June 19, 1928. 1,674,310

C. P. TOPPING

FORGING MACHINE AND METHOD

Filed Jan. 26, 1926 2 Sheets-Sheet 1

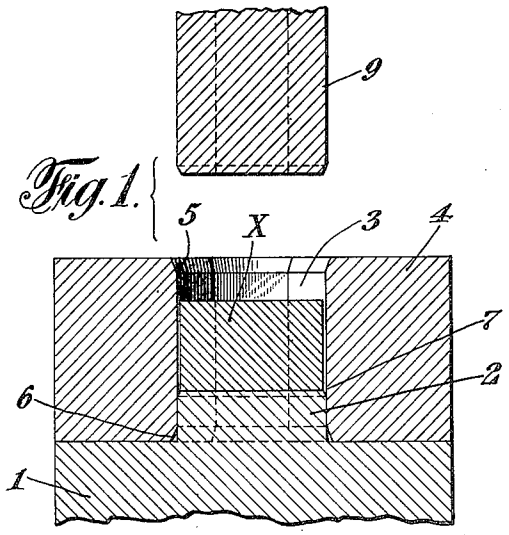


Fig. 1.

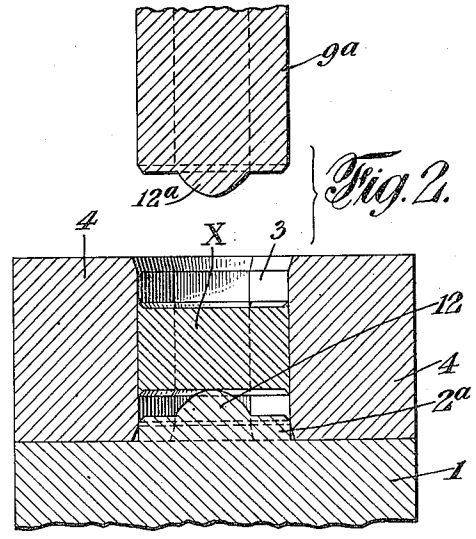


Fig. 2.

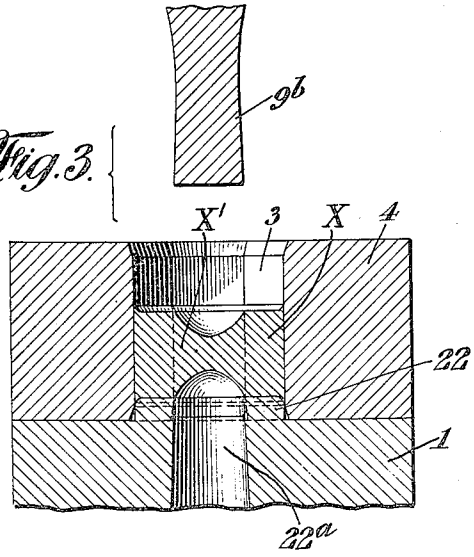


Fig. 3.

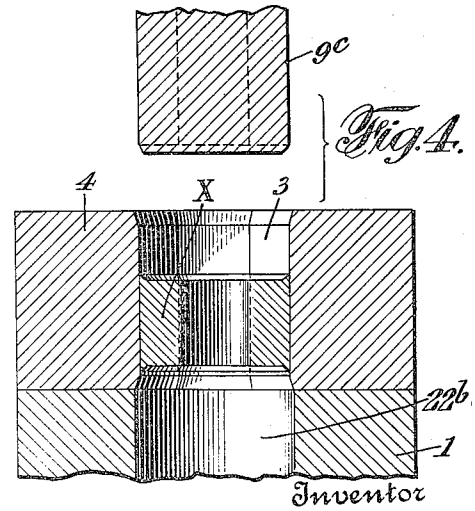


Fig. 4.

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FORGING MACHINE AND METHOD

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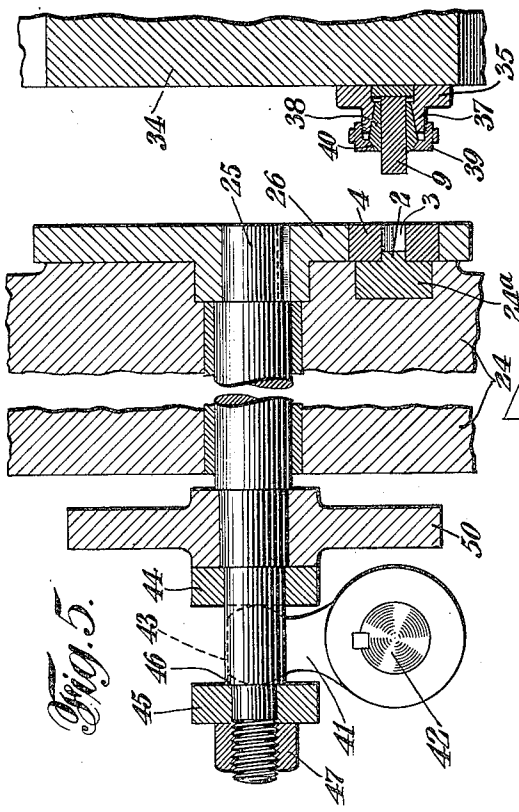


Fig. 5.

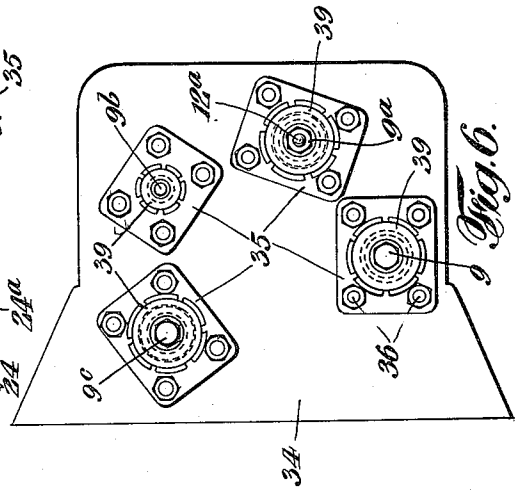


Fig. 6.

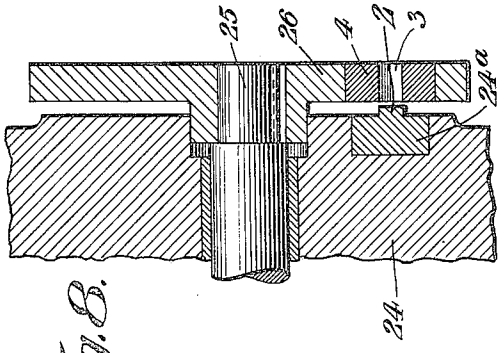


Fig. 8.

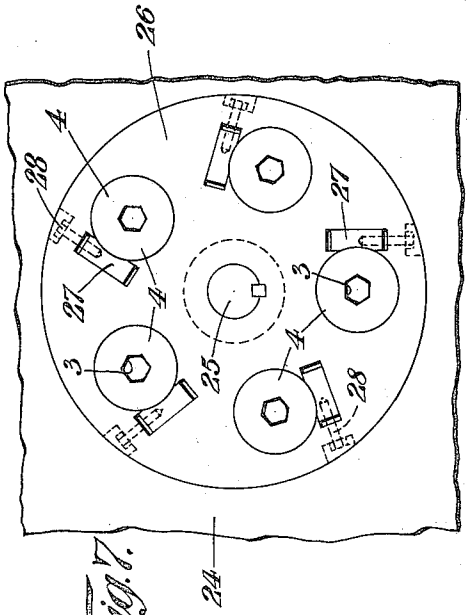


Fig. 7.

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UNITED STATES PATENT OFFICE.

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FORGING MACHINE AND METHOD.

Application filed January 26, 1926. Serial No. 83,978.

My present invention is disclosed herein as applied to forging nut blanks or the like from slugs of iron or steel of the grades commonly employed for such articles, and certain features of the invention are of particular advantage as applied to cold forging and piercing slugs cut from bars to produce nut blanks. It will be found that the apparatus and also certain generic features of the method are applicable to forging other articles from other materials.

The machine provides for a plurality of working steps successively performed on each slug, the several successive steps being simultaneously performed on a number of slugs corresponding to the number of the steps. The steps involve application of high pressures, and at least one shaping operation taking effect simultaneously on both faces of the blank, combined with shaping of the periphery by spreading of the metal against a peripheral shaping surface. The latter is particularly important for perfectly forming sound corners and edges on cold forged nuts. My invention contemplates the use of a slug which may be markedly misshapen, provided it contains the proper volume of metal but which, in any event, is of less diameter than the nut to be produced, and a novel feature of the nut is the employment of a peripheral female die, open at both ends, midway of which the blank is lodged by the first expanding operation and in which it is carried until the final step, where it is ejected as a nut blank. In this periphery-shaping carrier die, the successive steps are formed by pairs of cooperating dies, to which the carrier is successively indexed. One important feature of these dies is that both members are projected into the carrier cavity from opposite ends thereof and one of them is preferably a stationary projection over which the slug carrying female die is fitted, as part of the indexing operation, forming with the carrier a complete female die with a closed end, into the other end of which the pressure applying male die is reciprocated to apply the required great pressure. The machine, therefore, comprises essentially a massive fixed member carrying equally spaced die faces elevated above the surface of the anvil member on projections adapted to accurately fit the periphery forming elements of the second or carrier member, means for indexing the carrier member over the several projections of the stationary or anvil member, together with a third operating member which applies the pressure to the blank in the carrier between intervals of the indexing.

The above and other features of my invention will be more evident from the following description in connection with the accompanying drawings, in which

Figs. 1, 2, 3 and 4 are sections showing the three die members, the blanks therein and the operations performed on the blanks;

Fig. 5 is a somewhat diagrammatic axial section through the indexing carrier and cooperating forming members;

Fig. 6 is a face view of the upper member shown in Fig. 1, showing the arrangement of the several male die members;

Fig. 7 is a similar face view of the carrier member, showing the peripheral female die members thereon; and

Fig. 8 is a detail axial section showing certain of the parts of Fig. 1 while the carrier is indexing.

In Fig. 1, the anvil member, 1, has an upward, preferably integral, projection to fit the interior peripheral die surface, 3, of carrier 4, said surface in this case being hexagonal, the open ends being formed with outwardly beveled portions, 5 and 6, respectively. In Figs. 1 to 4 the female carrier die is the same, and the anvil die is the same and the projections on the latter are the same so far as concerns fitting the interior of the carrier die, but the blank shaping ends of these projections, as also the cooperating shaping dies entering through the other end of the carried die, are specifically different as required for the successive steps of the operation.

In Fig. 1 the projection, 2, extends upward, so that the blank x is supported approximately midway of the peripheral shaping die, 3. Its upper face is plane, with a slight inward bevel at the edges to permit flow of the metal for formation of square corners on the blank and the cooperating movable die member, 9, has a precisely similar plane face, beveled edges and hexagonal periphery.

As shown in Fig. 1, the blank x contains metal sufficient for the completed nut, but it does not fit the cavity, the misshaping being

relatively great where the slug is cut flatwise from a rectangular bar or as close as may be desired if cut from a hexagonal bar at right angles to the axis thereof.

However the slug is produced, the first operation is application of great pressure by descent of the male die, 9, spreading the metal of the slug, driving it into firm engagement with the hexagonal walls, 3, and partly filling the corners of the hexagon.

Upon completion of the first step and withdrawal of the bar, 9, the carrier, 4, is indexed to the position shown in Fig. 2, where the cooperating upper and lower die faces have an annular surface corresponding to the face of the nut blank to be produced and opposite convex hemispherical or egg-shaped projections, 12, 12^a, on 2^a and 9^a, respectively, with a diameter approximately equal to the hole to be pierced through the nut. It will be noted that the total height of the projection, including the hex-fitting base, 2^a, and the ovoid projection, 12, is approximately the same as the total height of projection 2, this being necessary because the blank x is now, so to speak, "frozen" in intermediate engagement with the carrier die 3, to such an extent that proper indexing and solid engagement of the carrier die, 4, with the support surface of anvil, 1, would be prevented by the blank. Operation of this mechanism simultaneously spreads the material and wipes the blank axially downward in the female carrier die, to the position and shape shown in Fig. 3. In this operation, the metal has had an opportunity to flow vertically, thereby thickening the blank and at the same time affording the interior flow, draw and wiping of the periphery of the metal to make perfect surfaces and corners. In Fig. 3 the height and peripheral shape of projection 22 is the same as that of 2^a in the preceding figure, with the result that the blank in the indexed position rests firmly on the surface of 22, while the lower surface of the carrier 4 is in firm engagement with the anvil member, 1. In this position, the punch, 9^b, punches out the slug, x', the effort required being less, and the smoothness of the punched hole much greater by reason of the ovoid cavities into which the compressed metal can flow. The slug x', is ejected through a central opening 22^a through the top of projection, 22 extending down through carrier, 1.

The carrier is then indexed to the position shown in Fig. 4, where the completed nut blank, x, is ejected through outlet, 22^b, in anvil member 1, by reciprocation of punch member, 9^c.

In the foregoing I have described the relations and movements of parts as "upper", "lower", etc., but this is merely for convenience in identifying parts as shown in Figs. 1 to 4, and it will be understood that the operations are the same when the movements are horizontal instead of vertical or, indeed, for any intermediate angle. As a matter of fact, there is distinct advantage in having the carrier rotate in a vertical plane, the reciprocation of the moving male dies being horizontal to correspond. The latter arrangement is indicated in Figs. 5, 6, 7 and 8, which also indicate more or less diagrammatically certain of the details of the apparatus and driving mechanism. As concerns general organization of parts, Fig. 5 shows the stationary upright support, 24, in which is journaled shaft 25 carrying a turret, 26, in which the periphery forming carrier dies, 4, are removable cylindrical members, held in desired position of angular adjustment by locking blocks, 27, adjusted and held by bolts, 28.

The forward face of member 24 carries the projections, 2, which fit into the carrier dies, and these projections may be on separate removable bases, 24^a, held fixed in recesses of 24 in any desired way, the locking means similar to that employed for carriers 4 being suitable for this purpose also. The reciprocating male members, 9, 9^a, etc., are mounted upon a horizontal reciprocating slide, 34, in any desired way, the means shown in connection with 9 being a rectangular plate, 35, secured by four bolts, 36, and formed with an upstanding boss, 37, coned interiorly to fit a split conical bushing, 38, the interior of which is powerfully clamped against the sides of die member, 9, by annular collar, 39, screwing onto the outside of 37 and provided with an inner conical surface, 40, adapted to fit a corresponding surface on the bushing, 38.

Any suitable means may be employed for longitudinally reciprocating the shaft, 25, to move the carrier, 26, to the position shown in Fig. 8, where it is free from projections, 2, 2^a, etc., to rotate it to a new indexed position and move it back again to position shown in Fig. 5, where the carrier rests solidly against the front face of 24, with die member, 2, projecting into another carrier, 4. Means for this purpose is diagrammatically indicated as including an arm, 41, on shaft, 42, having a head, 43, loosely engaged between collars, 44 and 45, the latter being held against a shoulder, 46, on shaft 25 by means of a nut, 47, screwing on the end of the shaft. The wheel, 50, is diagrammatic, showing a suitable means which may be the slotted member of a Geneva stop, whereby the carrier 26 is rotated for indexing while the parts are in the position shown in Fig. 8.

With the above construction, it will be evident that the backing support, 24, for the die member 2, being stationary, may be of practically unlimited strength and massiveness, to withstand shock of impact of the moving die members, as well as the follow

up pressure thereof, while at the same time minimum mass and weight are permissible for the carrier, 26, this being the only part that moves in performing the indexing operation. It will be understood in this connection that massive inertia backing for the female die is highly important, since any yield whatever at this point, will subtract from the useful work done in forming the blank within the die, and the present construction, whereby the inertia element remains stationary during the indexing operation leaves the designer free to utilize any massiveness that may be desirable in view of the forces employed.

I claim:

1. The machine for forging nut blanks, including an open-ended, periphery-forming carrier die, cooperating relatively movable dies operating through the ends of said carrier die for applying pressure to expand a slug of insufficient diameter but proper volume, into a rigid lateral engagement with the periphery-forming walls of the open-ended carrier die intermediate the ends thereof, and mechanism for moving the latter while the blank is so held out of engagement with said relatively movable dies and into another position for operative engagement with other pressure devices successively operating through the ends of said carrier die to perform other nut forming operations on the blank.

2. The machine for forging nut blanks, including an open-ended, periphery-forming carrier die, cooperating relatively movable dies operating through the ends of said carrier die for applying pressure to expand a slug of insufficient diameter but proper volume, into rigid lateral engagement with the periphery-forming walls of the open-ended carrier die intermediate the ends thereof, and mechanism for moving the latter while the blank is so held out of engagement with said relatively movable dies and into another position for operative engagement with other pressure devices successively operating through the ends of said carrier die to perform other nut forming operations on the blank, the latter pressure devices including means for axially punching the central portions of the blank to form a perforation therethrough and means for forcing the blank out of the carrier die.

3. The machine for forging nut blanks, including an open-ended, periphery-forming carrier die, cooperating relatively movable dies operating through the ends of said carrier die for applying pressure to expand a slug of insufficient diameter but proper volume, into rigid lateral engagement with the periphery-forming walls approximately midway between the ends of the open-ended carrier die, and mechanism for moving the latter while the blank is so held intermediate the ends thereof, out of engagement with said relatively movable dies and into another position for operative engagement with other pressure devices successively operating through the ends of said carrier die to perform other nut forming operations on the blank, the latter pressure devices including means for application of end pressure to form central depressions and cause lateral flow of the metal, thereby thinning the center that is to be punched and thickening the annulus portion that is to form the nut; means for axially punching the central portions of the blank to form a perforation therethrough, and means for forcing the blank out of the carrier die.

4. A nut blank forming machine, including an open-ended, periphery forming carrier die, a plurality of pairs of relatively movable, end pressure dies, operating through the ends of said carrier die, and means for presenting the carrier die successively in alignment between the cooperating members of each pair of the end pressure dies for endwise engagement of said end pressure dies with a blank positioned intermediate the ends of said carrier die; said means including a turret mounted on an axis parallel with the direction of relative movement of the end pressure dies.

5. A nut blank forming machine, including an open-ended, periphery forming carrier die, a plurality of pairs of relatively reciprocating dies operating through the ends of said carrier die for endwise engagement with a blank positioned intermediate the ends of said carrier die, and means for presenting the carrier die successively in alignment between the cooperating members of each pair of the end forming dies, said means including a turret mounted on a horizontal axis parallel with the movement of said end forming dies.

6. A nut blank forging machine, including a stationary support having a plurality of end pressure dies on one face thereof and a blank carrying turret mounted to rotate on an axis parallel with the direction of projection of said stationary end pressure dies and having a plurality of similarly spaced, open-ended periphery-forming dies, consisting of passages opening through the turret and means for indexing them to register with said stationary dies successively, in combination with a reciprocatory slide member carrying cooperating end pressure dies aligned with said stationary dies, operating simultaneously on the several blanks in the periphery-forming die passages through the ends thereof and successively on each blank, the several pairs of cooperating dies including a primary pair adapted to expand a blank into secure lateral engagement with the walls within the die passages of the turret.

7. A nut blank forging machine, includ-

ing a stationary support having a plurality of end pressure dies on one face thereof and a blank carrying turret mounted to rotate on an axis parallel with the direction of projection of said stationary end pressure dies and having a plurality of similarly spaced, open-ended periphery-forming dies, consisting of passages opening through the turret and means for indexing them to register with said stationary dies successively, in combination with a reciprocatory slide member carrying cooperating end pressure dies aligned with said stationary dies, operating simultaneously on the several blanks in the periphery-forming die passages through the ends thereof and successively on each blank, the several pairs of cooperating dies including a primary pair adapted to expand a blank into secure lateral engagement with the walls within the die passages of the turret, and another pair adapted to punch the central opening.

8. A nut blank forging machine, including a stationary support having a plurality of end pressure dies on one face thereof and a blank carrying turret mounted to rotate on an axis parallel with the direction of projection of said stationary end pressure dies and having a plurality of similarly spaced, open-ended periphery-forming dies, consisting of passages opening through the turret and means for indexing them to register with said stationary dies successively, in combination with a reciprocatory slide member carrying cooperating end pressure dies aligned with said stationary dies, operating simultaneously on the several blanks in the periphery-forming die passages through the ends thereof and successively on each blank, the several pairs of cooperating dies including a primary pair adapted to expand a blank into secure lateral engagement with the walls within the die passages of the turret, another pair adapted to displace the metal to form central depressions, and another pair adapted to punch the central opening.

9. A nut blank forging machine, including a massive stationary support having a plurality of suitably spaced, parallel dies projecting horizontally from a vertical face thereof; a turret member mounted in said stationary support and rotating on a horizontal axis parallel with the direction of said stationary dies, said turret having a plurality of similarly spaced, periphery-forming die passages opening therethrough adapted to register with and fit over said projecting stationary dies; and means for axially shifting the turret out of and into engagement with said projecting dies and for rotary indexing while disengaged, in combination with a slide member carrying cooperating end pressure dies aligned with said stationary dies, the aligned dies including a primary pair adapted to initially expand each blank into secure lateral engagement with the walls of its periphery forming passage in the turret.

10. A nut blank forging machine, including a massive stationary support having a plurality of suitably spaced, parallel dies projecting horizontally from a vertical face thereof; a turret member mounted in said stationary support and rotating on a horizontal axis parallel with the direction of said stationary dies, said turret having a plurality of similarly spaced, periphery-forming die passages opening therethrough adapted to register with and fit over said projecting stationary dies; and means for axially shifting the turret out of and into engagement with said projecting dies and for rotary indexing while disengaged, in combination with a slide member carrying cooperating end pressure dies aligned with said stationary dies, the aligned dies including a primary pair adapted to initially expand each blank into secure lateral engagement with the walls of its periphery forming passage in the turret, approximately midway of said passage and a subsequently acting pair adapted to form central depressions thickening the edge portions of the blank and forcing the entire blank bodily a substantial distance toward the exit end of said passage.

11. The method of forging nut blanks, which includes expanding a slug of insufficient diameter but of proper volume, into rigid lateral engagement with periphery-forming walls intermediate the end of an open-ended die by simultaneous pressure of end-forming dies projecting within the ends of said open-ended die and while the blank is so held, successively subjecting it to other pressure devices successively operating through the ends of said die to perform other nut forming operations on the blank including application of end pressure to form central depressions and to simultaneously move the blank for wiping the periphery.

12. The method of forging nut blanks, which includes expanding a slug of insufficient diameter but of proper volume, into rigid lateral engagement with periphery-forming walls intermediate the ends of an open-ended die by simultaneous pressure of end-forming dies projecting within the ends of said open-ended die, and while the blank is so held, successively subjecting it to other pressure devices successively operating through the ends of said die to perform other nut forming operations on the blank, including application of end pressure to form central depressions and to simultaneously move the blank for wiping the periphery and axially punching to form the perforation through the nut blank and finally punching the blank out of the carrier die.

13. The method of forging nut blanks,

which includes expanding a slug of insufficient diameter but of proper volume, into rigid lateral engagement with periphery-forming walls intermediate the ends of an open-ended die by simultaneous pressure of end-forming dies projecting within the ends of said open-ended die, and while the blank is so held, successively subjecting it to other pressure devices successively operating through the ends of said die to perform other nut forming operations on the blank, including application of end pressure to form central depressions and cause lateral flow of the metal while simultaneously moving the blank to wipe the periphery, thereby thinning the center, that is to be punched and thickening the annulus portion that is to form the nut, axially punching to form the perforation through the nut blank and finally punching the blank out of the carrier die.

Signed at North Tonawanda in the county of Niagara, and State of New York, this nineteenth day of January, A. D. 1926.

CHARLES P. TOPPING.