Sept. 7, 1965 G. L. WIEBER 3,204,442

METHOD FOR SIMULTANEOUSLY IMPARTING AN ALTERNATE SERIES OF THREAD FORMS ON A WORKPIECE

Filed July 30, 1963 2 Sheets-Sheet 1

Fig. 1

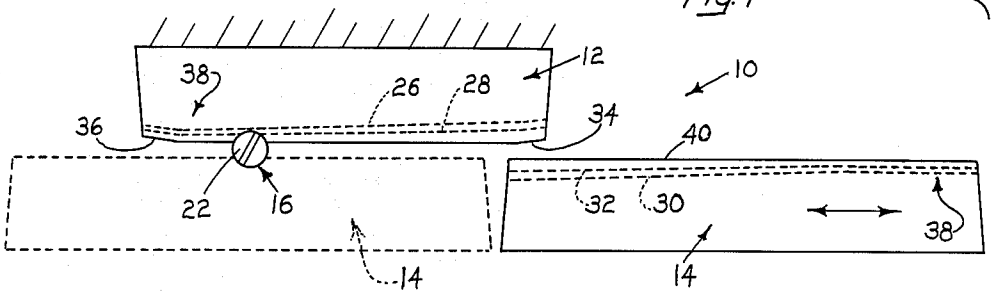


Fig. 2

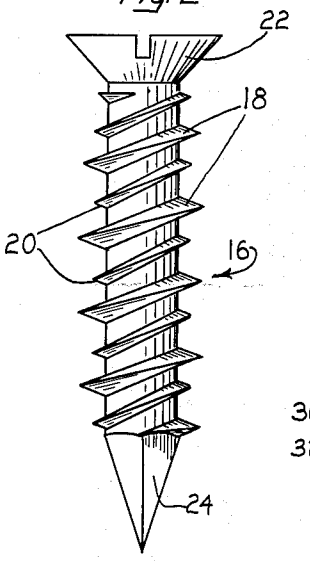


Fig. 3

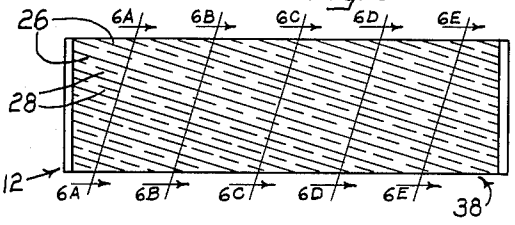


Fig. 4

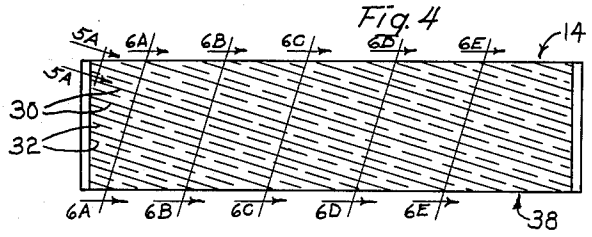


Fig. 5

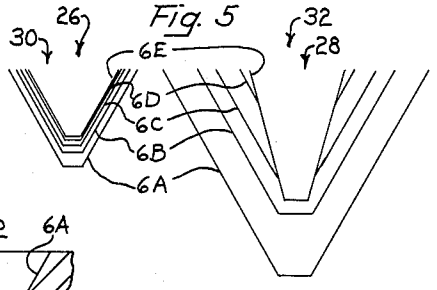
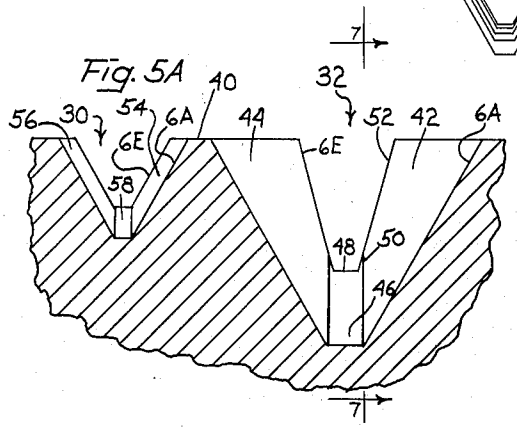


Fig. 5A



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Filed July 30, 1963 2 Sheets-Sheet 2

Fig. 6A

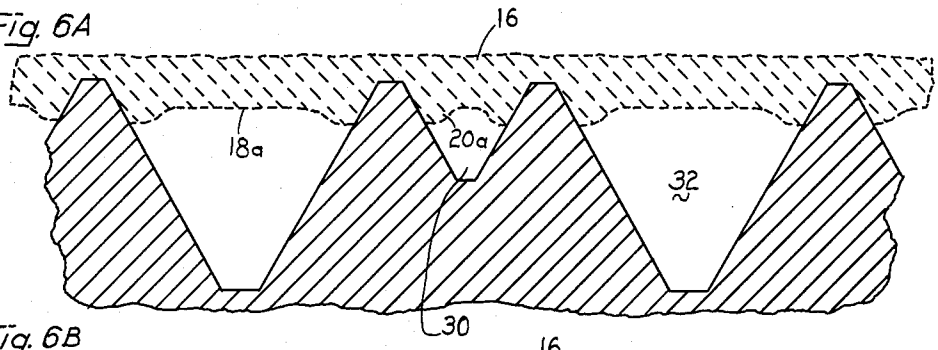


Fig. 6B

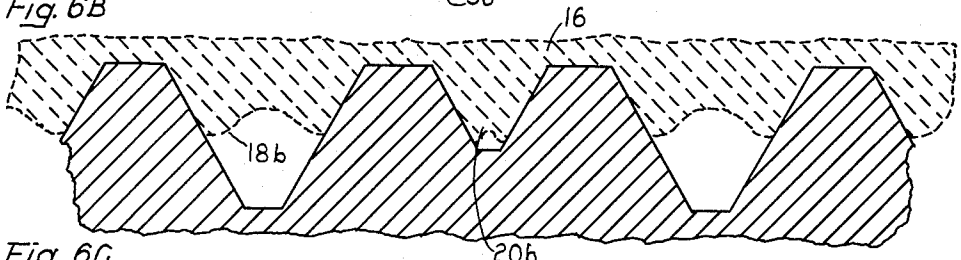


Fig. 6C

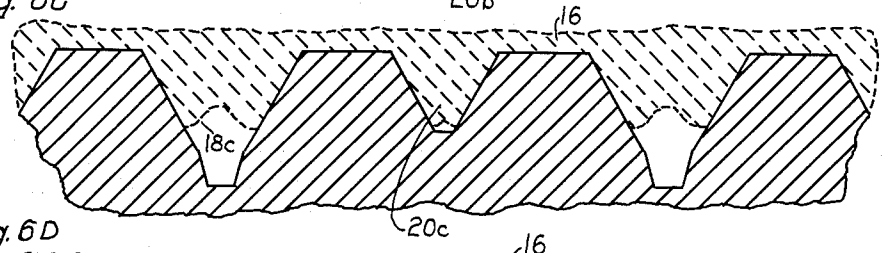


Fig. 6D

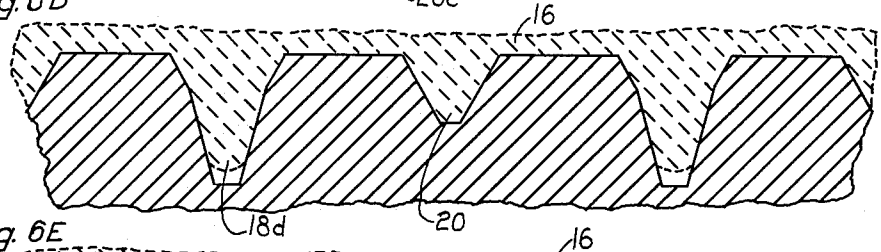


Fig. 6E

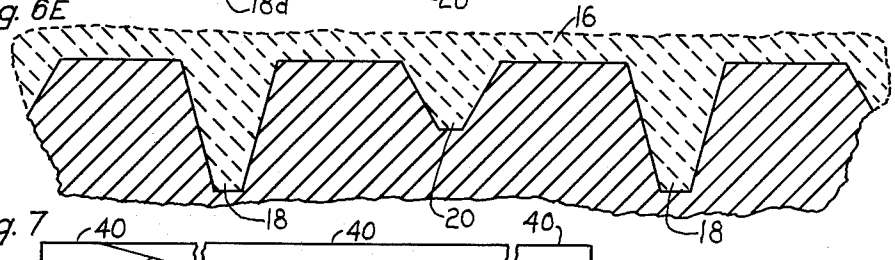
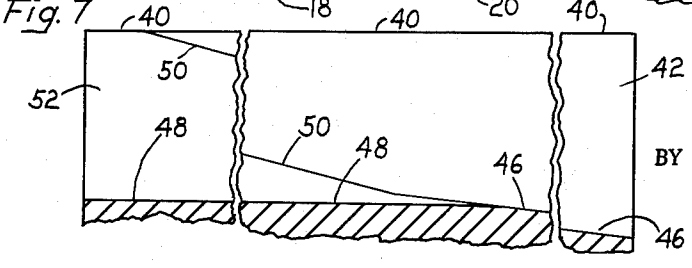


Fig. 7



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United States Patent Office 3,204,442 Patented Sept. 7, 1965

3,204,442

METHOD FOR SIMULTANEOUSLY IMPARTING AN ALTERNATE SERIES OF THREAD FORMS ON A WORKPIECE

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Filed July 30, 1963, Ser. No. 298,766
7 Claims. (Cl. 72—88)

This invention relates in general to a method and apparatus for simultaneously imparting an alternate series of thread forms on a workpiece and more particularly relates to a method and apparatus for simultaneously imparting an alternate series of thread forms where one form extends radially outwardly a substantially greater amount than the next alternate form on a screw shank or the like.

The thread rolling of screw or bolt workpiece shanks is normally accomplished by thread rolling dies having parallel grooves therein, the grooves being substantially identical in configuration. In some thread rolling dies, the dies are reciprocated past each other with the path of motion of one of the dies being at a slight angle to the axis of the other die (which is usually stationary).

The instant method and apparatus relates to the use of a pair of die blocks which have reciprocatory relative motion in substantially parallel plane.

In order to provide the desired high-low thread forms alternating on the workpiece shank, it has been found necessary and desirable to provide adjacent grooves which have initially different depths in the die blocks, initially different widths, and the side walls converge at different rates along the length of the respective grooves. It has further been found necessary and desirable to provide a wide acceptance angle for the groove which provides the radially larger thread which starts the material of the workpiece shank moving from its original grain structure with a semigentle movement rather than an abrupt change which would occur with a sharper acceptance angle.

It is a general object of this invention to provide a method and apparatus for thread rolling relatively high and relatively low threads on a screw shank in alternate arrangement.

It is a further object of this invention to provide a method and apparatus for providing screw threads of the aforenoted type in a manner which is fast, economically feasible, and provides a uniform high quality product.

A still further object of this invention is to provide a method and apparatus of the aforenoted type wherein the tooling may be made by standard techniques and which has relatively long life in actual use.

The novel features which are characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood by the following description of a specific embodiment when read in conjunction with the accompanying drawings in which:

FIG. 1 is a semidiagrammatic view of fixed and reciprocating die blocks and their relative relationships during the thread rolling operation;

FIG. 2 is a side elevational view indicating the product obtainable by the disclosed method and apparatus;

FIG. 3 is a semidiagrammatic side elevational view of the stationary die block shown in FIG. 1;

FIG. 4 is a semidiagrammatic side elevational view similar to FIG. 3 showing the die block which reciprocates in FIG. 1;

FIG. 5 is a semidiagrammatic showing of a plurality of outline sectional views along the grooves in the die

blocks showing the varying rates of changes in the depth and width of the grooves along the length thereof;

FIG. 5A is a sectional view along lines 5A—5A of FIG. 4, said view being considerably enlarged in scale.

FIGS. 6A through 6E are a plurality of sectional views, greatly enlarged, taken along the respective lines 6A, 6B, 6C, 6D, and 6E of FIGS. 3 and 4 indicating the various changes represented along the sectional lines and illustrate the thread forming characteristics of the die related to the flow of material axially to the workpiece as it would pass through the areas designated by lines 6A—6A through 6E—6E (which are normal to the thread form) of FIGS. 3 and 4; and

FIG. 7 is a sectional view along lines 7—7 of FIG. 5A.

Means for feeding screw blanks for cooperation with a pair of relatively reciprocating die members are well known and shall not be discussed further. This invention relates to the die blocks **10** comprising a stationary die block means **12** and a reciprocating die block means **14**. As shown in FIG. 1, the die block **14** is operable to move substantially parallel to die block **12** to roll threads on a workpiece **16** to provide alternate high threads **18** and relatively low threads **20** simultaneously. It will be noted that the high threads **18** extend radially outwardly a considerably greater distance than do the alternate low threads **20**. The screw blank **16** has a pointed tip **24** and a head portion **22** which is cross-slotted or otherwise formed for imparting rotation to the blank. The precise form of head **22** and entering end **24** may be varied within wide limits depending upon the application desired and form no part of the instant invention.

While the die blocks **12** and **14** are of different overall lengths, as is conventional the essential characteristics of each die block are the same and unless specific differences are discussed between the different die blocks, it will be assumed that the identical feature will be found on both except for considerations of left and right hand faces in opposition to each other. The die block **12** and the die block **14** are each formed with alternate grooves which are generally parallel to each other and differ from each other. The grooves traverse the die block at a predetermined angle as determined by the lead and diameter of the finished screw desired. As shown in FIGS. 3 and 4 the grooves **26** and **30** in full line are shallower grooves relative to grooves **28** and **32** shown in dotted line. The shallower grooves impart the thread form **20** on the screw blank whereas the deeper grooves **28** and **32** impart a thread form **18** on the screw blank.

As can be perceived intuitively from FIGS. 5 and 5A, each of the grooves **26**, **30** and **28**, **32** progressively vary in width and depth along the length thereof and at different rates relative to each other. As shown in FIG. 5, outline sectional views taken as indicated along FIGS. 3 and 4, indicate the progressive change along the length of the grooves. FIGS. 6A through 6E correspond to the outline sectional views and show the gathering of the material from the screw blank as the thread is being formed.

The stationary die block **12** has an entering end portion **34** and a trailing end portion **36** wherein the operating face of the die block is recessed slightly for respectively facilitating entrance of the screw blank and removal of same from between the die blocks as is conventional. Each of the die blocks **12** and **14** have an ironing portion **38** where the grooves are of constant width and depth for a predetermined portion of the groove length for purposes of truing up the blank and the screw thread formed thereon after they have been formed by the die blocks.

Turning now to FIGS. 5A and 7, the die blocks have an operating face **40** in which the grooves **30** and **32** are formed. (Grooves **26–28** are similar to grooves **30–32**

except for overall absolute length.) The groove **32** for forming the thread **18** has opposed side walls **42** and **44** and a bottom wall **46** which changes in character at **48** as shall be described. As can be seen in FIG. 5A, the side walls **42** and **44** progressively converge toward each other and the bottom wall **46** progressively comes closer to the operating face **40**, i.e., the groove becomes progressively shallower for a major portion of its length. This is perhaps best illustrated in FIG. 7. The groove **32** may be formed by first passing a cutter having an outline shape as shown at **6E** in FIG. 5 across the die face parallel to surface **40** and then passing a cutter having an outline shape such as shown in FIG. 6A across the face **40** while progressively relatively moving the cutter and die block on an angle to each other so that the groove becomes shallower. After the second cutter has run out with the first cutter (for example a 30° cutter) the second cutter (for example a 60° cutter) having an outlined form as shown at **6A** is superimposed upon the first groove, said second cutter being moved at an inclination angle relative to the die block so that the depth of the groove blends into the form **6E**. The narrower angle cutter forms the bottom surface **48** of the groove and the intersection where the two cutters remove the stock and blend together on the different angles is shown at **50** in FIG. 7, the slope of the side walls **42** and **52** are different, caused by the different angularities of the two different cutters. The groove **30** is formed by a single cutter (for example a 60° cutter) to provide side walls **54** and **56** which are converging toward each other and a bottom wall **58** which is moving toward surface **40** at a constant rate along the length thereof except for ironing portion **38**.

As shown in FIGS. 6A through 6E, a blank interposed between the two die blocks **12** and **14** will form the threads **18** and **20**. FIG. 6A is a sectional view showing the gathering of the material approximately at the start of the thread forming operation. The wide acceptance angle of groove **32** at the start of the groove is efficacious to gather the material from the screw blank **16**. FIG. 6B is a projection at approximately 30% of the thread transformation, it being noted that thread portion **20***b* is quite well filled out whereas thread portion **18***b* is not. The projection in FIG. 6C shows the thread **20***c* is almost completely filled out whereas **18***c* is not formed, the projection being taken at approximately 60% of the thread transformation. The projection shown in FIG. 6D shows that the thread **20** is not fully formed whereas thread portion **18***d* is only about 90% formed and FIG. 6E shows the complete thread formation of both threads **18** and **20** at the finished portion of the die. FIGS. 6A through 6E are actual projections respectively of one-half, three, five and seven turns of a screw blank on a thirty times size scale. However, it will be realized that in rolling screws, the percentage of thread forming transformation per turn of the blank will vary depending upon size of blanks, etc.

The ironing section **38** on the die block allows the screw blank to regain a circular shape from an oval shape and trues up the threads. The threads that are formed by this method are found to be quite strong and well formed.

It will be noted as shown in FIG. 6A that the groove **32** has a wide mouth which provides a wide acceptance angle which starts the material moving on the screw blank from its original grain structure toward forming the very "high" thread with a semigentle movement rather than an abrupt change that would occur with a much narrower

mouth. It will be further noted that the grooves **30** and **32** are of different depths along the length thereof, are of different widths along the length thereof and that the grooves converge at different rates. Also it will be noted that the low thread **20** is fully formed prior to the formation of the higher thread **18**.

Although a specific embodiment of the method and apparatus for simultaneously forming high and low threads on screw blanks have been shown and described, it is with full awareness that many modifications thereof are possible. The invention therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim:

1. The method of forming high and low threads on a cylindrical screw blank located between opposed dies comprising the steps of relatively moving the dies and the blank, by said moving of dies and blank displacing material for the high threads at a first rate, and displacing material for the low threads at a second rate which is less than said first rate, and decreasing the rates of displacing material for both high and low threads as said moving of die and blank proceeds.

2. The method set forth in claim **1** including the step of ironing the respective threads after forming same to true up the threads and the blank.

3. The method set forth in claim **1** wherein relatively moving the dies and the blanks imparts a rolling movement to the blank in a plane parallel to the long axis of the blank.

4. The method set forth in claim **1** wherein the rate of displacing the material for forming the high thread is varied during the formation of the thread.

5. The method according to claim **1** wherein the rates at which the material is displaced and the threads formed are determined by the diminishing depths, widths and degrees of wall convergence of the thread-forming grooves in the dies.

6. The method of forming high and low threads on a cylindrical screw blank located between opposed dies comprising the steps of relatively moving the dies and the blank, by said movement displacing material for the high threads at a first rate, displacing material for the low threads at a second rate which is less than said first rate, and forming completely the low threads before forming completely the high threads.

7. The method according to claim **6** wherein the rates at which the material is displaced and the threads formed are determined by the diminishing depths, widths and degrees of wall convergence of the thread-forming grooves in the dies.

References Cited by the Examiner

UNITED STATES PATENTS

370,354	9/87	Rogers	80—9
425,035	4/90	Jones	80—9
2,183,688	12/39	Olson	80—9
2,562,516	7/51	Williams	80—61
2,679,774	6/54	MacDonald	80—61
2,760,388	8/56	Seibert	80—9
3,019,677	2/62	Cermatori	80—9
3,069,941	12/62	Baubles	80—6

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