Oct. 15, 1968 R. W. ORLOMOSKI 3,405,545

ROLLED THREAD DIE WITH TRACTION NOTCHES

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Fig. 1.

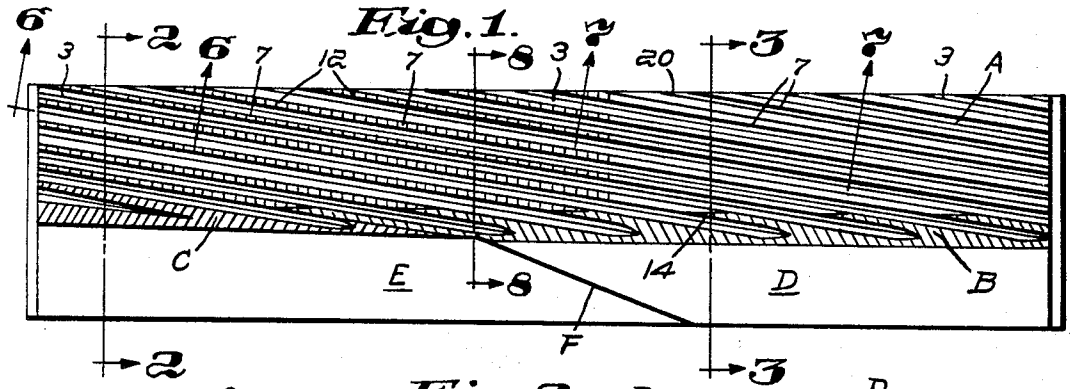


Fig. 2.

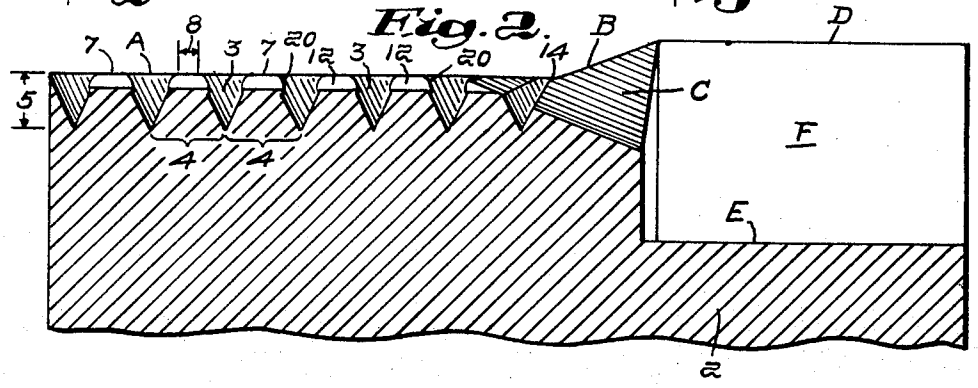


Fig. 3.

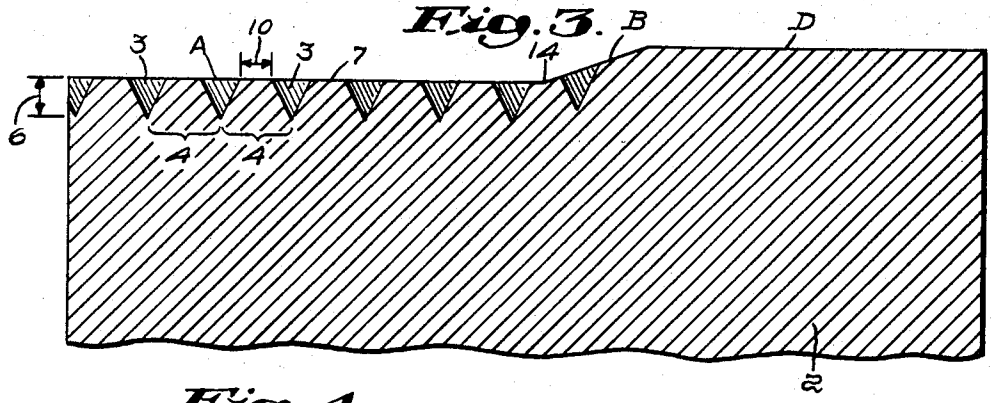
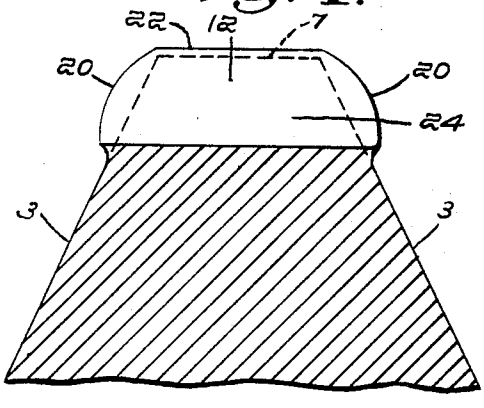


Fig. 4.



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Fig. 5.

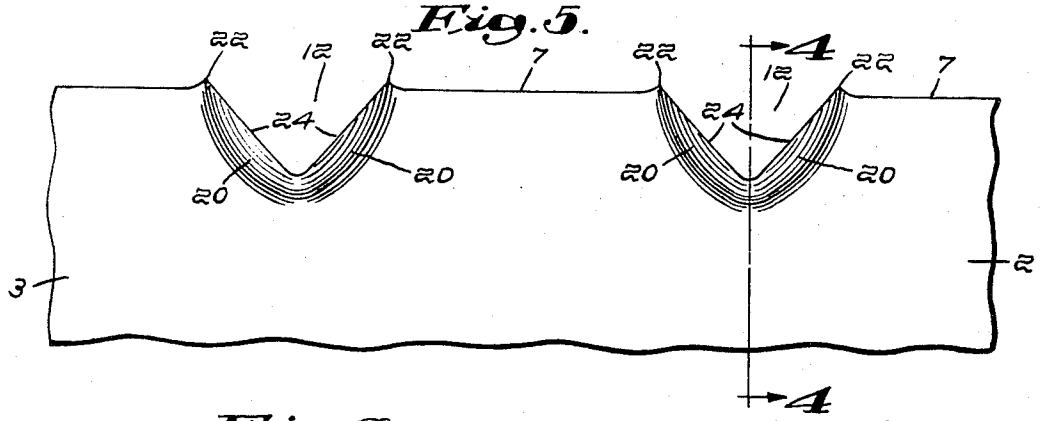


Fig. 6.

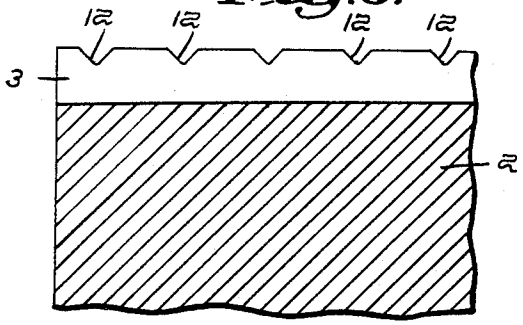


Fig. 7.

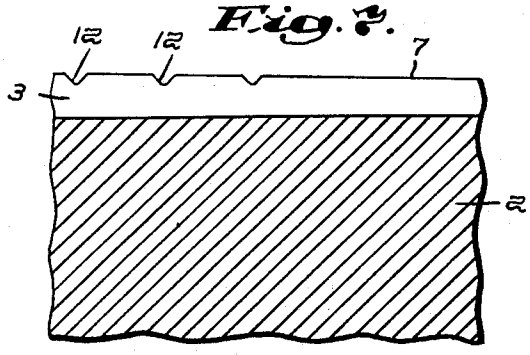


Fig. 9.

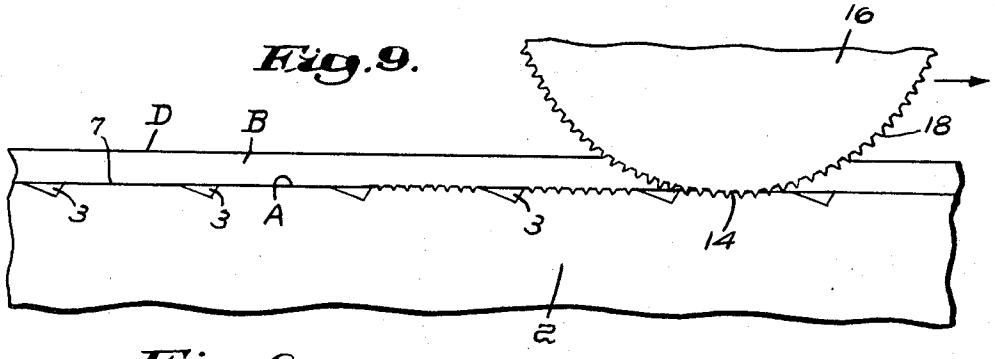
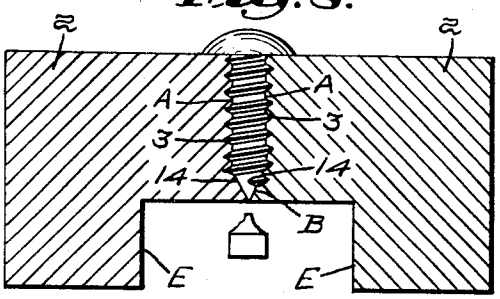


Fig. 8.



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3,405,545
ROLLED THREAD DIE WITH TRACTION NOTCHES

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9 Claims. (Cl. 72—88)

This invention is concerned with dies of the type used in producing screws or other threaded elements by the process known as die rolling.

The art of producing screws by means of thread rolling dies is old and well known. The improvement herein disclosed and claimed is not in the construction of the thread rolling dies insofar as their characteristics for producing threads of the required shape are concerned, but rather with a die having crosswise extending serrations or traction notches of novel configuration, which traction notches insure that each cylindrical blank introduced between the dies at the commencement of each thread rolling operation will be caused to rotate.

The crosswise notches of the present invention may be formed rather than cut in the die through the use of a toothed tool which is rolled along the die under pressure. Alternatively, they may be pressed in simultaneously through the use of a flat die that contains the required number of teeth, or they may be formed by a single point staking tool.

Traction notches in thread rolling dies have been used heretofore as means for inducing initial and continued rotation of the blank. The need for such notches became obvious at an early stage in the development of the thread rolling dies. However, up to the present, the crosswise extending notches in the lands of the die between the thread creating grooves have always been made through the use of milling cutters. These cutters, in creating the notches, cut away some of the material of the lands of the die as the notches are formed. This materially weakens the die thread. Since the notches are numerous and closely adjacent each other, premature die thread failure always occurs in this area. Milled traction notches have, in general, been capable of causing the blank to roll properly as the thread rolling operation is commenced. On the other hand, failures have been not uncommon. Furthermore, the milled notch process, apart from causing die thread failure, has been particularly unsatisfactory in connection with screw rolling operations in which the finished product has a threaded point.

To create a properly threaded point, the die necessarily includes a bottom portion which slopes toward the center line of the screw and comes into action only after the thread rolling operation is well underway. The lands between the thread grooves that extend into the inwardly sloping portion should be smooth and free of traction notches so that the pointed portion of the screw, because of its smaller diameter, can slip readily with respect to that part of the die as the threading of the body of the screw progresses.

However, it will be appreciated that when a milling cutter is passed across the lands of the die to create the notches it must be stopped well short of the heel line (the line where the vertical and sloping parts of the die meet) if the cutter is not to cut into the inwardly sloping portion of the die. On the other hand, if the crosswise movement of the milling cutter is continued until the heel line is reached (which is the preferred terminal point for the notches), then inevitably there will be notches cut into the inwardly sloping land portions, which notches will encounter the slipping pointed portion of the screw with bad results.

Accordingly, in the present invention it is proposed

that the notches be created in the lands between the threading grooves by rolling therealong a tool with transverse teeth under suitable pressure. This process gives three desirable results. First, the notches are created by deformation of the die thread in a manner which causes substantial lateral extrusion and limited upward extrusion of the metal. The metal is in effect forged to its new configuration with no weakening of the die thread. This creates a notch having an edge formation which is much more effective for gripping the blank and gives more positive assurance that the blank will be rotated without fail on each threading operation. A second advantage of rolling the notches into the blank is that the notches may be brought exactly to the heel line without any notches appearing in the lands of the inwardly sloping portion with which the pointed portion of the screw engages. A final advantage is that the notches in the lands of the die are of continuously decreasing depth. The notches are deepest at the die end at which the threading operation starts and decrease gradually to the discontinuance point somewhat more than halfway along the die. This result is achieved by merely applying constant force to the toothed tool as it rolls along the die. The tool teeth at the entering end of the die enter the lands of the die more deeply because the lands between the die grooves at the starting end are narrower and contain less metal than at the finishing end. This decrease in the notch depth, which is also found in the cut notches of the prior art, has the desirable effect during the threading operation of enabling the die to smooth progressively the developing threads of the screw as well as the helical surface between the threads. This smoothing effect coupled with the absence of notches in the last part of the die eliminates from the finished screw any surface deformations that might have been created during the first part of the rolling operation.

While it has been stated that the preferred method of creating the notches is by rolling them into the lands of the die, it has also been found possible to form the notches through the use of a flat unit containing a plurality of parallel crosswise extending notch producing teeth. This unit when pressed against the lands of the die will create all of the notches by simultaneous deformation of the metal.

The creation of the notches in the thread rolling die in either case is done while the die is in annealed condition. Thereafter it may be hardened in conventional manner so that the laterally extending forged portions at the edges of the notches have a life that is commensurate with the life of the die itself.

These and other objects of the invention will be more fully understood as the description proceeds with the aid of the accompanying drawings in which:

FIG. 1 is a vertical elevation of one of a pair of cooperating dies showing preferred positioning of the notches in the lands of the die;

FIG. 2 is an enlarged vertical section taken on the line 2—2 of FIG. 1;

FIG. 3 is an enlarged vertical section taken on the line 3—3 of FIG. 1;

FIG. 4 is a still further enlargement of one of the notches shown in FIG. 2 illustrating the character of the metal deformation. This view is also a section taken on the line 4—4 of FIG. 5;

FIG. 5 is a greatly enlarged view looking upwardly along the line 6—6 of FIG. 1. This view considered with FIG. 4 shows the nature of the deformation of the metal at the edges of the notches;

FIG. 6 is a section taken on the line 6—6 of FIG. 1, to smaller scale than FIG. 5, showing the notches at the left or starting end of the die of FIG. 1;

FIG. 7 is a section on the line 7—7 of FIG. 1 corresponding to FIG. 6 as to scale to show the decreasing depth of the die grooves and the decreasing depth of the traction notches;

FIG. 8 is a section of two thread rolling dies in normal operative position taken approximately on the line 8—8 of FIG. 1; and

FIG. 9 is a top plan view of FIG. 1 illustrating the preferred manner in which the notches are formed in the lands.

In the further description of the invention, it will be understood that in the thread rolling operation of screws with which the dies in question are concerned there are two dies as illustrated in FIG. 8, each die being similar to that shown in FIG. 1. One die is held fast in the machine and the other die is reciprocated horizontally with respect to the fixed die. The dies have their thread creating grooved faces in vertical position, and they are so arranged as to stroke and spacing that a blank of proper dimensions can be introduced between the dies when the movable die is at the beginning end of its stroke. The movable die then advances parallel to the fixed die, causing the blank to be rolled therebetween. The squeezing of the rotating blank between the dies causes extrusion of part of the metal to fill progressively the grooves of the dies so that when the movable die has passed beyond the end of the fixed die the blank has been converted to a screw with a finished thread thereon.

Accordingly, the description of the single die shown in the drawings will be understood to be equally applicable to the other of the pair of dies. It will be understood that the two dies that receive the notches are identical in configuration as to the thread creating grooved vertical surfaces, the heel line and the inwardly sloping portion that produces the threaded point. It will also be understood that the notches and the method of creating the notches may of course be used with other types of dies for rolling threads from a blank whether or not the dies produce a pointed screw.

Referring first to FIGS. 1, 2 and 3, the vertical faces of the die 2 is indicated generally at A. The inwardly sloping portion of the die that creates the threaded point is indicated at B. The back point area is indicated at C. This portion C which slopes in the opposite direction from inwardly sloping area B acts in cooperation therewith to create and finally cut off the slug that develops at the end of the blank as the screw point is being formed (see FIG. 8).

The area D is a flat vertical portion of the die extending downwardly from area B. In operation the areas D of the dies are parallel and pass closely adjacent each other. The surface E is the vertical surface of a cutaway area in which the slug is produced.

As can be seen from an inspection of FIGS. 2 and 3, which are sections on the lines 2—2 and 3—3 respectively of FIG. 1, the grooves 3 of the die, while of constant pitch as indicated by the brackets 4, are of steadily decreasing depth as suggested by the dimensions 5 in FIG. 2 and 6 in FIG. 3. As the grooves 3 decrease in depth from the left end to the right end of die 2, there is a gradual increase in the width of the lands 7 from the left end of the die of FIG. 1 to the right end as indicated by the dimensions 8 and 10 in FIGS. 2 and 3. The angularity of the sides of the grooves 3 is constant from one end of the die to the other. The reason for the above referred to change in dimensions of the grooves and lands is to facilitate the deformation of the cylindrical blank to a threaded screw. That part of the blank between the grooves 3 is forced by the pressure of the lands axially and outwardly to progressively fill the die grooves thus to create the fully finished threads at the end of the operation.

In FIG. 1, the notches that have been placed crosswise in the lands of the dies are indicated by the short transverse lines 12. These notches are shown in greater detail in FIGS. 2, 4, 5, 6 and 7. No notches appear in FIG. 3 because this section is in the finishing portion of the die where no notches are needed or desired. The notches are on the flat vertical surfaces of the lands of the die and, as indicated in FIG. 1, they are all above the heel line 14. The notches are preferably created through the use of a circular toothed roller shown at 16 in FIG. 9 and having crosswise extending teeth 18 thereon. The length of the teeth 18 should be at least the distance from the heel line 14 to the upper edge 20 of the die as shown in FIG. 1. The teeth of course could be longer so that the roller 16 could be used with dies of greater vertical dimensions. However, it will be appreciated that the roller 16 with the teeth 18 may be placed against the vertical surface A of the die and by applying suitable force therebetween the roller can be rolled along to create the required notches. It is preferable to roll the notches in from the right to the left as viewed in FIG. 1 or from the left to the right as viewed in FIG. 9. As the lands get narrower the depth of the notches will automatically increase as long as constant pressure is used. The increasing depth of the notches 12 is shown in FIGS. 6, 7 and 9.

As the teeth 18 of roller 16 are forced into the lands of the die, a forging action occurs and the metal is deformed substantially in the manner indicated most clearly in FIGS. 4 and 5. It is extruded laterally to form ears 20 and is extruded upwardly, although not as much as laterally, to produce small upwardly extending teeth 22. The teeth 18 on roller 16 are preferably cut at 90° which results in flat inner surfaces of the notches as indicated at 24 in FIG. 5. The depth of each notch will vary according to the screw size from .003" to .014" at the start and to .001" to .005" at the finish end, giving a horizontal distance across the notches varying from a maximum of .028" to a minimum of .002". The spacing of the notches along the lands should be in the order of ⅛ of the circumference of the blank so that the gripping of the blank by the ears and teeth of the successive notches will follow closely. The foregoing dimensions are not critical and may be varied somewhat although the figures given have been found to be satisfactory in practice. Generally speaking, the larger the diameter of the stock to be threaded, the larger the notches will be to insure satisfactory gripping of the stock and initiation of rolling movement.

The notches in FIG. 1 are shown as extending at right angles to the top of the dies. They could be, if desired, at right angles to the die grooves 3 or even at some other angle extending effectively crosswise of the lands 7.

As will be understood by those familiar with this art, at the commencement of the rolling action the narrow lands at the left end of the die as shown in FIG. 1 enter the cylindrical blank to a depth which is dependent on the desired thread configuration to start outward and axial movement of the metal therebetween. This displaced part immediately becomes adjacent and engaged by the ears 20 and teeth 22 at the edges of the notches as the stock rolls along between the dies. As the screw thread is progressively formed, new portions of the stock are gripped by the closely spaced succeeding ears 20 and teeth 22, permitting the previously slightly marred surface of the developing thread to be progressively smoothed out by that portion of the die which it then engages below the ears 20. By the time the work has passed perhaps a third of the way along the die, the threads have been sufficiently developed so that continued rotation of the work is assured. Thus when the work has arrived at section 3 of FIG. 1, for example, the point will have been formed, the thread almost completely formed, and the work will have passed by the last of the notches. The dies, now effectively engaging the almost completely formed thread, roll the work the rest of the way to burnish the surface and to complete the extrusion of the thread to the very bottom of the die grooves. Then when the finished screw leaves the righthand end of the die of FIG. 1 it is com-

plete in all respects with little or no marks originally formed therein by the ears **20** and teeth **22** showing.

It is intended to cover all changes and modifications of the examples of the invention herein chosen for purposes of the disclosure which do not constitute departures from the spirit and scope of the invention.

I claim:

1. In a die of a pair of cooperating dies for rolling threads in a cylindrical work piece and on which dies are a plurality of parallel thread forming grooves separated by lands, means for insuring rotation of said work piece as the dies are moved relative to each other with the work piece squeezed therebetween, said means comprising a plurality of rows of notches crossing said lands, the edges of the notches extending transversely beyond the walls of the said grooves to form ears, said ears being formed of metal integral with said die which metal has been displaced from its original position in said die as said notches were formed, said ears adapted to grip and rotate each said work piece during the thread forming operation, the rows of said notches terminating at a position sufficiently far from the finishing end of said die to permit the dies, during the last rotations of said work piece, to remove any surface irregularities in the work piece caused by said ears.

2. Means for insuring rotation of cylindrical stock fed to a pair of cooperating thread rolling dies of the type having parallel thread forming grooves and lands therebetween, said means comprising notches extending across the lands of the die and having ears at the edges of each said notch extending into the said die grooves, said notches being uniformly spaced longitudinally of the die but being of progressively decreasing depth from the stock entering end of the die.

3. Means for insuring rotation of stock as set forth in claim **2** in which said ears are formed from metal displaced from the portion of said land in which said notch was created.

4. The method of creating notches in the tapering land portions of a grooved metal die for rolling threads on a cylindrical work piece, said method comprising the steps of forcing parallel teeth of a separate tool into said lands while said lands are in unhardened condition thereby displacing the metal engaged by said teeth and forming a plurality of notches in the said lands between said grooves and simultaneously, during the formation of said notches, forcing said displaced metal transversely of said lands into said grooves for a short distance to create ears in said grooves capable of gripping and insuring rotation of said work piece when it is introduced between a pair of said dies.

5. The method set forth in claim **4** in which some of the metal displaced during the formation of said notches is raised above the surface of each said land.

6. The method set forth in claim **4** in which the notches in the said tapering lands are formed by applying uniform pressure of said tool teeth against said lands resulting in notches which progressively decrease in depth from the work piece entering end of the die because of the increasing resistance to deformation as the lands widen.

7. The method of forming notches with work gripping portions at the edges thereof in the lands between the grooves of a metal thread rolling die which die includes a grooved sloping pointing surface, comprising the steps of utilizing a notch forming tool having parallel closely spaced teeth thereon, pressing said tool against said lands under pressure sufficient to force said teeth into said lands to create notches and at the same time to extrude the metal displaced in the formation of said notches laterally into said grooves and above said lands, said notches extending only as far as the line of intersection between the plane of said lands and said groved sloping pointing surface whereby no notches will appear in said sloping pointing surface.

8. The method set forth in claim **7** in which said notch forming tool rolls along said lands to form said notches successively.

9. The method set forth in claim **7** in which said notch forming tool forms all notches simultaneously.

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