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W. F. BORGES ET AL

2,665,818

EXPANSION CLOSURE PLUG

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Fig. 1.

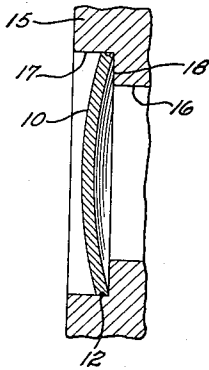


Fig. 3.

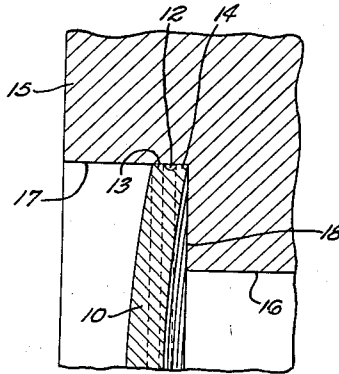
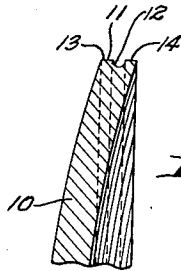


Fig. 2.

Fig. 4.

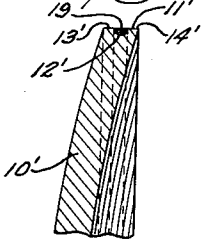


Fig. 5.

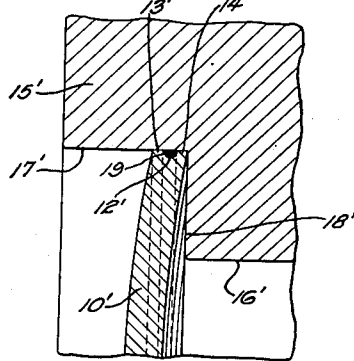
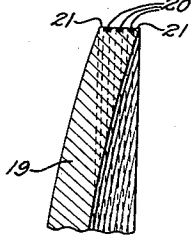


Fig. 6.



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EXPANSION CLOSURE PLUG

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8 Claims. (Cl. 220—24.5)

1

This invention relates to improvements in the art of closing cylindrical openings and more particularly openings such as the core holes in engine cylinder blocks or other openings where similar problems are present.

The Welch plug shown in Patent No. 1,058,210 has been long used by the engine industry. This type of plug has not been entirely satisfactory because of the fact that there is no assurance against leakage. In addition, Welch type plugs have, on occasion, dropped out of core holes completely, thereby permitting the cooling water of the engine to escape with resulting overheating of the engine.

With the advent of harder metals for use in engine cylinder blocks and heads, the problem of closing core holes has become more serious, since the Welch type of plug is less effective when used in blocks of hard metal than when used in blocks of softer material. Additional problems have also arisen, in recent years, because of the fact that high speed, mass production machinery frequently fails to perform accurate boring and other machining operations as compared with the operations heretofore performed by prior slow speed machines. As a result, core holes in present day engine blocks are frequently formed with chatter marks and other imperfections.

With the above in mind, it is a general object of the present invention to provide improvements in the art of closing cylindrical openings, whereby a fluid-tight, permanent closure is provided even though the opening is formed in relatively hard metal, and even though it has surface imperfections such as tool marks.

A further object of the invention is to provide an improved plug for the purpose described, said plug being in the form of a concavo-convex disc having its peripheral edge formed with a circumferential groove so located as to provide a pair of circumferential annular beads, said beads being adapted to be upset by engagement with the wall of the opening as a result of expanding deformation of the disc, with said beads sealingly engaging the wall of the opening and conforming with any irregularities in the wall surface.

A further object of the invention is to provide an improved device of the class described having a circumferential groove which is filled with flowable material to aid in forming a permanent seal.

A further object of the invention is to provide an improved device of the class described which can be applied in the same manner as conventional plugs, no special tools being required.

A further object of the invention is to provide

2

an improved device of the class described which is simple in construction, easy to manufacture, and otherwise well adapted for the purposes described.

With the above and other objects in view, the invention consists of the improvements in the art of closing cylindrical openings, and all of the steps, parts and combinations incident thereto, as set forth in the claims, and all equivalents thereof.

In the drawing accompanying and forming a part of this specification, wherein two forms of the invention are shown, and wherein like characters of reference indicate the same parts in all of the views:

Fig. 1 is a vertical sectional view showing the preferred form of plug, prior to deformation, positioned in a cylindrical opening such as the core hole of an engine cylinder block;

Fig. 2 is an enlarged fragmentary vertical sectional view of a portion of the device shown in Fig. 1;

Fig. 3 is an enlarged fragmentary vertical sectional view of the device of Fig. 1 after the latter has been expandingly deformed into sealing engagement with the wall of the opening;

Fig. 4 is an enlarged fragmentary vertical sectional view similar to Fig. 2 and showing a portion of a modified form of plug;

Fig. 5 is an enlarged fragmentary vertical sectional view similar to Fig. 3 showing the modified form of plug deformed into sealing engagement with the wall of an opening; and

Fig. 6 is a view similar to Fig. 2 illustrating an additional modification.

Referring more particularly to Figs. 1 and 2, the numeral 10 indicates a concavo-convex disc of suitable metal such as low carbon steel which is deformable only under substantial pressure, the disc having a substantially cylindrical peripheral edge surface 11. For certain requirements other material such as brass may be used for the disc. Formed in the peripheral surface 11 intermediate the width thereof, is a circumferentially extending groove 12 which provides a pair of spaced peripheral, circumferentially extending annular beads or flanges 13 and 14. In the usual automotive use, the width of the groove 12 is preferably one-third of the width of the edge surface 11, but this is not necessarily true. For automotive uses, the discs usually vary from about one-half inch to about three and one-half inches in diameter and the thickness is preferably one-fourth of an inch or less. When the disc has $\frac{3}{8}$ of an inch thickness the groove is prefer-

3

ably $\frac{1}{2}$ of an inch deep and approximately $\frac{1}{2}$ of an inch wide.

For purposes of illustration, the numeral 15 indicates an engine cylinder block formed with a core hole 16 which is counter-bored, as at 17, to provide a shoulder 18. The diameter of the cylindrical edge surface 11 of the disc 10 is preferably substantially equal to the diameter of the bore 17, so that the undeformed disc 10 has a snug fit in the bore when placed therein.

The disc 10 is expanded into position in the bore 17 by a blow from a hammer or other suitable instrument which deforms it to the more flattened shape shown in Fig. 3. As the disc 10 is thus expanded, the beads 13 and 14 are forced radially outwardly under extreme pressure into contact with the wall surface of the bore 17. The beforementioned extreme pressure causes upsetting of the metal of the beads 13 and 14 against the bore wall, forcing said beads to sealingly engage the surface of the bore 17 and conform with any surface irregularities.

Figs. 4 and 5 show a modified form of disc 10' which is substantially identical with the disc 10. The parts of the disc 10' which are indicated by primed numerals are similar to corresponding parts of the disc 10 indicated by unprimed numerals. The disc 10' is formed with a circumferential groove 12' in its edge surface 11', which groove is entirely filled with flowable material 19.

The flowable material is preferably a solid although it need not necessarily be so. It usually is important that the flowable material be softer than the material of which the disc is made. Lead, copper, brass, lead-tin alloys, and non-brittle plastic materials of a type which are flowable only under relatively high pressure and which are stable under conditions of use such as those which are to be encountered may be employed. It is to be emphasized, however, that the broader aspects of this form of the invention contemplate the use of the groove as a confining carrier for any flowable material which has sealing characteristics suitable for the particular requirement.

In sealing a bore such as the bore 17' by means of the improved disc 10', the same procedure is followed as has been described with respect to the sealing of the bore 17 with the disc 10. When the disc 10' is expandingly deformed the beads 13' and 14' are pushed radially outwardly with extreme pressure into contact with the wall of the bore 17' as shown in Fig. 5. This pressure is sufficient to cause upsetting of the beads 13' and 14'. As the beads 13' and 14' are upset, extreme pressure is also exerted on the flowable material 19, and the latter then flows into any irregularities in the wall surface of the bore 17'. Just as in the case of the beads 13 and 14 of the disc 10, the beads 13' and 14', upon being upset, conform to the surface contours of the bore 17' and, aided by the flowable material 19, form a permanent and positive seal.

In Fig. 6 an additional modification is illustrated. Here the disc 19, which is substantially the same as the discs 10 and 10' is formed with a plurality of circumferential grooves 20. In the illustrated embodiment, there are three grooves, and as a result, there are four circumferential beads 21. This form of the invention is used in the same way as heretofore described and may be used with or without a flowable material in the grooves 20, Fig. 6 showing such flowable material. When the disc is expanded into position in a bore such as the bore 17 of Fig. 1, the beads 21

4

are upset against the bore wall to sealingly engage the surface and conform with surface irregularities. If a flowable material is employed in the grooves, as heretofore described in connection with Fig. 4, such material will aid in forming a permanent and positive seal. It is, of course, practical to utilize a greater or lesser number of grooves than is illustrated in Fig. 6.

It is to be understood that the invention disclosed herein is not limited to the details of construction and arrangement of parts illustrated in the accompanying drawing, but that various changes and modifications may be made without departing from the spirit of the invention. All of such changes as well as alternative uses are contemplated as may come within the scope of the claims.

What we claim is:

1. A closure for a cylindrical opening, comprising: a concavo-convex disc of material which is deformable under substantial pressure, said disc having a substantially cylindrical peripheral edge surface, said edge surface being formed with an annular groove; and a normally solid flowable sealing material filling said annular groove to a point where it is substantially flush with said cylindrical edge surface.

2. A closure for a cylindrical opening, comprising: a concavo-convex disc of material which is deformable under substantial pressure; a pair of spaced radially outwardly directed annular beads formed on the peripheral edge of said disc, there being an annular groove between said beads, the outer diameters of said beads being substantially equal to the diameter of the opening to be closed; and an annular ring of normally solid flowable sealing material encircling said disc and normally confined between said beads and substantially filling said annular groove to a point where it is flush with the outer diameters of said beads.

3. A closure for a cylindrical opening, comprising: a concavo-convex disc of material which is deformable under substantial pressure; a pair of spaced radially outwardly directed annular beads formed on the peripheral edge of said disc, there being an annular groove between said beads, the outer diameters of said beads being substantially equal to the diameter of the opening to be closed; and an annular ring of material which is normally solid but which is softer than the material of the disc encircling said disc and normally confined between said beads and substantially filling said annular groove to a point where it is flush with the outer diameters of said beads.

4. A closure for a cylindrical opening, comprising: a concavo-convex disc of material which is deformable under substantial pressure; a pair of spaced radially outwardly directed annular beads formed on the peripheral edge of said disc, there being an annular groove between said beads, the outer diameters of said beads being substantially equal to the diameter of the opening to be closed; and an annular ring of lead-containing sealing material encircling said disc and normally confined between said beads and substantially filling said annular groove to a point where it is flush with the outer diameters of said beads.

5. In combination: a member having a cylindrical opening; a concavo-convex disc of material which is deformable under substantial pressure seated in said opening, said disc having a pair of spaced outwardly directed annular beads on its peripheral edge which are in tight partially de-

5

formed contact with the wall of said opening, there being an annular groove between said beads and there being a normally hard sealing material of a type which is flowable under pressure filling said groove and being also in a state of having overflowed said groove so that it fills irregularities which are located between said beads and wall and coacts with said beads in forming a complete seal.

6. In combination: a member having a cylindrical opening; a concavo-convex disc of material which is deformable under substantial pressure seated in said opening, said disc having a pair of spaced outwardly directed annular beads on its peripheral edge which are in tight partially deformed contact with the wall of said opening, there being an annular groove between said beads and there being a lead-containing sealing metal filling said groove and also in a state of having overflowed said groove so that it fills irregularities which are located between said beads and wall and coacts with said beads in forming a complete seal.

7. In combination: a member having a cylindrical opening; a concavo-convex disc of material which is deformable under substantial pressure seated in said opening, said disc having a pair of spaced outwardly directed annular beads on its peripheral edge which are in tight partially deformed contact with the wall of said opening, there being an annular groove between said beads and there being sealing material formed of metal which is softer than the metal of the disc and which is flowable under pressure filling said groove and also in a state of having overflowed said groove so that it fills irregularities which are located between said beads and wall and coacts with said beads in forming a complete seal.

6

8. In combination: a member having a cylindrical opening and having a counterbore communicating with an end of said opening, there being a shoulder between said opening and counterbore; a concavo-convex disc of material which is deformable under substantial pressure seated in said counterbore against said shoulder with its concave side facing inwardly, said disc having a pair of spaced outwardly directed annular beads on its peripheral edge which are in tight, partially deformed contact with the wall of said counterbore, there being an annular groove between said beads and there being sealing material of a type which is flowable under pressure filling said groove and also in a condition of having overflowed said groove so that it fills irregularities which are located between said beads and wall to coact with said beads in forming a complete seal.

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