Oct. 19, 1948. H. T. M. RICE 2,451,512

MEANS FOR PRESS FORGING ARTICLES

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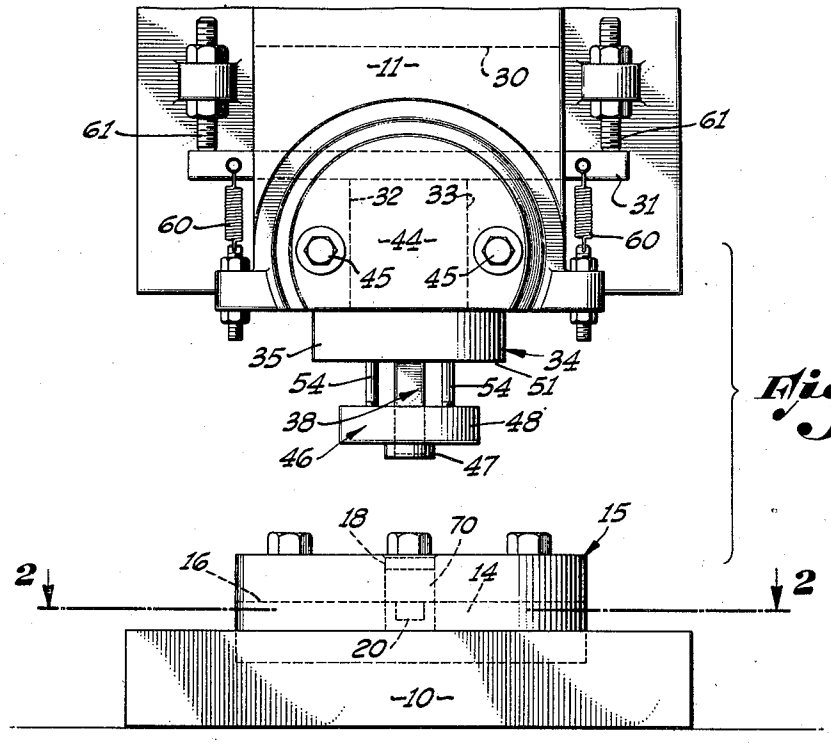


Fig. 1.

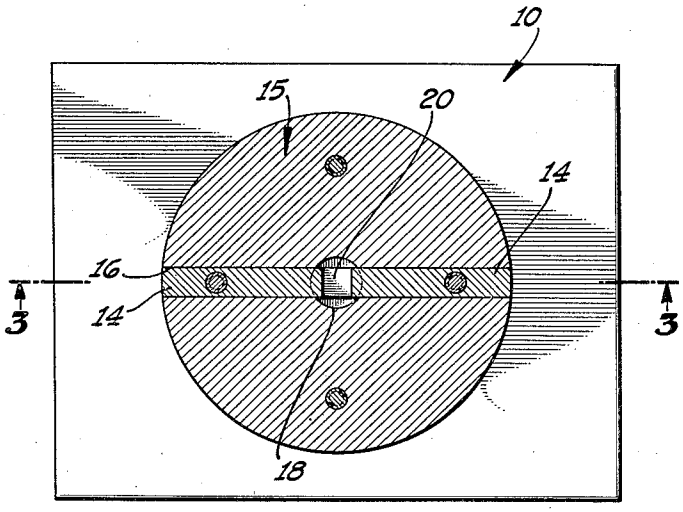


Fig. 2.

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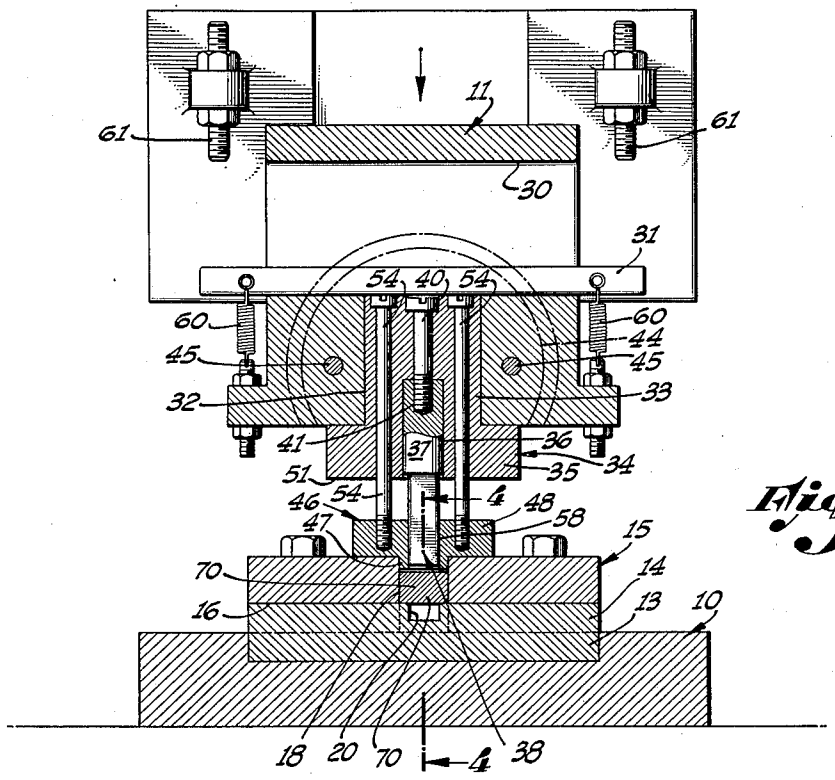


Fig. 3.

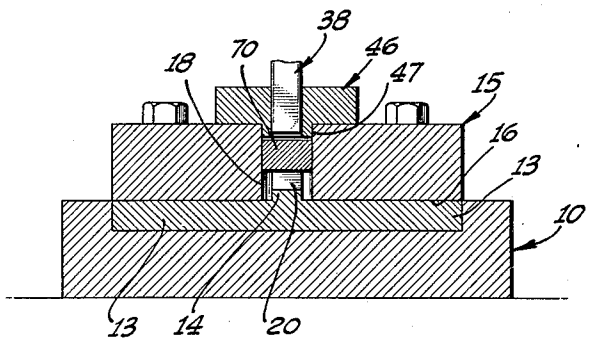


Fig. 4.

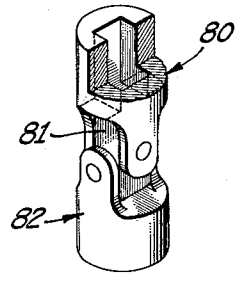


Fig. 5.

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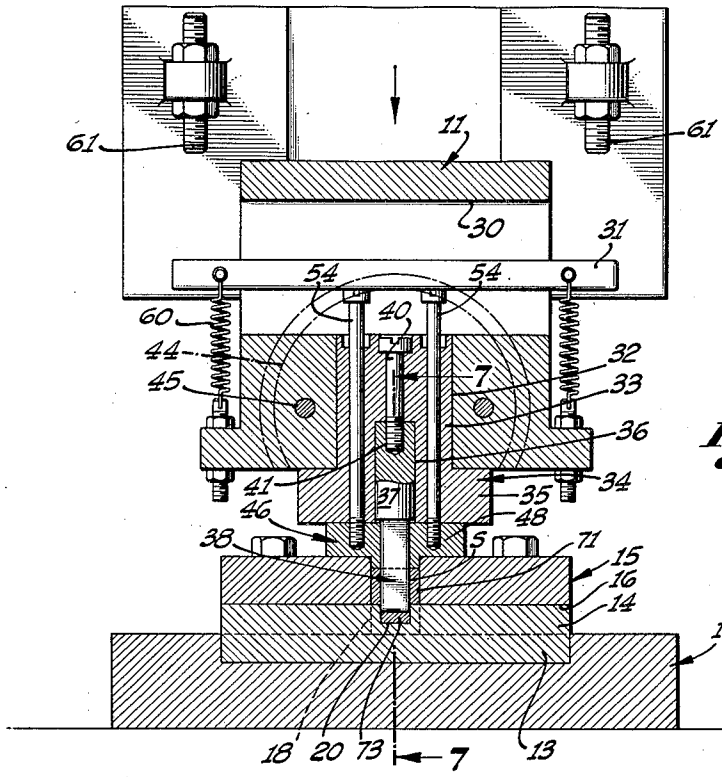


Fig. 6.

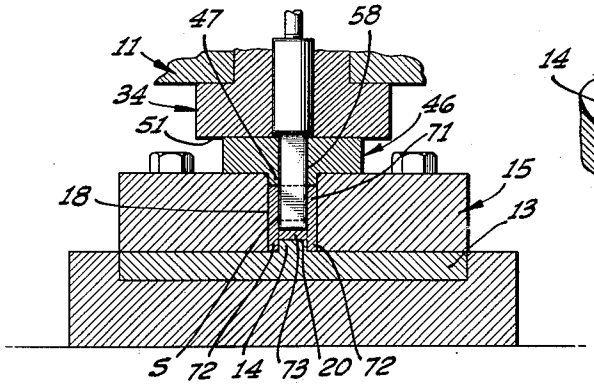


Fig. 7.

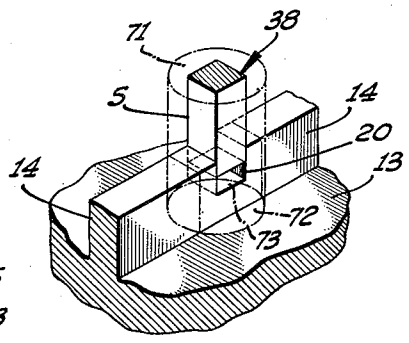


Fig. 8.

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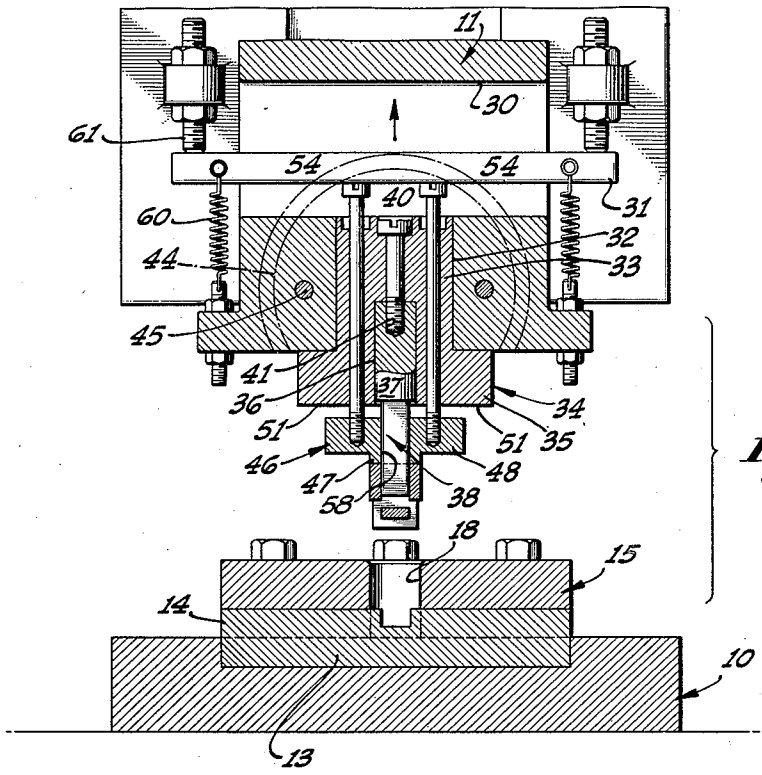


Fig. 9.

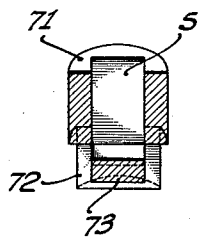


Fig. 10.

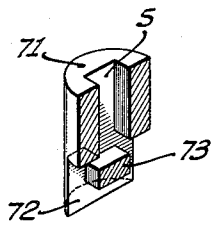


Fig. 12.

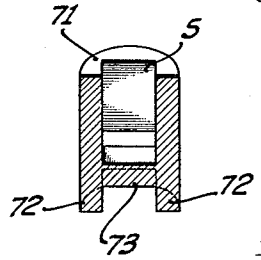


Fig. 11.

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MEANS FOR PRESS FORGING ARTICLES

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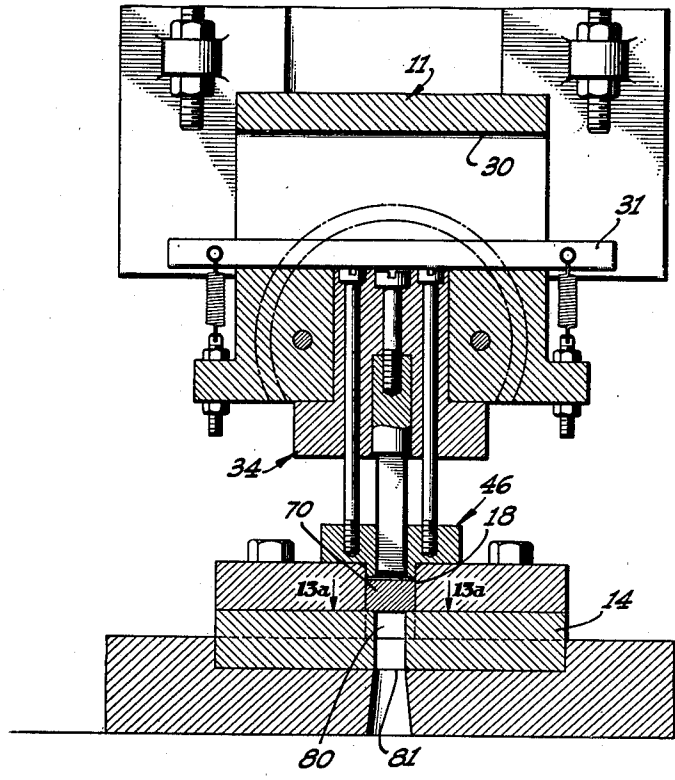
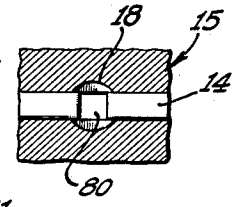


Fig. 13.

Fig. 13a.



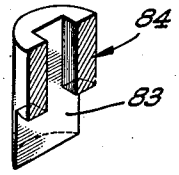


Fig. 15.

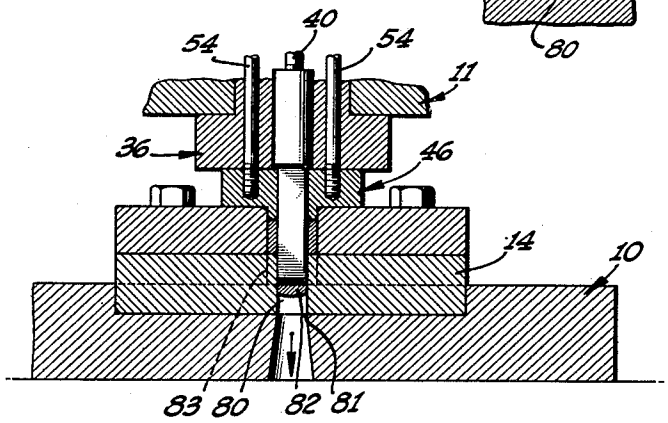


Fig. 14.

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Patented Oct. 19, 1948 2,451,512

UNITED STATES PATENT OFFICE

2,451,512

MEANS FOR PRESS FORGING ARTICLES

Henry T. M. Rice, San Marino, Calif.

Application May 26, 1944, Serial No. 537,390

9 Claims. (Cl. 78—9)

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This invention relates generally to apparatus for manufacturing parts for universal wrench sockets and the like by press forging procedures.

Universal sockets of the type referred to comprise two socketed elements, each formed with a pair of furcations, a connecting block partially received between each of the pairs of furcations, and pivots connecting the blocks to the pairs of furcations on pivot axes at right angles to one another. The sockets may be designed one to receive a bolt head or nut, and the other a squared wrench handle, or both may be squared. It is to the press forging production of a square socketed element of such a character that the present invention is directed.

Forging may be defined as the packing or kneading of a metal to close and weld voids in the original metal, and to compact and consolidate the crystalline structure, whereby the strength of the metal is greatly increased. The metal may be so packed or kneaded under repeated hammer blows, or by squeezing in a press under extreme hydraulic pressure. In press forging, there is a deep or "through" penetration of the metal by the extreme pressure exerted, and maximum refinement of the crystalline structure throughout the product results.

Despite the attractiveness of the press forging type of operation, however, methods and apparatus for press forging universal socket elements of the type mentioned above have not appeared, and it may be stated that the general object of the present invention is the provision of novel and improved apparatus for press forging articles of the kind indicated.

The present application may be regarded as dealing specifically with certain apparatus coming under the general heading of the subject matter disclosed in my copending application, entitled Method and means for making wrench sockets and the like, filed May 24, 1944, Serial No. 537,064, and wherein claims generic to the present invention will be found.

Reference is directed to said copending application for a discussion of certain of the advantages characteristic of the subject matter common to the two cases.

The present invention will be best understood by now referring to the following detailed description of certain present illustrative embodiments thereof, reference for this purpose being had to the accompanying drawings, in which:

Fig. 1 is a fragmentary side elevational view of a hydraulic press, showing the upper portion of a stationary bed, and the lower portion of the vertically movable plunger head, the plunger head being shown at the top of its stroke, just before descending;

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Fig. 2 is a horizontal section taken on line 2—2 of Fig. 1;

Fig. 3 is a vertical medial section taken in accordance with line 3—3 of Fig. 2, and showing the plunger head in an operating position following that indicated in Fig. 1;

Fig. 4 is a section taken on line 4—4 of Fig. 3;

Fig. 5 is a perspective view, partially sectionalized, of a universal socket tool of a more or less conventional type, having a square socketed part such as may be manufactured by the methods of the present invention;

Fig. 6 is a view similar to Fig. 3, but showing the parts of the plunger head moved to their ultimate downward position;

Fig. 7 is a section taken on line 7—7 of Fig. 6;

Fig. 8 is a fragmentary perspective of the die insert and die punch, in a position corresponding to that of Figs. 6 and 7;

Fig. 9 is a view similar to Fig. 6, but showing the plunger head being retracted upwardly, and the forged product being stripped from the die punch;

Figs. 10, 11 and 12 are half sections in perspective of the product, viewed in various aspects;

Fig. 13 is a view similar to Fig. 3, but showing a modified setup;

Fig. 13*a* is a detail section on line 13*a*—13*a* of Fig. 13;

Fig. 14 is a fragmentary view similar to a portion of Fig. 13, but showing a subsequent operating position; and

Fig. 15 is a half section in perspective of the product resulting from the operation and method of Figs. 14 and 15.

In the drawings, and referring more particularly to Figs. 1 through 12, the numerals 10 and 11 designate, respectively, the horizontal bed and vertically movable plunger head of a hydraulic press, which may be generally of conventional design. Sunk into the flat, horizontal upper face of bed 10 is an abutment in the form of a disc 13 whose upper face is formed with a diametral rib 14, the upper face of the disc being flush with the face of bed 10, and the rib 14 rising above said face as clearly appears in the drawings. Resting on the disc 13 is a die block disc 15, preferably of the same diameter as disc 13, and the underside of this disc 15 has a diametral slot 16 which receives the aforesaid rib 14. This die block 15 is of the one-piece or nonparting type, and is of course formed of suitably hardened steel. It is

formed with a central cylindrical bore or die cavity 18, which extends through it from face to face. While the die cavity is here illustrated as of substantially equal diameters at the upper and lower faces of the die block, there is nothing to prevent the use of convergence, if desired, from the surface toward the lower end, and as a matter of fact, a slight taper will facilitate extraction of the product from the die. However, it is essential that the cavity be of a nonundercut character, i. e. that its cross-sectional dimensions nowhere exceed the dimensions of its mouth, since otherwise extraction of the product through said mouth would be an impossibility.

The aforementioned rib 14 is of a thickness equal to the desired dimension between the furcations to be formed on the product, and it is formed with a squared notch 20 centralized within the die cavity and of a width preferably equal to the thickness of the rib. The depth of this notch may vary with circumstances, as will later more fully appear, but may typically be approximately as illustrated in the drawings.

The vertical plunger head 11 is provided with the usual lateral cross-slot 30 for a knockout bar 31, and below slot 30 with a vertical bore 32 opening through its lower end. Received in this bore is the reduced cylindrical shank 33 of a die punch holder 34, which also has an enlarged head 35 at its lower end adapted to engage the underside of plunger head 11. Extending upwardly into the member 34 is a bore or socket 36 adapted to receive the shank 37 of a die punch 38 of squared cross-sectional form. This die punch is secured to the member 35 by means of a screw 40 reaching downwardly from the upper end of shank 33 and engaging a screw threaded socket 41 in the end of the punch shank 37. As shown, the head of the screw 40 is preferably countersunk into the shank 33. The shank 33 is removably secured in position in the plunger head 11 by means of a removable insert clamp block 44 secured to the plunger head by means of screws 45, and designed to clampingly engage the shank 23. Such construction is more or less conventional and will be readily understood.

Also carried by plunger head 11 is a member 46 functioning, first, as a closure for the upper end of the die cavity, and second, as a stripper for removing the forged product from the die punch. This member 46 comprises, in the present embodiment of the invention, a lower annular part 47 which is receivable, with a close sliding fit, in the mouth or upper end portion of the cylindrical die cavity 17, and an enlarged upper disc-like part 48 whose horizontal lower surface is engageable with the top face of the die block when the closure part 47 has been fully inserted within the die cavity 17, and whose horizontal upper surface is adapted to be engaged by the horizontal lower face 51 of the die punch holder 34. As here shown, the member 46 is carried by a pair of long screws 54 which reach downwardly through the die punch holder 34, the heads of said screws being countersunk into the upper end of the latter, and the lower ends of the screws being screwed into the disc 48, in the manner clearly illustrated in the drawings. The screws 54 are of such length that the member 46 is normally suspended in a position spaced somewhat below die punch holder 34 (Fig. 1) and the screws 54 are slidable in said holder 34 to permit relative movement between die punch holder 34 and member 46. The member 46 is provided with a square aperture 58 adapted to receive the squared punch with a close sliding fit.

The knockout bar 31 is normally held down to the lower end of slot 30 by means of coil springs 60 connected between its ends and the lower end portion of the plunger head 11. In the course of upward movement of the plunger head, the two ends of the knockout bar engage a pair of stationary stop screws 61 (Fig. 9), which limit the upward movement of the bar 31 and arrest the same while the plunger head is still rising. The knockout bar 31 passes over and engages the heads of the two screws 54 in the performance of a function which will presently appear.

Fig. 1 shows the press in the preliminary position, a billet of metal 70, preferably heated to a forging temperature, having been deposited in the die cavity 17. The plunger head then descends, shortly reaching the position of Fig. 3, wherein die closure element 47 has been inserted within the mouth of the die cavity and the disc like member 48 has come into engagement with the upper face of the die block. With continued downward movement of plunger head 11, the die punch holder 34 will then slide downwardly on the screws 54, the heads of which, remaining stationary, arrest downward movement of knockout bar 31, so that the latter moves relatively upwardly in the slot 30 of the still descending plunger head. The springs 60 are, of course, stretched out at this time.

The descending die punch next engages and is forced into the billet, forming the socket *s*, and causing metal to flow downwardly around the two sides of the notched rib 14 and into the notch itself, as well as upwardly around the outside of the punch into engagement with the die closure member 47. Figs. 6 and 7 illustrate how the metal has been forced to form an upper socket portion 71 of circular external shape and squared internal shape, and also to flow downwardly to form a pair of downwardly extending furcations 72, and a connecting web or bridge member 73 formed within the notch 20. The punch may descend sufficiently to be received partially within this notch, and the thickness of the web or bridge piece depends upon the final clearance between the bottom of the notch and the lowermost position of the punch.

Fig. 9 shows a subsequent stage, the plunger head having been elevated nearly, but not quite, to its initial position, and the knock-out bar 31 having come into engagement with the stop screws 61, and therefore, through its engagement with the screws 54, having arrested upward movement of the die closure member 46. It will be understood that the socketed product will tend to seize onto the die punch, and will be elevated with the latter when the plunger head moves up. However, the member 46 is arrested in its upward movement by the engagement of knock-out bar 31 with stop screws 61, and annular element 47, which will be observed to be in contact with the upper end of the socketed product, will strip the latter off the punch as the punch continues to rise with the plunger head. It will be understood that by the time the plunger head has been elevated the remainder of the distance from the position of Fig. 9 to that of Fig. 1, the socketed product will have been stripped entirely from the punch.

The resulting product will be understood better by reference to Figs. 10–12. It will be seen that there has been an upward flow of metal around the outside of the punch, in the nature of a

"flash," which is moulded to a smoothed finish at the top by its engagement with the die closure element **47**. This "flash" becomes the upper portion of the side wall of the socket. At the same time, metal has been extruded downwardly around the two sides of the insert rib **13** to form the legs or furcations **72**, a portion of the metal between those legs having been moved or squeezed by the punch downwardly into the notch **20** to form the bridge piece **73** that joins said legs.

The product as shown in Figs. 10–12 may have the bridge piece subsequently sheared out, as will readily be understood, and the legs may then be clipped to desired contour and drilled or punched to receive a pivot pin, thus completing the upper square-socketed element **80** of the universal wrench tool of Fig. 5. The manner of acccomplishing these finishing operations with conventional shearing and clipping tools will be obvious to those skilled in the art, and no illustration thereof is deemed necessary herein. The element **80** is shown in Fig. 5 as pivoted to a connecting block **81**, which is in turn pivoted to the furcations of a socketed element **82**, which may have a square or other socket as will be understood. If it is to have a "12-point" socket, it may be made by the procedure disclosed in my above mentioned copending application Serial No. 537,064. There may be various occasions wherein for reasons of added strength, the device of Figs. 10–12 has utility with the bridge piece **73** in place, and the present invention furnishes a method and means for press forging such a product.

Figs. 13 through 15 show a modified embodiment of the invention, designed to produce the ultimate press forging in one operation. The apparatus is in this instance generally similar to that previously described, with the principal exception that the notch **20** in the rib **14** of the die insert structure becomes an aperture **80** of squared cross-section extending downwardly through the rib and on entirely through the disc **13**, the bed **10** being provided with an outlet opening **81** aligned with said aperture for the passage of a waste slug of material. The only other difference is that the die punch must be given a somewhat increased length of travel, resulting in some changes of proportion in the structure, as will be evident from a comparison of Fig. 13 with Fig. 3.

Fig. 13 shows a position corresponding to that of Fig. 3, and shows the heated billet **70** in place in the die cavity, with the die closure member **46** lowered to its ultimate position, and the die punch just before engaging the billet. Fig. 14 shows the position of the parts at the end of the down stroke of the die punch, and shows that the punch has continued on downwardly, forcing a slug of metal **82** on downwardly through the aperture **80**, whence it will fall from the apparatus via the waste outlet **81**. Otherwise, the operation is precisely the same as that previously described. The characteristic operation of Figs. 13 through 15 is thus that the die punch continues on downwardly, gradually moving the slug **82** to the bottom of the two downwardly extending furcations **83** formed on the two sides of the insert rib, and finally shearing it therefrom. The resulting product, designated generally by numeral **84**, is shown in half-section perspective in Fig. 15, and it will be evident how such product, thus produced in one step, may be clipped and drilled or punched for use in such a tool as is illustrated in Fig. 5.

I have herein illustrated and described certain

particular methods and apparatus as illustrative of the invention; it is to be understood of course that the invention is not to be construed as limited to the specific embodiments herein described, which are for illustrative purposes only, and are subject to substantial modification without departing from the spirit and scope of the invention.

I claim:

1. Press forging apparatus of the character described, comprising: a die block having a die cavity sunk therein, a die punch reciprocable into and out of said die cavity, an abutment closing the inner end of said die cavity and formed with a transverse rib extending transversely across the inner end portion of the cavity and spaced from two opposite sides thereof, and a central notch in said rib adapted to slidably receive the end portion of said punch.

2. Press forging apparatus of the character described, comprising: a die block having a die cavity sunk therein, a die punch reciprocable into and out of said die cavity, and an abutment closing the inner end of said die cavity and formed with a transverse rib extending transversely across the inner end portion of the cavity and spaced from two opposite sides thereof, there being an aperture dimensioned to slidably receive said die punch extending through said rib and abutment.

3. Press forging apparatus of the character described, comprising: a die block having a die cavity sunk therein, a die punch of square cross-sectional form reciprocable into and out of said die cavity, an abutment closing the inner end of said die cavity and formed with a transverse rib extending transversely across the inner end portion of the cavity and spaced from two opposite sides thereof, and a central notch of square cross-sectional form in said rib adapted to slidably receive the end portion of said punch.

4. Press forging apparatus of the character described, comprising: a die block having a die cavity sunk therein, a die punch of square cross-sectional form reciprocable into and out of said die cavity, and an abutment closing the inner end of said die cavity and formed with a transverse rib extending transversely across the inner end portion of the cavity and spaced from two opposite sides thereof, there being an aperture dimensioned to slidably receive said die punch extending through said rib and abutment.

5. Press forging apparatus of the character described, comprising: a die block having a substantially cylindrical, nonundercut die cavity extending therethrough, a die punch of rectangular cross-section reciprocable into and out of said die cavity, an abutment engaging the underside of said die block and closing the inner end of said die cavity, a rib on said abutment extending transversely across the inner end portion of said die cavity and spaced from opposite sides thereof, and a central rectangular notch in said rib adapted to slidably receive the end portion of said punch.

6. Press forging apparatus of the character described, comprising: a die block having a substantially cylindrical, nonundercut die cavity extending therethrough, a die punch of rectangular cross-section reciprocable into and out of said die cavity, an abutment engaging the underside of said die block and closing the inner end of said die cavity, a rib on said abutment extending transversely across the inner end portion of said die cavity and spaced from opposite sides there-

of, and a central rectangular notch extending through said rib and abutment adapted to slidably receive the end portion of said punch.

7. Press forging apparatus of the character described, comprising: a die block having a die cavity sunk therein, a die punch reciprocable into and out of said die cavity, a closure for the inner end of said die cavity, a transverse bar positioned immediately forwardly of said closure extending transversely across the inner end portion of the cavity and spaced from two opposite sides thereof, and a central notch in said bar adapted to slidably receive the end portion of said punch.

8. Press forging apparatus of the character described, comprising: a die block having a die cavity sunk therein, a die punch reciprocable into and out of said die cavity, a closure for the inner end of said die cavity, a transverse bar positioned immediately forwardly of said closure extending transversely across the inner end portion of the cavity and spaced from two opposite sides thereof, and an aperture dimensioned to slidably receive said die punch extending through said bar and closure.

9. Press forging apparatus of the character described, comprising: a die block having a die cavity sunk therein, a die punch reciprocable into and out of said die cavity, a closure for the inner end of said die cavity, a transverse bar positioned immediately forwardly of said closure extending transversely across the inner end portion of the cavity and spaced from two opposite sides thereof, there being a central opening in said bar adapted to slidably receive said die punch.

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