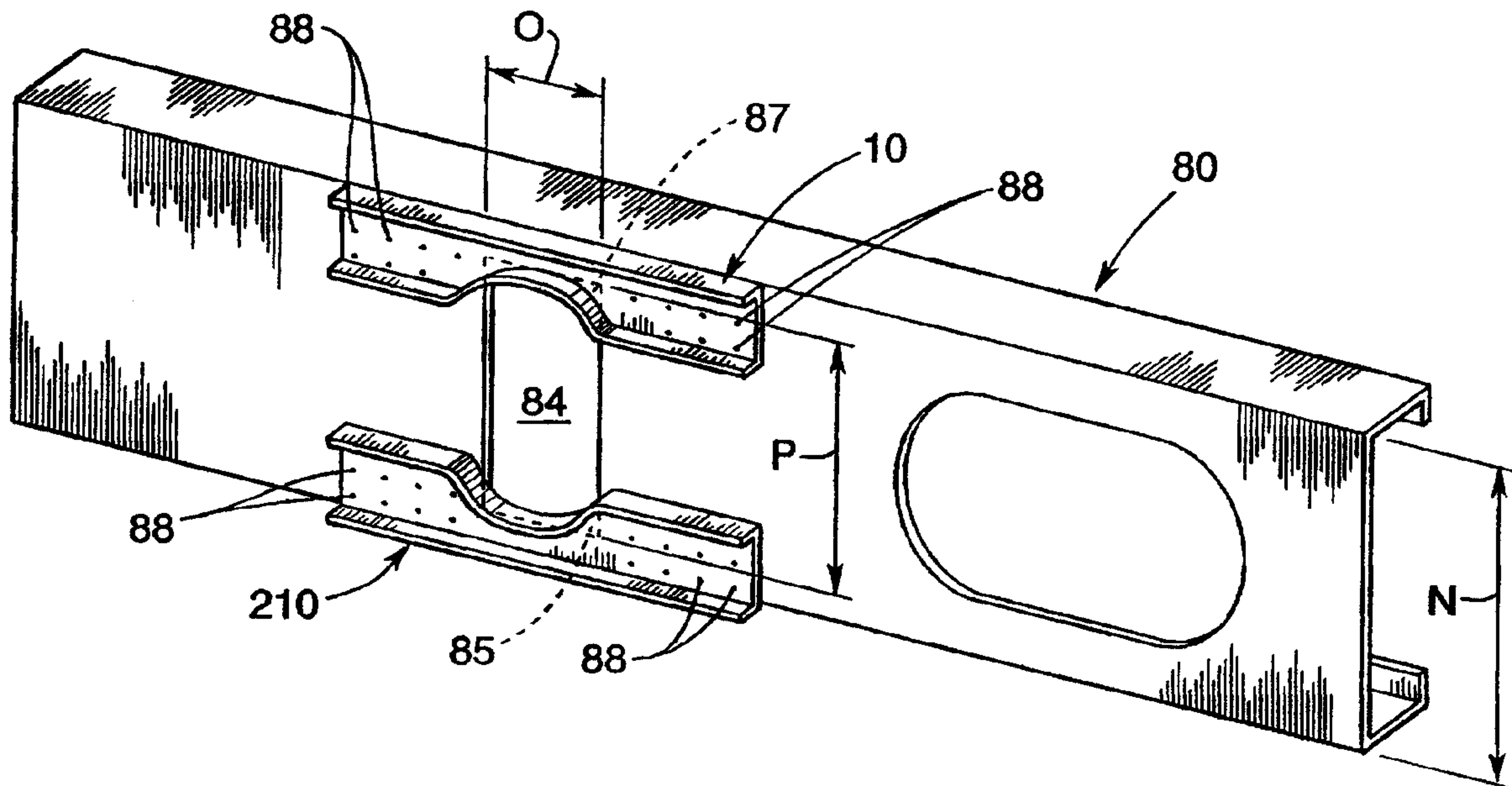




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(54) Titre : APPAREIL DE RENFORCEMENT D'UNE SOLIVE METALLIQUE A L'ENDROIT D'UNE OUVERTURE PERCEE DANS LA SOLIVE ET METHODES DE FORMAGE D'OUVERTURES RENFORCEES DANS DES ELEMENTS DE SUPPORT METALLIQUES  
(54) Title: APPARATUS FOR REINFORCING A PORTION OF A METAL JOIST ADJACENT AN OPENING THERETHROUGHT AND METHODS FOR FORMING REINFORCED OPENINGS IN METAL SUPPORT MEMBERS



(57) Abrégé/Abstract:  
Apparatus and methods for reinforcing an opening in a support member such as a joist.

ABSTRACT OF THE DISCLOSURE

Apparatus and methods for reinforcing an opening in a support member such as a joist.

TITLE

5 APPARATUS FOR REINFORCING A  
PORTION OF A METAL JOIST ADJACENT  
AN OPENING THERE THROUGH AND  
METHODS FOR FORMING REINFORCED  
OPENINGS IN METAL SUPPORT MEMBERS

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CROSS-REFERENCE TO RELATED APPLICATIONS

Not applicable.

15

FEDERALLY SPONSORED RESEARCH

Not applicable.

BACKGROUND OF THE INVENTION

20

FIELD OF THE INVENTION

The subject invention relates to building members and,  
more particularly, to apparatuses and methods for reinforcing  
openings in joists.

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DESCRIPTION OF THE INVENTION BACKGROUND

Conventional floor construction methods typically comprise  
installing "header" members on the top of support walls that  
may be fabricated from, for example, concrete blocks, wood or

metal studs. The header members may be fabricated from metal or wood and are supported on the wall. Other beam members, commonly referred to as joists, are used to span from wall to wall between the headers and are connected to the headers by 5 suitable fasteners. The joists are typically arranged parallel to each other with 8", 16" or 24" between their respective centers, depending upon the load characteristics that the floor must accommodate. A sheathing material such as plywood is then attached to the upper edges of the joists to form the floor 10 surface.

After the floor is constructed, other trades must then install the utility members such as pipes, heating ducts, cables, wires, etc. Such utility members must be installed in such a manner so as to not affect the structural integrity of 15 the floor system. Yet it is desirable to support the utility members in the floor system to minimize its intrusion into the livable space and without compromising the structural integrity of the floor.

One method that has been employed in the past for 20 reinforcing an opening provided in a metal joist is illustrated in Figure 1. As can be seen in that Figure, two pieces of angle 210 are attached to the web 282 of a metal joist 280 adjacent each end of an opening 290 provided in the web 282. When using such approach, the number and configuration of

screws used are dependent upon the installation and loading characteristics of the joist.

#### SUMMARY OF THE INVENTION

5 In accordance with one form of the present invention, there is provided an apparatus for reinforcing a portion of a metal joist adjacent an opening extending through a portion of the metal joist. In one embodiment, the apparatus comprises a first reinforcement plate having a first side and a second  
10 side. The reinforcement plate has a pair of joist attachment ends and the second side has a non-linear profile between the pair of attachment ends.

Another embodiment of the present invention comprises an apparatus for reinforcing a portion of a metal joist adjacent  
15 an opening extending through a portion of the metal joist. The apparatus comprises a first C-shaped reinforcement plate that has a front surface and a rear surface and a first leg that protrudes from the front surface and a second leg that protrudes from the front surface. The second leg has an  
20 arcuately shaped portion therein. The apparatus also includes a second C-shaped reinforcement plate that has a front surface and a rear surface and a primary leg that protrudes from the front surface and a secondary leg that protrudes from the front surface. The secondary leg has an arcuately shaped portion

therein.

Another embodiment of the present invention comprises a method for forming a reinforced opening in the web of a metal support member. One embodiment of the method comprises forming  
5 an opening through the web, the opening having a top end portion and a bottom end portion and a width. The method also includes attaching a reinforcement member having a length that is greater than the width of the opening to portions of the web adjacent the opening such that a central portion of the  
10 reinforcement member spans across the top end portion or bottom end portion of the opening.

Another embodiment of the present invention comprises a method for forming a reinforced opening in the web of a metal support member. The method includes forming an opening through  
15 the web, the opening having a top end portion and a bottom end portion and a width and a height. The method also includes attaching a first reinforcement member having a length that is greater than the width of the opening to portions of the web adjacent the opening such that a central portion of the first  
20 reinforcement member spans across the top end portion of the opening. A second reinforcement member having a length that is greater than the width of the opening is attached to portions of the web adjacent the opening such that a central portion of the second reinforcement member spans across the bottom end

portion of the opening.

Yet another embodiment of the present invention comprises a method of reinforcing an opening in a support member through which a utility member having an outer perimeter protrudes.

5 The method may include attaching a first reinforcement member having a first edge portion which corresponds in shape to a portion of the perimeter of the utility member to the support member such that the first edge portion is oriented adjacent the portion of the perimeter of the utility member. The method  
10 may further include attaching a second reinforcement member having a second edge portion corresponding in shape to another portion of the perimeter of the utility member to the support member such the second edge of the second reinforcement member is oriented adjacent the another portion of the perimeter of  
15 the utility member.

#### BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying Figures, there are shown present  
20 embodiments of the invention wherein like reference numerals are employed to designate like parts and wherein:

FIG. 1 is a perspective view of a prior arrangement for reinforcing an opening provided in a metal joist;

FIG. 2 is a rear elevational view of one embodiment of a

reinforcement plate of the present invention;

FIG. 3 is a cross-sectional view of the reinforcement plate of Figure 2 taken along line III-III in Figure 2;

FIG. 4 is a is a cross-sectional view of the reinforcement  
5 plate of Figure 1 taken along line IV-IV in Figure 2;

FIG. 5 is perspective view of first and second reinforcement plate embodiments of the present invention attached to a metal joist to reinforce an opening in the web of the metal joist;

10 FIG. 6 is a rear elevational view of one embodiment of a second reinforcement plate of the present invention;

FIG. 7 is a cross-sectional view of the second reinforcement plate of Figure 6 taken along line VII-VII in Figure 6;

15 FIG. 8 is a is a cross-sectional view of the reinforcement plate of Figure 6 taken along line VIII-VIII in Figure 6; and

FIG. 9 is a perspective view of first and second reinforcement plate embodiments attached to a metal joist to reinforce an opening therein and a utility member extending  
20 through the reinforced opening in the joist.

#### DETAILED DESCRIPTION OF THE EMBODIMENTS OF THE INVENTION

Referring now to the drawings for the purposes of illustrating the present embodiments of the invention only and



not for the purposes of limiting the same, Figures 2-4 illustrate one embodiment of a first reinforcement plate 10 of the present invention. As can be seen in those Figures, the first reinforcement plate 10 has a first lateral edge 12 and a second lateral edge 14. The first reinforcement plate 10 may be fabricated from suitable metal material such as galvanized steel, stainless steel, etc. and have a planar front surface 16 and a planar rear surface 18. In addition, the first reinforcement plate 10 also has a central section generally designated as 20 and two attachment ends, generally designated as 40 and 50.

Also in this embodiment, a first leg 22 protrudes from the first lateral edge at an angle "A" relative to the front surface 16. See Figures 3 and 4. In one embodiment, angle "A" is substantially  $90^\circ$ . As used herein, the term "substantially" means within the common tolerances of the manufacturing processes employed to fabricate the member. As can be seen in Figures 3 and 4, a second leg 24 also protrudes relative to the second lateral edge 14 at an angle "B" from the front surface 16. In one embodiment, angle "B" is substantially  $90^\circ$ .

To accommodate variously shaped utility members, the second lateral edge 14 and corresponding second leg 24 may have a non-linear shape. For example, as shown in Figures 2 and 5, the portion of the second lateral edge 14 and second leg 24

that corresponds to the central portion 20 of the first reinforcement plate 10 is somewhat arcuate. As can be seen in those Figures, the second leg 24 essentially has a central portion 26, and eight segments (27, 28, 29, 30, 31, 32, 33, 34). Such configuration of segments may be formed in the second side and second leg 24 by, for example, conventional steel stamping apparatuses and methods and result in a generally arcuate shape.

In this embodiment, the first joist attachment end 40 is provided with a plurality of attachment holes 42. Likewise, the second joist attachment end 50 has a plurality of joist attachment holes 52 therethrough. Those of ordinary skill in the art will appreciate that fasteners, such as screws, bolts, rivets, etc. may be inserted through the holes and corresponding holes in the web of a joist to attach the reinforcement plate to the joist as will be discussed in further detail below.

Figure 2 illustrates one embodiment of the first reinforcement plate 10 of the present invention. In that embodiment, the first reinforcement plate 10 is fabricated from steel, plastic, composite material, etc. and is approximately 13 inches (33.02cm) long (dimension "C") and has a height of approximately 3.5 inches (8.9cm) (dimension "D"). Also in that embodiment, dimension "E" is approximately 4 inches (10.16cm),

dimension "F" is approximately 2 inches (5.08cm) and dimension "G" is approximately 1 inch (2.54cm). Dimension "H" is approximately 1.5 inches (38.1mm). The first and second legs are each approximately 0.5 inches (12.7mm) long (dimension "I"). With respect to the fastener holes, dimension "J" is approximately 0.250 inches (6.35mm) and dimension "K" is approximately 1.5 inches (38.1mm). Letter "L" represents a two inch (50.88mm) radius and letter "M" represents a one inch (25.4mm) radius.

10 Figure 5 illustrates the attachment of the first reinforcement plate 10 to the web 82 of a metal joist 80. For example, the installer may cut an opening 84 of desired size and shape in the web 82, with for example, a plasma cutter or saw. Those of ordinary skill in the art will recognize that 15 the opening 84 must be appropriately sized and shaped so as to not compromise the structural integrity of the joist 80 when under load. It can compromise strength if it is fixed afterward. For example, for a 12 inch joist 80 fabricated, the opening 84 may be rectangular in shape and be approximately 4 20 inches (10.16 cm) long (dimension "O") and 8 inches wide (dimension "P") and have a bottom end portion 85 and a top end portion 87. However, if reinforced "O" may be increased to, for example, 8 inches. After the opening 84 has been formed through the web of the joist 80, the reinforcement plate 10 is

oriented as shown in Figure 5. It will be appreciated that the length of the reinforcement plate 10 (dimension "C") is greater than the length of the opening 84 (dimension "O") such that the reinforcement plate 10 spans across the top end portion 85 (or 5 bottom end portion 87) of the opening 84. If the reinforcement plate 10 is to be attached to the web 82 by mechanical fasteners 88 (i.e., screws, bolts, rivets, etc.), the user may employ the reinforcement plate 10 as a template to drill holes through the web 82 that correspond to the fastener holes (42, 10 52) in the reinforcement plate 10. Thereafter, fasteners 88 are installed in the aligned fastener holes to affix the reinforcement plate 10 to the web 82. Those of ordinary skill in the art will appreciate that depending upon the particular application, it is conceivable that the reinforcement plate 10 15 may be welded or glued to the web 82 in addition to or in place of the fasteners 88.

In another embodiment of the present invention, a second reinforcement plate 110 may be employed. The second reinforcement plate 110 may be substantially identical to the 20 first reinforcement plate 10 and have a primary edge 112 and a secondary edge 114. The second reinforcement plate 110 may be fabricated from suitable metal material such as galvanized steel, stainless steel, etc. and have a planar front surface 116 and a planar rear surface 118. In addition, the second

reinforcement plate 110 also has a central section generally designated as 120 and two second joist attachment ends, generally designated as 140 and 150.

Also in this embodiment, a primary leg 122 protrudes from the primary lateral edge 112 at an angle "A'" from the front surface 116. In one embodiment, angle "A'" is substantially 90°. As can be seen in Figures 7 and 8, a secondary leg 124 also protrudes from the secondary lateral edge 114 at an angle "B'" from the front surface 116. In one embodiment, angle "B'" is substantially 90°.

To accommodate variously shaped utility members, the secondary edge 114 and corresponding secondary leg 124 may have a non-linear shape. For example, as shown in Figures 5 and 6, the portion of the secondary leg 124 that corresponds to the central portion 120 of the second reinforcement plate 110 is somewhat arcuate. As can be seen in those Figures, the secondary leg essentially has a central portion 126, and eight segments (127, 128, 129, 130, 131, 132, 133, 134). Such configuration of segments may be formed in the secondary leg 124 by conventional metal stamping apparatuses and methods and results in a generally arcuate shape.

In this embodiment, each of the second joist attachment ends (140, 150) is provided with a plurality of attachment holes (142, 152), respectively. Those of ordinary skill in the

art will appreciate that fasteners 88, such as screws, bolts, rivets, etc. may be inserted through the holes and corresponding holes in the web 82 of a joist 80 to attach the second reinforcement plate 110 to the joist in the same manner as was discussed above with respect to attachment of the first reinforcement plate 10 to the joist web 82.

If desired, a utility member 190 having a shape that corresponds to the shape of the opening 84 as modified by the reinforcement plates may be inserted through the opening.

Those of ordinary skill in the art will appreciate that the second and secondary legs (24, 124) of the reinforcement plates (10, 110), respectively may be so shaped to correspond to the shape of the outer perimeter of the utility member 190 when the utility member 190 is inserted through the opening 84. See Figure 9.

From the above discussion, it is apparent that the present many of the problems encountered when constructing floor systems. For example, various embodiments of the present invention permit the installer to reinforce a hole in a joist or other support member after a utility member has already been installed such that it passes through the hole. This was not possible in the past when using one piece reinforcing members that required the utility member to be passed through an opening in the reinforcing member during installation. Those

of ordinary skill in the art will, of course, appreciate that various changes in the details, materials and arrangement of parts which have been herein described and illustrated in order to explain the nature of the invention may be made by the  
5 skilled artisan within the principle and scope of the invention as expressed in the appended claims.

What is claimed is:

1. Apparatus for reinforcing a portion of a metal joist adjacent an opening extending through a portion of the metal joist, said apparatus comprising a first reinforcement plate having a first lateral edge and a second lateral edge, said first reinforcement plate having a pair of joist attachment ends and wherein said second lateral edge has a non-linear profile between said pair of joist attachment ends.

2. The apparatus of claim 1 further comprising:  
a first leg protruding from said lateral edge side; and  
a second leg protruding from said second lateral edge.

3. The apparatus of claim 2 wherein said first reinforcement plate has a front surface and a rear surface and wherein said first leg protrudes from said first lateral edge at a first angle relative to said front surface and wherein said second leg protrudes from said second lateral edge at a second angle relative to said front surface.

4. The apparatus of claim 3 wherein said first and second angles are each substantially ninety degrees.



5. The apparatus of claim 1 wherein each said joist attachment portion has at least one fastener hole therethrough.

6. The apparatus of claim 1 wherein said non-linear profile comprises an arcuate shape.

7. The apparatus of claim 1 further comprising a second reinforcement plate having a primary edge and a secondary edge, said second reinforcement plate having a pair of second joist attachment ends and wherein said secondary edge has a second non-linear profile between said pair of second joist attachment ends.

8. The apparatus of claim 7 further comprising:  
a primary leg protruding from said primary edge; and  
a secondary leg protruding from said secondary edge.

9. The apparatus of claim 8 wherein said second reinforcement plate has a front surface and a rear surface and wherein said primary leg protrudes from said primary edge at a primary angle relative to said front surface and wherein said secondary leg protrudes from said secondary edge at a secondary angle relative to said first side.

10. The apparatus of claim 9 wherein said primary and secondary angles are each substantially ninety degrees.

11. The apparatus of claim 7 wherein each said second joist attachment portion has at least one fastener hole therethrough.

12. The apparatus of claim 1 wherein said second non-linear profile comprises an arcuate shape.

13. Apparatus for reinforcing a portion of a metal joist adjacent an opening extending through a portion of the metal joist, said apparatus comprising:

a first C-shaped reinforcement plate having a front surface and a rear surface and a first leg protruding from said front surface and a second leg protruding from said front surface, said second leg having an arcuately shaped portion therein; and

a second C-shaped reinforcement plate having a front surface and a rear surface and a primary leg protruding from said front surface and a secondary leg protruding from said front surface, said secondary leg having an arcuately shaped portion therein.

14. A method of supporting a utility member having an outer perimeter through an opening in a support member, comprising:

forming an opening through the web of sufficient size and shape to permit the utility member to extend therethrough, the opening having an upper end and a lower end;

preforming a first profile in a first lateral edge of a first reinforcement member which corresponds in shape to a portion of the perimeter of the utility member;

attaching the first reinforcement member such that the portion of the first lateral edge having a first profile therein is oriented adjacent the bottom end portion of the opening;

preforming a second profile in a second lateral edge of a second reinforcement member which corresponds in shape to another portion of the perimeter of the utility member;

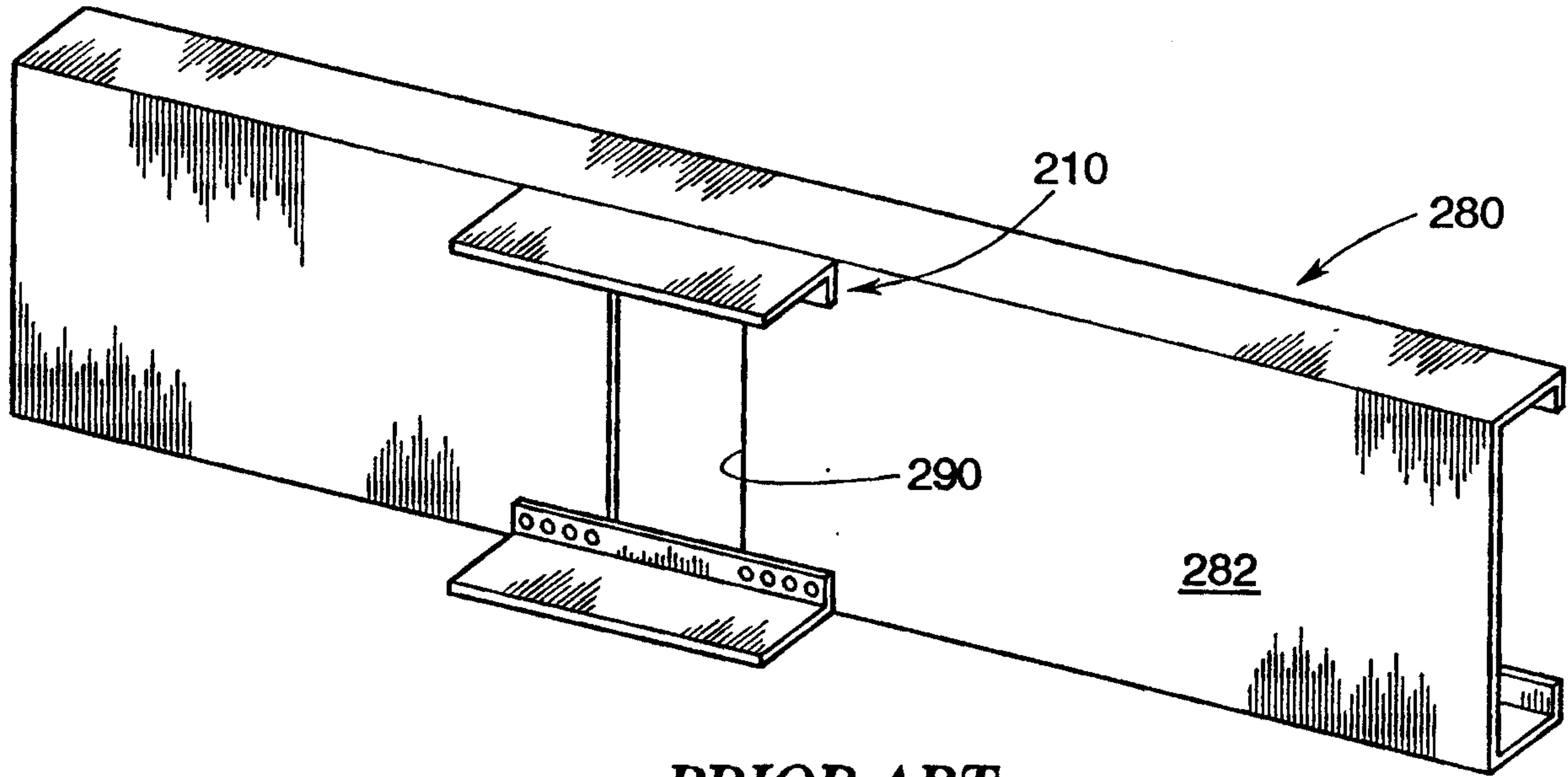
attaching the second reinforcement member such that the portion of the second lateral edge of the second reinforcement member is oriented adjacent the top end portion of the opening;  
and

inserting the utility member into the opening such that a portion of the utility member is received between the first and second reinforcement members.

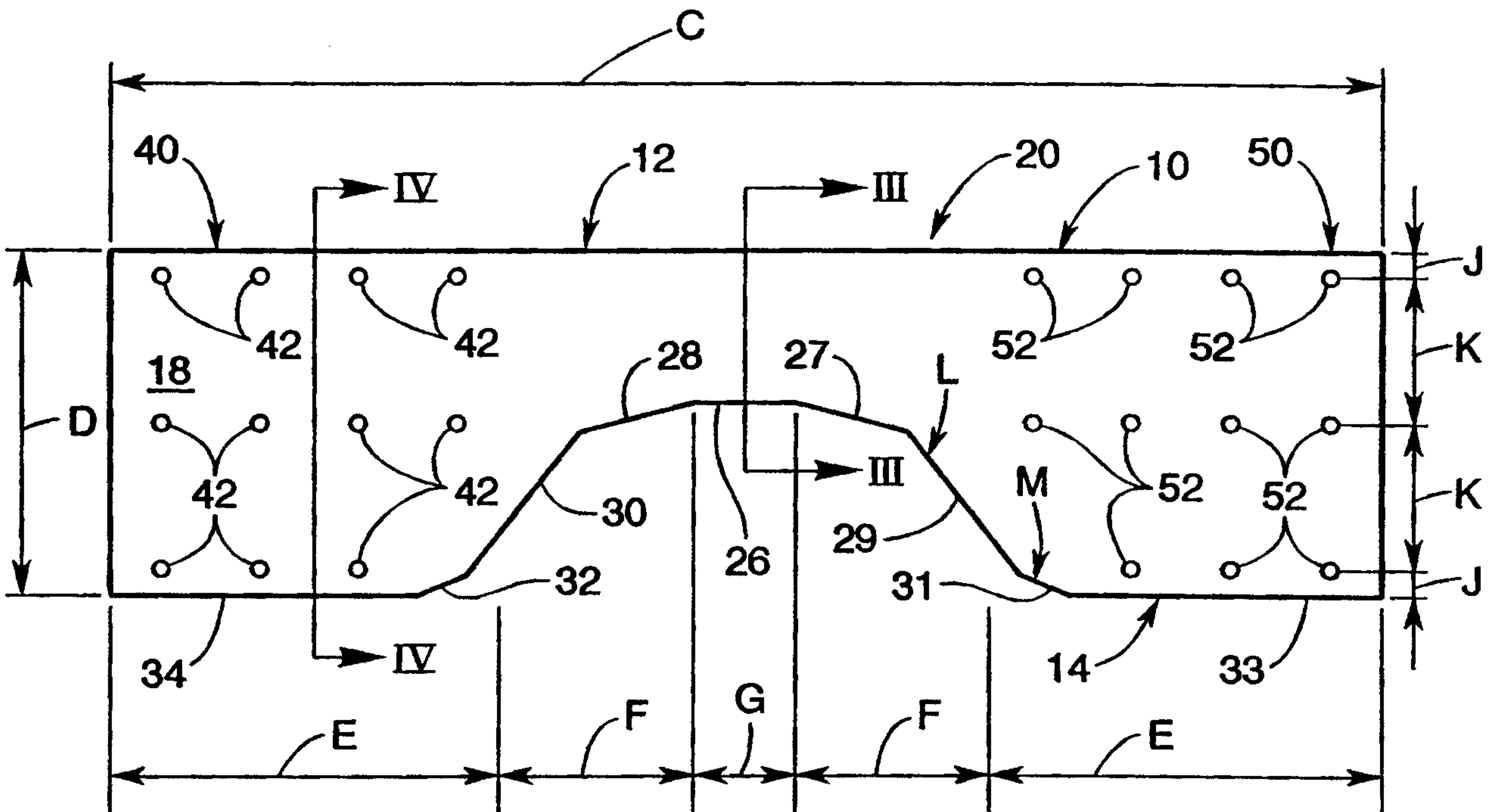
15. A method of reinforcing an opening in a support member through which a utility member having an outer perimeter protrudes, the method comprising:

attaching a first reinforcement member having a first edge portion which corresponds in shape to a portion of the perimeter of the utility member to the support member such that the first edge portion is oriented adjacent the portion of the perimeter of the utility member; and

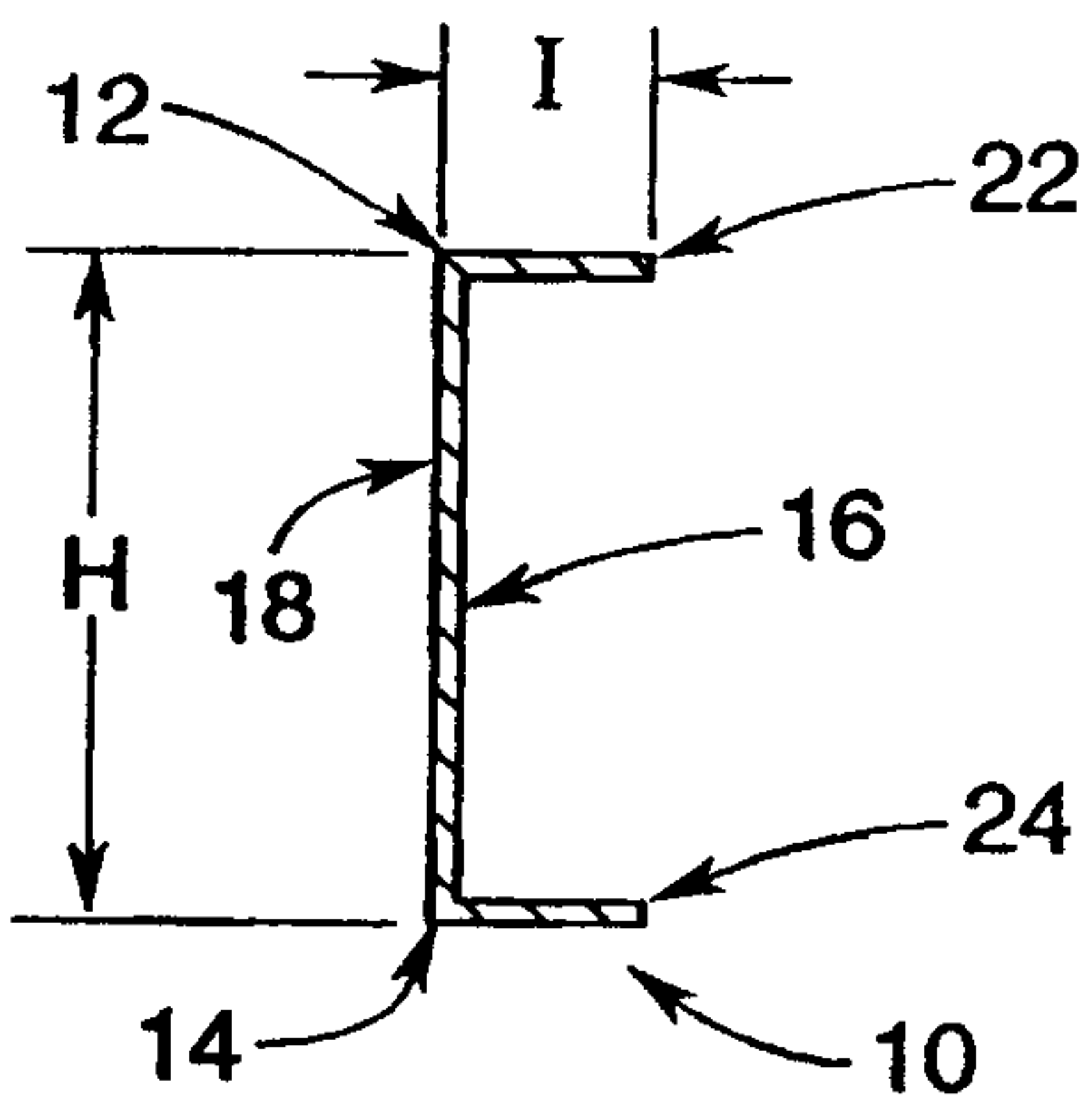
attaching a second reinforcement member having a second edge portion corresponding in shape to another portion of the perimeter of the utility member to the support member such the second edge of the second reinforcement member is oriented adjacent the another portion of the perimeter of the utility member.



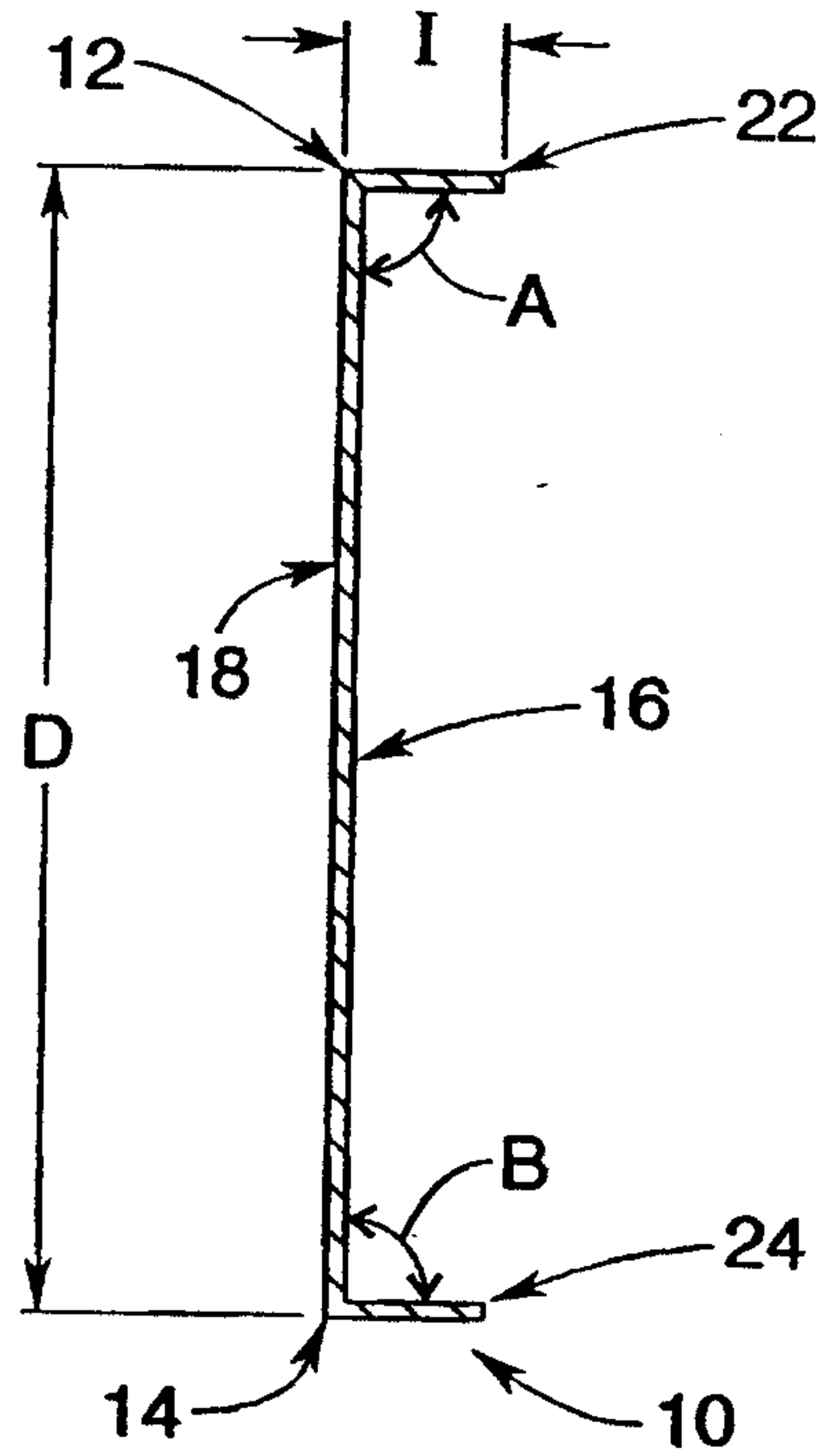
PRIOR ART  
*Fig. 1*



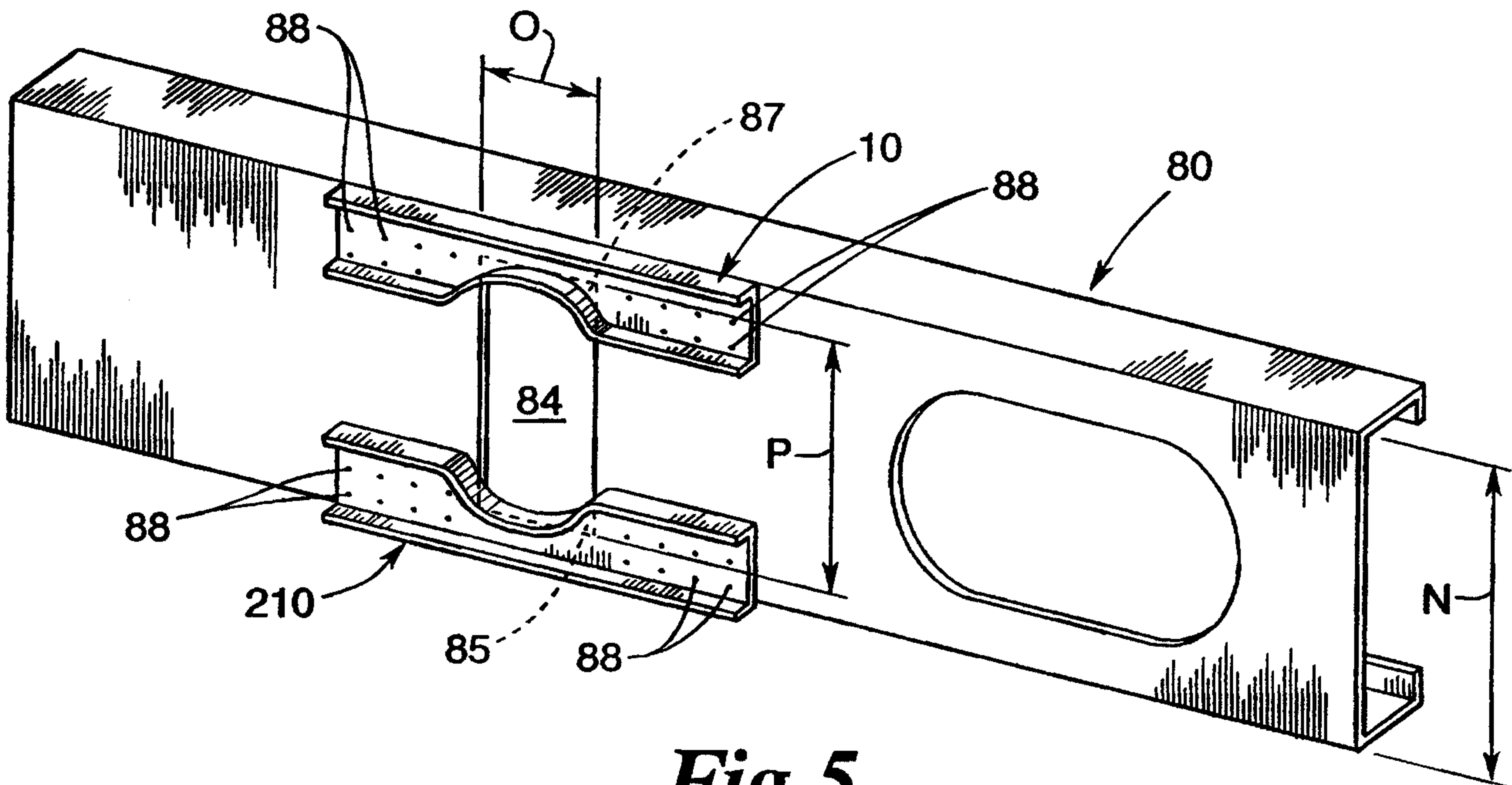
*Fig. 2*



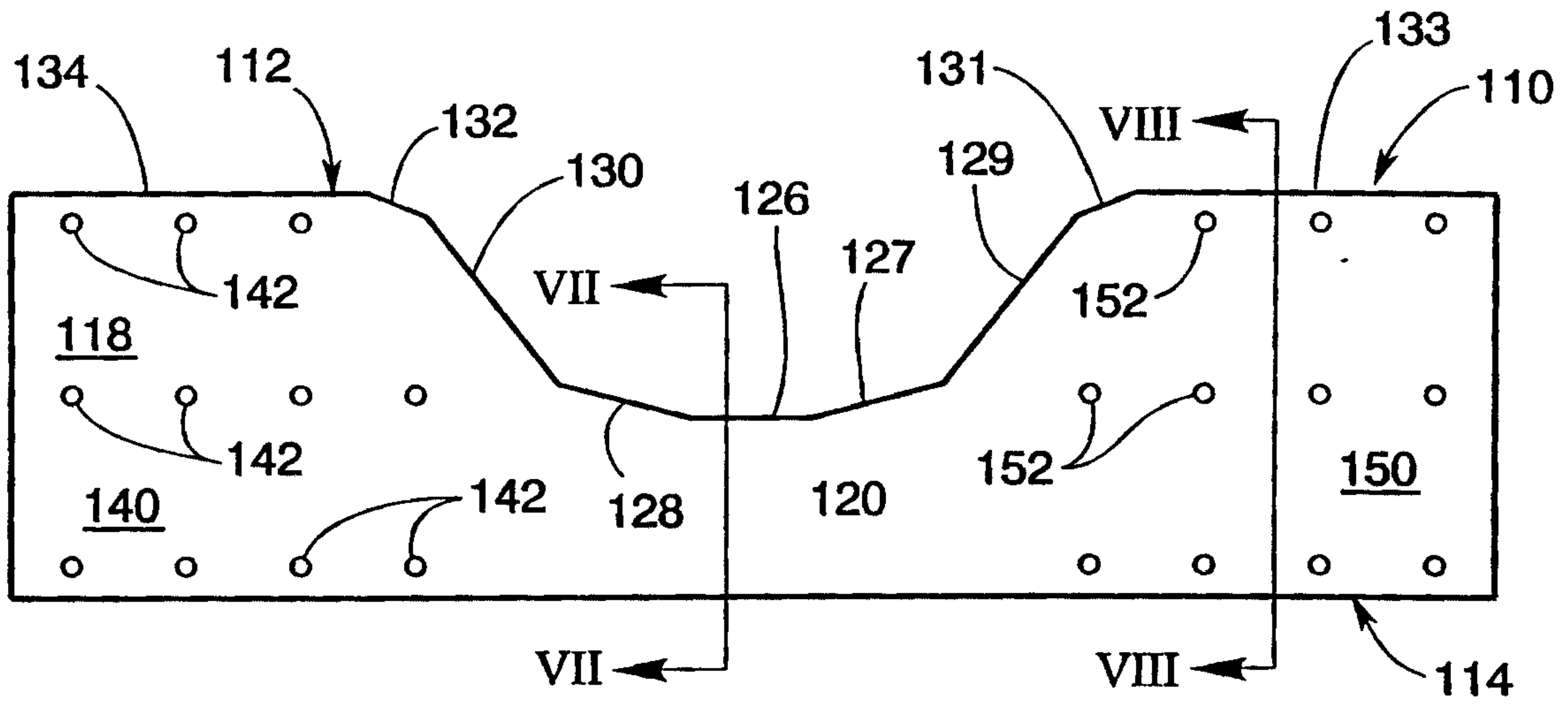
*Fig. 3*



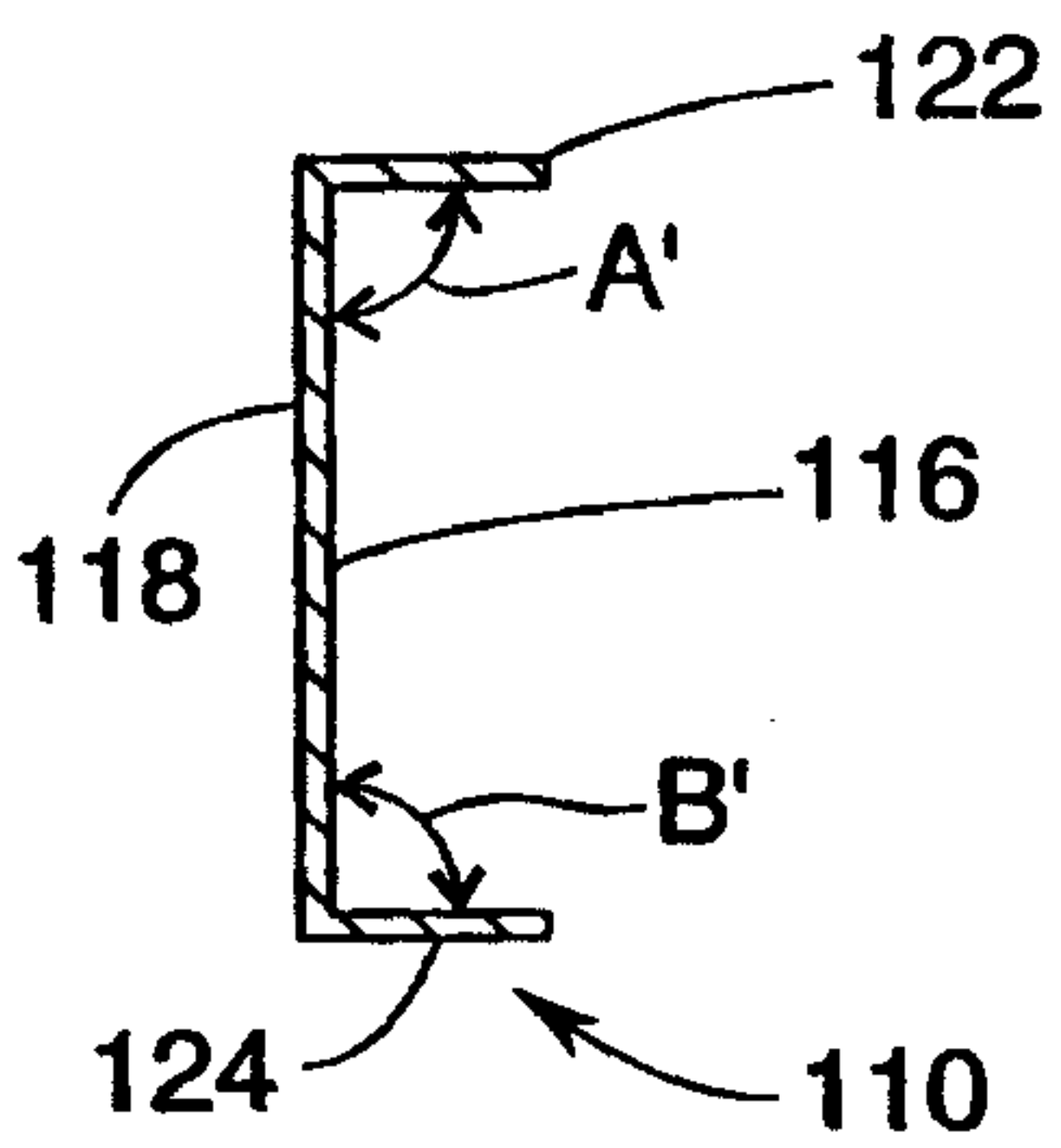
*Fig. 4*



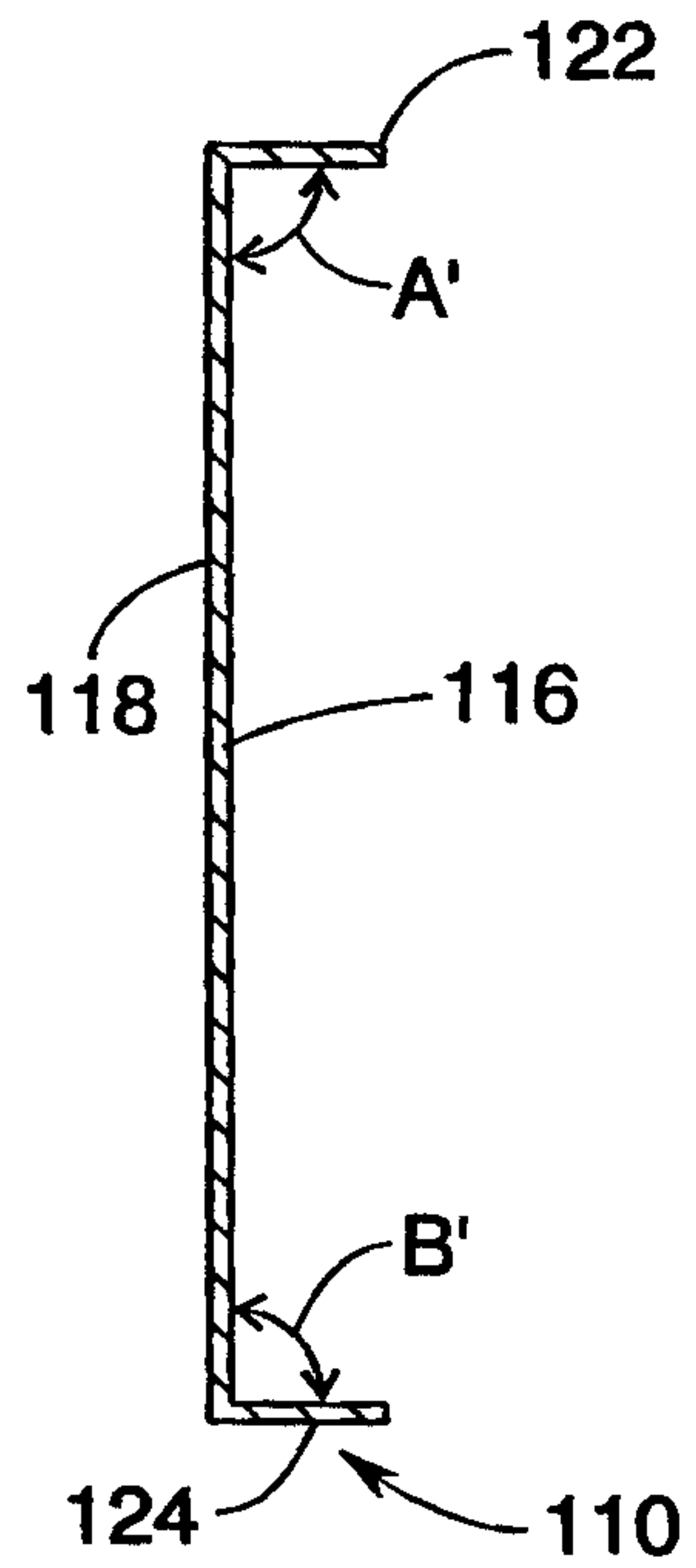
*Fig. 5*



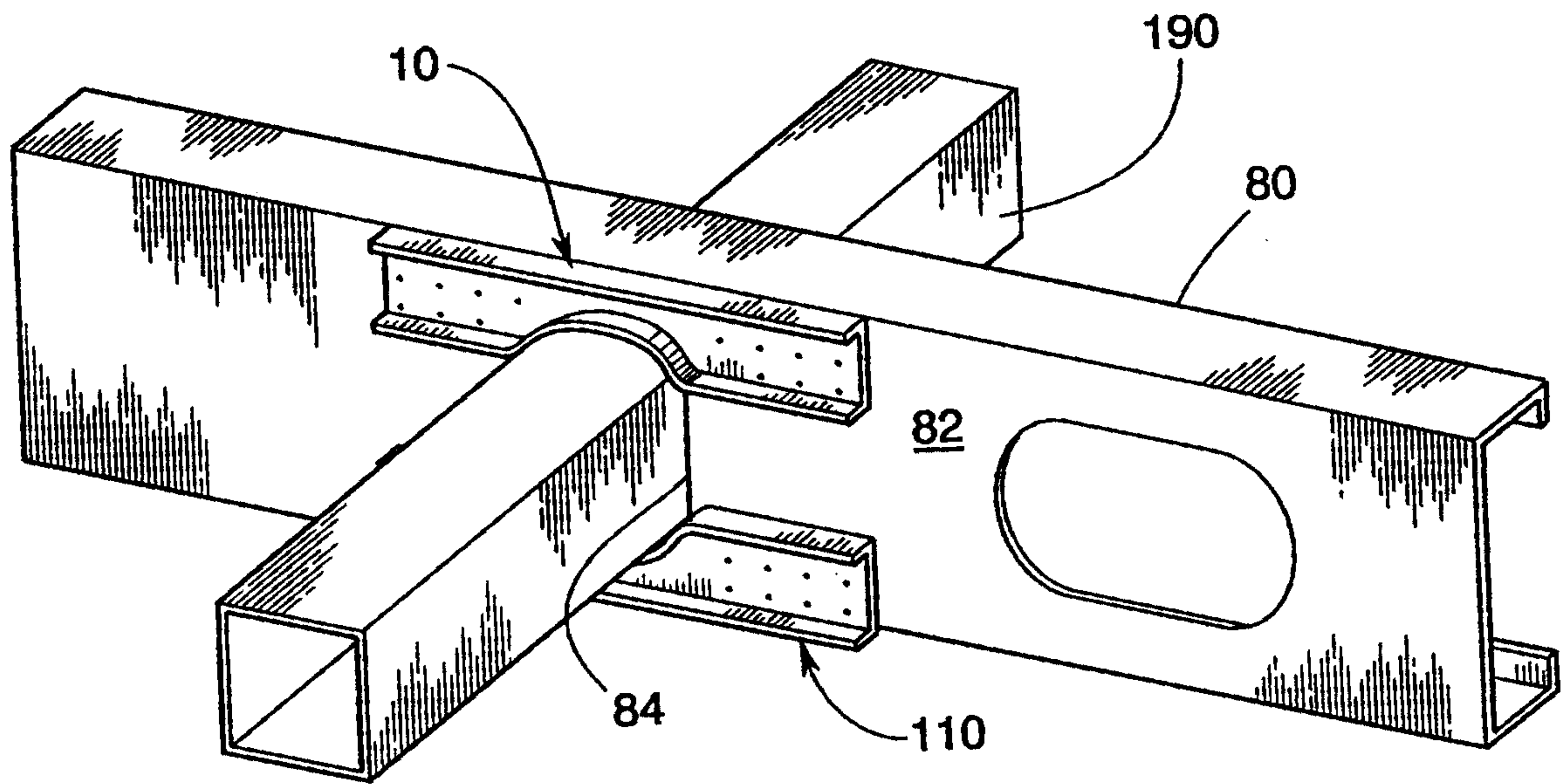
*Fig. 6*



*Fig. 7*



*Fig. 8*



*Fig. 9*



