Dec. 29, 1936. R. A. MITCHELL 2,066,186

TRUING DIE AND METHOD

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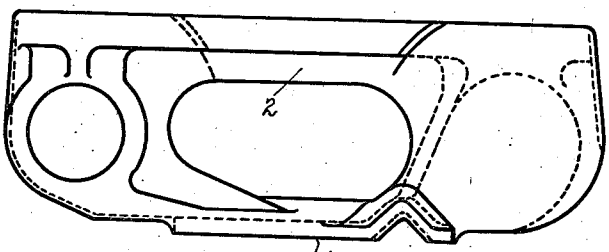
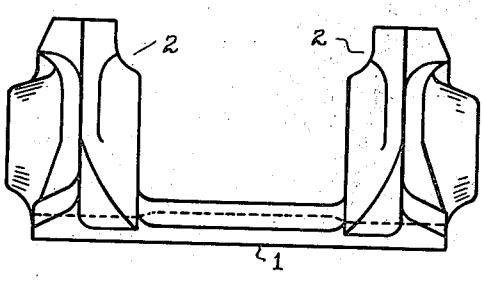


Fig. I

Fig. II



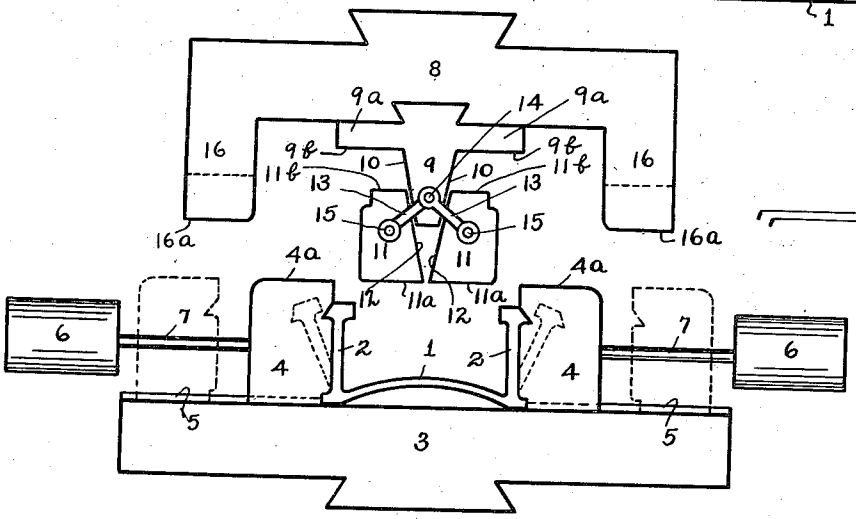


Fig. III

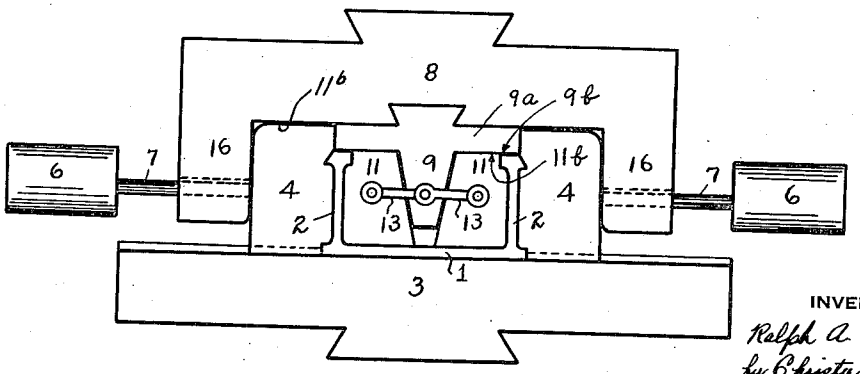


Fig. IV

INVENTOR

Ralph A. Mitchell

by Christy and Weston

his attorneys

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TRUING DIE AND METHOD

Ralph A. Mitchell, Edgeworth, Pa., assignor to The Cleveland Tractor Company, a corporation of Ohio

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9 Claims. (Cl. 153—34)

This invention relates to truing dies for bringing to form and to sharply defined contour forged articles of a particular type, and to a method of truing such articles involving the use of truing dies.

It has become a special and desirable practice in the manufacture of track shoes for track-laying tractors to forge rather than to cast the shoes. As forged, tractor shoes comprise a base, or web, which is forged in arcuate form with the convex side of the web lying between the side walls of the article. These side walls extend with opposite inclination from the side edges of the web. It is necessary to bring this forged article into a form in which the web lies in a single plane, and the side walls extend perpendicularly to the plane of the web. The problem is complicated by the fact that the side walls carry terminal flanges, which extend toward each other. The operation also is not merely a straightening one; but, the side walls of the articles being of relatively complex conformation, the operation involves also the truing of the side wall contours.

There are well-known to the art structures involving the use of expanding dies positioned within articles or material to be formed, and external dies cooperatively mounted with respect to the expansible interior dies. Specific adaptations of this principle have been utilized for the purpose of finally shaping and truing such arcuately forged tractor shoes, which involve the simultaneous operation of side dies and an intermediate expansible die upon the web and walls of the arcuately forged shoe.

Having in mind to simplify and improve a die structure for such purpose, and to provide an improved method of shaping and truing such tractor shoes, I have discovered that structural simplicity of the dies may be obtained, and the performance of the dies may be improved, by initially bringing the side shaping and truing dies into a position proximate to each other, and bearing against the side walls of the forging to bring such side walls into perpendicular position, prior to the action of the expansible inner, or intermediate, die, and to perform the truing operation wholly by means of the inner die.

In the accompanying drawing Fig. I is a side elevation of a completed tractor shoe illustrating the complex conformation of the shoe.

Fig. II is an end elevation of a tractor shoe having the complex conformation of the shoe shown in Fig. I.

Fig. III is an elevation of my truing die assembly, showing in full lines the position of the elements and the condition of the forging after the action of the side dies on the forging, and before the action of the expansible inner dies on the forging, and illustrating in dotted lines the position of the side walls of the forging, and the position of the side dies before action of the side dies on the walls of the forging.

Fig. IV is a side elevation of my truing die assembly, illustrating the position of the elements, and the condition of the forging upon completion of the truing operation.

As shown in several figures of the drawing, the tractor shoe comprises a base, or web, 1, flat throughout the greater proportion of its area, and side walls 2 extended perpendicularly to the web 1. Referring to Fig. III of the drawing, and to the dotted line representation of the forging side walls therein, I have shown a forging of this nature which has, by some suitable operation, had its initial arrangement modified to decrease the curvature of the web, and to bring the side walls of the forging closer together than they are as the forging is initially produced. As shown in this figure of the drawing, however, the web 1 of the forging is still concavo-convex, as viewed in end elevation, and the side walls 2 still lie in a position of opposite inclination to each other, and to a plane surface upon which the forging is placed.

Referring to my die assembly, reference numeral 3 designates a base plate, or bed, upon which the forging is placed, with the concave side of the web toward the surface of the bed, and the side walls 2 extending with opposite inclination from the plane of the bed surface. Side dies 4, having their opposed faces contoured conformably to the desired conformation and contour of the outer side wall surfaces of the tractor shoe, are slidably mounted on rails 5 of the bed for traversable movement toward and away from each other. When brought into their proximate position, as shown in full lines in Fig. III of the drawing, the side dies 4 bring the side walls 2 into a position perpendicular to the upper surface of the bed 3.

It will be understood that the operation of bringing the side walls 2 of the forging, as still at an approximate forging temperature, into the perpendicular is a relatively light one. Movement of the side dies into their proximate position, with forging walls perpendicular to the bed, may, therefore, be performed by any suitable means, and may, if desired, be performed by hand-operated tools. I have shown for this purpose a pair of low-pressure air cylinders 6, connected with the side dies 4 by stems 7.

As noted above, Fig. III illustrates in full lines the first stage of the operation, in which the side walls 2 of the forging have been brought by the side dies 4 into a position perpendicular to the upper surface of the bed 3, without the exercise of pressure internally of the forging, either to flatten the web 1 of the forging, or to true the contours of its side walls 2. These latter operations are performed by the expansible inner die, acting against the bed 3 and against the side dies 4 as the latter are held stationary in their proximate position.

The mounting for the expansible inner die is provided by a platen 8, which is adapted for mounting on a head movable vertically toward and away from the horizontally positioned bed 3. Medianly of the platen 8, I mount a wedge 9, which has downwardly convergent side faces 10, and laterally extended wings 9a with plane lower faces 9b. Wings 9a form a base from which the wedge proper depends.

The side elements 11 of the expansible die have interiorly opposed faces 12 which are upwardly divergent at an angle approximating the inclination of the wedge faces 10. These side elements 11 are freely suspended from the wedge 9 by means of links 13, which have a common pivot 14 on the wedge, and a pivot 15 with each of the side dies severally. This free pivotal suspension of the side elements 11 from the wedge elements 9 causes the dies normally to approach each other closely at their lower terminal, as they extend below the lower terminal of the wedge 9. In their upper region the side elements 11 of the die are spaced by the lower region of the wedge which lies between them. This is the normal and contracted condition of the die, and is a condition which the die elements assume under the influence of gravity, and without the exercise of any other force upon the elements of the die.

It will be observed, particularly by observing Fig. IV of the drawing, that the wings 9a of the inner die have a spread such that they enter between the opposed faces of the side dies 4 in the proximate position of the latter. They may, therefore, in the final stage of downward platen movement, enter between the side dies to bear upon the upper surfaces of the side wall flanges, and ultimately upon the upper faces 11b of the collapsible side elements 11. The thickness of these wings 9a is such that they may bear upon the side walls and collapsible elements, during the final stage of platen movement, and before the under face of the platen contacts the upper faces 4a of the side dies.

If, however, the platen be moved so as to bring the lower surfaces of the side elements against a transverse surface, capable of opposing resistance to their movement, continued movement of the platen toward the surface causes continued movement of the wedge 9 with respect to the side elements 11 of the die. Because of the cooperating inclination of the wedge faces 10 and the faces 12 of the side elements, this continued movement exerts on the side elements a wedging action, forcing them laterally away from each other. This expanding action continues until the links 13 are brought into a position extending in a common transverse plane. Upon vertical movement of the die-carrying platen away from the horizontal surface upon which the die has been expanded, the dies fall under the force of gravity into the contracted position above described. It may be explained that this collapsing action initiates by the fact that the wedge, being positively connected with the platen, has an initial retractile movement independent of the side elements of the die, thus breaking the dead-center position of the links 13 as they lie in common plane transversely to the vertical movement of the platen.

Relating the above-described description of the structure and operation of the expansible inner die to the operation of shaping and truing the forging, the expansible die, in the contracted position which it assumes under the influence of gravity, enters between the side walls of the forging, after they have been made perpendicular to the bed 3. When, in downward movement of the platen, the lower surfaces of the side elements 11 of the expansible die contact the convex face of the forging web 2, they flatten it against the web-supporting bed 3. Continued downward movement of the platen, vertical movement of the side elements 11 being checked, causes the wedge 9 to spread the side elements from their position shown in Fig. III of the drawing, into the position shown in Fig. IV of the drawing. In assuming this latter position, the outer faces of the side elements are forced strongly against the inner faces of the forging side walls 2, so that the side walls 2 are forcefully compressed between the side elements of the expansible die, and the opposite inner faces of the side dies 4.

At the end of the platen stroke, the under faces 9b of the wedge-wings 9a strike the upper faces 11b of the side elements 11 of the inner die, giving a final flattening stroke to the web of the forging. They also come to rest upon the upper faces of the side walls 2 of the forging, completing the truing and finishing of the side walls and side wall flanges, by flattening the upper surfaces of the side walls, and by firmly forcing the flanges of the side walls against the appropriately contoured opposed faces of the outer shaping dies 4 and inner die elements 11. Similarly, this compressive force tends sharply to accentuate the truing effect throughout the entire area of the side walls.

In order that the side dies 4 may be so positively supported in their proximate position that forces transmitted by the expansible inner die through the forging walls do not tend to separate them, I provide abutments which, when positioned behind the side dies, hold them immovable in their proximate position. To this end the platen 8 carries a yoke, shown as of one piece with the platen, which has dependent fixed horns 16. These horns 16 are so spaced from each other that they wholly span the side dies 4 in the proximate position of the latter. That is, the horns 16 of the yoke are so spaced that they have a free sliding fit with the outer faces of the side dies 4, when downward movement of the platen causes the horns 16 of the yoke to embrace the side dies 4 as the latter stand in their proximate position in which they have brought the side walls 2 of the forging in a position parallel to each other, and perpendicular to the upper surface of the bed 3. In Fig. III of the drawing, it will be noted that the vertical distance between the horizontal planes including, respectively, the lower edge 16a of each of the yokes, and the upper edge 4a of each of the side dies, is substantially less than the vertical distance separating the lower faces 11a of the die elements 11, and the convex upper surface of the forging web 1. The fixed horns 16 of the yoke spanning the side dies 4, therefore, pass behind the side dies, to provide abutment for the side dies, before there is any tendency for the ex-

pansible inner die to expand against the walls of the forging.

The positive truing forces are, therefore, provided wholly by the expansion of the inner die against the walls of the forging, and by the vertically directed compressive effect exerted by the inner die. The side dies 4 serve merely to provide a temporarily fixed, and appropriately contoured, abutment reactive to the possible forces exerted by expansion of the inner die. Upon vertical retraction of the platen 8, the contraction of the inner expansible die, above described, permits its withdrawal from between the flanged sides of the forging.

My truing die assembly is clearly of great structural simplicity, and the shaping and truing operation is, therefore, an operation of great simplicity. Thus, I provide but light forces to bring the side walls of the forging into position parallel to each other, and perpendicular to the surfaces of the bed upon which the forging rests. Downward movement of the platen provides fixed abutment, against which the expansible inner die may act, without exerting any force causing the side dies further to approach each other.

The final stage of the platen travel exerts a sharply delivered flattening force on the forging web, and exerts a sharply delivered, vertically compressive force on the forging walls. This contributes to the production of sharply defined, well finished, articles.

My simple apparatus is so constructed that there is no need for delicate timing of the operations performed by it. It is necessary merely that the side dies be brought into their proximate position before the platen is caused to descend, and to exert a truing effect on the forging. It is so positive in its operation that, in the manufacture of tractor shoes (a difficult operation), the percentage of rejectable tractor shoes is less than one per cent. the total output. This is a percentage far lower than that obtainable by using complex machines to finally shape, and to true, tractor shoes forged with an arcuate web and with divergent side walls.

Because of the simplicity of the operation performed on the articles which are by it finally shaped, and trued, this final operation is performed upon the forged articles without reheating them after forging. This fact not only sounds in operating economy, but also results in lessened scale formation, and consequent surface irregularities in the finished article.

I claim as my invention:

1. The herein described method of truing forged tractor shoes and similarly shaped forged articles comprising an arcuate web with side walls inclined oppositely from the web and having terminal flanges extended inwardly toward each other which comprises positioning the forging on a supporting bed with the side walls extending outwardly and upwardly therefrom, forcing side-shaping elements against the outer faces of the forging walls bringing the walls into position approximately parallel to each other, in such proximate position of the side elements providing abutment therebehind, and truing the forging wholly by vertically directed compressive forces exerted upon the web and the upper surfaces of the forging side walls and by expanding forces exerted against the inner surface of the forging walls and through the forging walls against the abutment-supported side dies.

2. The combination of dies for shaping and truing channel-shaped forgings comprising a basal element or bed, side dies movable toward each other into a predetermined spaced position, means for supporting said side dies in their predetermined proximate spaced position against forces tending further to separate the side dies, with a platen-carried die assembly movable toward and from said bed comprising a centrally positioned spreading member and die elements arranged to be separated thereby together with wings extended laterally at the base of said spreading member, said die assembly being so proportioned and arranged that both the central expansible structure of the assembly and the wings of the assembly may enter between the side dies in the predetermined proximate spaced position of the side dies respectively to bear upon the web and the upper side wall surfaces of the channel-shaped forging.

3. The herein described shaping and truing die combination in accordance with claim 2 in which the means for supporting the side dies in their proximate spaced position comprise a platen-carried yoke having fixed horns spaced wholly in all positions of the yoke relatively to the bed to span the said side dies and by approach to the bed to define the maximum spacing of the side dies in predetermined proximate position of the side dies.

4. The herein described shaping and truing die combination in accordance with claim 2 in which the expansible structure of the platen-carried die assembly comprises a central wedge element and two side elements having faces inclined oppositely to each other and cooperatively with the inclination of the wedge, and linkages pivotally suspending the side elements from the wedge element in manner to cause the side elements as suspended from the wedge to approach each other in downward movement of said side elements under the force of gravity.

5. The combination of dies for shaping and truing channel-shaped forgings comprising a basal element or bed, side dies adapted to lie as abutments against the outer surfaces of the side walls of a channel-shaped forging, with a platen-carried die assembly movable toward and from said bed comprising a centrally positioned spreading member and die elements arranged to be separated thereby together with wings extended laterally from the base of the spreading member, said die assembly being so proportioned and arranged that both the central expansible structure of the assembly and the wings of the assembly may enter between the side dies respectively to bear upon the web and the upper side wall surfaces of the channel-shaped forging.

6. The herein described shaping and truing die combination in accordance with claim 5 in which the expansible structure of the platen-carried die assembly comprises a central wedge element and two side elements having faces inclined oppositely to each other and cooperatively with the inclination of the wedge, and linkages pivotally suspending the side elements from the wedge element in manner to cause the side elements as suspended from the wedge to approach each other in downward movement of said side elements under the force of gravity.

7. The herein described method of shaping and truing channel-shaped forgings which comprises positioning the forging web on a supporting bed with the side walls of the channel extending upwardly therefrom, providing abutment outwardly of the channel side walls, and truing the forging wholly by the resultants of compressive forces

wholly vertical in the direction of their initial application exerted upon the web and the upper surfaces of the forging side walls and through the forging side walls against the abutments therewithout.

8. The herein described apparatus for truing forged tractor shoes and similarly shaped articles comprising an arcuate web with side walls inclined oppositely from the web and having terminal flanges extended inwardly toward each other which apparatus comprises a horizontal web-supporting bed, dies supported by the web-supporting bed and movable toward and from each other thereon and in their proximate position adapted to bring the side walls of the forging into position perpendicular to the web-supporting bed, a platen movable vertically toward and from said bed having thereon a yoke with the horns thereof fixed in spaced relation wholly to span the said side dies in their proximate position and by approach to the bed to provide abutment behind the side dies, and an expansible die carried by the platen between the horns of the yoke and comprising a central wedge element and two side elements having faces inclined oppositely to each other and cooperatively with the inclination of the wedge together with linkages pivotally suspending the side elements from the wedge element in manner to cause the side elements as suspended from the wedge to approach each other under the force of gravity in downward movement, the said expansible die being adapted to enter between the forging side walls and to bear against the arcuate web of the forging and being adapted to expand against the inner surface of the forging walls under the force of downward movement resisted by the web-supporting bed.

9. The herein described apparatus for truing forged tractor shoes and similarly shaped articles comprising an arcuate web with side walls inclined oppositely from the web and having terminal flanges extended inwardly toward each other which apparatus comprises a web-supporting bed, dies adapted to stand on the web-supporting bed outwardly of the forging side walls to provide abutment therewithout, a platen movable vertically toward and from the web-supporting bed and carrying dependent spaced horns forming a yoke, and an expansible die carried by the platen between the horns of the yoke and comprising a central wedge element and two side elements having faces inclined oppositely to each other and cooperatively with the inclination of the wedge together with linkages pivotally suspending the side elements from the wedge element in manner to cause the side elements as suspended from the wedge to approach each other under the force of gravity in downward movement, the said expansible die being adapted to enter between the forging side walls and to bear against the arcuate web of the forging and being adapted to expand against the inner surface of the forging walls under the force of downward movement resisted by the web-supporting bed.

RALPH A. MITCHELL.