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T. COLLINS

2,446,692

STRUCTURAL MEMBER

Original Filed April 7, 1942

FIG. 1.

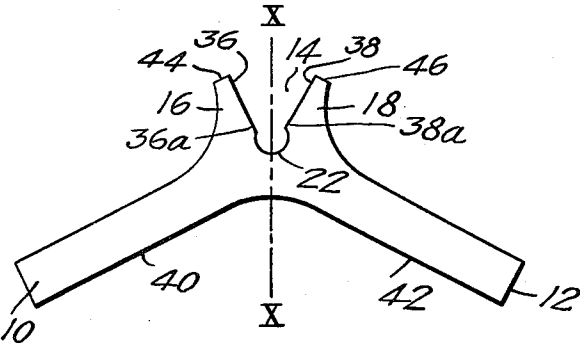


FIG. 2.

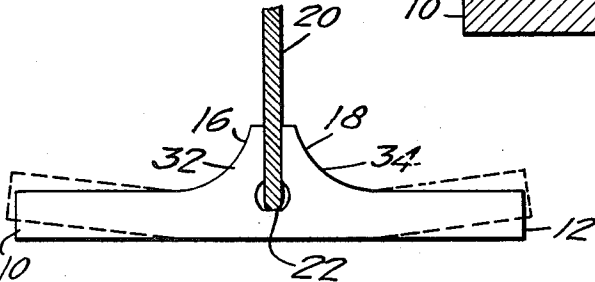


FIG. 3.

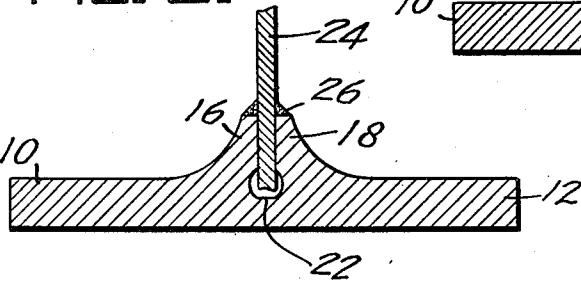


FIG. 4.

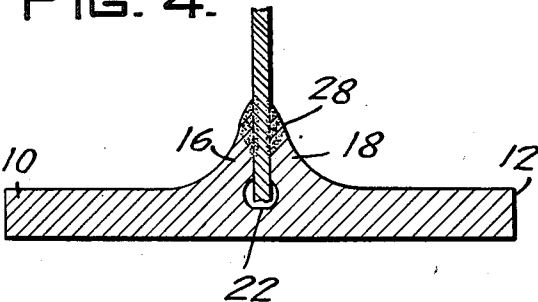


FIG. 5.

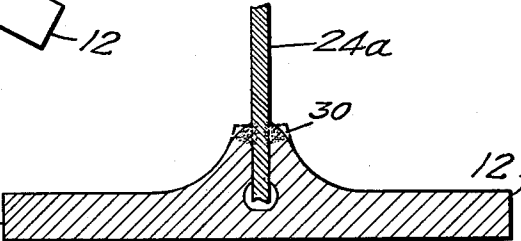
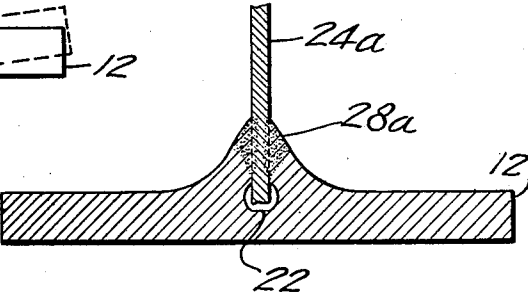


FIG. 6.



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2,446,692

STRUCTURAL MEMBER

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2 Claims. (Cl. 29—190)

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The present application is a division of application Serial No. 438,043, filed April 7, 1942, now Patent No. 2,376,574, and relates to specific features of improvement in structural members, as herein claimed.

Various objects and advantages resulting from the adoption and use of the invention will be apparent from the following detailed description when read in connection with the accompanying drawings and the appended claims.

In the drawings:

Figure 1 illustrates a step in the method and also the cross-sectional contour of one of the novel elements in the initial stage of its production;

Figure 2 illustrates a further step in the method of producing the improved structural member;

Figure 3 illustrates a step following that illustrated in Figure 2 wherein a separately formed web member is united to a flange element by fillet welds;

Figure 4 is a cross section of a completed structural member made in accordance with the invention;

Figure 5 is a view similar to Figure 3 illustrating an alternative method wherein the preliminary joining of the web member to the flange member is accomplished by fusing the parent metal of the flange member; and

Figure 6 is a cross-sectional view of a structural element produced by following the method illustrated in Figure 5.

Referring in detail to the drawings, in making the member embodying the present invention I provide a flanged member substantially or approximately of the cross-sectional shape shown in Figure 1 which includes side flanges 10 and 12 which are obliquely inclined with respect to one another, the angle of inclination being symmetrical about the vertical axis $x-x$. The flanged element is provided with a V-shaped notch 14 which is flanked by thickened bodies of fillet metal 16 and 18.

The flanged element such as shown in Figure 1 can be readily produced from blooms or billets similar to those from which standard structural I-beams, channels, rails and the like are usually formed by conventional forms of rolling mill equipment.

The flange element of Figure 1 is next bent to the condition illustrated in Figure 2 by forcing a blade 20 toward the V-shaped notch 14 and into contact with the curvilinear base 22 thereof. Continued downward movement of the blade 20 will cause flexure of the metal in the region of

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the axis $x-x$ so as to thus flatten the flange member to the condition shown in Figure 2 wherein the flanges occupy approximately a common horizontal plane as shown. Thus there is produced the intermediate flanged element with a narrow central slot extending longitudinally thereof, the width of which is determined by the thickness of the blade 20. The blade is then withdrawn and a web plate 24 is inserted in the slot flanked by the fillet bodies 16 and 18. Then a plurality of preliminary tack welds 26 are made at a plurality of longitudinally spaced points. These spaced tack welds serve to temporarily unite the web plate 24 to the flanged member. Thereafter permanent fillet welds are made so as to homogeneously unite the flange metal to the web metal in the region of the fillet bodies 16 and 18. Otherwise expressed, a homogeneous union of the two metals is made by establishing a zone of fusion in the region such as indicated at 28 in Figure 4.

The described tack welds and fillet welds are made by depositing extraneous metal from a welding rod or the like. As illustrated in Figures 5 and 6, I may fuse a portion of the parent metal, for example, that indicated in the region of the zone 30 in Figure 5, in order to make the temporary connection between the web plate 24^a and the flanged member. Thereafter a continued welding operation will be carried on so as to homogeneously unite the web plate with the flange member by a zone of fusion such as indicated at 28^a in Figure 6. Thus an autogenous welded union between the flange element and the web plate is effected.

The flange element as above indicated can be produced as an integral metal piece by rolling on a standard structural mill and the notch 14 can thus be precisely formed economically by eliminating conventional make-ready requirements such as the elimination of precise sizing and special edge conditioning of the web plate element and blocking, clamping or jiggling separately pieces in position for welding. The substantially V-shaped central notch can be rolled to a predetermined size and shape to receive a web plate 24 of any desired thickness or gauge and the web plate utilized can be of stock flat rolled material producible on a quantity basis by conventional rolling mill methods.

The flared-shaped notch 14 illustrated has an arcuate apex portion 22 and is of a contour devoid of reentrance angles and is also devoid of parallel faces. Thus the notch can be readily formed by a rolling operation in a mill. Likewise the outer

arcuate fillet faces 32 and 34 can similarly be produced by a rolling operation. It is noted that the converging side faces 36 and 38 of the notch 14 are disposed approximately at right angles to the planes of the underfaces 40 and 42 of the flange portions 10 and 12. The upper edge faces 44 and 46 of the fillet bodies 16 and 18 are approximately parallel to the planes 40 and 42 and are, therefore perpendicular to the notch faces 36 and 38.

With the blank of the configuration shown in Figure 1 it will be apparent that upon bending the same to the condition of Figure 2, the same will be flattened. In this operation a lower die, not shown, will be employed and the metal will be worked in the region of the line $x-x$ of Figure 1 by reason of the downward bending force exerted by the blade 20. As the blade descends, the bottom faces 40 and 42 of the flanges 10 and 12 will be flattened against the bottom die and at some stage of this operation the notched faces 36 and 38 will come into contact with the opposite side faces of the descending blade 20. From that stage on to the completion of the flattening operation, two edges of the rolled section will be maintained in spaced relation by the blade 20 so that the final width of the slot between the plane faces 36 and 38 will have been determined by the thickness or gauge of the blade 20. It is therefore apparent that by selecting a blade of predetermined thickness a slot of any desired width can be readily produced.

In the bending operation it will be observed that in the initial stages only the central portion of the rolled blank of Figure 2 is subjected to working. Thereafter there is added a component of elongation which continues throughout the latter phases of the flattening operation as the blade continues to descend from the position intermediate that shown in Figure 1 to the position of Figure 2. Close analysis of the exact nature of this deformation will confirm that what at first glance appears to be a pivoting about the edges 36^a and 38^a, with consequent unrelieved elongation during the latter phase of the flattening operation, does actually involve sliding the edges 36^a and 38^a vertically downward along the side faces of the blade 20 and that the flattening operation is in reality a bending operation from start to finish about a centroid that is progressively displaced upward. There may, and with blades of preferred thickness there will, continue to be compression of the metal at the arcuate bottom or base of the groove 14 throughout the whole cycle of the flattening operation.

In some cases I contemplate a slight overflattening operation, by which I mean the blade 20 may be caused to move down to such an extent that it will depress the central portion of the flanged element to a plane below the true horizontal to thus dispose the outer flange portions to the positions indicated at dotted lines in Figure 2. This overflattening will compensate for the tendency of the parts to spring back after the flattening operation and will generally be required only in the case of very heavy sections or when using a blade of maximum allowable thickness. It may also be desirable to apply heat to the central median region of the section corresponding to its zone of deformation.

After the rolled steel flange member has been conditioned as shown in Figure 2, the flat rolled steel web plate 24 will be inserted in the central notch to a sufficient depth and the parts may be maintained in assembled relation such as shown

in Figure 3 solely by friction due to their mutual interengagement. However, in some cases I contemplate making temporary tack welds at spaced points prior to the final welding to the condition shown in Figure 4. The depth of slot between the faces 36 and 38 will usually be greater than will be actually required in order to secure the minimum required engagement and therefore the depth (not thickness) dimension of the web plate element may vary within the limits and still permit the overall dimension of the assembled section to be that desired. Moreover, since the concealed edge of the web plate element need not necessarily be seated against the bottom of the notch 14, the condition of the extreme inner edge of the web plate 24 is of no significance to the construction; hence no special finishing of this edge is required.

In Figure 3 there is shown a clearance between the lower edge of the web plate 24 and the notch in which it is seated so as to pictorially represent this point. This is a feature of practical importance in the interest of economy since certain irregularities and working tolerances can thus be allowed for. The utilization of temporary tack welds described secures the parts in position for final welding without the use of relatively expensive blocking, clamping or jiggling devices. The final homogeneous union of the web plate to the flanged element may be accomplished either by fillet welding, as illustrated in Figures 3 and 4, or by use of a carbon arc, an autogenous weld may be secured by fusing the parent metal, as illustrated in Figures 5 and 6.

From the foregoing it is apparent by the practice of the improved method set forth, I make available accurately dimensioned flanged structural members which are fabricated from rolled web and flange elements whose dimensions need not be precise either as to width dimension or as to edge conditioning. Thus rough rolling tolerances can be allowed. The welded joints are of such nature that the sections so fabricated will be precisely and generously filleted without resort to elaborate or extravagant weld metal deposition or finish grinding.

By reserving one determinant manipulation of the rolled shape, viz., its flattening with coincident slot forming, it is possible to employ a desired single size and weight of flange element for application to web plate elements of a variety of thicknesses.

By engaging the web plate in a squared and fitted slot in the flange element, any waviness of the edge of the web plate or any tendency for it to become wavy during welding is rendered inconsequential by positioning the edge of the web plate element in spaced relation to the flange element throughout the length of the section.

By employing a flange element which can, by tack welding alone, be fixed in proper relative position with the web plate, with which it is to be united by fusion welding, my invention dispenses with any necessity for blocking, clamping or jiggling the separate elements preparatory to welding.

An important advantage to be secured by the adoption and use of this invention arises from a particular construction of the component parts that are homogeneously united by bodies of fused metal or spliced together by welding after separate fabrication. By extending the web plate beyond the ends of the flange elements for one of two abutting weldment ends and extending the flange elements a corresponding distance beyond the end of the web plate element for the

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other, the two weldments can be brought together into socket engagement, temporarily secured in proper relative position by a minimum of welding, and their splicing subsequently completed by both full butt welding of web plate elements and flange elements and full fillet welding of the lapped elements without resort to the use of splice plates, temporary bolts, clamps or other auxiliaries and without effecting a break in any of the lines of construction.

While I have described a preferred embodiment of the improved structural member, it is to be understood that various modifications and substitutions may be made without departure from the invention as defined in the appended claims.

I claim:

1. A rolled metal article of such shape in cross-section as to comprise two equal and oppositely inclined flanges symmetrically disposed on opposite sides of a median center line between them, respective thickened fillet bodies of equal cross-sectional area spaced symmetrically about said median line and located in the region thereof, said fillet bodies being of such cross-sectional contour as to define the boundaries of a notch with outwardly flaring faces connected by an arcuate central groove which is bisected by said median line, the whole element being thus shaped to facilitate economical production on a rolling mill.

2. A rolled metal article comprising in cross-section two equal and oppositely inclined flanges symmetrically disposed on each side of a median plane, thickened fillet bodies of similar cross-

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section joined to said flanges and being symmetrical with said median plane, said fillet bodies being of cross-sectional contour to define the boundaries of a notch with outwardly flaring faces connected by an arcuate central groove bisected by said median plane, said flaring faces being respectively perpendicular to said flanges, the edges between said flaring faces and said groove adapted to form fulcrums about which the member may be bent to place said flaring faces in spaced parallel relation, the whole article being shaped for economical production on a rolling mill.

TAPPAN COLLINS.

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