United States Patent

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[54] SELF-POINTING THREAD ROLLING DIES

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[52] **U.S. Cl.** **72/469**

[51] **Int. Cl.** **B21h 3/06**

[58] **Field of Search** 72/88, 90, 469

[56] **References Cited**

UNITED STATES PATENTS

Re26,518	1/1969	Mau et al.	72/88 X
419,292	1/1890	Simonds	72/88
446,932	2/1891	Simonds	72/88
387,184	7/1888	Rogers	72/88
3,538,739	11/1970	Orlomoski	72/469
3,538,740	11/1970	Orlomoski	72/469

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[57] **ABSTRACT**

A pair of self-pointing thread rolling dies is illustrated for forming a threaded and pointed screw from an unpointed blank having excess material in the shank. During the rolling operation the excess material is formed into a slug which is separated from the finished screw. Each die includes a slug forming surface formed with driving serrations thereon. The projections of the serrations into the plane of movement of the axis of the blank are inclined with respect to a referenced plane perpendicular to the direction of relative die movement. The inclined serrations provide a smoother drive for the slug and improve the uniformity of location of slug separation so that the uniformity of the screws formed by the dies is improved. The point burning of the screw is also reduced and die life is improved. In one embodiment the serrations are inclined in the same general direction with respect to the referenced plane and in another embodiment, they are inclined in opposite directions with respect thereto.

20 Claims, 8 Drawing Figures

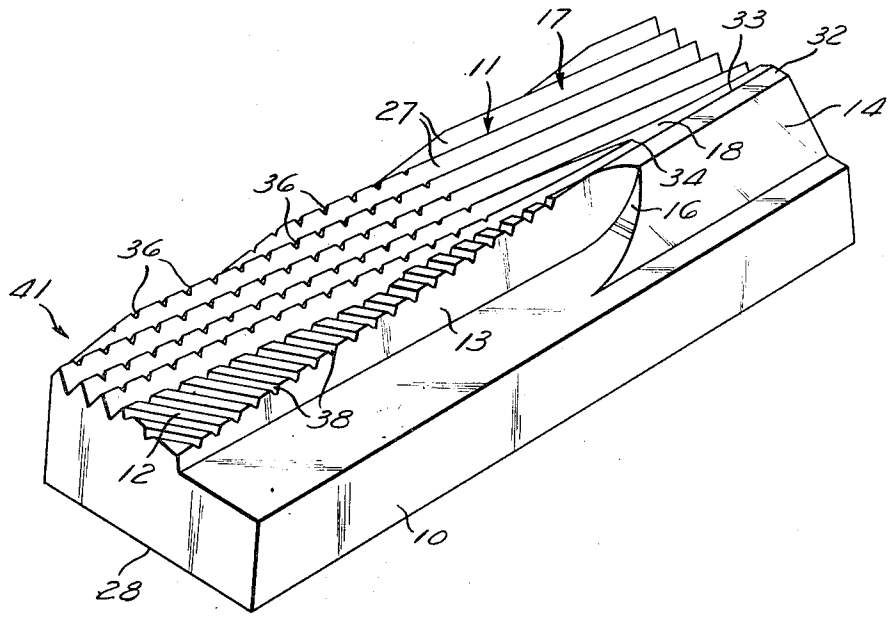
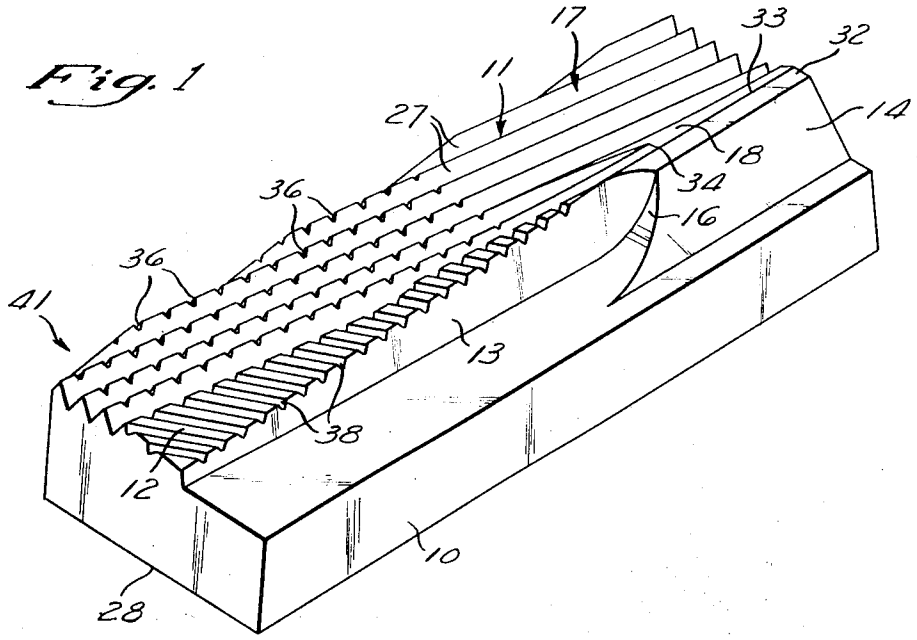


Fig. 1



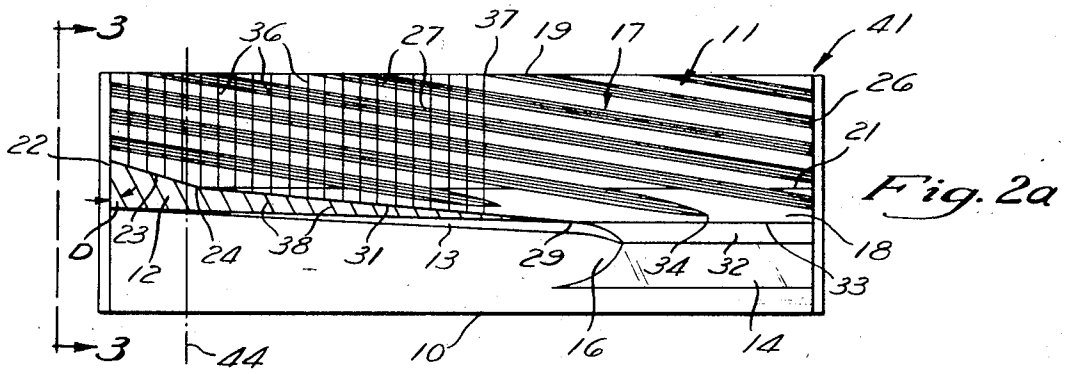


Fig. 2a

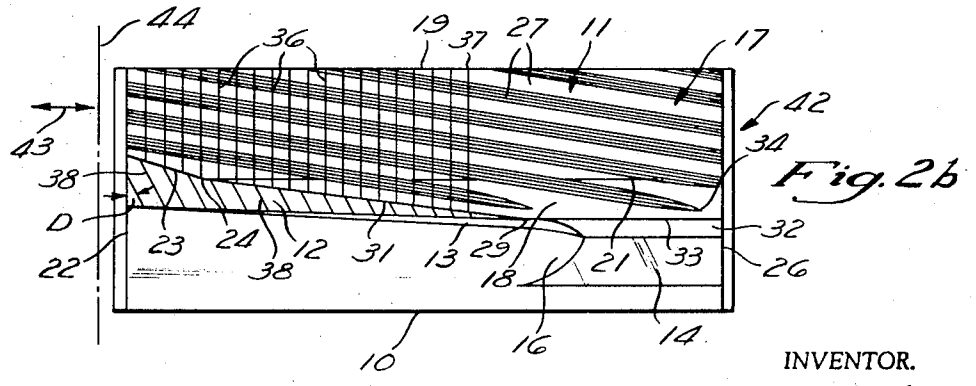


Fig. 2b

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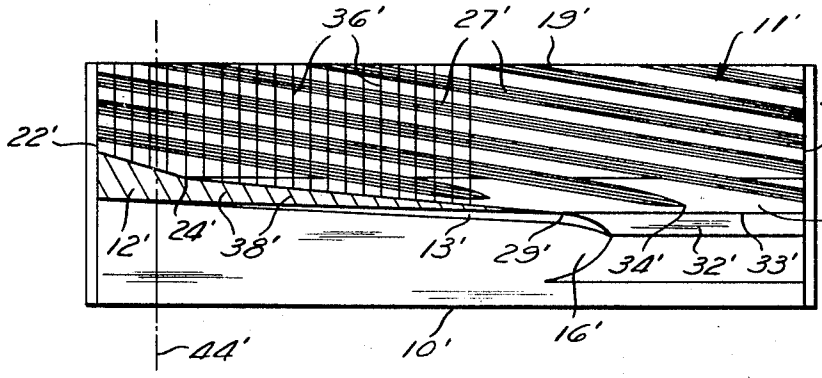


Fig. 4a

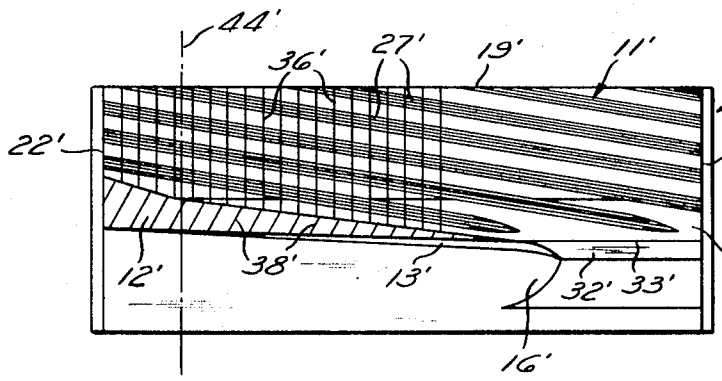


Fig. 4b

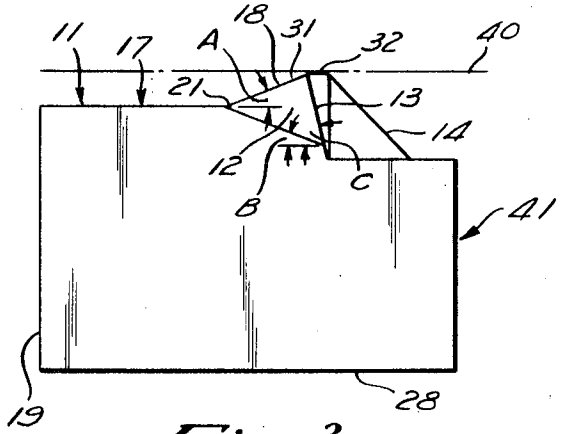


Fig. 3

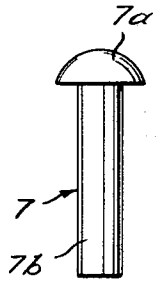


Fig. 5

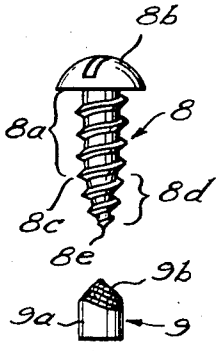


Fig. 6

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SELF-POINTING THREAD ROLLING DIES

BACKGROUND OF THE INVENTION

This invention relates generally to the manufacture of threaded articles such as screws or the like and more particularly to novel and improved self-pointing thread rolling dies for use in the manufacture of pointed screws from unpointed blanks.

PRIOR ART

Thread rolling dies which combine the function of pointing and threading of a blank are known. For example, the U.S. Pat. to Mau et al., No. 3,176,491 which was reissued as Re 26,518, and the U.S. Pat. to Vellier, No. 2,373,878 describe such dies. The latter patent describes a manufacturing procedure in which the shank of the blank is provided with excess material which flows from the pointed zone back along the shank as the point is being formed. In the Mau et al. patent the dies are arranged to cause excess material to be separated from the screws as a slug.

When the blanks are formed by dies which produce a separated slug it is important to arrange the dies so that the amount of metal remaining in the screw is uniformly controlled and is the amount necessary to provide a point shaped and filled in the desired manner. Such dies are usually provided with slug forming surfaces which extend from the forward end of each die to a location spaced from the rearward end of each die. The slug should separate from the blank as the rearward end of the slug forming surface is approached. If the slugs separate too soon, insufficient metal remains to form a completely filled point and if it separates too late, excessive metal remains causing excessive die wear and sometimes causing die breakage. With the prior art dies, such as the dies formed in the manner disclosed in the Mau et al. patent cited above, difficulty is sometimes encountered in that the location of slug separation varies from blank to blank and the production of screws is not completely uniform.

SUMMARY OF THE INVENTION

The present invention is directed to novel and improved dies for forming pointed and threaded screws from blanks having a generally cylindrical shank with excess material therein. The dies are shaped so that in a single rolling operation, the shank of the blank is pointed and threaded and the excess material is separated as a slug. Dies incorporating this invention are formed with slug forming surfaces which have serrations inclined with respect to a plane perpendicular to the direction of relative die movement. It has been found that such inclined serrations provided improved point control in that slug separation tends to occur consistently at the same location along the die surfaces so that the screws formed by a given pair of dies tend to be very uniform. It has also been found that dies incorporating this invention tend to result in reduced burning of the point of the screws and tend to have increased die life when compared to similar dies having serrations along the slug forming surface which are substantially parallel to a plane perpendicular to the direction of relative die movement.

When the serrations are both inclined in the same direction, screws are produced which tend to have a sharper point. On the other hand, when the serrations on the slug forming surfaces of one die are inclined in a direction opposite to the corresponding serrations on the other die, a screw is produced tending to have a somewhat blunter end. In some instances a very sharp point is desired. For example, sheet metal screws intended for use without predrilled holes normally require a very sharp point. On the other hand, when the screws are intended to be used with predrilled holes, a blunter point is more desirable since a blunt point does not tend to produce as much packaging and handling difficulties.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of one die of a pair of self-pointing thread rolling dies incorporating this invention illustrating the angulated or inclined serrations on the slug forming surface;

FIGS. **2***a* and **2***b* are plan views of the long and short dies, respectively, of a pair of mating dies in which the serrations along the slug forming surfaces are both inclined in the same direction;

FIG. **3** is an end view taken along **3**—**3** of FIG. **2***a* with thread grooves and serrations not illustrated for purposes of simplification;

FIGS. **4***a* and **4***b* are plan views of dies similar to the dies illustrated in FIGS. **2***a* and **2***b* excepting for the fact that these dies are formed with serrations along the slug forming surfaces which are inclined in opposite directions with respect to each other;

FIG. **5** is a side elevation of a blank of the type which is rolled formed with dies in accordance with this invention, and;

FIG. **6** is a side elevation of a finished screw formed from the blank illustrated in FIG. **5** with the separated slug also illustrated.

The illustrated dies consist of a long die and a short die which are reciprocated relative to each other while they are positioned in face-to-face adjacency. An unthreaded blank **7** of the type illustrated in FIG. **5** is passed between the dies with a rolling action. It is during the movement of the blank between the dies that the blank is simultaneously pointed and threaded to the finished screw **8** illustrated in FIG. **6**. Also during this movement, the excess material in the shank of the blank is separated from the screw in the form of a slug **9**.

The blank **7** is formed with a head **7***a*, usually in a header or the like, and a cylindrical shank **7***b* having a length equal to or greater than the shank length of the finished screw. The finished screw **8** is formed with a threaded main shank portion **8***a* of uniform diameter extending from the head **8***b* to the location **8***c*. Beyond the location **8***c* the shank is formed with a generally conical threaded point **8***d*. In the illustrated screw, the threads extend substantially all the way to the point **8***e* and the point is sharp. The excess material from the shank **7***b* of the blank is separated from the screw as a slug **9** having a cylindrical section **9***a* and a generally conical end portion **9***b*.

Both of the dies of a given pair of dies are formed with similar shank and thread forming surfaces and in the case of the dies illustrated in FIGS. **2***a* and **2***b*, both pairs are formed with similar slug forming surfaces. In the pair of dies illustrated in FIGS. **4***a* and **4***b*, the slug forming surfaces are provided with oppositely inclined serrations which will be described in more detail below.

FIG. **1** is a perspective view of the long die **41** of a pair of dies illustrated in FIGS. **2***a* and **2***b*. 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**. It is these surfaces that 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 slug 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 two surfaces **17** engages and forms the threads on the main shank portion **8***a*. 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 portion **8***d* on the finished screw. It is recognized that the surfaces **17** and **18** are not planar surfaces since thread grooves **27** are formed therein. However, in the manufacture of the dies it is customary to form the die with planar surfaces and then to cut the grooves and serrations therein. Therefore, for purposes of description, the term "sur-

face" will be used as though planar surfaces were referred to with the understanding that such surface may have thread forming grooves or serrations therein.

The main shank forming surface **17** extends from one side edge **19** of the die to the point forming surface **18** and joins therewith along the junction line **21**. Because the point forming surface **18** does not extend all the way to the forward end **22** of the die, the main shank forming surface joins the slug forming surface **12** at the junction line **23** between the forward end of the die **22** and the forward end of the point forming surface at **24**. The main shank forming surface extends the full length of the die to the trailing edge **26** and is parallel to the back surface **28** of the die and is also parallel to the plane of movement of the axis of the blank as the blank is rolled between the pair of dies.

The point forming surface **18** joins the main shank forming surface **17** along the junction line **21** which extends parallel to the edge **19** from the forward end **24** of the point forming surface **18** to the trailing edge **26** of the die. The point forming surface **18** is inclined upwardly from the junction line **21** at an angle A (illustrated in FIG. **3**) which is determined by the desired point angle of the screw to be formed by the dies. In the illustrated dies the angle A is 20°. The edges of the point forming surface **18** diverge and it increases in lateral width from its forward end at **24** to the location **29** at the trailing end of the slug forming surface **12**. The slug forming surface joins the point forming surface along a straight junction line **31**. Between the location **29** and the trailing edge **26** of the die, the point forming surface is of constant lateral width and extends to and joins with a face surface **32** along a junction line **33** therebetween. The thread grooves extend up along the point forming surface **18** and taper out at their ends **34** substantially adjacent to the junction line **33**. The thread grooves are inclined with respect to the side edge **19** of the die at an angle equal to the lead angle of the thread to be formed on the finished screw.

The slug forming surface **12** is inclined in two directions. Laterally it is inclined back from the face of the die at an angle B, and longitudinally it is inclined upward toward the plane of movement **40** of the axis of the blank. In the illustrated die the angle B is 20°. However, other angles of inclination can be utilized. The longitudinal inclination toward the plane **40** of the axis of the blank is such that the slug forming surface along its edge **31** extends upwardly through a distance substantially equal to the radius of the blank in the distance between the locations **24** and **29**. In the illustrated embodiment, the back surface **13** is formed at an angle C of about 75° as illustrated in FIG. **3**.

In order to insure that the blank does not slip excessively with respect to the forming surfaces as it is rolled between the dies, the thread and point forming surfaces **11** are provided with serrations **36** which extend laterally across the thread and point forming surfaces **11** from the edge **19** to the junction lines **23** and **31** and substantially perpendicular to the edge **19**. These serrations are spaced longitudinally along the die from the forward edge **22** to a location at **37** ahead of the trailing edge **29** of the slug forming surface **12**. The remainder of the thread and point forming surfaces between the location **37** and **26** are not provided with lateral serrations so that the finished screw has a smooth finish.

The slug forming surface **12** is also formed with serrations **38**. However, these serrations are inclined with respect to the serrations **36**. These serrations function to assist in causing the slug portion of the blank to roll along the dies with the other portions of the blank, but in addition, because of their inclination, provide a control of the point form of the finished screw in a manner discussed in more detail below.

In most machines utilizing dies of the type illustrated in FIGS. *2a* and *2b* the short die **42** is mounted on the machine frame and does not move. The long die **41** is usually supported on a reciprocating slide in a position with its main shank forming surface **17** parallel to and spaced from the main shank forming surface **17** of the short die **42** by a distance determined by the root diameter of the screw to be formed by the dies. The die **41** is carried by the slide back and forth relative to the short die **42** in a direction **43** which is parallel to its side edge **19**. Therefore, the two dies are moved relative to each other in a direction **43** which is parallel to the side edges **19** of both of the dies and the head moves along these side edges during rolling.

In accordance with this invention, the serrations **38** along the slug forming surface **12** are formed so that their projections into the plane of movement **40** of the axis of the blanks are inclined with respect to the plane schematically illustrated at **44** which is perpendicular to the direction of relative movement during die reciprocation. The use of the referenced plane **44** and the plane of movement **40** of the axis of the blanks (which is parallel to the plane of the drawings of FIGS. *2a* and *2b*) to define the angle of inclination is preferable since the slug forming surfaces **12** of the two dies are not parallel to each other and are not parallel to any other planar surfaces of the dies. Preferably, the angle of inclination D between such projections of the serrations **38** and the plane **44** is between 15° and 45°. When the serrations **38** of both of the dies are inclined in the same direction as illustrated in FIGS. *2a* and *2b*, it has been found that the screws tend to be formed with sharp points.

In some instances, particularly when it is desired to form screws which have a relatively blunt point, the pair of dies illustrated in FIGS. *4a* and *4b* may be used. These dies **41'** and **42'** differ from the dies in FIGS. *2a* and *2b* in that the projections of the serrations along the point forming surfaces extend in opposite directions with respect to the referenced plane. In the embodiment of FIGS. *4a* and *4b* similar reference numerals will be used to designate similar parts with a prime (') added to indicate that reference is made to the second embodiment.

The die **41'** illustrated in FIG. *4a* is identical to the die **41** of FIG. *2a*. In the die **41'** the serrations **38'** along the slug forming surface **12'** are inclined with respect to the referenced plane **44'** in the same direction as the thread forming grooves **27'**. However, the serrations **38'** on the die **42'** are inclined with respect to the referenced plane **44'** in a direction opposite to the direction of the serrations **38'** of the die **41'** and opposite to the direction of the thread forming grooves **27'**. When these dies are used to roll screws, the serrations **38'** tend to result in a diamond shaped working of the slug in that the serrations **38'** on the two dies work the slugs in opposite directions. It is found that slug separation tends to occur earlier when the serrations are inclined in opposite directions as illustrated in FIGS. *4a* and *4b* so that a blunter screw tends to be produced. It is believed that such earlier separation tends to occur because the oppositely inclined serrations tend to break up the metal during the point and slug forming process. However, improved uniformity in separation is still maintained.

The improved point control caused by the inclined serrations along the slug forming surface occurs in part due to the fact that a given serration remains in contact with the slug material for a longer period and thereby provides a smoother and more uniform drive for the slug. Such serrations engage the slug material first at one end and then progressively along their length. On the other hand, when the projections of such serrations are substantially parallel to the referenced plane, as suggested by Mau et al. supra, a given serration tends to engage the blank abruptly along its length and then move out of engagement abruptly. Such abrupt engagement and disengagement tends to result in a nonuniform stress on the material joining the slug and the remainder of the blank and tends to cause non-uniform separation of the slug. When slug separation occurs prematurely, the point of the screw is unfilled and when it occurs too late excessive material remains in the screw. Excessive material tends to cause excessive burning of the point and excessive die wear.

With the present invention with the inclined serrations, it has been found that the uniformity of slug separation is improved and that uniformity of screw production is improved.

Further, since the tendency for excess material to be present is reduced, the point burning is reduced and die life is improved.

A relatively smooth drive is provided when the angle of inclination of the projections of the serrations into the plane 40 with respect to the referenced planes 44 or 44' is within the range of about 15° and 45°. However, it is preferred that such angle be at least 20°. If such angle is too small, the smoothness of the drive of the slug by the serrations is not improved as much as possible. However, if the angle is too great, the direction of the serrations tends to approach the direction of relative die movement and the serrations loose their effectiveness in driving the slug. Within the range of about 15° to 45° the drive is relatively smooth and effective.

The longitudinal spacing between the serrations is also a factor in determining their effectiveness. Preferably, the spacing is sufficiently small so that the slug is in contact with at least one serration on at least one die substantially all of the time. If the angle of inclination is increased, the longitudinal spacing can be increased somewhat without objectionable sacrifice of the effectiveness of the slug drive. Similarly, screws of larger diameters do not require the serrations to be close together. It is, however, preferable to maintain a small spacing between the serrations to insure an effective drive for the slug. In most instances effective driving of the slug is provided if there are at least about 24 serrations per inch when the screws being formed are of relatively small diameters.

In one instance a life test was performed on a pair of dies incorporating this invention. These dies differed from the corresponding conventional dies only in that the serrations along the slug forming surfaces were inclined with respect to the referenced plane 44. It was found that these dies satisfactorily produced over 782,000 screws before the die wear was sufficiently bad to prevent further use of the dies. Conventional similar dies, under similar conditions, however, normally only produced between 200,000 and 300,000 screws before excessive wear occurred.

The dies illustrated in FIGS. 2*a* and 2*b* are formed with the serrations 38 both inclined in the same direction at an angle arranged so that their projections into the plane of movement of the blank axis intersect the referenced plane 44 at an angle of 30°. The dies illustrated in FIGS. 4*a* and 4*b* are formed with serrations inclined in opposite directions, but their projections are also inclined at 30° with respect to the referenced plane. It should be understood that it is not necessary to form both of the dies of a given pair with exactly the same angle of inclination and that in some instances, the angle of inclination of one die can substantially exceed the angle of inclination of the other die. This is true whether the embodiment is of the general form illustrated in FIGS. 2*a* and 2*b* or in the embodiment of FIGS. 4*a* and 4*b*.

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

What is claimed is:

1. A pair of thread rolling dies for forming a threaded and pointed screw from a blank having a generally cylindrical shank with excess material therein comprising a pair of die members adapted to be positioned opposite each other and moved relative to each other in a first direction to roll a blank therebetween with the axis of said blank in a first plane substantially parallel to said one direction, said dies each being formed with thread and point forming surfaces operable to point said shank and form threads therealong, each of said dies also being formed with slug forming surfaces operable to form said excess material into a slug and separate said slug from said screw, said slug forming surfaces each being formed with serrations therein which are spaced therealong in said first direction, said serrations of at least one die being angulated so that their projections in said first plane extend at an angle with respect to a referenced plane perpendicular to said first direction.

2. A pair of thread rolling dies as set forth in claim 1 wherein said serrations on both of said dies are angulated so that their projections in said first plane extend at an angle with respect to said referenced plane.

3. A pair of thread rolling dies as set forth in claim 1 wherein said angle of said serrations on said one die is between 15° and 45°.

4. A pair of thread rolling dies as set forth in claim 3 wherein said angle of said serrations of said one die is at least 20°.

5. A pair of thread rolling dies as set forth in claim 1 wherein said one die is longer than the other die of said pair of dies.

6. A pair of thread rolling dies as set forth in claim 5 wherein said thread and point forming surfaces are provided with thread forming grooves inclined with respect to said referenced plane in the same general direction as said serrations on said one die.

7. A pair of thread rolling dies for forming a threaded and pointed screw from a blank having a generally cylindrical shank with excess material therein comprising a pair of die members adapted to be positioned opposite each other and moved relative to each other in a first direction to roll a blank therebetween with the axis of said blank in a first plane substantially parallel to said one direction, said dies each being formed with thread and point forming surfaces operable to point said shank and form threads therealong, each of said dies also being formed with slug forming surfaces operable to form said excess material into a slug and separate said slug from said screw, said slug forming surfaces each being formed with serrations therein which are spaced therealong in said first direction, said serrations being angulated so that their projections in said first plane extend at angles with respect to a referenced plane perpendicular to said first direction and are inclined in the same general direction with respect thereto.

8. A pair of thread rolling dies as set forth in claim 7 wherein said angle of said serrations of one die is equal to said angle of said serrations on the other of said dies.

9. A pair of thread rolling dies as set forth in claim 8 wherein said angle of said serrations on both of said dies is between 15° and 45°.

10. A pair of thread rolling dies as set forth in claim 9 wherein said angle of said serrations is at least 20° on both of said dies.

11. A pair of thread rolling dies as set forth in claim 7 wherein said angle of said serrations on one die is between 15° and 45°.

12. A pair of thread rolling dies as set forth in claim 11 wherein said angle of said serrations on said one die is at least 20°.

13. A pair of thread rolling dies for forming a threaded and pointed screw from a blank having a generally cylindrical shank with excess material therein comprising a pair of die members adapted to be positioned opposite each other and moved relative to each other in a first direction to roll a blank therebetween with the axis of said blank in a first plane substantially parallel to said one direction, said dies each being formed with thread and point forming surfaces operable to point said shank and form threads therealong, each of said dies also being formed with slug forming surfaces operable to form said excess material into a slug and separate said slug from said screw, said slug forming surfaces each being formed with serrations therein which are spaced therealong in said first direction, said serrations being angulated to that their projections in said first plane extend at angles with respect to a referenced plane perpendicular to said first direction and are inclined in generally opposite directions with respect thereto.

14. A pair of thread rolling dies as set forth in claim 13 wherein said angle of said serrations on one die is substantially equal to said angle of said serrations on the other die.

15. A pair of thread rolling dies as set forth in claim 14 wherein said angle of said serrations is between 15° and 45°.

16. A pair of thread rolling dies as set forth in claim 15 wherein said angle of said serrations is at least 20°.

17. A pair of thread rolling dies as set forth in claim 13 wherein said angle of said serrations on one die is between 15° and 45°.

18. A pair of thread rolling dies as set forth in claim 17 wherein said angle of said serrations on said one die is at least equal to 20°.

19. A pair of thread rolling dies for forming a threaded and pointed screw from a blank having a generally cylindrical shank with excess material therein comprising a pair of die members adapted to be positioned opposite each other and moved relative to each other in a first direction to roll a blank therebetween, said dies each being formed with thread and point forming surfaces operable to point said shank and form threads therealong, each of said dies also being formed with slug forming surfaces operable to form said excess material into a slug and separate said slug from said screw, said slug forming surfaces each being formed with surface irregularities shaped and located along said slug forming surface to provide a sufficient drive with the slug portion of said blank to cause said slug portion to be driven along said dies with the remainder of said blank without inducing sufficiently abrupt stresses to cause nonuniformity in slug separation.

20. A pair of thread rolling dies as set forth in claim 19 wherein said surface irregularities are serrations which are angulated to engage the slug first at one end and thereafter progressively engage said slug along its length from said one end.

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