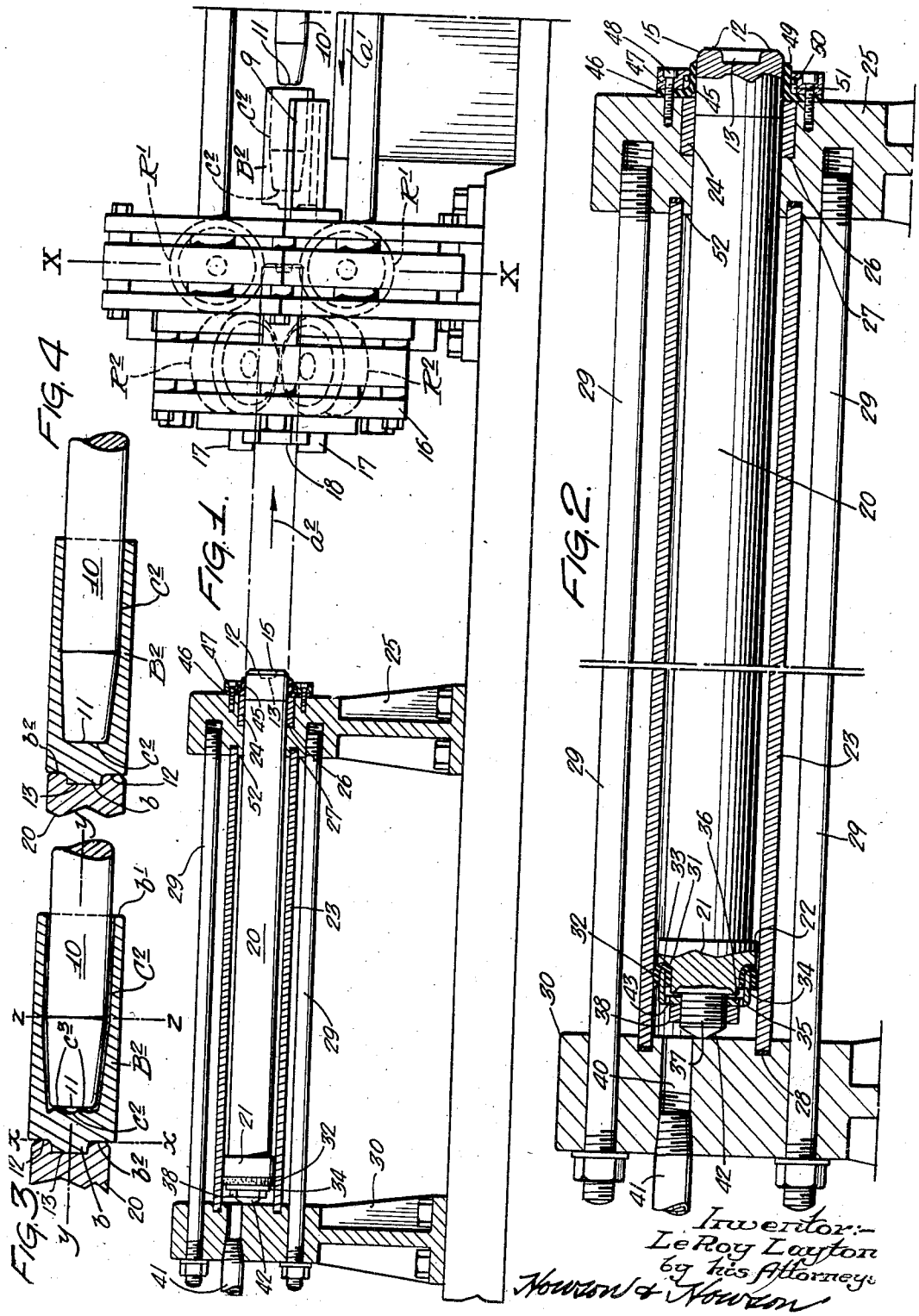
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FORGING RETARDER FOR DRAW BENCHES

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FORGING RETARDER FOR DRAWBENCHES

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3 Claims. (Cl. 80—12)

This invention relates to an apparatus for yieldably exerting axial pressure against the closed ends of hollow forgings, such as artillery shell forgings, inversely to the forward movement of the forgings through one or more roll passes of a draw bench, in opposition to and in axial alignment with the mandrel of the draw bench, by which the forgings are successively advanced through said pass or passes, while the rolls of each pass simultaneously exert lateral pressure inwardly against the side walls of the forgings.

The apparatus of the present invention is adapted for use in conjunction with the method and apparatus for finishing forgings, as respectively disclosed in my prior United States Letters Patent No. 2,278,325, dated March 31, 1942, and No. 2,248,002, dated July 1, 1941.

The apparatus of the present invention constitutes an improvement on and a simplification of an apparatus for applying back pressure to forgings in draw bench passes which is disclosed in my copending application, Serial No. 445,798, filed June 4, 1942.

The apparatus of the present invention is adapted for carrying out the steps of the process set forth in the aforesaid copending application, in conjunction with the steps of the process set forth in the aforesaid prior patents.

The apparatus disclosed in the aforesaid copending application is adapted for applying relatively heavy inverse pressures against the closed ends of advancing forgings, while the apparatus of the present invention is adapted for applying a relatively lighter inverse pressure against the advancing forgings, which permits simplification of the structure.

In the accompanying drawing:

Fig. 1 is a side elevation, partly in section, of the apparatus of the present invention operating in conjunction with the apparatus disclosed in the aforesaid prior patents;

Fig. 2 is an enlarged sectional elevation of the pressure applying mechanism;

Fig. 3 is a longitudinal sectional view of a hollow shell forging as it is being advanced by the mandrel of a draw bench, prior to the application of the inverse pressure against the closed end of the forging; and

Fig. 4 is a view similar to Fig. 3 showing the forging and mandrel subsequent to the application of the inverse pressure by the apparatus shown in Fig. 1, and to the passage of the forging through the roll passes of the draw bench.

In the manufacture of hollow forgings such, for example, as those employed as high explosive artillery projectiles, a heated billet is placed in a die and axially pierced to provide a cavity for reception of the explosive used for bursting the projectile.

The interior surfaces of the explosive receiving cavities are finished in accordance with the process disclosed in the aforesaid prior patents.

In accordance with the process disclosed in said prior patents, the initial cavity of the primary forging is slightly larger in diameter than the cavity of the finished projectile. The reduction of the diameter is effected by placing a mandrel in the initial cavity of the primary forging, which is of the same diameter as the cavity of the finished forging, and forcing the forging through the throat of a ring or roll pass or passes of a draw bench, by which lateral pressure is applied to the exterior of the primary forging, as the forging is moved forwardly through the pass or passes by the mandrel, which effects a radial contraction of the primary forging around the mandrel and a consequent reduction in the diameter of the cavity of the primary forging to the diameter of the mandrel, in the finished forging.

The ends of the punches by which the initial cavities are formed in the primary forgings, after effecting a number of piercings, become worn or pitted and produce or leave small protuberances or other irregularities in the bases of the initial cavities of subsequently pierced billets. Such irregularities prevent the finishing mandrel from seating properly in the bases of the cavities during the finishing operation.

If a ring pass is employed in the finishing process, and the diameter of the throat of such pass is sufficiently smaller than the outside diameter of the primary forging to apply enough resistance to the advancement of the forging through the throat by said mandrel to eradicate such irregularities, the external bottom surface of the forging, which normally is formed in a plane at right angles to the axis of the forging, frequently becomes bulged and in some instances is actually pierced through by the nose of the mandrel, due to the excess pressure required to force the forging through the greatly under-sized throat of the ring.

If a roll pass is employed for finishing the forgings the possibilities of bulging or perforating the exterior bottoms thereof are practically eliminated. However, the protuberances remain in the bases of the explosive cavities and prevent proper shaping thereof by the nose of the mandrel. As the throat of the roll pass is decreased, to apply sufficient resistance to the forward mo-

tion of the forging to effect eradication of the protuberances, the radial pressure exerted by the pass rolls increases and frequently effects an axial forward elongation of the forging in front of the nose of the mandrel, as that portion of the forging which lies in the cross-sectional plane of or adjacent to the extremity of the nose passes through the bight of the rolls of the pass.

The aforesaid conditions are obviated by the application of inverse pressure to the exterior bottom surface of the closed end of each forging, by means of an anvil shaped to conform to the closed end of the forging and which is adapted to make and to retain full contact therewith during initial movement of the closed end of the forging into the throat of the pass and during the passage of that portion of the forging which surrounds the tapered end of the mandrel through the roll pass or passes.

As disclosed in the aforesaid prior patents, and as shown in Fig. 1 of the present case, a hot primary forging B^2, which has been pierced to form the explosive receiving chamber C^2 thereof, is placed in a horizontally disposed trough 9, with the horizontal axis of the forging coaxially aligned with the longitudinal axis of a horizontally movable mandrel 10 of a draw bench. As previously noted, the piercing C^2 is slightly greater, cross-sectionally, than the mandrel 10, at substantially all corresponding cross-sectional planes of the mandrel and the forging.

The mandrel 10 is advanced axially into the cavity C^2 of the primary forging B^2, freely, and without making any substantial contact with the interior surfaces of the cavity C^2, until the extreme end 11 of the mandrel comes into contact of the base c^2 of the cavity C^2. Continued axial movement of the mandrel 10 advances the forging B^2 into the bight of a series of rolls R^1, R^1, having concave faces which collectively constitute the throat of a first or preliminary pass, concentric to the longitudinal axis of the horizontally movable mandrel 10.

Continued axial movement of the mandrel 10 in the direction of the arrow a^1, Fig. 1, forces the forging B^2 through the first roll pass formed by the rolls R^1, R^1 into and through the bight of a second series of rolls R^2, R^2 which collectively constitute the throat of a second or finishing roll pass concentric to the axis of the mandrel 10.

The throat of the first roll pass is of slightly smaller diameter than the outside of the forging B^2, consequently, as the forging is advanced through the first roll pass, its outside diameter is reduced to the diameter of the pass. In effecting such reduction, radial contraction and compacting of the hot metal of the forging B^2 around the outer surface of the mandrel 10 is effected and causes the interior surface of the explosive chamber or cavity C^2 to be brought into close intimate finishing contact with the outer surfaces of the mandrel.

The diameter of the second roll pass is but slightly smaller than the diameter of the forging after it leaves the first roll pass and acts primarily to eradicate any fine ridges which may have been formed on the outer surface of the forging by the abutting edges of the rolls R^1, R^1 of the first pass, the rolls of the second pass being staggered to the extent of 45° about the axis of the mandrel with respect to the rolls of the first pass for that purpose.

As shown in Fig. 3, the external flat bottom surface b^2 of the forging B^2 is disposed in a plane x—x at right angles to the longitudinal axis y—y of the forging B^2. The bottom b^2 is provided with a pad b which extends outwardly beyond the plane x—x of the bottom b^2, and is of relatively smaller diameter than said bottom.

According to the present invention, when the bottom b^2 of the forging B^2 advances in the direction of the arrow a^1, to a position wherein the plane x—x of the bottom b^2 coincides with the plane X—X of the bight of the rolls R^1, R^1 of the first pass, said bottom is engaged by the end face 12 of an anvil 15 which has been moved in the direction of the arrow a^2 through the throat of the second roll pass until the plane of the end face 12 of the anvil 15 coincides with the plane X—X of the bight of the rolls R^1, R^1, said end face 12 of the anvil 15 being provided with a recess 13 into which the axial projection b of the forging B^2 extends.

The mandrel 10 is advanced in the direction of the arrow a^1 and advances the forging B^2 through the roll passes R^1, R^2 under a predetermined hydraulic pressure of, for example, 90 tons per square inch. In the present instance, this advancing force is opposed by an inversely acting force of substantially 1500 pounds per square inch, for example, as applied by the anvil 15. Consequently, as the nose 11 of the mandrel 10 moves into the cavity C^2 of the forging B^2 and engages the high points of the protuberances, ridges, or other irregularities c^3 on the base c^2 of the forging B^2, the inverse pressure applied by the anvil 15, and distributed uniformly over the entire area of the external bottom surface b^2 of the forging, momentarily stops the advance of the forging B^2, while the mandrel 10 continues to advance. Thus, any protuberances, etc., c^3 previously formed in the bottom c^2 of the cavity C2 are flattened out by the end 11 of the mandrel 10.

After flattening any protuberances, ridges etc. in the base c^2 of the cavity C2, the heavy pressure exerted in the direction of the arrow a^1 by the mandrel 10, which far exceeds the inverse pressure applied by the anvil 15 to the closed end b^2 of the forging B^2, causes said anvil to yield and recede.

The concurrent movement of the mandrel 10, anvil 15 and bottom portion of the forging B^2 which is interposed between the nose 11 of the mandrel 10 and the face 12 of the anvil 15, continues until that portion of the mandrel lying in the plane z—z, where the tapered end of the mandrel joins with the cylindrical body of the mandrel, arrives at the plane X—X of the bight of the preliminary roll pass R^1, R^1, whereupon, the inverse pressure applied by the anvil 15 is released, and the remainder of the passage of the forging B^2 through the roll passes R^1, R^2 continues in the normal manner disclosed in the aforesaid prior patents.

The advancement of the forging B^2 in the direction of the arrow a^1 is continued until the rear or open end b^1 of the forging has passed through and beyond the housing 16 in which the rolls R^2, R^2 of the second roll pass are rotatably mounted, and beyond the stripper plate 18 which is slidably mounted in guides 17, 17, secured to the rear face of the housing 16.

After the end b^1 of the forging B^2 has passed beyond the rear face of the stripper plate 18, said stripper plate is moved transversely across the path traversed by the forging, after which the direction of axial movement of the mandrel 10 is reversed, which causes the rear end b^1 of the forging B^2 to engage the rear face of the stripper

plate and effect stripping of the completed forging off the end of the mandrel 10.

In the present instance, the anvil 15 is removably mounted on or forms one end of a horizontally reciprocable ram 20. The outside diameter of the anvil 15 and that of the ram 20 are such as to permit passage of the anvil and the forward end of the ram in the direction of the arrow a^2 through the throat of the pass formed by the rolls R^2, R^2, and into the throat of the pass formed by the rolls R^1, R^1, with the face 12 of the anvil 15 coinciding with the plane X—X of the bight of the rolls R^1, R^1.

The end of the ram 20, opposite to that on which the anvil 15 is carried, is provided with a head 21 of larger diameter than the body of the ram 20, and by which an annular shoulder 22 is formed on said ram. The head 21 of the ram 20 is slidably mounted in a cylinder 23, and the body of the ram 20 is slidably mounted in a bearing ring 24.

The bearing ring 24 is mounted in a counterbore 26 formed in a pedestal 25 which is also provided with an annular groove 27 for the reception of one end of the cylinder 23. The opposite end of the cylinder 23 is mounted in an annular groove 28 formed on the inner face of a second pedestal 30. The pedestals 25 and 30 are connected together by tie rods 29, 29.

The head 21 of the ram 20 is provided with an annular concave recess 31 for the reception of a U-shaped packing ring 32. Located in the annular groove 33 of the packing ring 32 is an annular flange 34 of a packing retainer cap 35.

The head 36 of the cap 35 is bored to receive a threaded axial projection 37 of the ram 20 on which is threaded a retaining nut 38 by which the flange 34 of the cap 35 is pressed down into the annular recess or groove 33 of the packing 32.

Fluid pressure for advancing the ram 20 and anvil 15 in the direction of the arrow a^2 is admitted to one end of the cylinder 23, between the head 21 of the ram and the cylinder head as formed by the pedestal 30, through an opening 40 formed in the head of the pedestal 30, and connected by a pipe 41 to a suitable hydraulic accumulator regulated to supply the necessary back pressure in the cylinder 23 for holding the anvil 15 in contact with the face b^2 of the forging B^2, as the forging is advanced through the roll passes by the mandrel 10.

The pipe 41 is provided with any suitable form of control valve (not shown) by which the fluid pressure may be cut off and released from the cylinder 23 to permit free return movement of the ram 20 by the forward advancing movement of the forging B^2 after the tapered end of the mandrel has progressed to or beyond the plane X—X of the roll pass R^1, R^1.

To provide sufficient initial fluid capacity in the end of the cylinder 23, between the head 21 of the ram and the head of the cylinder as formed by the pedestal 30, the threaded projection 37 on the end of the ram 20 is extended beyond the nut 38, and in the present instance, tapered as indicated at 42 to make contact with the pedestal 30 and to effect stopping of the ram with the head 21 thereof in spaced relation to the pedestal 30.

In order to equalize the pressure of the motivating fluid against the inner and outer concentric parts of the U-shaped packing element 32, the cap 35 is provided with one or more openings 43 through which the fluid pressure may pass to the inside of the cap 35.

In order to prevent scale or dirt, which may collect on the projected ram 20, from passing into the bore of the cylinder 23, the pedestal 35 is provided with a ring 45 of resilient material of substantially L-shaped cross-section, with one leg 46 clamped against one face of the pedestal 35 by a retaining ring 47, and secured in bolts or screws 48.

The second leg 49 of the wiper 45 snugly engages the outside surface of the ram 20, and is urged into contact therewith at all times by a contractible resilient ring 50 which surrounds the leg or flange 46, and is held within an annular recess 51 formed on the retaining ring 47.

When the ram 20 is fully extended with the face 12 of the anvil 15 coinciding with the plane X—X of the roll pass R^1, the shoulder 22 of the ram contacts with a similar shoulder 52 formed on the pedestal 25 within the cylinder 23, thereby limiting the outward motion of the ram relative to the cylinder and effecting positioning of the forging engaging face 12 of the anvil in correct position to make initial contact with the forging being advanced into the bight of the rolls R^1, R^1, by the mandrel 10.

From the foregoing description taken with the disclosure of the drawing it will be clear that, due to the lighter inverse pressure required in some instances, a simplified back pressure is made possible, with the pressure applying ram and its operating cylinder in direct axially aligned relation to the mandrel, without necessitating any intervening power multiplying leverage system as disclosed in the aforesaid copending application.

I claim:

1. A device for finishing the cavity walls of a hollow forging having one end closed, comprising a pass formed of a plurality of rolls disposed in planes radial to the axis of said pass and rotatable about axes disposed transversely to the axis of said pass said rolls having circumferentially grooved transversely concave faces collectively constituting a substantially completely circular throat in said pass through which the hollow forging is adapted to be advanced to produce a continuous circular exterior surface on the forging, an axially movable mandrel in axial alignment with said pass and seatable in the base of the forging cavity for advancing the forging through the longitudinally rolling circular throat of said pass, a cylinder axially aligned with said pass and said mandrel, and a ram movable axially in said cylinder with one end of the ram projecting out of one end of the cylinder to the transverse plane of the axes of the rolls constituting the entrance end of said throat for applying axial inverse pressure to the exterior of the closed end of the forging in opposition to the axial movement of the forging through said pass by said mandrel by which axial and radial distortive bulging of the forging at and adjacent the closed end thereof is eliminated during introduction of said closed end of the forging into and the advancing of said end of the forging through said throat.

2. A device for finishing the cavity walls of a hollow forging having one end closed, comprising a pass formed of a plurality of rolls disposed in planes radial to the axis of said pass and rotatable about axes disposed transversely to the axis of said pass said rolls having circumferentially

grooved transversely concave faces collectively constituting a substantially completely circular throat in said pass through which the hollow forging is adapted to be advanced to produce a continuous circular exterior surface on the forging, an axially movable mandrel in axial alignment with said pass and seatable in the base of the forging cavity for advancing the forging through the longitudinally rolling circular throat of said pass, a cylinder axially aligned with said pass and said mandrel, a ram movable axially in said cylinder with one end of the ram projecting out of one end of the cylinder to the transverse plane of the axes of the rolls constituting the entrance end of said throat for applying axial inverse pressure to the exterior of the closed end of the forging in opposition to the axial movement of the forging through said pass by said mandrel by which axial and radial distortive bulging of the forging at and adjacent the closed end thereof is eliminated during introduction of said closed end of the forging into and the advancing of said end of the forging through said throat, and means for limiting the inverse movement of the ram for initially positioning the pressure applying face thereof in the plane of the axes of the rolls constituting said entrance end of said pass.

3. A device for finishing the cavity walls of a hollow forging having one end closed, comprising a pass, an axially movable mandrel in axial alignment with said pass and seatable in the base of the forging cavity for advancing the forging through said pass, a cylinder axially aligned with said pass and said mandrel, a ram movable axially in said cylinder with one end of the ram projecting out of one end of the cylinder for applying axial inverse pressure to the exterior of the closed end of the forging in opposition to the axial movement of the forging through said pass by said mandrel, an annular shoulder at the opposite end of the ram located within the cylinder, an annular packing ring encircling said ram with an outer flange in contact with the inner wall of the cylinder, an inner flange in encircling contact with said ram, and a connecting base portion in contact with said shoulder, a cap over the last said end of the ram and including an annular flange in an annular groove formed by and between the flanges of said ring, means on the ram for forcing the annular edge of the cap flange against the base of the groove in said ring and said base portion of the ring into contact with said shoulder, and ports in said cap within said cap flange for admitting ram motivating fluid against the inner flange of said ring equal to the pressure exerted by said fluid against the outer flange of said ring during said application of inverse pressure against the advancing forging, said cap forcing means functioning as a stop for said ram in one direction within the cylinder to provide space for said motivating fluid between one end of the cylinder and the capped end of the ram for initially moving the ram in the opposite direction in the cylinder.

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