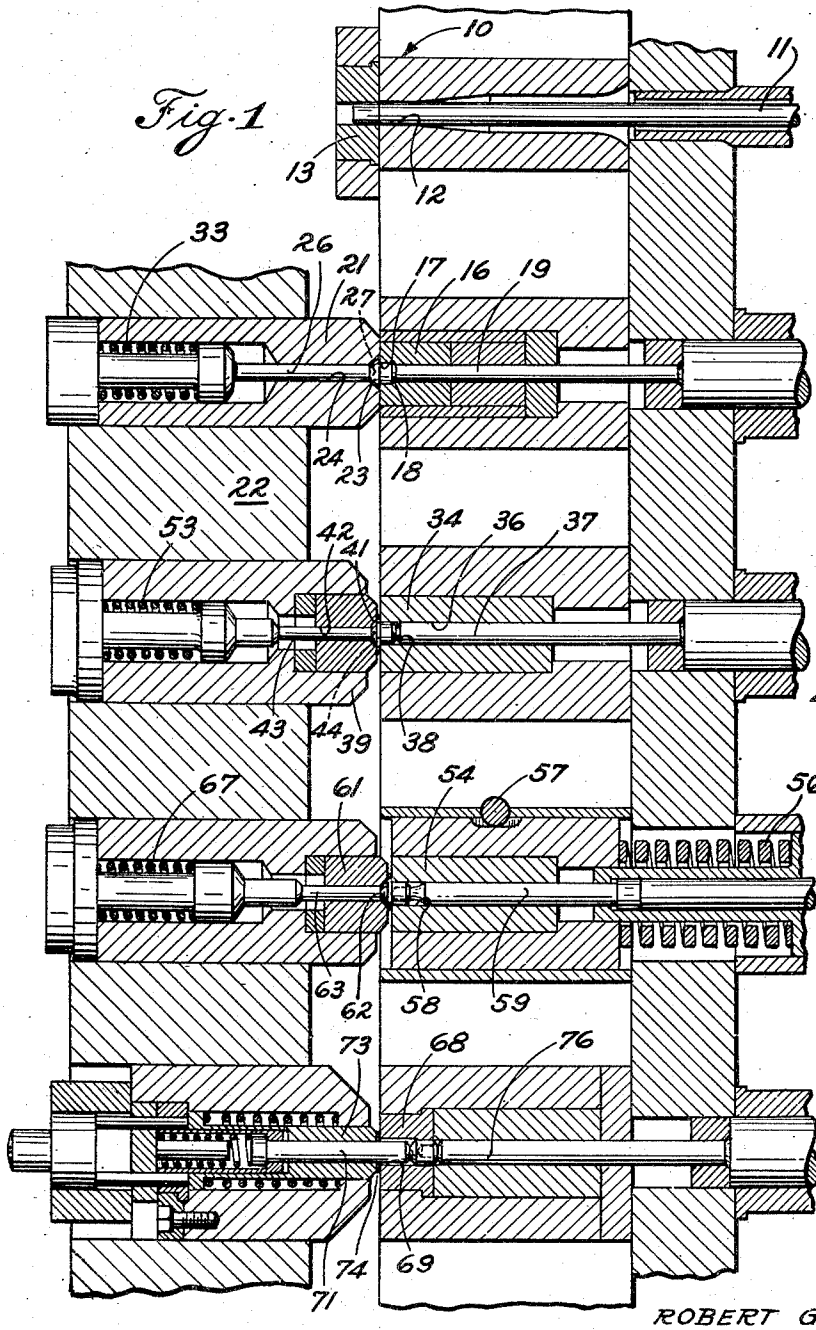
Nov. 19, 1957 R. G. FRIEDMAN 2,813,279

METHOD OF MAKING HEXAGON SOCKET TYPE CUP POINT SET SCREW BLANKS

Filed Aug. 14, 1953

Fig. 1



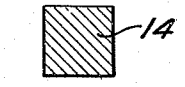


Fig. 2

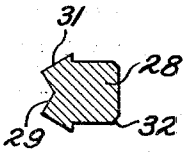


Fig. 2a

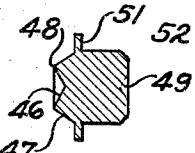


Fig. 2b

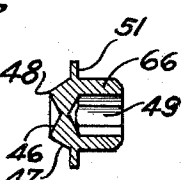


Fig. 2c

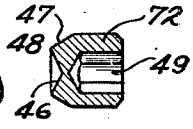


Fig. 2d

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METHOD OF MAKING HEXAGON SOCKET TYPE CUP POINT SET SCREW BLANKS

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5 Claims. (Cl. 10—10)

This invention relates generally to forming metal articles and more particularly to the forging of set screw blanks by progressive forging operations.

It is an important object of this invention to provide a method for forging set screw blanks which permits the utilization of high speed low cost forging methods in the production of such blanks.

It is another object of this invention to provide a method of forging set screw blanks which results in a set screw blank having close tolerances and greater strength and hardness than set screws formed by ordinary machining methods.

It is still another object of this invention to provide a method for forging set screw blanks wherein the corners and edges of the blank are properly filed out and formed.

The foregoing and other objects and advantages will become apparent in view of the following description taken in conjunction with the drawings, wherein:

Fig. 1 is a plan view of the various stations of a forging apparatus incorporating this invention; and

Figs. 2, 2*a*, 2*b*, 2*c*, and 2*d* are enlarged cross sectional views showing the blank at each of the stations shown in Fig. 1.

A method of forging set screws according to this invention comprises forging one end of a blank with high pressures to produce a sharply filled contour without excessively work hardening the remainder of the blank and then piercing a hole into the other end of the blank. Preferably the desired point is formed on one end of the blank by double blow heading and a polygonal hole is then pierced into the previously worked portion of the blank which is to be externally threaded and the entire operation is carried out in a progressive header or the like without the necessity of intermediate annealing. The embodiment disclosed includes the steps of cutting a blank from wire or rod stock and positioning it in a first forging station wherein a portion of the blank adjacent to one end is upset forming an axial conical recess and an outer conical surface. The blank is then inserted in the second forging die station wherein the one end described above is further forged so as to form a relatively flat external conical surface and the other end may be recessed to provide an internal conical surface. That portion of the blank adjacent to the space between the two dies at the second station is extruded into the opening thereby forming a flash to relieve the excessive pressure formed at this die station. The blank is then transferred to still another die station wherein the blank is pressed over the end of a polygonal punch thereby forming a polygonal socket in said other end of the blank. The blank is then transferred to the final station wherein the flash is trimmed thereby providing a finished set screw blank ready for external threading about the socketed portions.

The process according to this invention is adapted to be carried out by a multistation header wherein appropriate transfer members are supplied to transfer the blank progressively from one station to the next. By

utilizing such a machine a large number of blanks may be rapidly forged thereby substantially reducing the unit cost of the completed blank.

In order to insure complete filling of the corners of the dies this invention contemplates the formation of flash in the second forging station. By providing more metal in the initial blank than is necessary to fill the dies for the completed blank an extremely high pressure on the blank as it is forged is insured. The excess metal is permitted to flash out between the dies thereby resulting in very accurate control of the finished blank with the results that relatively close tolerances may be maintained. In the past for forging of items such as set screw blanks difficulty has been present in insuring that the points or edges of the blank are properly filled and the use of excessive metal in the initial blank as described above has resulted in the elimination of this problem.

For a more complete understanding of this invention reference should be made to the drawings wherein the cut-off station designated as **10** is provided. The stock is preferably supplied in the form of wire or rod stock **11** which is fed through the bore **12** in the cut-off station **10**. The stock feeds through the bore **12** and projects beyond the forward face of the die breast **9** as shown in Fig. 1. Suitable feed and stop means are provided but for purposes of simplicity are not shown in the drawings. The shearing member **13** engages the stock projecting beyond the die breast **9** and shears off a blank **14** from the stock **11**. The blank **14** is then positioned in front of the first forging die **16** which is formed with a first bore **17** having substantially the same diameter as the diameter of the stock. The inner end of the first bore **17** terminates in an inclined or transition section **18** which is adapted to form a chamfer on one end of the blank. The knockout pin **19** is positioned with its forward face adjacent to the inner end of the transition section **18** and forms the bottom of the cavity in the die **16**. The arrangement of the die **16** and the knockout pin **19** provides for the admission of a portion of the blank into the die cavity leaving an outer portion projecting beyond the die face **6**. This outer portion is upset by the movable die **21** mounted on the header slide schematically shown at **22**. The movable die **21** is formed with a conically shaped die cavity **23** which terminates in the bore **24**. The punch **26** is positioned in the bore **24** and is formed with a forward conical punching surface **27** which projects into the die cavity **23**.

When the header slide moves forward the projecting portion of the blank is engaged by the movable die **21** and the punch **26** thereby upsetting the projecting portion and forming a first intermediate blank **28** which has a relatively flat conical recess **29** in the end thereof formed by the punch **26** and an outer conical surface **31**. The transition section **18** also forms a chamfer **32** on the other end of the first intermediate blank **28** thereby eliminating any sharp edges. In the preferred embodiment the puch is biased toward the die breast **9** by the spring **33** so that it projects beyond the movable die **21** when the header slide is spaced from the die breast. This structure is utilized so that the punch **26** will engage the blank before the header slide reaches the forward position thereby securing control of the blank and permitting the withdrawal of the transfer fingers. The transfer mechanism is not shown for the purposes of simplification. As the header slide recedes the first intermediate blank **28** is ejected from the die **16** by the knockout pin **19** into transfer fingers which transfer the first intermediate blank to the second forging station where the blank is positioned in front of the second forging station **34**.

The die **34**, like the die **16**, is formed with a bore **36** having a diameter substantially equal to the bore **17**. A

knockout pin 37 is positioned in the bore 36 and is formed with a conical punching end surface 38 which is positioned at a point spaced from the face of the die 34. The movable die 39 is mounted on the header slide 22 and is formed with a relatively flat conical die cavity 41 which is coaxial with the bore 36. The inner end of the conical die cavity 41 terminates in a bore 42 in which the punch 43 is positioned. The punch 43, like the punch 26, is formed with a conical punching end surface 44 which projects into the cavity 41. The forward end surface 38 of the knockout pin 37 in cooperation with the die 34 forms a die cavity adapted to receive the portion of the first intermediate blank 28 which is not upset and the upset portion with the surface of the recess 29 and the surface 31 project beyond the forward face of the die 34.

When the header slide reaches the forward position adjacent to the die breast 9 the projecting portion of the first intermediate blank 28 is engaged by the punch 43 and the die 39 thereby upsetting the projecting portion to form the conical recess 46 and a relatively flat outer conical surface 47 which intersects at an annular edge 48. The action of the die 39 and the punch 43 also presses the blank against the end surface 38 of the knockout pin 37 thereby forming an axial recess 49 in the rearward end of the blank. Since the knockout pin 37 is radially supported by the bore 36 in the die 34 the recess 49 is accurately located. In order to insure that the annular edge 48 is properly filled the dies at the second forging station are proportioned so that the excess metal in the first intermediate blank 28 will flash out between the forward surface of the dies 34 and 39. By supplying an excess of metal large compression forces on the blank are insured which result in a properly filled out annular edge 48 and by providing for the flash 51 uniformity of the final blank wherein the tolerances are closely maintained is insured.

The second intermediate blank 52 is thus formed by the dies in the second forging station which has the forward end shape substantially formed as it will appear in the finished set screw blank. The spring 53 in the second forging die station operates much the same way as the spring 33 in the first forging die station and operates to bias the punch 43 toward the forward position when the header slide is not adjacent to the die breast 9 and the knockout pin 37 is used to eject the second intermediate blank from the die 34 as the header slide moves away from the die breast 9 after the completion of the forging at this station.

Transfer fingers move the second intermediate blank to the third forging die station where the blank is pierced to form the polygonal cavity of the finished set screw blank. The sliding die 54 is mounted in the die breast 9 and is adapted for limited reciprocation therein. A heavy spring 56 biases the die 54 toward the forward position adjacent to the face of the die breast 9 and a ball type stop means 57 may be utilized to limit the amount of reciprocation of the die 54. The die 54 is formed with a bore 58 having substantially the same diameter as the bores 36 and 17. A piercing tool 59 is mounted within the bore 58 and is arranged so that it is held stationary relative to the die breast 9 during the forging operation in the third forging die station. The movable die 61 is mounted on the header slide 22 and is formed with a die cavity 62 having substantially the same shape as the die cavity 41. Again, a puch 63 is mounted in the movable die 61 with a projecting conical end surface extending into the die cavity 62. As the header slide moves toward the forward position adjacent to the die breast 9 the movable die 61 and the punch 63 engage the end of the second intermediate blank 53 forcing the blank into the bore 58 of the die 54 until the flash 51 engages the forward face of both of the dies. The sliding die 54 and the blank recede as the header slide continues to advance. In the preferred embodiment the forward end of the punch or piercing tool 59 then engages the rearward end of the second intermediate blank 52. Since the recess 49 in the rearward end of the second intermediate blank 52 is accurately located it guides the end of the piercing tool 59 as the tool engages the blank. The header slide continues to move forward causing the sliding die 54 and the second intermediate blank 52 to move axially toward the piercing tool 59 causing the piercing tool which is formed with a polygonal forward end to pierce a polygonal recess 64 in the rearward end of the blank thereby forming the third intermediate blank 66. Here again, a spring 67 is utilized to bias the punch 63 toward the die breast 9. After the header slide 22 has moved away from the die breast 9 at the completion of the forging stroke the piercing tool 59 moves outwardly relative to the die breast 9 carrying the third intermediate blank 66 out of the sliding die 54. At this time a stripper means which is not shown for purposes of simplification grips the third intermediate blank 66 and strips it from the piercing tool 59 as the piercing tool returns to its initial position.

Transfer fingers then transfer the third intermediate blank 66 to the fourth die station. A shearing die 68 is mounted at the fourth die station and is formed with a bore 69 having a diameter substantially equal to the diameter of the bore 58 in the die 54. A punch 71 is mounted in the header slide coaxial with the bore 59 and is formed with a diameter slightly less than the diameter of the bore 59 and a forward face adapted to fit into the conical recess 46. As the header slide moves toward the die breast 9 the punch 71 engages the third intermediate blank 66 forcing the blank into the bore 69 of the shearing die 68 thereby shearing the flash from the blank thus completing the forging operations on the set screw blank 72.

A stripper sleeve 73 is positioned around the punch 51 and moves forward relative to the punch 71 as the header slide moves away from the die breast thereby stripping the flash 74 from the punch 71. Thereafter the knockout punch 76 ejects the finished blank from the die 68 whereupon the blank is transferred to any further operation such as threading and the like which must be performed to complete the finished set screw.

By providing the rearward recess 49 to guide the piercing tool 59 during the initiation of the piercing blank an accurately located polygonal hole is formed in the finished blank. Also, by utilizing the sliding die 54 a longer die life is insured since the sliding action between the blank and the die is reduced to a minimum.

By forming a set screw blank according to this invention the metal is work-hardened thereby permitting the use of low cost materials for the manufacture of the blank whereas in earlier methods wherein the blanks are cut by screw machines or the like no appreciable work-hardening was present to improve the quality of the finished screw blank. The portion of the blank forming the point is subjected to high pressures and to a double blow heading operation filling out the contours sharply and cleanly and providing substantial work hardening. The remainder of the blank which is to be socketed is protected from high forging pressures during the forming of the point so that it is not substantially work hardened prior to the socketing operation thereby avoiding the necessity of any intermediate annealing and avoiding hardening the socketed portion to such an extent as to interfere with subsequent threading.

Having completed a detailed description of a preferred embodiment of the present invention so that others skilled in the art may be able to understand and practice the same, I state that what I desire to secure by Letters Patent is not limited by said preferred embodiment but rather is defined in what is claimed.

What is claimed is:

1. That method of making a socketed set screw having a cup point which comprises upsetting one end of a cylindrical blank to form a cylindrical shank portion and a conical head portion having its maximum diameter at the

juncture between the head and the shank and having a reversely disposed conical recess at the end face of the head portion and thereafter pressing the blank axially between a cylindrical die confining the shank and a die conforming to the head portion, forming an annular flash at the juncture between the head and the shank and thereafter piercing a hex socket in the shank portion while the blank is gripped across said annular flash and axially supported at said head end and thereafter trimming the flash from the blank.

2. That method of making a socketed cup point set screw which comprises preliminarily upsetting a cylindrical blank to provide a head portion and a shank portion, said shank portion being confined during said upsetting in a cylindrical die wherein the bottom portion of the cylindrical die is provided with a chamfer to form a chamfer in the end of the shank portion and wherein said upsetting of the head is effected by a conical die sloping from a maximum diameter to a minimum diameter at the end face of the head portion of the blank and wherein the end face of the head die is provided with a conical point and thereafter pressing said blank axially between dies confining the head and shank to further upset said head and forming an annular flash at the juncture between the head and shank at said maximum diameter section and thereafter piercing the chamfered end of the shank of the blank axially by forcing a hex punch into the end face of the blank a distance corresponding to the distance from the end face of the shank of the blank to said annular flash and thereafter trimming the blank by forcing the same through a trim die having a maximum diameter corresponding to the diameter of the pierced shank portion of the blank.

3. That method of forming a cup pointed socketed set screw blank which comprises preliminarily upsetting a conical head on a cylindrical blank while a part of the cylindrical blank is confined by a cylindrical die and wherein the tool upsetting the head is provided with a conical recess having a maximum diameter greater than the maximum diameter of the shank portion of the blank and the central portion of the head upsetting tool is provided with a point to form the cup point of the finished article and thereafter axially pressing the blank with the head and shank confined to further upset said head and forming an annular flash at the juncture between the upset head and the shank and thereafter piercing the shank portion of the blank with a hex tool while the flash portion of the blank is gripped between co-operating dies confining the head of the blank and the cylindrical side walls of the shank and thereafter trimming the flash from the blank by gripping the flash between co-operating dies and moving the blank axially into one of said co-operating dies by a punch on the other whereby the flange is impaled on the punch.

4. That method of making a socketed cup point cap screw which comprises holding the major portion of a

cylindrical blank in a cylindrical die and leaving a portion of the blank projecting from said cylindrical die and preliminarily upsetting said projecting portion to a diameter greater than said shank portion, the tool upsetting said head portion having a central conical point to indent the head portion of the blank to a depth corresponding to the depth of the cup point in the finished article and thereafter confining the upset blank between the pair of co-operating dies, one die being shaped to conform to the shank portion of the blank and the other die being shaped to conform substantially to the cup point of the finished article and moving said dies toward each other to further upset said head and forming an annular flash at the juncture between the shank and the tapered point of the finished article and thereafter forcing the blank through a trim die having a circular opening wherein the diameter of the opening corresponds to the diameter of the shank portion of the blank whereby the flash is trimmed from the blank.

5. That method of forming a socketed cup point set screw having a hex socket through the major portion of its length and a point sloping from the maximum diameter of the set screw blank toward one end face which has a cup point therein which comprises confining the major portion of a cylindrical blank in a cylindrical die and upsetting the projecting end portion of the blank which ultimately forms the cup point of the set screw, said upsetting operation being effected by a conical tool having a central pointed area to form the cup point and thereafter compressing the blank axially to flow a portion of the upset metal outwardly into an annular flash and at the same time reducing the upset portion between the flash and the cup point of the blank substantially to the dimensions of the finished article and thereafter confining the metal of the blank having the flash thereon by gripping the blank across the flash and confining the head and side walls of the blank while a hex tool is forced into the end face of the blank opposite the cup point, said hex tool having a point which moves axially into the blank a distance corresponding to the distance between the flash and the pierced end of the blank and thereafter trimming the flash from the blank by forcing the blank through a trim die having a diameter corresponding substantially to the diameter of the pierced portion of the blank.

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