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METHOD OF AND APPARATUS FOR GENERATING HOLES IN METAL.

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1,148,065. Patented July 27, 1915.

Fig. 1.

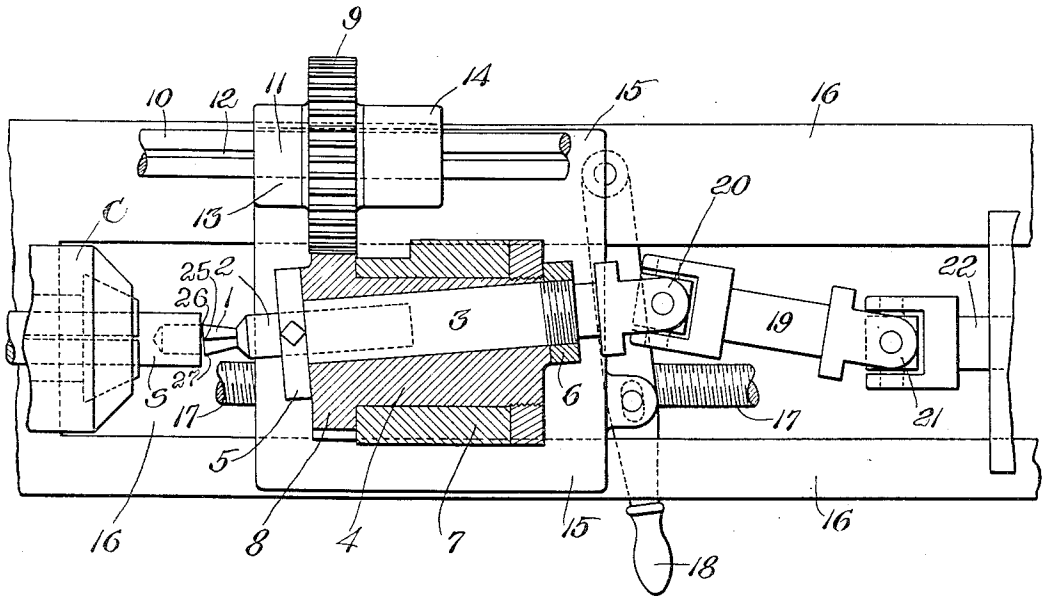


Fig. 2.

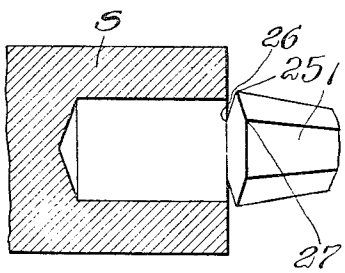


Fig. 3.

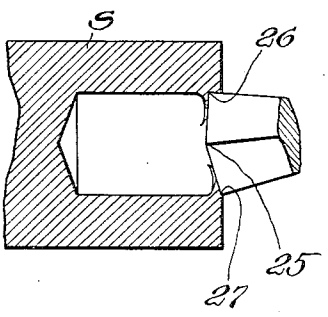
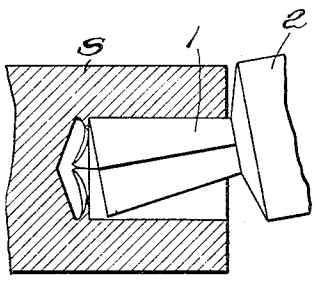


Fig. 4.



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METHOD OF AND APPARATUS FOR GENERATING HOLES IN METAL.

1,148,065. Specification of Letters Patent. Patented July 27, 1915.

Application filed February 18, 1915. Serial No. 9,142.

To all whom it may concern:

Be it known that I, HENRY ERNEST WARREN, a citizen of the United States, residing at Lancaster, in the county of Lancaster and State of Pennsylvania, have invented certain new and useful Improvements in Methods of and Apparatus for Generating Holes in Metal; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to a method of and apparatus for generating polygonal holes in metal, and more particularly to a method of and apparatus for generating hexagonal holes in set screws. In Letters Patent No. 1,123,045 dated December 29, 1914, the method of generating polygonal holes in metal therein described is generic in its nature. That method is the genus method of generating polygonal holes in metal and the present method is a specific form of the genus method.

The object of the invention then, is to produce a specific method of generating polygonal holes in metal and an apparatus for carrying that method into effect.

The invention consists in the method and apparatus hereinafter described and particularly defined in the claims.

In the accompanying drawings depicting somewhat diagrammatically an apparatus for carrying the invention into effect, Figure 1 is a plan of the machine, partly in section, and Figs. 2, 3 and 4, illustrate the action of the tool on the stock; Fig. 2 is a view looking at the tool at right angles to the view in Fig. 1; Figs. 3 and 4 are views at right angles to Fig. 2.

The stock S of which the set-screw is manufactured is supported for the performance upon it of the operation of generating the polygonal hole, in the chuck *c*, which is supported in the usual manner upon the hollow head stock spindle (not shown) of the machine. The present method is adapted to be used in connection with any usual type of automatic screw machine, and such machines being well known to those skilled in the art, it has not been considered necessary to illustrate one: a simple form of mechanism will accordingly suffice for illustrating an embodiment of the apparatus forming the subject of this invention. Preliminary to the operation of generating the hexagonal hole, a round hole with a diameter equal to the distance between two opposite sides of the regular polygon forming the hexagonal hole is drilled in the end of the stock. The hole generating tool 1 has a shank 2 which is adapted to be received in a sleeve or collet 3 which is arranged at an angle of about 1½ degrees to the axis of the head stock of the lathe, and loosely supported in a geared spindle 4, being secured against longitudinal movement therein between the collar 5 and the nut 6. The angle of off-set of the collet 3 is shown exaggerated in the drawing for the sake of clearness. The axis of the geared spindle 4 is coincident with or parallel to an extension of the axis of the head stock of the lathe. To position the collet 3 then, properly, relatively to the axis of the stock in which the polygonal hole is to be generated, it is simply necessary to bore the recess in the spindle into which the collet is received, at an angle of about 1½ degrees to, the axis of the spindle. This geared spindle 4 is loosely mounted in and adapted to rotate in a tool support 7. The spindle supports upon its forward end a gear 8 which takes against the forward end of the support 7; a nut upon the rear end of the spindle serves to maintain the spindle in its bearing and affords provision for adjusting the longitudinal movement or end-play of the spindle. The spindle gear 8 meshes with and is driven by a driving gear 9 slidingly mounted on a shaft 10 and held against rotating relatively thereto by a key 11 sunk into a spline 12 in the shaft and received in a key way in the gear. The gear is positioned between two uprights 13 and 14 which are provided with apertures for the free passage of the shaft 10 therethrough and are made integral with a base 15 with which the support 7 is also made integral. This base 15 constitutes a slide or tool carriage and is adapted to slide longitudinally toward and away from the stock, upon the lathe ways 16. Longitudinal motion is imparted to the carriage 15 either automatically through the screw 17 or manually by the handle 18 which is suitably connected with the carriage and a stationary part of the lathe. A knuckle shaft 19 joined at its forward end to the

rear end of the collet 3 by the universal joint 20, and at its rear end to a shaft or rod 22 by a second universal joint 21. The rod 22 is adapted to be received slidingly within a recess in a stationary support. The knuckle shaft 19 serves to prevent the collet 3 from rotating in the spindle 4 and also from rotating with the spindle, and yet allows a relative motion between the collet and the spindle.

Power is applied to the shaft 10 in any suitable manner, as by belt or gear connected either with the driving means of the lathe itself or otherwise. When the apparatus described above, which embraces the essential features of the polygonal hole generating apparatus of the invention, is in process of generating a hole, and the tool is being fed into the stock, the carriage carries the two gears 8 and 9 forward together, gear 8 being carried forward by the support 7 and gear 9 by the upright 14, the gear 9 sliding upon and rotating with the shaft 10, and thereby causing the geared spindle 4 to rotate in its bearing in the support 7. The rotation of the spindle causes a gyrating motion to be imparted to the collet 3 and therefore to the tool. In the illustrated embodiment of the invention a truncated regular hexagonal pyramid constitutes the hole generating tool 1 whose cutting edges are formed by the intersection of the larger base with the sides of the pyramid. These cutting edges perform the cutting operation in generating the polygonal hole in the stock. The tool is joined by its smaller base with the tool shank 2.

The genus method of generating polygonal holes in metal as elucidated in Letters Patent No. 1,123,045 consists in supporting the stock or metal, to be operated upon, and the hole generating tool, with their axes in the same plane and at an angle to each other, revolving them synchronously and causing them to move progressively toward each other. The present or specific method of generating polygonal holes in metal contemplates supporting the metal or stock to be operated upon in the same manner as in the genus method; the stock, however, is not rotated but remains stationary; unless it is desired to advance the stock upon the tool; in that case, the movement is not rotative, but longitudinal. The hole generating tool, moreover, is not supported nor maintained in the same plane with the stock, except that the center of the truncated end of the tool upon the perimeter of whose surface the cutting edges are formed, always intersects the axis of the polygonal hole being generated in the stock. The tool is supported in such position relatively to the axis of the stock that when motion is imparted to the tool (through the means described above) the shank end of the tool is caused to revolve about the axis of the stock extended, while the center of the truncated end of the tool intersects the axis of the stock. The motion of the axis of the tool then is gyratory and the path traveled by it forms a cone of which the apex is the center of the truncated end of the tool and the base the circle circumscribed by the end of the shank. When longitudinal motion is also imparted to the tool, it then describes a spiral. This gyrating motion of the tool causes its truncated end to maintain a regular wabbling movement which constitutes the cutting motion.

Now, while the stock S is held stationary and the hole generating tool 1 is caused to gyrate, owing to the rotation of the geared spindle 3, and the tool is fed forward progressively, either by hand or by power, in the direction of the axis of the stock, the cutting edges of the hole generating tool are forced into the metal of the stock and generate a hole therein which, in the case under consideration is a regular hexagonal prism. Upon the completion of the hexagonal hole generating operation in the end of the stock, if set screws are to be manufactured from the stock, the exterior of the stock will be screw threaded, and then the set-screw will be finished off in any usual manner.

Referring to Fig. 2, it will be observed that while the stock S remains stationary, and the tool 1 is caused to gyrate only, and is not advanced upon the stock, there is no action of the tool upon the metal; but when the tool is advanced upon the stock, then the tool begins its operation of forming the hole in the stock. To elucidate, the hole generating operation, it is supposed that the tool is gyrating in a direction opposite to the travel of the hands of a clock. Owing to the gyrating motion of the tool, the truncated surface of the tool is constantly shifting its plane, therefore the edges of this truncated surface are successively presented to the stock. Now as the tool is fed into the stock during its gyratory motion, the cutting edges of the tool attack the stock in their path of travel and force it therefrom by a shearing action, as will be apparent from a consideration of the change in position of point 25 as illustrated in Figs. 2 and 3. While point 25 is traveling from its position as indicated in Fig. 2 to its position as indicated in Fig. 3, the edge 25—26 will have performed a cutting operation; it is then withdrawn from operation by the gyratory motion of the tool the change of the position of which is due to the gyration as shown in Fig. 3 and the next successive cutting edge 25—27 is brought into cutting operation in exactly the same manner. The other cutting edges of the tool are brought into and withdrawn from operation in the

same way. It is apparent, therefore, that the generating of the hole is due both to the longitudinal and gyratory movement of the tool, and this combination of movements causes a progressive shearing of the stock by the tool. Now, inasmuch as the tool has no rotative movement, each cutting edge of the tool will be brought into contact with only that side of the hole upon which it is projected. It is to be observed that during the gyration of the tool and its progress into the stock, the center of the end surface of the tool moves only longitudinally, therefore the hole generated by the tool has exactly the same size and contour as the truncated end of the tool, whether it be regular or irregular, or composed of curved and straight lines.

While the present invention is a species of the genus described in said patent, the invention herein claimed is in itself broad and comprehensve in character as the method may be practised by widely different forms of apparatus and the apparatus is susceptible of embodiment in various forms.

Having thus described my invention what I claim is:

1. A method of generating holes in stock which consists in maintaining the stock to be operated upon and the tool operating upon the stock from rotating and with their axes at an angle to each other, the center of the cutting end of the tool being intersected by the axis of the stock, gyrating the tool about the extended axis of the stock and moving the stock and tool relatively to each other to cause the tool to enter the stock to generate a hole in the stock corresponding in form and size to the form and size of the end of the tool.

2. A method of generating holes in stock which consists in supporting the stock to be operated upon in suitable stationary position, and subjecting it to the action of a tapered tool supported by its smaller end with its axis at an angle to the axis of the hole to be generated, the center of the cutting end of the tool being intersected by the axis of the stock, and in causing the tool to gyrate in relation to the stock and to move progressively into the stock.

3. An apparatus for generating holes in stock having, in combination, means for supporting the stock, means for supporting and gyrating a tool for operating upon the stock, the axis of the supporting means for the stock intersecting the center of the cutting end of the tool, and means for feeding the tool into the stock.

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