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Tsurumi

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[54] CYLINDRICAL STRUCTURE

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[30] **Foreign Application Priority Data**

July 31, 1970 Japan 45/67627

[52] **U.S. Cl.** ..... **52/245,** 52/247, 52/726, 52/729, 287/189.36 B

[51] **Int. Cl.** **E04c 3/06,** E04c 3/32

[58] **Field of Search** ..... 52/245, 247, 575, 52/726, 729; 287/189.36 R, 2, 189.36 B; 138/155, 159; 61/53

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Primary Examiner—Frank L. Abbott
Assistant Examiner—Leslie A. Braun
Attorney—Dawson, Tilton, Fallon & Lungmus

[57] **ABSTRACT**

Structural components are provided which are particularly suitable for assembling cylindrical structures such as chimneys. The components include an elongated beam having a generally H-shaped transverse cross section and a relatively short joint which also has a generally H-shaped transverse cross section. The beam includes longitudinally extending generally parallel flanges which are joined by a web portion, and each end of each flange is provided with longitudinal slots adjacent each side. The web may also be provided with a longitudinally extending slot at each end. The joint also includes spaced apart generally parallel flanges joined by a web portion. The structure is assembled by arranging a row of beams side by side and inserting the joints so that flanges thereof extend generally perpendicularly to the flanges of the beams and are received in the slots thereof. The joints may be secured to the beams, and thereafter another row of beams can be arranged end to end with the first row and joined thereto by the joints.

7 Claims, 10 Drawing Figures

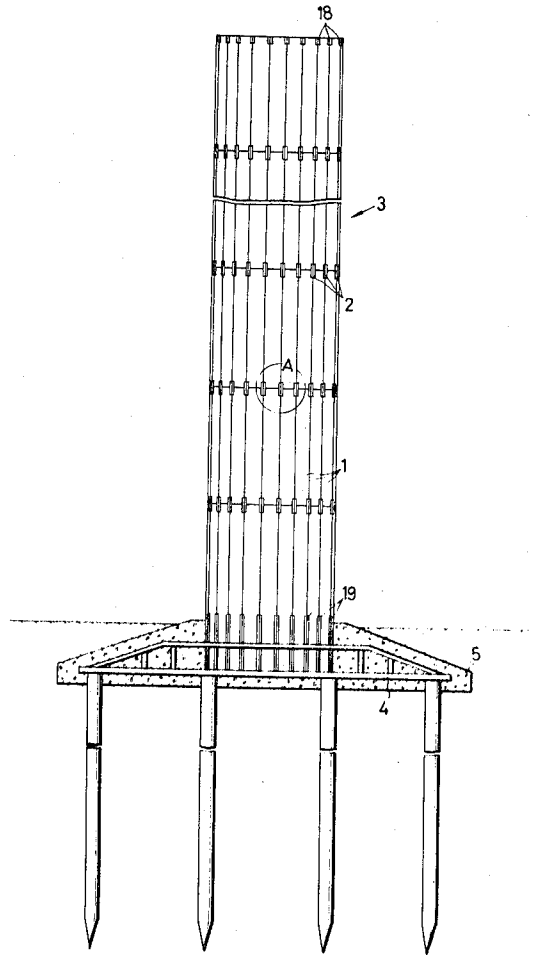

FIG. 1

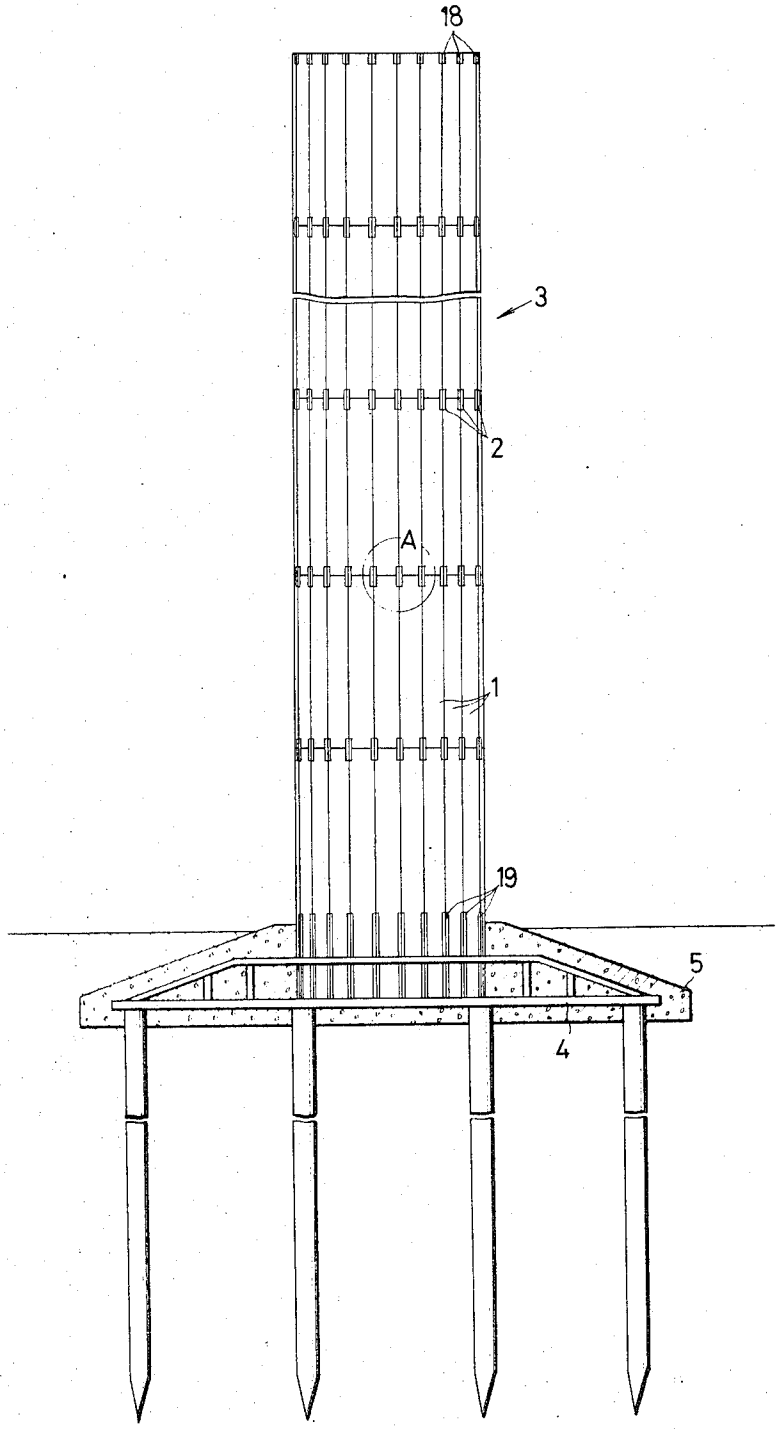

FIG. 2

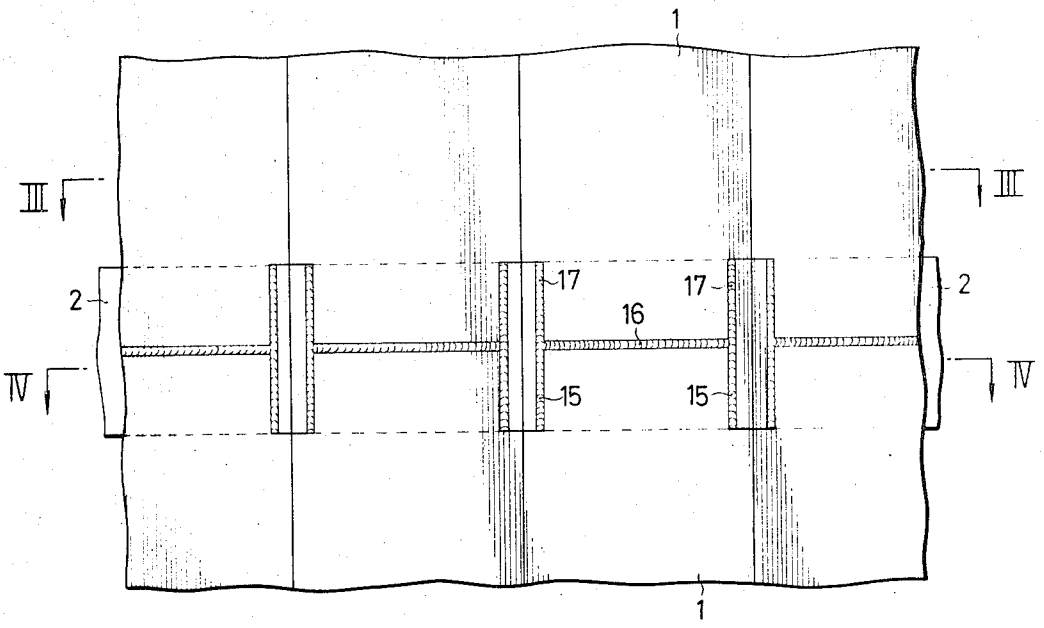

FIG. 3

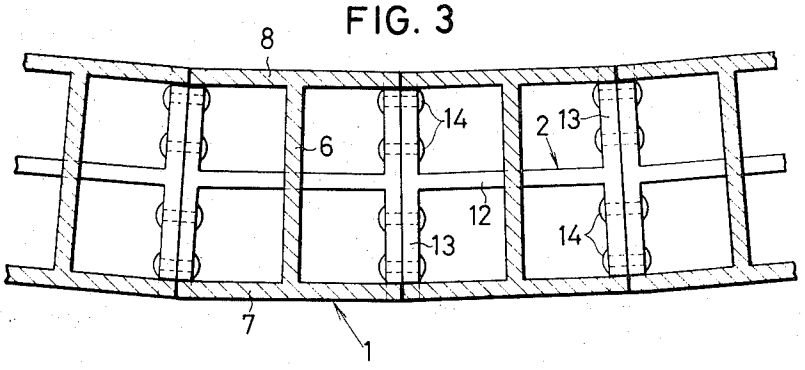

FIG. 4

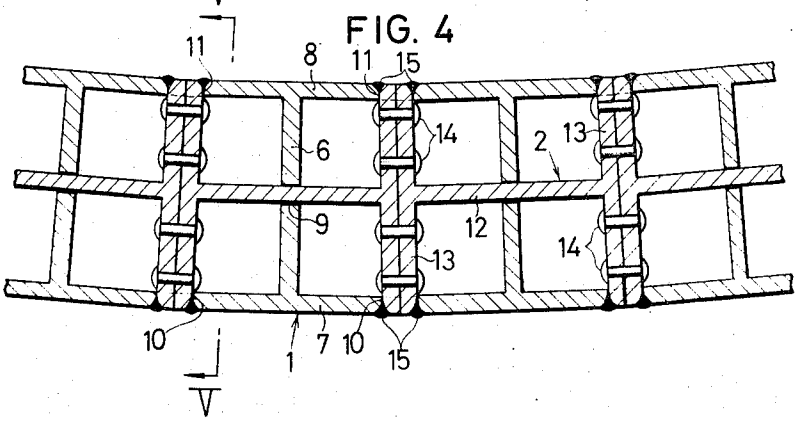

FIG. 5

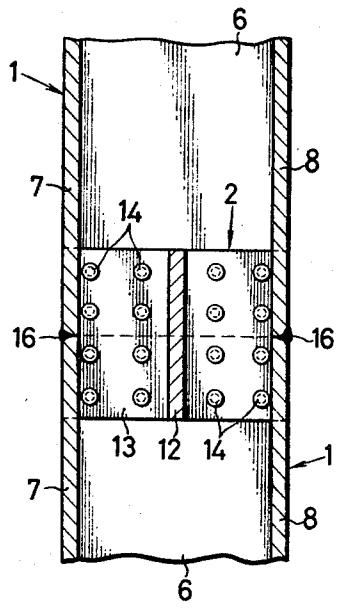

FIG. 7

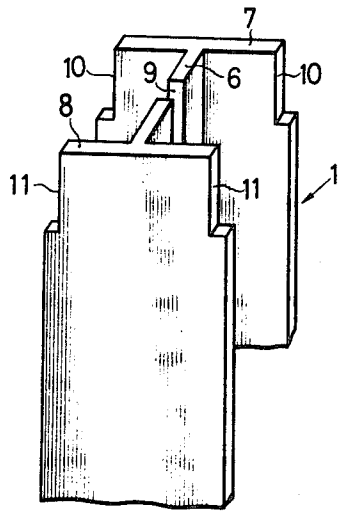

FIG. 6

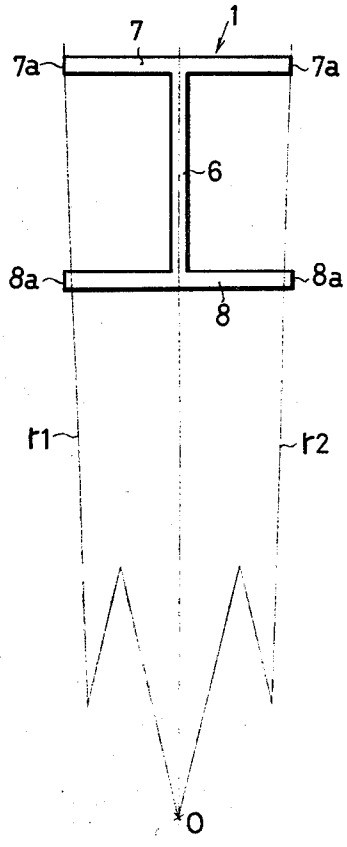

FIG. 8

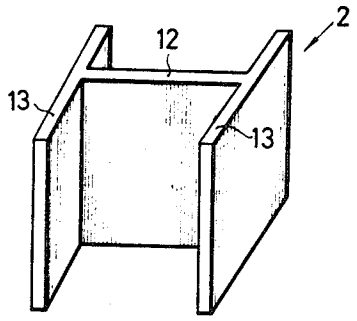

FIG. 9

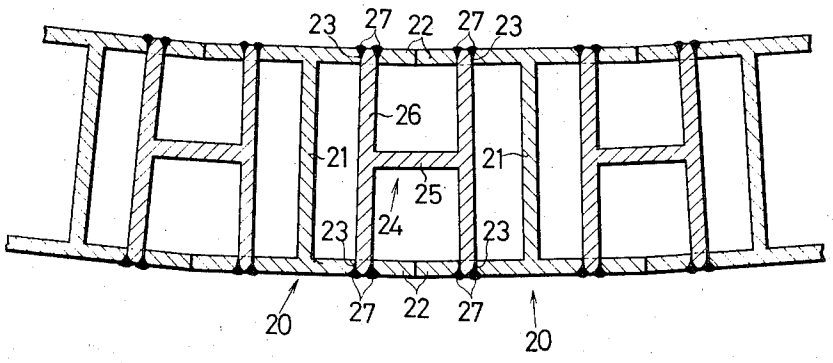
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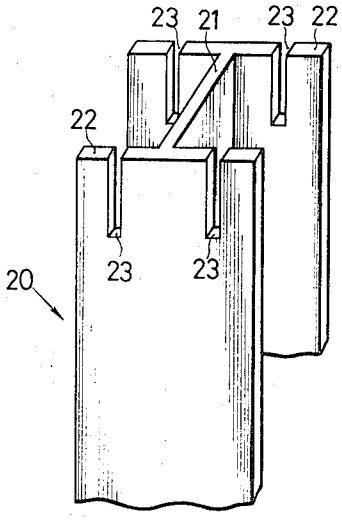
FIG. 10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CYLINDRICAL STRUCTURE

BACKGROUND AND SUMMARY

The present invention relates to a cylindrical structure.

As the pollution problem is getting worse in recent years, chimneys as smoke diffusing means become ever taller and there arises a need to construct a superhigh chimney measuring 300 to 450 m in height. More particularly, the present invention relates to a cylindrical structure to be used as such superhigh chimney.

Conventionally, thick plates of a predetermined area were bent into a cylindrical form to obtain cylinder units, which were then laid one upon another and welded together to construct a chimney of a desired height. However, such method had a possibility of inconformity between cross sections of the cylinder units to be joined together as well as a liability to a defect attributable to welding operation. Moreover, in view of the strength of the structure constructed by the conventional method, the height of the chimney was limited to about 120 m. A chimney exceeding this limit was therefore externally supported by an iron tower, the arrangement being such that horizontal force was supported by the iron tower so as to enable the chimney to withstand only the weight thereof, but even in such case, the height of the chimney was limited to about 150 m for structural reasons.

An object of this invention is to overcome difficulties in the structure of chimneys as well as problems encountered in constructing tall chimneys.

The cylindrical structure in accordance with this invention comprises H-shaped steel members arranged in a polygonal form and joints of H-shaped cross section interconnecting the H-shaped steel members in horizontal direction and joining the same together also in vertical direction, each of the H-shaped steel members having an inner flange smaller than an outer flange thereof in width and formed at each end thereof with cutouts having a depth of at least half the length of the joint, the flanges of adjacent H-shaped steel members being in butting contact with each other, the joints being fitted into upper and lower H-shaped steel members with the cross sectional planes of the flanges intersecting the upper and lower steel members.

In the case of the cylindrical structure of this invention, each of the H-shaped steel members constituting the wall sustains those positioned thereon with respect to the weight acting as vertical force and, as for a horizontal force, each of the H-shaped steel members absorbs the resulting stress when the steel member flexes. Since the junction of the H-shaped steel members where they are joined in longitudinal direction includes the joint which is positioned in a different direction from the H-shaped steel members but is substantially identical therewith in section, the junction has a very high strength and good resistance to stress such as torsion. The butting contact between the end faces of the H-shaped steel members gives an excellent bond whereby load will be directly transmitted.

In addition, the cylindrical structure which comprises a mere combination of the H-shaped steel members and joints is extremely easy to construct, saves labor and can be completed in a remarkably shortened period of time.

It has become possible to construct a superhigh chimney because the joints connecting the H-shaped steel members reinforce the junction and serve to distribute the external forces to which some steel members are subjected to the other steel members.

The present invention will be described in greater detail with reference to the accompanying drawings.

DESCRIPTION OF THE DRAWING

FIG. 1 is a front view showing a structure in accordance with invention which serves as a chimney;

FIG. 2 is a front view on an enlarged scale showing portion A of FIG. 1;

FIG. 3 is a sectional view taken along the line III—III in FIG. 2;

FIG. 4 is a sectional view taken along the line IV — IV in FIG. 2;

FIG. 5 is a sectional view taken along the line V — V in FIG. 4;

FIG. 6 is a plan view showing an H-shaped steel member to illustrate how the opposite side edges are to be cut off;

FIG. 7 is an enlarged perspective view showing the end to be joined of the H-shaped steel member;

FIG. 8 is an enlarged perspective view of a joint;

FIG. 9 is a sectional view corresponding to FIG. 4 and showing another embodiment of this invention; and

FIG. 10 is an enlarged perspective view showing the end to be joined of the H-shaped steel member in FIG. 4.

DESCRIPTION OF SPECIFIC EMBODIMENTS

Although the embodiments below relate to chimneys, the cylindrical structure in accordance with this invention is not limited only to chimneys but is applicable for other purposes.

Referring to embodiments, the present invention will be described below. FIG. 1 shows a chimney 1 including H-shaped steel members 1 arranged in a polygonal shape and joints 2 H-shaped in cross section and joining the H-shaped steel members 1 in vertical direction, the joints 2 being interconnected in an annular form. The lower portion of the chimney 3 is secured to a base 5 provided with anchor frame 4.

The H-shaped steel member 1 includes a web 6 and flanges 7 and 8 and, for application as an constituent element of chimney, the steel member is so dimensioned by cutting off that the inner flange 8 is smaller than the outer flange 7 in width. The amount to be removed by cutting off depends on the diameter of chimney 3 to be constructed. FIG. 6 show the portions 8*a* to be cut off for removal which are positioned outside the lines r_1 and r_2 extending from the center 0 of the chimney 3 to the outer corners of opposite edges of outer flange 7 of the H-shaped steel member 1 to be used as the wall material of the chimney. Where the diameter of the chimney 3 is small, portions 7*a* of the outer flange 7 outside the lines r_1 and r_2 are also removed by cutting off. It will be seen in FIG. 7 that the H-shaped steel member 1 thus machined is then formed, at each of its opposite ends, with a cutout 9 in the web 6 at the center of width thereof, with cutouts 10 and 11 formed in the opposite edges of the flanges 7 and 8 in facing relationship, each of the cutouts 10 and 11 being exposed at one side thereof.

As illustrated in FIG. 8, the joint 2 for connecting the H-shaped steel members in longitudinal direction is H-shaped in cross section and includes flanges 13 with a

web 12 interposed therebetween. Both flanges 13 are brought closer toward each other inwardly so as to be in conformity with the lines r_1 and r_2 shown in FIG. 6. The depth of the cutouts 9, 10 and 11 in the H-shaped steel member is half the length of the joint 2 or greater.

In order to assemble the H-shaped steel member 1 and the joint 2 together, the lower half of the joint 2 is fitted concentrically to the end of the H-shaped steel member to be joined therewith by utilizing the cutouts 9, 10, 11 therein, with the web of the joint 2 at a right angle with that of the H-shaped steel member. At this time, the joints 2 are joined together in an annular form by means of rivets 14 as shown in FIGS. 4 and 5. In place of rivets 14, high tension bolts may of course be used, or connection may be achieved by welding. Then the joints are secured by bolts, it will be understood that the flanges thereof will be provided with both openings (not shown in FIG. 8). Thus, the H-shaped steel members 1 are joined with the joints 2 respectively and the steel members are arranged in a polygonal form. As illustrated in FIG. 2, the junctions of the flanges 7 and 8 of H-shaped steel members 1 with the flanges 13 of the joints are welded together, the welds being indicated at 15. In the same manner as with the abovementioned H-shaped steel members, an H-shaped steel member 1 having an end of the same shape as that of the H-shaped steel member 1 already joined with the joint 2 is assembled with the upper half of the joint 2, whereby the webs 6 and flanges 7 and 8 of the upper and lower H-shaped steel members 1 are brought into butting contact with each other respectively. To insure such butting contact, the depth of the cutouts 9, 10, 11 in both H-shaped steel members 1 may preferably be slightly greater than half the length of the joint 2. The upper H-shaped steel members 1 are also joined with the joints 2 one after another into a polygonal form. The butting portions of the flanges of the upper and lower H-shaped steel members 1 are welded together, and the junctions of the flanges 7 and 8 of the upper H-shaped steel members with the flanges 13 of the joints 2 are also welded, the welds being indicated at 16 and 17.

The upper and lower ends of the chimney 3 are provided with joints 18 and 19 which are respectively connected together into annular form. The joints at the lower end are further connected to the anchor frame 4 extending from the base 5. As apparent from FIG. 1, the joints 18 at the upper end of the chimney 3 may be half the length of the other joints 2, but they may be of the same length as the other joints 2 in the case where a platform or a portion having a smaller diameter is to be mounted at the upper end. The platform or the like is welded to the upper half portions of the joints which are left projected. The joints 19 at the lower end may preferably be longer than the other joints 2, since they are secured to the base 5.

In constructing the chimney 3, assemblage begins at the base 5 and the joints 2 and the H-shaped steel members 1 are joined together alternately, with assembled structure progressively lifted upward by building up for successive joining operation. Alternatively, the joints 2 may be firmly joined together in an annular form beforehand in the factory and the resulting assembly is then fitted into H-shaped members at a construction site, this operation being carried out repeatedly.

In the foregoing assembling operation, the cutouts 9, 10 and 11 in the H-shaped steel member serve as a guide when the web 12 and flanges 13 of the joint 2 are fitted therein, so that assemblage can be conducted smoothly and readily, with joining errors minimized. Moreover, when the joints 2 are very firmly joined together in an annular form, it is possible to eliminate welding between adjacent H-shaped steel members. Since the overall length of the weld will then be reduced a great deal, the construction cost can be reduced.

With the cylindrical structure embodying the present invention, a group of joints 2 having H-shaped cross section and interconnected into an annular form corresponds to a bamboo joint, and accordingly, calculation of buckling of column can be made with ease. For this reason, a very strong structure can be obtained.

FIGS. 9 and 10 illustrate another embodiment of this invention, which embodiment is characterized in that a joint engages both of adjacent H-shaped steel members. In this embodiment, a cutout is not formed in the web 21 of an H-shaped steel member 20, but cutouts 23 are provided in flanges 22 in facing relationship, each cutout 23 being positioned midway between each side edge thereof and the portion from which the web 21 extends. Accordingly, the web 25 of a joint 24 is shorter than the web 12 of the joint 2 of the foregoing embodiment and does not intersect the web 21 of the H-shaped steel member 21. Opposite flanges 26 of the joint 24 are fitted into the cutouts 23 of the adjacent H-shaped steel members 20 and the joint 24 and the steel members 20 are welded together. Indicated at 27 are welds. In accordance with this embodiment, the construction process is simplified the more because there is no need to interconnect the joints 24.

However, in order to obtain a structure of a higher strength, it is possible to form the cutout 23 with a width twice the with of the flange 26 so as to interpose another joint of the similar shape between the joints 24 shown in FIG. 9 and thereby connect all the joints in an annular form.

To sum up, this invention makes it possible to construct a strong chimney in a short period of time and at a low cost.

What I claim as my invention is:

1. A structure comprising a plurality of elongated vertically extending beams and a plurality of vertically extending joints, each beam being generally H-shaped in transverse cross section and including a pair of generally parallel generally planar inner and outer elongated flanges having upper and lower ends and a pair of longitudinally extending sides and a longitudinally extending generally planar web extending between the flanges at their approximate midportions and having upper and lower ends, the outer flange being wider than the inner flange, each end of the flanges being provided with a longitudinally extending cutout adjacent each of the sides thereof, each joint being generally H-shaped in transverse cross section and including a pair of flanges and a web extending between the flanges at their approximate midportions, the flanges extending angularly with respect to each other to form an acute included angle therebetween, the beams being arranged in first and second sets of parallel beams, the beams of the first and second sets being generally aligned end-to-end, the longitudinal sides of the inner and outer flanges of each beam of each set abutting the longitudinal sides of the inner and outer flanges, respectively, of the adjacent beams of the set whereby the

flanges form generally polygonal shapes, a joint being interposed between each beam of one of the sets and the aligned beam of the other set, the flanges of each joint extending between the flanges of the associated beams and being received in the cutouts in the flanges of the associated beams, means securing the flanges of each joint to the flanges of the associated beam and means securing adjacent joints whereby the joints connect adjacent beams of each set and aligned beams of the first and second sets.

2. The combination of claim 1 in which a line extending from one of the sides of the outer flange of each beam to the adjacent side of the inner flange of the beam forms an acute angle with a line extending between the other sides of the outer and inner flanges of the beam, the flanges of the joint defining an acute angle approximately equal to the acute angle defined by said lines.

3. The structure of claim 1 in which the cutouts in the flanges of each beam extend inwardly from the sides thereof, each end of the web of each beam also being provided with a longitudinally extending cutout, the web of each joint extending generally perpendicularly to the web of the associated beam and being received in the cutout thereof, the flanges of adjacent joints being secured.

4. The structure of claim 3 in which each flange of each joint abuts a flange of an adjacent joint and is secured thereto.

5. The structure of claim 1 in which the longitudinal side edges of the beams of each set abut the longitudinal side edges of the adjacent beams of the set.

6. The structure of claim 1 in which the longitudinal side edges of each beam of the first set are aligned with the longitudinal side edges of a beam of the second set.

7. A structure comprising a plurality of elongated vertically extending beams and a plurality of vertically extending joints, each beam being generally H-shaped in transverse cross section and including a pair of generally parallel generally planar inner and outer elongated flanges having upper and lower ends and a pair of longitudinally extending sides and a longitudinally extending generally planar web extending between the flanges at their approximate midportions and having upper and lower ends, the outer flange being wider than the inner flange, each flange of each beam being provided with a longitudinally extending cutout between the juncture of the web of the beam with the flange and each of the longitudinally extending sides, each joint being generally H-shaped in transverse cross section and including a pair of flanges and a web extending between the flanges at their approximate midportions, the flanges extending angularly with respect to each other to form an acute included angle therebetween, the beams being arranged in first and second sets of parallel beams, the beams of the first and second sets being generally aligned end-to-end, the longitudinal sides of the inner and outer flanges of each beam of each set abutting the longitudinal sides of the inner and outer flanges, respectively, of the adjacent beams of the set whereby the flanges form generally polygonal shapes, a joint being interposed between a pair of beams of one of the sets and the aligned pair of beams of the other set, each joint having one flange thereof received in a pair of cutouts in aligned beams and the other flange received in a pair of cutouts in the adjacent aligned beam, each flange of each joint being secured to the associated beams.

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