March 14, 1967 R. F. MOYER 3,308,524

METHOD OF MAKING A DIE BUSHING WITH A REPLACEABLE LINER

Filed Jan. 22, 1964

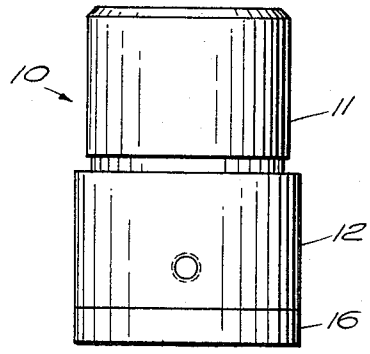


FIG. 1

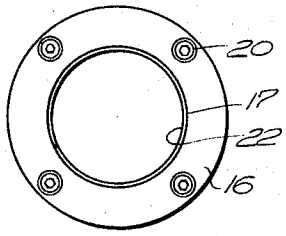


FIG. 2

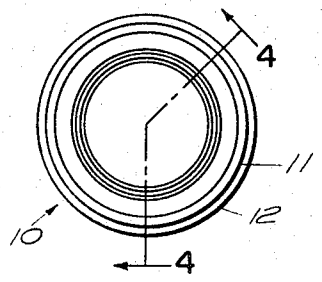


FIG. 3

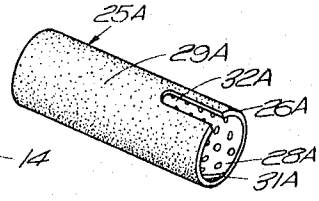


FIG. 6

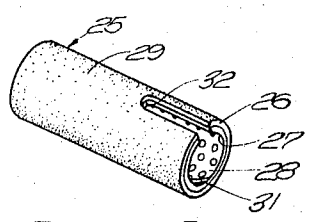


FIG. 5

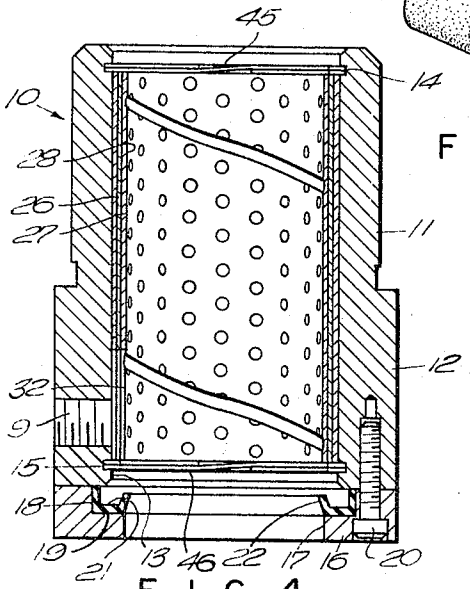


FIG. 4

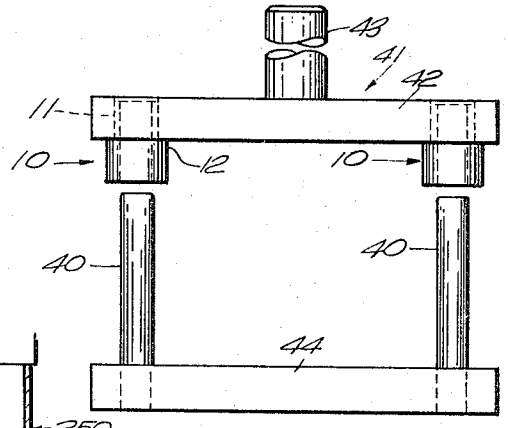


FIG. 7

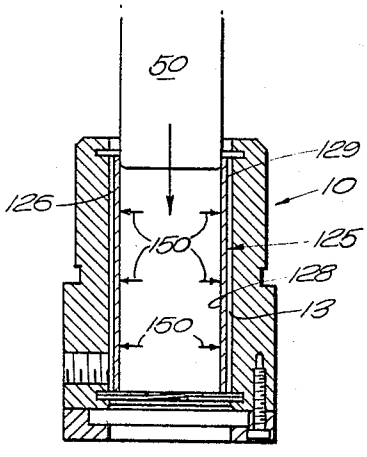


FIG. 8

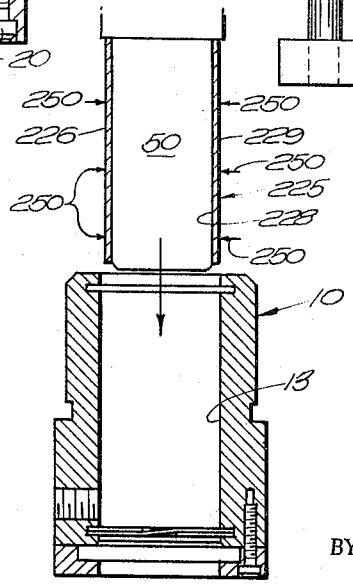


FIG. 9

INVENTOR.
ROBERT FRANKLIN MOYER
BY
William Frederick Werner
ATTORNEY

United States Patent Office 3,308,524
Patented Mar. 14, 1967



3,308,524

# METHOD OF MAKING A DIE BUSHING WITH A REPLACEABLE LINER

Robert Franklin Moyer, Warwick, R.I., assignor to Harsco Corporation, Harrisburg, Pa., a corporation of Delaware

Filed Jan. 22, 1964, Ser. No. 339,526
6 Claims. (Cl. 29—149.5)

This invention relates to die bushing liners and more particularly to die bushing liners which may be removed and replaced in die bushings and a method for fabricating said die bushing liners.

This case is a continuation-in-part of U.S. Patent No. 3,149,887, dated September 22, 1964.

One of the objects of the present invention is to provide a method of making a die bushing with a replaceable liner.

Another object is to provide a method for fabricating a die bushing liner.

In the conventional die set the upper or punch carrying plate is provided with either two or four bushings located in the corner areas of the upper plate. The lower or die carrying plate is provided with either two or four posts located in the corner areas of the lower plate.

The posts cooperatively mate with the bushings in the normal function of the die set as a punch press reciprocates the upper plate toward and away from the lower plate. The sliding movement of the bushing upon the mating post wears the bushing. The accuracy of the mating relationship is thereby destroyed. The accuracy of the mating relationship between the post and mating bushing determines the accuracy between the punch and die and therefore of the article produced by the punch and die.

As the bushings wear "play" develops between the post and mating bushing. Thus accurately and uniformly sized and shaped articles are no longer produced by the die set. In addition the "play" causes misalignment of the punch carrying plate with the die carrying plate, thereby, causing the punch to be misaligned with the die. As the punch press forces the punch against the die in misaligned relationship, the punch is broken or damaged and the die is damaged. The cost of producing punches and dies runs into many thousands of dollars.

It would appear to be a simple matter to provide a die bushing with a replaceable sleeve or liner when the bushing becomes worn and the accurate mating relationship between the post and bushing is destroyed. However, such is not the case because the reciprocating movement of the punch press causes heat to develop due to friction, in both the post and mating bushing. The heat generated in the bushing causes a liner to "freeze" or bind to the bushing, thereby destroying the purpose for which the liner was placed in the bushing, namely, to be removed and replaced when the inside diameter of the liner becomes worn.

As the punch and die mate during the work cycle, fine metallic dust and splinters are created. The dust and splinters are created from the action of the punch piercing the metal strip.

The dust and splinters find their way between the post and mating bushing. The heat generated by friction, the pressure of the punch press, and the dust and splinters combine to reduce the space or tolerance between the outside diameter of the post and the inside diameter of the bushing. Eventually the dust and splinter accumulation cause "galling" and/or welding of the post of the bushing. The post becomes frozen or jammed into the bushing. The punch press having a positive action, thereby causes an accident to the operative and destruction to the very valuable punch and die.



The present invention was created to alleviate all of these undesirable and costly conditions in a die set by providing a liner which may be removed from the bushing, regardless of the adverse conditions under which the die set functions.

Other objects of the present invention will become apparent in part and be pointed out in part in the following specification and claims.

Referring to the drawings in which similar characters of reference indicate corresponding part in all the figures:

FIGURE 1 is a side elevational view of the new and improved die bushing provided with a removable liner.

FIGURE 2 is a top plan view of FIGURE 1.

FIGURE 3 is a bottom plan view of FIGURE 1.

FIGURE 4 is a vertical cross sectional view taken on line 4—4 of FIGURE 2.

FIGURE 5 is a perspective view of a liner fabricated from a bimetallic material.

FIGURE 6 is a perspective view of a liner fabricated from a single metallic material.

FIGURE 7 is a side elevational view of a die set provided with the new and improved die bushing liners.

FIGURE 8 is a cross sectional view of a die bushing taken along line 8—8 of FIGURE 1, in the process of having a liner placed therein.

FIGURE 9 is a cross sectional view of a die bushing similar to FIGURE 8 indicating another method of placing a liner therein.

In proceeding with this invention reference is made to all figures in the drawing. A die bushing fabricated of steel, generally indicated by reference numeral **10**, consists of a cylindrical body, externally provided with a reduced diameter **11** terminating in a flange **12**. Internally, die bushing **10** is provided with an axial bore **13** and two grooves **14** and **15** adjacent opposite ends of said die bushing **10** (see FIGURE 4). Die bushing **10** may be provided with a tapped hole **9**. Said cylindrical body constituting a supporting shell.

A liner, cylindrical in form, generally indicated by reference numeral **25**, may be fabricated from a bimetallic element as shown in FIGURE 5 or a single metallic element as shown in FIGURE 6 by **25A**. Referring to FIGURE 5, a layer of bearing metal **27** is laminated to a sheet of steel **26**. The bimetallic laminated sheet is cut into strips which are formed into a round or cylindrical shape and brazed to provide a permanent cylinder. The steel outside diameter **26** of liner **25** is ground to a precision size. The internal diameter **28** of bearing metal is reamed to a precision size.

The outside diameter **26** of the liner **25** in FIGURE 5 and the outside diameter **26A** of liner **25A** in FIGURE 6 is then subjected to an electrolytic coating of a nonferrous metal such as copper or a steam pressure application of cadmium **29** in FIGURE 5 and **29A** in FIGURE 6. Preferably the coating is kept to approximately five ten-thousandths of an inch in thickness thus limiting the increase in outside diameter of the liner to approximately one-thousandth of an inch.

The internal diameters **28** and **28A** may be provided with an oil groove **31** and **31A** respectively. Both liners **25** and **25A** may be provided with slots **32** and **32A** respectively for purposes which will presently appear.

The difference between the diameter of the axial bore **13** and the outside diameters **26** or **26A** is preferably approximately one thousandth of an inch after the coating **29** or **29A** is applied. Both liners **25** and **25A** are placed or forced into axial bore **13**. The copper or cadmium coatings **29** or **29A** serve two functions. The first function is as an insulating medium between the steel of the die bushing **10** and the main material of the liners. Should the die bushing **10** steel and the liner material engage, they could rust into position and be jammed or frozen

permanently or they could gall together due to frictional heat.

The second and most important function served by the copper or cadmium coatings 29 or 29A is its cooperative function as a "backing up fuller." The coating 29 compensates for irregularities in either axial bore 13 or outside diameters 26 or 26A when they unite, thus preserving the vital size and concentric shape of the inside diameters 28 and 28A so vital to the proper function of the post 40 and the die set.

Two preferred ways of fitting liners to die bushings are illustrated in FIGURES 8 and 9. These liners are indicated by the numerals 125 and 225 in FIGURES 8 and 9 respectively.

In FIGURE 9 liner 225 prior to being pressed into axial bore 13, is placed upon a gage or aligning post 50. The gage or aligning post 50 is provided with an exacting outside diameter. The highest skill of the tool making art plus precision machinery is needed to provide the exacting outside diameter.

The gage or aligning post 50 is placed within internal diameter 228 with a slight slop in the fit. With the coating 229 the outside diameter 226 of the liner 225 is slightly larger than the interior diameter of bore 13 of the bushing 10. The aligning post 50 then forces liner 225 into die bushing 10 with the copper coating 29 engaging the steel surface of axial bore 13. Because of its slight oversize the liner 225 is squeezed down onto post 50 as it is pressed into the bushing 10. During this procedure the coating 229 acts as a lubricant. The arrows 250 illustrate the inward pressing of the liner during this procedure.

It is well known in the art, that is is impossible for all practical and commercial and manufacturing purposes, to fabricate the inside diameter of one member and the outside diameter of a mating member to absolute zero variation. The variation is called tolerance. The tolerance between a one inch diameter gage post an the inside diameter of a mating bushing liner is normally between three ten thousandths of an inch and four ten thousandths of an inch. In a two inch diameter gage post the tolerance between a mating bushing liner would normally be between five ten-thousandths and eight ten-thousandths of an inch.

In another approach the aligning post 50, in FIGURE 8, as it is forced into liner 125 while in position within die bushing 10, causes the liner 125, which is slightly smaller in its internal diameter 128 than the outside diameter of the post 50 to increase in size as shown by arrows 150 to fit properly within the bore 13. The coating 129, which is softer than the steel of either bushing 10 or liner 125, accommodates itself to tolerance variation, so that, any tolerance variation between axial bore 13 and outside diameter 126 of liner 125 is not reflected in the dimension of the inside diameter 128 of liner 125. If the coating 129 is not applied a tolerance variation may be present in the inside diameter 128 due to misalignment, to the detriment of the proper funtcioning of the mating die set post (See FIGURE 7.)

A collar 16 (see FIGURE 4) provided with an axial passageway 17 and a shelf consisting of a cylindrical wall 18 and a wall 19 at right angles to said cylindrical wall 18 is removably secured to one end of die bushing 10 by means of screws 20. Said axial passageway 17 having a diameter larger than internal diameter 28. A wiping ring 21 is fixed in position between the shelf and the end of die bushing 10. Wiping ring 21 is shaped to lie against cylindrical wall 18 and wall 19 with a flexible tongue 22 overlying axial passageway 17.

A die set generally indicated by reference numeral 41, (see FIGURE 7) consists of an upper or punch carrying plate 42 provided with a punch press attaching stem 43 and a die carrying plate 44 normally secured to the bed of a punch press. The punch carrying plate 42 is provided (as illustrated) with two bushing receiving orifices into which the reduced diameters 11 of the die bushings 10 are forced with a "drive fit." The die carrying plate 44 is adapted to have die posts 40 secured therein.



In nomal punch press operation die posts 40 slidingly engage the inside diameters 28 of liners 25 secured in die bushings 10, for example, by means of snap rings 45, 46 located in grooves 14, 15, respectively. Lubricating oil may be passed through tapped hole 9, through slot 32 into oil groove 31. The film of oil coating inside diameter 28 will be approximately one ten-throusandth of an inch thick. Thus, the precision and magnitude of the very slight tolerances or variations of the parts constituting the present invention can be understood and appreciated.

Having shown and described various embodiments of the present invention by way of example, it should be realized that structural changes could be made and other examples given without departing from either the spirit or scope of this invention.

What I claim is:

1. A method of fabricating a substantially cylindrical die bushing containing a liner in an axial bore thereof comprising the steps of forming a cylindrical liner member of bimetallic laminate material having an outer steel shell and an inner layer of bearing metal which is softer than said steel, coating the outer surface of the outer steel shell with a layer of non-ferrous metal having a thickness in the order of five ten-thousandths of an inch, placing said liner member on a gage post having a standard outside diameter, the internal diameter of said liner member being larger than the outside diameter of said post to a limit of .04% of the outside diameter of said post, forcing said liner member into said bore of said bushing by means of said gage post whereby said layer of non-ferrous metal is caused to conform to any variations present in said bore, removing said gage post and inserting locking means at each end of said liner for retaining said liner in said bushing.

2. A method of fabricating a substantially cylindrical die bushing containing a liner in an axial bore thereof comprising the steps of forming a hollow cylindrical liner member containing an inner surface of bearing metal, coating the outer surface of said liner member with a layer of non-ferrous metal having a thickness in the order of five ten-thousandths of an inch, placing said liner member on a gage post having a standard outside diameter which is slightly smaller than the internal diameter of said liner, forcing said liner member, which has an outside diameter slightly larger than the internal diameter of said bore of said die bushing, into said bore by means of said gage post whereby said bore compresses said liner about said gage post to properly size said liner and said outer layer of non-ferrous metal on said liner acts as a lubricant and is caused to conform to any variations present in said bore, removing said gage post and locking said liner in place.

3. A method according to claim 2 wherein the differences between the outside diameter of said gage post and the internal diameter of said liner, also between the outside diameter of said liner and the internal diameter of said bore of said die bushing is on the order of .04% of the outside diameter of said gage post.

4. A method of fabricating a substantially cylindrical die bushing containing a liner in an axial bore thereof comprising the steps of forming a hollow cylindrical liner member having an interior bore containing an inner surface of bearing metal, coating the outer surface of said liner member with a layer of non-ferrous metal having a thickness in the order of five ten-thousandths of an inch, placing said liner member within said bore of said die bushing which bore has an internal diameter slightly larger than the external diameter of said liner, forcing a gage post having a standard outside diameter which is slightly larger than the interior bore of said liner member whereby said gage post expands said liner into firm engagement with the bore of said die bushing with said

outer layer of non-ferrous metal conforming to any variations present in said bore, and said liner is properly sized on said gage post, removing said gage post and locking said liner in place.

5. A method according to claim 4 wherein the differences between the internal diameter of said bore of die bushing and the external diameter of said liner, also between the outside diameter of said gage post and the interior diameter of said interior bore of said liner member is on the order of .04% of the outside diameter of said gage post.

6. A method of fabricating a substantially cylindrical die bushing containing a liner in an axial bore thereof comprising the steps of forming a hollow cylindrical liner member having an interior bore containing an inner surface of bearing metal, coating the outer surface of said liner member with a layer of non-ferrous metal having a thickness in the order of five ten-thousandths of an inch, utilizing a gage post having a standard outside diameter



to force said liner into a proper desired size within said die bushing with said outer layer of non-ferrous metal being squeezed between said liner and said die bushing and conforming to any irregularities in the bore of said die bushing, removing said gage post and locking said liner in place.

**References Cited by the Examiner**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,274,961 | 3/1942 | Horger | 29—458 |
| 2,646,824 | 7/1953 | Johnson | 29—149.5 |
| 2,751,260 | 6/1956 | Janizewski | 308—4 |
| 2,855,666 | 10/1958 | Gleitz | 29—525 |
| 3,039,829 | 6/1962 | Onulak | 308—4 |
| 3,149,887 | 9/1964 | Moyer | 308—3.5 |

JOHN F. CAMPBELL, *Primary Examiner.*

THOMAS H. EAGER, *Examiner.*