May 28, 1940. C. A. McCUTCHEON 2,202,018

METAL-SHAPING APPARATUS

Filed May 18, 1939 4 Sheets-Sheet 1

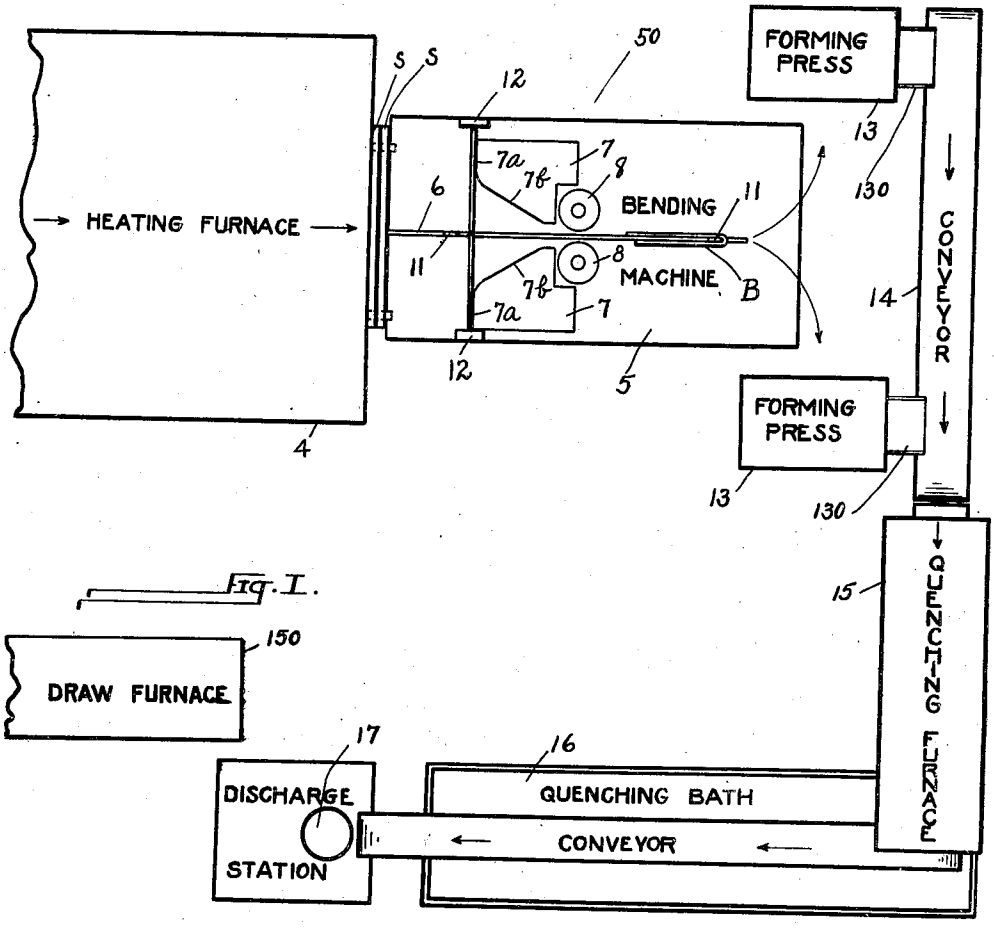


Fig. I.

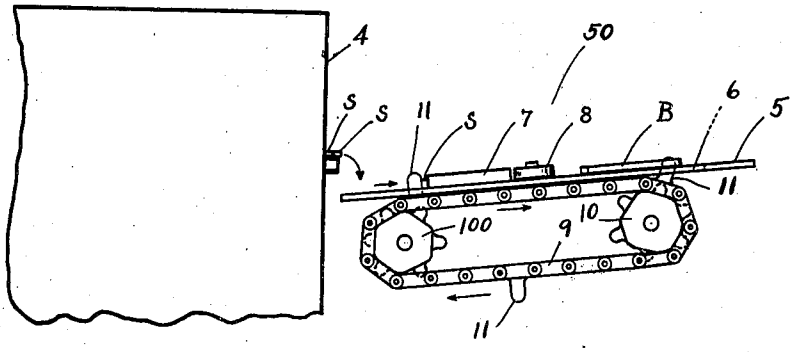


Fig. II.

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METAL-SHAPING APPARATUS

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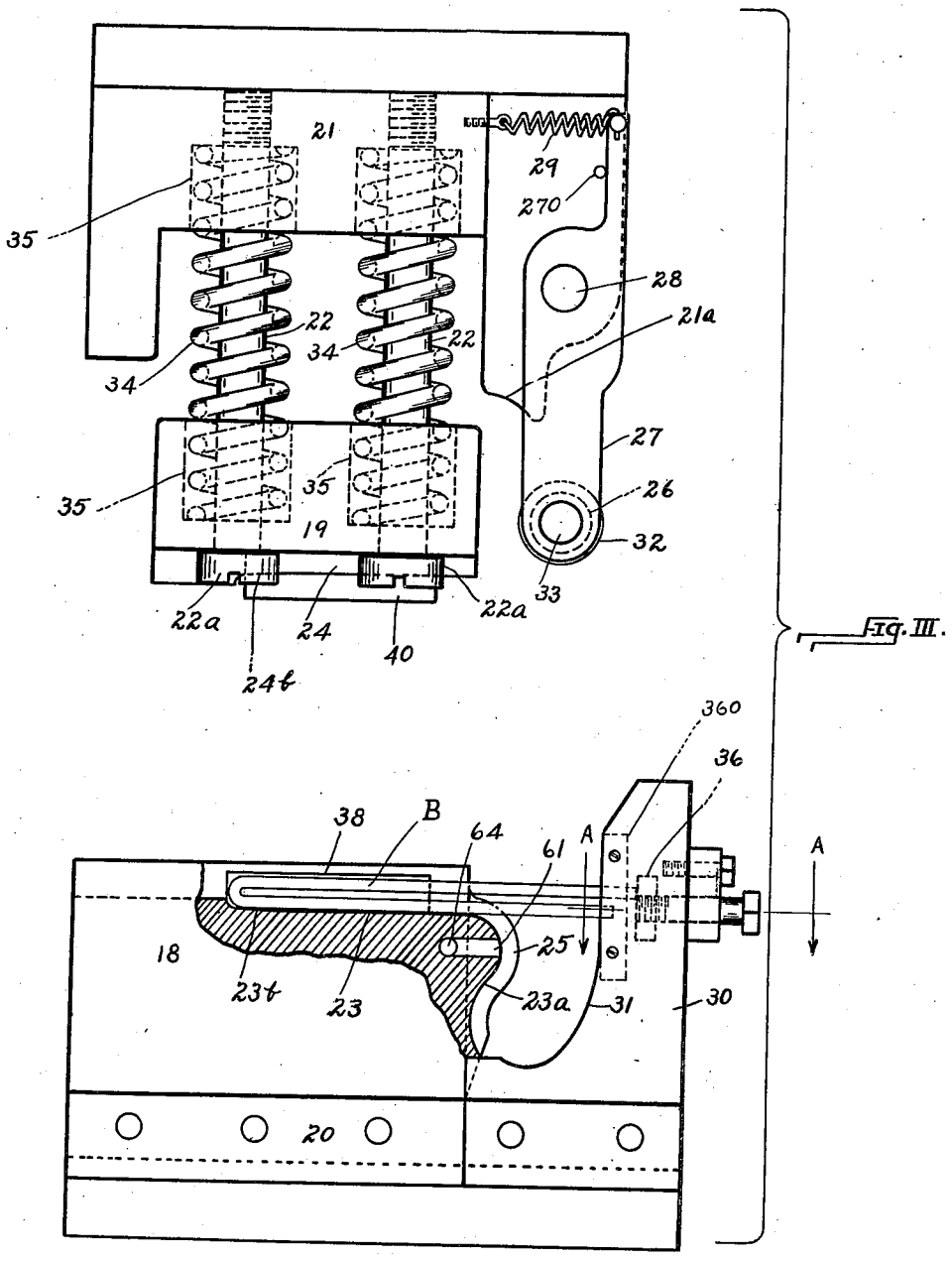


Fig. III.

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METAL-SHAPING APPARATUS

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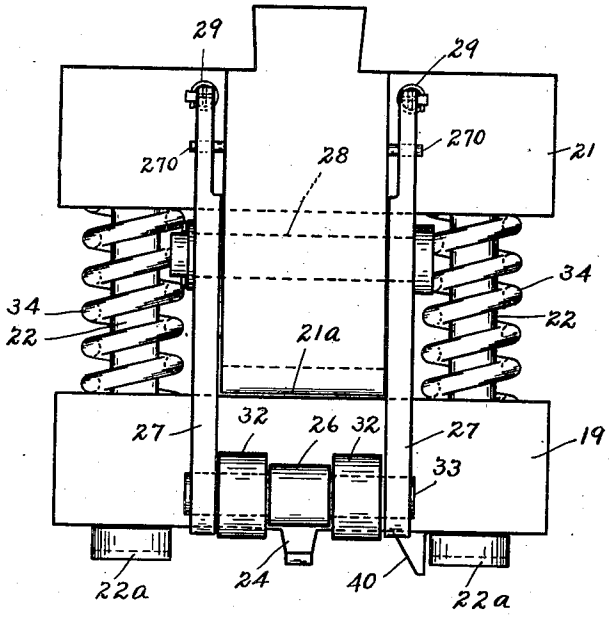


Fig. IV.

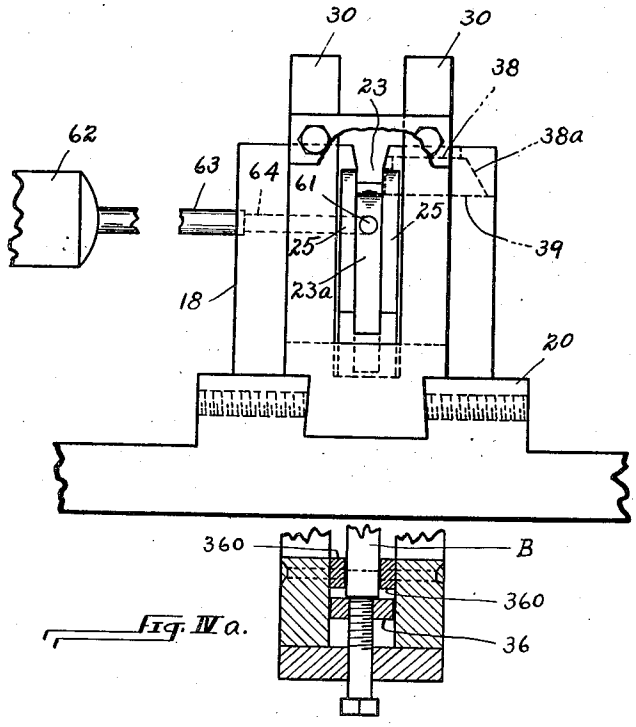


Fig. IV a.

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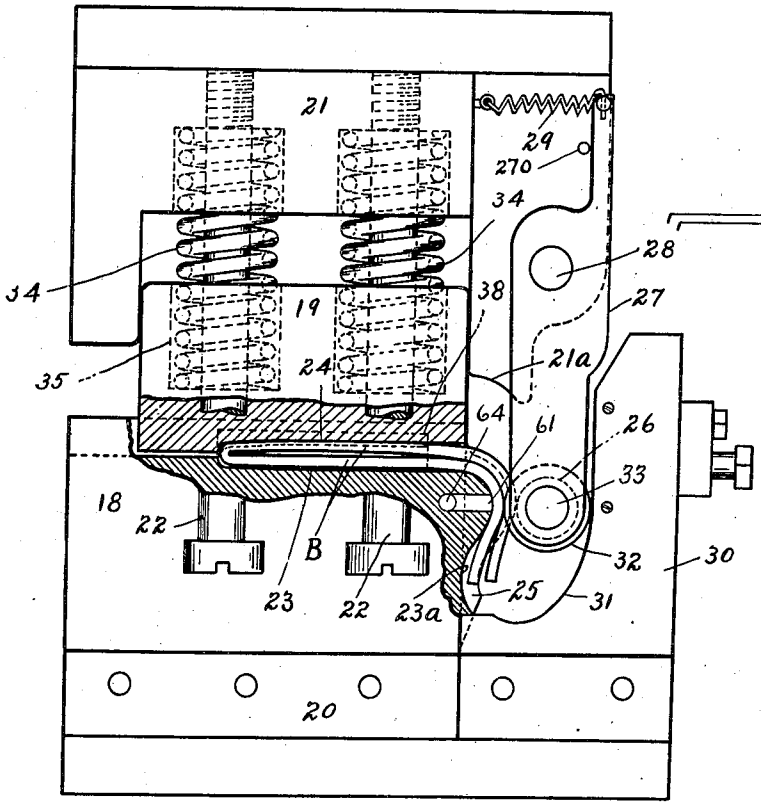


Fig. V.

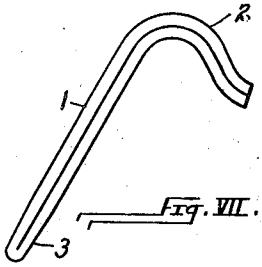


Fig. VII.

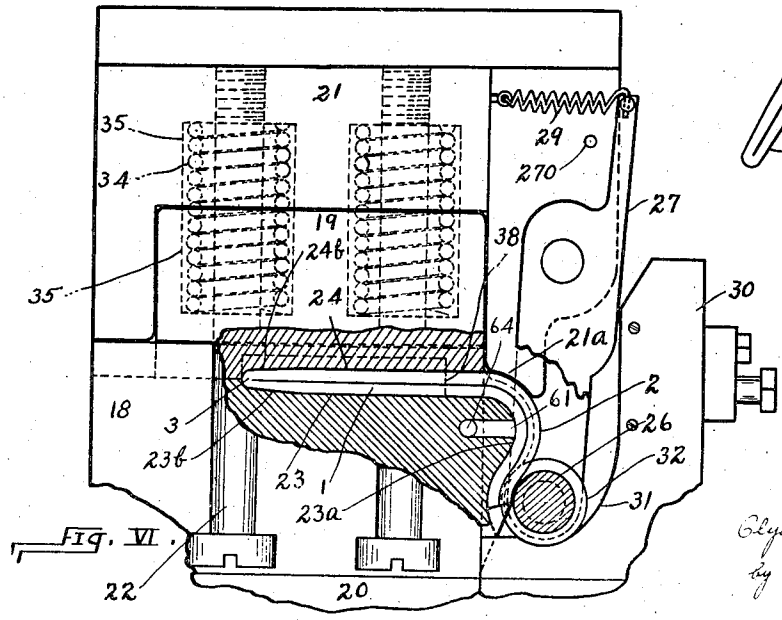


Fig. VI.

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Patented May 28, 1940 2,202,018

UNITED STATES PATENT OFFICE

2,202,018

METAL-SHAPING APPARATUS

Clyde A. McCutcheon, Coraopolis, Pa., assignor to Pittsburgh Forgings Company, a corporation of Delaware

Application May 18, 1939, Serial No. 274,397

3 Claims. (Cl. 153—33)

My invention relates to the manufacture of metal articles, particularly to articles that are shaped from bars or straps of steel. The invention consists in improvements in apparatus.

In Letters Patent of the United States, No. 2,015,194, granted on September 24, 1935, to one Max Ruping, a resilient rail fastener is illustrated and described, and in exemplary way I shall describe the apparatus of the present invention as it has been developed for the manufacture of such rail fastener.

In the accompanying drawings Fig. I is a diagrammatic view in plan of apparatus in which the invention is embodied. Fig. II is a fragmentary view in side elevation of a heating furnace and bending machine with which the apparatus may be organized. Fig. III is a view to larger scale, showing partly in side elevation and partly in vertical section the cooperating dies of the apparatus; the dies are in open-work-receiving position, and a blank is shown in the matrix of the lower die, ready for the upper die to close upon it. Fig. IV is a view in front elevation of the parts shown in Fig. III, with the blank omitted. Fig. IV*a* is a fragmentary sectional view on the plane A—A of Fig. III. Fig. V is a view comparable with Fig. III, showing the upper die in course of descent upon the lower, and illustrating the blank partly formed into the ultimate article. Fig. VI is a view comparable with Figs. III and V, showing the dies completely closed and the article completely formed. And Fig. VII is a view in side elevation of the finished article.

The resilient rail fastener is illustrated in Fig. VII of the drawings. It consists in a bipartite body that includes a shank portion 1 and a head portion 2, integrally formed of a medially folded strap of spring steel. The two limbs of the strap extend from the fold in face-to-face contact, and the body of metal at the fold is externally tapered, as at 3, to provide a blunt point. At the end opposite such point the bipartite body of the article extends laterally (reversely curved in its extent) and provides the head 2. The head is in effect a cantilever leaf-spring extending from the shank 1. For further details in the matters of structure, use, and advantages of this rail spike, reference may be made to the Ruping patent, above noted.

In Fig. I the reference numeral 4 is applied to a heating furnace in which straps S of steel, cut to proper length, are heated to a temperature at which they may be worked and shaped in the manner presently to be described. In this case the steel of which the straps are formed is a spring steel, including from .90 to 1.05 per cent. carbon, and the straps are heated to a working temperature of 1700° F., more or less. The heated straps are removed (either automatically or manually) from the furnace, and positioned one by one upon the table 5 of a bending machine 50.

The table 5 is provided with a medial slot 6, and upon the face of the table a pair of work-shaping blocks 7, 7 and rolls 8, 8 are mounted, one block and one roll on each side of the slot 6, as shown in Fig. I. Beneath the table (Fig. II) an endless chain 9 is trained over sprocket wheels 10 and 100, and in known way an electric motor and driving connections (not shown) are provided for rotating the sprocket-wheels and driving the chain 9 in the direction of the arrows in Fig. II. The chain carries a plurality of dogs 11 that are arranged at suitably spaced points in the peripheral extent of the chain, and in the operation of the machine these dogs, moving upward around the sprocket wheel 100, enter the slot 6 in the table 5 and travel in left-to-right direction. As shown in Fig. II, the distal ends of the advancing dogs project above the surface of the table 5, and as presently will appear, provide traveling abutments that cooperate with the blocks 7, 7 and rolls 8, 8 in shaping the work.

More specifically, the heated straps S are ejected or removed one by one from the furnace 4 and positioned upon the top of table 5. Each strap S is centered between gauge-blocks 12, 12 on the table (Fig. I) and brought to position against the edges 7*a*, 7*a* of the blocks; while the strap lies in such position one of the continuously traveling dogs 11 (the first dog to enter the slot 6 when the strap has been so positioned) moves into contact with the strap, and, while the opposite ends of the strap bear against the stationary edges 7*a*, 7*a*, the advancing dog carries the medial body portion of the strap forward between the two convergent edges 7*b*, 7*b* of the blocks. As the center of the strap is thus carried inward between the blocks 7, 7, the opposite ends of the strap swing angularly from the edges 7*a*, 7*a*, and the body of the strap becomes V-shaped. In the continuous advance of the dog the strap is carried, with the apex of the V in the lead, from the pass between the blocks 7, 7 into and through the pass formed by and between the rolls 8, 8, with the consequence and effect that the legs of the V are brought together, forming the strap into a narrow U-shaped blank B, as shown. When the trailing end of the blank B emerges from the roll pass, the dog reaches the end of the horizontal course through which the chain 9

travels, and as the chain rounds the sprocket-wheel 10 in clockwise direction (Fig. II), the dog moves downward in circular course and is withdrawn first from the folded end of the blank and then from the slot 6 in the table 5. The blank lies freely upon the surface of the table.

At this point in the specification, it is to be noted that the gauge-blocks 12, 12 are arranged at unequal intervals on opposite sides of the slot 6 in the table, to the end that one leg of the U-shaped blank shall be slightly longer than the other, as shown in Fig. I. The advantage of this refinement will presently appear.

At the delivery end of the table 5, two forming presses 13, 13 are arranged, and in these presses the U-shaped blanks B are formed into the article shown in Fig. VII. Ordinarily, one press only is operated, the other being held in readiness in case of a breakdown. In service the blanks B are removed (either mechanically or manually) from the table 5, and introduced one by one to the active forming press. In a single stroke of the press, each blank B is formed into a finished article (Fig. VII).

Upon leaving the forming dies of the press, the formed articles move down a slideway 130 to the surface of an endless conveyor 14, and on such conveyor are carried into an annealing furnace 15. Emerging from the annealing furnace, the articles are conveyed through a quenching bath 16, and from the quenching bath the articles go to a draw furnace 150. If, as sometimes will be the case, the draw furnace is remote from the quenching bath, the articles are collected in a receptacle 17 at the delivery end of the bath, and in such receptacle the articles are carried to and introduced to the remote draw furnace. If, on the other hand, available space permits the draw furnace 150 to be located adjacent to the discharge end of the quenching bath, the articles coming from the bath are conveyed immediately into the furnace.

It will be understood that the operation of the press 13 and the speed of the conveyor 14 may be so regulated that the forged articles are delivered to quenching furnace 15 at a temperature of from 900 to 1300 degrees F. Indeed, the speeds of advance of the articles through each unit of the apparatus may be regulated so that the annealing, quenching, and drawing of the articles is accomplished in accordance with recognized good practice. Further detail in the matter of heat treatment is unnecessary to a full understanding of the invention.

The invention is centered in the forming presses 13. Turning to Figs. III to VI, it will be perceived that each press includes a female die and a male die. The female die consists in an anvil block 18 which is integrated with a base 20, and the male die consists in a block 19, held in assembly with a head 21, by means of a plurality of vertical stems—in this case four stems 22. The female die assembly 18, 20 is rigidly secured upon the bed of the press (not shown), while the male die assembly 19, 21 is carried by the vertically reciprocable cross-head of the press. I do not show the press structure proper, for the reason that there are many known makes of presses which may be used, and there is no radical departure from common practice in the manner in which I assemble the dies in the press.

When the cross-head of the press is at the upper end of its stroke, the dies are separated, as shown in Figs. III and IV; and, alternately, when the cross-head is at the lower end of its stroke, the dies are powerfully closed, as shown in Fig. VI.

Within the upper face of the die block 18 a matrix 23 is formed, and this matrix is adapted when the press closes to receive a male portion 24 carried by the die block 19, and to cooperate with such male die portion in shaping the folded end of a blank B into the shank portion 1, 3 of the rail fastener. (Note Figs. VI and VII.) The matrix 23 is continued downward from the upper horizontal face of the die block 18 between two vertical flanges 25 on the side of the die block, and the body of the block between these flanges is contoured, providing a matrix portion 23*a* in the form of the head 2 of the rail fastener. And it will be noted that the outer edges of the flanges 25 are parallel with the contoured wall of such matrix portion.

Means cooperate with the matrix portion 23*a*, while the folded end of a blank B is by the male die held captive in matrix 23, in forming the bipartite end of the blank into the curved head of the rail fastener. Such means consist in this case in a roll 26, arranged between, and trunnioned in, the lower ends of a pair of lever arms 27. The lever arms 27 are pivoted, on a common axis 28, to the body of the upper die-carrying block 21, and a tension spring 29 is secured between such block and the upper end of each arm 27. The block 21 carries abutments, in this case in the form of rigid pins 270, that prevent the arms 27 from swinging counterclockwise from the vertical position in which they appear, one behind the other, in Fig. III, but it will be understood that, opposed by spring tension, the arms may swing in unison through a limited range in clockwise direction. On the base 20 of the lower die assembly two vertical cam-bars 30 are rigidly mounted, and on the axle 33 of the roll 26 at the lower ends of lever arms 27 two cam rollers 32 are mounted for free rotation. In the operation of the press, when the upper die assembly closes upon the lower, the rollers 32 (moving downward with the upper die assembly) engage and roll upon the inwardly curved edges 31 of the cam-bars 30, with the consequence and effect that the descending lever arms 27 are swung clockwise and the roll 26 caused accurately to shape the bipartite end of a blank B to the contour of the matrix portion 23*a*.

As already mentioned, the upper die block 19 is assembled with the supporting block 21, by means of four stems 22. These stems consist, in this case, in bolts whose threaded ends are rigidly secured in the body of the block 21; the four bolts extend in parallelism downward from the supporting block 21 and carry heads 22*a* at their lower ends, and between the heads 22*a* and the body of block 21, the die block 19 is vertically movable on the shanks of the bolts. A helical compression spring 34 is mounted on the shank of each bolt or stem 22. These springs are effective between the blocks 21 and 19, and tend to maintain the block 19 in a position spaced from the bottom of block 21, with the bottom of the block 19 bearing against the heads of the bolts 22. (Note Fig. III.) And it is to be noted that the bodies of the blocks 19 and 21 are recessed, as at 35, to receive the opposite ends of the springs 34. By virtue of such structure, the block 21 may, as presently will appear, be closed tightly upon the block 19, with the springs 34 compressed and nested entirely within the pockets 35.

In the operation of the press, a heated blank B is removed from the table 5 (Fig. I), and, while the continuously reciprocated upper die assembly is at the top of its stroke, the blank is positioned in the matrix 23 of the lower die block. It is important to note that the U-shaped blank is placed in the matrix, with the longer leg of the U above the shorter, and in order to facilitate the accurate positioning of the blank in the matrix, I provide a fixed, though adjustable, stop 36, and a pair of lateral guides 360, such guides being spaced-apart laterally and arranged at an interval from and in parallelism with the flanges 25 on the female die block. (Note Figs. III and IV*a*). Conveniently, the stop 36 and guides 360 are carried by the cam-bars 30, as shown. The blank B is positioned in the die block 18, with the end of the longer leg of the U abutting against the stop 36, and with the ends of both legs between the guides 360. (Note Fig. III.) Presently, the continuously reciprocated upper die assembly descends, and in the course of such positive movement the following operations are effected:

1. The male die portion 24 of the die block 19 enters the matrix 23 and engages the folded end of the blank B. The downwardly moving die block 19 is arrested, with the folded end of the blank securely clamped, under the tension of springs 34, between the die blocks 18 and 19.

2. While the two limbs at the folded end of the blank are thus held against longitudinal displacement in the matrix 23, the spring-resisted descent of the head 21 and lever arms 27 continues unabated; the interval between the block 19 and the head 21 decreases, the rollers 32 at the lower ends of the lever arms 27, thus carried downward, make contact with the upper ends of the vertical cam-rails 30; the compression of springs 34 increases; and the pressure on the clamped end of the blank is correspondingly increased.

3. The roll 26, carried downward by the descending lever arms 27, moves into contact with the paired limbs of the blank extending from the closed dies. As the movement of the descending parts continues without interruption, the otherwise free limbs of the blank are by the roll pressed downward and rolled, from a medial point outward, limb against limb, into the crook-shaped matrix portion 23*a*. (Note Fig. V.) The cam edges 31 are so contoured that, as the rollers 32 move downward in contact therewith, the paired lever arms 27, holding at first to a straight vertical course, swing clockwise and move the descending roll 26 through such path that the bipartite end of the blank is formed to the exact curvature of the matrix portion 23*a*. The desired crook-shaped head is thus formed in the article. (Note Fig. VI.)

4. As the roll 26 approaches the end of its blank-forming sweep, the springs 34 are completely compressed within the pockets 35, and the descending block 21 closes upon the die block 19. While the bipartite end of the formed crook is by the roll 26 secured upon the contoured surface of the die block 18, the supporting head 21 abuts upon the die block 19 and presses it downward with great pressure. That is to say, the die block 19 is forced downward from the position shown in Fig. V, in which it primarily serves to clamp the folded end of the blank upon the block 18, to the position shown in Fig. VI, in which the male die portion 24 cooperates with the matrix 23 in tightly closing the folded end of the blank and pressing it to its ultimate shape. It will be noted that the die portion 24 and matrix 23 are so particularly fashioned (at 24*b* and 23*b*) that the desired slight taper 3 is provided at the pointed end of the shank.

5. Simultaneously with such powerful closing of the die block 19 upon the block 18, the crook-shaped head of the formed article is engaged by a portion of the block 21. That is, a rigid die portion 21*a* depends from the body of the block 21, and the lower end of this portion 21*a* is shaped to the curvature of the formed article, in the region between the shank portion 1 and the head portion 2. As the die block 19 enters its ultimate shank-forming position (Fig. VI), the die portion 21*a* closes tightly upon the shaped blank, as shown, with the effect that not only is relative movement between the two limbs of the formed article prevented, but a "set" is given to the metal in the region of greatest curvature.

The advantage of forming one leg of the U-shaped blank longer than the other will now be manifest. Comparing Figs. III and VI, it will be understood that, while the folded end of the blank is held against longitudinal displacement and the roller 26 is shaping the bipartite end of the blank against the contoured die block, the outer ends of the two limbs of the blank are free for relative longitudinal movement. Thus, during the rolling of the bipartite end of the blank against the convex face of the die block 18, relative movement between the outer ends of the limbs is effected. The greater length of the upper limb of the U makes compensation for the radial difference in curvature between the inner and outer limbs of the blank, so that in the finished article the outer ends of the two limbs lie flush, or substantially so, as shown in Figs. VI and VII.

In refinement of the apparatus described, I provide means for laterally flattening and aligning the two limbs in the shank portion of the formed article, it being noted that the lateral guides 360 on the bars 30 and the flanges 25 on the contoured face of block 18 serve to insure that the limbs shall be aligned in the crook-shaped head portion. Such means consist in a die plate or slide 38 (Fig. IV) arranged in a slideway 39 in the body of the lower die block 18. The upper die block 19 carries a cam block 40 which, when die block 19 is powerfully closed upon block 18, moves downward upon an inclined face 38*a* on the outer edge of die plate 38, and effects the movement of the die plate inward, pressing its inner edge forcefully against the folded body of metal within the matrix 23. In such manner the two limbs of the article are die-pressed into precise alignment.

In still further refinement of the apparatus described, I provide means for dislodging the formed article from the matrix in die block 18. Specifically, I provide an orifice 61 in the wall of the matrix, preferably in the contoured floor of the matrix and at the point where the convexity of the contour is greatest. (Note Figs. III to VI.) Fluid under pressure is supplied to this orifice, and preferably compressed air is the fluid used. In this case a tank 62 of compressed air is connected to the orifice, by means of a lead 63 and a passage 64 formed in the body of the die block. Advantageously, if not essentially, communication between the tank and the orifice remains open, and so long as the orifice 61 is uncovered a jet of air plays into the open atmosphere.

When in service the upper die assembly of the machine descends and presses the bipartite end of a blank into the matrix portion 23*a*, the orifice 61 is closed by the body of the blank being shaped. The flow of air from the orifice is thus interrupted, but it will be understood that air at supply pressure is effective upon the inner surface of the crook-shaped head of the formed article. When in due course the upper die assembly rises, this air pressure is effective to dislodge the formed article from the die 18, and the blast of air thus released blows the article longitudinally away from the die and directs it to the slideway 130 (Fig. I), whence the article moves under gravity to the conveyor 14. It may additionally be mentioned that the streaming air, impinging upon and deflected by the body of the article leaving the die, serves to cleanse the matrix of scale.

In the foregoing specification the dies have been described as they operate in a vertically reciprocable press, but it will be understood that they may be embodied in a horizontally reciprocated press or bulldozer. And it goes without saying that other variations from the description may be made within the terms and intent of the appended claims. And as an example of a variation contemplated, I mention that the limbs of the U-shaped blanks need not be spaced apart, as described; that is to say, the limbs may be tightly closed in surface-to-surface contact before the blanks are introduced to the dies of the forming press.

The application for this patent comprised a continuation in part of application Serial No. 209,403, filed May 23, 1938.

I claim as my invention:

1. In apparatus including upper and lower dies relatively movable for shaping a bipartite blank between them, a matrix including a contoured wall portion in the lower die, and means carried by the upper die and movable, during the closing of the dies, to shape the blank upon such contoured wall portion; the refinement herein described that consists in spaced-apart flanges extending at the sides of said contoured wall portion of the matrix and adapted laterally to secure in alignment the limbs of said bipartite blank shaped to the contour of such wall portion, together with spaced-apart guides arranged at an interval from and extending in parallelism with said flanges, said guides adapted to receive between them the end of a bipartite blank to be shaped between said dies and adapted during the shaping of the blank laterally to align the ends of the limbs of the blank with the contoured wall portion of the matrix between said flanges.

2. In apparatus for shaping a metal blank, said apparatus including a male die, a female die including a matrix adapted to receive such blank, said male die being reciprocable into blank-shaping position relatively to said female die, and an auxiliary die member; the refinement herein described that consists in a window formed in the wall of the matrix in said female die, said auxiliary die comprising a slide aligned with said window, and means operating as said dies close to shift said slide inward of said window into contact with the blank enclosed in said matrix.

3. In apparatus for shaping bipartite blanks with their two limbs in face-to-face contact, said apparatus including two dies movable on a line normal to the plane of the meeting faces of the two limbs of such a blank positioned between the dies, a blank-shaping roll mounted in angularly movable members on one of said dies, and means organized with the other of said dies for effecting, upon relative movement of the dies, an angular movement of said roll-supporting members; the refinement herein described that consists in means for truing the alignment of the two limbs of the die-shaped bipartite article, said last means including a slide adapted, upon the closing of the dies, to move in a direction parallel to the plane of the meeting faces of the two limbs of the article positioned between the dies.

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