No. 631,158. Patented Aug. 15, 1899.

F. G. ECHOLS.

METAL CUTTING TOOL AND THE ART OF MAKING SAME.

(Application filed Nov. 4, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

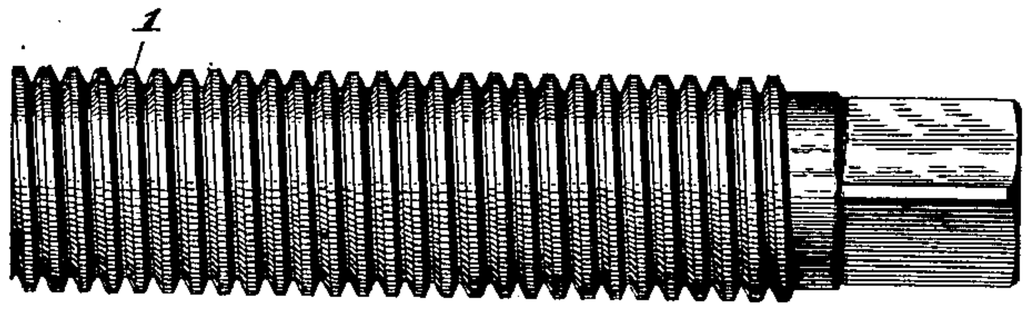

Fig. 2.

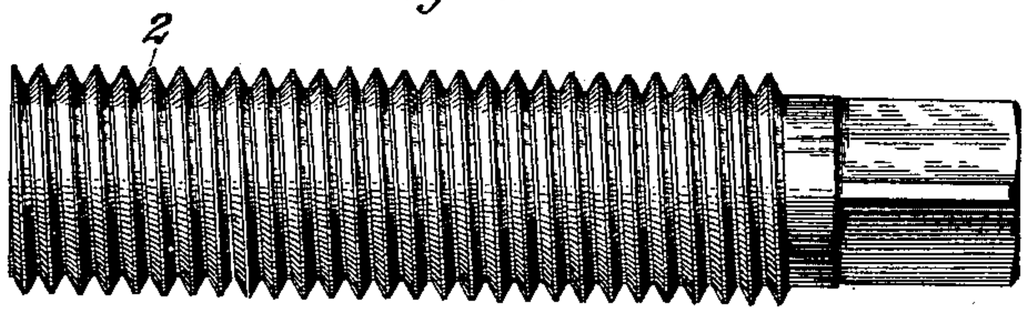

Fig. 3.

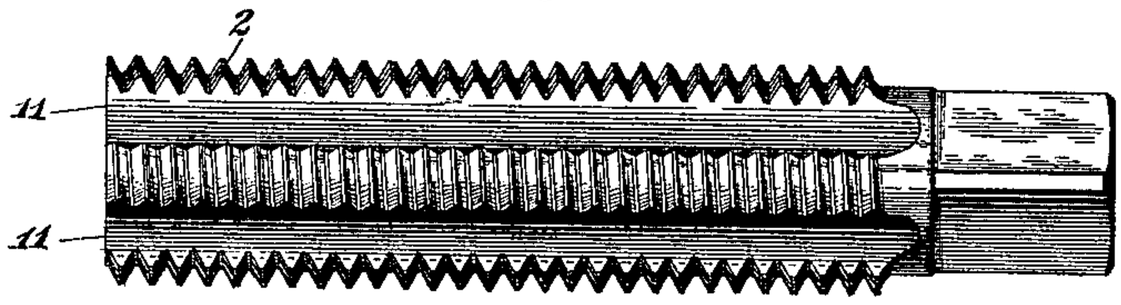

Fig. 4.

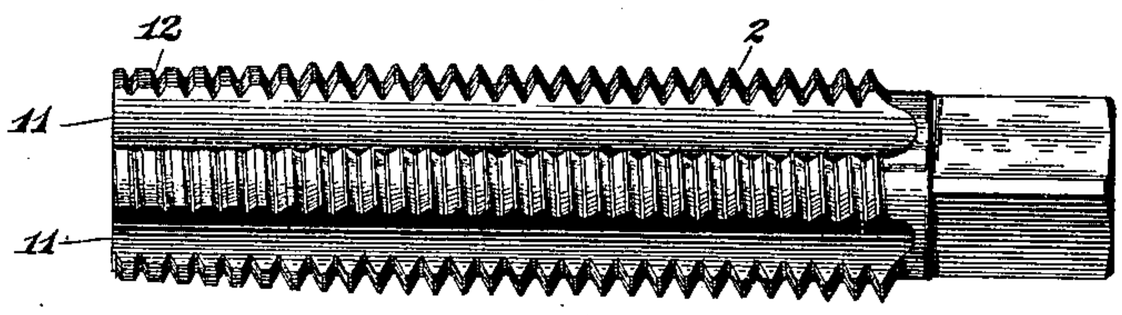

Fig. 5.

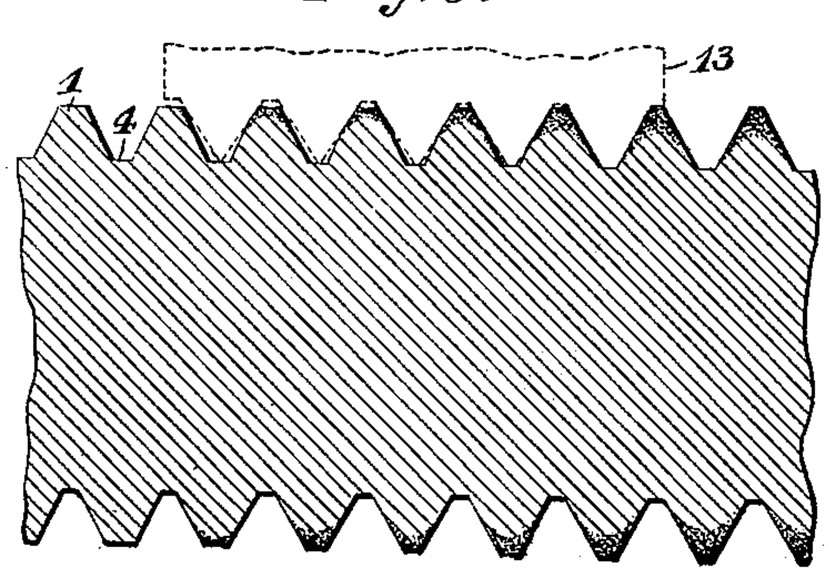

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Fig. 6.

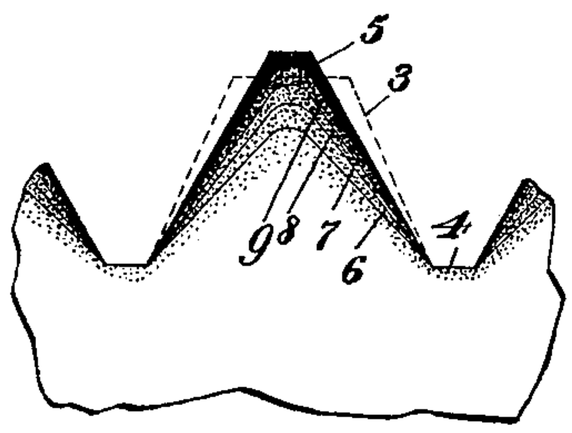


Fig. 7.

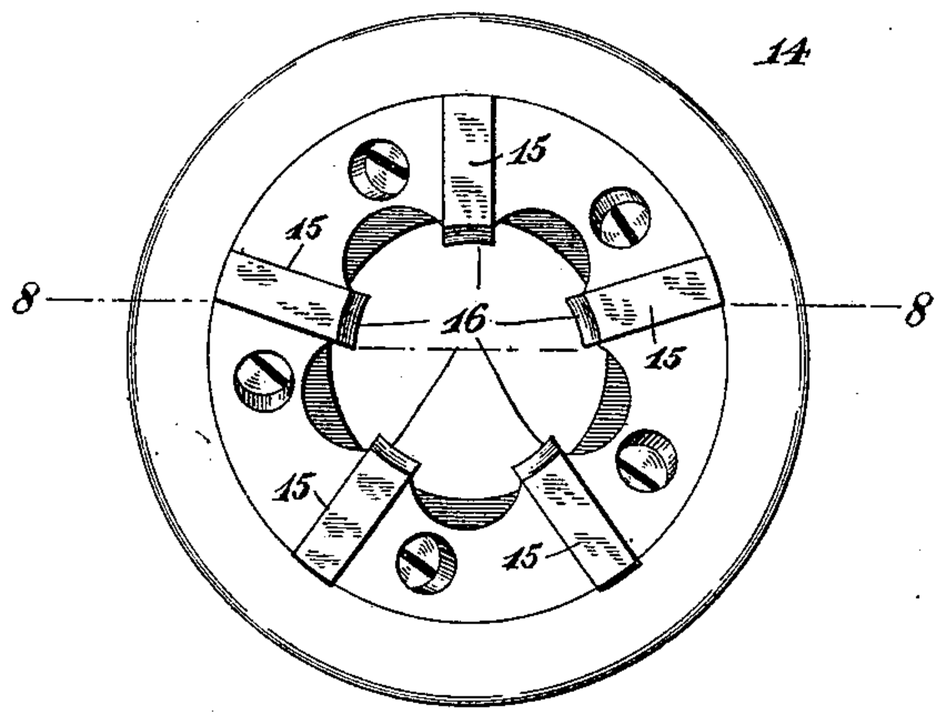
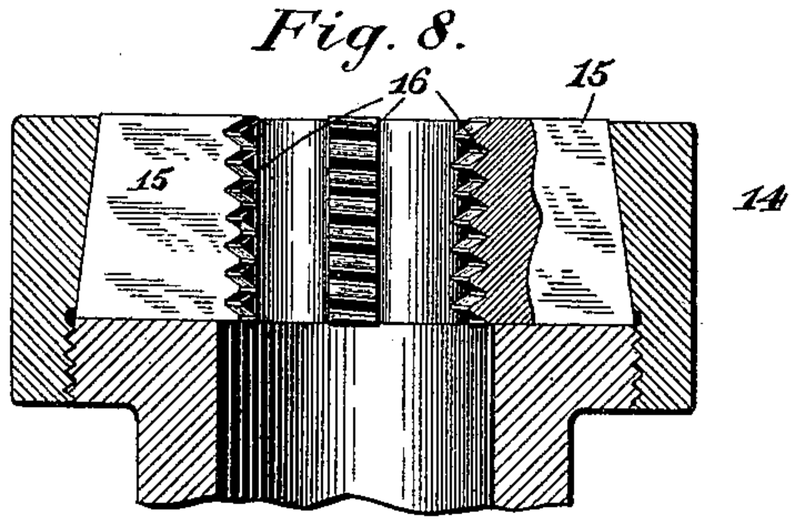


Fig. 8.



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UNITED STATES PATENT OFFICE.

FRANK G. ECHOLS, OF HARTFORD, CONNECTICUT.

METAL-CUTTING TOOL AND THE ART OF MAKING SAME.

SPECIFICATION forming part of Letters Patent No. 631,158, dated August 15, 1899.

Application filed November 4, 1898. Serial No. 695,430. (No model.)

To all whom it may concern:

Be it known that I, FRANK G. ECHOLS, a citizen of the United States, residing in Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Metal-Cutting Tools and the Art of Making Same, of which the following is a specification.

This invention relates to metal-cutting tools, and has for its object the production of such tools of superior quality and precision and to furnish the same with accurately-formed cutting edges of high efficiency.

My invention, as hereinafter illustrated and described, is applied to a screw-cutting tool, although, as is obvious, it is of general application and may be applied to reamers, broaches, and other forms of tools having raised or rib-like working surfaces. In the manufacture of taps and dies it is a great desideratum to equip the same with accurately-formed cutting edges of high efficiency the teeth of which are of uniform size and shape and of superior strength and durability, and with this object in view I proceed as follows: When my invention is applied to the manufacture of screw-cutting tools, as hereinafter described, the blank is prepared for the finishing operation by having cut therein a thread of a slightly less height than the normal height of the finished thread, and which thread should correspond in pitch with the required pitch of said finished thread and should have such a cross-sectional form as will properly distribute the metal in the cross-sectional area of each thread-blank for producing during the rolling operation a thread of the required standard form and size and at the same time to accomplish this result by a certain reforming of the mass of metal in the thread-blank, whereby the edge of the thread will be produced from the metal which lies in the blank—that is, in the middle part of the outer portion of the thread-blank—whereby the metal of the finished thread is subjected to a large amount of rolling in the outer portion thereof and to a correspondingly-decreasing amount of rolling from said outer part of the thread inwardly toward the body of the finished tool. By means of this method of producing the finished thread for the tool the part of the thread which in the finished tool is subjected to the greatest amount of work is produced by subjecting the metal thereof to the greatest amount of rolling and to a rolling operation continued for the longest period of time, and the base portion of the thread is left in substantially the same condition in which it existed in the blank as originally formed in its rough state, in virtue of which the body of the tool is kept free of any internal strains which might otherwise be caused by the subjection thereof to the rolling operation, for, as is well known, in this general department of the metal-working art the subjection of a cylindrical body of metal (such as a tool-blank) to external rolling produces in the blank unequal strains in the different parts thereof, thereby tending during the subsequent hardening operation to which the finished blank is subjected to distort the tool or to change the final exact measurements. By means of my present improvement and by subjecting the specially-shaped thread-blank to the rolling operation, beginning at the outer portion thereof and extending gradually toward the base of the thread-blank, and this rolling operation decreasing in depth of effect from the edge portion of the thread toward the body of the blank, it will be evident that in the base portion of the finished thread the metal remains in substantially the same condition in which it existed in the thread-blank, and therefore does not have the effect of transmitting the results of the rolling operation into the outer portion of the body of the tool.

By means of my present invention the screw-cutting tools—that is, the finished threaded blanks therefor—are produced of the required high quality and precision of form and size and are so produced at an extremely low cost relatively to their quality and value. Also, the surfaces of the finished thread are rendered so perfect in form and of such homogeneous quality by the rolling operation to which the same are subjected, and especially by reason of the peculiar manner in which the operation is carried out, that the material of the thread on the surface portions of the same is "wrought together and welded," so to speak, into a perfect condition in which the various imperfections of

surface and of metal—such, for instance, as the minute incipient cracks which often exist in metals—are completely eliminated, thereby securing in the finished tool a uniformity and perfection of the highest importance.

In the accompanying drawings, in which my invention is illustrated, similar characters referring to like parts throughout the several views, Figure 1 is a side elevation of a tap-blank having a cut thread of truncated form. Fig. 2 is a side elevation of said blank after the thread has been cold-rolled to finish and precisionize the same. Fig. 3 is a similar view of a tap-blank after the longitudinal flutes or grooves have been formed therein. Fig. 4 is a like view of a finished fluted tap-blank having a cold-rolled thread and the usual tapered entering end. Fig. 5 is a central longitudinal section of a blank, illustrating the action of the rolling-die thereon, the latter being shown in dotted lines. Fig. 6 is an enlarged diagrammatic view of a thread-tooth, showing the displacement and gradual compaction of the metal during the operation of rolling the same from the blank into precisionized form. Figs. 7 and 8 are plan and sectional views, respectively, of a screw-cutting die involving my invention.

As above stated, the invention consists, in a general way, in the art of manufacturing metal-cutting tools, and in carrying out the same when applied to the manufacture of screw-cutting tools a cylindrical blank is first formed and is then subjected to a cutting or metal-removing operation, by which a primitive thread 1, of truncated form, is developed therein, as illustrated in Fig. 1. The thread of this blank is then subjected to a cold-rolling operation, by which it is brought to its complete and precisionized form, as illustrated at 2 in Fig. 2.

Referring to Fig. 6, which illustrates diagrammatically the method of cold-rolling each convolution or thread of the blank illustrated in Fig. 1, the primitive cross-sectional form of the thread is shown by the dotted line 3, the outer portion of the cylindrical body of the tool is illustrated by 4, and the finished cross-sectional form of the thread is indicated by the solid line 5. The character of the result which is obtained by subjecting the thread-blank 1 to the rolling operation, whereby it is reshaped into the finished thread 5, is illustrated by the lines 6, 7, 8, and 9 and by the degrees in the dark character of the stippling in the areas between the line 6 and said lines 7, 8, and 9, which lines may be considered as fairly representing the changed character of the metal wrought in different portions of the cross-sectional area of the thread by the continued rolling to which each individual thread-blank or convolution is subjected. It will be observed that the metal in the base portion of the thread and outside of the boundary-line 4 of the tool-body is represented as being in its original normal condition corresponding to the condition of the metal in the body of the tool, so that this body portion is unchanged by the subjection of the thread-blank thereon to the rolling operation. This result is secured through the limitation of the rolling action, whereby the change of character of the metal of the thread is restricted to the outer portion and to the side surface portions of the thread-blank and is prevented from extending into the inner portion of the finished thread. This inner portion of the finished thread stands between the reshaped and roll-hardened portion of the thread and the body portion of the tool, and thus acts as a species of barrier for preventing the strains due to the rolling operation from extending into the body of the tool, which would obviously tend to reduce the stability of said body portion during the subsequent hardening operation.

In Fig. 3 a tap is shown having the finished thread 2 and with the usual flutes or longitudinal grooves 11 therein. In Fig. 4 the tap is represented in the same manner, but with its entering end tapered by removing a certain portion of the thread, as at 12.

A section of the roll for forming the finished thread in the tap-blank is illustrated by dotted lines in Fig. 5 and indicated by the numeral 13, and it will be observed by reference to this figure that the primary or incipient threads produced by the cutting operation are illustrated at the left thereof, whereas the finished and precisionized threads are shown at the right.

In Fig. 7 I have shown my invention as applied to an ordinary sectional screw-cutting die 14, in which individual die-sections 15 are illustrated as provided with cold-rolled precisionized threads formed in the manner above described, said threads being indicated in said figure and also in the sectional view Fig. 8 by the numeral 16. After the threads have been formed in the blank in the manner above described the same is hardened in the usual manner, and it will be found that on account of the peculiar displacement of the metal during the rolling operation the tools will not become warped or distorted during the hardening operation and that the precisionized thread will remain true and perfect, of much greater efficiency than the old forms of thread, and possessing not only perfect precisionized cutting-surfaces, but also the quality of endurance to a greater degree than has heretofore been the case.

Although my invention is illustrated and described as applied to screw-cutting tools, yet I desire it to be distinctly understood that it is not limited thereto, it being of general application to all forms of metal-cutting tools which are formed by first manufacturing the tool in its primitive form by cutting or removing the metal from the blank of which it is made and by subsequently cold-rolling and finally hardening the working surfaces of said tool.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. An improvement in the art of manufacturing tools, which consists in first forming the working portion of the tool by cutting or removing the metal therefrom to produce a raised surface or rib, and subsequently finisning said surface or rib by cold pressure.

2. An improvement in the art of manufacturing screw-cutting tools, which consists in first forming a thread by cutting or removing the metal from the blank, and, secondly, cold-rolling said thread to finish and precisionize the same.

3. An improvement in the art of manufacturing screw-cutting tools, which consists in first cutting a thread to a truncated form, and finally cold-rolling said thread to finish and precisionize the same.

4. An improvement in the art of manufacturing screw-cutting taps, which consists in first removing the metal of the tap-body to produce a truncated thread, and finally cold-rolling said truncated thread to a finished form, substantially as and for the purpose specified.

5. An improvement in the art of manufacturing threaded tools, which consists in first cutting the thread to a truncated form; secondly, cold-rolling the truncated thread to a finished form; and finally, hardening the tool.

6. An improvement in the art of manufacturing screw-cutting taps, which consists in first forming a thread on the tap-blank by cutting or removing the metal therefrom, said thread being of truncated form; second, cold-rolling the truncated thread to finish the same; third, grooving the tap; and fourth, hardening the same.

7. A tool made by cutting the metal from the body thereof to form a projection of approximately finished form and then finishing said projection by cold pressure, thereby imparting to the tool the qualities specified.

8. A screw-cutting tool having a thread formed by removing the metal from the body of the tool and then cold-rolling said thread to complete and precisionize the same.

9. A screw-cutting tap having a thread formed by removing the metal from the body of the tap and then cold-rolling said thread to complete and precisionize the same.

10. A screw-cutting tap formed by cutting and removing the metal to produce the thread and by cold-rolling said thread to complete form, said tap being hardened, substantially as and for the purpose specified.

11. A screw-cutting tap having a thread made by cutting the metal from the body thereof and by cold-rolling said thread to complete and precisionize the same, said tap being grooved or fluted longitudinally and hardened.

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