

Feb. 1, 1944.

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2,340,529

METHOD OF MAKING SOCKET WRENCHES

Filed March 3, 1943

3 Sheets-Sheet 1

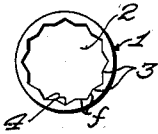


FIG. 2

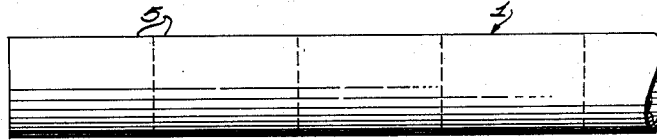


FIG. 1

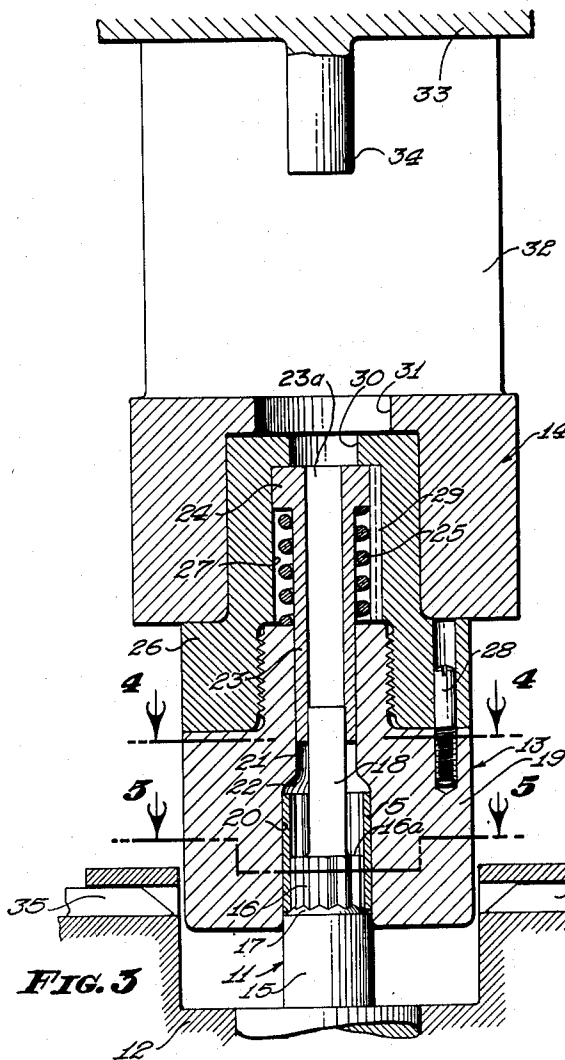


FIG. 3

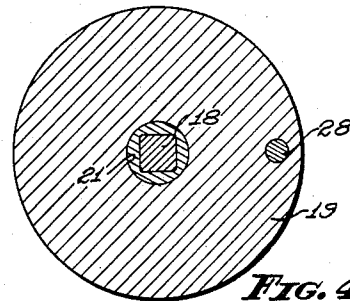


FIG. 4

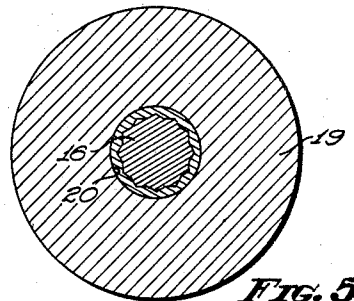
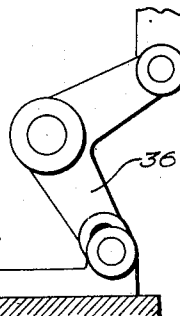


FIG. 5



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FIG. 10

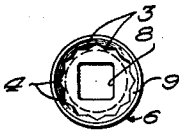


FIG. 11

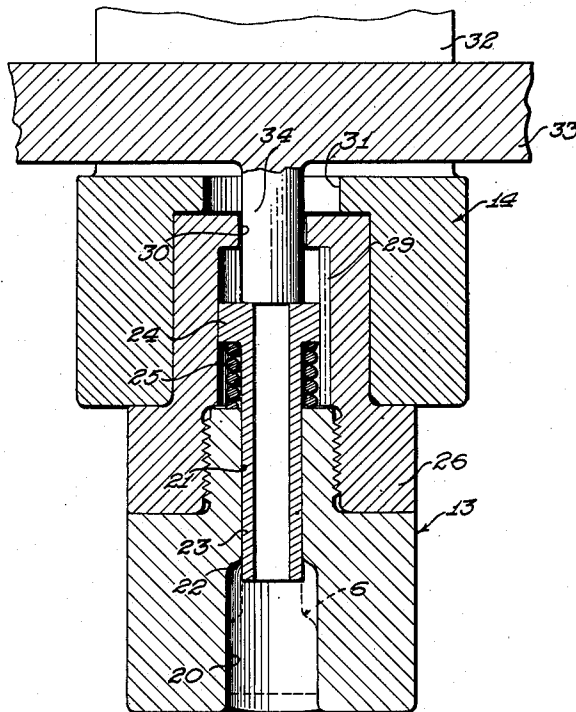


FIG. 8

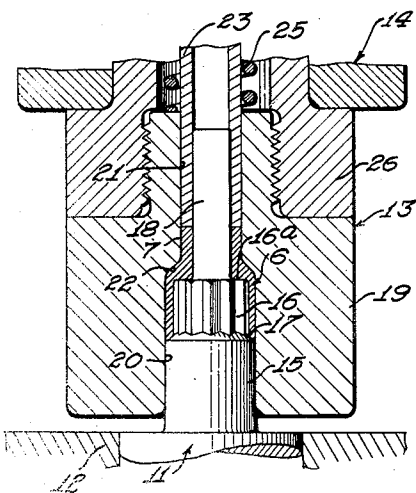


FIG. 6

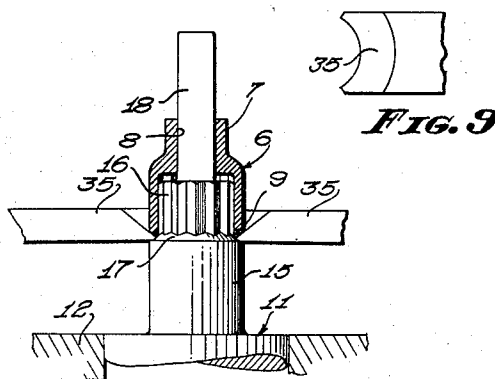


FIG. 7

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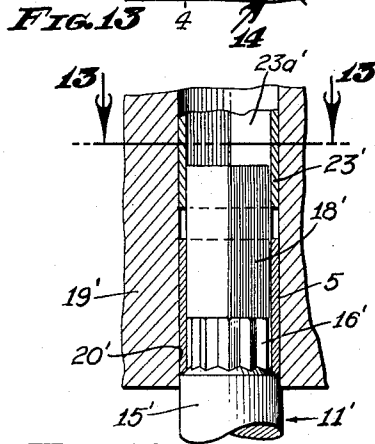
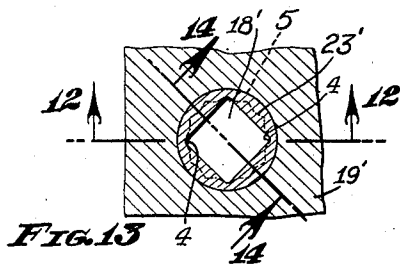


FIG. 12

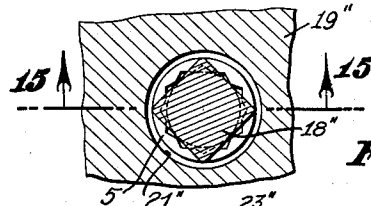


FIG. 16

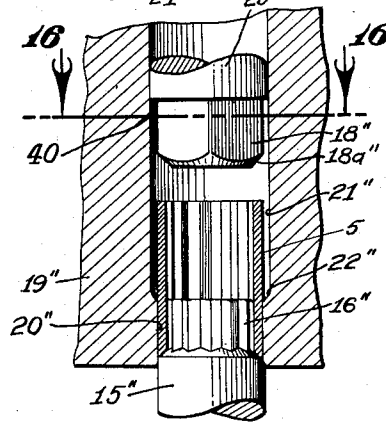


FIG. 15

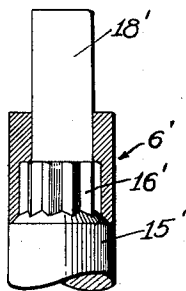


FIG. 14

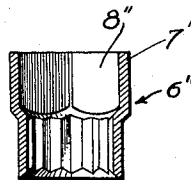


FIG. 17

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2,340,529

METHOD OF MAKING SOCKET WRENCHES

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Application March 3, 1943, Serial No. 477,788

14 Cl-ims. (Cl. 76-114)

This invention relates to methods of making socket wrenches, and is concerned particularly with simplification, speed-up, and savings in stock in socket wrench manufacture.

The conventional method of manufacturing socket wrenches consists in boring a solid cylindrical bar of material to form a major diametered opening extending inwardly from one end, and a minor diametered opening extending in from the other, and then broaching the walls of these two openings to shape them properly to fit respectively a bolt head or nut and a square handle member. Such a method necessarily wastes a large percentage of the stock, usually more than fifty per cent. Furthermore, these operations are both time-consuming and expensive.

The general object of the present invention is to provide a method of making socket wrenches which eliminates the above-mentioned disadvantages inherent in the conventional methods of manufacture.

A more particular object is to provide a method of making socket wrenches which virtually eliminates any wastage of stock whatsoever.

A further object is to provide a simplified, high speed method of making socket wrenches which eliminates machining, drilling, broaching or other similar expensive and time-consuming operations requiring skilled workmen.

The method of the present invention, in a form adapted to the manufacture of one type of socket wrench, comprises first the preparation of a tubular blank having interior bolt head or nut engaging faces and corners. While insofar as the broader aspects of the invention are concerned, this blank may be produced by any desired type of operation, it is a feature of the invention, in one of its more particular aspects, that these blanks be produced by a novel procedure comprising the drawing of a long cylindrical tube whose interior is shaped with longitudinal bolt head engaging faces and corners of the conventional form, e. g., twenty four of such faces for a "twelve point" wrench, adapted to receive a polygonal bolt head or nut, and then the cutting of this tube into the desired blanks. These blanks, however produced, are made of predetermined length, each being of a predetermined length greater than the length dimension of the final wrench to be formed. Finally, by an upsetting operation, the blank is shortened in length and one end portion thereof reduced about a square die member to form the square socketed handle-receiving portion of the wrench, the other end portion of the blank being meanwhile held

to the initially prepared internal form. By this operation, the one end portion of the blank is converted from the initial interior conformation to a square socketed conformation, the shortening in length and reduction furnishing the stock required for this transformation, while the remainder of the blank retains its initially prepared bolt head or nut engaging faces and corners. For the purpose of some wrenches in which it may not be desirable to reduce the outside diameter of the handle receiving end, the stock required may all be obtained by shortening of the blank. The method may also be practiced in the more infrequent case in which it may be desired to have the handle receiving end of the wrench larger in diameter than the bolt head receiving end. In such case, the handle receiving end is both expanded and converted to square interior form, the blank being sufficiently shortened in the operation to furnish the material required. Both of the indicated cases, however, involve the holding of the initially prepared interior bolt head engaging faces and corners in the bolt head receiving portion of the blank in substantially the initially prepared cross-sectional configuration.

The invention will be better understood by now referring to the following detailed description, reference for the purpose being had to the accompanying drawings, in which:

Fig. 1 is a fragmentary elevational view, and Fig. 2 is an end elevational view, of a drawn seamless tubing, the interior of which is shaped to accommodate a bolt head or nut of given size and illustrating the result of the first or initial step in my method;

Fig. 3 is a fragmentary, partially elevational and partially sectional view of a pressing or stamping die structure used to form the tubing blanks into socket wrenches, the die being shown in the beginning of its operation just before acting upon the tubing blank;

Figs. 4 and 5 are transverse sectional views taken through 4-4 and 5-5, respectively, of Fig. 3;

Fig. 6 is a fragmentary, partially elevational and partially sectional view of the die structure similar to Fig. 3, but showing the parts in the positions assumed when the forming operation has just been completed;

Fig. 7 is a fragmentary partially elevational and partially sectional view of the male die member after the forming operation, showing the completed socket wrench thereon and the action of the stripping members;

Fig. 8 is a similar fragmentary partially elevational and partially sectional view of the female die member when moved to its clear position after forming the socket wrench and indicating the ejector tube and its action should the socket wrench remain therein, the socket wrench being indicated by dotted lines;

Fig. 9 is a fragmentary plan view of one of the stripping members that coacts with the male die member;

Figs. 10 and 11 are side and bottom views respectively of the finished socket wrench;

Fig. 12 is a view similar to a portion of Fig. 3, but showing a modification;

Fig. 13 is a section on line 13—13 of Fig. 12;

Fig. 14 is a section on line 14—14 of Fig. 13, the female die structure being omitted, and the view showing the finished wrench;

Fig. 15 is a view similar to a portion of Fig. 3, but showing another modification;

Fig. 16 is a section on line 16—16 of Fig. 15; and

Fig. 17 is a longitudinal sectional view of a socket wrench formed by the die means illustrated in Figs. 15 and 16.

The initial step in one present illustrative form of my method of making socket wrenches consists in forming, preferably by drawing, a seamless tube 1 of suitable steel, such as chrome molybdenum steel, to an outside diameter equal to the desired outer diameter of the finished socket wrench, and with a bore or central opening 2 shaped to fit over a polygonal bolt head or nut. This tube is drawn hot by conventional means and methods known to the art, and not necessary to set forth herein. The tubing wall is preferably as thin as possible commensurate with the strain to which the socket wrench will be subjected in service so that it will fit into places having little clearance. If the socket wrench is intended to fit a hexagonal bolt head or nut, the bore 2 is preferably given what is known in art as a "twelve point" form, that is, is formed with twenty-four internal wrench engaging faces or facets *f*, arranged at angles to form twelve "points" 3 and twelve corners or corner-receiving channels 4 adapted to receive the corners of the bolt head or nut, so that the bolt head or nut may fit in either of two positions. If the socket wrench is then used to receive a square bolt head, the latter may be received in any one of three positions.

The tubing 1 is next cut to predetermined lengths, preferably by use of a cutting wheel, as indicated by the dotted lines in Fig. 1, forming blanks 5 such as shown in section in Figs. 3 and 5.

The forming or upsetting die structure comprises a male die member 11 set in a base 12 of a conventional press frame and a female die assembly 13 carried by a press ram 14. The male die member 11 includes a cylindrical lower portion 15 equal in diameter to the outside diameter of the blank 5. Above this is an intermediate portion 16, which is externally shaped in conformity with or complementary to the interior of the blank 5, so that the blank will fit over it with a close sliding fit. At the juncture between the cylindrical portion 15 and the portion 16, the male die may be formed with a rudimentary beveled portion or fillet 17. Above the portion 16, the male die member is reduced in diameter, so as to form an upwardly facing shoulder 16a, above which extends a stem 18 which is of the same cross-sectional shape as, and approximately the size of, the portion of the wrench handle

which is intended to be received within the wrench handle socket. Thus, and as here shown, the reduced stem 18 may be square in cross section.

The upper or female die structure 13 includes a female die block 19 having a socket 20 in its lower end adapted to receive the blank 5 and the cylindrical portion 15 of the male die member 11 with a snug sliding fit, socket 20 being of a length equal to the finally desired length of the bolt head receiving portion of the finished socket wrench. Continuing from the inner end of the socket 20 is a bore 21 of reduced diameter, being equal to the desired diameter of the finished handle receiving portion of the socket wrench. The socket 20 and bore 21 are connected by a faired inclined shoulder 22, as illustrated.

Slidably fitted within the bore 21 is an ejector tube 23 having a square opening 23a extending longitudinally therethrough and adapted to accommodate the stem 18 with sliding fit. The ejector tube is enlarged at its upper end forming a head 24, and between said head and the upper end of the die block is a spring 25 tending to hold the ejector tube in its uppermost position, as illustrated in Fig. 3.

The upper end of the die block 19 is reduced in diameter and externally threaded to receive a cap block 26 having a bore 27 of sufficient diameter to accommodate the head of the ejector tube. The cap block is pinned against rotation relative to the die block by a set screw 28 and the side of the bore 27 is provided with a key 29 (see Fig. 3), coacting with the head 24 of the ejector tube 23 to hold it in alignment with square stem 18.

The upper portion of the cap block 26 is reduced in diameter and fitted in the press ram 14. An opening 30 is provided in the upper end of the cap block, this opening being of smaller diameter than head 24, so as to form an internal flange limiting upward movement of the ejector tube. A registering opening 31 is provided in the ram 14, and the latter is also provided with a transverse clearance slot 32. In the particular press here shown for illustrative purposes, the press includes a fixed crossbar 33 fitting within the slot 32 and carrying a stop pin 34, which will engage the upper end of the ejector tube when the press ram is in its upper position, as shown in Fig. 8, whereby the socket wrench, indicated by the dotted lines in said figure, will be ejected.

In the event that the finished socket wrench should remain fixed to the male die member instead of within the female die assembly, two or more stripper members 35 may be provided at the sides of the male die member. These may be moved into engagement with the lower edge of the socket wrench upon completion of the later-described forming operation and subsequent elevation of the female die assembly, by suitable means such as a link and lever arrangement indicated generally at 36 in Fig. 3. As will be evident without the necessity of illustration, this arrangement may be so inter-connected with the press, as for instance with the usual crank, not shown, that the stripper members will be automatically advanced as the press ram is elevated.

Operation of the forming die structure to form the blank 5 into the completed socket wrench is illustrated in Figs. 3, 6, 7 and 8. In Fig. 3, the blank 5 is shown in position on the male die member and the female die block has descended to the point at which the blank is about to be

engaged by the shoulder 22. Preferably, particularly if high alloy steels are used, the blank is heated to a suitable forging temperature before introduction into the die, and is thus in a condition to be upset and formed as desired without undesirable weakening, as now to be described.

Continued downward travel of the female die block below the position of Fig. 3 and to the position of Fig. 6 results in application of end pressure to the blank 5 through engagement of the upper end of the blank by the shoulder 22 of the female die block, and consequent downward and inward deformation or upsetting of the upper portion of the blank until it fully occupies the space between the square stem 18 and the bore 21 below the ejector tube 23. The volume of this space is calculated to be just equal to the volume of metal of the blank projecting above the shoulder 16a, taking into the consideration the slight downward movement of the lower portion of blank 5 in order to conform to the bevel at 17. The bevel 17 may or may not be used, as desired, and it will of course be understood that if no such bevel is provided, there will be no such slight downward movement of the lower end portion of the blank, as mentioned. Excepting for any such possible slight downward movement owing to the provision of such a bevel, the entire lower end portion of the blank is held precisely to its initial form and dimensions during the forming operation, the exterior diameter as well as the interior wrench-engaging faces / preferably remaining unchanged throughout. The length of the blank as a whole, however, is substantially reduced, and the upper end portion substantially reduced in diameter, while the portions of the nut or bolt head engaging faces 3 above the shoulder 16a have been forced or displaced inwardly against the square stem 18, which in effect defines the predetermined boundaries of the desired handle receiving socket, so that now the interior opening of the upper portion of the formed socket wrench, designated by the numeral 6, has a square opening or handle receiving socket conforming to the square stem 18. At the juncture between this square opening and the unchanged lower portion of the wrench is a downwardly facing shoulder, as clearly appears in Fig. 6, while the outside of the wrench has a tapering shoulder conforming to the die shoulder 22 connecting the unchanged lower portion of the wrench with the reduced portion 7, all as clearly shown in the drawings.

The single described movement of the die structure thus completes the forming operation. When the male and female die members separate, the finished socket wrench 6 may remain on the male die as indicated by the solid lines in Fig. 7, or within the female die block as indicated by the dotted lines in Fig. 8. In the one case, it will be loosened by the stripper members 35, and in the other, by ejector tube 23.

The finished socket wrench 6 is illustrated in Figs. 10 and 11, and as finished, has a reduced portion 7 formed with a square handle-receiving opening 8 therein, the portion 7 being connected by the described tapering shoulder portion with the nut or bolt head receiving portion of the wrench, which both internally and externally remains in the form of the initially drawn tube 1.

Attention is particularly called to the fact that there is no wastage of material whatsoever beyond the negligible amount involved in severing the tube 1 into the blanks 5. Moreover, the

manufacturing operations are reduced to a minimum, and completed socket wrenches may be manufactured at a substantially increased rate of production as compared with heretofore known methods of manufacture. The completed wrench, while utilizing a minimum of material, is inherently strong in its completed form, and compares favorably in appearance and strength with wrenches manufactured by slower and more costly prior methods.

Figs. 12, 13 and 14 show a modification of the die structure by which socket wrenches may be manufactured in accordance with the invention without reduction in the diameter of the handle receiving portion thereof. Numeral 5 again designates the blank, and it is to be understood that this blank may be the same as the blank formed and utilized in the previously described form of the invention. Numeral 11' designates the male die member, including cylindrical lower portion 15', equal in diameter to the outside diameter of the blank, intermediate portion 16', externally shaped in conformity with the interior of the blank 5, and stem 18' of square cross-section extending upwardly above portion 16'. This entire male die assembly, and the base therefor, may be exactly similar to that shown in Fig. 3, with the exception that the stem 18' is enlarged so that its diagonal dimension is just equal to the internal diameter of the blank measured between corners 4. The blank 5 will then just receive the stem 18' with a sliding fit, as will be readily understood by an inspection of Fig. 13.

The upper or female die sector includes female die block 19', only fragmentarily appearing in Figs. 12 and 13, having socket or bore 20' adapted to receive the blank 5 and the cylindrical portion 15' of die 11' with a snug-sliding fit. This bore 20' is not reduced, as in the case of Fig. 3, but is to be understood as extending upwardly throughout block 19' at uniform diameter. In other words, the socket 20 and reduced bore 21 of Fig. 3 are substituted for by a continuous bore 20 of uniform diameter extending from bottom to top of the die block 19'.

Slidably fitted within bore 20' is tube 23' having square opening 23a' adapted to accommodate stem 18' with sliding fit. This tube 23' will be understood as corresponding entirely to tube 23 of the form of Fig. 3, excepting for the enlargement in diameter necessary to afford the sliding fit within bore 20', and excepting for the further fact that its lower end has not only an ejecting function, but also the function of upsetting the blank to conform it to the stem 18'.

Excepting for the modifications appearing in Figs. 12 and 13, the die structure may be entirely similar to that illustrated in Fig. 3. The modified operation of the form of Figs. 12-14 is as follows: In the downward travel of the die block 19' and tube 23', the lower end of the latter engages the upper end of the blank, resulting in downward and inward deformation of the upper portion of the blank until it fully occupies the space between the square stem 18' and the bore 20' below the lower end of tube 23'. The result of the operation is illustrated in Fig. 14, the blank having been shortened and the metal thereof moved inwardly above male die portion 16' to conform to the square stem 18'. The finished socket 6', not yet removed from the male die member in Fig. 14, is entirely similar to the socket wrench 6 of Figs. 10 and 11, with the sole exception that the outside diameter of its

upper handle-socketed portion has been maintained at the initial outside diameter of the original blank 5. Thus the wrench in this form is of uniform diameter from end to end.

In Figs. 15 to 17 is illustrated a further modification, in which the handle-socketed end of the wrench is actually enlarged in diameter. In this instance, the male die member includes cylindrical portion 11'', slidably receivable within die bore 20'', and portion 16'' shaped for reception within the blank 5, which again is like the original blank 5 of the previously described form of the invention. The male die member in this instance is not provided with a square shank like the shank 18 of Fig. 3.

The upper or female die structure includes die block 19'', which is to be understood to be like the die block 19 of Fig. 3 excepting for noted modification. The bore 20'' extending upwardly into block 19'' leads to an enlarging offset or outwardly and upwardly inclined shoulder 22'', which connects bore 20'' with a bore 21'' of increased diameter, being equal to the diameter of the finished handle receiving portion of the socket wrench. The bore 21'' is to be understood as continuing upwardly through the upper end of the die block, like the bore 21 of Fig. 3.

The hollow ejector tube 23 of the form of Fig. 3 is replaced by a solid cylindrical member 23'', which, except for being solid rather than hollow, may have its upper end arrangements and mounting the same as those provided for the ejector tube 23 in the case of Fig. 3. Additionally, the lower end of the cylinder 23'' has an integrally formed downwardly projecting male die element or stem 18'' of square cross-section and of a size equal to the desired wrench handle socket, which size in this instance is greater than the initial opening inside the blank 5. The lower end of the stem 18'' has a tapered or beveled nose 18a'' capable of entry inside the blank 5.

Operation of the form of Figs. 15 and 16 is as follows: The descending female die assembly, carrying with it the member 22'' and squared stem 18'', forces the latter inside the upper portion of the blank 5, expanding the blank to an outside diameter equal to the diameter of the enlarged bore 21''. The shoulder 40 at the juncture of stem 18'' with cylindrical member 23'' eventually engages the upper end of the blank, forcing the metal of the blank above the die shoulder 22'' downwardly and laterally or inwardly so as to conform to the square stem 18''. The described reduction in length of the blank furnishes the metal required for the expansion in diameter as well as that required to convert the handle-receiving portion from "12 point" to square form. Fig. 17 shows the completed socket wrench 6'' having the enlarged portion 7'' formed with the square handle-receiving socket 8.

As will appear, the several forms of my invention have in common the preserving of the initial interior bolt head or nut-receiving portion of the wrench while shortening the length of and converting the interior of the remaining portion of the wrench to form a handle receiving socket, the additional metal required for the socket being obtained, at least in part, from the shortening operation. In the preferred, first-described form of the invention, the handle socket portion of the wrench is formed by additionally reducing the diameter thereof, so that additional metal is available for conforming the wrench to the socket formation, and not so much reduction in length is required.

I claim:

1. A method of making socket wrenches, characterized by: forming an elongated tube having interior nut engaging faces and corners; severing said tube into blanks of predetermined length; and upsetting and reducing the diameter of one end portion of said blank to form a constricted handle receiving socket while retaining the other end portion of said blank in substantially its initial form.

2. A method of making socket wrenches, characterized by: drawing an elongated tubing having interior nut receiving faces and corners throughout its length; severing said tubing into blanks of predetermined length; and upsetting and reducing the diameter of one end portion of each blank about a mandrel substantially the size and shape of the handle for the finished socket wrench while retaining the other end of said blank in substantially its initial form.

3. A method of making socket wrenches, characterized by: drawing a tube having external and internal diameters of the finished socket wrench and having internal nut engaging faces and corners; severing said tube into blanks of predetermined lengths; and hot pressing one end portion of each of said blanks by constriction about a mandrel to form a handle receiving socket while restraining the other end portion of said blank against alteration of the form of its internal nut engaging faces.

4. A method of making socket wrenches, characterized by: forming a tubular blank of uniform cross section having internal nut engaging faces and corners extending from end to end; and deforming one end portion only of the blank by constriction and compression about a mandrel while restraining the other end against deformation to form a handle receiving socket of smaller size than the initial opening through the tubular blank.

5. A method of making socket wrenches, characterized by: forming simultaneously and uniformly from end to end the exterior cylindrical wall and interior nut engaging faces and corners of a tubular blank adapted to receive a nut; and deforming one end portion only of the blank by constriction and compression about a mandrel while restraining the other end against deformation to form a handle receiving socket of smaller size than the initial opening through the tubular blank.

6. A method of making socket wrenches characterized by: forming an elongated tube having from end to end a number of nut engaging faces and nut receiving corners which is a multiple of the number of corners of the nut to be received; cutting said tube into blanks of predetermined length; placing a blank so cut on a mandrel having a portion shaped in conformity with the interior of said blank and extending part way there-through with a close sliding fit and a stem portion of smaller cross-sectional size projecting from said mandrel portion through the remaining portion of said blank; and forcing over said blank a socket having a portion conforming to the exterior of said blank and a constricted portion until said constricted portion has upset said last mentioned portion of said blank into conformity with said stem portion.

7. A method of making socket wrenches, characterized by: forming an elongated tube having interior nut engaging faces and corners extending from end to end; severing said tube into blanks of predetermined length; and supporting one of

said blanks over part of its length both externally and internally while reducing the remaining portion by axial and radial compression about a mandrel to form a constricted handle receiving portion.

8. A method of making socket wrenches, characterized by: forming an elongated tube having interior nut engaging faces and corners extending from end to end; severing said tube into blanks of predetermined length; supporting one of said blanks over part of its length both externally and internally while reducing the remaining portion by axial and radial compression about a mandrel to form a constricted handle receiving portion; and urging said blank axially in its entirety during forming of said handle receiving portion to bear the axial extremity of said supported portion against a beveling face thereby to form an internal bevel.

9. A method of making socket wrenches, characterized by: forming an elongated tube having interior nut engaging faces and corners extending from end to end; severing said tube into blanks of lengths a predetermined extent longer than the wrenches to be produced; and internally supporting one end portion of a blank against deformation of its nut engaging faces and corners while constricting the other end portions of said blank about a mandrel of the cross-sectional form of a wrench handle and simultaneously exerting end pressure against the latter end portion of the blank to compress the length of said blank to the finally desired wrench length.

10. A method of making socket wrenches, characterized by: forming an elongated tube having interior nut engaging faces and corners extending from end to end; severing said tube into blanks of lengths a predetermined extent longer than the wrenches to be produced; and externally and internally supporting one end portion of a blank against deformation while reducing and shortening the other end portion thereof by radial inward and longitudinal end pressure thereon and conforming the inside of said reduced and shortened portions to receive a wrench handle.

11. A method of making socket wrenches, characterized by: forming an elongated tube having interior nut engaging faces and corners extending

from end to end; severing said tube into blanks of lengths a predetermined extent longer than the wrenches to be produced; and externally and internally supporting one end portion of a blank

5 against deformation while forming a handle-receiving socket in the other end portion thereof by applying end pressure thereto to shorten it and cause a lateral displacement of metal into conformation with a male die member positioned
10 inside the blank.

12. A method of making socket wrenches, characterized by: forming a tubular wrench blank having interior nut engaging faces and corners extending from end to end; internally
15 supporting one end portion of said blank against deformation; and forming a handle-receiving socket in the other end portion thereof by applying end pressure thereto to shorten it while confining its outer surface to the finally desired
20 outside diameter and permitting a resultant lateral displacement of metal to the boundaries of the desired handle-receiving socket.

13. A method of making socket wrenches, characterized by: drawing an elongated tube having interior nut engaging faces and corners extending longitudinally from end to end; severing
25 said tube into blanks of predetermined lengths greater than the lengths of the final wrenches; internally supporting one end portion of one of said blanks against deformation; and forming a
30 handle-receiving socket in the other end portion thereof by applying end pressure thereto to shorten it while confining its outer surface to the finally desired outside diameter and permitting a
35 resultant lateral displacement of metal to the boundaries of the desired handle-receiving socket.

14. A method of making socket wrenches characterized by: first forming a tubular blank having internal nut engaging faces and corners, and then
40 supporting the internal nut engaging faces and corners at one end portion of the blank while forming a handle receiving socket in the other end portion of the blank by applying end pressure to the blank to shorten it and to cause a displacement of metal to the predetermined boundaries of the handle receiving socket.
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