No. 632,862. Patented Sept. 12, 1899.

H. L. ARNOLD.

TAP AND REAMER AND METHOD OF MAKING SAME.

(Application filed Aug. 31, 1898.)

(No Model.)

Fig. 1.

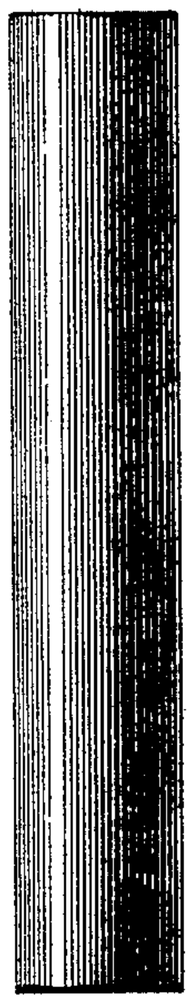


Fig. 2.

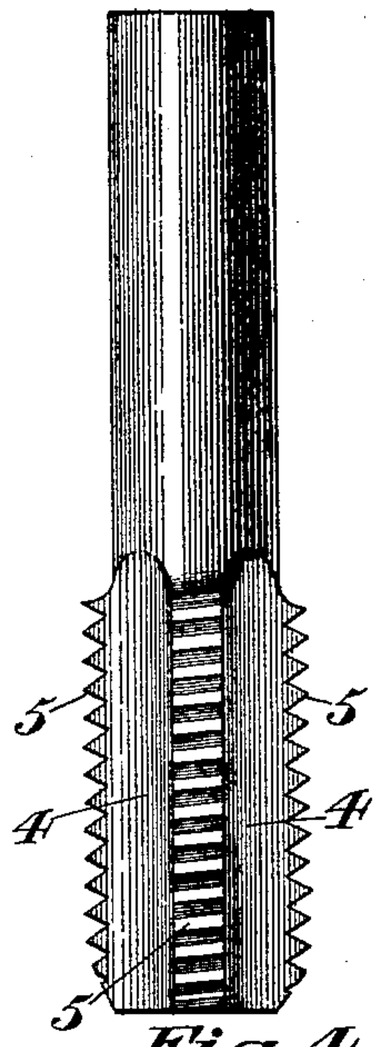


Fig. 3.

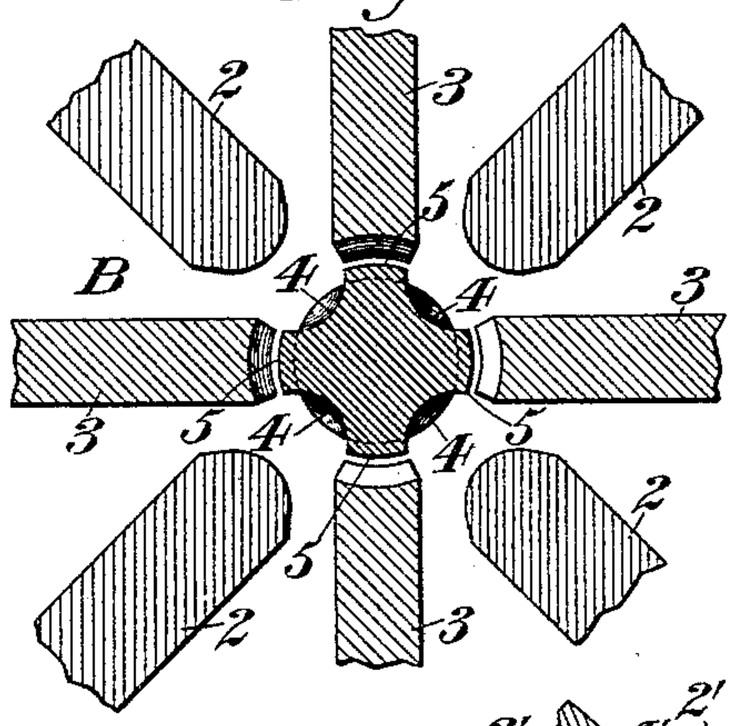


Fig. 4.

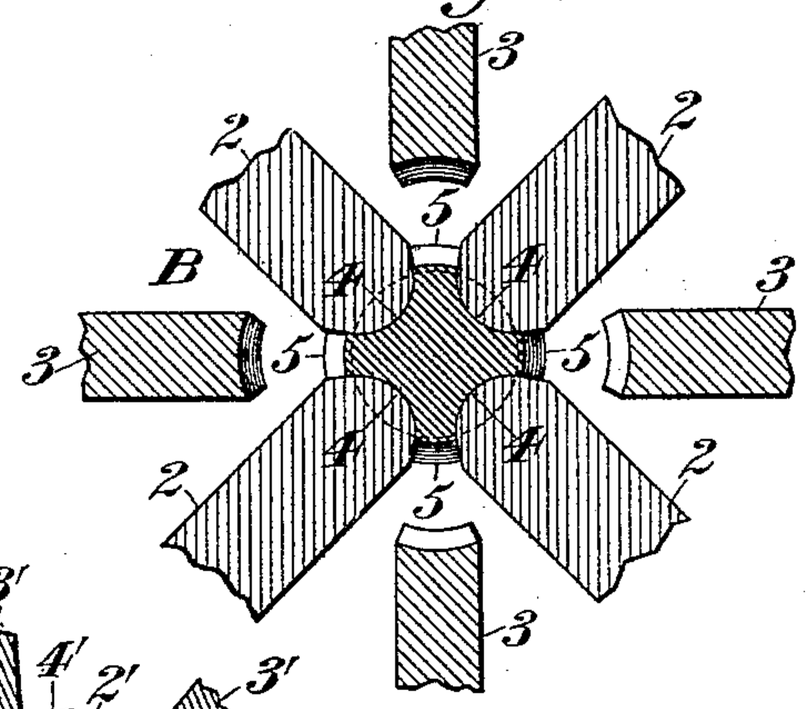
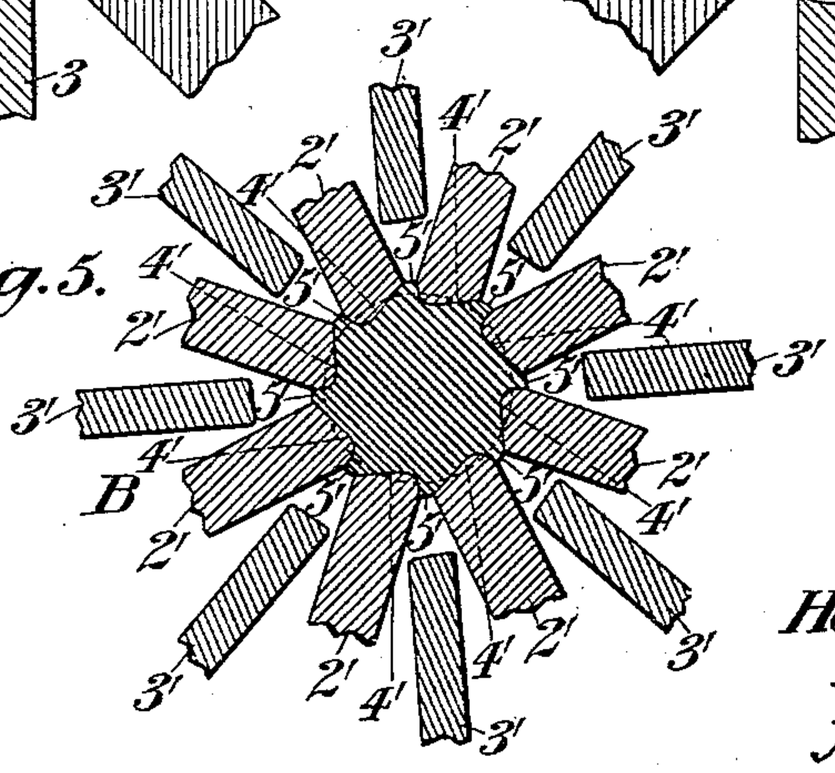


Fig. 5.



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UNITED STATES PATENT OFFICE.

HORACE L. ARNOLD, OF NEW YORK, N. Y.

TAP AND REAMER AND METHOD OF MAKING SAME.

SPECIFICATION forming part of Letters Patent No. 632,862, dated September 12, 1899.

Application filed August 31, 1898. Serial No. 689,897. (No model.)

To all whom it may concern:

Be it known that I, HORACE L. ARNOLD, a citizen of the United States, residing in New York, borough of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Taps and Reamers and Methods of Making the Same, of which the following is a specification.

This invention relates to metal-cutting tools and to the method of making such tools, and has reference especially to the manufacture of taps and reamers.

The object of the invention is to provide an improved metal-cutting tool, such as a cutting tap or reamer of superior quality and durability, and an improved method of making the same without the loss during the formation of such tool of any of the metal of the original blank and by means of which the "lands" or elevations having suitable working faces, are formed out of portions of the body-blank, together with the flutes, by gradual or step-by-step compression and during and alternately with the formation of such flutes.

A further object of the invention is to provide an improved cutting-tool—such, for instance, as a tap—and a method of making the same, in which the metal forming the teeth is worked from toward the center outwardly, and which tap will have its cutting-teeth surfaced on both their sides or outer or inclined faces and on their end faces by compression-surfaces located in transverse directions, so that the cutting angle or edge of the teeth will have a double resistance to wear and be of superior quality and efficiency.

In the drawings accompanying and forming part of this specification, Figure 1 is a side view of a blank from which the improved tool may be formed. Fig. 2 is a side view of a completed tap made from a blank, such as shown and described herein. Fig. 3 is a transverse sectional view of the blank shown in Fig. 1 after the same has been partially treated, together with a like view of the means or dies operating thereon, said view showing the flutes and lands partially formed and one set of dies again commencing to act on the lands. Fig. 4 is a view similar to Fig. 3, showing the other set of dies acting on the flutes intermediate the lands; and Fig. 5 is a cross-sectional view of a blank after the same has been partially treated to form a reamer, together with a means for operating on said blank, the flute-forming dies being shown in position forming the lands or teeth of said reamer.

Similar characters of reference designate like parts in all the figures of the drawings.

According to my present invention I take a blank of any suitable shape adapted for the purpose—such, for instance, as a cylindrical blank, although such blank may be in some cases of other shapes, as polygonal—and subject this blank to pressure between dies operated either by hand appliance or mechanical means, the action of such dies being applied in circumferential or separated zones extending around the blank and such zones extending throughout such portion of the length of the blank as is required to form the cutting or working faces of the tool. This blank will be preferably subjected to pressure in the flutes and on the lands laterally, thereby to maintain the blank in accurate shape and secure a gradual shaping of the same extending through a considerable number of forming impressions, whereby the particles of metal forming the tool will be caused to move with a minimum of destructive effect and gradually transform the original plain blank into the finished fluted tool, this being a reamer or tap, as the case may be.

This invention is especially applicable to the production of fluted taps, which of course require that the dies operating upon the lands between the flutes shall be provided with teeth-forming notches corresponding with the thread to be cut by the tap.

As a preface to a further description of this improved method of forming this improved cutting-tool I desire to state that while the same may in practice be more economically and readily carried out by machinery yet this improved method may be carried out by hand or by use of a hand appliance, if desired.

It is also to be understood that by the expression "cold," as used herein throughout the description and claims, it is intended to mean that the metal should not be heated to a sufficient extent to permit it to flow easily under pressure. By the term "zones," as herein used, it is intended to mean parts or

areas of the blank which are separate one from another. Hence by the term "circumferential zones" it is to be understood that such zones are disposed around the circumference of the blank; but the expression "circumference" is not intended necessarily and exclusively to mean a circular arc.

In carrying out this improved process of making fluted tools—such, for instance, as fluted taps—the blank is subjected to flute-forming tools, whereby the metal is thrown outward laterally—that is, transversely of the axis of the blank, so as to throw up or elevate the land portions of the tool from the metal displaced in forming the flutes, this operation being effected by a gradual displacement through repeated step-by-step operations of the dies or forming-tools, which during their operation, will gradually be brought nearer and nearer, preferably by very slight steps of advance, toward the axis of the blank, and so operate to throw up the land portions without material elongation of the blank. During the formation of the lands and alternately with each such operation they are treated to transform them into the desired working faces. In this way I am able to form a finished tool from a blank of a size as small as or less than the diameter of the bottom of the threads of the finished tool, and thus produce the finished tool having a shank of less diameter than the cutting edges without requiring any of the metal to be removed either to reduce said shank or form the working end of the tool and without any preliminary operations on the blank.

In practice the blank (designated in a general way by A) to be operated on and transformed into the finished tool may be supported in some suitable manner, as likewise may also be the means for operating on the blank. This blank-operating means (designated in a general way by B) for forming said cutting-tools may comprise two sets of tools or dies, one set operative to throw up the lands by forming the flutes and the other to shape or treat the lands formed by the flute-forming tools. In practice the flute and land treating tools or dies preferably comprise two independent sets of dies, as 2 and 3, each set preferably corresponding in number with the number of flutes or the lands, as the case may be, to be formed, the flute-forming dies, as 2, having their operating faces formed in accordance with the shape of the flute and the land-treating dies, as 3, having a construction adapted to form the desired working face of the tool, whether this be teeth-forming notches or cutting-faces, and each die preferably having a working surface coinciding with the length of the flute or land, as the case may be, to be formed.

In carrying out this improved method the blank, which may be first heated, if desired, but preferably cold, is disposed in position, and one of the sets of dies, as 2, is operated to engage the blank in circumferential zones, whereby in the form of tap shown herein four longitudinally-extending flutes or grooves 4 are simultaneously formed, thereby forming four lands or working faces 5. This set of dies 2 is followed by the other set of dies, as 3, which operate on the lands 5 to give them the desired form of working face.

In practice since it is desirable to gradually form the flutes, whereby a gradual formation of the land portions of the tool is obtained, the sets of dies operate in alternation, first to form the lands by forming the flutes, and then to transform such lands into the desired working faces, such alternate operations continuing until the circumference or periphery of the blank which is engaged by the flute-forming dies is gradually shaped into land portions, usually of greater diameter than the original shank, and the proper working or cutting surface given thereto. The shank of the tool may then be treated in any suitable manner, if desired, to give it any desired structure or shape to adapt it to the purpose for which the tool is to be used. From the foregoing it will thus be seen that the working faces are formed simultaneously with—that is to say, during—the formation of the lands. From the foregoing it will also be seen that a blank of the same diameter throughout or of a less diameter at one portion than another may be provided with working faces formed therefrom, the diameter of which may be greater than the diameter of the original blank, and that all of such working faces may be simultaneously formed, so that the blank may be supported on all sides simultaneously by the operating tools or dies.

By this method a superior tool is produced at much less cost than heretofore, since the blank may be treated cold, thereby to form working faces, which are of superior quality, owing to the compression treatment described, and which tool, especially the working end thereof, may be formed complete without the loss of any of the metal present in the original blank, since owing to the compression step the metal of the tool, especially that of the working faces, is materially condensed, which treatment gives to the working edges high efficiency and great durability. Moreover, it will be seen that a feature peculiar to the improved tap made according to my present invention is that the teeth of the tap are brought to shape by gradual step-by-step forming-pressure alternately applied to both of the surfaces which meet at the working or cutting edge of the tool, said working or cutting edge being formed by the "junction," so to speak, of the face surface of the tooth with the outer surface of the same, so that in the present improvement the several cutting-teeth of the tap are surfaced both on their sides or outer or inclined faces and on the ends of the teeth by compression-surfaces, and these two compression-surfaces being located in transverse directions integrally join each other at the cutting end faces

of the teeth to form the cutting angle or edge of the tooth and to give the tooth at that point a double resistance to wear, whereby the completed article is produced with teeth of a superior quality and efficiency, especially as the compression-surfaces have their most condensed portions or layers on the extreme outside of the tooth, and thence grow less and less dense as they proceed inwardly toward the center of the tooth. In this improvement, therefore, since these characteristics of construction are the same on the end faces of the tooth as on the side or inclined faces of the same, it follows that those portions of the tooth which form the cutting angle or edge thereof when presented flatwise to the metal to be removed in the usual manner will be more durable, owing to their superior quality and increased resistance at this point than they would be if the teeth were only compression-surfaced at the sides or inclined faces thereof, since in the latter case the ends not being compressed to the same density as the sides the cutting edge would be less effective to cut, as one part or the end would be weaker than another part thereof, and hence the tap-teeth would sooner become worn. This would be especially the case in those instances where the tap is first formed with the teeth extending entirely around the circumference of the blank, after which sections of such teeth are removed to form the flutes, since by the removal of such sections the outer condensed portions or layers which are the most compression-hardened are removed, leaving the ends of the teeth practically uncompressed in a direction transverse to the inclined or outer surfaces of such teeth.

In the present improvement the extreme outer compression-surfaces, as above set forth, join and reinforce each other, and so give the cutting angle or edge of the tooth a superior quality and increased strength and resistance to wear, so that, as already pointed out, the character of the surface which is driven against the metal to be removed is of a peculiar formation, due to the particular manner in which the respective surfaces are simultaneously produced. Moreover, it will be seen that by the present method of constructing my improved cutting-tool, such as a tap, the metal forming the tooth is worked from toward the center of the blank outwardly, whereas in methods heretofore used for making taps the metal is worked from the outer surface of the blank toward the center—that is to say, in my method the teeth are formed or worked from their base upward, since the metal forming the teeth is gradually elevated or built up by the "land-forming" dies, during which gradual operation the tooth-forming dies operate to shape such teeth, so that the metal forming the teeth is first acted upon at its base, whereas according to the old method the outer cylindrical surface of the blank is first acted upon, the forming tool or die gradually working inward toward the center.

In forming a reamer in practice two sets of dies may also be used, one set, as 2′, for forming the grooves or flutes 4′ of the desired shape, and the other set, as 3′, for treating the lands or cutting-faces 5′ of the reamer, and for maintaining the required diameter of the tool such dies may have their working faces constructed to form the desired shape of reamer and may be operated in substantially the manner set forth for the making of the improved tap herein described.

I claim as my invention—

1. A tap having a plurality of sets of transversely-extending cutting-teeth, each set alternating with a longitudinally-extending groove or flute, said teeth having their end faces and their inclined or outer sides surfaced by compression-surfaces and formed by compressing step by step the body of a blank in separated longitudinally-extending zones to form lands elevated from said body, and during the formation of such elevated lands and alternately with each formative step thereof compressing the outer faces of said lands to form said transversely-extending cutting-teeth.

2. A tool having a plurality of working faces surfaced on their ends and on their outer faces by compression-surfaces, and formed by elevating longitudinal sections of the body of the tool by subjecting the blank for the tool to step-by-step compression in separated longitudinally-extending zones, to thereby form a plurality of elevated lands, and during the elevation of such lands and alternately with each formative step thereof compressing the outer faces thereof to form the desired working faces.

3. A tool having a plurality of working faces formed by compressing, step by step, a blank in separated zones to form longitudinally-located lands, and alternately with each such compressing step treating the lands to form the desired working faces.

4. A tool comprising a shank having a plurality of working faces of greater diameter than said shank, and formed by treating a blank of substantially the same diameter throughout to compression, step by step, in circumferential zones, thereby to form a plurality of independent lands, and then alternately with each such compressing step compressing said lands to form said working faces.

5. The method of forming a tap having a plurality of sets of cutting-teeth, which consists in subjecting a blank to step-by-step cold compression to gradually form from toward the center of such blank, outwardly, a plurality of elevated portions or lands, and during the formation of such lands working the same from toward the center of such blank, outwardly, to form the cutting-teeth.

6. The method of forming a metal-working

tool having alternate flutes and working faces, which consists in subjecting a blank to step-by-step compression to form a plurality of longitudinally-extending separated flutes, and simultaneously forming by the displacement of the metal laterally relatively to said flutes a plurality of longitudinally-extending separated lands, and, during the formation of such lands and alternately with each such compressing, treating said lands to form them into the desired working faces.

7. The method of forming a metal-working tool having alternate flutes and working faces, which consists in subjecting a blank to step-by-step compression to form a plurality of longitudinally-extending separated flutes, and simultaneously forming by the displacement of the metal laterally relatively to said flutes a plurality of longitudinally-extending separated lands, and, during the formation of such lands and alternately with each such compressing, compressing said lands to form them into a plurality of working faces.

8. The method of forming a tap or reamer having alternate flutes and working faces, the latter surfaced at their outer faces and at their ends by compression-surfaces, and which consists in subjecting a blank to step-by-step cold compression, thereby to form a plurality of longitudinally-extending separated flutes, and simultaneously forming by the displacement and elevation of the metal laterally relatively to said flutes a plurality of longitudinally-extending separated lands, and during the formation of such lands, and alternately with each such compression, cold compressing said lands to form thereon working faces.

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