Sept. 19, 1961 A. SPOKES 3,000,420

NUT WITH RECESSES TO RECEIVE METAL OF THE WORKPIECE

Filed March 14, 1958

Fig. 1.

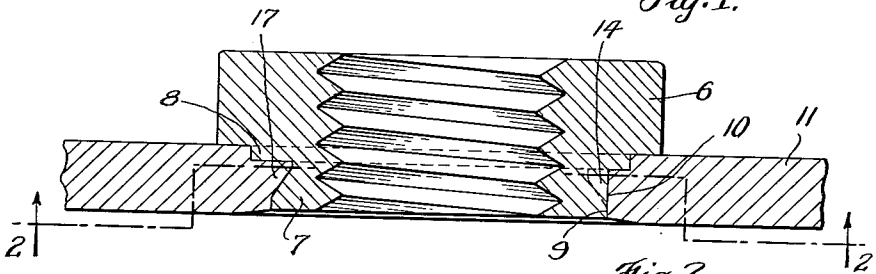


Fig. 2.

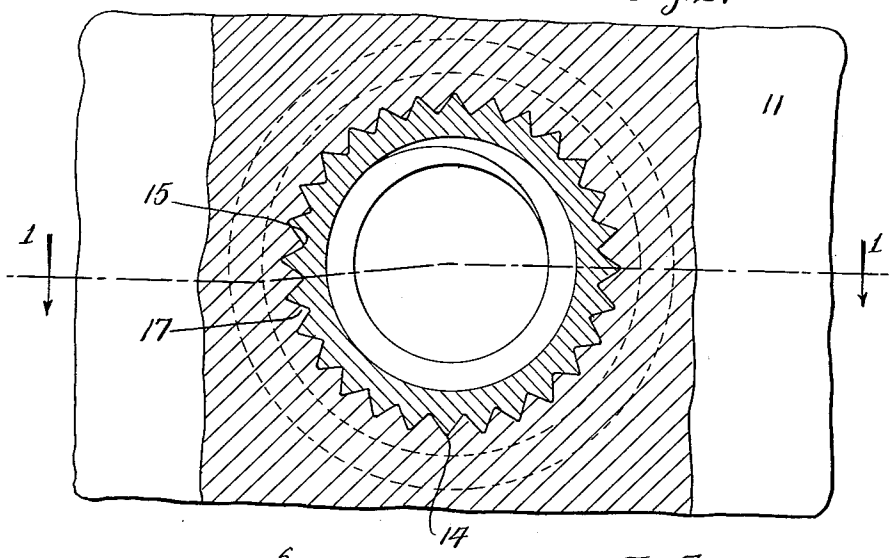


Fig. 3.

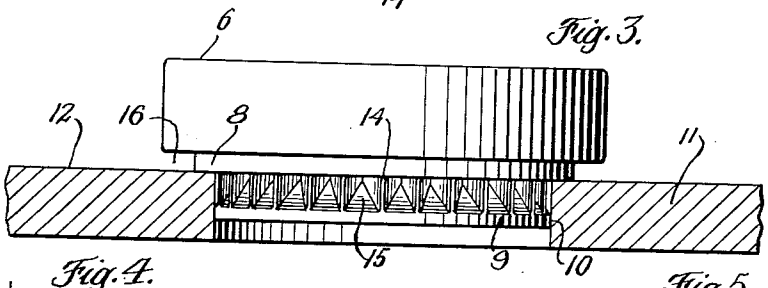


Fig. 4.

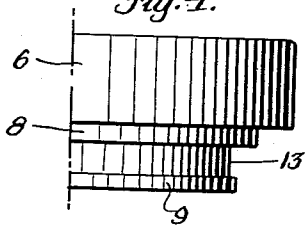
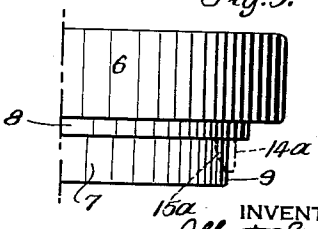


Fig. 5.



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NUT WITH RECESSES TO RECEIVE METAL OF THE WORKPIECE

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4 Claims. (Cl. 151—41.73)

This invention relates to the art of forming and attaching a metal boss or like member in an aperture or opening in a relatively thin metal member. Members of this kind frequently take the form of nuts or grommets which in themselves are intended to be used as a means for attaching other parts to metal plates. However, I wish it to be understood that the features of construction and the principles of my improved method do not necessarily have to be limited to this type of attaching member because the invention can be used in connection with the attachment of drill bushings, shafts, pins or the like. Therefore, in the following description and claims the terms "boss" is intended to be construed as covering any member which can be formed and secured in a hole or an aperture in the manner disclosed herein.

The principal objects of the invention include the provision of a boss or the like as well as a method of forming and attaching it whereby there is much less liability of buckling or warping the sheets to which the boss is to be attached than has heretofore been possible with known devices and methods; the provision of a boss and a method of manufacturing and attaching it by means of which the metal of the boss and the metal of the member to which it is attached are swaged or flowed in a manner which increases the density of the metal at critical points thereby strengthening the joint rather than weakening it; the provision of means whereby a boss may be more easily inserted and secured in the aperture or hole with which it is to be associated; the provision of a boss which can be relatively easily and inexpensively manufactured and secured in place; and the provision of a boss and a method of attaching it by means of which the boss can be more securely fastened and held against rotation than has heretofore been possible with known devices.

How the foregoing objects and advantages are attained together with such others as may appear hereinafter or are incident to my invention will now be described in connection with the accompanying drawing wherein:

FIGURE 1 is a cross section of a boss or the like embodying my improvements shown in its seated or completely secured position, the section being taken as indicated by the line 1—1 in FIGURE 2;

FIGURE 2 is a section taken on the line 2—2 of FIGURE 1;

FIGURE 3 is a section similar to that of FIGURE 1 but showing the boss as fitted into the aperture but before being secured therein;

FIGURE 4 is a half elevation of a boss or the like according to my invention showing a detail of one form of the invention; and

FIGURE 5 is a half elevation of a member embodying my invention but showing a modified construction.

In the accompanying drawings it will be noted that the invention is illustrated as taking the form of an internally threaded nut, the nut being intended for use as a holding means for other parts. However, it is to be understood that this showing is merely by way of exemplification and not limitation.

In FIGURES 1 to 4 inclusive it will be seen that the nut illustrated has a head portion 6, a shank portion 7 and a shoulder portion 8 between the two, the shoulder being of relatively shallow depth compared to the shank 7. The shank 7 has a pilot dimension 9 which corresponds to the diameter of the apertures 10 in which the nut is to be secured. In the present showing of the invention the nut is fastened to a relatively thin metal plate member 11. In this connection it will be understood, of course, that before the nut has been attached to the plate as shown in FIGURES 1 and 2, the aperture 10 in the plate 11 is of one diameter throughout so that when the nut is placed in position in the aperture the shoulder 8 is adapted to rest upon the upper surface 12 of the plate as shown in FIGURE 3.

In the embodiment of FIGURES 1 to 4 inclusive a reduced neck or annular recess 13 is formed in the shank immediately below the shoulder 8 as shown to best advantage in FIGURE 4. In this reduced neck I form a plurality of axially disposed ribs 14 which are arranged annularly around the periphery of the reduced neck. These ribs are tapered inwardly from the periphery of the shank toward the under face of the shoulder 8 whereby to deepen the valleys or pockets 15 between the ribs in the region of the under face of the shoulder for a purpose which will appear below.

The ribs 14 with the intervening pockets 15 may be formed in a number of ways although I prefer to employ a method of procedure which involves a pressure application of sufficient magnitude or force to flow the metal to the desired configuration as by means of a knurling roll or equivalent tool designed to press the metal to produce the desired shape. However, the ribs and valleys therebetween might be formed in some other manner as by a molding or cutting operation. The reason I prefer a flowing or swaging operation is because to flow or swage the metal increases its density and, therefore, strengthens the body of the metal at the weakest portion of the nut. Also the ribs themselves serve as additional strengthening means at the point where strength is most needed. If the ribs and intervening valleys are formed by molding or cutting the metal this strengthening feature is not attained although the member so manufactured can be equally securely fastened to the sheet metal member according to the method now to be described.

A nut, boss or the like formed in the manner described is placed in the aperture 10 in the sheet metal member 11 as shown in FIGURE 3 which leaves the under face of the head 6 of the nut or other member clear of the upper surface 12 of the sheet. In other words, there is a gap 16 at this point between the under face of the head 6 and the upper face of the plate 11. After insertion the nut is then driven home or pressed into position with sufficient force to bring the under face of the head 6 tightly against the upper face of the sheet and during this operation the shoulder 8 swages the metal of the plate 11 into the valleys or pockets 15 between the ribs 14, most of the metal, of course, flowing down into the deeper portion of the valleys 15. The metal so flowed is shown at 17 in FIGURES 1 and 2. This operation, therefore, provides for firm fastening of the nut in the sheet and prevents all possibility of the nut turning in the aperture.

In the modification of FIGURE 5, no preformed neck or recess 13 is employed, the shank of the nut having the ribs and intervening recesses 14*a* and 15*a* swaged or pressed directly in the surface thereof by a knurling roll or equivalent tool. However, it will be noted that in this event the ribs 14*a* will project outwardly somewhat beyond the diameter of the pilot portion 9 as indicated in dotted lines in FIGURE 5, the reason for this being that the metal must flow outward somewhat to form the ribs and the depressions. The result is essentially the same although the grip of the sheet metal on the nut after the nut has been applied is probably more secure in the modification of FIGURES 1 to 4 inclusive. Furthermore,

when attaching the nut of FIGURE 5 the pressure applied will have to be sufficient to force the protruding portions 14*a* of the ribs into the aperture in order to seat the under face of the head against the upper face of the sheet. The action is very similar but naturally involves a slight change in the disposition of the flowed metal.

From all of the foregoing it will now be appreciated that the shoulder 8, in effect, constitutes a swaging ring which pushes or flows the metal of the sheet or member to which the nut is attached into the depressions or valleys between the ribs in such a way as to cause the flowed metal to be separated by the tops or ridges of the ribs into as many sections as there are ribs on the periphery of the neck. This promotes easier insertion and also tends to relieve the stresses and strains which are normally set up by the operation. In relieving these stresses and strains I also relieve the tendency toward buckling or warping of the metal sheet which is a very important advantage especially where the sheets are relatively thin.

The anti-twist value and the pullout value attainable with my invention are exceptionally high. The invention makes possible very rapid production as well as quick and easy application of the nut to the sheet. All that it is necessary to do in applying devices employing my invention is to force them into position with sufficient pressure to accomplish the required flowing of the metal and this can be effected with an arbor press or a hydraulic press or sometimes even with an ordinary hammer.

I claim:

1. An internally threaded nut adapted to be mounted in a generally circular aperture in relatively thin sheet metal without distorting the metal, said nut comprising a shank, said shank having a generally cylindrical pilot portion on its free end of a diameter sufficiently less than that of the aperture for free engagement therein, an annular generally cylindrical shoulder on the other end of said shank spaced from said pilot portion and having a diameter appreciably greater than that of said pilot portion for engagement with the face of the metal bounding the aperture, and an enlarged head adjacent to and outward of said shoulder having a diameter substantially greater than that of said shoulder, the axial distance between said head and the free end of said shank being less than the thickness of the metal, said shank being formed circumferentially thereabout in the space between the pilot portion and shoulder with a plurality of recesses each extending from said pilot portion to and terminating at said shoulder, said recesses being of increasing depth in the direction toward said shoudler and having radially outwardly diverging side walls defining of the region between each adjacent pair of recesses a radially outwardly tapering rib extending longitudinally of said shank, said ribs terminating at their radially outer extremities substantially flush with said pilot portion throughout their entire length, forcing of said shoulder against said metal face effecting cold-flow deformation of the metal radially inward in generally inverse proportion to the distance away from said shoulder, whereby said recesses serve to conformably receive such deformed metal to firmly and nonrotatably secure said nut and said ribs serve to effect breaking engagement with the metal being deformed for minimum distortion and strain of said metal and nut.

2. An internally threaded nut adapted to be mounted in a generally circular aperture in relatively thin sheet metal without distorting the metal, said nut comprising a shank, said shank having a generally cylindrical pilot portion on its free end of a diameter sufficiently less than that of the aperture for free engagement therein, an annular generally cylindrical shoulder on the other end of said shank spaced from said pilot portion and having a diameter appreciably greater than that of said pilot portion for engagement with the face of the metal bounding the aperture, and an enlarged head adjacent to and outward of said shoulder having a diameter substantially greater than that of said shoulder, the axial distance between said head and the free end of said shank being less than the thickness of the metal, said shank being formed circumferentially thereabout in the space between the pilot portion and shoulder with a plurality of recesses each extending from said pilot portion to and terminating at said shoulder, said recesses being of increasing depth in the direction toward said shoulder and having radially outwardly diverging side walls defining of the region between each adjacent pair of recesses a radially outwardly tapering rib extending longitudinally of said shank, said ribs terminating at their radially outer extremities substantially flush with said pilot portion throughout their entire length and said recesses being cold-rolled to compress and work harden the nut regions radially inward of said recesses for increased strength, forcing of said shoulder against said metal face effecting cold-flow deformation of the metal radially inward in generally inverse proportion to the distance away from said shoulder, whereby said recesses serve to conformably receive such deformed metal to firmly and nonrotatably secure said nut and said ribs serve to effect breaking engagement with the metal being deformed for minimum distortion and strain of said metal and nut.

3. The combination including a thin metal sheet having a generally circular aperture, and an insert comprising a shank located within said aperture and having a generally cylindrical pilot portion on its free end of a diameter just freely engaged in said aperture, an annular shoulder on the other end of said shank spaced from said pilot portion and having a diameter appreciably greater than that of said pilot portion and embedded in the face region of said metal sheet bounding said aperture, and an enlarged head adjacent to and outward of said shoulder exteriorly of said aperture and having a diameter substantially greater than that of said shoulder, the axial distance between said head and the free end of said shank being less than the thickness of said sheet, said shank being formed circumferentially thereabout in the space between said pilot portion and shoulder with a plurality of recesses each extending from said pilot portion to and terminating at said shoulder, said recesses being of increasing depth in the direction toward said shoulder and having radially outwardly diverging side walls defining of the region between each adjacent pair of recesses a radially outwardly tapering rib, said ribs terminating at their radially outer extremities substantially flush with said pilot portion throughout their entire length, and the material of said sheet bounding said aperture being cold-worked radially inward to substantially fill said recesses, whereby said recesses conformably receive the deformed metal of said sheet with minimum distortion and strain of said sheet and insert.

4. The combination including a thin metal sheet having a generally circular aperture, and an insert comprising a shank located within said aperture and having a generally cylindrical pilot portion on its free end of a diameter just freely engaged in said aperture, an annular shoulder on the other end of said shank spaced from said pilot portion and having a diameter appreciably greater than that of said pilot portion and embedded in the face region of said metal sheet bounding said aperture, and an enlarged head adjacent to and outward of said shoulder exteriorly of said aperture and having a diameter substantially greater than that of said shoulder, the axial distance between said head and the free end of said shank being less than the thickness of said sheet, said shank being formed circumferentially thereabout in the space between said pilot portion and shoulder with a plurality of recesses each extending from said pilot portion to and terminating at said shoulder, said recesses being of increasing depth in the direction toward said shoulder and having radially outwardly diverging side walls defining of the region between each adjacent pair of recesses a radially outwardly tapering rib, said ribs terminating at their radially outer extremities substantially flush with

said pilot portion throughout their entire length, said recesses being cold-rolled to compress and work harden the regions radially inward of said recesses for increased strength, and the material of said sheet bounding said aperture being cold-worked radially inward to substantially fill said recesses, whereby said recesses conformably receive the deformed metal of said sheet with minimum distortion and strain of said sheet and insert.

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