Dec. 13, 1932. R. V. PROCTOR 1,890,949

METHOD AND APPARATUS FOR BENDING

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Fig. 1.

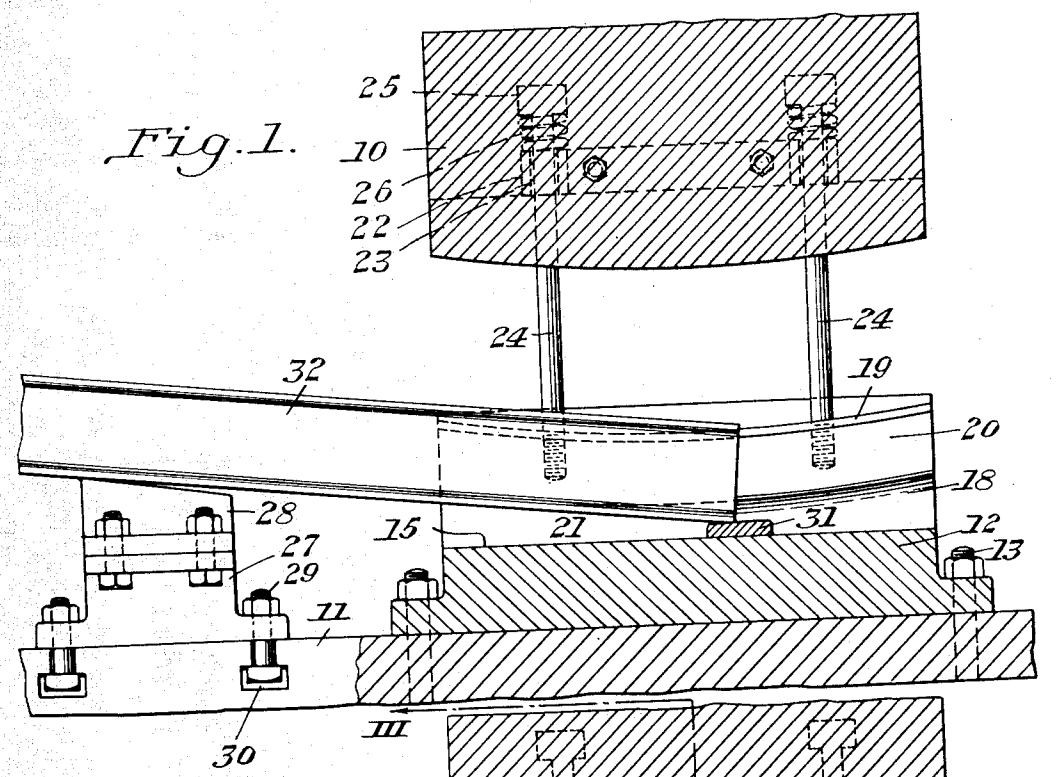
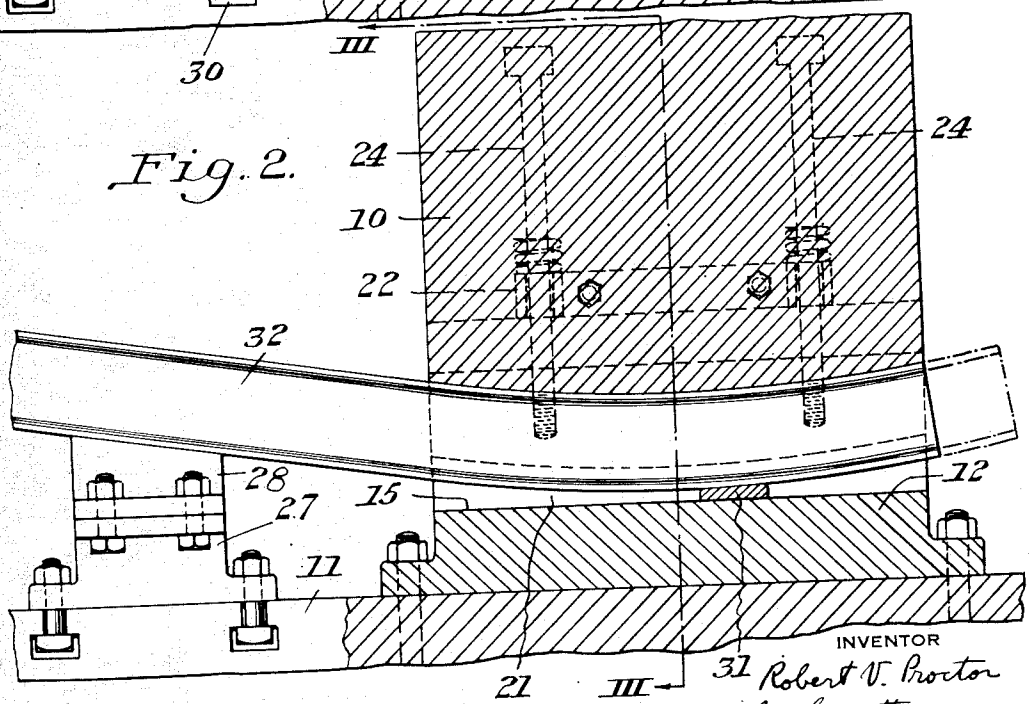


Fig. 2.



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Fig. 3.

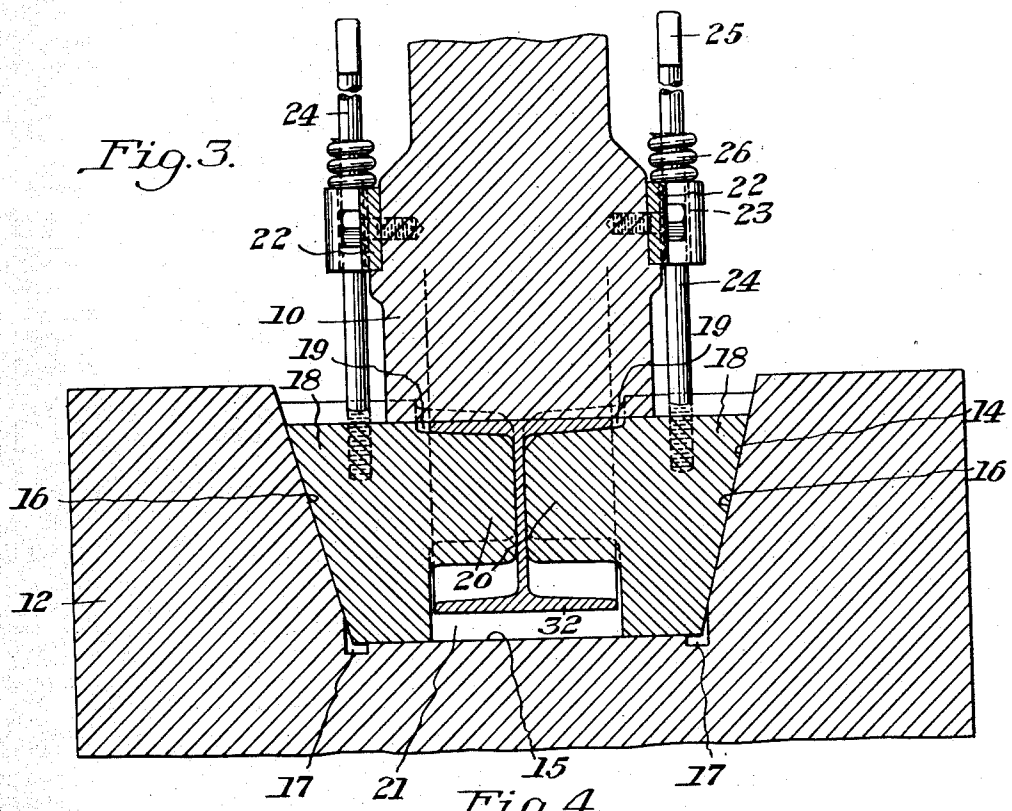
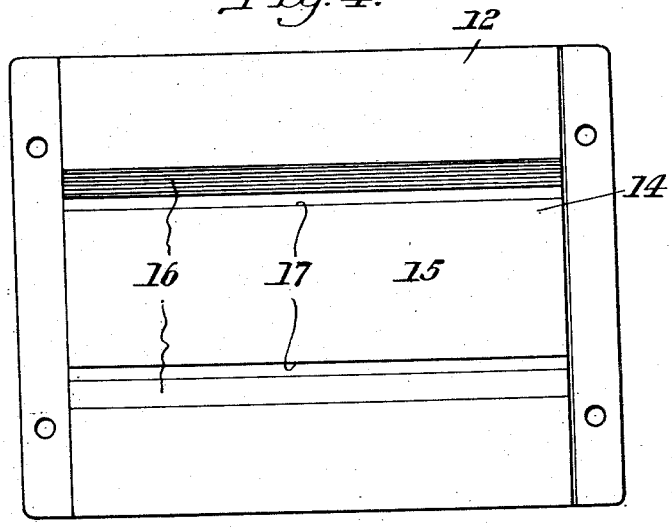


Fig. 4.



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UNITED STATES PATENT OFFICE

ROBERT V. PROCTOR, OF YOUNGSTOWN, OHIO, ASSIGNOR TO THE COMMERCIAL SHEARING & STAMPING COMPANY, OF YOUNGSTOWN, OHIO, A CORPORATION OF OHIO

METHOD AND APPARATUS FOR BENDING

Application filed May 7, 1931. Serial No. 535,610.

My invention relates to a method and means for imparting a bend of desired curvature to metallic members, such as standard structural shapes.

In many types of steel construction work, it frequently becomes necessary to provide standard structural shapes, such as I-beams, H-beams, channels and the like, with a bend of a certain radius of curvature. Structural shapes of such character are, obviously, not susceptible to bending by the ordinary method of supporting the member at two points and striking a blow on top of the member between the points of support. Such a method, if attempted, results in the destruction of the member, because of the crippling of the web by buckling. It is desirable, of course, for reasons of low cost and convenience, to bend the shapes while cold to the desired radius.

In order to make it possible to bend structural shapes, the cross section of which has a large moment of inertia about its neutral axis, to any desired radius, I have invented a method and apparatus, according to which the member to be bent is supported by its upper flange in suitably curved bending dies having portions adapted to grip and laterally support the web of the member being bent. The lower flange of the member is thus suspended freely for the stretching produced by the bending of the member. The upper flange is subjected to compression but does not change its dimensions noticeably. The web of the member, being supported laterally, is not subject to crippling or failure by buckling, twisting or tearing, as might be the result of an attempt to bend the shape by the method of supporting it at two points and applying bending pressure therebetween.

In accordance with my invention, I provide a die shoe adapted to be supported on the bed plate of a press or hammer of suitable capacity. In the die shoe, I provide a recess having tapering side walls for receiving clapper dies. These dies have recesses in their upper faces for receiving the top flange of a structural shape, such as an I-beam, H-beam, channel, or the like, and a projecting face for engaging the web of the member and providing lateral support therefor. The movable head of the press or hammer is adapted to strike the top flange of the member to be bent while supported between the clapper dies. The lower flange of the member is thus suspended freely for stretching.

The sides of the clapper dies are tapered to engage the tapering side walls in the die shoe, whereby, upon application of pressure by the head of the press, the clapper dies are forced into firm engagement with the web of the structural shape being bent. Preferably, there is a loose connection provided between the head and the clapper dies, so that the latter are slightly raised by the upward movement of the former. This momentarily frees the web of the member to be bent and permits it to be advanced through the die for a succession of bending blows. I also prefer to provide a support for the lower flange of the entering end of the member being bent, as well as an outboard support for the free unbent end thereof, for the purpose of convenience in manipulation, as well as for assuring the production of the desired bend in the portion of the member between the dies.

For a more complete understanding of the invention, reference is made to the accompanying drawings illustrating a present preferred embodiment of the invention.

In the drawings—

Figure 1 is a longitudinal sectional view taken centrally of a die press adapted for use in carrying out the invention, with a member to be bent in its initial entering position, and the head of the press raised;

Figure 2 is a view similar to Figure 1, after the bent member has been partially advanced through the dies, showing the head of the press effecting a bending operation;

Figure 3 is a sectional view taken along the plane of line III—III of Figure 2; and

Figure 4 is a top plan view of the die shoe.

Referring now in detail to the drawings, a die press of the ordinary construction includes a reciprocable head 10 and a bed plate 11. A die shoe 12 is bolted to the bed plate 11 by bolts 13. The die shoe 12 has a longitudinal recess 14 therein with a flat bottom

15 and tapering side walls 16. The intersections of the side walls 16 and the bottom 15 of the recess 14 are relieved at 17 for convenience in machining.

A pair of clapper dies 18 are received within the recess 14 in the die shoe 12. Each clapper die has a recessed shoulder 19 adapted to receive the inner surface of the upper flange of a structural shape to be bent. The clapper dies are also provided with projecting faces 20 terminating short of the bottom of the dies for engaging the web of a structural shape positioned therebetween. The web engaging faces or jaws 20 define a free space 21 between the dies and the bottom of the recess 14 of the die shoe 12, wherein the lower flange of a structural shape to be bent is freely suspended for stretching. A loose connection between the clapper dies 18 and the head 10 of the press is provided and includes yoke bars 22 bolted to the sides of the head 10 and provided with eyes 23. Lifter rods 24 traverse the eyes 23 and are threaded into the top of the clapper dies. The lifter rods 24 have T-heads 25 and compression springs 26. The lifter rods 24 have a loose fit in the eyes 23, so that slight oscillation of the rods in the eyes is permitted. When the head 10 is lifted, the springs 26 are compressed between the eyes 23 and the T-heads 25 on the lifter rods 24 to slightly lift the clapper dies 18, so that a structural shape therebetween is free for advancing movement between the dies.

In order to facilitate manipulation of a structural member being bent, I provide a pier 27 having a removable face 28. This pier also serves to insure bending of that portion of the member between the dies to the proper degree, with respect to the straight portion outside the dies. The pier 27 is shiftably secured to the bed plate 11 by bolts 29, the heads of which move in T-slots 30 in the bed plate 11.

In entering a member to be bent, it will be found desirable to support the end of the lower flange thereof to prevent tearing of the web from the flange on the initial bending stroke. Such a support may take the form of a wedge 31 adapted to rest on the bottom surface 15 of the recess 14 of the die shoe 12, while a member is receiving its first bending stroke.

The method of bending structural shapes by means of the apparatus hereinabove described may be carried out as follows. A straight length of a structural member, such as an H-beam 32, is inserted between the clapper dies 18 with its upper flanges received in the shoulders in the curved upper surface of the dies. Depending on the curvature of the top face of the dies, the extent to which the straight member 32 can be inserted therebetween is limited. Generally, the member to be bent will be adjusted to a position similar to that indicated in Figure 1. The wedge 31 is inserted beneath the end of the lower flange of the member 32 and the head 10 of the press is lowered to engage the outer surface of the upper flange and effect the bending of that portion of the member between the dies.

I prefer to employ a press of the type which provides a heavy blow sufficient for imparting a permanent set to the metal of the member 32, of the desired curvature. The curvature of the bend imparted to the member, of course, is determined by the curvature of the top of the dies 18 to which the curvature of the bottom of the head 10 should generally correspond. Obviously, dies of different degrees of curvature will be required to bend members to different radii of curvature. It may also prove desirable to provide means for securing to the head 10 one of a number of removable shoes having faces of different curvature corresponding to that of the dies 18, for bending members to different radii.

As the head 10 of the press descends, the dies 18 are forced into firm engagement with the web of the member 32 by the tapered fit with the recess 14 in the die shoe 12. As the head descends further into engagement with the top flange of the member 32, that portion of the member between the dies is bent to the desired curvature without any buckling, warping or twisting of the web. Since the latter is firmly supported laterally by the jaws 20 of the dies, it is preserved in its original condition, except that it is bent to the desired curvature in its own plane. The lower flange of the member 32, being suspended freely between the clapper dies, is permitted to stretch the amount required by the degree of curvature imparted to the member. The wedge 31 prevents the end of the lower flange from cracking away from the web, as it might do without the support afforded thereby.

When the first bending blow has been effected, the head 10 is withdrawn to an extent such as to slightly raise the dies 18. The center of gravity of the dies, obviously, is offset with respect to their points of support, so that the weight of the dies and the beam carried thereon tends to swing them slightly to disengage the jaws 20 from the web of the H-beam. This disengagement makes it possible for a worker to advance the member 32 further into dies, so that a straight portion of the member will be exposed to the action thereof. Generally, the wedge 31 may be removed after the first few bending operations, since there is no tendency for the lower flange to separate from the web thereafter. By continuing the operations above described, the member 32 attains the shape indicated in Figure 2. If it is desired to bend a portion only of the structural member, leaving the remainder thereof in its original

straight condition, the pier 27 insures the bending of the bent portion to the required degree. The shoe 28 carried by the pier may be removed or replaced by substitute shoes of different design to produce different degrees of curvature in the member 32.

It will be apparent that the method and apparatus described above permit the bending of structural shapes without crippling or deforming the web, by supporting the top flange and allowing the bottom flange to hang free for stretching as the member is bent. As the member being bent is pushed down into the clappers, the web is firmly supported laterally against any possibility of lateral bending.

While I have shown the head of the press engaging the top surface of the clapper dies, this is not necessary, since the upper flanges of the beam may rest directly on the flat surface of the dies, so that only the beam is engaged by the head. According to the invention, the bending operation is carried out by performing the bending of the top flange of the member, supporting the web laterally and suspending the lower flange freely for stretching. The method and apparatus herein described are applicable to I-beams, H-beams, channels, or the like, either one or two at a time, bulb angles, Z-bars, or the like, or to any structural shape that has one or two flanges thereon.

Although I have described but a single preferred embodiment of the apparatus and the method constituting my invention, it will be obvious that the apparatus may be otherwise embodied and the method performed in a variety of ways. The described embodiment and method, therefore, are no limitation upon the invention, which may be practiced otherwise, within the scope of the appended claims, without departing from the spirit of the invention.

I claim:

1. Bending dies for members having a web and a flange extending therefrom, comprising opposed, movable jaws having flange-engaging shoulders, and web-engaging faces, said faces being recessed to accommodate portions of said members, and a shoe with inclined walls for forcing said jaws together.

2. A two part die for bending flanged members with webs, comprising a pair of blocks having their top surfaces adapted to engage a flange on said members and projecting faces for gripping a web thereof, and a die shoe with inclined walls for receiving said blocks and forcing them together.

3. A two part die for bending flanged members with webs, comprising a pair of blocks having their top surfaces adapted to engage a flange on said members and projecting faces for gripping a web thereof, said faces being recessed to accommodate additional flanges or other irregularities on said web, and a base for supporting the blocks having inclined walls for forcing them together.

4. Apparatus for bending flanged, webbed members comprising a die shoe, clapper dies supported therein for simultaneously supporting a flange and gripping a web, a punch for bending the member while held by said dies, and a loose connection between said punch and dies.

5. Apparatus for bending flanged, webbed members comprising a die shoe, clapper dies supported therein for simultaneously supporting a flange and gripping a web, a punch for bending the member while held by said dies, and a loose connection between said punch and dies, said shoes having means for forcing the dies into engagement with a web therebetween when the punch is lowered.

6. Apparatus for bending flanged, webbed members comprising a die shoe having inclined walls, clapper dies supported therein for simultaneously suspending one flange freely on another flange and gripping the web, and a punch for engaging the suspending flange exclusively and bending the member while held by said dies.

7. Bending dies for members having flanges and webs, comprising jaws movable toward and away from each other and having shoulders for engaging the under surface of a flange to suspend a member with another flange free, and a die shoe with inclined walls for forcing the jaws into engagement with said webs.

8. Bending apparatus comprising a die shoe, clapper dies having a tapered fit therein, said dies having surfaces adapted to engage the inner surface of a flange of a structural member and a web thereof, and means for applying bending pressure to the outer surface of said flange.

9. In a method of bending members having a web and flanges at the edges of the web, the steps including supporting one flange uppermost vertically to suspend another flange freely therebelow, supporting the web laterally throughout the bending zone, and applying pressure to the upper flange only.

10. A method of bending a structural member having flanges connected by a web, including the steps of supporting one flange uppermost from beneath so that another flange is substantially freely suspended therebelow, applying bending pressure to the top of the upper flange and supporting the lower flange adjacent the end of said member.

In testimony whereof I have hereunto set my hand.

ROBERT V. PROCTOR.