Oct. 8, 1929. H. M. NORTHRUP 1,730,377

CYLINDRICAL PLUG AND METHOD OF MAKING

Filed May 10, 1928

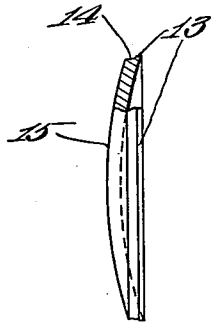


Fig. 1.

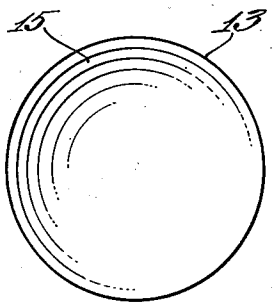


Fig. 2.

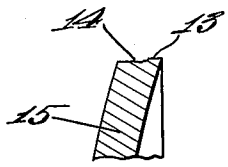


Fig. 3.

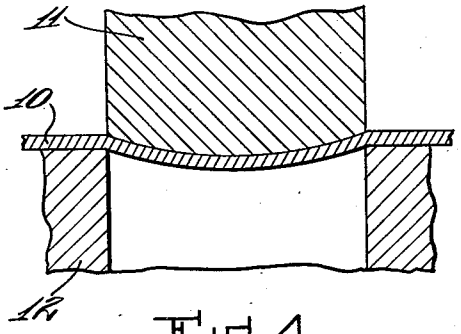


Fig. 4.

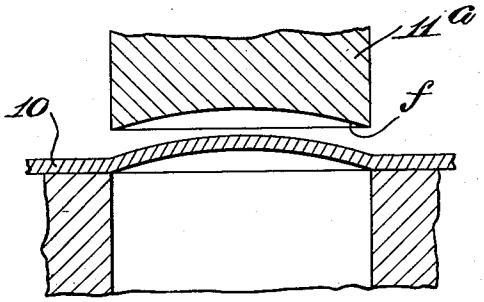


Fig. 5.

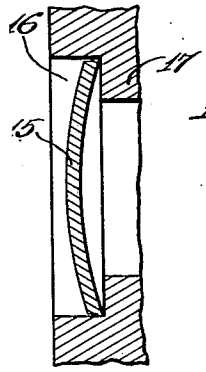


Fig. 7.

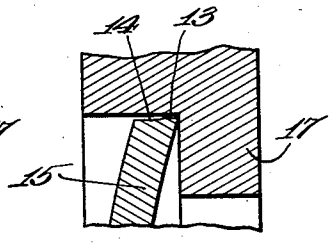


Fig. 8.

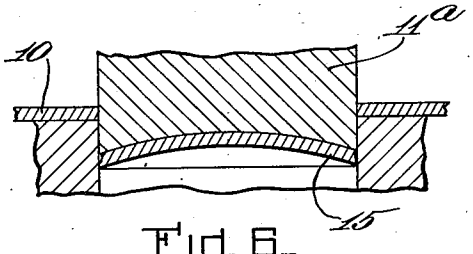


Fig. 6.

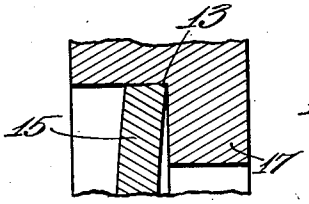


Fig. 9.

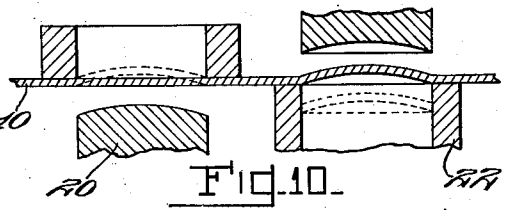


Fig. 10.

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# UNITED STATES PATENT OFFICE

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## CYLINDRICAL PLUG AND METHOD OF MAKING

Application filed May 10, 1928. Serial No. 276,660.

This invention relates to a device for closing cylindrical openings and to a method for producing the same. While applicable to plugs for a great variety of uses, my invention is of special usefulness in its application to plugs for closing holes in metallic substances as for example the core holes in engine blocks.

The object of my invention is to provide an improved form of plug which when secured in the opening will form a truer and more liquid-tight closure than has heretofore been possible.

My invention contemplates the use of concavo-convex or dome-shaped plugs such as are described generally in the United States Patent No. 1,058,210, granted April 8, 1913, to Allie Ray Welch and Fred Stimpson Welch, and constitutes an improvement thereon.

In the manufacture of concavo-convex plugs commonly known as Welch plugs the usual practice is to stamp the plug from the sheet metal in two operations. The metal from which the plug is formed is first domed and then cut or died out. While these operations are distinct they are in practice performed almost simultaneously. After the doming operation the female portion of the die is toward the convex side of the plug and the male portion of the die is toward the concave side. It has been found by repeated experiments that the cutting out of the plug is not a true cutting operation but that the metal will be partly cut and partly sheared off, the metal farthest from the female die being broken or torn away, leaving a ragged edge. The result of this operation is to provide an edge having a trimmed, smooth surface adjacent the convex side of the plug while the edge adjoining the concave side will be ragged and uneven. This is unsatisfactory since when the plug is expanded within the opening to be closed the concave side of the edge expands to a greater extent than the convex side and therefore must be depended upon principally for the sealing of the hole. In many of the uses to which concavo-convex plugs are put the plugs after being expanded in place are subjected to severe internal liquid pressures. Due to the ragged character of the edge on the concave side difficulty has been encountered in procuring a satisfactory fluid-tight closure which will not leak. To overcome this difficulty it is the practice in many machine shops to paint the interior of the opening to be closed with white lead, Duco or other substances in order to fill in the irregularities in the surface of contact between the edge of the plug and the wall of the opening.

By my invention I have provided an improved form of cylindrical plug which is adapted to make a much more perfect contact with the interior of the bore to be closed, thereby greatly increasing the cohesion between the plug and the wall of the opening and forming a more dependable liquid seal.

My invention will best be understood if the following description is read in connection with the accompanying drawings, in which:

Fig. 1 is a side elevation partly in section of a plug showing the finely trimmed character of the edge adjacent the concave face.

Fig. 2 is a plan view of the concave face showing the circular form of the plug.

Fig. 3 is an enlarged fragmentary sectional view showing the partially cut and partially torn or broken away character of the edge of the plug after the stamping operation.

Fig. 4 is a vertical section showing the stock in position between the punch and die after the doming operation and before it is cut out.

Fig. 5 shows the stock in reverse position and about to be punched, with the concave face of the dome portion in contact with the female die.

Fig. 6 shows the finished plug immediately after the stamping operation.

Fig. 7 is a view of the plug inserted in the bore to be closed before being expanded therein.

Fig. 8 is a detail view of the assembly shown in Fig 7, showing the character of the edge in enlarged form.

Fig. 9 is a detail view of the same after the pressing operation, showing the manner

in which the trimmed edge adjacent the concave face of the plug engages the interior wall of the bore to be closed.

Fig 10 is a schematic view of a modified manner of producing the plug.

In carrying out my invention a piece of the metal stock 10 is inserted between the end of a slightly rounded or bull-nosed punch 11 and a female die 12, as illustrated in Fig 4. As the punch 11 is lowered, the stock 10 will be distorted and given a concavo-convex or dome shape. The stock is then presented to a die arranged so that it will contact initially with the concave face of the domed portion of the stock. This may be accomplished in a variety of ways. The stock may be inverted after the doming operation as illustrated in Fig. 5, so that the concave face of the domed portion of the stock will rest against the cutting edges of the female die. As the punch $11^a$ which is provided with a concave face *f* conforming to the shape of the domed portion of the stock is lowered the plug will be stamped or cut out, as illustrated in Fig 6.

A preferred arrangement for presenting the domed portion of the stock so that the concave portion will make initial contact with the die is illustrated in Fig. 10. The punch 20 for doming the stock 10 may be spaced from the die 22 so that the stock is fed progressively from the position of the doming operation into operative position for the die. This arangement is preferred because it can be simply and readily performed and does not require the extra step of inverting the stock. The relative position of the punch and die members is unimportant, the important thing being that the female die member be made to contact initially with the concave portion of the domed stock.

The character of the edge of the disc thus formed will depend to some degree on the clearance between the punch and die members during the cutting operation, the closer the fit the more satisfactory being the result. In practice, however, there is always some bending strain on the material being stamped and the plug will be partly cut and partly broken off, leaving a large portion of the face of the plug comparatively rough and uneven. The portion of the edge which first engages the female die will be cut and will therefore have a smooth and finely trimmed surface, while the portion of the edge furtherst from the die will be sheared off and have a torn appearance. The character of the edge is illustrated in Fig. 3, wherein the portion 13 of the edge of the plug illustrates the smooth, evenly cut surface of the edge which first came in contact with the die, while the torn and uneven portion 14 shows the result of the shearing action as the plug is broken off from the stock.

In Fig. 7 a plug 15 is shown inserted in a bore 16 against the counterbore 17 in position to be expanded thereagainst. The smooth portion of the edge 13 is adjacent the concave face of the plug and abuts the counterbore 17. In the enlarged detail view in Fig. 8 the relation of the edge of the plug to the interior wall of the bore before the pressing operation is clearly illustrated. In seating the plug 15 against the counterbore 17 pressure is applied to the convex surface of the plug by means of a seating tool or in any suitable manner, thereby flattening th plug against the counterbore and causing it to expand laterally until the edges of the plug bear against the interior of the bore with great pressure. Depending somewhat upon the hardness of the material used, the pressure exerted by the plug against the interior of the bore in many commercial applications reaches very great proportions indeed, sometimes reaching several thousand pounds.

As the plug is expanded within the bore to be closed, the convex surface of the plug which has been initially stretched by the doming operation tends to contact while the concave face of the plug is expanded outwardly against the wall of the bore. Since it is that portion of the edge abutting the concave face which must be largely depended upon for the effective closing of the bore, the importance of having that portion of the edge smoothly finished will be readily apparent. By increasing the area of contact the smooth surface greatly increases the cohesion between the plug and the bore thereby giving it a much greater holding power than is possible when the edge is torn or uneven.

With a plug having the edge formed in the manner disclosed herein it is unnecessary to paint the interior of the bore to be closed with white lead. Duco or other substances in order to fill the interstices of the metal, and a much firmer union and a more dependable liquid seal is achieved than has heretofore been possible.

It is to be understood that the invention disclosed herein is capable of other embodiments and is not limited to the details of construction and arrangement of parts which are illustrated in the accompanying drawings, but is to be limited only by the following claims.

What I claim is:

1. The method of forming a concavo-convex disk adapted for use in closing substantially cylindrical holes in castings which comprises doming a metal blank to form opposed convex and concave faces, and punching out the disk by cutting the disk edge smoother at the concave face of the disk than at the convex face thereof.

2. The method of forming a closure for substantially cylindrical holes in castings

which comprises the steps of doming a portion of a metal blank, placing the concave face of the domed portion in contact with a female die, and punching out the said domed portion, thereby providing a disk having a smoother edge adjacent the concave side than the edge adjacent the convex side.

3. A device for closing core holes in castings, comprising a concavo-convex plug having substantially cylindrical edges, the portion of the edge adjacent the concave face of the plug being smoother than the edge next to the convex face.

4. The method of forming a plug for closing holes in metal bodies comprising the steps of punching the stock to give it a concavo-convex surface, progressing the stock into operative position with a die located on the concave side of the stock and dieing out the plug, thereby providing it with a smooth edge adjacent its concave face.

In testimony whereof I affix my signature.

HOMER M. NORTHRUP.