HARDENING COATING FOR THREAD ROLLING DIES

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References Cited

UNITED STATES PATENTS

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2,753,261 7/1956 Goetzel 72/469

3,217,530 11/1965 Sato 72/88

3,405,545 10/1968 Orlomoski 72/469

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ABSTRACT

A thread rolling die is disclosed for threading a generally cylindrical bolt or screw blank. Such die is characterized by a thin electric arc-applied coating of a hard metal or a carbide of a hard metal which coating is applied only to the gripping surfaces of the die. The thread forming or extrusion surfaces remain substantially free of such coating. The present invention relates to the die and to the method for increasing the useful life thereof.

5 Claims, 3 Drawing Figures
HARDENING COATING FOR THREAD ROLLING DIES

BACKGROUND OF THE INVENTION

This invention relates generally to thread rolling dies and more particularly to thread rolling dies which are provided with a nodularized carbide coating on selected blank engaging surfaces. In general, the coating is applied by a sputtering technique utilizing a rotating electrode formed of a hardened metal carbide, e.g., tungsten or silicon or chromium carbide.

PRIOR ART

Thread rolling dies of various types are known. Such dies fall generally into two categories; flat dies which reciprocate with respect to each other and rotary dies which may either rotate or oscillate with respect to each other.

In the past, various types of steel have been used to form thread rolling dies and such steel has been provided with various types of heat treatment or the like to improve the die life by reducing the rate of wear. In addition, in such dies various arrangements have been utilized to provide improved blank control. For example, serrations are often provided on dies to reduce or eliminate slippage during the rolling operation. Proper control of the blank tends to produce an improved product and also tends to improve the die life.

The dies in accordance with the present invention may be of any of the usual types. However, the present invention as illustrated is particularly suited to cut-off type thread rolling dies used to form gimlet pointed screws, such as sheet metal screws. Typical examples of such dies of the prior art are illustrated in the patent to Yankee, U.S. Pat. No. 3,654,800; the patents to Orlomosky, U.S. Pat. Nos. 3,538,739 and 3,538,740; the patent to Mau et al., U.S. Pat. No. 3,176,491, reissued as U.S. Pat. No. Re. 26,518.

SUMMARY OF THE INVENTION

It has now been found that by providing a nodularized hard metal or metal carbide surface on the blank gripping surfaces of the thread rolling dies, tool life may be improved by from 50% to 100%. Additionally, and most unexpectedly, it has been found that the range of materials which can be handled by thread rolling techniques has been extended. For example, aircraft bolts may now be formed by thread rolling techniques whereas heretofore the nature of the materials and the quality required has normally necessitated their manufacture by other means.

Briefly stated, the present invention is in a thread rolling die for use in forming a threaded screw from a blank having a generally cylindrical shank. The thread forming means comprise a projecting root-forming portion which in the illustrated embodiment is flattened, a recessed crest-forming portion, and thread side-forming portions joining the root and crest-forming portions. The projecting flattened root-forming portions are provided with a nodularized hard metal or hard metal carbide surface, and the surface of the crest and thread side-forming portions are maintained substantially free of the nodularized metal or metal carbide. In the preferred embodiment, the metal carbide is tungsten carbide.

The method of the present invention contemplates connecting the die to one side of a source of electric current, preferably A.C., and a rotating electrically charged electrode material to the other side of such electrical energy source. At a voltage of from about 15 to 40 volts and an amperage of from about 15 to 20 amps, an electric arc between the die surface and the tip of the rotating electrode is struck, and deposition of electrode material onto the die surface occurs as a rough or nodularized thin coating adhered as in the case of any weldment. No coating is deposited in the groove in the die surface. The rotating electrode is conveniently cooled with a suitable cooling medium, i.e., air, during the application of the coating. Deposition of the coating material occurs only where the die surface is confronted by the electrode, and there is no throwing or flowing of the molten electrode material into the grooves in such a way as to cause adhesion to the die metal in those regions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of one die of a pair of self-pointing or cut-off thread rolling dies incorporating this invention.

FIG. 2 is a perspective fragmentary view at an enlarged scale showing the nodularized coating on the flattened root-forming portions, and the crest and side-forming portions being substantially free of nodularized metallic carbide.

FIG. 3 is an enlarged fragmentary perspective view of a second embodiment of the invention in which the die is formed with serrations.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring now more particularly to FIGS. 1 and 2, the die structure illustrated is very similar to the die structure shown in U.S. Pat. No. 3,654,800 in FIG. 1 thereof with the exception that serrations are not provided and a nodularized coating of a metallic carbide has been provided on the root-forming portions. It should be understood that even though the present invention is illustrated in conjunction with a cut-off die similar to the die disclosed in the aforesaid U.S. Pat. No. 3,654,800, other thread rolling dies may be provided with the nodularized coatings of the present invention to the achievement of the advantages noted herein.

FIG. 1 is a perspective view of a long die of a pair of cut-off dies such as those shown in U.S. Pat. No. 3,654,800. The die 41 includes an elongated body 10 with a thread and point-forming surface 11 thereon. The die is also provided with a slug-forming surface 12. These surfaces perform the operating functions on the blank. The die also includes a back surface 13 which is normally formed at a sufficiently steep angle to prevent it from engaging the slug with sufficient force to cause any forming functions. Similarly the die is formed with a clearance surface 14 and a curved section 16 which deflects the slugs clear of the dies if it does not fall free by gravity at a fast enough rate.

The thread and point-forming surface 11 includes two cooperating surfaces, both of which are provided with thread-forming grooves 27. The first of these surfaces 17 engages and forms the threads on the main shank portion. The second surface 18 is the point-forming portion and it is this surface of the die which in cooperation with the slug-forming surface forms the point on the finished screw. It is recognized that the surfaces 17 and 18 are not planar surfaces since the
thread grooves 17 are formed therein. However, in the manufacture of dies, it is customary to form the die with planar surfaces and then to cut the grooves 27. Therefore, for purposes of description the term "surface" will be used as though planar surfaces were referred to with the understanding that such surface may have thread-forming grooves therein.

Referring to FIG. 2 which is a fragmentary perspectival view on an enlarged scale of the die shown in FIG. 1, there is shown the thread-forming means comprising a projecting root-forming portion 40, a recessed crest-forming portion 42 and thread side-forming portions 44 and 46 joining the root and crest-forming portions, respectively. As shown in FIG. 2, the flattened root-forming portion 40 is provided with a thin nodularized carbide coating 48, e.g., tungsten carbide, applied by any suitable means such as that described below. It should be noted that the surfaces of the crest-forming portion 42 and the thread side-forming portions 44 and 46 are substantially free of nodularized tungsten carbide. The thickness of the coating is usually less than about 0.001 inch. The coating is also provided on the planar surface 12 as illustrated in FIG. 1.

The method by which the carbide coating is applied is quite simple and contemplates the use of a rotating electrode which is connected to one side of an alternating current source, the metallic die body itself either being directly connected to the other side of an alternating current source or supported upon a base which in turn is connected to an alternating current source. The rotating electrode may be formed of a suitable hard coating material, such as tungsten carbide. Such material is very hard and, due to its nodulized character, it provides a rough surface. The hardness provides wear resistance while the roughness resists slippage between the die and the blank.

In order to prevent overheating of the rotating electrode, the electrode may be provided with a hollow bore extending therethrough and communicating with a source of pressurized air or inert gas. Alternatively, the application of the coating may occur in the presence of a static cooling atmosphere, e.g., air or inert gas such as nitrogen, helium, carbon dioxide, or the like. The current at which the coating is applied is approximately 30 volts A.C. at an amperage of from 15 to 20 amps. Any suitable source of electric power may be utilized so long as the voltage is in the range of from 15 to 50 volts, and the amperage drawn at the time of arcing is from 15 to 30 amps. In general, these levels of current are below those normally used in arc welding.

Arcing between the rotating electrode and the planar surface of the die is quite evident and is sufficient to cause deposition of metal from the rotating cooled electrode. The coating which is applied is extremely thin and rough and I use the term "nodularized" to denote the roughened re-deposited surface coating adhered to the surface as by welding. When viewed through a microscope the coating appears as a multitude of separate droplet-shaped nodules. The roughened surface is readily visible under a microscope. The crest-forming portion 42 and the sloping side portions 44 and 46 are seen under a microscope to be free of deposited metal. Deposition occurs only on the die surface where contacted by the rotating electrode. The electrode develops a pencil point appearance from use. The resulting surface is quite hard, and die-life ranging from 50% to 100% longer than heretofore obtainable has been experienced. While the entire planar surface of the die may be coated in the manner indicated above, it has been found preferable to coat with a very rough coating applied at a higher amperage over that portion from the starting end 52 to about the center of the die length.

The balance of the die can be either uncoated or coated with electrode material at a lower amperage to deposit a much smoother albeit quality hard coating to the surface. The portions of the die contacting the blank at the ends of the stroke experience lower pressures and therefore less wear than the starting portions of the die. Consequently, it is often not necessary to coat the die along its entire length. Also the surfaces within the groove are not subjected to as high a pressure as the surfaces 40 so it is desirable to provide a structure in which the rough coating is not present in the grooves themselves since such a rough coating would tend to cause a roughening of the thread portion of the finished screw.

In the past, it has been common to provide serrations such as the serration 54 illustrated in FIG. 3 to limit or resist slipping of the blank during the initial forming process. Such serrations although they reduce slippage weakened the die and also tended to cause a rough surface in the finished screw. With the present invention, the hard coating is usually sufficiently rough to prevent the slippage as well as to improve die life without the need for serrations. However, if serrations are required even when the nodularized coating is provided, they may be used to further resist slippage. FIG. 3 illustrates such a die where lateral serrations are provided across the die in combination with a hard nodularized coating in accordance with the present invention. Here again, the nodularized coating exists only along the flat upper surface of the die and does not extend down into the serrations to any appreciable extent.

With a die manufactured in accordance with the present invention, greatly improved die life is provided and greater control of the blank is achieved. Consequently, in many instances, it is not necessary to utilize the serrations generally used in the past, and it is possible to manufacture higher quality threaded devices.

Although preferred embodiments of this invention are illustrated, it should be understood that various modifications and rearrangements of parts may be resorted to without departing from the scope of the invention disclosed and claimed herein.

We claim:

1. A thread rolling die for use with a corresponding thread rolling die in forming a threaded screw from a blank, said die including thread-forming means comprising a tool steel body formed with a projecting flattened thread root-forming portion, a recessed thread crest-forming portion, and thread side-forming portions joining the root and crest-forming portions, said projecting flattened root-forming portion having a nodularized surface of droplet-shaped nodules in which the nodules are formed of a material in a group including hard metal and metal carbides, and the surface of said crest and thread side-forming portions being substantially free of nodularized surface.

2. A thread rolling die in accordance with claim 1 in which the metal carbide is tungsten carbide.

3. A thread rolling die as set forth in claim 1 wherein said die is a cut-off die having a slab-forming surface,
4. A thread rolling die as set forth in claim 1 wherein said die is provided with lateral serrations and said serrations are substantially free of said nodularized surface.

5. A thread rolling die as set forth in claim 1 wherein said nodularized surface is not provided along the finish end part of said die.