# United States Patent [19]

**Dickson**

[11] **3,789,643**

[45] **Feb. 5, 1974**


[54] **DOUBLE ANGLE CUTOFF DIE AND METHOD FOR ROLLING SCREWS**


[75] Inventor: **Joseph F. Dickson,** Oxford, Mass.

[73] Assignee: **Reed Rolled Thread Die Company,** Holden, Mass.



[22] Filed: **Feb. 10, 1972**

[21] Appl. No.: **225,242**

[52] **U.S. Cl.** ...................................... **72/469,** 10/152

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

[58] **Field of Search** ...... 72/88, 90, 469; 10/9, 87, 4; 83/643



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,538,739 | 11/1970 | Orlomoski | 72/469 |
| 3,217,530 | 11/1965 | Sato | 72/469 |
| 3,176,491 | 4/1965 | Mau et al. | 72/88 |
| 3,726,171 | 4/1973 | Strybel | 83/643 |

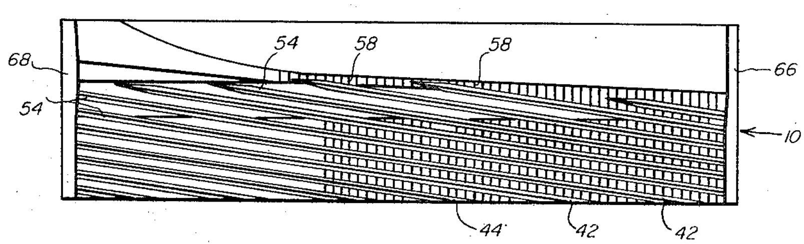


*Primary Examiner*—Milton S. Mehr


[57] **ABSTRACT**


This invention relates to gimlet point screws and thread rolling dies for making such screws. A full precisely formed gimlet point is achieved by means of an extruding cutoff ramp having a high rate of penetration initially followed by a more gradual penetration to remove the extrusion slug.


**12 Claims, 8 Drawing Figures**



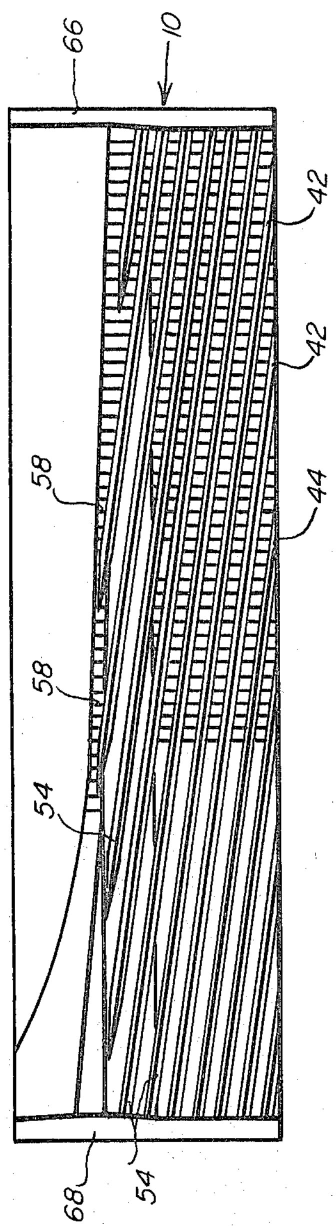

66
10
42
42
44
58
58
54
68
54

Fig_1

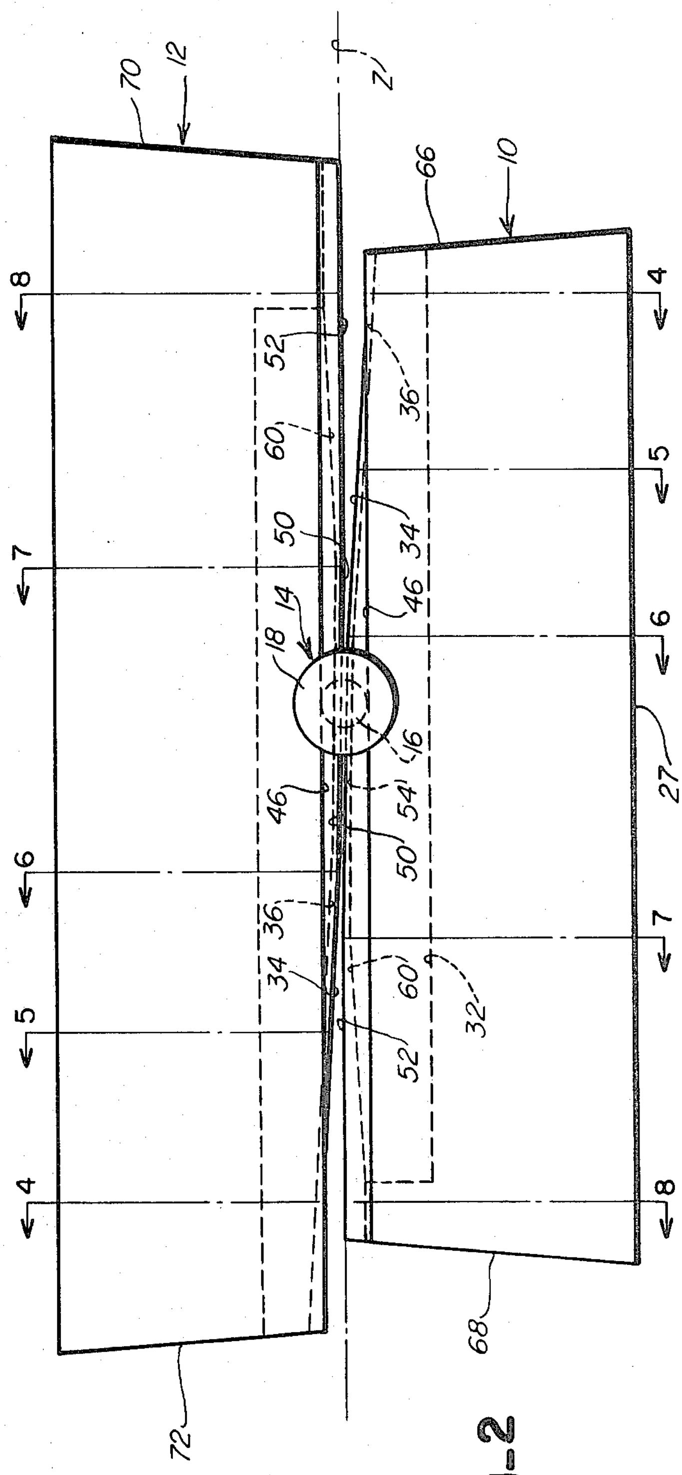

70
12
Z
66
10
8
4
52
36
60
5
50
34
7
46
14
18
6
16
27
46
54
50
6
36
7
34
60
32
5
52
4
8
68
72

Fig_2

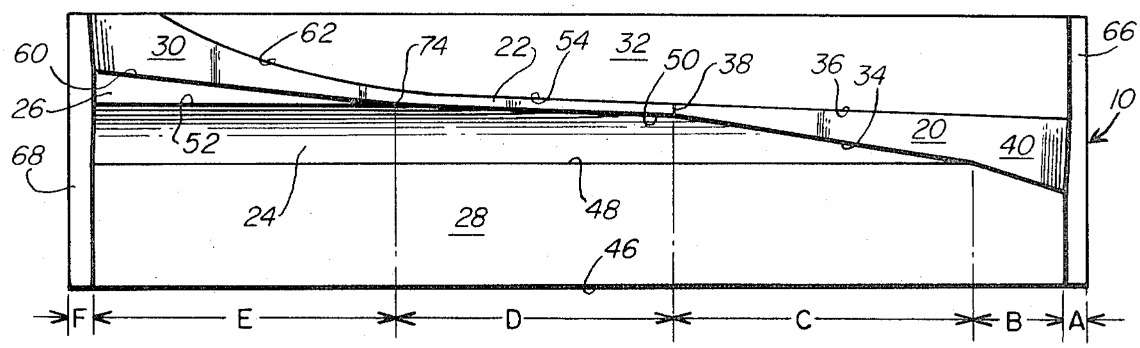



Fig_3

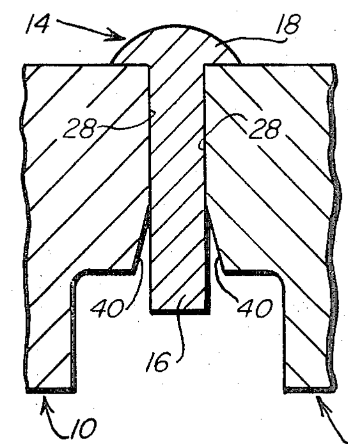



Fig_4

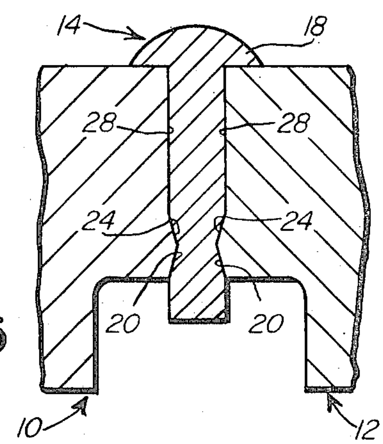



Fig_5

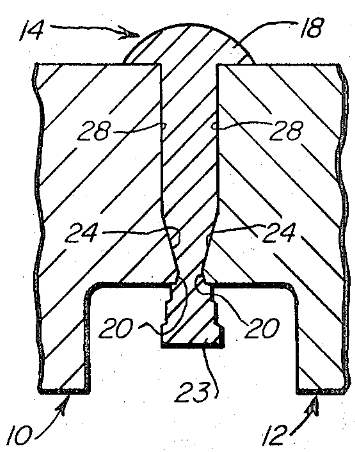



Fig_6

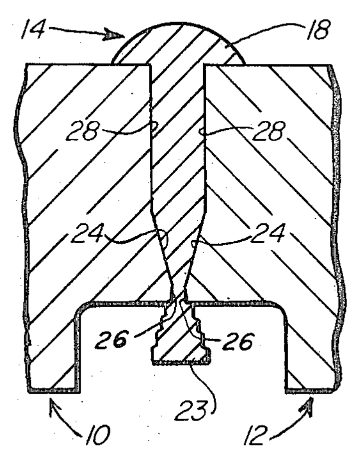



Fig_7

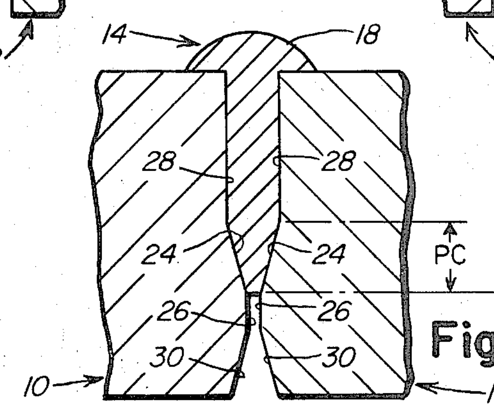



Fig_8

# DOUBLE ANGLE CUTOFF DIE AND METHOD FOR ROLLING SCREWS

## BACKGROUND OF THE INVENTION

The field of this invention pertains to methods and tools for rolling threads on workpieces as they pass between a pair of elongated generally planar dies which are relatively displaced to produce surface material flow on the workpiece to form a continuous thread. More particularly, the invention pertains to means for rolling gimlet point screws utilizing a single multiplane face of each of the two dies. These dies allow the use of straight, i.e., cylindrical blanks to be used as opposed to blanks having preformed points. The use of such dies reduces the headed blank costs as well as the size of blank inventories.

The present invention has been found to be most useful with respect to flat rolling dies in conventional thread rolling machines. In such machines the shorter of a pair of dies is ordinarily held stationary while the longer die is moved in a direction parallel to a longitudinal reference plane in which the axis of rotation of the body portion of the workpiece travels as the workpiece rolls between the pair of dies. Ordinarily no appreciable axial movement of the workpiece occurs during the rolling operation. The diameter of the finished thread is controlled by the diameter of the blank and the distance between the dies at the finish end of the stroke. The workpiece typically will be steel although any extrudable commercially employed material may be used.

Various dies have been devised in the past to produce gimlet point screws from cylindrical blanks such as that described in Mau et al U.S. Pat. No. Re26,518. Screws produced in accordance with the dies described therein are sometimes vulnerable to bad point formation. Specifically, the points may be stringy or not solid because the final point formation must necessarily occur over a relatively short distance. The rate of final point formation in such dies is the same as the rate used in rough forming the point initially from the cylindrical blank. A closely related problem that occurs with such dies is that poor point thread formation may occur because there are rlatively few ridges available on the point threading surface to form the point threads.

Another problem which has occurred with such designs is that the movement of metal with some materials is sufficiently slow to create a work hardening effect that impedes subsequent formations. This problem is most acute in the formation of gimlet points since such points are formed after the body threads have begun to be formed. It is also most acute with certain materials that are particularly vulnerable to work hardening such as 300 series stainless steel or C-1022 carbon steel which, because of its manganese composition, is more vulnerable to work hardening.

Accordingly, a primary object of this invention is to provide dies for rolling and a method for rolling gimlet point screws wherein full points and point thread formations are consistently produced.

Another object of the present invention is to provide dies which are of minimum length and which minimize cold working effects on the screw blank.

Still another object is to provide a method and an apparatus wherein the slug cutoff is delayed until a relatively full, sharp point is produced.



A further object of the invention is to gradually urge a slug of excess material away from the screw point during the final forming and threading thereof.

## SUMMARY OF THE INVENTION

It has now been found that the foregoing and related objects can be readily attained in dies for forming the circumference of a cylindrical workpiece and for severing the cylindrical workpiece. The dies have a first surface for forming the cylindrical workpiece having a mean or average plane which will be coincident with the first surface if the surface is planar. A cutoff ramp is disposed in upstanding relationship to the mean plane for severing the cylindrical workpiece having a first plane inclined at a first angle to the mean plane and a second plane inclined at a second angle to the mean plane. The angles will always be different although most preferably the first angle is greater than the second angle. In its preferred aspect, the dies have a generally planar second surface extending between the first surface and the cutoff ramp. The second surface is obliquely disposed with respect to the mean plane to form a pointed surface on a workpiece adjacent to the end formed when the cutoff ramp severs the cylindrical workpiece.

In one preferred form wherein the first plane engages the workpiece before the second plane, the cutoff ramp penetrates into the workpiece three quarters of its total penetration in the first one-half of its length which contacts the workpiece. In another preferred form the cutoff ramp penetrates seven-eights of its maximum penetration into the workpiece after three quarters of the length of the cutoff ramp has passed over the cylindrical workpiece.

The invention also contemplates the method of severing the end of a cylindrical workpiece comprising urging a first portion of an upstanding cutoff ramp having a generally planar outer face against one longitudinal portion of the cylindrical workpiece as it is rotated, and then urging a second portion of the cutoff ramp inclined at a different angle than the first portion against the one longitudinal portion of said cylindrical workpiece so that the rate of penetration into the cylindrical workpiece vaires between the first and second portions.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view to a greatly enlarged scale of the short die of a pair of thread rolling dies in accordance with the invention;

FIG. 2 is a side elevational view to a greatly enlarged scale of a pair of thread rolling dies consisting of the short die in FIG. 1 together with a long die in the matched position with a screw blank therebetween;

FIG. 3 is a top plan view to a greatly enlarged scale of the die shown in FIG. 1 before ridges and traction notches have been formed therein showing the planar faces on the top surface of the die more clearly;

FIG. 4 is a transverse sectional view to a greatly enlarged scale taken along the line 4—4 of FIG. 2 when these lines on the upper and lower dies are in vertical alignment prior to horizontal movement of the long die to the left as viewed to the FIG. 2 position and with a diameter of the workpiece aligned with the section lines but with the threads omitted to more clearly show the extruding action of the dies in forming the gimlet point;

FIG. 5 is a transverse sectional view to a greatly enlarged scale taken along the line 5—5 of FIG. 2 when these section lines on the upper and lower dies are in vertical alignment prior to horizontal movement of the long die to the left as viewed to the FIG. 2 position and with a diameter of the workpiece aligned with these lines but with the threads omitted to more clearly show the extruding action of the dies in forming the gimlet point;

FIG. 6 is a transverse sectional view to a greatly enlarged scale taken along the line 6—6 of FIG. 2 when these section lines on the upper and lower dies are in vertical alignment prior to horizontal movement of the long die to the FIG. 2 position and with a diameter of the workpiece aligned with the section lines but with the threads omitted to more clearly show the formation of the gimlet point;

FIG. 7 is a transverse sectional view to a greatly enlarged scale taken along the line 7—7 of FIG. 2 when these section lines on the upper and lower dies are in vertical alignment after horizontal movement of the upper die from the FIG. 2 position and with a diameter of the workpiece aligned with these section lines but with the threads omitted to more clearly show the point formation; and

FIG. 8 is a transverse sectional view to a greatly enlarged scale taken along the line 8—8 of FIG. 2 when these section lines on the upper and lower dies are in vertical alignment after horizontal movement of the upper die from the FIG. 2 position and with a diameter of the workpiece aligned with these section lines but with the threads omitted to more clearly show the point formation.

## DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Turning now in detail to FIGS. 1, 2 and 3 of the drawings, therein illustrated is a short die 10 embodying the present invention and having a plurality of discrete regions, each of which is adapted to operate in conjunction with a corresponding region on a long die 12 to vary the form of a blank or workpiece 14 having a cylindrical body portion 16 and a head 18. As is customary in such dies, there is an exact counterpart having identical shape and size on the long die for every portion of the short die except the end portions. The long die 12 is provided with extensions which typically may be one quarter of one inch on each end. The extensions are provided for end-wise adjustment purposes.

Referring now particularly to FIG. 3, the discrete transverse regions of short die 10 are identified by letters A through F. During the rolling operation, the workpiece 14 is rolled from region B on short die 10 and long die 12 to region E on short die 10 and long die 12. Regions A and F are the sloping end portions by which the die is mounted. Region B is the point relief area in which the screw blank is first positioned between the dies. Region C includes the cutoff or extruding ramp first plane 20 in which the ramp penetrates the workpiece cylindrical portion 16 at a high rate. In region D the angle of incidence of the cutoff ramp with respect to the workpiece is altered and a cutoff ramp second plane 22 thereof continues to penetrate the workpiece at a lower rate. The end of the cutoff ramp occurs at the end of region D at which time the extrusion slug 23 is fully formed although not yet severed from the cylindrical body portion 16 of the workpiece. FIG. 7 best illustrates this action. In region E the point threading surface 24, which started in region C, continues to fully form the threads on the gimlet point which has been fully formed at the end of region D. A planar land surface 26 is parallel to the base 27 of the short die 10 as well as to plane Z which is defined by the successive positions of the longitudinal axis of the cylindrical portion 16 of blank 14. This surface 26 provides the final severance of the extrusion slug 23 as the corresponding surface 26 from the long die bears against it and increases in width as the workpiece cylindrical portion 16 passes therebetween. The body threading surface 28 extends through regions B, C, D and E and provides for threading of the body in a conventional manner. Back taper portion 30 is provided to urge the extrusion slug 23 away from the pair of dies 10 and 12. Back cut surface 32 is cut away to provide an area for the extrusion slug 23 to drop away. Region E is the finish dwell and rolloff area which is provided to guide the fully formed screw away from the dies 10 and 12.

Turning now to the specific contours of the various surfaces within the defined regions, the first plane 20 of the extruder or cutoff ramp is substantially trapezoidal having converging sides 34 and 36 as well as a side 38 which is substantially parallel to the fourth side which is not illustrated in the drawings although it is coextensive with a line perpendicular to the longitudinal center line of the short die 10 and separating regions B and C. Surface 40 is coplanar with cutoff ramp first plane 20 but is considered a discrete surface because the cutoff or extrusion has not yet begun which forms the gimlet point as is apparent by reference to FIG. 4. It will be observed there that the cylindrical surface 16 of the workpiece 14 has not yet been deformed although it is gripped by the body threading portion 28. The body threading portion 28 is provided with a plurality of ridges 42 which form the body threads on the workpiece 14 as well as a plurality of crossnicks or traction notches as described in Orlomoski U.S. Pat. No. 3,405,545 having the same assignee as the present invention. The traction notches avoid slippage of the workpiece with respect to the die during the rolling operation. The body threading portion 28 lies between the edge 46 of the top surface of the die and heel line 48 which defines the intersection between the body threading surface 28 and the point threading surface 24. Surface 24 is bounded on the opposite side by edge 34 of cutoff ramp first plane 20, edge 50 of cutoff ramp second plane 22 and edge 52 of surface 26. Ridges 54 are provided on the point threading surface 24 in the conventional manner. The body threading surface 28 is disposed substantially parallel to the base 27 of short die 10. Point threading surface 24 is disposed at an angle corresponding to the angle of the gimlet point of the screw as is best seen by reference to FIGS. 5 through 8. The angle will not change throughout the length of the point threading surface 24 although as is most evident in FIG. 3 the width of this surface will vary.

Extrusion ramp first plane 20 forms an angle with reference plane Z and also base 27 which is most evident in FIG. 2 wherein edges 34 and 36 are clearly shown. It will be seen that an angle is formed between reference plane Z and extruder ramp first plane 20 when short die 10 is viewed lengthwise as in FIG. 2. The size of this angle will be discussed hereafter. It is also evident from FIG. 2 that viewing the end of die 10 that the extrusion ramp first plane **20** is canted at an angle. That angle which tends to force the extrusion slug **23** away from the cylindrical surface **16** of the workpiece **14** will normally be less than twenty degrees.

Similarly, the cutoff ramp second plane **22** will have an angle with respect to reference plane Z which when viewed from the end of short die **10** will also normally be less than 20°. The angle of this same surface when viewed from the side as in FIG. **2** is indicated by the edges shown in that view. Both the cutoff ramp first plane **20** and second plane **22** are provided with traction notches **58** which are desirable to insure that the extrusion slug **23** is forced to rotate with the cylindrical portion **16** of the workpiece **14.** The land surface **26** has diverging edges **52** and **60** which urge the extrusion slug **23** away from the cylindrical portion **16** after the extrusion slug **23** has been fully formed. The land surface **26** is normally substantially parallel to reference plane Z and the sides thereof diverge at an angle of approximately fifteen degrees. Wide variations in this angle are necessary with various screw sizes. The back taper portion **30** of the die is adjacent to the land surface **26** and is also bounded by an arcuate portion **62** of the back cut surface **32.** Oblique end surfaces **66, 68** are provided on short die **10** for gripping by the thread rolling machine. Similarly, oblique ends **70, 72** are provided on long die **12** for gripping by the thread rolling machine.

It should be understood that the cutoff ramp extends the length of regions C and D. Stated another way, the cutoff ramp extends the length of extrusion ramp first plane **20** and extrusion ramp second plane **22.** The total length ordinarily corresponds to about three complete turns of the workpiece **14.** It should be understood however that the length may vary and that a length corresponding to as many as five turns may be provided with the length being largely dependent upon the size of the screw being rolled and the positioning of the holders for the dies in the thread rolling machine being used. The length of the cutoff ramp may also be defined as the length of the top surface (regions B, C, D and E) less the length of the point relief area (region B) and the length of the dwell and rolloff area (region E). Region E is normally equal in length to one to one and one-half blank circumferences plus the length of rolloff. The length of rolloff will normally be about one screw major diameter. Region B is the length of point relief which normally will be fixed for any one size of die. The length corresponding to specific dies which are normally used are No. 00 — **3/16** inch, No. 0 — ¼ inch, No. 10 — ⅜ inch, and No. 20 — ½ inch. It will be understood by those skilled in the art that normally any one rolling machine will hold only one length of die and also that any one die may be used for a number of sizes. Accordingly, the number of blank circumferences equal to the cutoff ramp length will vary when different sizes of blanks are rolled on the same die.

The distance between the projection of the heel line **48** and point **74,** which is sometimes referred to as point X on a horizontal plane as in FIG. **3,** corresponds to the point constant of the gimlet point screw being rolled. The point constant of the gimlet point screw is the longitudinal distance between the extreme tip of the point and the end of sloping surfaces leading away from the point. This dimension has been labeled PC in FIG. **8.** The distance between the projection of point **74** and heel line **48** on a vertical plane as in FIG. **2** is known as the "height of curve." Since the angle between body threading surface and point threading surface **24** for any one die is constant, the ratio of (1) the vertical distance of any point on edge **50** or **34** to the heel line **48** to (2) the horizontal distance of that point on edge **50** or **34** to the heel line **48** is equal the ratio of the height of curve and point constant. For any specific gimlet point screw, the dimensions of the point constant and the height of curve dimensions of the die are fixed. Other variations in the cutoff ramp are a matter of the designers choice.

It has been found empirically that optimum point formation occurs when the intersection of edge **34** and edge **22** respectively of cutoff ramp first plane **20** and cutoff ramp second plane **22** is positioned so as to be, when projected in a top plan view such as FIG. **3,** a horizontal distance from the heel line **48** equal to three-fourths of the point constant distance mid-way between the ends of the cutoff ramp. As explained above, the ratio of the vertical height to the vertical distance of a point on the inner edge of the cutoff ramp is equal to the ratio of the height of curve to the point constant. Accordingly, the edge **34** of cutoff ramp first plane **20** is diverging rapidly from heel line **48** in region C as projected in a horizontal plane such as FIG. **2.** It is also diverging from heel line **48** as projected in a vertical plane, as in FIG. **3,** an amount proportionate to the ratio of the point constant to the height of curve. It follows that a point on first plane edge **34** which has a horizontal height from heel line **48** equal to three-fourths of the point constant distance has also a horizontal distance from the heel line equal to three-fourths of the height of curve. In other words in the first form the cutoff ramp innersurface penetrates three-fourths of the point constant distance in one-half of the length of the cutoff ramp.

In another preferred form edges **34** and **50** intersect at a point which is three-fourths of the length of the cutoff ramp with seven-eighths of the point constant. In the second form, the cutoff ramp innersurface penetrates seven-eighths of the point constant in three-fourths of the length of the cutoff ramp.

The size that is most desirable will vary with the size of the screw being rolled. More particularly, this latter embodiment has been found particularly satisfactory with No. 12 screw diameters as well as larger sizes. The first embodiment has been most successful with No. 0 through No. 10 screw diameters.

As noted before, the long die **12** is provided with an exact counterpart having identical shape in size of each portion of the short die with the exception that extensions which typically may be in the order of one-quarter of an inch are provided which increase the length of the point relief area (region B) and the finish relief area (region E). The lengths of regions C and D in short die **10** and long die **12** are identical and the distances between the section shown in FIGS. **4, 5, 6, 7** and **8** are identical in the two dies.

Turning now in detail to FIGS. **4, 5, 6, 7** and **8** the functioning of the short die **10** in cooperation with the long die **12** will be more apparent. The workpiece **14** is fed between body threading surfaces **28** of short die **10** and long die **12.** FIG. **4** as well as FIGS. **5, 6, 7** and **8** have been simplified by eliminating the threads to show in greater detail the point forming action of the dies. As long die **12** is longitudinally displaced, the workpiece is passed from region B to region C and specifically to the position shown in FIG. 5 wherein point threading surface **24** has started and as will be apparent in succeeding sectional views and also from FIG. 3 that surface is increasing its contact with the cylindrical surface **16** of the workpiece **14.** Also, at this cross-sectional point, the cutoff ramp **20** has begun to contact a portion of the cylindrical body portion **16** of the workpiece **14** and has begun to form the extrusion slug **23** and to urge it away from the head **18** of the workpiece **14.** In FIG. **6** is shown the operation of the various surfaces of the dies **10** and **12** at a point shortly after the workpiece **14** has been rolled into region D. It will be seen that the bulk of the extrusion slug **23** has been formed and that most of the point of the workpiece has also been formed by point threading surfaces **24.** The penetration of the cutoff ramp first plane **20** has been completed at this cross-sectional point, and it is most apparent that the bulk of its penetration into the workpiece **14** cylindrical portion **16** has occurred at this cross-sectional position.

Referring now to FIG. **7,** the section shown is the beginning of region E. After the workpiece **14** has moved further past point **74,** the extrusion slug **23** has been fully formed and further movement of the workpiece **14** toward the end of the dies **10** and **12** will cause the back taper portion **30** to sever the extrusion slug **23** from the rest of the workpiece **14.** In the transverse cross-section shown in FIG. **8,** the extrusion slug **23** has been completely severed and the workpiece has been completely formed preparatory to being ejected from the dies.

Although the present invention has been illustrated and described with respect to a particular form of flat die, it should be appreciated by those skilled in the art that it also has application for use with planetary dies and with respect to forming various surfaces including double lead screws as well as single lead screws and also in rolling other desired forms applied by rolling instead of merely threads. The location of the intersection of cutoff ramp first plane **20** and second plane **22** will vary with the size of the screw blank. The angle of the extruder ramp with respect to reference plane Z as viewed from the end of the die may vary between 0° and 20° although an angle of 15° is most commonly used. Also, this angle may vary throughout the length of the extruder ramp and may for example be initially 15° and then may be increased to 20° at a point of later contact with the workpiece particularly in the area near where the extrusion slug **23** is severed. Many of the other surfaces may be varied to a substantial degree without departing from the invention.

Thus, it can be seen from the foregoing detailed specification and drawings that the present invention provides a highly effective cutoff die and method for rolling screws which is capable of forming full points and point thread formations in a consistent manner. The dies by combining a cutoff ramp having a rapid rate of penetration or initial formation initially followed by a slow or final rate of penetration or final formation provide the full point without the necessity for an extremely long die which would otherwise be necessary to accomplish the desired result and which would produce undesirable cold working effects. The slower rate of final penetration or formation gradually urges the extrusion slug away from the screw point during the final forming and threading thereof.

What I claim as new and desire to secure by Letters Patent of the United States is:

**1.** A roll forming die for forming the circumference of a cylindrical workpiece and for pointing and severing the cylindrical workpiece wherein the die is provided with (a) a first surface for forming a body portion of a cylindrical workpiece, said first surface having a mean plane and (b) a cutoff ramp upstanding from said mean plane for pointing and severing the cylindrical workpiece, said cutoff ramp rising from said first surface of the die for forming the workpiece and having a first plane inclined at a first angle to said mean plane and a second plane inclined at a second angle to said mean plane, said second angle being different than said first angle, said cutoff ramp having a point threading surface on the side thereof between said mean plane and the uppermost portion of said cutoff ramp.

**2.** A die as set forth in claim **1** wherein said first angle is greater than said second angle.

**3.** A roll forming die as set forth in claim **2** wherein a generally planar second surface extends between said first surface and said cutoff ramp, said second surface being obliquely disposed with respect to said mean plane to form a pointed surface on the workpiece adjacent to the end formed when said cutoff ramp severs the cylindrical workpiece.

**4.** A roll forming die as set forth in claim **3** wherein said first and said second surfaces are provided with a plurality of ridges for forming a continuous thread on the cylindrical workpiece.

**5.** A roll forming die as set forth in claim **4** wherein said first plane engages said workpiece before the second plane and said cutoff ramp penetrates into the workpiece three quarters of its total penetration in the first one-half of its length which contacts the workpiece.

**6.** A roll forming die as set forth in claim **4** wherein said first plane engages said workpiece before said second plane and said cutoff ramp penetrates seven-eights of its maximum penetration into the workpiece after three quarters of the length of the cutoff ramp has passed over the cylindrical workpiece.

**7.** A pair of roll forming dies for forming the circumference of a cylindrical workpiece and for pointing and severing the cylindrical workpiece wherein each die is provided with (a) a first surface for forming a body portion of a cylindrical workpiece, said first surface having a mean plane and (b) a cutoff ramp upstanding from said mean plane for pointing and severing the cylindrical workpiece, said cutoff ramp rising from said first surface of the die for forming the workpiece and having a first plane inclined at a first angle to said mean plane and a second plane inclined at a second angle to said mean plane, said second angle being different than said first angle, said cutoff ramp having a point threading surface on the side thereof between said mean plane and the uppermost portion of said cutoff ramp.

**8.** A pair of dies as set forth in claim **7** wherein said first angle is greater than said second angle.

**9.** A pair of roll forming dies as set forth in claim **8** wherein each of said dies has a generally planar second surface extending between said first surface and said cutoff ramp, each of said second surfaces being obliquely disposed with respect to said mean plane to form a pointed surface on said workpiece adjacent to the end formed when said cutoff ramp severs the cylindrical workpiece.

**10.** A pair of roll forming dies as set forth in claim **9** wherein said first and said second surfaces are each provided with a plurality of ridges for forming a continuous thread on the cylindrical workpiece.

**11.** A pair of roll forming dies as set forth in claim **10** wherein said first plane engages said workpiece before said second plane and said cutoff ramp penetrates into the workpiece three quarters of its total penetration in the first one-half of its length which contacts the workpiece.

**12.** A pair of roll forming dies as set forth in claim **10** wherein said first plane of each die engages said workpiece before said second plane and said cutoff ramp penetrates seven-eighths of its maximum penetration into the workpiece after three quarters of the length of the cutoff ramp has passed over the workpiece.

* * * * *

# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

**Patent No.** 3,789,643 **Dated** February 5, 1974

**Inventor(s)** Joseph F. Dickson

**It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:**

In The Assignee:

Delete "Reed Rolled Thread Die Company" and substitute therefor --Litton Industrial Products, Inc.--.

In The Specification:

Column 1, line 45, delete "rlatively" and substitute therefor --relatively--.

Column 2, line 44, delete "vaires" and substitute therefor --varies--.

Signed and sealed this 16th day of July 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents