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COMPRESSIBLE MEANS FOR BUSHINGS

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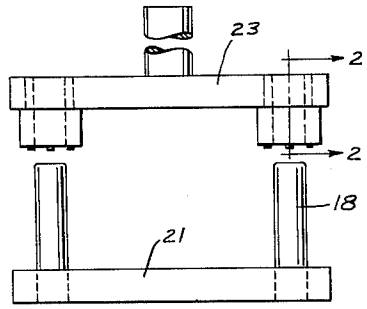


Fig 1

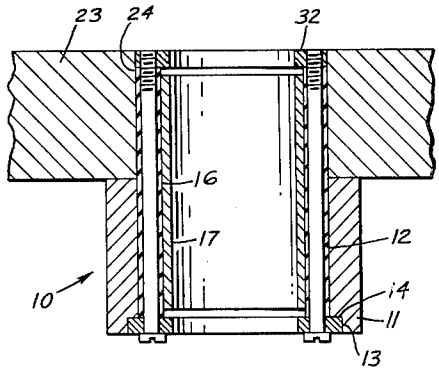


Fig 2

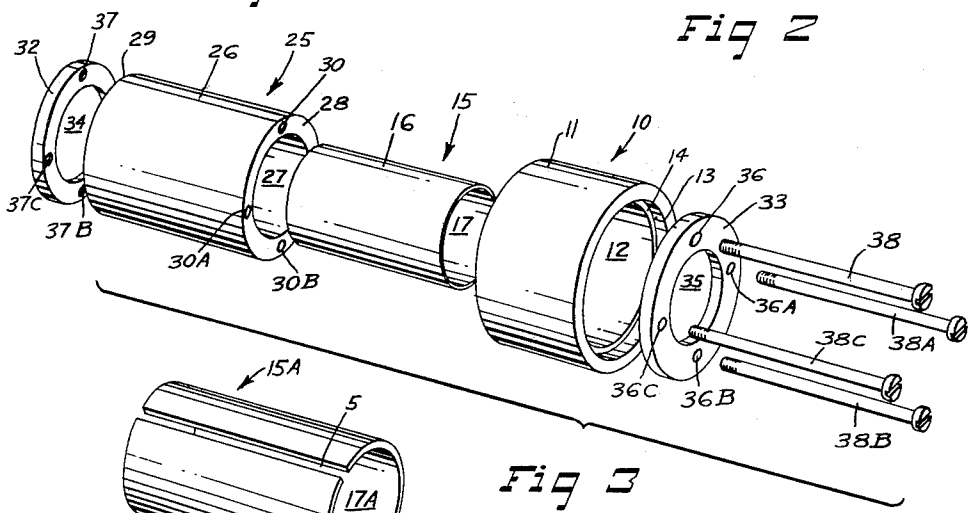


Fig 3

Fig 5

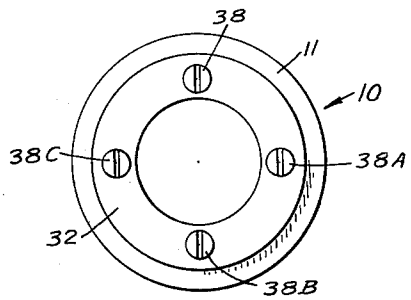


Fig 4

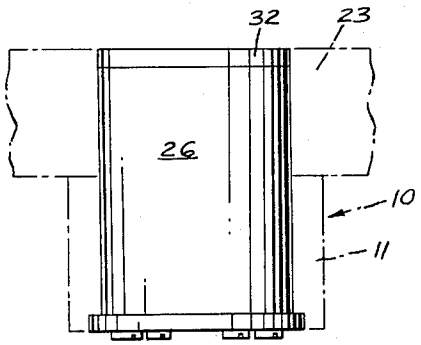


Fig 6

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COMPRESSIBLE MEANS FOR BUSHINGS

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This invention relates to compressible means for bushings and more particularly to means for compressing and thereby reducing the inside diameter of a liner in a die set.

One of the objects of the present invention is to provide a means for uniform circumferential reduction of the inside diameter of the liner in a die bushing.

Another object of the present invention is to provide a means for readily replacing the liner in a die bushing.

And still another object of the present invention is to provide means for adjusting the internal diameter of the liner in a die bushing whereby the mating relationship, between the liner and slidingly engaging mating post, is adjusted especially in a manner to compensate for wear.

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 slidingly engaging or mating posts located in the corresponding corner areas of the lower plate.

As the punch press, in which the die set is secured, reciprocates, the upper plate moves toward and away from the lower plate. This movement causes the die bushings to slide up and down on the stationary post. This 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 mating of the punch with the die and therefore of the article produced by the punch and die. As the wear increases, the punch misaligns with the die until the wear and misalignment become sufficiently great to cause a clash of the punch with the die. Thus, the punch is broken; the die damaged and production is stopped. The resulting economic loss is great.

It would appear to be a simple matter to provide a die bushing with a replaceable sleeve and 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 the 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, clearance or tolerance between the outside diameter of the post and the inside diameter of the bushing. Eventually the dust and splinter accumulation causes "gaulling" and/or welding of the post to 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 obviate all of these undesirable and costly conditions in a die set by

providing a liner which may be varied as to its inside diameter and 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 parts in all the figures:

FIGURE 1 is a side elevational view of a conventional die set provided with the new and improved compressible means for bushings.

FIGURE 2 is a vertical cross sectional view taken on line 2—2 of FIGURE 1.

FIGURE 3 is an exploded perspective view of the new and improved compressible means for bushings.

FIGURE 4 is a bottom plan view of FIGURE 2 with the punch carrying plate removed.

FIGURE 5 is a perspective view of a modified form of liner.

FIGURE 6 is a side elevational view of the new and improved compressible means for bushings.

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 **11**. Internally, die bushing **10** is provided with a cylindrical axial bore **12**, and a cylindrical recess **13** which forms a cylindrical shoulder **14**.

A cylindrical liner, generally indicated by reference numeral **15**, is provided with an outside diameter **16** and an inside diameter **17**. Liner **15** may be fabricated from bronze bushing material. The inside diameter is manufactured with an extremely accurate dimension.

The inside diameter **17** of liner **15** slidingly engages the outside diameter of post **18**. When a post **18** having a one inch diameter is used, then the inside diameter **17** of liner **15** is between two ten thousandths of an inch and five ten thousandths of an inch larger than the outside diameter dimension of mating post **18**.

When a post **18** having a three inch diameter is used, then the inside diameter **17** of liner **15** is between six ten thousandths and one thousandth of an inch larger than the outside diameter dimension of mating post **18**.

A cylindrical sleeve, generally indicated by reference numeral **25**, is provided with an outside diameter **26**, a cylindrical bore **27**, and opposite end faces **28**, **29**. A plurality of transverse clearance orifices **30**, **30A**, **30B** etc., are provided longitudinally in cylindrical sleeve **25**. The clearance orifices **30** are illustrated as four in number but they could be any plurality, two, three or more in number.

Cylindrical sleeve **25** is fabricated from elastic material, preferably from the group of chemical compounds known as polyeurothane and especially the material known as "Elasta Cast." Such material permits collar **25** to act as a compressible locking piece. As will presently appear, collar **25** is so constructed that, when means holding the sides of collar **25** are tightened, the compressible locking collar **25** will expand outwardly to frictionally engage axial bore **12**. As axial bore **12** sets up a resistance to the further expansion of compressible locking collar **25**, said collar **25** contracts to frictionally grip and compress liner **15** through the engagement of bore **27** with outside diameter **16**.

It is not enough that cylindrical sleeve **25** expand outwardly and contract inwardly. The expansion and contraction must be circumferentially uniform. The inward action of compression must not be elongated or elliptical or act on one area of the inner circumference with greater force than another area. Many elastic or resilient materials will do just that when endwise thrust is

applied to them. There are materials which react uniformly and "Elastacast" is one of them.

Two side or ring members 32, 33 are provided; fabricated from rigid material such as steel. Side or ring members 32, 33 are provided with cylindrical axial passageways 34, 35, respectively. Ring member 33 is provided with clearance orifices, 36, 36A, 36B, etc., axially aligned with clearance orifices 30, 30A, 30B, etc. Ring member 32 is provided with threaded orifices 37, 37A, 37B, etc., axially aligned with clearance orifices 30, 30A, 30B, etc. Bolts 38, 38A, 38B, etc., are adapted to pass through clearance orifices and rotatively engage the respective threaded orifices 37, 37A, 37B, etc., whereby ring members 32, 33 abutting end faces 29, 28, respectively, draw ring members 32, 33 toward or away from each other to apply more or less pressure upon elastic cylindrical sleeve 25. Liner 15 located in elastic cylindrical sleeve 25 with outside diameter 16 engaging the wall of bore 27 and outside diameter 26 engaging axial bore 12 are thereby subjected to the pressure created in elastic cylindrical sleeve 25.

The conventional die set comprises a punch carrying or upper plate 23 provided with a stem 22 used as the fastening means of securing plate 23 to the movable arm of a punch press (not shown); and a die carrying or lower plate 21 secured to the bed of a punch press (not shown). Die carrying plate 21 is provided with a plurality of posts 18. Punch carrying plate 23 is provided with an equal plurality of bores 24 adapted to accommodate a plurality of mating bushings 10.

In assembling the component parts illustrated in FIGURE 3 into the working relationship shown in FIGURES 1, 2 and 6, liner 15 is placed in bore 27 with outside diameter 16 engaging the wall or surface of bore 27.

Ring member 33 is placed in cylindrical recess 13 abutting cylindrical shoulder 14. Cylindrical sleeve 25 is placed in axial bore 12 with end face 28 abutting ring member 33 and thereby projecting beyond the end of die bushing 10. Ring member 32 is then brought against end face 29. The various clearance orifices 36, etc., 30, etc.,and threaded orifices 37, etc., are placed in lateral alignment so that bolts 38, etc., may pass through clearance orifices 36, etc., 30, etc., and be rotatively engaged with threaded orifices 37, etc., whereby ring members 32, 33 squeeze or compress, endwise, cylindrical sleeve 25. Before this compression exceeds a very slight amount, the extended or exposed end of cylindrical sleeve 25 is inserted into a bore 24 provided in punch carrying plate 23. Bolts 38 are then rotated to draw ring members 32, 33 toward each other to compress compressible locking collar 25 an amount sufficient to expand said collar into a binding relation between outside diameter 26 with axial bore 12 and bore 24. Punch carrying plate 23 and die bushing 10 are fabricated from steel. The walls of axial bore 12 and bore 24 act as a backstop for the expansion of compressible locking collar 25. Therefore, these walls stop the expansion of compressible locking collar 25 and convert the expansion into contraction as ring members are drawn toward each other. In this manner bore 27 contracts or squeezes outside diameter 16 to grip liner 15. If this contraction or squeezing action is sufficiently great, the inside diameter 17 will be reduced an amount permitted by the inherent resiliency of liner 25. In a liner 15 fabricated from bronze material the inside diameter 17 may be reduced as much as one thousandth (.001) of an inch. This amount is sufficiently great to take up wear and to permit an adjustment between the inside diameter 17 and the outside diameter of mating post 18. Thus the economic life of the liner 15 is prolonged and savings are made in manufacturing costs used to create the critical mating relationship between liner 15 and post 18. In addition the expansion and contraction characteristics of compressible locking collar 25 permit the easy removal of said collar from axial bore 12 and bore 24; thus facilitating the replacement of line 15 after it has become unduly worn.

FIGURE 5 illustrates a liner 15A provided with a slit 5 which would permit a reduction of more than one thousandth of an inch in inside diameter 17A. However, it will readily be observed that liner 15A could be squeezed an amount sufficient to cause inside diameter 17A to become oval in shape instead of concentric. This is an undesirable and unsatisfactory condition as inside diameter 17A must be concentric to the outside diameter of post 18 for a satisfactory mating relationship having a critical tolerance relationship.

Having shown and described a preferred embodiment 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. In a die set having in combination a punch carrying plate provided with a plurality of bushing holding orifices and a cooperating die carrying plate provided with a plurality of mating posts for aligning the punch carrying plate with the die carrying plate, that improvement in said bushings which consists of a cylindrical body having a cylindrical axial bore, a cylindrical liner having a cylindrical inside diameter and an outside diameter, a resilient cylindrical sleeve consisting of a cylindrical bore, an outside diameter and opposite end faces, said cylindrical liner located within said resilient cylindrical sleeve, a first ring member provided with a cylindrical axial passageway, a second ring member provided with a cylindrical axial passageway, said first and second ring members abutting, respectively, said opposite end faces, with said cylindrical axial passageways in axial alignment with said cylindrical inside diameter, said first and second ring members fabricated from rigid material, said resilient cylindrical sleeve having one portion of said outside diameter located in one of said plurality of bushing holding orifices and the remaining portion of said outside diameter located in said axial bore and means to move said first and second ring members toward and away from each other, whereby said outside diameter removably secures both said cylindrical body to said punch carrying plate and said cylindrical liner to said cylindrical axial bore.

2. In a die set having in combination a punch carrying plate provided with a plurality of bushing holding orifices and a cooperating die carrying plate provided with a plurality of mating posts for aligning the punch carrying plate with the die carrying plate, that improvement in said bushings which consists of a cylindrical body having an axial bore, a cylindrical liner having an inside diameter, and an outside diameter, a resilient cylindrical sleeve consisting of a bore, an outside diameter and opposite end faces, said cylindrical liner located within said resilient cylindrical sleeve, a first ring member provided with an axial passageway, a second ring member provided with an axial passageway, said first and second ring members abutting, respectively, said opposite end faces, with said axial passageways in axial alignment with said inside diameter, said first and second ring members fabricated from rigid material, said resilient cylindrical sleeve having one portion of said outside diameter located in one of said plurality of bushing holding orifices and the remaining portion of said outside diameter located in said axial bore and means to move said first and second ring members toward and away from each other, whereby said outside diameter removably secures both said cylindrical body to said punch carrying plate and said cylindrical liner to said cylindrical axial bore, with the inside diameter of said cylindrical liner uniformly varying in diameter in direct proportion to the force exerted by said resilient cylindrical sleeve upon said cylindrical liner.

3. In a die set having in combination a punch carrying plate provided with a plurality of bushing holding orifices and a cooperating die carrying plate provided with a plurality of mating posts for aligning the punch

carrying plate with the die carrying plate, that improvement in said bushings which consists of a cylindrical body having an axial bore, a cylindrical liner having an inside diameter, and an outside diameter, a longitudinal slit in said outside diameter, a resilient cylindrical sleeve consisting of a bore, an outside diameter and opposite end faces, said cylindrical liner located within said resilient cylindrical sleeve, a first ring member provided with an axial passageway, a second ring member provided with an axial passageway, said first and second ring members abutting, respectively, said opposite end faces, with said axial passageways in axial alignment with said inside diameter, said first and second ring members fabricated from rigid material, said resilient cylindrical sleeve having one portion of said outside diameter located in one of said plurality of bushing holding orifices and the remaining portion of said outside diameter located in said axial bore and means to move said first and second ring members toward and away from each other, whereby said outside diameter removably secures both said cylindrical body to said punch carrying plate and said cylindrical liner to said cylindrical axial bore, with the inside diameter of said cylindrical liner uniformly varying in diameter in direct proportion to the force exerted by said resilient cylindrical sleeve upon said cylindrical liner.

4. In a die set having in combination a punch carrying plate provided with a plurality of bushing holding orifices and a cooperating die carrying plate provided with a plurality of mating posts for aligning the die carrying plate with the punch carrying plate, that improvement in said bushings which consists of a cylindrical body having an axial bore and an axial cylindrical recess forming a shoulder, a cylindrical liner having an inside diameter, and an outside diameter, a cylindrical sleeve fabricated from elastic material, consisting of a bore, an outside diameter and opposite end faces, a plurality of clearance orifices provided longitudinally in said cylindrical sleeve, said cylindrical liner located within said cylindrical sleeve with said outside diameter engaging said bore, said cylindrical sleeve positioned with portion of the outside diameter located in one of said plurality of bushing holding orifices, and the remaining portion of the outside diameter located in said axial bore, a first ring member having an axial passageway and a plurality of clearance orifices axially aligned with said first mentioned clearance orifices, said ring member fabricated of rigid material and located in said axial cylindrical recess and abutting said shoulder and engaging one of said end faces, a second ring member having an axial passageway and a plurality of tapped orifices axially aligned with the aforementioned clearance orifices, said ring member fabricated of rigid material and axially aligned with said inside diameter and abutting the other of said opposite end faces, and a plurality of bolts located, respectively, in said plurality of clearance orifices and rotatively mounted, respectively in said tapped orifices, whereby rotation of said studs moves said ring members toward and away from each other to cause said cylindrical sleeve to expand outwardly to engage and be limited in expansion movement by said axial bore and said bore and to contract to grasp and squeeze the outside diameter of said cylindrical liner.

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