

June 4, 1963

A. W. HEINLE

3,092,222

CRUCIFORM STRUCTURAL STEEL COLUMNS

Filed Feb. 26, 1958

2 Sheets-Sheet 1

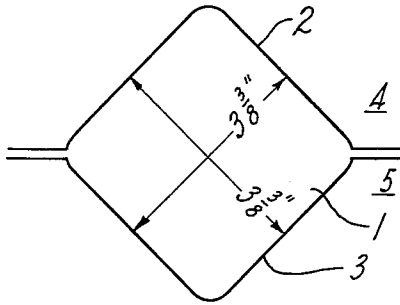


Fig. 1

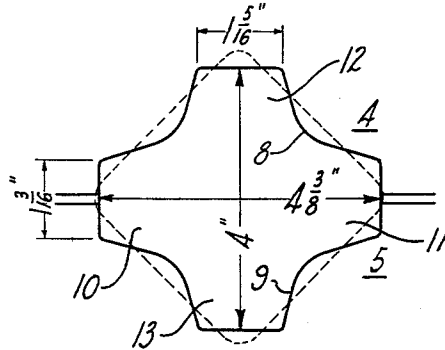


Fig. 2

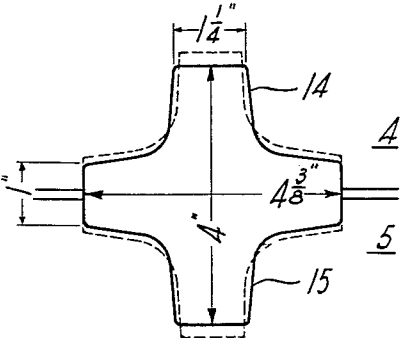


Fig. 3

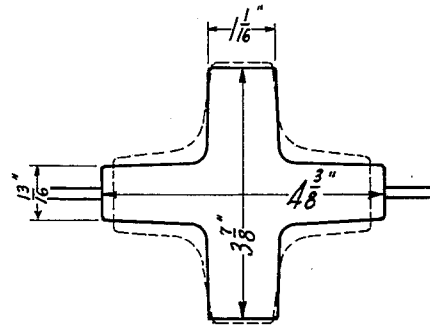


Fig. 4

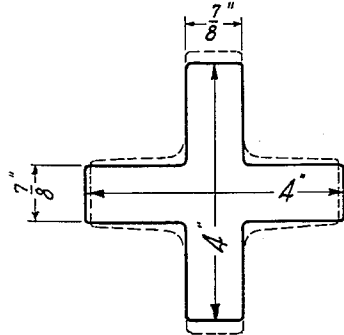


Fig. 5

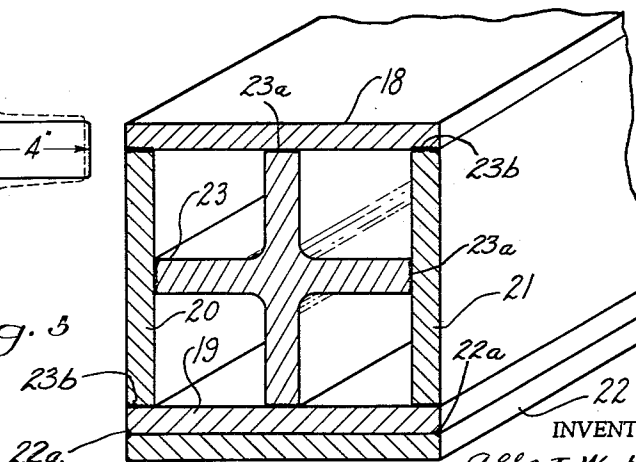


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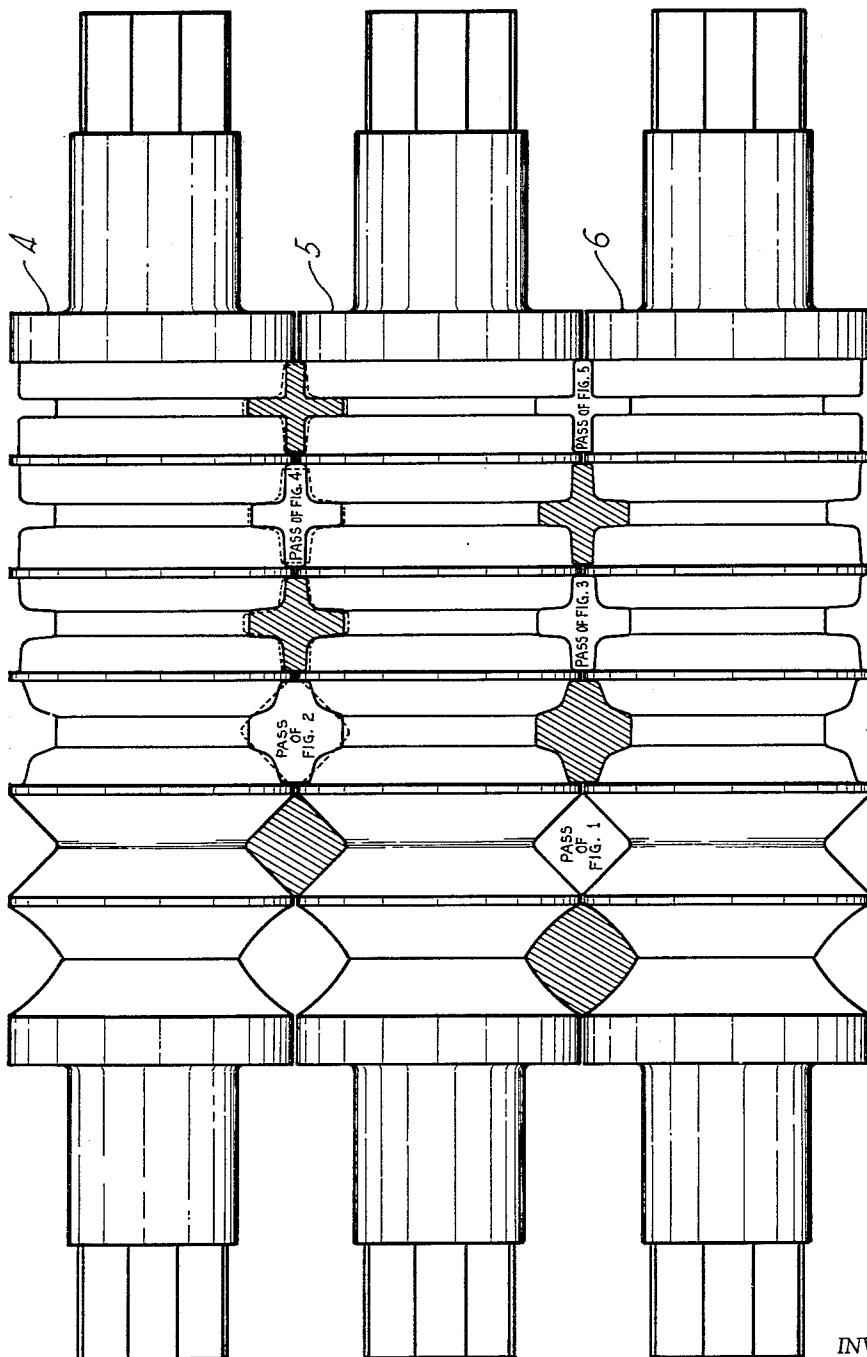
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## CRUCIFORM STRUCTURAL STEEL COLUMNS

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2 Sheets-Sheet 2



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3,092,222

**CRUCIFORM STRUCTURAL STEEL COLUMNS**  
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1 Claim. (Cl. 189-41)

This invention relates to structural steel members such as columns for buildings, and it is among the objects thereof to form steel columns of cruciform shape with blunt or sharp flanges of rectangular shape and of equal thickness uniform to their base by rolling methods that do not adversely affect the grain or physical structure of the rolled steel and which shall produce a cruciform shape in a minimum number of passes. Heretofore building columns were, in the main, of H-shape and are about 18" square weighing somewhat around 300 pounds to the foot. In accordance with the present invention a column of cruciform shape is produced of substantially the same cross sectional area and the same strength as the H-column of like dimensions and weighing about 10% less than the H-column, thus effecting a savings of approximately 10% in the steel used for the columns which is large tonnage in the construction of multiple story buildings. Also, the cruciform shape adapts itself to reduction of the cross-sectional area of building columns in end to end relation as the height decreases progressively and as the load is reduced from story to story, the cruciform shape being especially adapted for such reduction in the cross-sectional area of adjacent columns. The cruciform shape column further adapts itself to fabrication of other useful building and bridge structures by attaching plates by welding to the flanges of the column.

It is therefore a primary object of this invention to provide a column of cruciform shape in which the column and flanges are formed by a minimum number of heavy reduction roll passes to simultaneously elongate and compress the metal and produce sharp or blunt flanges of uniform thickness and of substantially the thickness of the web of H-shaped columns of comparable size, as distinguished from the method of rolling star bars with tapered flanges, all as more fully described in my co-pending application entitled "Method of and Apparatus for Rolling Cruciform Columns," Serial No. 798,902, filed March 12, 1959, but now abandoned.

These and other objects of the invention will become more apparent from a consideration of the accompanying drawings constituting a part hereof in which like reference characters designate like parts and in which:

FIGURE 1 is a diagrammatic illustration of a diamond shaped roll pass for roughing billets to be reduced to cruciform shaped columns;

FIGURE 2 is a diagrammatic view of a roll pass initially forming the cruciform shape, the dotted lines illustrating the diamond shaped bar of FIGURE 1 that was employed to form the bar in the FIGURE 2 pass;

FIGURES 3 and 4 are diagrammatic views illustrating subsequent reduction passes in the manufacture of a cruciform shaped bar or column;

FIGURE 5 illustrates the finished cruciform bar for use as a column or beam;

FIGURE 6 is an end view of a rolled cruciform shaped column made in accordance with the present invention, boxed in with side plates, to form a fabricated column or beam;

FIGURE 7 is a front elevation of a three high roll set showing the five passes of FIGURES 1 through 5.

With reference to FIGURES 1 to 5 and 7 of the draw-

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ings, the method of rolling the cruciform shaped column is as follows:

In FIGURE 1, the billet 1 which has been formed by flat rolling to break off the scale, is of uniform dimensions  $3\frac{3}{8}" \times 3\frac{3}{8}"$  across its flat sides and is shown in a diamond shaped pass 2 and 3 of rolls 4, 5 and 6. In FIGURE 2, the diamond shaped billet is shown in dot and dash lines and the cruciform shape of the pass in rolls 4, 5 and 6 is shown by the full lines 8 and 9. It will be noted that in FIGURE 2 the cruciform shape is  $4\frac{3}{8}"$  axially of the roll and only  $4"$  radially of the roll. The tip of the wings 10 and 11 are  $1\frac{1}{16}"$  wide and wings 12 and 13,  $1\frac{1}{16}"$  wide. In FIGURE 3 the cruciform shaped billet or bar rolled in the pass of FIGURE 2 is turned  $90^\circ$  with the long dimension  $4\frac{3}{8}"$  vertically disposed in the radial grooves 14 and 15 of rolls 4, 5 and 6 and it is again reduced to where the long dimension is axially of the rolls, the dot and dash lines illustrating the shape of the bar of the pass in FIGURE 2 before it is reduced to the shape of the solid line in FIGURE 3.

Again in FIGURE 4 the cruciform shaped bar is turned  $90^\circ$  and is given a substantial reduction with the long axis of the cruciform cross-section disposed axially of the rolls, and in the final or finishing pass the bar of FIGURE 4 is again turned  $90^\circ$  and given a finishing pass to the dimension of FIGURE 5 where the transverse axes through the flanges are the same in both directions.

FIGURE 7 shows the complete conformation of the heavy cruciform section, starting with a rough gothic shaped pass at the left hand side of the rolls, the diamond shape of FIGURE 1, the heavy reduction passes of FIGURES 2, 3, 4 and the finished cruciform section of FIGURE 5.

It will be noted from the above, that the successive roll passes effects a great reduction and compression because every other pass will compress the grain structure that has been elongated in the former pass and it will be noted that the thinnest flange enters the widest pass because it is turned  $90^\circ$  so that there can be no sticking of the bar in the passes.

For example, in FIGURE 2 the  $1\frac{1}{16}"$  flange of the bar is one-sixteenth smaller than the  $1\frac{1}{4}"$  groove of FIGURE 3, in which it is rolled after turning  $90^\circ$ . In FIGURE 4, the  $1"$  flange of the bar rolled in the pass of FIGURE 3 is rolled in the  $1\frac{1}{16}"$  groove of the pass of FIGURE 4 after turning  $90^\circ$  and the  $1\frac{3}{16}"$  flange rolled in the pass of FIGURE 4 is turned  $90^\circ$  and rolled in the  $\frac{1}{16}"$  larger pass of FIGURE 5. There is therefore no sticking of the bar in successive roll passes. As will be seen in FIG. 5 of the drawings, the width of the vertical flange is increased from  $1\frac{3}{16}"$  to  $\frac{7}{8}"$ , thus providing a cruciform structure of uniform flange length and thickness.

The box-like construction of FIGURE 6 is effected by the welding of the outer plates 18, 19, 20 and 21 to the flanges 23 of the cruciform beam as indicated at 23a and, as shown, double plates as indicated at 22 may be used if desired.

As shown in FIG. 6 plates 18, 19, 20 and 21 are of substantially the same thickness as the flanges 23 of the cruciform member and are preferably of the same material. One pair of plates 18 and 19 is of greater width than the other pair, 20 and 21, and the entire width of the plates 18 and 19 is substantially equal in width to the aligned flanges 23 of the cruciform member plus the thickness of the other pair of plates 20 and 21, so that the plates when welded together as indicated at 23b, present substantially flush surfaces at the junctions of the inner sides of the wider pair of plates with the side edges of the narrower pair of plates.

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When double plates are used, the outer plate 22 is welded, as at 22a to one of the inner plates, for example, plate 19.

By this box-like construction the cruciform section may be employed as a beam or girder as well as a column.

It is evident from the foregoing description of the invention that cruciform columns may be produced by rolling with a minimum number of passes and by getting substantial reduction in successive passes, every pass requiring that the cruciform shaped bar be turned 90° so that the flanges of lesser dimensions are fitted into the groove of the succeeding pass which is wider than the flange so that the flange will not stick in the pass.

There is sufficient difference in the length of the flanges between successive passes to require compression after every heavy reduction or elongation pass and in the final pass, as is shown by the dot and dash lines, the cruciform shaped column is symmetrically formed with the flange metal that was elongated in the previous pass subjected to compression and the metal that was compressed in the previous pass subjected to a slight reduction or elongation.

Although one embodiment of the invention has been herein illustrated and described, it will be evident to those skilled in the art that various modifications may be made in the details of construction without departing from the principles herein set forth.

I claim:

An elongated axially rigid longitudinal force supporting column comprised of a single cruciform piece of

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rolled steel having flanges of uniform length and thickness, wall plates of substantially the same thickness and material as said flanges welded at substantially their mid points to the outer edges of said flanges to form a box-like column comprised of two pairs of opposed flat parallel plates, the plates of one pair being wider than, and extending over the ends of the other pair with the extending portions of said one pair welded to the ends of said other pair, the entire width of the wider plates being substantially equal to the widths of the aligned flanges of the cruciform piece plus the thickness of said other pair of plates whereby the welded plates present substantially flush surfaces at the junction of said one pair of plates with said other pair of plates.

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