Jan. 23, 1934. A. J. LANGHAMMER 1,944,246

SIZING APPARATUS

Filed Jan. 13, 1931 2 Sheets-Sheet 1

Fig. 5.

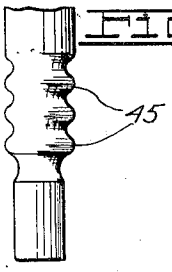


Fig. 6.

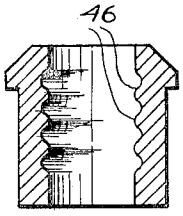


Fig. 1.

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Filed Jan. 13, 1931 2 Sheets-Sheet 2

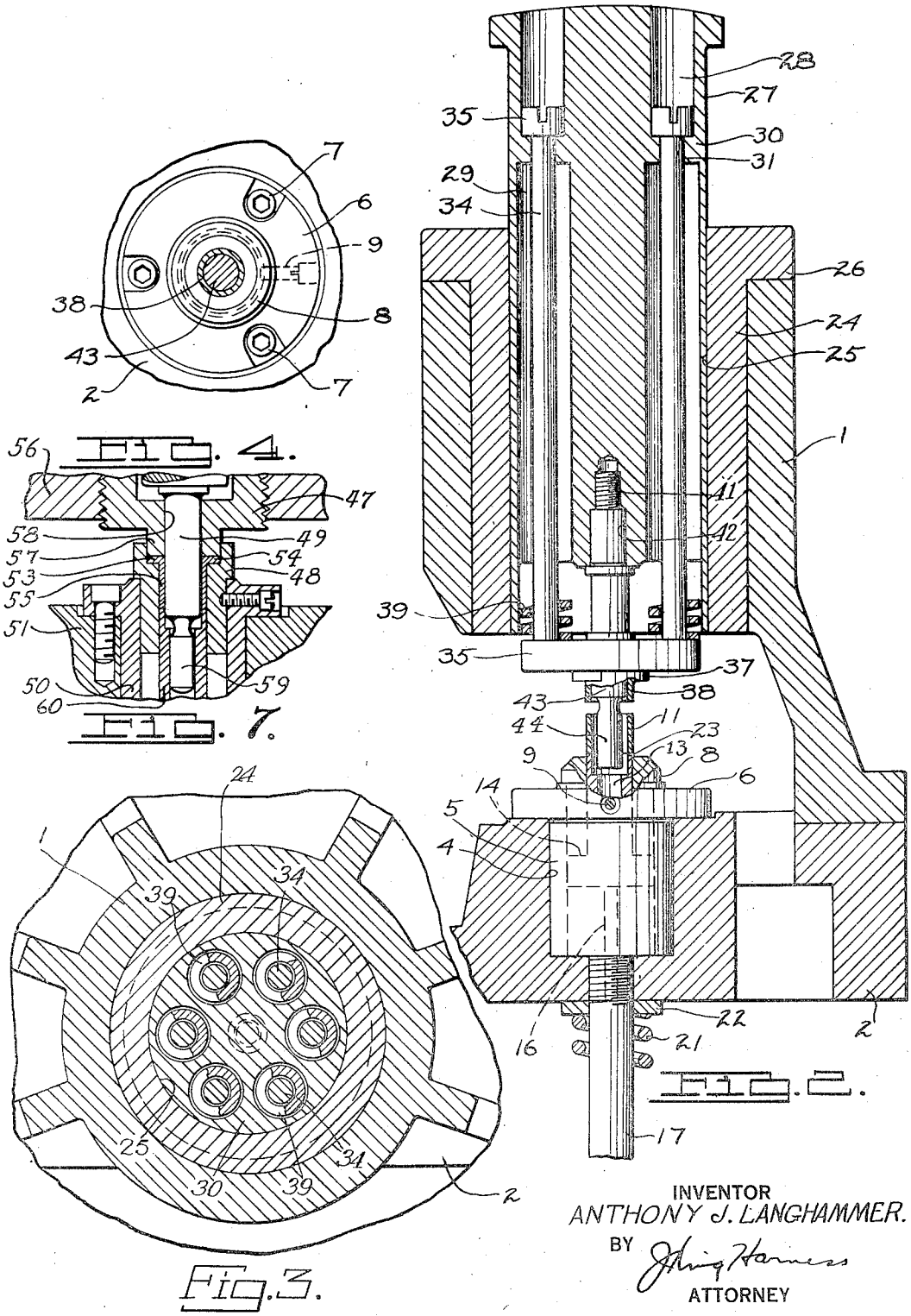


Fig. 4.

Fig. 7.

Fig. 2.

Fig. 3.

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SIZING APPARATUS

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11 Claims. (Cl. 29—90)

This invention relates to improved burnishing apparatus for sizing bushings, particularly journal bushings which are formed of porous metal.

In sizing bearing sleeves composed of either porous or impervious compositions, it is essential to produce inner and outer peripheries that are concentric within very close limits. This requirement necessitates accurate guiding of the movable sizing element during its insertion into the stationary sizing die and rigidity of the structure in which the sizing elements are supported. Precaution must also be taken in applying the force of the actuating mechanism upon the ram which carries the movable sizing die so as to avoid misalignment of the sizing parts during operation.

One of the primary objects of this invention is to provide improved apparatus for sizing bushings, particularly of the porous type, which is operable by a single action punching press of any type.

Further objects of this invention are to provide improved sizing apparatus which is adapted to simultaneously bring both the inner and outer diameters of a journal bushing to predetermined dimensions; to provide apparatus of this kind which forms inner and outer peripheries that are concentric within very close limits; to provide a rigid supporting structure of arch-shaped construction for retaining male and female sizing dies in axial alignment; to provide yieldable means in apparatus of this kind for initially pressing a bushing into a female sizing die with a predetermined pressure of moderately low amplitude so as to size the outer periphery thereof without crushing the unsupported length of the bushing; to provide means for positively forcing a sizing arbor into the interior of the bushing after it is received in the female sizing die so as to size the inner periphery of the bushing; to provide a guide for one end of the male sizing element which is extended into the female sizing die before the arbor is inserted into the bushing so as to accurately retain the arbor and female sizing die in concentric relation; to provide guiding means for the end of the arbor which also function before the arbor starts to pass into the bushing; and to provide apparatus for operating the yieldably and positively acting members in a predetermined timed relation so as to prevent insertion of the arbor before the walls of the bearing are supported externally in the female sizing element.

Other objects of the invention are to provide resilient means for yieldably forcing a bushing into a female sizing die that is adapted to bear between the latter and the structure upon which the arbor is supported so as to extract the arbor from the bushing; and to provide means which are energized by the yieldable member during insertion of the bushing into the female sizing die for discharging the bushing after the arbor is retracted.

Another object of the invention is to provide improved tools for burnishing both the inner and outer peripheries of bushings, which are particularly adapted for sizing bushings that are composed of sintered porous metal compositions.

An illustrative embodiment of the invention is shown in the accompanying drawings, in which:

Fig. 1 is a central vertical section of a burnishing machine which embodies my invention showing the position of the parts of the apparatus at the end of a sizing operation.

Fig. 2 is a central vertical section, taken at right angles to the section shown in Fig. 1, and illustrating the parts of the apparatus in condition for performing a sizing operation.

Fig. 3 is a transverse horizontal section taken on the line 3—3 of Fig. 1.

Fig. 4 is a transverse horizontal section taken on the line 4—4 of Fig. 1.

Fig. 5 is a side elevation of a burnishing arbor which embodies a further development of my invention.

Fig. 6 is a central vertical section of a female sizing die showing a still further development of the invention.

Fig. 7 is a fragmentary vertical section of a pair of dies, particularly adapted for sizing flanged bushings and which are operable by the mechanism shown in Figs. 1 to 4 inclusive.

In the form shown, my improved burnishing apparatus includes upper and lower supporting structures 1 and 2 which are rigidly attached together by bolts 3. Formed in the lower part 2 of the supporting structure is a cylindrical passage 4 in which a sleeve or die holder 5 is mounted. The die holder 5 has a radial flange 6 at its upper end which is seated upon the top surface of the supporting structure 2 and secured against displacement by bolts 7. Seated in the upper end of the die holder 5 is a female sizing die 8 of tubular shape which is held in the die holder by a set screw 9. The sizing die 8 has an accurately machined internal bore 10 of predetermined dimension for receiving a bushing 11.

Slidably mounted in the interior of the die holder 5 below the die 8 is a plunger 12 having a central pilot passage 13. The plunger 12 has an

enlarged head 14 which closely fits the interior of the die holder 5 and the head carries downwardly extending rods 15 which are slidably received in apertures 16 in the lower supporting structure 2. The apertures 16 are spaced around a downwardly extending post 17 which is screw threaded in an aperture 18 in the lower supporting structure. Threaded on the lower end of the post 17 is an adjustable nut 19 on which a washer 20 is seated. A spring 21 is held under compression between the washer 20 and a washer 22 which bears upon the lower extremities of the rods 15 so as to normally hold the plunger 12 in its uppermost position, shown in Fig. 2, wherein its upper beveled extremity 23 protrudes slightly beyond the upper extremity of the die 8 for receiving the bushing 11.

A sleeve 24 is mounted in a cylindrical passage 25 in the upper supporting structure 1 which is co-axial with the passage 4 of the lower supporting structure. This sleeve has a radial flange 26 on its outer end which is seated on the corresponding end of the upper supporting structure. Slidably mounted in the sleeve 24 is a ram 27 of cylindrical shape which is provided with a series of pairs of vertically aligned passages 28 and 29 which are radially spaced about its longitudinal axis. These passages are separated by a web 30 through which extends an aperture 31 that communicates with the upper and lower passages. A felt washer or gasket 32 is seated in a recess in the outer extremity of the flange 26 of the sleeve and held against displacement by a flat plate-like ring 33.

Slidably mounted in the aperture 31 in each web 30 is a bolt 34 having a head 35 located in the upper passage 28 and a shank and threaded end portion located in the lower passage 29. The lower extremities of the bolts 34 are threaded in a ring shaped cross head 35 on which is mounted a threaded bushing 36 that has a shoulder 37 and a protruding tubular element 38. The tubular element 38 is located in axial alignment with the die part and is receivable in the bore 10 thereof, as illustrated in Fig. 1. The shoulder 37 engages the upper extremity of the die 8 and limits downward movement of the cross head. Surrounding the shank portion of each bolt 34 is a helical compression spring 39 which bears between the cross head 35 and the web 30 of the ram 27. These springs normally urge the cross head downwardly in advance of the ram.

Adjustably threaded at 41 in a passage 42 which is formed at the central portion of the ram 27 is a sizing arbor 43. The arbor 43 is located in axial alignment with the sizing die 8 and is accurately machined so as to be receivable in the passage 10 of the die with a clearance between the peripheries of the passage and arbor equal to the thickness which is desired in the bushing. This arbor has a pilot 44 on its lower extremity which is received in the pilot passage 13 of the plunger 12 as the ram is urged downwardly.

The arbor 43 is at all times guided in the tubular element 38 and the arbor is not inserted into the bushing 11 until after the tubular element has been extended into the female sizing die 8. The pilot 44 is also received in the pilot passage 13 before the arbor enters the bushing. In this manner, the arbor 43 is guided at both ends during its insertion into the bushing and as a result, it is accurately held in axial alignment with the female sizing die so as to form closely concentric inner and outer peripheries.

In operation, a bushing to be sized is placed upon the beveled protruding extremity of the plunger 12 in the manner illustrated in Fig. 2, and the ram 27 is urged downwardly by any punching apparatus (not shown) which operates upon the head 45 of the ram. The head 45 is sealed upon the upper extremity 46 of the ram 27 which is slightly rounded for allowing the head to rock so as to apply the force of the operating apparatus axially upon the ram, thus preventing misalignment of the arbor with respect to the female sizing die.

During the initial downward movement of the ram 27, the protruding tubular element 38 on the cross head 35 engages the upper extremity of the bushing 11. Further movement of the ram places the springs 39 under compression so as to yieldably press the bushing into the female sizing die 8 against the retarding action of friction on the sides of the bushing and against the action of the spring 21. The tubular element enters the female die 8 and remains therein during sizing of the inner periphery of the bushing so as to retain the arbor in concentric relationship to the female sizing die. This guiding action, together with that of the pilot 44 which enters the pilot passage 13 before the arbor enters the bushing, assures concentricity of the resulting inner and outer peripheries of the bushing. As the bushing is inserted into the female die 8 by the yieldable pressing unit of the apparatus, the plunger 12 is moved downwardly to its lowermost position, shown in Fig. 1, and the spring 21 is energized. The springs 39 hold the cross head 35 in spaced relation to the lower end of the ram so as to retain the lower end of the arbor 43 within the tubular element 38 during insertion of the bushing into the female sizing dies and to prevent its insertion into the bushing while the sides thereof are unsupported by the female sizing die 8.

The dies 47 and 48 and the plunger 49, illustrated in the form of my invention shown in Fig. 7, are adapted to size flanged bushings. The lower die 48 is received in a socket or sleeve 50 which is mounted in a support 51, substantially identical to the support and sleeve, respectively shown in Figs. 1 and 2 and it is provided at its upper end with a recess 53 for receiving the flange 54 of a bushing 55. The upper die 47 is threaded on a cross head 56 of a fixture which is substantially identical to the fixture illustrated in Figs. 1 and 2, on which the cross head 35 is carried.

Formed on the lower end of the die 47 is a protruding collar or sleeve 57 that is provided with a passage 58 in which the upper end of the plunger or arbor 49 is guided. The protruding sleeve 57 is receivable in the end recess 53 of the female die 48 and it is adapted to size the thickness of the flange 54 to a predetermined dimension by compressing and compacting the material thereof. This protruding element closely fits within the walls of the end recess 53 and accurately positions the passage 58 and the arbor 49 in concentric relationship with respect to the female die 48.

The lower end of the plunger 49 is held in concentric relation to the female die 48 by a pilot pin 59 which is received in a pilot sleeve 60 that is slidably mounted in the socket 50 in the manner illustrated in Figs. 1 and 2. The bushing 55 is forced into the female die part 48 by engagement of the protruding sleeve 57 with the outer side of the flange 54 which is firmly compressed to a predetermined thickness between the inner walls of the recess and the extremity of the protruding sleeve. Then the plunger is inserted through

the bushing so as to size the inner periphery thereof.

With this construction, the pilot pin 59 enters the pilot sleeve 60 and the protruding sleeve 57 enters the end recess 53 before the plunger 49 is forced into the bushing, therefore the plunger is guided at both ends by elements which are accurately held in concentric relationship with respect to the female sizing die. In this way, the inner and outer diameters of the bushing are formed concentrically within very close limits.

Arbors of the type shown in Fig. 5 may be used in conjunction with the above apertures for sizing bushings of either porous or non-porous metals. This arbor includes a series of rings 45 which vary in diameter from a minimum at the lower end of the arbor to a maximum at the upper end thereof. With this tool a burnishing operation, closely resembling a broaching, may be performed.

The female sizing die, shown in Fig. 6, has a series of spaced, inwardly extending rings 46 which vary in inner diameter from a maximum at the upper end of the die to a minimum at the lower end of the die. This female sizing die may be used in conjunction with a plain cylindrical arbor of the type shown in Figs. 1 to 4, inclusive, or it may be used with a broach-like arbor of the type shown in Fig. 5. With the tools shown in Figs. 6 and 5, the outer and inner diameters of a bushing are gradually changed in dimension as the bushing is forced into the female die and as the arbor is passed into the bushing respectfully.

Although but several specific embodiments of this invention have herein been shown and described, it will be understood that various changes in the size, shape and arrangement of parts may be made without departing from the spirit of my invention and it is not my intention to limit its scope other than by the terms of the appended claims.

What I claim is:

1. Apparatus for burnishing bushings including a pair of spaced supports, a female sizing die on one of said supports, a ram slidably mounted on the other support, a sizing arbor mounted on said ram in axial alignment with said female sizing die, a member on said ram for pressing a bushing into said female sizing die, and means bearing between said ram and said member for yieldably holding an extremity of the latter in advance of said arbor until the bushing is fully inserted in said female sizing die and adapted to withdraw said sizing arbor from the interior of a bushing at the end of a sizing operation prior to the removal of said bushing from said female sizing die.

2. Apparatus for sizing the internal and external peripheries of a tubular article including a pair of supports, an element for sizing the external periphery of said article mounted on one of said supports, a member slidably mounted on the other support having an element for sizing the internal periphery of said article, means slidably mounted on said member for yieldably urging said article into the external sizing element and a resilient element bearing between said member and the means slidably mounted thereon for withdrawing said internal sizing element prior to removal of said article from said external sizing member, a sleeve slidably mounted in said external sizing element, and means including a spring normally yieldably holding an end of said sleeve in advance of an end of said external sizing element for positioning an article in registration with the interior thereof, said spring being adapted to urge said sleeve toward its normal position with sufficient force to remove said article from the external sizing element after the internal sizing member is retracted.

3. Apparatus for sizing the internal and external peripheries of a bushing including a pair of supports, an element on one of said supports for sizing the exterior of said bushing, a ram slidably mounted on the other support having a rigidly attached internal sizing element, a cross head shiftably mounted on said ram, and springs bearing between said ram and cross head for holding the latter in advance of said internal sizing element during insertion of said bushing into the external sizing element, said springs being adapted to extract said internal sizing element from said bushing.

4. Apparatus for sizing the internal and external peripheries of a bushing including a pair of supports, an element on one of said supports for sizing the exterior of said bushing, a ram slidably mounted on the other support, a cross head shiftably mounted on said ram having a member thereon for inserting a bushing into said external sizing element, springs bearing between said ram and cross head for yieldably holding the latter normally in advance of said internal sizing element, and means on said cross head and on one of said supports respectively for arresting the movement of said cross head when the bushing is fullly inserted in said external sizing element so as to permit the internal sizing element to protrude in advance of said cross head when said bushing is fully inserted.

5. Apparatus for burnishing bushings including a pair of spaced supports, a female sizing die on one of said supports for receiving a bushing, a ram slidably mounted on the other support having a male sizing die for insertion into said female sizing die, a member shiftably mounted on said ram having a guide insertable into said female sizing die for accurately holding said die in concentric relationship, and springs bearing between said ram and said member for projecting said guide into said female sizing die prior to insertion of said male sizing die into a bushing.

6. Apparatus for sizing the internal and external peripheries of a tubular article including a pair of supports, an element for sizing the external periphery of said article fixed on one of said supports, a member slidably mounted on the other support having an element for sizing the internal periphery of said article, means having a resilient member compressible during movement of said internal sizing element toward said article for inserting the latter into the outer periphery sizing element, and a guide on said means concentric with said internal sizing element and receivable in said external sizing element for retaining said sizing elements in concentric relationship, said guide being normally urged into said external sizing element by said resilient member prior to insertion of said internal sizing element into said article.

7. Apparatus for sizing the internal and external peripheries of a tubular article including a pair of supports, an element for sizing the external periphery of said article fixed on one of said supports, a member slidably mounted on the other support having an element for sizing the internal periphery of said article, and means having a resilient member compressible during movement of said internal sizing element toward said article for inserting the latter into the outer periphery sizing element.

8. Apparatus for burnishing the inner and out-

er peripheries of a tubular article including a pair of spaced supports, a member for sizing the outer periphery of said article on one of said supports, a member shiftably mounted on the other support having means for sizing the inner periphery of said article, means slidably mounted on said shiftable member engageable with said article, and a resilient element bearing between said means and said shiftable member for withdrawing said inner periphery sizing member and urging said means against said article so as to hold the latter against removal from said outer periphery sizing member during such withdrawing action.

9. Apparatus for burnishing the inner and outer peripheries of a tubular article including a pair of spaced supports, a member for sizing the outer periphery of said article on one of said supports, a member for sizing the inner periphery of said article slidably mounted on the other support, means for bearing between said outer and inner periphery sizing members including a resilient element compressible during insertion of said inner periphery sizing member into said article for withdrawing said inner periphery sizing member after the completion of a sizing operation and prior to removal of the article from said outer periphery sizing member, and ejecting means for discharging said article from said apparatus when the inner periphery sizing member is withdrawn.

10. Apparatus for sizing the internal and external peripheries of a tubular article including a pair of supports, an element for sizing the external periphery of said article fixed on one of said supports, a member slidably mounted on the other support having an element for sizing the internal periphery of said article, means slidably mounted on said member having a collar concentric with said internal sizing element and receivable in said external sizing element for retaining said sizing elements in concentric relationship, and springs bearing between said slidably mounted member and the shiftable means thereon for yieldably holding said collar in advance of said internal sizing element and adapted to insert said collar into said external sizing element prior to insertion of said internal sizing element into said tubular article.

11. Apparatus for sizing the internal and external peripheries of a tubular article including a pair of supports having substantially concentric passages therein, an element for sizing the external periphery of said article fixed in the passage of one of said supports, an ejecting member having a pilot bore therein slidably mounted in the passage of the latter support and having a peripheral portion closely fitting the inner periphery thereof for maintaining said pilot bore in concentric relation with the passages of said supports, a member slidably mounted in the passage of the other support having an internal sizing element, a collar slidably mounted on said shiftable member concentric with said internal sizing element and receivable in said external sizing element for maintaining one end of said internal sizing element concentric with said external sizing element, a pilot pin on said internal sizing element receivable in the pilot bore of said ejecting member for maintaining the other end of said internal sizing element concentric with said external sizing element, resilient means for urging said ejecting member outwardly and presenting the entrance to the pilot bore at the entrance of said external sizing element, and resilient means for inserting said collar into the entrance of said external sizing element in advance of said internal sizing element.

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