Sept. 7, 1965 G. L. WIEBER 3,204,516

METHOD AND APPARATUS FOR FORMING A DRILLING POINT AND THE ARTICLE SO FORMED

Filed Jan. 29, 1962 2 Sheets-Sheet 1

Fig.1

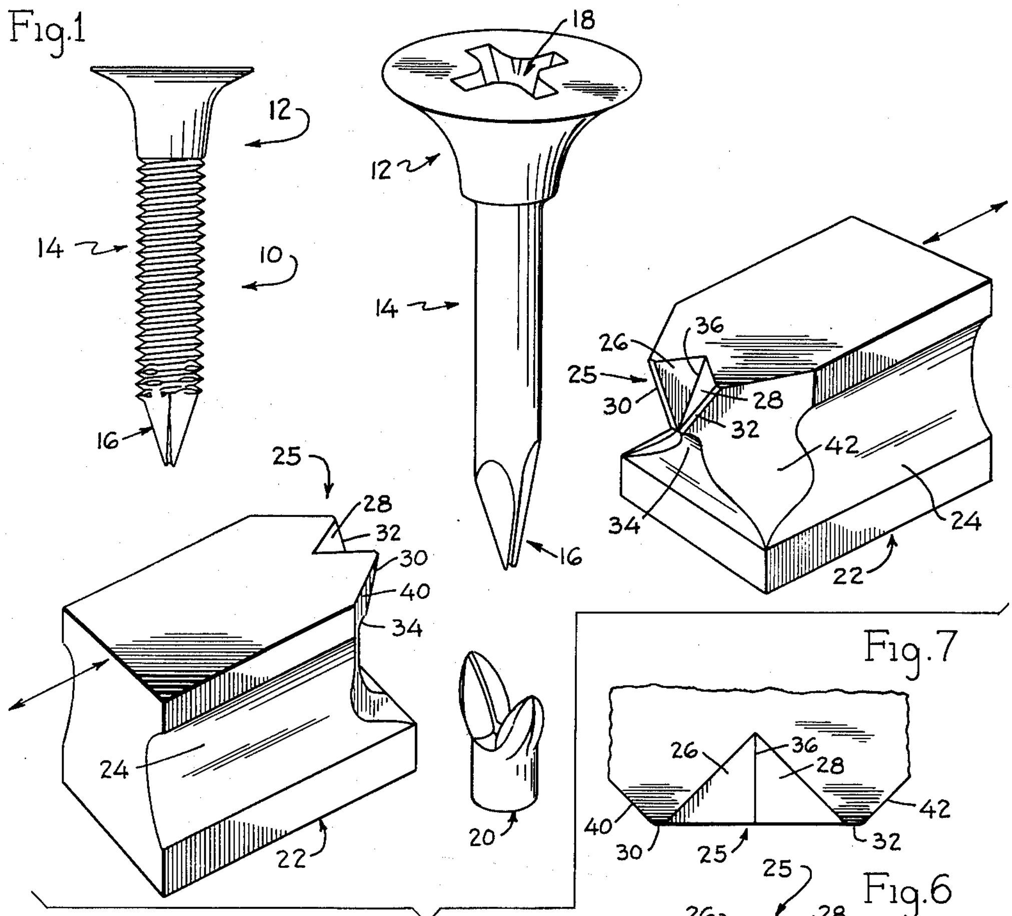


Fig.2

Fig.6

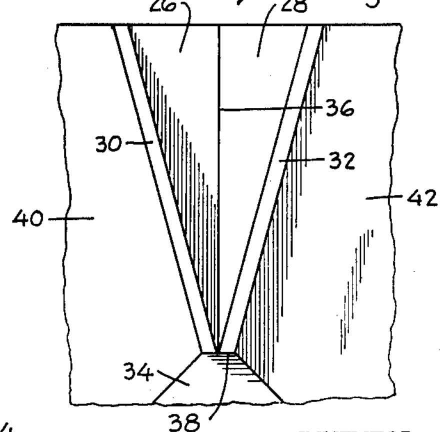


Fig. 3

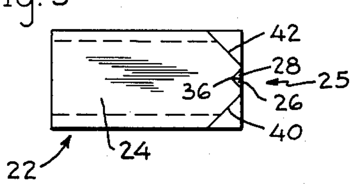


Fig.4

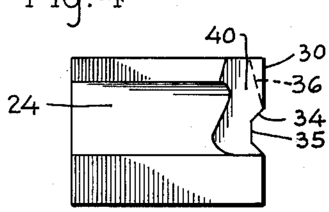
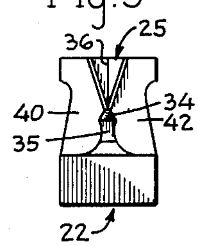


Fig.5



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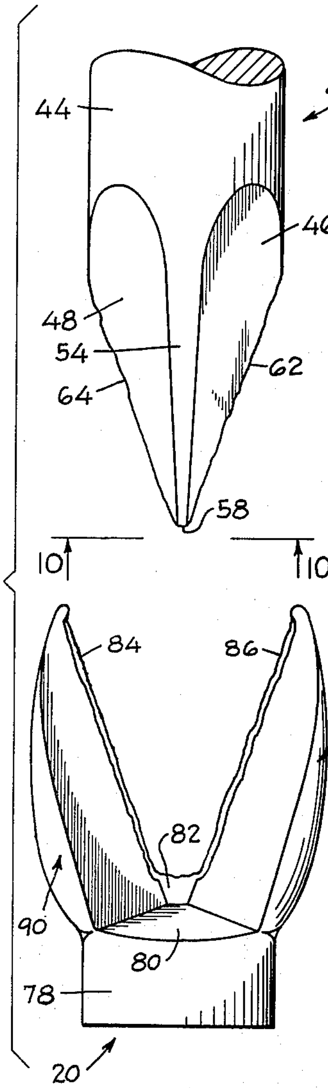

Fig. 8

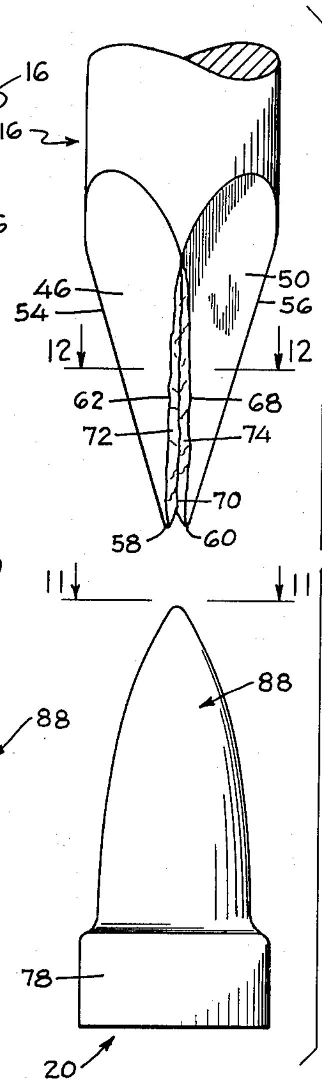

Fig. 9

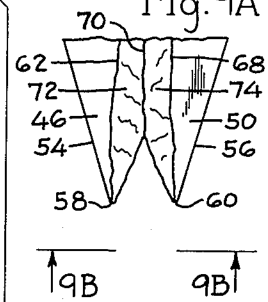

Fig. 9A

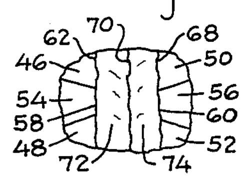

Fig. 9B

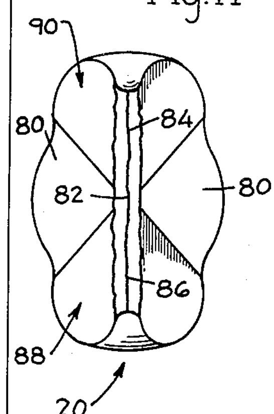

Fig. 11

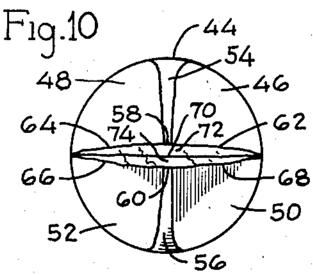

Fig. 10

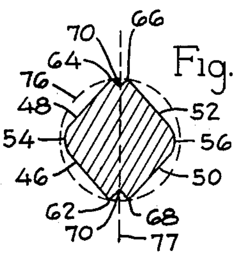

Fig. 12

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3,204,516

METHOD AND APPARATUS FOR FORMING A DRILLING POINT AND THE ARTICLE SO FORMED

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4 Claims. (Cl. 85—41)

This invention relates in general to a method and apparatus for forming a drilling point on a screw blank and to the article so formed. More particularly, this invention relates to a special construction of a pinch pointing die and its coaction with a fastener blank and in addition relates to the drilling point so formed.

Fasteners such as screws and nails have heretofore been formed with a somewhat pyramidal shaped point which, through long usage, is commonly referred to as a nail point. In nails, the precise configuration of the point is generally not of major significance except in a most general way since its penetration into the work material is by impact rather than by rotation. The standard method of forming a so called nail point on a fastener blank has become known as a "pinch pointing" technique and involves the movement of two opposed dies toward each other in a manner to pinch off the end of a generally round shank so as to provide a rather sharp point. When a standard pinch pointing die is used to pinch off or point the entering end of a threaded fastener, such as a screw or the like, certain disabilities appear in the point. While the drilling characteristics of a pinch pointed screw as made by the prior art procedures are better than a blunt end, severe disabilities have been encountered particularly when the drilling screws are used for initial drilling of metal such as, for example, steel or other relatively hard work materials. The nature of prior art pinch pointing techniques was such as to leave a very thin web or thin extension of material at the extreme tip of the fastener. This thin web while very sharp had the propensity of effectively elongating the point in a manner which is detrimental to efficient drilling. More particularly, this extension is very thin and very weak and has the tendency to be bent over in hoppering for the thread rolling operation on the fastener which is subsequential to the forming of the point.

In those cases where the prior art thin web was not bent over in the hoppering for the thread rolling operation, a further problem developed in that the point became exceedingly brittle since it becomes completely cased in the hardening operation, and thus had a tendency to break off at the start of drilling. The breaking off of this thin point then exposes a soft core at the center of the screw which in turn made drilling impractical.

Another prior art problem in forming drill points on screws as distant from nails is that occasionally the nib representing the waste material from the pinching operation would stick to the end of this elongated point on the fastener shank. A nib stuck on a screw shank poses a severe hazard to gumming up the thread rolling apparatus, a problem not encountered in the forming of nails and the like.

It is a general object of this invention to provide an improved die and method of use of same which provides an improved pinch pointed drilling point and which overcomes the aforenoted problems of prior art manufacturing as well as the problems encountered in use of the finished fastener.

More particularly, it is an object of this invention to provide an improved die construction which is sturdy and provides backup strength to the so called cutting edges, provides a relatively wide range of tolerances for misalignment of opposed dies and is otherwise well adapted for the pinch pointing operation.

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Still another object of this invention is to provide a die construction as above identified which incorporates structural relations which provides a positive separation of the nib from the shank so as to provide a uniform product for post operations.

Still another object of this invention is to provide a die construction which imparts a strong axial separating bias to the nib and the shank in a direction substantially aligned with the axis of the shank while simultaneously imparting a transverse pinching action so that a complex cutting and shearing action takes place in a manner that aids in preserving the die life of the tooling.

A further object of this invention is to provide a method of making a drill point on a threaded type fastener which is rapid, is economical, and which is well adapted to mass manufacturing techniques.

A still further object of this invention is to provide a method of making a drill point by a pinching method which eliminates the detrimental thin web end referred to above.

Still another object of this invention is to provide a method of making a drilling point screw by a pinch pointing technique wherein a web of material is "sucked" from the extreme point of the shank in a manner to expose two sharp drilling points, each of which have relatively shallow angles so as to be sturdy and are separated from each other by a groove.

Another object of this invention is to provide a method as above-described wherein shallow grooves are formed on two opposed nominal corner edges of a somewhat pyramidal type point of a fastener to expose cutting edges which are relatively sharp while providing relieved surfaces therebehind.

Still another object of this invention is to provide a method of forming a pinch point on a fastener wherein a transverse cross section through the axis at the point exposes a parallelogram-shaped section rather than a rhomboidal shape whereby the edges associated with the above-mentioned grooves extend further from the axis of the fastener than do the remaining two opposed corners.

Still another object of this invention is to provide a drilling point type screw which may be driven like a nail as well as providing exceptionally good drilling characteristics in work materials such as steel and the like.

Still another object of this invention is to provide a drilling point screw having two sharp points at the entering end which are separated by a groove to provide excellent drilling characteristics.

Still another object of this invention is to provide a screw construction which exposes sharp cutting and reaming edges, each having a negative rake independent of small variations encountered in mass manufacture.

Still another object of this invention is to provide a screw as above-identified wherein the points on the entering end takes hardening extremely well, can be made by relatively simple single operation mass manufacturing techniques, and is otherwise well adapted for the purposes for which it is designed.

The novel features that are characteristic of the invention are set forth with particularity in the appended claims. The invention itself, 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 connection with the accompanying drawings in which:

FIG. 1 is a side elevational view of a completed fastener made in accordance with the inventive concepts;

FIG. 2 is a semidiagrammatic perspective view illustrating the pinching dies and their coaction with a fastener blank and the nib formed in the pinching operation;

FIG. 3 is a top plan view of one of the dies illustrated in FIG. 2;

FIG. 4 is a side elevational view of the dies shown in FIG. 3;

FIG. 5 is a right hand end elevational view of the dies shown in FIG. 3;

FIG. 6 is an enlarged fragmentary view of a portion of FIG. 5;

FIG. 7 is an enlarged fragmentary view of a portion of FIG. 3;

FIG. 8 is an enlarged side elevational view of the entering end of the fastener shank and the nib formed in the pinching operation;

FIG. 9 is another side elevational view taken at 90° of rotation of the view of FIG. 8;

FIG. 9A is an enlarged fragmentary view of the extreme end of the fastener shown in FIG. 9;

FIG. 9B is a view along lines 9B—9B of FIG. 9A;

FIG. 10 is a plan view of the end of the fastener taken along lines 10—10 of FIG. 8;

FIG. 11 is a top view of the nib taken along lines 11—11 of FIG. 9; and

FIG. 12 is a sectional view taken along lines 12—12 of FIG. 9, certain reference lines being shown in this view for purposes of illustration.

Rotary fasteners **10**, which will drill their own holes in hard work materials such as metal and the like, are experiencing an ever increasing demand particularly with the wide dispersion of power screw drivers in industry. Fasteners **10** are conventionally formed with a head portion **12** of suitable configuration, a shank **14** which is here shown threaded with conventional screw threads in FIG. 1 and as an unthreaded blank in the other figures and an entering end **16** at the extremity of the shank **14** opposite to the head **12**. The head **12** may be formed with rotation imparting means **18** of any suitable variety.

This invention is concerned with the entering end **16**. The so called pinch pointing of the entering end **16** to form a good drilling point is of economic and practical importance since the basic machine techniques are well understood and high speed commercial machinery is available for performing this function. Further, the pinch pointing of the entering end **16** may be accomplished while the fastener blank is in unthreaded form, which eliminates post forming operations, such as slotting or grooving on the point after the thread rolling or thread cutting operation. The pinching operation is a cold forming operation on an unthreaded screw blank and is done in such a manner that a small nib **20** is removed from the end of the shank **14**, said nib being scrap.

Referring to FIG. 2 of the drawings, it will be seen that two opposed dies **22** are used in the pinching operation, the holders for the dies and the die actuating means being shown semidiagrammatically with arrows. The individual dies **22** are preferably identical and are preferably configured to form a rather long, tapered, somewhat diamond shaped or pyramidal point of the entering end **16** of the screw blank. The dies **22** are preferably made of suitable tool steel material, and each have a body portion **24** with one end of each of the dies being engageable with the fastener blank. The operating face of the die (the right hand end in FIGS. 3 and 4) is formed with a somewhat V-shaped groove means having an included angle in the vicinity of 36° (as viewed in FIGS. 5 and 6). The groove means **25** is formed by the wall surface **26** and **28** which are symmetrically disposed on opposite sides of the juncture line **36** as best perceived in FIGS. 2, 5 and 6. The surfaces **26** and **28** and thus the juncture line **36** recede in horizontal extent from the plane of the end surface of the body **24** at a predetermined angle from the plane, the preferred angularity being in the neighborhood of 18° to provide a rather long point on the end of the shank.

Of particular note are the substantially flat outline surfaces **30** and **32** which outline the groove means **25** in the plane of the end of the body as shown in FIGS. 2 through 7. For No. 8 size screws, the surfaces **30** and **32** are approximately .005 inch wide. It will be noted that surfaces **30** and **32** are in a plane essentially vertical as depicted in FIGS. 4–6 and terminate at their lower end at a rather sharp line **38** formed by the intersection of a surface **34**. The surface **34** and thus line **38** also intersects the apex of surfaces **26** and **28**. The surfaces **26** and **28** are essentially right angular in the horizontal plane as shown in FIGS. 3 and 7. Surface **34** diverges from the plane of outline surfaces **30** and **32** at an angle greater than the divergence of the juncture line **36** of surfaces **26** and **28** and in the opposite direction. In the embodiment shown, surface **34** diverges from vertical (in FIG. 4) at approximately 45°. Surface 34 has a trapezoidal shape and acts as a wedge surface together with surfaces **26** and **28** as shall become apparent. Surface **35**, which defines the lower edge of surface **34**, is offset inwardly from the plane of surfaces **30–32** and is not a working surface of the die. The groove means **25** where it intersects the top surface of the die is preferably slightly larger in width than the diameter of the shank **14** in its unthreaded form. Immediately outboard of surfaces **30** and **32**, are relief surfaces **40** and **42**. Surfaces **40** and **42** are substantially at 90° to surfaces **26** and **28** respectively as measured in the horizontal plane of the body body and as viewed in FIG. 3. Surfaces **40** and **42** respectively are each undercut or relieved at a slight angle, for example, approximately 13°. Thus, where surfaces **40** and **42** respectively intersect with substantially vertical surfaces **30** and **32** (as seen in FIG. 4), a sharp edge surface is formed at the respective junctures for purposes hereinafter appearing.

Certain relationships in the die are of particular importance. The outline surfaces **30** and **32** of the die are disposed and maintained in a plane parallel with the axis of the fastener blank and are substantially coplanar with each other. Due to the width of surfaces **30** and **32** substantial backup strength is given to the working edges which substantially increases the life of the die. Further, it is important to note that the surfaces **30** and **32** terminate on a sharp edge **38** which is tangent to the apex of surfaces **26** and **28**, said edge **38** being normal to the vertical axis of the body **24** and also forms the juncture edge of surface **34**. Edge **38** is bounded on each end by the relief surfaces **40–42** forms the termination of surfaces **30** and **32** and the apex of surfaces **26** and **28**, and is the upper terminal edge of surface **34**. Surface **34** is of particular importance in the pinching action in imparting a separating movement to the nib **20** to cause separation of the nib from the shank. Since the diverging angle of surface **34** relative to the plane of surfaces **30–32** is greater than the angularity of juncture line **36** of surfaces **26** and **28**, it imparts a substantial separating force to the nib even though the surface area of surface **34** is smaller than the active surfaces of surfaces **26** and **28** in the pinching action. The advantages of this particular construction will be explained in more detail hereinafter.

In operation the two dies are placed in suitable machinery of commercially available form, and are moved toward and away from each other in a plane transverse to the planes of surfaces **30** and **32** of the respective dies. A shank of a fastener is disposed between the two dies, the axis of the shank being essentially aligned with a plane passing through the juncture line **36** of the surfaces **26** and **28** of each of the dies. Line **38** on each of the dies are disposed relative to the screw shank so that it is spaced from the end of the initially underformed shank a distance greater than the vertical height of surface **34** of the dies (assuming the dies are disposed as shown in FIG. 2). As the two dies **22** are moved toward each other and toward the shank of the fastener, the shank is first engaged by the area around edge **38** of the dies.

As the two dies continue to move toward each other, progressively greater portions of surfaces **26**, **28** and **34** engage the shank of the fastener and a pinching cold forming action takes place. A separating movement between the shank **14** and the nib **20** is imparted by the relative divergence of surfaces **26** and **28** to surface **34** about edge **38**, said separating action being along the axis of the fastener. As the two dies get closer and closer together the separating forces become progressively stronger and at a predetermined time prior to opposed surfaces **30** and **32** engaging their opposites on the other opposed die, the nib is forceably separated from the shank. In other words, while there is cutting action imposed upon the shank relative to the nib by the outboard and inboard edges of surfaces **30** and **32** at their points of juncture respectively with surfaces **40**, **26**, **28**, **42** and **34**, a separate force is working, namely, the wedging action in the vertical plane imparted by the reverse angularities of surfaces **34** and **26–28**. This literally pulls the nib **20** from the shank **14** of the screw, said separating force becoming so great that the material is literally torn apart rather than cut apart when the two dies **22** are quite close together. Due to the configuration of the dies, a web of material is "sucked" from the shank between opposed edges **38** and opposed surfaces **30–32** so as to provide very important structural relationships in the entering end **16** of the fastener. This results in a shallow channel on each side of the fastener point coextensive with at least a major portion of the vertical height thereof, as well as a relatively deeper channel at the tip of the fastener.

It is important to note that the angularity of surfaces **26** and **28** is such, that in the forming of the point, material of the shank does not flow into the sharp corners defined by the juncture line **36** of surfaces **26** and **28**. Thus, with the angularity of surfaces **26** and **28** relative to the width of the opening of the groove means **25** at the points of juncture with surfaces **30** and **32** as shown results in the entering end **16** not being formed into a perfect rhomboid in cross section. Rather, the corners of the entering end **16**, which are formed by surfaces **30** and **32** on the dies, are spaced further outwardly from the axis of the fastener shank than those corners formed adjacent to the juncture line **36** of surfaces **26** and **28** for purposes hereinafter appearing.

Due to the flatness or width of surfaces **30** and **32** on the opposed dies, exact alignment of the two dies is not an absolute necessity. This obtains since the parting action in the vertical plane imposed by the wedging action of surface **34** contributes much to the separating force on the nib. Also the sharpening of the tools for cutting purposes is not as critical as in dies heretofore and increased die life is a concomitant of this structure due to the backup strength to the cutting edges.

Referring now to FIGS. 8 through 12, it will be seen that the pinching action of the dies **22** on the essentially round wire stock **44** of the fastener forms the entering end **16** with four faces **46**, **48**, **50** and **52** each of which is flat. This is preferred, but as will become apparent, the entering end could be cone shaped by making die surfaces **26–28** rounded (not shown) with a small loss in cutting ability in the fastener. Surfaces **26** and **28** of one die **22** form surfaces **46** and **48** on the entering end **16** and surfaces **26** and **28** of the other die form the other surfaces **50** and **52**. The areas **54** and **56** on opposite sides of the entering end **16** intermediate the four flat surfaces are rounded rather than being sharp since the material will not flow into the sharp corner formed by the line **36** on the dies at the juncture of surfaces **26** and **28**. Further, surfaces **54** and **56** preferredly have an inclination toward the axis so that they are disposed closer to the axis of the fastener than are edge surfaces **62**, **64**, **66** and **68** at the same vertical height.

A pair of spaced points **58** and **60** are formed at the extreme terminal end of the shank. The points **58** and **60** are each relatively sturdy and have essentially the same axial extent. Sturdiness is imparted to the points **58** and **60** by the angularity of the rather rough side walls **72** and **74** of the groove **70**. The groove **70** is disposed in a plane parallel with the axis and extends down one side of the entering end **16** and up the other side as perhaps best shown in FIGS. 7 and 10. The groove **70** is deeper where it traverses the extreme terminal end of the shank and progressively fades out as it approaches the cylindrical surface of the non-deformed shank. The groove **70** is formed in the shank by the separating force between the nib **20** and the shank **14** of the fastener imparted by the dies, such that the web **82** on the nib **20** and the surfaces **84** and **86** on the two ears **88** and **90** of the nib are literally pulled from the interior of the shank to define the relatively sharp jagged edges **62**, **64**, **66** and **68**. Due to the aforementioned angularity of the side walls **72** and **74** of the groove **70** and due to the angularity of edges **62** through **68**, relative to the axis of the shank, edges **62** through **68** become relatively sharp jagged cutting edges on the entering end **16**.

As perhaps best perceived in FIG. 12, the edges **62** through **68** are spaced further from the axis (see reference circle **76**) in the diametrical plane than are surfaces **54** and **56**. Thus, these edges serve to engage the work material when the screw is used for drilling purposes. Each edge **62** through **68** will become a cutting edge if the two dies **22** are exactly aligned and portions **54** and **56** are directly opposite each other. Each cutting edge has a relieved surface immediately behind the cutting edge independent of whether or not the screw has a right hand or a left hand thread. Assuming a right hand thread, cutting edge **66** has a relieved surface immediately behind it caused by the side wall **74** of the groove **70**, and cutting edge **64** has a relieved surface formed by surface **48** on the point. The same considerations apply relative to cutting edges **62** and **68** and the reverse will occur if a left hand thread is put on the screw.

A plus advantage occurs to operation of the instant dies and the point that is formed on the blank in that misalignment of the dies does not radically derate the formed point. In the event the dies are misaligned in the horizontal plane, the two halves of the entering end **16** will be shifted vertically relative to each other along reference line **77** as pictured in FIG. 12. When this occurs, two of the cutting edges will become more prominent and will bear most of the burden of cutting. For example, assume that the right half of the entering end as pictured in FIG. 12 is shifted upwardly relative to the left half on opposite sides of reference line **77**. In that event, cutting edges **66** and **62** would become the most prominent and bear the most burden of the cutting action of the entering end. On the other hand, if the right hand half of the entering end **16** is shifted downwardly relative to the left hand half along line **77** of FIG. 12 cutting edges **64** and **68** would become the most prominent. In either event the cutting edges which come into engagement with the work material maintain a negative rake and are quite effective in cutting.

Due to the relative sturdiness of the two points **58** and **60**, they take case hardening very well and do not have a tendency to break off in drilling. Because the two points are spaced relatively close together, cutting action immediately occurs upon rotation of the entering end. In other words, the two spaced points or tips **58** and **60**, immediately start cutting action as contrasted with a single point which at the start of any drilling action essentially acts as a bearing point and has to wear down until cutting edges come into play.

A comparative test between a screw made by the instant method with a point substantially as shown in FIGS. 8 through 12 made with dies as shown in FIGS. 2 through 7, as contrasted with a conventional pinch pointed entering end when used in identical steel material with identical pressures applied to the screw, cuts the drilling time from 11 seconds to 2 seconds.

The characteristics of the entering end of the screw are probably more completely conveyed from a configuration standpoint by also considering the nib **20** which is shown on the bottom of FIGS. 8 and 9 and is also shown in FIG. 11. The dies **22** engage the shank **14** at a point spaced from end **78**. The web **82**, between the two upstanding ears **88** and **90**, is the portion that is pulled out from between the two points **58** and **60**. The portions **84** and **86** on the inboard edges of the two ears **88** and **90** form the material that forms the shallower portion of the groove **70** which is sucked out of the shank. Surface **80** on the nib is formed by surface **34** on the die and imparts the separating motion to the nib from the terminal end **16**.

It is important to note that in commercial production, due to tolerance differences in the wire stock used to form the fasteners, due to wear in the die slides, and due to possible small misalignments of the two dies relative to each other, the ears **88** and **90** on the nib **20** as well as the points **58** and **60** are not always completely symmetrical. However, as aforementioned, due to the configuration and other considerations as above-discussed, the entering end **16** on the shank that is formed performs extremely well and makes a very good drilling point. The operation also gives improved die life as has been discussed, said dies being less critical in alignment than those heretofore known. The method disclosed involves the "sucking" of materials from the interior of the shank in a manner to provide spaced apart points which have an exceptionally good starting action for drilling with a concomitant advantage of providing cutting edges progressing from the tip, each of which have a negative rake.

Although specific embodiments of the invention 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.

What is claimed as the invention is:

1. A screw member having an essentially nail-type point on its entering end, said entering end being substantially pyramidal in configuration and having a relatively long taper, said pyramidal shaped entering end providing first, second, third, and fourth converging surfaces, each of which is substantially flat, each of said converging surfaces having first and second juncture edge surfaces, each of said first juncture edge surfaces being spaced from the axis of said entering end a predetermined distance less than the spacing of said second juncture edge surface as measured in the diametrical plane, shallow groove means defining said second juncture edge surface of each of said flat surfaces, each of said second juncture edge surfaces being spaced from and substantially parallel to each other to provide cutting edges, said second juncture surfaces each being in a plane substantially parallel with the axis of said fastener.

2. A screw member having an essentially nail-type point on its entering end, said entering end being substantially pyramidal in configuration and having a relatively long taper, said pyramidal shaped entering end providing first, second, third, and fourth converging surfaces, each of which is substantially flat, each of said converging surfaces having first and second juncture edge surfaces, each of said first juncture edge surfaces being rounded and spaced from the axis of said entering end a predetermined distance less than the spacing of said second juncture edge surface as measured in the diametrical plane, said second juncture edge surface of each of said flat surfaces being separated by a groove and spaced from and substantially parallel to each other to provide four cutting edges, said cutting edges each being in a plane substantially parallel with the axis of said fastener and each having a negative rake independent of the direction of rotation of the entering end.

3. A drill point fastener having an entering end on a shank, said entering end presenting flat converging surfaces in quadrature, groove means in said entering end lying essentially in a plane parallel with and traversing the axis of said fastener, said groove means being relatively shallow to define spaced tips on opposite sides of the axis of the fastener and at the extreme terminal end of said shank, said groove means extending from said extreme terminal end along each side of said entering end to form opposed cutting edges on said converging surfaces, said cutting edges being relatively jagged coextensive the length thereof, said groove means where it traverses the axis of the fastener being relatively deeper than the depth of the groove at points extending along the sides of said entering end.

4. A pinch pointed drill fastener having an entering end on a shank, said entering end presenting a point having first, second, third and fourth converging surfaces positioned in quadrature, groove means in said entering end lying essentially in a plane parallel with and traversing the axis of said fastener and the apex of said point, said groove means being generally V-shaped and relatively shallow to define a pair of spaced tips at the entering end of said point, said groove then extending upwardly on one side of the fastener between the first and second surfaces and also extending upwardly on the opposite side of the fastener between the third and fourth surfaces to space said surfaces from each other and to form generally opposed cutting edges on the adjacent spaced edges of said converging surfaces, said groove means being relatively deeper where it traverses the axis of the fastener than the depth of the groove at points extending along the sides of said entering end, the walls forming said V-shaped groove means having a jagged surface texture.

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EDWARD C. ALLEN, *Primary Examiner.*

CARL W. TOLMIN, *Examiner.*