprene plug member **12**, the reason for which will subsequently appear. Also as FIGURES 2 and 3 show, the head of bolt **14** is buried sufficiently deep within the body of neoprene plug member **12** to bring the outer surface of the

bolt head, shown at 14*aa*, fairly close to the bottom face of the plug member and leave a relatively thin layer of neoprene, shown at 12*b*, shielding the bolt head from contact with engine coolant when the freeze plug is installed for service. The reason for this, as will be appreciated, is to provide the freeze plug bolt with protection from corrosion, as well as to give the plug added strength and durability.

Bolt 14 is preferably made of steel because of the cheapness and ready availability of that material, but it can, of course, be made of brass, or other material less subject to corrosion, if desired. When a bolt of such material other than steel is employed, there is less critical necessity for the outer surface of its head to be completely sealed within plug member 12 in the drawing-illustrated fashion, although such sealing would still be desirable because of the added strength it would give to the freeze plug unit.

The head of bolt 14 is embedded concentrically within plug member 12 so that its shaft is concentrically aligned therewithin in the manner illustrated in the drawing. The length of the bolt shaft is so adjusted that it extends outwardly from plug member 12 a predetermined distance, as will subsequently be discussed in greater detail.

Neoprene plug member 12 is sized and shaped to fit matingly within a freeze plug opening in the water jacket wall of a water-cooled internal combustion engine, a fragmentary portion of such a wall being shown at W in FIGURE 1, and a freeze plug opening therein at W*a*, the wall and opening being hereinafter respectively referred to by those symbols. To install freeze plug 10 in an opening such as W*a*, plug member 12 is inserted by hand into the opening from its outer side, with shaft 14*b* of bolt 14 extending outwardly (to the right in the FIGURE 1 view), to flushness of the outer face of the plug member with the wall surface immediately surrounding the freeze plug opening, all as indicated in FIGURE 1. Ideally, the plug member of the freeze plug should be of such diameter as to fit snugly enough within the freeze plug opening to remain in place without support when inserted therein, yet not so tightly as to make its insertion by hand unduly difficult.

After the freeze plug has been inserted into opening W*a* of wall W in the above-described manner, its plug member fills the opening to substantially the full depth of the latter. As the next step in the freeze plug installation procedure, washer 16 is fitted around the projecting end of bolt shaft 14*b*. After emplacement of the washer on the bolt shaft, wing nut 18 is threadedly engaged with the latter and turned until it is flush against the washer and the washer is flush against both the outer face of plug member 12 and, around its radially outer portion, the engine block wall surrounding the freeze plug opening. The resulting overlap of the engine block wall by the outer portion of washer 16 is illustrated at 16*a* in FIGURE 1 and is an important, although noncritical, feature of my invention in that it serves to protect plug member 12 from exposure to the surrounding atmosphere. Such exposure, as will be appreciated, would be damaging to the plug member because of the oxidative, and consequent weakening and cracking, effect of air on rubber.

After wing nut 18 has been drawn snugly against washer 16 and the latter secured flush against plug member 12 in the above-indicated fashion, the freeze plug is tightened in place in the freeze plug opening, with its peripheral edge will in sealing contact with the engine block wall defining the opening, by a slight twist of wing nut 18 in the appropriate direction. This twist can be easily accomplished by hand, without the aid of a wrench or pliers, as I have determined by actual test using freeze plugs physically similar to freeze plug 10 previously made up for such testing purposes. In this connection, I have discovered that a quarter turn of the wing nut on the bolt of a freeze plug inserted, but not yet tightened, in a

freeze plug opening secures the plug so tightly within the opening that it cannot thereafter be removed by hand. Additional tightness can, at any time, be achieved in an installed freeze plug by merely turning its lock nut equivalent of wing nut 18 through an additional tightening increment. Such turning can often be accomplished by hand, without the aid of any tool or tools.

The tightening of wing nut 18 on bolt 14 when freeze plug 10 is inserted ina freeze plug opening in the above-described way results in compression of that part of neoprene plug member 12 caught between the bolt head and washer 16, and consequent radial expansion of the plug, both inwardly and outwardly, in the area annularly surrounding bolt 14 within the freeze plug opening. It is to accommodate the inward expansion of, and prevent possible damage to, the plug member that annular space 12*a* is provided around bolt shaft 14*b* therein. The radially outward expansion of the plug member forces it into ever-tightening contact with the defining wall of the freeze plug opening, until the resultant pressure therebetween is sufficient to seal them together.

While I am not certain of the pattern of forces set up within plug member 12 during the aforesaid nut tightening procedure, I believe that pattern to be substantially consistent with the foregoing comments in point. I further believe, although again I am not certain, that the compression of that portion of plug member 12 between the head of bolt 14 and washer 16, and the confining presence of the freeze plug opening wall therearound, creates a tendency for the neoprene in the plug member to flow backwardly, to the left in FIGURE 1, around the peripheral edge of bolt head 14*a* to escape the pressures built up in the forward portion of the plug member during the turning of wing nut 18 for plug tightening purposes.

If neoprene plug member 12 reacts to the tightening pressure from wing nut 18 in the above-postulated manner, I believe, without wishing to be bound thereby, that the backward direction of neoprene flow to the pressure-free area behind the head of bolt member 14 causes radially inward contraction of the peripheral edge, shown at 12*c*, of the rear surface of plug member 12 in the manner graphically illustrated in FIGURE 1. I further believe, again without wishing to be bound, that the movement of bolt head 14*a* during tightening of freeze plug 10 in the freeze plug opening exerts a pulling force on a concentrically inner portion of that part of plug member 12 disposed to the rear of the bolt head, thereby causing the rear face of the plug member to dish slightly inwardly and its peripheral edge to contract in enhancement of any contraction resulting from the above-described neoprene flow effect.

Although, as already emphasized, the above-indicated play of forces in, and resulting physical distortion of, the neoprene plug member of the freeze plug in use, is only postulation and not proven fact, FIGURE 1 shows freeze plug 10 installed in sealing contact within opening W*a* in wall W in exaggerated consistency therewith. Even if such postulation be incorrect, however, both the hole-plugging efficacy of the freeze plug, and the general way in which the plug functions in use, are illustrated with sufficient adequacy in FIGURE 1 to teach these aspects of my invention, any technical imperfections in the figure notwithstanding. Under any circumstances, therefore, FIGURE 1 is clearly adequate to illustrate effective usage of freezing plug 10 an serve the obvious purpose of teaching that aspect of my invention.

Most of the references to my freeze plug in the foregoing description have been couched in language suggestive of limitation of the freeze plug to a neoprene plug member, as exemplified by neoprene plug member 12 of freeze plug 10, having a bolt partially embedded therein, as exemplified by bolt 14, and a cooperating washer, as exemplified by washer 16. While this concept of the freeze plug is correct, it must be remembered that an accommo-

dative lock, or tightening, nut, as exemplified by wing nut **18**, is necessary for proper utilization of the plug, at least in either of its drawing-illustrated forms. In somewhat related vein, it is accurate to say that the hole plugging component of the freeze plug, as exemplified by the plug-member-bolt combination of freeze plug **10**, constitutes a "bare bones" embodiment of my invention, since its sale, with appropriate instructions, for use with off-the-shelf washer and nut hardware items available anywhere makes it possible for purchasers to practice the invention almost as easily as can purchasers of the hole plugging component and its cooperating hardware as a complete unit.

Directing attention again to the drawing, and specifically FIGURE 1, it will be observed that the shaft of bolt **14** projects only slightly beyond its area of threaded contact with wing nut **18** when the latter is threaded and tightened thereon as illustrated. The reason for the relatively short length of bolt **14** is to permit its use on automobile, and other, engines having minimal working space for the removal, and replacement, of freeze plugs. Where the freeze plug must be handled in such tight quarters (as exemplified by the cramped spaces on engines having their freeze plug openings partially blocked by motor mounts), a flat hexagonal, or other-shaped, nut can be substituted for wing nut **18**, in which case, the length of bolt **14**, rather than of the extending wings of the wing nut, is the measure for freeze plug working clearance determination. The advantage of making the freeze plug bolt as short as practicably possible under the circumstances will be appreciated and the substantial consistency of the length of bolt **14** with this criterion will be recognized.

FIGURE 4 illustrates an alternative form of my freeze plug, hereinafter referred to as freeze plug **20**, comprising a neoprene plug member and partially embedded bolt similar to plug **12** and bolt **14** of freeze plug **10**, except that the shape of the bolt head and accommodating hollow therefor in the plug member differs as shown from the shape of the respective plug **10** counterparts of those features. The principal reason for including the FIGURE 4 embodiment of my freeze plug in the drawing is to provide bolt design variation in illustration of that aspect of my invention. In this connection, a bolt of any head shape, so long as the head has an undersurface adequate for the proper transmission of pressure on a cooperating plug member in accordance with present teachings, will suffice as a suitable bolt member for my freeze plug.

While each of the drawing-illustrated embodiments of my freeze plug is shown with an annular space around the shaft at its embedded bolt in its neoprene plug member, such space is not a critically necessary feature of my invention, since the freeze plug can function (although perhaps not as effectively) without it, and may be dispensed with entirely if desired. Where such a space is provided, however, it can be of any size or shape consistent with proper functioning of the freeze plug. The selection of a space of suitable size, shape, or both, for purposes of my invention is not difficult, and can be easily made, in the light of present teachings, by the routineer in art to which this disclosure is directed. As will be apparent, the space need not be very great, and, in fact, the danger of providing too much space for the compressed neoprene to flow inwardly into, thereby causing enough pressure loss around the outer perimeter of the plug member to weaken the sealing effectiveness of the freeze plug, must be carefully avoided.

The plug members of freeze plugs **10** and **20** have both been described as of neoprene construction because of the optimum suitability of neoprene for service under the environmental conditions encountered by freeze plugs in use. It is not necessary, however, that the plug members be made of neoprene and they can be constructed of any other suitably resilient material so characterized as to insure use and functioning of my freeze plug in substantially the manner taught herein. As will be appreciated, the selection of a suitable material of construction for the plug member of my invention can be made with little or no difficulty by the skilled in the art having the present teachings to guide them.

The plugging device of this invention is believed to have its greatest use potential as a freeze plug for water-cooled internal combustion engines and for this reason has been illustrated in the drawing, and herein described, with great emphasis on its freeze plug applicability. It is to be understood, however, that the device is not limited to such freeze plug applicability and can be employed anywhere, and for any purpose, to which its unique design lends it.

My plugging device can, of course, vary size- and weight-wise within the scope of this invention. In this connection, no present necessity is seen for going into a more detailed discussion of plugging device sizes, since, as previously indicated, the devices will typically be used as freeze plugs and those familiar with water-cooled automobile, and other internal combustion, engines are well aware of the size range of freeze plug openings (and the required sizes of plugging means therefor) in such engines. Because of the relatively small number of freeze plug opening sizes, and degrees of size differential between individual freeze plug openings, in the many brands and models of presently existing automobile engines, coupled with the size adjustability feature, previously discussed, of my novel plugging means, about a dozen different sizes of the plugging means will adequately serve most of the freeze plug needs of today's motor cars.

While no great amount of emphasis has been heretofore focused on this particular aspect of my invention, it will nevertheless be apparent, in the light of present teachings, that my novel freeze plug is much more easily removable from an installation site than the conventional freeze plug of previous reference. This, of course, constitutes a prime advantage of my freeze plug over its more conventional counterpart.

The present invention has been described in considerable detail in order to comply with the applicable provisions of the patent law by providing a full public disclosure of at least one of its forms. Such detailed disclosure is not, however, intended to in any way limit the broad features or principles of the invention, or the scope of patent monopoly sought to be granted. Accordingly, while the invention has been herein illustrated and described in what are conceived to be preferred and practical forms, it is emphasized that departures may be made therefrom within the scope of the invention. Certain of these departures have already been mentioned, and others will occur to those skilled in the art in the light of present teachings. Exemplary of the latter are the addition of useful but noncritical accessories to the plugging means of the invention; the elimination of any feature, or features, not critically essential to proper use and functioning of the plugging means; etc. As a specific example of the kind of modification here contemplated, a washer cut at an angle, or otherwise modified, to fit a particular installation site can be substituted for washer **16** of freeze plug **10** to form a unique embodiment of my invention intended for a specialized use.

It is emphasized, in final summary, that the scope of my invention extends to all variant forms of its drawing-illustrated embodiments encompassed by the language of the following claims.

I claim:

1. Adjustable means for plugging an opening comprising:

(a) resiliently deformable plug means shaped to fit within said opening; and

(b) bolt means having enlarged head means at one end and threaded at the other for nut receiving purposes;

(c) said bolt means having its end with enlarged head means sealingly embedded within, and its threaded end projecting from, said plug means, the character and extent of the embedment of the enlarged head means of said bolt means being virtually entire and such that said resiliently deformable plug means is expandable within said opening upon use of said adjustable means for plugging the opening;

(d) whereby insertion of said plug means into said opening with the threaded end of said bolt means extending outwardly, emplacement of washer means around said bolt means and tightening of threaded mating nut means on said bolt means against said washer means causes said plug means to expand outwardly in the area surrounding the shank of said bolt means and into sealing contact with the defining edge of said opening.

2. The adjustable means for plugging an opening of claim 1 in which said bolt means is a bolt having a relatively flat head, and the bolt is partially sealingly embedded concentrically within said plug means with the outer surface of its head closer to one, than to the other, face of the plug means, said plug means entirely shielding said head from exposure at said one face of said plug means.

3. The adjustable means of claim 1 in which said bolt means is a bolt with a shaft of round cross-section throughout its length and in which its end with enlarged head means is so partially sealingly embedded within said resiliently deformable plug means, and said resiliently deformable plug means is so configured, that there is a relatively narrow annular air space around that portion of said shaft necessarily surrounded by said plug means.

4. The adjustable means of claim 1 adapted primarily for use as a freeze plug for the sealing of a freeze plug opening in a water-cooled internal combustion engine, said plug means having a continuous outer cylindrical surface extending from one face thereof adjacent said head means to the opposite face thereof from which said threaded end projects, and washer means at said opposite face around said projecting end of said bolt means, said washer means being of sufficient size to extend radially beyond said cylindrical surface when placed around said bolt means with a face of said washer means flush against the said opposite face of said plug means.

5. The adjustable means of claim 1 in which the threaded end of said bolt means projecting from said plug means extends only for a distance substantially equal to the threaded length of said bolt means occupied by said washer means and said nut means of sub-paragraph (d) when said nut means is threadedly engaged with the bolt means and positioned flush against said washer means.

6. In a water jacket wall of an internal combustion engine, said jacket wall having an aperture therein, the improvement comprising:

a cylindrical block of resilient material received in said aperture and entirely closing said aperture, precluding passage of fluid from inside said wall through any portion of said aperture to outside said wall;

expander means inside said block and extending to the exterior thereof on only one end of said block, the extending portion being threaded,

a washer at said one end,

and a nut threadedly received on said extending portion and engaging said washer and thereby establishing compression and expansion in said block.

7. The combination of claim 6 wherein:

said expander means include a bolt having a head substantially entirely embedded in said block.

8. The combination of claim 7 wherein:

said extending portion is the shaft of said bolt.

9. The combination of claim 8 wherein said bolt is solid throughout its length.

10. The combination of claim 6 wherein:

said washer has an outer portion which overlaps said jacket wall, preventing exposure of said block to the environment external to said jacket wall.

11. The combination of claim 6 wherein said expander means include a bolt having a head entirely shielded from contact with engine coolant inside said wall by the material of said block.

12. The combination of claim 6 wherein said aperture has a circular wall devoid of threads.

References Cited

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