

Nov. 7, 1933.

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1,933,737

METHOD OF MAKING SCREWS AND BOLTS

Original Filed Jan. 30, 1929

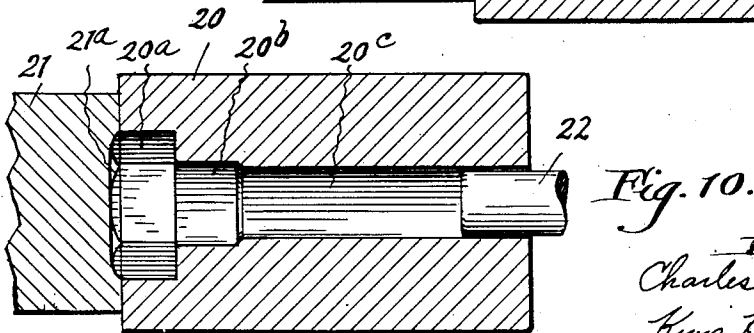
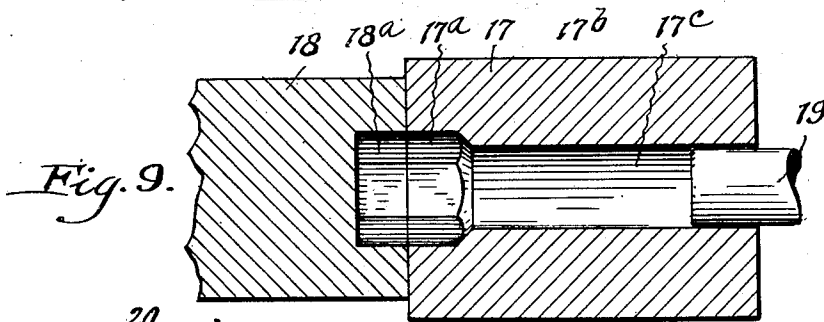
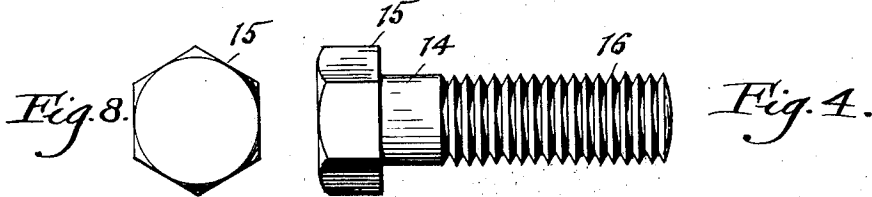
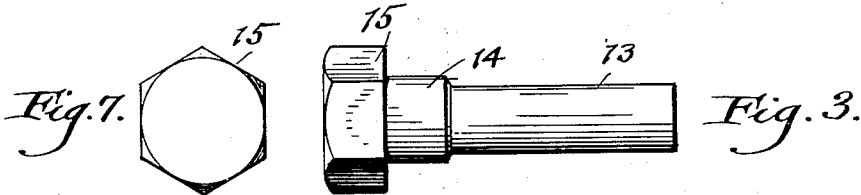
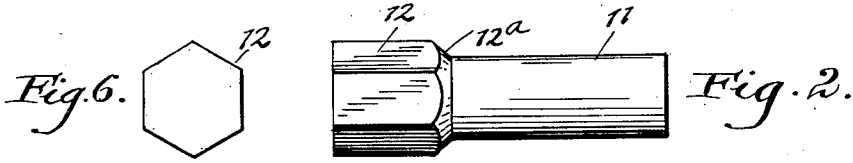
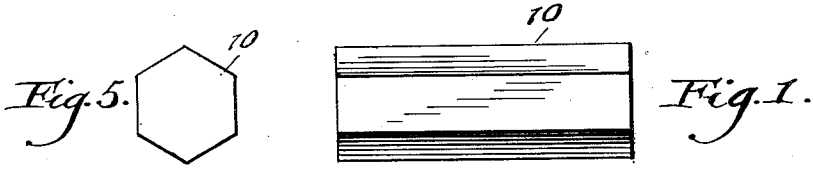


Fig. 10.

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UNITED STATES PATENT OFFICE

1,933,737

METHOD OF MAKING SCREWS AND BOLTS

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Application January 30, 1929, Serial No. 336,127
Renewed January 13, 1933

11 Claims. (Cl. 10—27)

This invention relates to a process of making screws and bolts, and in certain respects is an improvement over the process described in my prior Letters Patent No. 1,617,122.

5 The principal object of the present invention is to reduce the liability of fracture in the grain lines in that portion of the metal forming the head. In other words, it is one of the objects to reduce the liability of fracture of the head, due to what may be termed "heading strains".

10 In accordance with the process of my prior patent, which process is being used successfully and very extensively, a length of round stock of a diameter equal substantially to the over-all diameter of the thread to be formed is subjected to the action of drawing and upsetting dies which draw out a portion of the stock to the pitch diameter of the thread and upsets another portion to form a round head, and when certain kinds of screws, such as cap screws are formed, a portion of the stock of its original diameter is left between the reduced portion and the enlarged head portion. Thereafter a thread is rolled on the reduced portion and a polygonal head is formed on the round upset head portion by trimming dies, thus completing the article.

15 The said patented process is an improvement on a prior process which starts with a piece of stock of the pitch diameter of the thread and forms the head and intermediate portion by upsetting the stock leaving the part to be threaded at its original diameter. My patented process has numerous advantages over that last referred to, chief of which is that it reduces the liability of fracture of the head since there is used a stock of larger diameter and less upsetting is required to form the head. By the present process the liability of fracture of the head due to heading strains created in the head forming process is still further reduced.

20 My present process differs from the patented process in several particulars, chief of which is the fact that I start with a length of polygonal stock and draw out a portion of the same and at the same time, change it from polygonal to round shape so that it may be threaded. Preferably another portion of the polygonal stock is upset to form the polygonal head. The drawing may be accomplished in one or a plurality of drawing operations, two being sufficient and being preferred by me at the present time and preferably the expansion or upsetting of the polygonal stock to form the polygonal head or the major portion thereof takes place simultaneously with the last drawing step or operation.

The invention may be here briefly summarized as consisting in certain novel steps or combinations of steps of my improved process which will be described in the specification and set forth in the appended claims.

My invention may be used advantageously in forming practically all kinds of screws and bolts having polygonal heads, such as cap screws, machine bolts, carriage bolts and the like. Furthermore, it is not confined to a screw or bolt having a polygonal head with any number of sides, but may be used to advantage where the head is square, hexagonal, octagonal or, in fact, having any number of sides as may be found in articles of this character.

In the drawing I have illustrated my process applied to the production of a conventional form of cap screw, using stock of hexagonal shape, but these features are illustrated not by way of limitation but by way of example only.

Referring to the drawing, Fig. 1 is a side view of a length of polygonal stock (in this instance hex stock as above stated), the length being predetermined to form a screw or bolt of given size; Fig. 2 shows the partially completed blank after the first drawing operation; Fig. 3 shows the completed blank after the second drawing operation and the upsetting to form the polygonal head of the desired size; Fig. 4 shows the completed cap screw produced by rolling threads on a portion of the shank of the blank of Fig. 3; Figs. 5 to 8 inclusive are end views looking toward the right of the articles illustrated in Figs. 1 to 4; Fig. 9 is a cross-section of drawing dies employed for converting the length of stock of Fig. 1 to the shape illustrated in Fig. 2; and Fig. 10 illustrates in section dies for completing the blank shown in Fig. 3.

The length of stock designated 10 will be cut from a suitable polygonal bar or wire of indefinite length, it being understood that the stock which is operated on is in a cold state. It may at the same time that it is cut off be transferred over to the first drawing dies wherein a portion designated 11 is elongated, reduced in cross-section, and converted from polygonal shape to round shape. The diameter of the portion 11 is preferably equal to the over-all diameter of the threads to be subsequently formed, although I do not regard this as an essential feature or condition of this step of the process. The partially completed blank also has a polygonal portion 12 joined to the drawn portion 11 by a short tapered portion 12a. Generally the portion 12 is of the same cross-section as the original stock but its

cross-section may be slightly increased in the first drawing operation.

After this drawing operation, the partially completed blank is transferred to a pair of drawing and upsetting dies and here the stock is further drawn down, the portion to be threaded here designated 13 being drawn to the pitch diameter of the thread. If the screw or bolt is such that the entire shank is not to be threaded, there will be formed in this step of the process a round drawn portion 14 between the portion 12 and the head 15, the portion 14 having a diameter equal to the over-all diameter of the threads, and in this instance equal or substantially equal to the diameter 11 of the partially formed blank of Fig. 2.

At the same time that this drawing operation is performed, the undrawn polygonal portion 12 of Fig. 2 is subjected to an upsetting operation which reduces its length and expands it to form the completed head 15 having the same number of sides as the original stock 10. In this same operation the head may be crowned and otherwise completed, it only being necessary in order to complete the screw or bolt to roll the threads 16 onto the reduced portion 13 of Fig. 3, thus forming the finished article which is illustrated in Fig. 4.

For the first drawing operation, i. e., to produce the partially completed blank of Fig. 2, I may employ drawing dies such as illustrated in Fig. 9 wherein two die members 17 and 18 are illustrated. The die member 17 is generally stationary and the die member 18 is adapted to reciprocate toward and from the former, the dies being shown closed in Fig. 9. The die member 17 has a cavity 17a and the die member 18 has a cavity 18a, and when the dies are closed these cavities conform to the shape of and receive the polygonal portion 12 of the partially formed blank. The entire cavity which receives this portion of the blank may, if desired, be formed in the die member 17, but I prefer that it be formed partly in both die members. The polygonal shaped cavity 17a has at its inner end a conical portion 17b corresponding to the similar conical portion 12a of the partially formed blank of Fig. 2 between the polygonal and round portions 12 and 11, and beyond the conical portion 17b the cavity is continued with a cylindrical portion 17c having a diameter equal to that of the portion 11 of the partially formed blank of Fig. 2.

In practice, the lengths 10 are usually cut off automatically, and as a section is cut off, it is carried over into line with the cavity of die member 17. It is then struck by the reciprocating die 18 and driven inward, reducing and drawing out and at the same time changing to round shape a part of the stock to form the portion 11 of the partially completed blank of Fig. 2 and to conical shape the short portion 12a between the polygonal portion 12 and the round portion 11.

The stock is driven into the irregularly shaped cavity of die member 17 until it engages an adjustable stop member or gauge 19 which serves also as an ejector. In this operation there is preferably no change or material change in the cross-section of the portion 12 of the partially completed blank, though it may be slightly enlarged in this operation. Immediately after the closure of the dies of Fig. 9, they are opened and the partially completed blank is ejected.

Next, the blank is fed automatically or otherwise to drawing and upsetting dies which complete the blank, these preferably consisting of

two die members 20 and 21. The die member 20 has a polygonal cavity 20a which leads to a cylindrical portion 20b equal in length and diameter to the portion 14 of the blank of Fig. 3 and this portion of the cavity leads to a reduced portion 20c corresponding in diameter to the diameter of the portion 13 of the blank of Fig. 3. Into this portion of the cavity there extends a stop member or ejector 22 similar in purpose and function to the corresponding member 19 of Fig. 9. In practice, the die member 20 is stationary and the die member 21 reciprocates like the corresponding die member 18 of Fig. 9. This die member 21 has at its working face a slight concavity 21a forming the crown of the completed head, all of the head but the crown being preferably formed in the cavity 20a of the die member 20.

As the partially completed blank is fed between these die members, it is struck by the reciprocating die member 21 and driven endwise into the irregularly shaped cavity of the die member 20. This completes the drawing and reduction of the shank forming the round drawn portions 13 and 14 at the same time that the polygonal portion 12 of the partially formed blank is upset and expanded out to fill the polygonal portion 20a of the cavity in the die member 20 and the crowning cavity or recess 21a of the die member 21. In brief, in this operation the drawing of the shank is completed to the correct diameter or diameters and, likewise, the head of the blank is completely formed so that it is only necessary to roll the thread on the portion 13 of the blank to complete the article, as previously stated.

With my improved process, a skin hardening is obtained incident to the drawing operations with the attendant advantages fully described in my prior patent and the head is formed not only in its completed polygonal shape without necessity for a trimming operation required by my prior patented process, but there is less upsetting of the metal to form the head and consequently less heading stresses are set up in the head and there is considerably less liability of the head breaking off either in the forming process or when a wrench is applied to the head when the screw or bolt is subsequently put into use.

It will be apparent that if heads no larger than the original stock are desired, there need be no expanding step in the head-forming operation, but merely a crowning operation. It will also be apparent that if the original stock is not to be materially expanded, less stock will be necessary.

While I have described the preferred way of carrying out my invention, I do not desire to be confined to the precise steps or details described but aim in my claims to cover all modifications which do not involve a departure from the spirit and scope of my invention in its broadest aspects.

Having thus described my invention, what I claim is:

1. The method of making screw and bolt blanks which comprises converting to round shape by an extrusion process a portion of a length of polygonal stock of the cross-sectional shape of the head of the finished blank to form the shank and expanding, by an upsetting process the unreduced polygonal portion uniformly in all lateral directions into its final form as a head of the same polygonal shape.

2. The method of making screws and bolts which comprises extruding to round shape a portion of a length of polygonal stock of the cross-sectional shape of the head of the finished article to form the shank with a part having a diameter equal to the pitch diameter of the thread to be formed and another part having a diameter equal to the over-all diameter of the thread to be formed, enlarging another portion of said polygonal stock by an upsetting process uniformly in all lateral directions into its final form as a head of the same polygonal shape, and rolling the thread on that part of the shank which is of smaller diameter. 80
3. The method of making screw and bolt blanks which comprises extruding a portion of a length of polygonal stock of the cross-sectional shape of the head of the finished article to form a round cross section of a diameter equal to the over-all diameter of the threads of the finished article, then by a subsequent operation drawing down a portion of said round cross section to a diameter equal to the pitch diameter of the said threads, and in the said subsequent operation upsetting the remaining polygonal stock uniformly in all lateral directions into its final form as a head of the same polygonal shape. 85
4. The method of forming a screw and bolt blank from a length of polygonal stock of the same cross-sectional shape as the head of the finished article, which comprises forcing the length of stock endwise into a drawing die having the outer portion of its opening shaped to fit said stock and the inner portion of its opening cylindrical to form a round shank of reduced cross-section, and thereafter upsetting the unreduced polygonal portion of the length of stock uniformly in all lateral directions to form a head of the same cross-sectional shape as the stock. 90
5. The method of making screws and bolts which comprises extruding to round shape a portion of a length of polygonal stock to form the shank with a part having a diameter equal to the pitch diameter of the thread to be formed and another part having a diameter equal to the overall diameter of the thread to be formed and thereafter rolling a thread on the part of least diameter. 95
6. The method of making screws and bolts which comprises extruding to round shape a portion of a length of polygonal stock to form the shank with a part having a diameter equal to the pitch diameter of the thread to be formed and another part having a diameter equal to the overall diameter of the thread to be formed and thereafter finishing a head from the remaining original stock and rolling a thread on the portion of least diameter. 100
7. The method of making screws and bolts which comprises extruding a portion of a length of polygonal stock to form a round cross section of a diameter equal to the overall diameter of the threads of the finished shank, then by a subsequent operation drawing down a portion of said round cross section to a diameter equal to the pitch diameter of the threads and in the subsequent operation finishing the head and rolling a thread on the portion of least diameter. 105
8. The method of making screws and bolts which comprises severing elongated polygonal stock transversely into pieces, drawing a portion of each piece longitudinally to the largest diameter of the finished shank while retaining the remainder of the piece at the original size, drawing a portion of said previously drawn portion to a diameter less than the largest diameter of the finished shank portion to condition said last drawn portion for the rolling thereon of a thread which will merge with the adjacent end of said finished shank portion and rolling a thread on the last drawn portion. 110
9. The method of making screws and bolts which comprises extruding to round shape a portion of a length of polygonal stock which is larger than the extruded portion after extrusion but smaller than the head later formed on the unextruded portion, to form a shank for such screws and bolts with a part having a diameter equal to the pitch diameter of the thread to be formed and another part having a diameter equal to the overall diameter of the thread to be formed and thereafter rolling a thread on the part of least diameter. 115
10. The method of making screws and bolts comprising providing a length of polygonal stock which is larger than the ultimate extruded screw and bolt shank and smaller than the head later to be formed on the unextruded portion, extruding the major portion of said length of stock to form round shank portions of predetermined smaller diameter than said stock, and upsetting the unextruded portion of the stock to form a polygonal head of greater size but of less length than said stock, finally rolling threads on the portion of least diameter. 120
11. The method of making screws and bolts comprising cutting off lengths of stock from polygonal stock which is greater in diameter than the shank of the screw or bolt but less in diameter than the head to be formed, subjecting each such length of stock to a cold extruding operation whereby a major portion thereof is converted to round form and of a diameter equal to the overall diameter of the thread to be formed, subjecting said so treated length of stock to operations which simultaneously further cold reduce a portion of said extruded portion to a diameter equal to the pitch diameter of the thread to be formed thereon and upset the unreduced portion of the length of stock to form a finished polygonal head, and thereafter rolling a thread on the doubly reduced portion. 125

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