DIE FOR USE IN BENDING FLAT METAL STOCK AND THE LIKE

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FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6

FIG. 7

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This invention relates to apparatus for use in bending flat metal stock such as sheet metal, cold rolled bar stock and the like and more particularly relates to a die for use in conjunction with a bending punch in the ram of a power brake or the like for bending such flat stock.

In bending flat metal stock and particularly sheet metal, it has been common practice to employ fixed V-shaped female dies and punches formed to the precise angle of the female die for bending flat metal stock. In order to change the degree to which the flat metal stock is bent, it has been necessary to change the V-shaped female die and to also change the punch. It will be understood that it is therefore necessary if these V-shaped female dies and punches are to be used, that a complete set of dies and punches be kept on hand to accomplish bending of metal to all the different angles. In addition, another complete set of dies is necessary in order to produce a rounding or curvature at the bend of a predetermined radius. In addition to the fact that a large number of sets of dies must be kept on hand, these V-shaped female dies have the disadvantage of producing distinctly perceptible marks on the metal stock adjacent the bend along the lines at which the edges of the female die engage the sheet metal stock when the punch is ramedmed into the stock for moving it into the die and producing the bend. These marks are highly objectionable to many manufacturers having rigid quality specifications.

With these comments in mind it is to the elimination of these and other disadvantages to which the present invention is directed, along with the inclusion therein of other novel and desirable features.

An object of my invention is to provide a new and improved die apparatus of simple and inexpensive construction and operation for use in conjunction with a bending punch in a power brake or the like for bending flat metal stock.

Another object of my invention is the provision of a die apparatus which, when used with a single punch in a power brake or the like is adapted for producing bends in flat metal stock to a number of different angles.

Another object of my invention is the provision of a die apparatus for use in a power brake or the like for producing in flat metal stock, bends which are either sharply angulated or are rounded, depending only on the configuration of the punch which is used therewith, and regardless of whether the bend is sharply angulated or rounded, the degree of bending may be varied over an extremely wide range, up to and beyond right angle bends.

A further object of my invention is the provision of novel die apparatus for producing either sharply angulated or rounded bends in flat metal stock such that two portions of the stock which lie in a common plane before the bending is accomplished, one of the portions may be bent and the other portion may be left in planar condition.

These and other objects and advantages of my invention will more fully appear from the following description made in connection with the accompanying drawings wherein like reference characters refer to the same or similar parts throughout the several views and in which:

Fig. 1 is a top plan view of the die apparatus and showing in dotted lines a typical position of the relationship of the punch and the metal stock in a bending operation; and also showing in dotted lines an alternate position of the die bars;

Fig. 2 is an enlarged end elevation view of the invention;

Fig. 3 is a detail section view through the apparatus and taken on a vertical plane as indicated at 3—3 in Fig. 1 and also showing the position of a typical punch which may be employed in a power brake in conjunction with the die apparatus;

Fig. 4 is a section view substantially similar to Fig. 3 and showing the apparatus in shifted condition wherein the punch has engaged the stock and produced a bend therein;

Fig. 5 is a composite view showing a number of pieces of flat metal stock bent to varying degrees with the single punch and die set-up shown in Figs. 3 and 4;

Fig. 6 is a section view taken on a vertical plane showing the die apparatus in use with a rounded punch as contrasted with the V-shaped punch shown in Figs. 3 and 4; and

Fig. 7 is a composite view of a number of specimens of flat metal stock bent with a rounded curvature as by the set-up shown in Fig. 6.

One form of the present invention is shown in the drawings and is described herein.

The present invention is designed for use in a power brake, of which bolster 10 is a part. On the ram (not shown) of the power brake is mounted an elongate bending punch 11 which, as shown in dotted lines in Fig. 1 to show its orientation with respect to the invention and which may be substantially V-shaped and sharply pointed as shown in Fig. 3, or which may be rounded as is shown in Fig. 6 and indicated by the numeral 11'.

The die apparatus or assembly, which is indicated in general by numeral 12, includes a body member 13 of rigid steel stock or the like which has means such as a depending rib or tongue 15 for mounting the body member in a predetermined location on the bolster 10 of the power brake, which has a groove or recess 16 into which the rib is inserted. The body member 13 has a flat and horizontally oriented upper surface 17.

A pair of elongate die bars 18 and 19 are mounted on the body member 13 in side-by-side relation, below the punch and on opposite sides thereof with the adjacent sides of the bars 18 and 19 engaging each other at a position which is aligned with the direction of movement of the punch 11. The die bars 18 and 19 have flat and highly polished upper surfaces 20 and 21 which lie in a common plane and in alignment with the upper surface 17 of body member 13.

The die bars 18 and 19 and the body member 13 have cooperating means for rotatably supporting the die bars on the body member. In the form shown, the die bars 18 and 19 have cylindrically rounded lower or bottom surfaces 22 and 23, and as best seen in Figs. 3 and 4, the die bars 18 and 19 are substantially semi-circular in cross sectional configuration. The body member 13 is provided with a pair of side-by-side bar-supporting cradles 24 extending throughout the entire length of the body member and the cradles 24 have cylindrically rounded bar-supporting upper bearing surfaces 24a which are substantially identical in configuration with the rounded bottom surfaces of the bars 18 and 19 whereby to permit rolling oscillation of the bars in the cradles. Because the bars are substantially semi-circular in cross sectional configuration, the upper surfaces 20 and 21.
thereof lie substantially in the rotation axes of the bars which extend longitudinally of the bars and on opposite sides of the punch, but it will be noticed that the positioning of the surfaces 20 and 21 might be changed such that the surfaces lie either above or below the rotation axes.

The body member 13 is shaped to define an open and unobstructed area below the inner or adjacent sides of the bars 18 and 19 to permit the punch to move downwardly between the bars, and in the form shown, a groove 25 is formed in the body member 13 throughout the length thereof and between the cradles 24.

It should be noted that the cradles 24 extend to both ends of the body member 13 to permit the bars 18 and 19 to extend with the stock and punch member. The bars 18 and 19, in the form shown, are slightly longer than the body member 13 and may extend outwardly beyond one end thereof.

Means are provided on the outwardly extending end portions 18a and 19a of bars 18 and 19 for normally holding the bars in a position such that the upper surfaces thereof are aligned with each other and for permitting rolling oscillation of the bars and causing the bars to return to their normal position. In the form shown, a rigid strap 26 extends across the end portions 18a and 19a of the bars in engagement with the upper surfaces of the bars 18 and 19. A bracket element 27 extends across bars 18 and 19 in underlying engagement with the rounded bottom surfaces 22 and 23 thereof, and in the form shown, the bracket member 27 has upstanding end portions 28 which are drilled and tapped at 29 to receive upstanding threaded posts 30 in stationary condition thereon. The strap 28 has apertures 31 at its opposite ends which are slightly larger than the post 30 so as to permit vertical movement of the strap 26 along the post.

A pair of compression springs 32 are respectively mounted on the posts and bear against the ends of strap 26 and against the heads 33 of posts 30 for normally urging the strap 26 downwardly and causing the bars 18 and 19 to return to their normal positions.

In operation, the body member is applied to the bolster of the power brake. The vertical position of the bolster and body member is then adjusted as to vary the magnitude of movement of the punch between the point at which the punch first engages the stock and the point at which the downward movement of the punch is terminated (this latter point is substantially constant because the ram of the power brake will have a substantially constant stroke length). A piece of stock S is then laid across the body member 13 and die bars 18 and 19 and the punch 11 is thereafter moved downwardly into engagement with the stock and will cause bending of the stock and rolling of the dies 22 and 23. It should be noted that during this bending operation the stock is supported at each side of the bend over a substantial surface area and as a result, there is no appreciable marking on the stock at the areas of engagement with the upper surfaces of the bars. It has been found preferable to apply a film of lubricant on the surfaces of the bars 18 and 19 to preclude any possibility of marking of the stock.

It will be seen in Fig. 4 that the punch and the bend in the stock move downwardly into the groove 25. When the bolster 10 is moved upwardly slightly, the punch will move downwardly into the groove 25 a slightly greater distance and will cause bending of the stock to a greater degree by using a single punch 11 and the die assembly 12, it has been found possible to produce bends in the varying degrees shown in Fig. 5. It should be noted that the bend at the inner surfaces S of each of the specimens shown in Fig. 5 is sharply angular, and at the outer surfaces S' the bend is slightly rounded. Furthermore, it has been demonstrated that with the present invention used in conjunction with a V-shaped sixty degree bending punch 11, bends similar to those shown in Fig. 5 have been produced in pieces of stock which varied from 0.010 inch aluminum sheet metal to ¼ inch cold rolled steel. In each case, it has been found that there is substantially no bowing or bending of the stock at positions immediately adjacent the point of bending.

In bending sheet metal stock, the problem frequently arises of bending one portion P, as seen in Fig. 1, and allowing another portion P' to remain un bent. The portions P and P' of the stock are separated from each other by a cut C. In these instances, P and allow the portion P' to remain unbent, the body member 13 is arranged on the bolster so that one end of the body member and the ends of the die bars 18 and 19 are disposed in vertical alignment with one end of the punch 11. The stock S is then placed on the bars 18 and 19 with the die C aligned with the ends of the bars and body member and the stock is positioned so that the inner terminal end of the cut C is disposed at least at the inner edges of the upper surfaces 20 and 21 of the die bars. When the punch is thereafter driven against the stock, the portion P of the stock is bent substantially as shown in Fig. 4 at an angle with relation to the general plane of the stock S and the portion P' will remain unbent and in the general plane of the stock S.

In this regard it should be pointed out that either end of the body member and die bars may be utilized for bending one portion of the stock. When the portion remains unbent. The bracket element and strap 26 may be slipped off the end portions 18a and 19a and then the die bars 18 and 19 may be moved longitudinally in the body member 13 to the dotted position B shown in Fig. 1, after which the strap 26 and bracket element 27 may be applied in the new position A indicated in Fig. 1.

The end portions 18a and 19a of the die bars will then be aligned with the corresponding end of the body member.

At this point it is also well to note that the die bars 18 and 19 are readily removable from the body member by merely lifting them out.

As seen in Figs. 6 and 7, a rounded punch 11' may be employed in a fashion substantially identical to the punch 11 for producing bends in a piece of stock wherein it is desired that the bend should be rounded instead of sharply angular. Again, the degree of bending is changed by merely adjusting the distance which the punch is permitted to move after the same has engaged the stock.

Fig. 7 shows 3 examples of specimens of stock bent to varying degrees by merely permitting the punch 11' to be moved further downwardly between the bars 18 and 19 after the punch has engaged the stock. Again, substantially no bowing or bending of the stock occurs in the area immediately adjacent the desired point of bending. It has been experienced that a sheet of ¼ inch of cold rolled steel could be bent in a single operation to approximately a right angle wherein the radius of curvature at the inner surface of the bend is ¾ of an inch and at the outside surface of the piece of stock at the bend there is no perceptible fracture. To produce such a bend without fracture by previously known methods and apparatus such as the fixed male and female V-shaped dies, previously mentioned herein, was impossible.

It will be noted that I have provided a new and improved die assembly employing rolling die bars for supporting a piece of stock over substantial areas thereof immediately adjacent the point of bending and thereby preventing marking of the stock and also permitting the identical die assembly and a single punch to be employed for producing bends of the stock without bowing or bending of the stock immediately adjacent the bend.

It will, of course, be understood that various changes may be made in the form, detail, arrangement and proportion of the parts without departing from the scope of my invention which consists of the manner described herein set forth in the appended claims.

What I claim is:

1. A die for use with a punch for bending flat metal stock, comprising a body member mounted below the
punch, a pair of elongate die bars having flat upper surfaces for supporting such metal stock, means for rotatably supporting the die bars on the body member for rotation about generally parallel axes extending longitudinally of the die bars, said die bars being disposed in side-by-side relationship to each other below and on opposed sides of the punch with the adjacent sides of the die bars being contiguous with each other when said surfaces are in alignment and presenting a substantially continuous planar surface normal to the movement of the punch, said body member having an unobstructed opening therein in alignment with the punch and below the adjacent sides of the die bars and extending to a greater depth than the furthest excursion of the punch therein, whereby the punch and metal stock may both be in spaced relationship to the body member when the punch is moved between the die bars in producing a bend in such metal stock.

2. The die as set forth in claim 1, wherein the said open and unobstructed area is defined by a groove in the body member and said means for rotatably supporting the diebars includes rounded bottom surfaces on each die bar and an elongate die bar-supporting cradle for each die bar, said cradles being die bar-supporting surfaces on said body member shaped to the identical rounded configuration of the bottom surfaces of the die bars.

3. The die as set forth in claim 2, wherein said cradles extend to at least one end of the body member and open generally outwardly in an endwise direction and said die bars extend to the open ends of the cradles to enable bending of only a portion of such metal stock.

4. The die as set forth in claim 2 wherein both ends of each cradle open outwardly in an endwise direction to enable the ends of the die bars to be positioned in alignment with either end of the body member.

5. The die as set forth in claim 1 and including resilient means cooperatively associated with the die bars for yieldably maintaining said surfaces in alignment.

6. The die as set forth in claim 1 and including a rigid strap extending across the die bars, means movably supporting the strap movement toward and from the die bars and spring means continuously urging said strap toward said die bars for yieldably maintaining the flat surfaces in alignment.

7. A die for use with a bending punch for bending flat metal stock, comprising a body member mounted below the punch, said body member having an opening therein in alignment with the punch and extending to a greater depth than the furthest excursion of the punch therein, a pair of elongate die bars having flat upper surfaces for supporting such metal stock, means for rotatably supporting the die bars on the body member for rotation of the die bars about generally parallel axes extending longitudinally thereof, said die bars being disposed in side-by-side relationship to each other below on opposite sides of the punch with the adjacent sides of the die bars continuous with each other when the flat surfaces are in alignment and presenting a substantially continuous planar surface normal to the movement of the punch whereby the punch and metal stock may be in spaced relationship to the body member when the punch is moved between the die bars in producing a bend in such metal stock, said body member having flat surfaces on both sides of the opening and in a common plane with the aligned surfaces of the die bars.

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