April 8, 1930. H. M. WILLIAMS ET AL 1,753,632

MACHINE FOR AND METHOD OF FINISHING BUSHINGS

Filed May 22, 1923 2 Sheets-Sheet 1

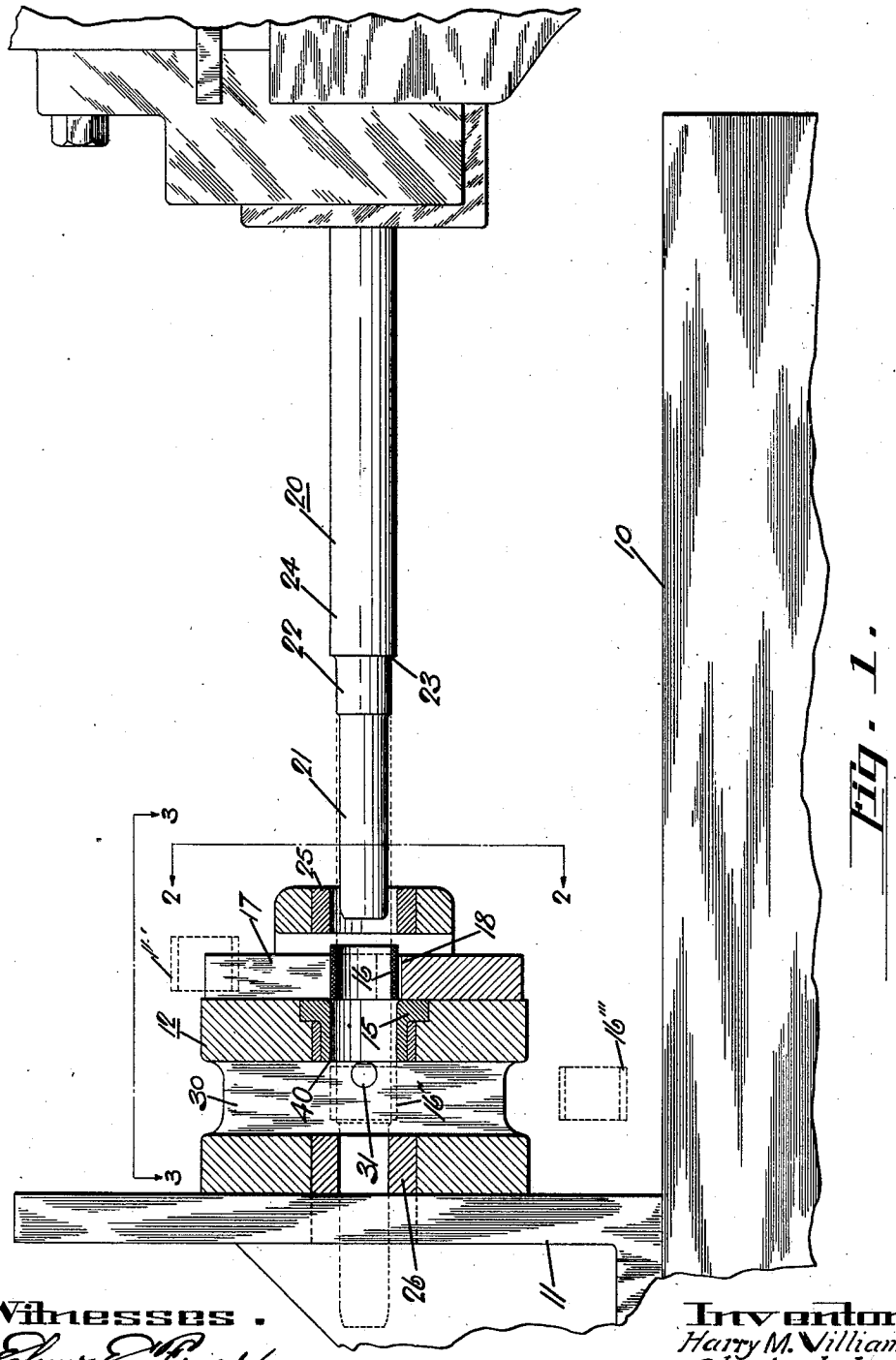

Fig. 1.

Witnesses.
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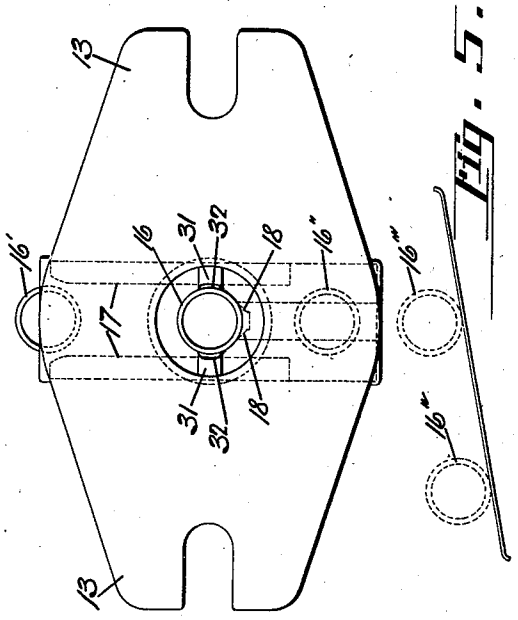

Fig. 5.

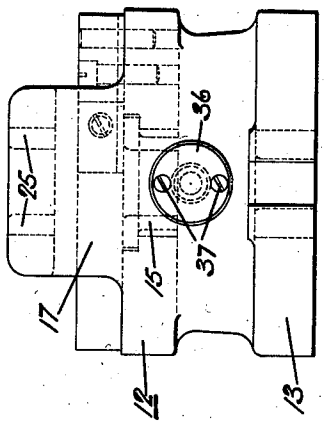

Fig. 4.

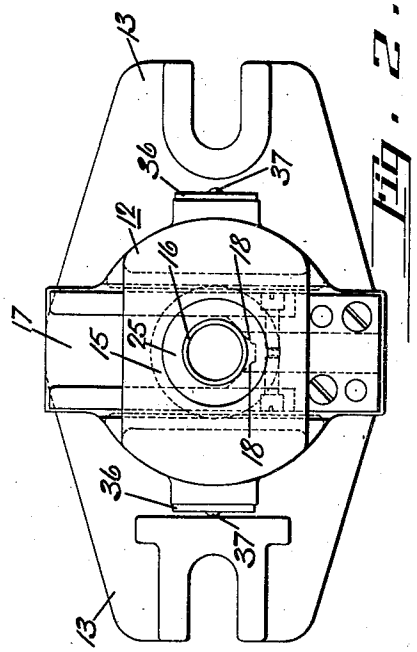

Fig. 2.

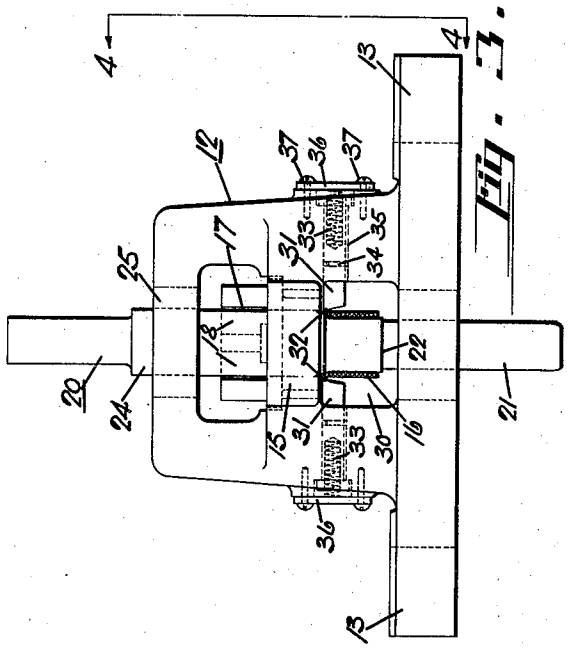

Fig. 3.

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UNITED STATES PATENT OFFICE

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MACHINE FOR AND METHOD OF FINISHING BUSHINGS

Application filed May 22, 1923. Serial No. 640,798.

This invention relates to a method of surfacing and sizing bushings to an exact predetermined size and to a machine for carrying out this method.

An object of this invention is the provision of a simple, economical, and very effective method of sizing bushings to an exact predetermined size and of giving them a smooth inner surface.

This invention is intended primarily for use with self lubricating bearing or guide bushings formed by mixing finely-divided particles of metal,—particularly of different metals capable of alloying when heated below the fusing point of at least one of them,—with a volatilizable substance, compressing a quantity of the mixture thus formed into the contour of a bushing, then heating the bushing blank thus formed in a non-oxidizing environment to such a temperature and for such a period that the particles of metal cohere or sinter together and the volatilizable substance passes from the bushing blank leaving it porous and susceptible of absorbing and retaining lubricants. In the practice of the described process it has been found that the bushings distort slightly or change their dimensions slightly during the heat treatment and hence it becomes important that the bushings be sized to the exact desired dimensions after the heat treatment. Also during the resizing of the bushings according to this invention the high pressure of the arbor and dies upon the walls of the bushing give the bushing a very smooth inner surface without reducing the porosity of said surface.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 shows the essential parts of a machine for carrying out the method of this invention, a bushing being shown in place ready to have the arbor inserted therethrough.

Fig. 2 shows a front elevation of the stationary head for supporting the die, taken on the line 2—2 of Fig. 1.

Fig. 3 is a plan view of the die head, taken on line 3—3 of Fig. 1.

Fig. 4 is a side elevation of the head, taken on line 4—4 of Fig. 3.

Fig. 5 is a rear elevation of the head and shows in dotted lines several positions of the bushings as they pass through slots provided in the head.

Throughout the several views of the drawings, similar reference characters refer to similar parts.

Numeral 10 designates the stationary base or bed plate of the press which supports the bracket 11 to which the die head 12 is rigidly secured by any suitable means such as by heavy bolts extending through holes or slots in the flanges 13 (see Figs. 2 and 5).

The sizing die 15 of suitably hardened steel is very rigidly secured in place, preferably by a pressed fit, as clearly shown in Fig. 1. The bushing 16 which is to be sized is dropped into place immediately in front of the die 15 through a suitable guide slot 17 and rests at the bottom of slot 17 upon a V-shaped support 18 so that it is aligned coaxially with the die 15. The reciprocating arbor 20 is co-axially aligned with the die 15 and is provided at its tip with a reduced diameter portion 21 which is readily inserted loosely through the bushing 16 and in this manner assists in guiding or aligning the bushing 16 with die 15. The portion 22 of arbor 20 is of slightly increased diameter and fits snugly but with sufficient clearance to prevent burnishing within the bushing 16 as the arbor 20 moves to the left, as viewed in Fig. 1, until the shoulder 23 of the arbor comes in contact with the edge of the bushing 16. However, before the portion 22 engages the bushing the enlarged portion 24 of the arbor 20 engages the guide 25 rigidly fixed to the head 12, and the portion 21 of the arbor engages the guide 26 and thus the arbor 20 is more accurately kept in absolute alignment with the die 15. After the shoulder 23 abuts the edge of bushing 16 further movement of arbor 20 to the left presses the bushing 16 through the die 15 and in so doing compresses the walls of the bushing between the die 15 and the portion 22 of the arbor beyond the

elastic limit of the material of which the bushing is composed. Hence when the bushing 16 has been pressed entirely through the die 15 into the open slot 30 the bushing will expand only a slight amount after the compressing pressure is removed. Thus the diameter of the die 15 and of the portion 22 of the arbor 20 determine the dimensions of the finished bushing, and the degree of compression of the walls of the bushing is determined by the dimensions of the bushing before it has been re-sized. The thickness of the walls of the bushing before re-sizing may be varied to vary the degree of compression to which the material of the bushing is subjected in the resizing operation. The high pressure exerted upon the inner surface of the bushing walls gives a very smooth surface which of course is highly advantageous when the bushing is to be used as a bearing. Furthermore, since there is no relative sliding of the arbor 20 within the bushing during the application of the pressure the porosity of the inner surface of the bushing will not be decreased.

Special means have been illustrated in the drawings for removing the bushing 16 from the arbor after it has passed through the die 15. For this purpose two spring pressed lugs 31 may be provided which extend laterally into the open slot 30, each lug 31 having a small beveled tip 32 which extends into the path of travel of bushing 16 as it is pressed through the die 15. When the bushing 16 strikes the beveled tips 32 the lugs 31 are pressed outward against the pressure of springs 33 to permit the bushing 16 to pass between the beveled tips 32 which slide along the surface of the bushing. When the bushing has traveled far enough the tips 32 snap behind the edge of the bushing and then when the arbor 20 is withdrawn the bushing 16 is held from backward motion by the lugs 31. As soon as the arbor is clear of the bushing 16 it will fall out through the open slot 30 as shown in dotted lines in Figs. 1 and 5. The beveled tips 32 are preferably arc-shaped while the lugs 31 may be round and held from rotating by small projecting pins 34 which ride in the small grooves 35, as will be readily understood. The springs 33 are slightly compressed and held in place by the small cover plates 36 secured by the screws 37.

It has been found however, that the spring lugs 31 may be dispensed with simply by providing a sharp inner edge 40 on the exit end of the die 15. The slight expansion of the bushing on emerging from die 15 will prevent the bushing from reentering the die when the arbor is withdrawn to the right as seen in Fig. 1. Also the slight expansion of the bushing will permit the easy withdrawal of the arbor from within the bushing.

While the machine illustrated in the drawings and described in detail herein may be used for carrying out the method of this invention, other machines may be devised for carrying out this same method and it is not intended that the invention be limited in any way other than by the scope of the appended claims.

What we claim is as follows:

1. A machine for sizing a compressible bushing, comprising in combination, an arbor having a portion upon which the bushing fits; a female die member having an aperture through which the arbor and bushing may be moved, said aperture being of lesser transverse diameter than the outside diameter of the bushing, the entrance edge of said aperture being rounded; means for supporting the arbor on each side of the bushing while the bushing is being moved through the female die member; and means for moving the arbor and its bushing through said die member.

2. A machine for sizing a compressible bushing, comprising in combination, an arbor providing three portions of varying diameters, the larger of which forms the main body of the arbor which is anchored to a movable member of the machine, the intermediate portion being smaller than the main body portion and upon which a bearing is adapted to fit so that its edge engages a shoulder formed between the body and intermediate portion, the third or free end portion being still smaller in diameter and providing a pilot for the arbor; a female die member having an aperture coaxial with the arbor for receiving the mandrel and its bushing, said aperture being slightly less in diameter than the outside diameter of the bushing and having a rounded entrance edge; supporting and guiding collars rigidly secured on opposite sides of the female die member and spaced therefrom for receiving the pilot and body portion of the arbor, respectively, to hold them in axial alignment with the aperture of said female die member while the bushing is being moved therethrough; and means for moving the arbor.

3. A machine for sizing a compressible bushing comprising, in combination, an arbor having a main supporting portion, a bushing receiving portion of smaller diameter than the main portion, thus providing a shoulder between said portions for engaging one end of the bushing, and a guiding portion of smaller diameter than the bushing receiving portion for holding the bushing in substantial alignment with the sizing die during the first part of the movement of said arbor; means connected with the main supporting portion for moving the arbor; a female die member through which bushing and arbor pass to compress the bushing around the arbor; and means for stripping the bushing from the arbor when the arbor is withdrawn from the die member.

4. A machine for sizing a compressible

bushing comprising, in combination, an arbor having a main supporting portion, a bushing receiving portion of smaller diameter than the main portion, thus providing a shoulder between said portions for engaging one end of the bushing, and a guiding portion of smaller diameter than the bushing receiving portion for holding the bushing in substantial alignment with the sizing die during the first part of the movement of said arbor; means connected with the main supporting portion for moving the arbor; a female die member through which bushing and arbor pass to compress the bushing around the arbor; and a lug resiliently urged toward the arbor for engaging the end of the bushing adjacent the shoulder in order to strip the bushing from the arbor.

5. The method of sizing a bushing of porous metallic material to a desired predetermined size, which consists in inserting therethrough an arbor having a diameter equal to the desired inner diameter of the bushing, then compressing the bushing on said arbor by passing the bushing through a die having the desired diameter while holding the bushing in fixed position relative to the arbor whereby burnishing of the inner surface of the bushing during the sizing operation is prevented.

6. The method of sizing a bushing of porous metallic material to a desired predetermined size which consists in inserting therethrough an arbor having a diameter equal to the desired inner diameter of the bushing, then moving the arbor to force the bushing through a die having substantially the desired outside diameter of the bushing and supporting the arbor on each side of the bushing during its movement.

In testimony whereof we hereto affix our signatures.

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CHARLES L. LEE.