

[54] **HIGH TOLERANCE HOLE-PLUG FOR SHEET METAL**

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 [22] Filed: **April 14, 1971**
 [21] Appl. No.: **133,851**

[52] U.S. Cl. **220/25, 138/89, 220/55 Y**
 [51] Int. Cl. **B65d 45/00**
 [58] Field of Search **220/25, 24, 55 R, 55 Y, 55 A, 220/55 G, 55 H, 55 K, 55 Z, 55 P; 138/89, 92**

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[57] **ABSTRACT**

The invention pertains to a hole-plug for closing an access aperture in a sheet or plate-like support member. An externally flanged cup configured to be loosely received in the aperture, with the flange overlying the margin thereof, is clamped to the support member by a malleable metal spider positioned within and crosswise of the bottom of the cup. Initially the mid-portion of the spider is arched centrally outwardly from the cup bottom, and the legs of the spider are reversely arched with the tips disposed in registering slots formed in the cup wall. Flattening the arched mid-portion of the spider toward the bottom wall of the cup when the plug is placed in the hole to be closed causes the legs of the spider to expand radially outwardly and their tips to curl back into clamping engagement with the opposite surface of the support member engaged by the peripheral flange of the cup.

13 Claims, 8 Drawing Figures

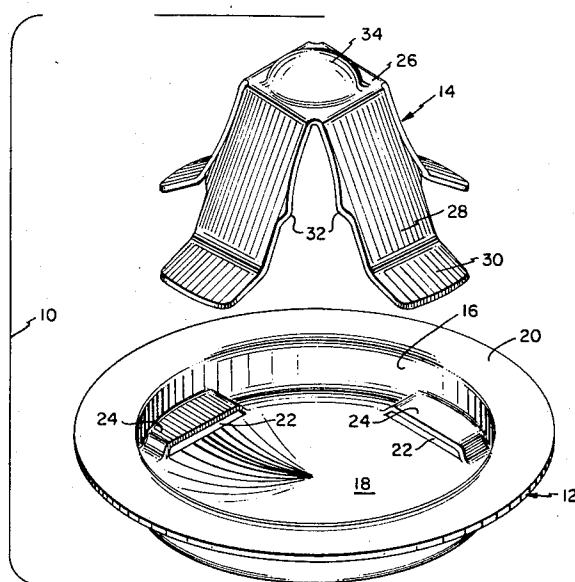


FIG. 1

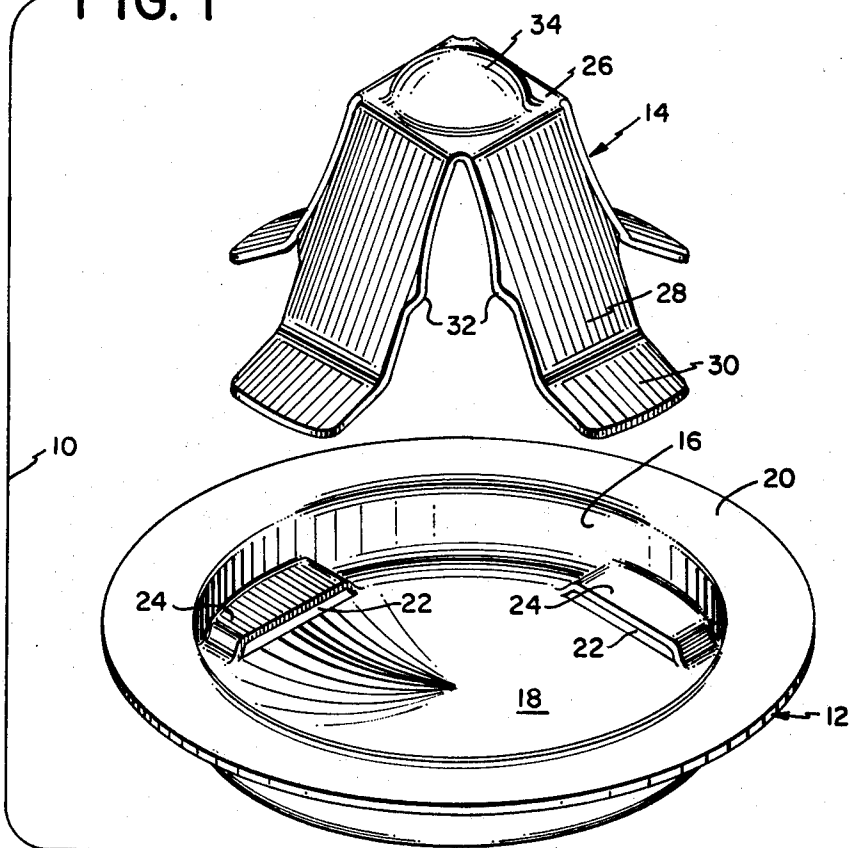
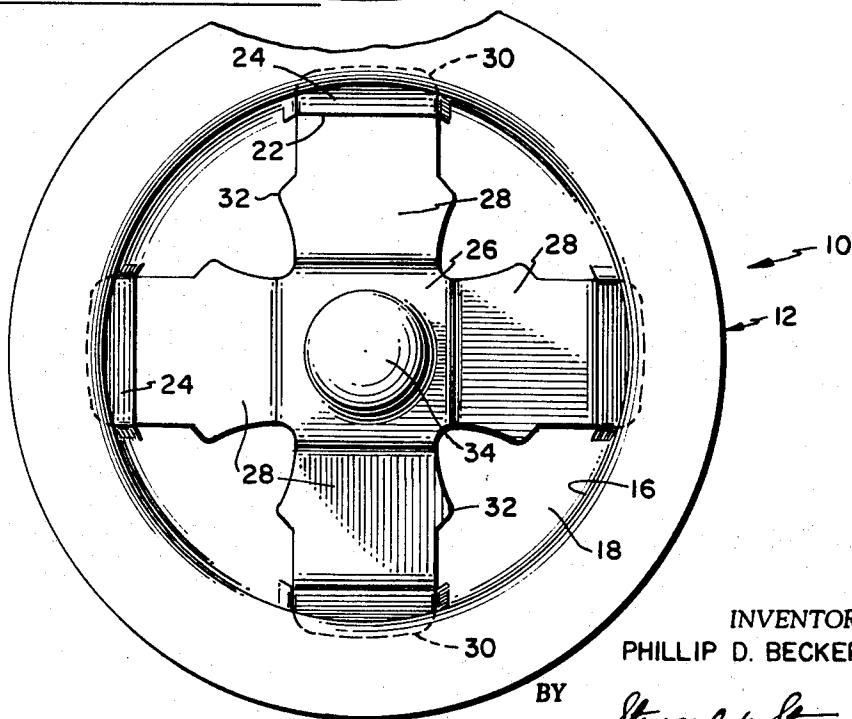


FIG. 2



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FIG. 3

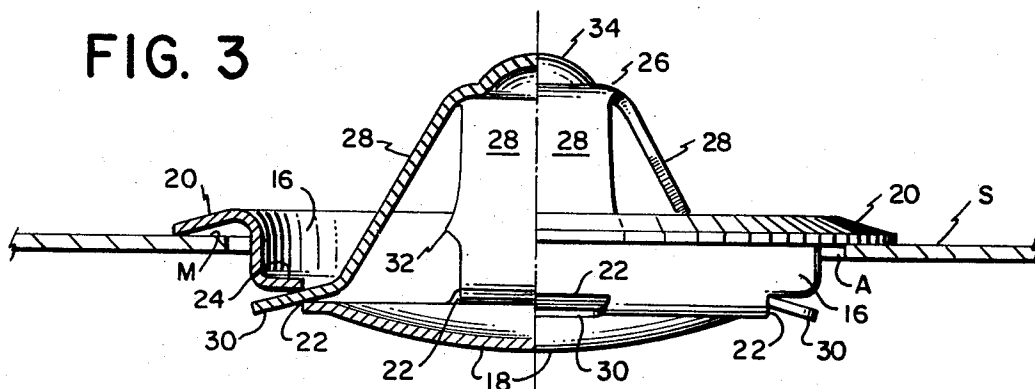


FIG. 4

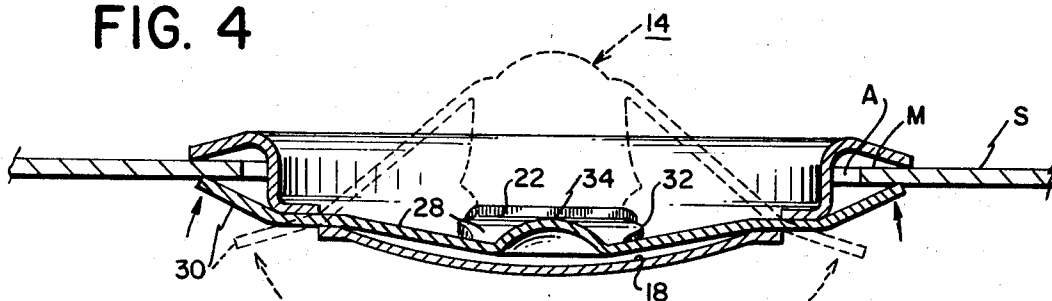


FIG. 5

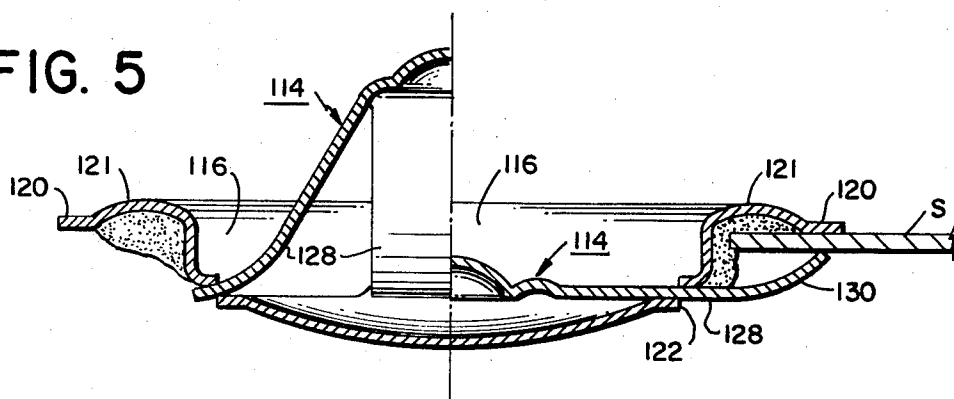


FIG. 6

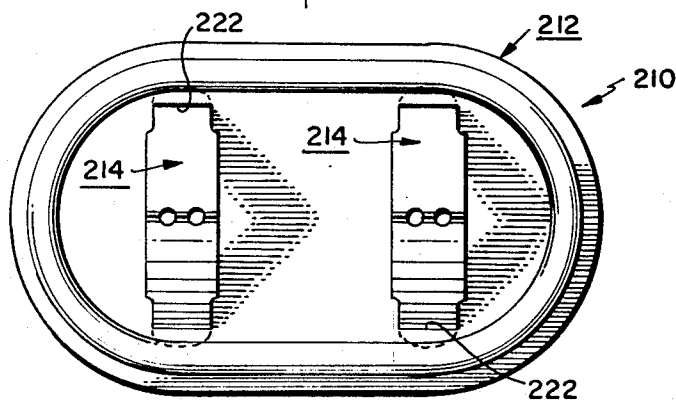


FIG. 7

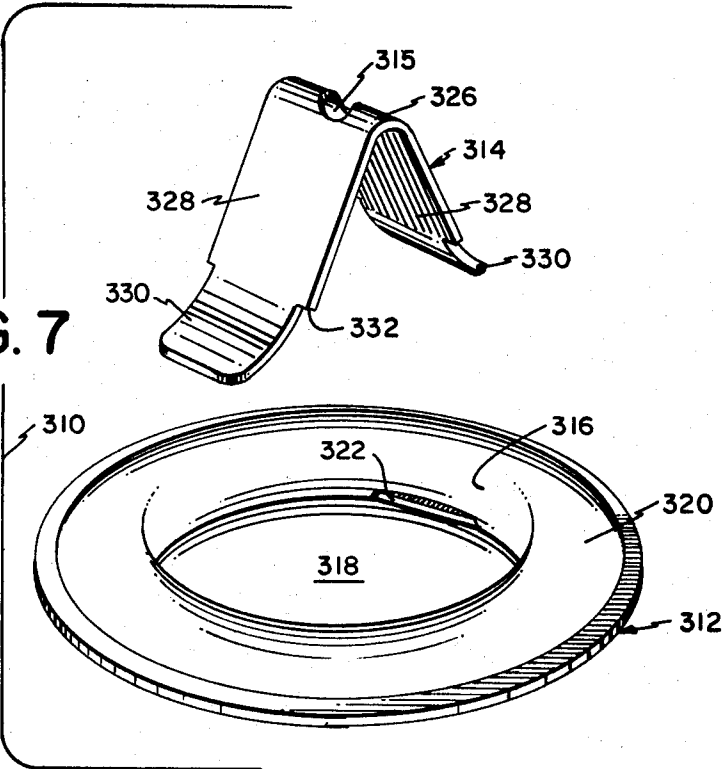
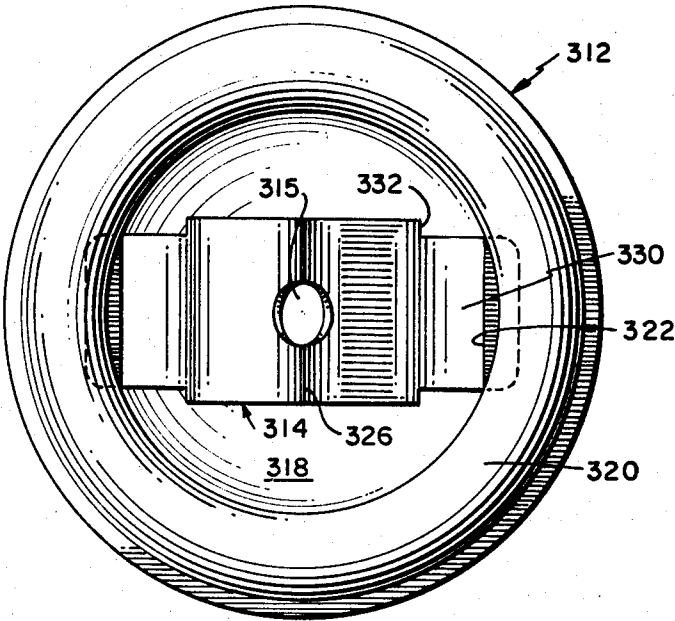


FIG. 8



HIGH TOLERANCE HOLE-PLUG FOR SHEET METAL

The invention disclosed herein is concerned with plugs adapted to be secured in and to close apertures in a sheet or plate-like support member. The principal purpose is to provide a closure for the aperture which effectively seals out dirt, water, fumes and the like, and is particularly useful in automotive structures for sealing access openings formed in body or chassis members to facilitate manufacturing operations such as assembly of component parts or drainage of excess rust-proofing composition. The plugs may also serve as a fastener device for securing two suitably apertured sheets or plate members together in certain instances.

It is an object of the invention to provide improvement in the means employed for securing a hole-plug in an aperture of a support member, particularly in respect to adaptability of a hole-plug of given standard size for slight variations in hole diameter or sheet material thickness of the support member.

It is a known fact, for example in mass production such as automotive manufacture, that wear of the tools used in punching access holes in various sections or parts of an automotive body or chassis result in time in deviations from the standard or designed diameter of such holes. It is also known that small deviations can occur in thickness of the sheet metal stock, from one roll to another, from which body sections and the like are formed. It is not always economically practical to maintain a very close tolerance on such aperture dimensions, and it is therefore common practice to rely instead on the plug to accommodate for such out-of-tolerance deviations.

One of the most common types of hole-plugs utilized heretofore consists of a central closure plate of a size and shape sufficient to overlap the margins of the aperture to be closed in a sheet support member, such plate having on its under surface depending resilient spring fingers which serve frictionally to engage the edge of the aperture and hold the cover plate in place on the sheet support when the plug is pushed or hammered into the hole. Conventionally too, the resilient fingers of the plug are formed with some form of de-
 5 tent means adjacent their outer extremities which snap under the edge of the aperture when the plug is fully inserted, so as to reinforce the retaining forces acting to maintain a plug in the hole. Unfortunately the adaptability of such conventional hole-plugs to out-of-tolerance holes is narrowly limited, due to inherent limitations in the physical properties of the metal used in forming the plug. Thus where other than strict design conditions are present, loss of such gripping action arises, particularly in the course of time over the useful life of the article of manufacture such as automobile body. This is of course aggravated by vibration and the plug will drop out of the support member. The initial fit of the plug in the hole is therefore quite critical and it is conventional practice for the manufacturer to carry in stock a series of plugs for each nominal hole diameter, where the plug diameters differ only slightly, in order to obtain a better initial fit in an out-of-tolerance hole. The same considerations apply with respect to allowing for variations in support sheet thicknesses, all of which result in the need to stock a multiplicity of hole-plugs for a supposedly standard size hole. In large mass production operations, such multiplicity of plug sizes is not only costly, but adds to the complexity of selecting the proper plug for any given instance.

Attempts have, of course, been made to overcome this problem by providing hole-plugs of designs capable of accommodating out-of-tolerance variations, but it appears that in general such previous designs involve rather complex structural arrangements of the hole-plugs, with the result that they are expensive. It is accordingly a further object of this invention to provide a hole-plug design of greater simplicity and lower cost of manufacture, without sacrifice in respect to adaptability to accommodate for substantial out-of-tolerance dimensions in respect to either the nominal size of the hole in the support member or the thickness of such member, or both.

The invention is illustrated by the several embodiments shown in the accompanying drawings in which:

FIG. 1 is an exploded view in perspective of a hole-plug of the present invention comprising a dished or cupped cover

member and a cooperating spider member for clamping the cover in position;

FIG. 2 is a top plan view of the assembled hole-plug ready for insertion in a hole;

5 FIG. 3 is a view, partly in cross-section, of a plug initially positioned in a hole to be sealed;

FIG. 4 is a cross-sectional view similar to FIG. 3 but showing the plug secured in the aperture of the support member;

10 FIG. 5 is a split cross-sectional view of a modified form of hole-plug, showing initial and clamping positions of the plug;

FIG. 6 is a top plan view of an oval-shaped plug;

FIG. 7 is an exploded view in perspective of a further modified hole-plug; and

15 FIG. 8 is a top plan view of the plug of FIG. 7 in its initial assembled condition.

A first form of the hole-plug incorporating the present invention is shown in FIGS. 1 through 4 of the accompanying drawings. The assembled hole-plug 10 in this embodiment consists of two members, the first being a shallow cup or dished plate 12, and the other a complementary clamping member or spider 14. Cup 12 is preferably formed of drawn sheet metal to provide a circular cylindrical side wall 16 integrally connected to a bottom wall 18 forming the closed end of the cup, and an integral externally peripheral flange 20 at the open end of the cup. Bottom wall 18 is pierced or slotted, as at 22, at circumferentially spaced points adjacent the juncture of bottom and side walls 18, 20, respectively. The chordal portions of bottom wall 18 subtended between slots 22 and the side wall of the cup are pressed axially inwardly of the cup to form bridging elements overlying the tips of the spider legs received in the slots.

Clamp member 14 which cooperates with the cup 12 is preferably a sheet metal stamping constituting a spider having a main central body portion 26 from which integrally connected legs 28 radiate, there being four such legs in the embodiment here shown oriented to register with slots 22 of cup 12. Legs 28 are bent along their longitudinal axes in respect to the body portion 26 of the spider to arch that body portion upwardly away from the plane defined by the tips or extremities of the legs. Legs 28 are also reversely arched near their free ends to provide tip portions 30 which are received in the respective slots 22 of the cup member in the assembled condition of the hole-plug 10, as seen in FIGS. 2 and 3. Longitudinally inwardly to each tip portion 30, the side edges of the legs are shouldered at 32 to form stops which, when engaged against opposite ends of the respective slots 22, prevent further extension beyond such shoulders of legs 28 relative to the slots. Preferably also the main body 26 of the spider 14 is domed upwardly, as seen at 34 in the drawings, to provide an impact resistant surface when the spider is hammered into clamping position.

The cylindrical or side wall 16 of cup 12 is configured to conform to the shape of an aperture A in sheet support member S to be closed by the hole-plug 10, forming a relatively loose peripheral fit therein, as best seen in FIGS. 3 and 4. And external flange 20 on cup 14 is likewise configured to the general shape of the aperture, but of a width sufficient to substantially overlap the margin M of the aperture A in the sheet support member S.

Referring now to FIG. 4, plug 10 is secured in closing relation to aperture A of sheet supporting member S by hammering the main body portion 26 of spider 14 downwardly toward bottom wall 18 of the closing cup member 12. In so doing, the spider 14 is deformed from its initial upwardly arched position shown in dotted lines in FIG. 4 to a substantially flat position adjacent the bottom wall 18 of cup 14, as shown in the solid line in FIG. 4. As spider 14 is flattened in this manner, legs 28 are caused to expand radially outward through slots 22 in the bottom wall of the cup, and by virtue of the reverse arch or bend of the tips portions 30 of the legs, they are forced upwardly into gripping engagement with the opposite face of sheet supporting member S from that engaged by flange 20. Shoulders 32 on legs 28 limit the extent to which each leg can

be forced outwardly through its respective slot 22, thereby ensuring that all legs are uniformly extended and that all of them project into gripping engagement with the undersurface of the sheet support member S.

In the illustrations given in FIGS. 3 and 4, the difference in diameter of aperture A of member S and that of the cup portion of plug 10 is somewhat exaggerated for purposes of clarity of illustration. However it will be apparent that the design of hole plug provides substantial leeway for oversize of the aperture from a nominal standard diameter, and the gripping engagement for securing the plug in position is not affected by such over-tolerance variation since the clamping action is not conditioned upon making a frictional fit with the edge wall of the aperture as in conventional hole-plugs. By the same token, reasonable variation in thickness of the support member S beyond a nominal standard likewise does not adversely effect the clamping action of the plug, since such variation is readily taken up by the spring action of tips 30 of spider 14 in engaging the undersurface of the support.

In the modified form of hole-plug shown in FIG. 5, the root portion 121 of flange 120 is arched to provide a pocket in conjunction with side wall 116 for the reception of a gasketing or sealing compound. This is preferably of the flowed-in type which adheres to the walls of the thus-formed pocket, as seen in the lefthand portion of the view in FIG. 5. When this plug is inserted in an aperture A of a supporting member S, the gasketing material is caused by the clamping action to deform about and provide a substantially fluid-tight seal around the periphery of the plug. (See the righthand portion of FIG. 5). This arrangement has the further advantage that some gasketing material is caused to flow about the intersection of legs 128 of the clamping spider with slots 122 of cup 112, thereby furthering a completely water-tight arrangement.

The foregoing embodiments of the invention illustrated in FIGS. 1 through 5 are all directed to plugs of circular configuration; but it is apparent that plugs of the invention can be adapted for use in closing apertures of non-circular form. For example, plug assemblies of square, rectangular or polyginal shape can be formed, or for example of elliptical contour as shown in FIG. 6. Furthermore the embodiment illustrated in that figure employs two separate clamping spiders 214, each extending transversely of the minor axis of the plug in spaced relation, although it will be apparent that a suitably formed one-piece, multi-legged spider similar to that illustrated in the foregoing examples could also be employed. The particular form of spiders 214 here shown are further described in connection with the following additional embodiment of the invention illustrated in FIG. 7 and 8.

Referring to FIG. 7, a circular hole-plug assembly 310 is again shown and comprises a shallow cup member 312 and cooperating two-legged spider or clamping member 314. Cup 312 is slotted at diametrically opposed locations at the juncture of side and bottom walls 316, 318, respectively to provide a pair of leg-receiving apertures 322. Spider 314 consists simply of a metal strap bent transversely of its length to form an intermediate arched body portion 326, from opposite sides of which legs 328 extend downwardly, terminating in reversely arched tip portions 330. Legs 328 are shouldered at 332 to provide stops for engaging the ends of slots 322 to limit the extent to which legs 328 can be forced outwardly through the slots of the cup member. In order to facilitate the flattening of spider 314, a hole 315 is punched through the central body portion 326, weakening it transversely at the center bend. In other respects this plug assembly is similar to those shown in the foregoing illustrations, except that the chordally subtended bridging portions adjacent slots 322 are omitted or at least minimized to the extent that it is practical to do so in piercing the sheet metal of the cup to provide the slots. Such bridging portions are sometimes helpful in securing a more water-tight fit between the cup and leg members, and may have a beneficial effect in assisting the clamping action of the spider legs. They are not however indispensable to the broader aspects of the invention.

Other adaptations of the invention include the use of the hole-plug as a fastener device for securing together two or more suitably apertured sheet or plate members by bringing their apertures into registry and then inserting a hole-plug and driving the spider legs into clamping position. In such use it is obvious that the depth of the cup member may have to be increased to accommodate the greater support member thickness.

The illustrated embodiments represent currently preferred specific forms of practicing the invention in the best known manner, but it will be obvious that various details of the design may be altered without departing from the inventive concept characterizing the invention. That is, a hole plug comprising a cup member which serves not only to form the closing cover for an aperture in a support member, but also as an anvil against which a clamping spider is deformed to cause its leg to project radially through slots in the cup member and into engagement with the opposite surface of the supporting member from that engaged by an external flange or periphery of the cup. The clamping action of the hole-plug thus produced is accordingly independent of the exact diameter of the aperture, within the limits of the width of the external peripheral flange, and also independent of the thickness of the apertured supporting member, again within limits of the cup depth.

What is claimed is:

1. A hole-plug for closing an aperture in a sheet support member, comprising
 - a sheet metal cup having a generally cylindrical side wall of a size and shape to be loosely received in the hole to be plugged, a bottom wall integrally joined to said side wall to form the closed end of said cup, and an external peripheral flange integrally joined to and extending radially outward from said side wall at the open end of said cup, said flange being of a width and contour to substantially overlie the margin of the hole to be plugged, and said cup having at least two, generally diametrically opposed, slots piercing the cup adjacent the juncture of said bottom and side walls;
 - a clamp member disposed in said cup for securing it in hole-plugging position in an aperture of a support member, said clamp member comprising a relatively stiff but malleable sheet metal spider having a main body portion and integrally connected leg portions radiating from said body portion and corresponding in number and circumferential orientation with said slots in said cup member so as to register therewith, said leg portions having their tips received in respective slots of said cups and making a close sliding fit therewith, said legs being arched to dispose said main body portion in elevated position in said cup member;
 - said clamp member being adapted and arranged to cause said leg portions to expand radially through said cup slots when the central arcuate body portion of said clamp member is flattened inwardly toward the bottom wall of said cup, whereby said tips are caused to overlap and grip the margin of the hole in said support member on the face thereof opposite that engaged by said annular cup flange.
2. A hole-plug as defined in claim 1, where the edges of the legs of said clamp member are formed to provide shoulders adjacent their free ends to engage opposite ends of said slots in said cup member and limit the radial expansion of each leg through its respective slot.
3. A hole-plug as defined in claim 2, wherein the free ends of said legs are reversely arched longitudinally outwardly of said shoulders.
4. A hole-plug as defined in claim 2, wherein said slots are formed in said bottom wall chordally thereof, and the subtended arcuate portions of the bottom wall are bridged inwardly to overlie the free ends of said legs.
5. A hole-plug as defined in claim 2, wherein said slots are formed in the side wall of said cup member to receive the free ends of said legs.

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6. A hole-plug as defined in claim 2, wherein said clamp member is formed with two legs and said cup member is provided with diametrically opposed slots to receive said legs.

7. A hole-plug as defined in claim 2, wherein said clamping member is formed with four legs and said cup member is provided with two pairs of slots, the slots in each pair being diametrically opposed to receive said legs.

8. A hole-plug as defined in claim 1, wherein said cup member is formed with two pairs of slots, the slots in each pair being diametrically opposed, and two clamp members, each such member having oppositely extending legs received in a respective pair of slots.

9. A hole-plug as defined in claim 8, wherein said cup

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member is of non-circular configuration.

10. A hole-plug as defined in claim 9, wherein said cup member is of elliptical configuration.

11. A hole-plug as defined in claim 1, wherein the center of said main body portion of said spider is formed with a dome.

12. A hole-plug as defined in claim 1, wherein the center of said spider body portion is bent transversely of the legs, and an aperture is formed in the bend.

13. A hole-plug as defined in claim 1, wherein a sealing compound is adhered to the under surface of the external peripheral flange of said cut adjacent the root of said flange.

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