May 7, 1940. J. H. DAVIS 2,199,620

METHOD OF SIZING AND RIVETING POROUS METAL ARTICLES

Filed Nov. 10, 1937

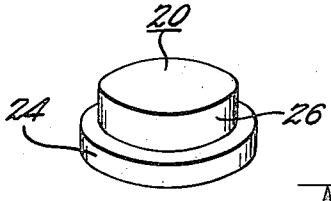

Fig. 1.

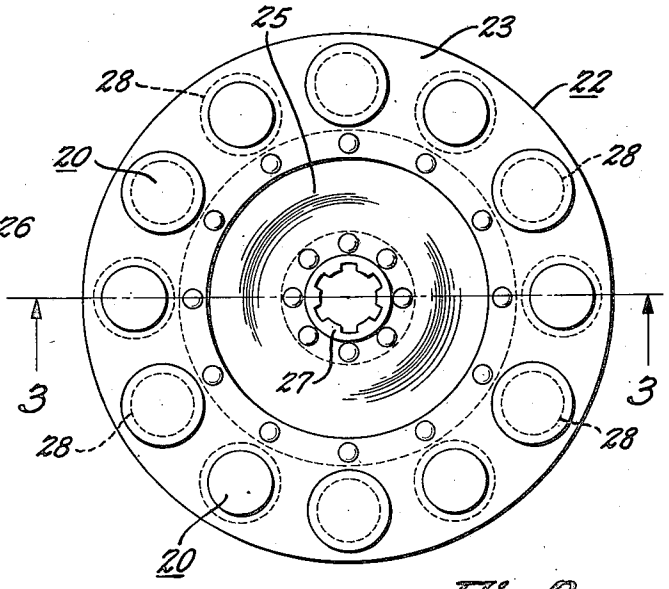

Fig. 2.

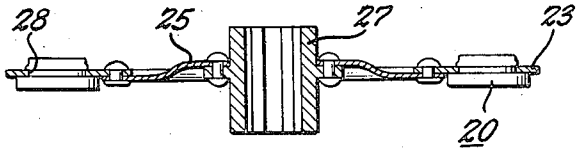

Fig. 3.

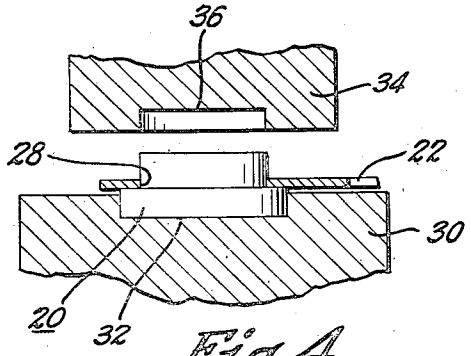

Fig. 4.

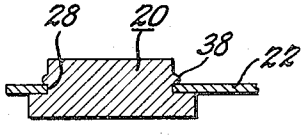

Fig. 5.

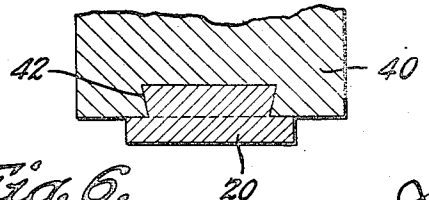

Fig. 6.

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METHOD OF SIZING AND RIVETING POROUS METAL ARTICLES

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5 Claims. (Cl. 29—149.5)

The present invention relates to the cold working of porous metal articles and more particularly to a method of cold working porous metal articles that are adapted to be used as friction or anti-friction surfaces between relatively movable supporting members.

One of the objects of the present invention is to provide a method for controlling the density of porous metal articles while simultaneously fastening said articles to a supporting member.

Another object of the invention is to provide a method for increasing the density of porous metal buttons, or plugs, while simultaneously fixedly fastening the same to a plate.

In carrying out the above objects it is a still further object of the invention to provide a method wherein the area of the friction, or anti-friction surface of the porous metal article, or button is maintained substantially constant while the aforementioned cold working operation is being performed.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein preferred embodiments of the present invention are clearly shown.

In the drawing:

Fig. 1 is a view in perspective of a preferred form of porous metal button, as used in carrying out the present invention.

Fig. 2 is a view of a clutch plate having a plurality of buttons, as shown in Fig. 1, assembled thereto.

Fig. 3 is a view taken on the line 3—3 of Fig. 2 illustrating the clutch plate in section.

Fig. 4 is a fragmentary view, in section, of one form of die utilized in assembling porous metal articles or buttons to a supporting plate.

Fig. 5 is a fragmentary view of the supporting plate, after the cold working operation, with a porous metal button fixedly fastened thereto, and

Fig. 6 is a fragmentary view of a modified construction wherein a button is shown fixedly fastened to a supporting member.

Articles formed from powdered metals have an inherent porosity, such porosity occurring as a result of the method used in fabricating such articles. One of such methods comprises intimate mixing of powdered metals, then compressing the mixture into a formed article of the desired shape and then sintering the formed article at a temperature sufficient to cause alloying or welding of the metallic particles to form a strong and continuous metallic network, analogous to a sponge. Such a method is described in detail in the patent to Williams 1,556,658 filed March 24, 1922, which is directed to the fabrication of porous bronze bearings from copper and tin powders. It is apparent that a similar procedure may be carried out with various other metal powders, as for example, copper, tin, iron or nickel powders or combinations thereof, together with additions of small quantities of such substances as graphite or mica etc.

Since the metal articles formed by the aforedescribed process have an inherent porosity, they likewise have a relatively low density compared to a like article formed by conventional alloying methods. Thus it is desirable, in some cases, to compress the porous sintered artice, prior to using the same, in order to increase its resistance to failure, due to compressive load. Such compression, or compacting increases the density of the article while simultaneously reducing the porosity thereof.

The present invention is directed to a method whereby porous metal articles may be riveted or otherwise fixedly fastened to a supporting member and simultaneously compressed to a predetermined degree of density, which degree of density may be duplicated any number of times so that each assembly fabricated by the present process is substantially identical in physical characteristics.

Referring to the drawing, one embodiment of the present invention is shown in Fig. 2 wherein a plurality of porous metal buttons 20 are illustrated fastened to a clutch plate 22. The plate 22 includes a rim 23 and a hub portion 25 which is riveted to the rim 23. The hub 25 has a spline 27 riveted thereto at the center thereof, which spline 27 may be used to engage the plate to a suitable central shaft. Each of the buttons 20 includes a shoulder or head portion 24 and a shank portion 26, of relatively smaller diameter than the diameter of the shoulder 24. The clutch plate 22 is pierced to provide a plurality of apertures 28 therethrough, which apertures 28 are of slightly greater diameter than the shank portions 26 of the buttons 20 so that the buttons 20 may be positioned on the plate 22 by passing the shank portions 26 thereof through the apertures 28.

It will be noted that the plate 22 is pierced an even number of times around the periphery of the rim 23 to provide an even number of apertures 28 therethrough, twelve being provided in the present instance, 30 degrees apart. The buttons 20 are preferably assembled through the apertures 28 so that alternate buttons are positioned

in opposite directions, thus every other button has its shoulder portion 24 on the same side of the plate 22, while the intermediate buttons 20 have their shoulder portions 24 on the opposite side of the plate 22. In this manner an equal area of porous metal friction surface is present at either side of the plate 22 since there are a similar number of shank portions 26 and shoulder portions 24 of the buttons 20 exposed at either side of the plate 22.

The plate 22 with the buttons 20 assembled thereto, is then positioned in the die 30 having plurality of recesses or cavities 32 therein, which recesses 32 are substantially equal in diameter to the portion of the button 20 which is to be positioned therein. Thus the die cavities 32 will be alternately spaced and have alternate diameters substantially equal to the shoulder portion 24 and substantially equal to the shank portion 26 of the button 20. The depth of each cavity 32, is the same and is slightly less than the height of the corresponding portion of the button 20 extending from the plate. A similar die 34 is also provided and has a similar number of recesses or cavities 36 therein that are disposed to register with the cavities 32 in die 30. The only difference being that the die 34 is revolved 30 degrees so that the cavities 36 therein are exactly opposite in diameter to the cavities 32 with which they register in the die 30. In other words a cavity 36 in die 34 is of such diameter as to substantially equal one portion of a button 20 while the corresponding registering cavity 32 in die 30 is substantially equal to the other portion of a button 20. The cavities 36 in die 34 are likewise of slightly less depth than the extending portions of the buttons 20. Thus when the dies 30 and 34 are moved relative to one another, that is moved toward one another, the buttons 20 are compressed endwise therebetween, but are not allowed to be deformed radially outwardly at the end surfaces thereof, the only deformation taking place substantially at the surface of the plate 32 is noted at 38 in Fig. 5. This slight deformation fixedly fastens the buttons 20 to the plate 22.

From the aforementioned description it will be noted that while the buttons 20 are being compressed endwise thereof they are increased in density since they are not allowed to expand or deform radially outwardly adjacent the ends thereof. Simultaneously with this increase in density, the buttons 20 are fixedly fastened to the plate 22. It is apparent that each clutch plate fabricated in the aforementioned manner will have an equal area of friction surface at either side thereof and the porous metal buttons 20 will be substantially the same density throughout.

Fig. 6 shows a modification of the aforementioned method of fixing the button 20 into a supporting member. In this instance a supporting member 40 is utilized having a recess 42 therein, which is undercut so that the base diameter of the recess 42 is greater than the diameter of the recess aperture at the surface of the member 40. Thus if a button 20 is utilized having a shank portion 26 of substantially the diameter of the aperture of the recess 42 and of a slightly greater height than depth of the recess 42 the same may be fixedly fastened to the member 40 by using a single die member such as 30. In this case the button 20 is compressed endwise, which causes the shank portion 26 thereof to be deformed radially outwardly to substantially fill the undercut portion of the recess 42 and thereby lock the button 20 in place therein. Simultaneously with this deforming operation the shoulder portion 24 of the button 20 is compressed endwise while the shoulder portion 24 is confined in the die 30 and in this manner the density of the button 20 is increased to a predetermined degree without distortion or change in area of the end surface thereof.

It is to be understood in either embodiment that any degree of density can be acquired, within reasonable limits, by regulating the depth of the recesses in the dies and that in all cases the surface area of each button 20 is maintained substantially constant.

It is to be understood that while the present description is directed to friction articles as used in clutch members, etc. that a similar procedure could be successfully carried out on anti-friction articles in which the porous metal buttons 20, or other porous metal articles, may be impregnated with oil. Likewise the invention is not limited in use to buttons, plugs, or the like, but may be successfully carried out whenever it is desired to fasten a porous metal article of any desired shape to a supporting member and thereby provide a surface for friction or anti-friction purposes of a predetermined density.

While the embodiments of the present invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. The method of fastening a porous metal wear plug made from sintered powdered metals and having a shouldered portion thereon to a supporting member and simultaneously compressing the plug to increase the density thereof which comprises the steps of, assembling the plug and the supporting member so that the shoulder portion of the plug abuts one surface of the member and the remainder of the plug passes within an aperture that passes through the member, placing the shoulder portion of the plug in a die of substantially the same diameter as the shouldered portion but of a depth less than the height of the shouldered portion, striking the portion of the plug that extends in the aperture so as to deform the same for causing the plug to be fastened to the member and for simultaneously compressing the shoulder portion of the plug to increase the density thereof without substantially changing the diameter thereof.

2. The method of controlling the hardness of a porous metal plug made from sintered metal powders and simultaneously fastening the same to a supporting member which comprises the steps of, forming a porous metal plug including a shoulder portion; assembling the plug and the supporting member so that the shoulder of the plug abuts the member and the smaller diameter portion of the plug extends through the member, placing the shoulder portion of plug in a supporting die of a predetermined depth and of substantially the same diameter as the shoulder, and then compressing the plug endwise and thereby deforming the extending portion of the plug at the point where it passes through the member for causing the plug to be fastened to the member, and simultaneously causing the larger diameter portion of the plug to be compressed within said die to a desired degree of density without substantially changing the diameter thereof.

3. The method of fixedly fastening a plurality of porous metal buttons to an apertured plate

and simultaneously increasing the density of said buttons which comprises the steps of; molding and sintering metal powders into porous metal buttons; assembling said buttons to said plate and through said apertures; simultaneously applying pressure to each of said buttons for compressing the buttons endwise thereof and thereby deforming the buttons for fixedly fastening the buttons to the clutch plate, and simultaneously causing an increase in density of the buttons.

4. The method of fixedly fastening a plurality of shouldered porous metal buttons to an apertured plate and simultaneously increasing the density of the buttons comprising the steps of; forming a plurality of porous metal buttons each having a shouldered portion and a portion of relatively smaller diameter; piercing a plate to form an even number of apertures therethrough; assembling the buttons to the plate through said apertures so that alternate buttons are inserted in the apertures in opposite directions to provide equal surface areas of porous metal at either side of the plate, placing the assembled buttons and plate in a die so that the shouldered portions thereof are confined in said die; and then applying pressure to the buttons for compressing the buttons endwise thereof and thereby deforming the smaller diameter portion of each of the buttons for fixedly fastening the buttons to the plate and simultaneously increasing the density of the buttons.

5. The method of fixedly fastening a plurality of shouldered porous metal buttons to an apertured plate and simultaneously increasing the density of the buttons comprising the steps of; forming a plurality of porous metal buttons each having a shouldered portion and a portion of relatively smaller diameter; piercing a plate to form an even number of apertures therethrough; assembling the buttons to the plate through said apertures so that alternate buttons are inserted in the apertures in opposite directions to provide equal surface areas of porous metal at either side of the plate; engaging both ends of said buttons with a die having bores therein substantially equal to the diameters of the respective ends of the buttons for preventing distortion at the ends of the buttons and thereby maintaining the surface areas of the buttons substantially constant, and then causing relative movement of said dies toward one another for compressing the buttons endwise and thereby deforming the buttons at the portions thereof which extend through the plate to fixedly fasten the buttons to the plate, and simultaneously causing the density of the buttons to be increased for increasing the compressive strength of the buttons.

JAMES H. DAVIS.