Oct. 26, 1948. F. L. PLUMMER 2,452,146

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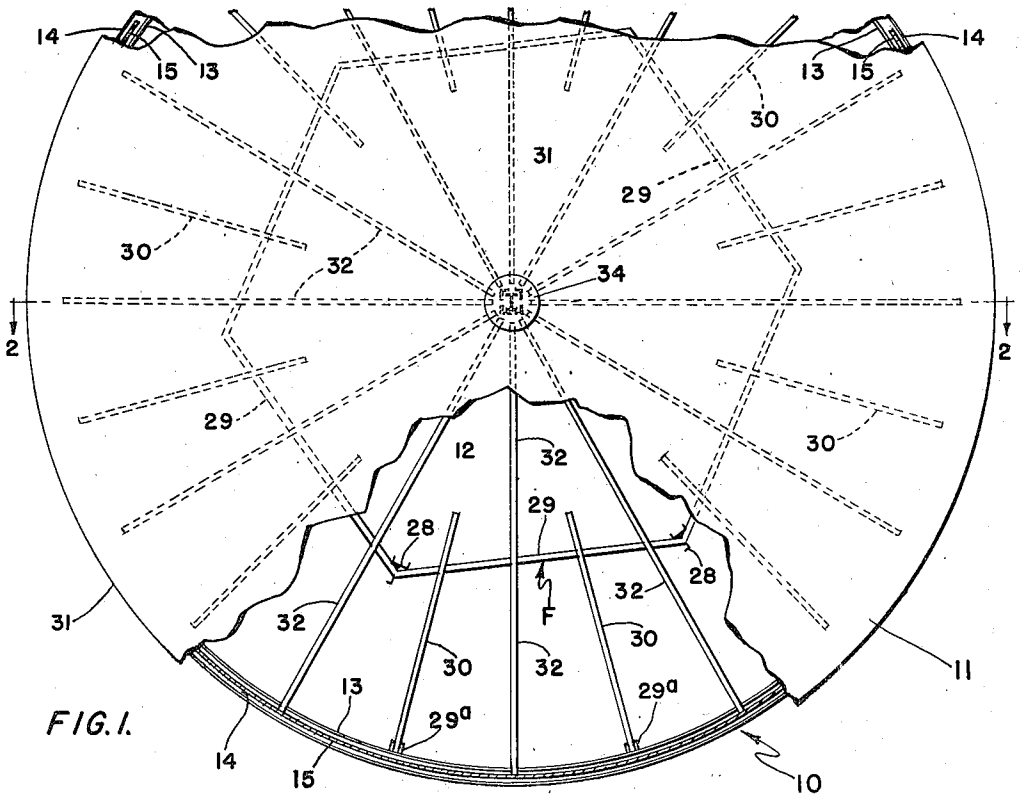


FIG. 1.

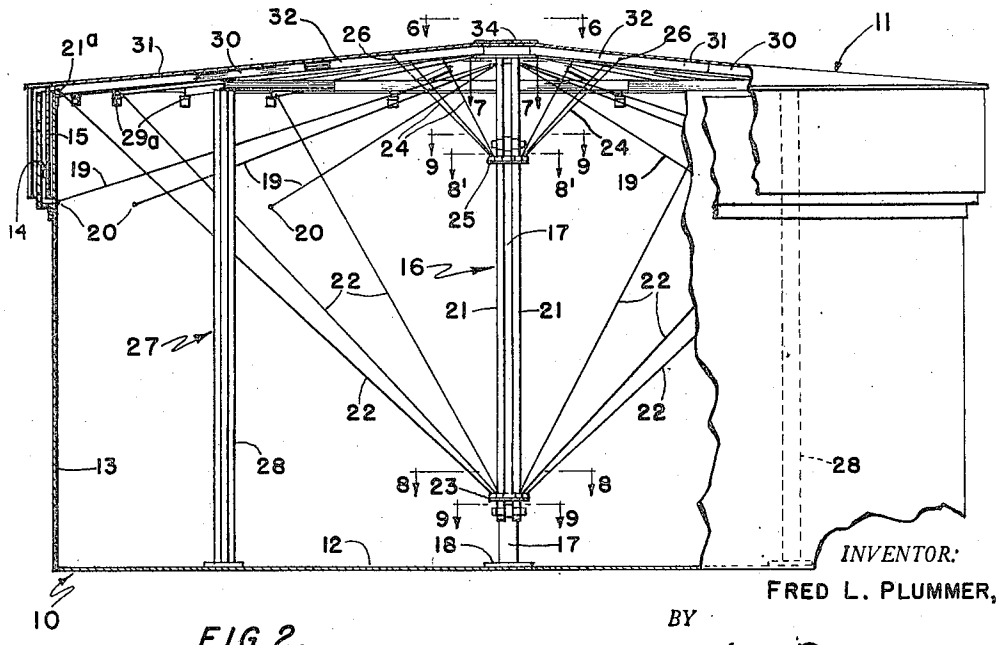


FIG. 2.

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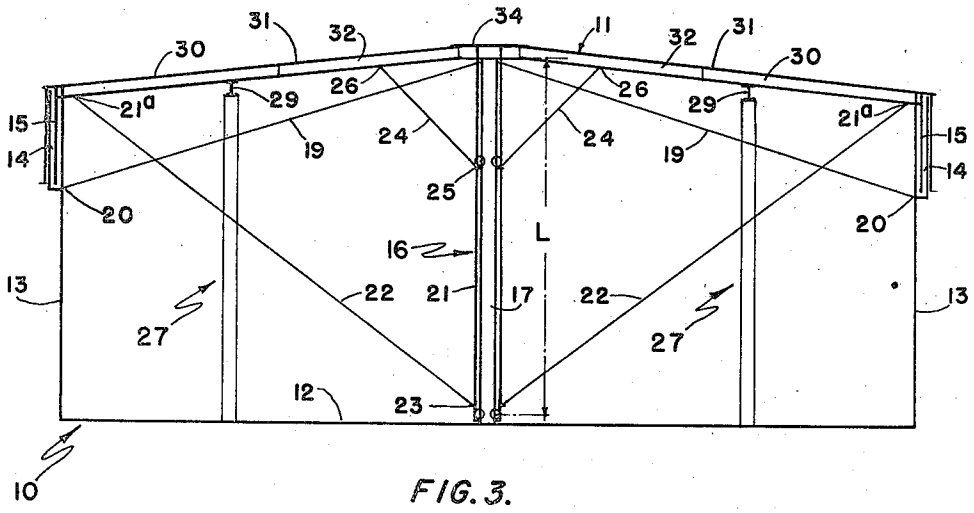


FIG. 3.

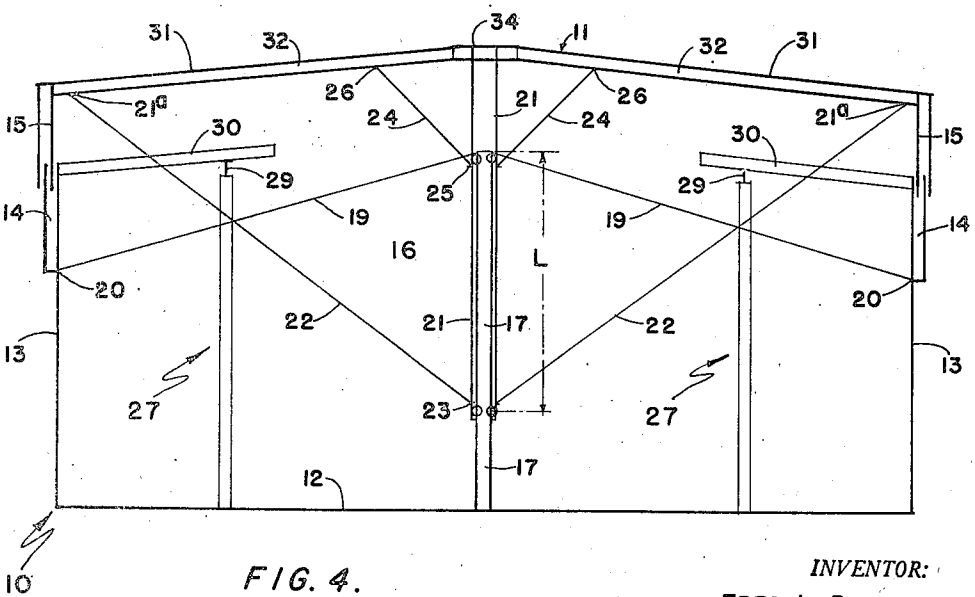


FIG. 4.

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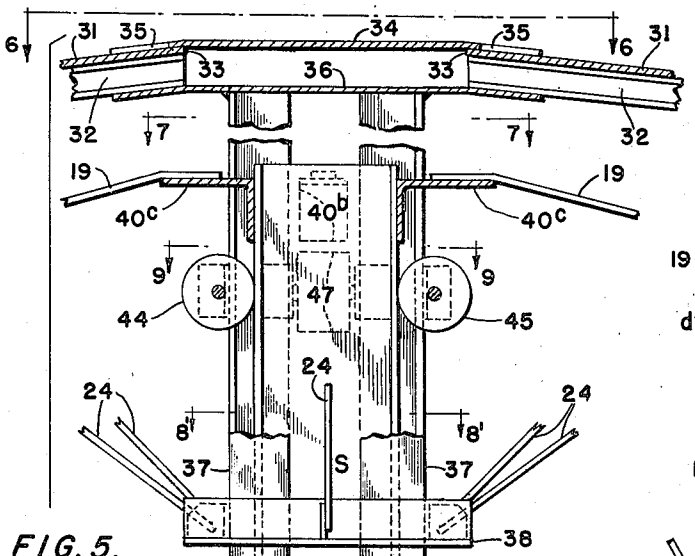
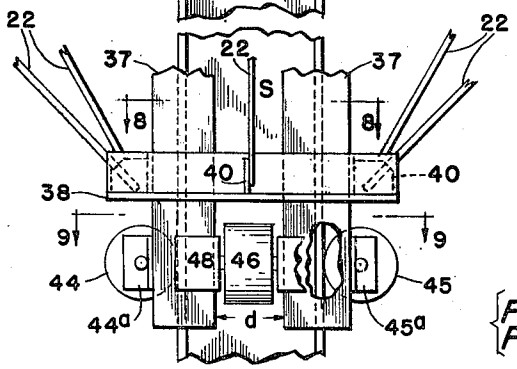


FIG. 5.



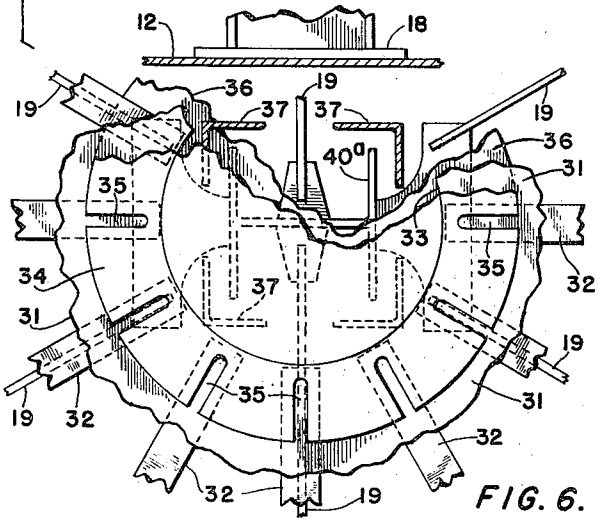
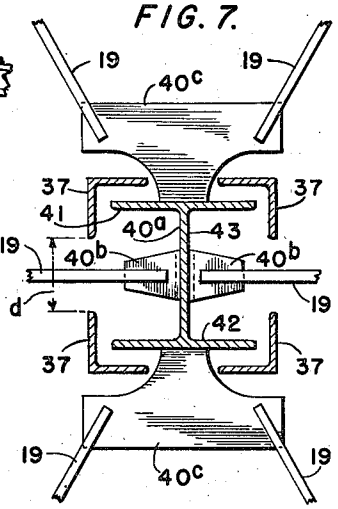


FIG. 6.

FIG. 7.



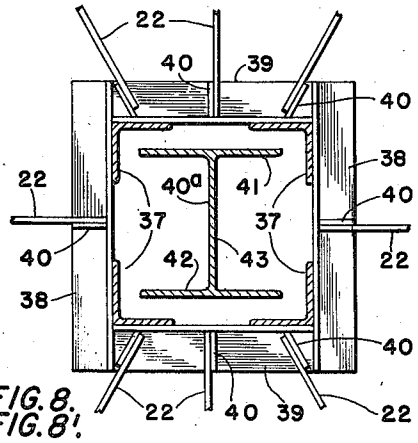


FIG. 8.
FIG. 8'.

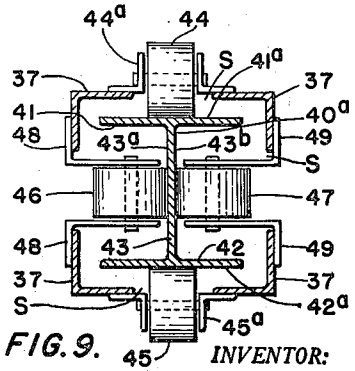


FIG. 9.

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UNITED STATES PATENT OFFICE

2,452,146

TANK TOP

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Application October 5, 1944, Serial No. 557,288

4 Claims. (Cl. 48—176)

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This invention relates to storage tanks for storing gases or volatile liquids which have a vapor space above them, and more particularly to the type of tank having variable gas or vapor space due to a roof or hood construction which is movable upwardly and downwardly with respect to the tank proper while maintaining sealing relationship therewith. More specifically this relates to anti-tilting or vertical guide devices for the cover.

The guide device of this invention is in the nature of telescoping elements which operatively interconnect the center of the tank bottom with the center of the cover. This involves vertical guide elements slideable concentrically relative to one another as distinguished from those devices which tend to prevent the tilting of the cover by way of compensating means or devices which are marginally or circumferentially interposed between the tank and the cover.

In a simple form of the anti-tilting device of this invention the guide elements comprise an upstanding post the lower end of which is at the center of the tank bottom and a sleeve-like member surrounding it unitary with and depending from the center of the movable roof.

As for the scope of this invention, however, the relationship of the parts may be reversed in that in some embodiments an upstanding sleeve might be used with a depending post, in which case the post is the movable element and the sleeve the stationary one. Therefore, the guiding elements of this telescoping device will herein also be defined as the inner or surrounded guide element and the outer or surrounding guide element.

It is among the objects of this invention to provide telescoping guide elements which are light and yet of great structural strength as against bending in relation to the tank and the cover relatively, and which are highly effective in providing a large anti-tilting moment, that is maximum stabilization of the cover relative to the tank even where large tank diameters are involved and hence where relatively large tilting moments may be incurred.

These objects are attained by a structural arrangement in which the anti-tilting moment is absorbed not merely by the post itself and its immediate anchoring or footing, but by the tank structure as a whole; that is the telescoping guide elements according to this invention are associated with a novel system of elements or guy wires whereby the movable as well as the stationary element of the telescoping guide device are effectively braced in relation to the cover and

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to the tank respectively, even though the length of the interengaging portions of the telescoping guide elements is kept at a favorable maximum providing effective guidance.

Features of this invention are concerned with the structural problem of providing an effective anti-tilting moment by way of a long vertical anti-tilting base as represented by the length of the interconnecting portions of the guide elements, and further by providing effective bracing of the engaging guide elements to enable them to absorb the bending or tilting moment with a minimum of mechanical stress.

According to one feature a relatively slender post rises from the bottom of the tank, the upper free end portion of which is braced as by guy wires radiating to the tank wall. A depending sleeve member surrounding the post is unitary with the movable cover and has its free lower end portion braced as by guy wires radiating to the marginal portion of the cover. The surrounded post and the surrounding sleeve element interengage along a major portion of their length so as to provide effective guidance in absorbing the anti-tilting moment of the cover, while the guy wires of the stationary post are allowed to extend through vertical slots in the movable sleeve element, thus allowing the cover to move vertically free from interference with the stationary guy wires.

Other features reside in the structural organization of the telescoping guide elements per se.

According to one feature a guide post provides two pairs of vertical guide faces for anti-friction rollers, the faces of each pair being parallel to one another, and the faces of one pair being at right angles to the faces of the other pair. The guide sleeve element of the movable cover is correspondingly provided with pairs of anti-friction rollers operating upon the vertical guide faces. According to one specific embodiment the post is in the nature of an I-beam set upright in which the opposed or outer faces of the flanges of the profile present one pair of vertical guide faces, while the faces of the web of the profile present the other pair.

Other features reside in details of anti-friction devices effective between the telescoping guide elements.

Other features reside in the structural organization of the telescoping elements per se. According to one specific embodiment the guide sleeve element is represented by a composite structure formed mainly by vertical elements or beam profiles rigidly interconnected to constitute a rigid

cage around a guide post. In this instance the spaces between the vertical members of the cage structure represent the vertical slots for the passage through which the stationary guy wires may extend.

The invention possesses other objects and features of advantage, some of which with the foregoing will be set forth in the following description. In the following description and in the claims, parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar parts as the art will permit. In the accompanying drawings there has been illustrated the best embodiment of the invention known to me, but such embodiment is to be regarded as typical only of many possible embodiments, and the invention is not to be limited thereto.

The novel features considered characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawings in which:

Fig. 1 is a top view upon the tank with the cover partially broken away.

Fig. 2 is a part sectional side view of the tank shown in Fig. 1.

Fig. 3 is a view of the tank similar to that in Fig. 2, however diagrammatic, showing the cover in its lower-most position.

Fig. 4 is a diagrammatic view similar to that in Fig. 3, however showing the cover in an elevated position.

Figs. 5, 6, 7, 8, and 9 show structural details of one embodiment of the guide device.

The tank construction as herein shown (see Figs. 1 and 2) comprises a tank or container 10 proper and a vertically movable roof or cover 11. The tank 10 comprises a bottom portion 12 and an upstanding circular wall portion 13 having an annular trough 14 to hold a sealing liquid in which immerses a skirt portion 15 unitary with and extending downward from the margin of the cover 11. The cover is vertically movable by virtue of this sealing arrangement and is vertically guided by means of a telescoping guide device 16 which is shown to comprise a stationary post 17 unitary with the tank 10 and fastened thereto as at 18 and braced against bending forces by means of guy wires 19 radiating from the top of the post to anchoring points 20 on the tank wall. The post 17 is surrounded by a sleeve-like guide member 21 herein more specifically shown as a cage-like construction which is unitary and movable with the cover 11 and braced against bending moments as by guy wires 22 radiating from an annular element 23 at the lower end portion of the guide member 21 to anchoring points 21a along the margin of the cover 11. Intermediate shorter guy wires 24 radiate from an annular member 25 at an intermediate point of guide member 21 to intermediate anchoring points 26 on the cover 11.

Within the tank 10 is provided an internal bracing frame or structure 27 serving a dual purpose to be presently explained. This frame 27 serves as a stop means for supporting the cover when in its lower limit position. The structure 27 is shown to comprise six posts 28 disposed at the corners of a hexagon and rigidly connected with one another by means of tie beams or members 29 constituting a hexagonal frame F as clearly shown in the plan view of Fig. 1. The hexagonal frame F in turn is braced against the tank wall as by radially disposed beams or tie members 30 two of which connect each beam 29 rigidly with the tank wall as at 29a. In this way the structure 27 not only serves to support the cover 11 in its lower limit position, but also as an internal bracing frame for the tank wall to enable it to absorb without undue stress the tension forces from the guy wires 19 when a tilting moment is imposed upon the cover 11.

Referring more specifically to the structural details of Figs. 5, 6, 7, 8, and 9, the cover 11 comprises plate 31 of shallow conical shape reinforced at the underside by radially extending ribs in the form of I-beams 32 which may be welded to the plate. A hole 33 in the plate 31, that is at the apex of the cone shape, is closed by a round plate or patch 34 on top, and shown to have radial slots 35 to serve as welding spots. A round plate 36 underneath acts as a reinforcement and is welded to the beams 32.

The guide member 21 in this embodiment comprises four vertical and rigidly interconnected component elements in form of angle irons 37 disposed so as to constitute the corner portions of a box-like cage construction which is square in cross-section. The angle irons 37 are spaced from one another a distance d providing in effect longitudinal vertical slots S through which may extend and in which may operate the stationary guy wires 19.

At their upper end the angle irons 37 are welded to the plate 36 to make a firm connection with cover plate. At their lower end the angle irons 37 are rigidly connected with one another by means of an annular member in a broad sense, namely, by a pair of angle irons 38 and a pair of angle irons 39 (see Fig. 8) fastened to the angle irons 37. Vertical tabs or rib portions 40 are welded to the angle irons 38 and 39, to which in turn are welded the guy wires 22. The shorter guy wires 24 have their lower ends anchored in a similar manner so that cross-sections 8—8 and 8¹—8¹ (see Fig. 5) become identical (see identical Figs. 8 and 8¹).

The stationary post 17 in this embodiment is in the form of a wide flange I-beam profile 40a having a pair of flanges 41 and 42, and a web 43. As herein shown the outer faces of the flanges present a pair of vertical parallel guide faces 41a and 42a, while the web presents a pair of guide faces 43a and 43b. Accordingly the surrounding guide member 21 is provided with anti-friction roller devices at the upper as well as at the lower end. Since the upper is identical to the lower anti-friction device, one cross-sectional view (Fig. 9) suffices for both. The device comprises two pairs of rollers, one pair of rollers 44 and 45 engaging the vertical guide faces 41a and 42a respectively, each roller being journalled in a pair of brackets 44a and 45a respectively, which brackets are fastened to a pair of associated vertical angle irons 37. In this way the rollers 44 and 45 extend through the spaces between the angle irons 37, which spaces also provide the slots to accommodate the stationary guy wires 19. The guy wires 19 are not directly fastened to the post 40a but (see Fig. 7) by way of one pair of plates 40b for anchoring one pair of guy wires and another pair of plates 40c for anchoring two pairs of guy wires. The plates are shown to be welded to the post, while the guy wires in turn are welded to the plates 40b and 40c respectively.

A second pair of rollers **46** and **47** engage the vertical guide faces **43a** and **43b**, each roller being journalled in a pair of brackets **48** and **49** respectively. These brackets differ somewhat from the brackets **44a** and **45a** in that they extend inwardly through the spaces S between the vertical angle irons **37**, so as to bring the rollers into engagement with the faces of the web **43**. The brackets **44a** and **45a** are fastened to a pair of associated vertical angle irons **37**.

The Figs. 3 and 4 represent the tank construction of Fig. 1 in diagrammatic fashion, in order to facilitate the understanding of the stresses—bending, tilting, and anti-tilting moments—which may be imposed upon the structure. Hence, as an important dimension, these figures also indicate the length L of the effective vertical distance between the upper and the lower anti-friction roller device, since the guiding efficiency is proportionate to the length of that distance.

I claim:

1. A tank construction having a tank, a cover vertically movable in sealing relationship with the tank providing a variable gas-holding space, and means for stabilizing the cover during its vertical movement comprising a stationary guide member upstanding in the tank, a movable guide member carried by the cover and having telescopic engagement with the stationary guide member whereby one of said guide members becomes the surrounding one and the other guide member becomes the surrounded one, the surrounded guide member having a first pair of vertical guide faces parallel to and opposing each other as well as a second pair of vertical guide faces parallel to and opposing each other extending at right angles to said first pair of guide faces, the surrounding guide member having vertical openings adapted to have extend therethrough radial stay members hereinafter defined, a first set of stay members cover, the stay members of the surrounded guide member to the tank wall, a second set of stay members extending radially from the movable guide member to the marginal portion of the cover, the stay members of the surrounded guide member extending through the vertical openings of the surrounding guide member, a first set comprising an upper and a lower pair of anti-friction rollers mounted upon the surrounding guide member and engaging said first pair of guide faces, and a second set comprising an upper and a lower pair of anti-friction rollers mounted upon the surrounding guide member and engaging said second pair of guide faces.

2. Apparatus according to claim 1, in which the surrounded guide member is a structural I-beam shape in which the faces of the web portions of the I-shape present said first pair of guide faces, and the outer faces of the flange portions of the I-shape present said second pair of guide faces.

3. Apparatus according to claim 1, in which the surrounded guide member is a structural I-beam shape in which the faces of the web portions of the I-shape present said first pair of guide faces, and the outer faces of the flange portions of the I-shape present said second pair of guide faces, and in which the surrounding guide member comprises vertically extending angle irons disposed to form the four corners of a box-shape and spaced from one another to provide said vertical openings, a pair of opposed sides of the box-shape being parallel to a pair of opposed guide faces.

4. Apparatus according to claim 1, in which the surrounding guide member comprises vertically extending angle irons disposed to form the four corners of a box shape and spaced from one another to provide said vertical openings, a pair of opposed sides of the box-shape being parallel to a pair of opposed guide faces.

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