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Polygonal stackable drum.

The specification discloses a number of improvements to polygonal, preferably square, stackable drums.

Specifically, the specification discloses, a polygonal, stackable drum (1) comprising:

a) a polygonal top (2) having an upraised perimetral rim, (3) formed with a channel (30) immediately inward from the rim (3), with or without a removable lid,

b) a polygonal base portion (31) at the bottom of the drum (1) with or without drain holes, having a plurality of feet (9) to be received within the channel (30) of an identical drum when a plurality of drums are stacked vertically on top of each other, wherein;

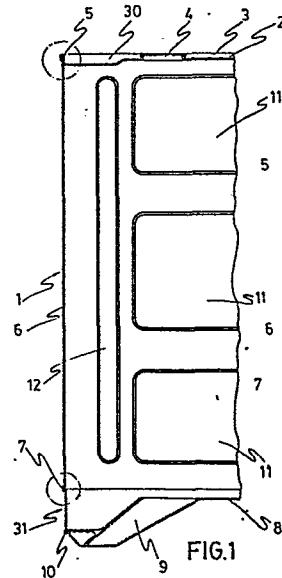
i) each foot (9) is provided with an outwardly projecting step (10) to rest upon the perimetral rim of said identical drum and to transmit the weight of the first drum to the perimetral rim of said identical drum, and,

ii) at least one foot (9) may be provided with a shoe, the or each shoe being fixedly attached to the foot, on or after forming of the foot, hook or sling receiving means may be provided on the foot or the shoe, and,

c) a side wall surface (6) with or without substantially vertical strengthening ribs, the perimetral rim (3) extending upwardly from the side wall surface;

wherein the side wall surface, the top and the base portion are disposed such that the weight of another such drum stacked above the first drum is transmitted through the peri-

metral rim of the first drum directly into and through the side wall surface and through the base portion to the perimetral rim of the said identical drum.



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IMPROVEMENTS TO POLYGONAL STACKABLE DRUMSField of the invention

The present invention relates to improvements to polygonal stackable drums.

Background Art

Spanish Utility Model No. 241877 discloses a stackable, square drum whose base had holes to allow the passage of the prongs of fork-lifts provided with beveled ends, in the jambs, and with a lintel in an inclined plane for displacing the centre of gravity towards the geometric centre of the load assembly, which enabled the usual load platforms or four elements pallets, to be dispensed with, and assisted the prongs of the fork-lift to enter and leave the holes, avoiding the possibility of their unexpectedly getting snagged or dragged.

Drums as described in, and contemporary with, the abovementioned prior art had an upper lid in which the perimetral bourdon, or rim, remained under the supporting member of a second drum placed on top of a first, whereby the weight load was applied in part directly to the lid and created the risk of denting the lid. Furthermore the actual shape of the lid was such that in certain cases fitting drums into a stack was

difficult.

United States Patent Application Serial Number 134874
filed March 28, 1980 and it's continuation-in-part filed
12 July 1982, disclose a drum wherein the perimetral
bourdon is raised and a channel for drainage is formed
5 parallel to the perimeter and immediately interior to
the raised bourdon. Furthermore, the support points of
the lower base of each drum were provided with a step so
disposed that the weight of each drum passed directly
through the vertical faces of the drum stacked below it.

10 It has now been determined that further improvements may
be made to drums whereby the operational lifetime may be
lengthened and the resistance of the drum to damage
while in use may be increased. Furthermore, additional
improvements have been made which further add to the
15 utility of the drum.

Summary of the invention

According to a first aspect of the present invention
there is provided a polygonal, stackable drum comprising;

a) a polygonal top having an upraised perimetral
rim, formed with a channel immediately inward from the
20 rim,

b) a polygonal base portion at the bottom of the
drum, having a plurality of feet to be received within
the channel of an identical drum when a plurality of
drums are stacked vertically on top of each other,

wherein;

i) each foot is provided with an outwardly projecting step to rest upon the perimetral rim of said identical drum and to transmit the weight of the first drum to the perimetral rim of said identical drum, and,

ii) at least one foot is provided with a shoe, the or each shoe being fixedly attached to the foot, on or after forming of the foot, and,

c) a side wall surface, the perimetral rim extending upwardly from the side wall surface;

wherein the side wall surface, the top and the base portion are disposed such that the weight of another such drum stacked above the first drum is transmitted through the perimetral rim of the first drum directly into and through the side wall surface and through the base portion to the perimetral rim of the said identical drum.

The or each shoe may be fixedly attached to the foot, on or after forming of the foot, by for example, spot welding, braising (if the drum is made of metal), ultrasonic welding (if the drum is made of a fusible plastics material) or by means of a screwed interconnection.

Conveniently, at least one part of the side wall surface is formed with a plurality of reinforcements to improve its mechanical strength.

Preferably, the drum is a substantially square prism.

By employing a square drum it is possible to obtain a drum with particular utility and ease of handling, however, it should be understood that a drum according to the present invention in any of its aspects may, for example, be hexagonal or triangular in horizontal section.

In a first series of embodiments the foot per se which is provided with the shoe is shorter than another foot which is not provided with a shoe so that the second foot is as long as the combination of the first foot with its shoe, thereby enabling the drum to stand level on a flat surface.

In a second series of embodiments, each foot is provided with a shoe.

In either of these two series of embodiments, the outwardly projecting step of each foot may either be provided on the respective foot itself or may be provided on a respective shoe. Where the shoe is provided with the projecting step, the step may either be pressed or rolled into the shoe. If the shoe is provided with a rolled projecting step it is possible that one limb of a carrying handle, or a length or

carrying cable may be passed through the central void of the rolling, thereby enabling the drum to be more easily handled.

Furthermore, the shoe may provide an attachment for a
5 slinging hook or the like. For example in one embodiment of the invention, the sole of at least one foot provided with a shoe is further provided with an inward pressing and the respective shoe is either;

provided with a corresponding aperture, whereby a
10 slinging hook or the like may enter the inward pressing of the foot and thereby enable the drum to be lifted, or,

provided with a corresponding inward pressing which substantially follows the contour of the inward pressing of the shoe, whereby a slinging hook or the like may
15 enter the inward pressing of the shoe and thereby enable the drum to be lifted,

in either of the two cases outlined above, the aperture adapted to receive the slinging hook or the like may be threaded, or otherwise provided with means to lock a
20 carrying means in place, such as a twistlock receiving plate.

It can be seen from the above that the shoe may be varied in profile or curvature in all planes relative to the foot and attached in such a way as to form an energy
25 absorbing member, both to give added mechanical protection to the drum in handling and to overcome the

effects of enviromental shock or vibrations during storage and transportation.

According to a second aspect of the present invention there is provided a polygonal, stackable drum comprising;

5 a) a polygonal top having an upraised perimetral rim, formed with a channel immediately inward from the rim,

b) a polygonal base portion at the bottom of the drum, having a plurality of feet to be received within
10 the channel of an identical drum when a plurality of drums are stacked vertically on top of each other, wherein each foot is provided with an outwardly projecting step to rest upon the perimetral rim of said identical drum and to transmit the weight of the first
15 drum to the perimetral rim of said identical drum.

c) a side wall surface, wherein;

i) the perimetral rim is formed as an upward extension of the side wall surface,

ii) the side wall surface is provided with a number
20 of pressed ribs to improve its mechanical strength, and,

iii) the side wall surface is provided with at least one carrying handle formed as a pressing in the side wall,

wherein the side wall surface, the top and the base
25 portion are disposed such that the weight of another such drum stacked above the first drum is transmitted through the perimetral rim of the first drum directly

into and through the side wall surface and through the base portion to the perimetral rim of the said identical drum.

Preferably the at least one carrying handle formed as a pressing in at least one side wall, is formed at or near the upper edge of the side wall. It is however envisaged that the said carrying handle may be disposed otherwise upon the side wall surface at any convenient location.

10 According to a third aspect of the present invention there is provided a polygonal, stackable drum comprising;

a) a polygonal top having an upraised perimetral rim, formed with a channel immediately inward from the rim, a substantially central aperture having a rolled edge, and a snug fitting lid with a dependent flange to close the said aperture

b) a polygonal base portion at the bottom of the drum, having a plurality of feet to be received within the channel of an identical drum when a plurality of drums are stacked vertically on top of each other, wherein each foot is provided with an outwardly projecting step to rest upon the perimetral rim of said identical drum and to transmit the weight of the first drum to the perimetral rim of said identical drum.

25 c) a side wall surface, wherein the perimetral rim is formed as an upward extension of the side wall

surface,

wherein the side wall surface, the top and the base portion are disposed such that the weight of another such drum stacked above the first drum is transmitted
5 through the perimetral rim of the first drum directly into and through the side wall surface and through the base portion to the perimetral rim of the said identical drum.

Conveniently, the rolled edge of the substantially
10 central aperture is attached to the opening of a bag for lining the drum, whereby interaction of the contents of the drum and the drum wall is prevented.

According to a fourth aspect of the present invention there is provided a polygonal, stackable drum comprising;
15 a) a polygonal top having an upraised perimetral rim, formed with a channel immediately inward from the rim, and having one or more apertures provided in the perimetral rim, wherein each aperture is provided with an inner lining sleeve extending through the aperture
20 and flanged so as to retain the sleeve within the said aperture,

b) a polygonal base portion at the bottom of the drum, having a plurality of feet to be received within the channel of an identical drum when a plurality of
25 drums are stacked vertically on top of each other, wherein each foot is provided with an outwardly

projecting step to rest upon the perimetral rim of said identical drum and to transmit the weight of the first drum to the perimetral rim of said identical drum.

c) a side wall surface, wherein the perimetral rim is formed as an upward extension of the side wall surface,

wherein the side wall surface, the top and the base portion are disposed such that the weight of another such drum stacked above the first drum is transmitted through the perimetral rim of the first drum directly into and through the side wall surface and through the base portion to the perimetral rim of the said identical drum.

By providing a series of apertures lined with sleeves in the manner described above it is possible that a plurality of laterally disposed drums may be secured together, or a single drum may be secured to a frame or support member by the use of a screw fixing, a drop-pin or the like. Furthermore the aperture may provide the function of a drain-hole to drain water from the channel without weakening the structure of the drum.

Preferably, the apertures are adapted to receive a carrying handle for enabling ease of transport of the drum.

According to a fifth aspect of the present invention

there is provided a polygonal, stackable drum comprising;

a) a polygonal top having an upraised perimetral rim, formed with a channel immediately inward from the rim,

5 b) a polygonal base portion at the bottom of the drum, having a plurality of feet to be received within the channel of an identical drum when a plurality of drums are stacked vertically on top of each other, wherein;

10 i) each foot is provided with an outwardly projecting step to rest upon the perimetral rim of said identical drum and to transmit the weight of the first drum to the perimetral rim of said identical drum, and,

15 ii) at least one foot is provided with a drain plug for filling or emptying the drum and reinforced by the addition of a shoe to the same foot, and,

c) a side wall surface, wherein the perimetral rim is formed as an upward extension of the side wall surface,

20 wherein the side wall surface, the top and the base portion are disposed such that the weight of another such drum stacked above the first drum is transmitted through the perimetral rim of the first drum directly into and through the side wall surface and through the
25 base portion to the perimetral rim of the said identical drum.

The drain plug may be located either on the sole of the

respective foot or on the side of the respective foot. The drain plug may also be employed in combination with any one or more of the further features of the invention disclosed herein.

5 According to a sixth aspect of the present invention there is provided a polygonal; stackable drum comprising;

a) a polygonal top having an upraised perimetral rim, formed with a channel immediately inward from the rim,

10 b) a polygonal base portion at the bottom of the drum, having a plurality of feet to be received within the channel of an identical drum when a plurality of drums are stacked vertically on top of each other, wherein each foot is provided with an outwardly
15 projecting step to rest upon the perimetral rim of said identical drum and to transmit the weight of the first drum to the perimetral rim of said identical drum.

c) a side wall surface, wherein;

20 i) the perimetral rim is formed as an upward extension of the side wall surface, and,

ii) at least one portion of the side wall surface is provided with a number of pressed ribs to improve its mechanical strength, whereby the pressed ribs of adjacent drums disposed laterally of each other
25 interlock thereby adding to the mechanical cohesion of a stack of said adjacent drums, and,

wherein the side wall surface, the top and the base

portion are disposed such that the weight of another such drum stacked above the first drum is transmitted through the perimetral rim of the first drum directly into and through the side wall surface and through the base portion to the perimetral rim of the said identical drum.

According to a seventh aspect of the present invention there is provided a polygonal, stackable drum comprising;

a) a polygonal top having an upraised perimetral rim, formed with a channel immediately inward from the rim,

b) a polygonal base portion at the bottom of the drum, having a plurality of feet to be received within the channel of an identical drum when a plurality of drums are stacked vertically on top of each other, wherein each foot is provided with an outwardly projecting step to rest upon the perimetral rim of said identical drum and to transmit the weight of the first drum to the perimetral rim of said identical drum.

c) a side wall surface, wherein;

i) the perimetral rim is formed as an upward extension of the side wall surface, and,

ii) at least one substantially vertical rib is provided in the side wall surface to act as a strut and thereby to improve its mechanical strength,

wherein the side wall surface, the top and the base portion are disposed such that the weight of another

such drum stacked above the first drum is transmitted through the perimetral rim of the first drum directly into and through the side wall surface and through the base portion to the perimetral rim of the said identical drum.

Preferably the substantially vertical ribs acting as struts are formed in pairs disposed adjacent some or all of the vertical edges of the drum, wherein one rib of each pair is disposed on each side of each said vertical edge.

According to an eighth aspect of the present invention there is provided a polygonal, stackable drum comprising;

a) a polygonal top having an upraised perimetral rim, formed with a channel immediately inward from the rim,

b) a polygonal base portion at the bottom of the drum, having a plurality of feet to be received within the channel of an identical drum when a plurality of drums are stacked vertically on top of each other, wherein each foot is provided with an outwardly projecting step to rest upon the perimetral rim of said identical drum and to transmit the weight of the first drum to the perimetral rim of said identical drum, and, each foot is formed together with the respective projecting step in a single pressing operation,

c) a side wall surface, wherein the perimetral rim

is formed as an upward extension of the side wall surface,

wherein the side wall surface, the top and the base portion are disposed such that the weight of another such drum stacked above the first drum is transmitted through the perimetral rim of the first drum directly into and through the side wall surface and through the base portion to the perimetral rim of the said identical drum.

10 According to a ninth aspect of the present invention there is provided a polygonal, stackable drum comprising;

a) a polygonal top having an upraised perimetral rim, formed with a channel immediately inward from the rim,

15 b) a polygonal base portion at the bottom of the drum and forming the floor of the drum, having a plurality of feet to be received within the channel of an identical drum when a plurality of drums are stacked vertically on top of each other, wherein each foot is provided with an outwardly projecting step to rest upon the perimetral rim of said identical drum and to transmit the weight of the first drum to the perimetral rim of said identical drum, and, each foot is formed with an inwardly facing sloping surface between the sole of the foot and the floor of the base portion.

25 c) a side wall surface, wherein the perimetral rim is formed as an upward extension of the side wall

surface,

wherein the side wall surface, the top and the base portion are disposed such that the weight of another such drum stacked above the first drum is transmitted through the perimetral rim of the first drum directly into and through the side wall surface and through the base portion to the perimetral rim of the said identical drum.

In any of the aspects of the invention described above the drum may be manufactured in metal or from a plastics material.

Furthermore, in any of the aspects of the invention described above, means for attaching carrying means may be formed in either the top or base portion of the drum.

Description of Drawings

The invention will be further described by way of example, with reference to the accompanying figures wherein;

Figure 1, shows a section through a drum according to the present invention taken along a diagonal,

Figure 2, shows an enlarged view of the seam between the top of the drum and the side wall surface,

Figure 3, shows an enlarged view of the seam between the base portion of the drum and the side wall surface,

Figure 4, shows a view of one foot of a drum according to the present invention seen from inside the

drum,

Figure 5, shows a section through one foot of a drum according to the present invention,

5 Figure 6, shows a view similar to that of figure 4, but with a draining hole provided,

Figure 7, shows a section through one foot of a drum according to the present invention and details of a shoe having a drain hole in the sole thereof,

10 Figure 8, shows a detail of the upper rim of a drum provided with an aperture in the rim,

Figure 9, shows a detail of the lower rim of a drum provided with a carrying handle above the rim,

15 Figure 10, shows a section through a drum according to the present invention taken along a diagonal, with added ribs provided to further strengthen the side wall surfaces,

Figure 11, shows a section through one foot of a drum according to the present invention with a variant of the shoe attached by spot welding,

20 Figure 12, shows the upper part of a drum according to the present invention, provided with a lid,

Figure 13 shows a modified shoe,

Figure 14 shows a modified shoe,

Figure 15 shows a modified foot, and,

25 Figure 16 shows in profile a further variant on the present invention.

Description of Embodiments of the Invention

In figures 1,2 and 3, there is shown a square, stackable

drum 1 comprising; a square top 2 having an upraised
perimetral rim 3 formed with a channel 30 immediately
inward from the rim. The perimetral rim 3 is formed as
an upward extension of the side wall surface 6. A
5 square base portion 31 is provided at the bottom of the
drum and forms both the floor 8 of the drum and each
foot 9 to be received within the channel 30 of an
identical drum when a plurality of such drums are
stacked vertically on top of each other.

10 The foot 9 is provided with an outwardly projecting step
10 to rest upon the perimetral rim 3 of an identical
drum.

The a side wall surface 6 is seamed to the the top 2 and
the base portion 31 at locations 5 and 7 respectively,
15 the nature of one possible variant on these seams being
shown in figures 2 and 3 respectively. The side wall
surface 6 has pressings 11 and 12 which act to
strengthen the side wall surface and prevent collapse of
an empty drum when a full drum is stacked above it. The
20 pressing 11 is a window-like pressing while the pressing
12 comprises a substantially vertical rib which is
provided in the side wall surface 6 to act as a strut.

An orifice 4 for a closure member is provided in the top
2.

Turning now to figure 4, there is shown a view of one foot of a drum according to the present invention seen from inside the drum. The pressed or rolled step 10 is seen from the inside together with the seam 7 between the side wall surface 6 and the base portion 31. In use the space within the foot 9 may be filled with a resin or other sealing compound to the level of the floor 8, to prevent residues accumulating when the drum is emptied.

The pressings 12 acting as struts may be formed in pairs disposed adjacent at least some of the vertical edges of the drum, with one rib of each pair disposed on each side of the respective vertical edge.

Figures 6 and 7 show respectively, a view similar to that of figure 4, but with a draining hole 13 provided in the wall of the foot 9 and a section through one foot of a drum according to the present invention with details of a shoe 14 having a drain hole 17 in the sole thereof.

In figure 7, The shoe 14 substantially follows the contour of the foot 9. The drain hole 17, pierces both the shoe 14 and the foot 15, and is sealed by a drain plug 16. In embodiments such as this, the sealing of the feet as described above is of particular utility.

The sloping surface 15, which forms the inward facing surface of the drum slopes between the sole 32 of the foot and the floor 8 of the drum, as does the sloping surface of the shoe 14. This sloping surface 14 is particularly useful when the drum is being lifted by a fork lift, when the forks are centred from any off-centre position as they impinge upon this surface.

Figure 8 shows a detail of the upper rim 3 of a drum provided with an aperture 18 in the rim. The aperture is provided with an inner lining sleeve 19 extending through the aperture and flanged so as to retain the sleeve within the said aperture. This aperture may act as a fixing point for a handle or a slinging hook. By providing a series of apertures lined with sleeves in the manner described above it is possible that a plurality of laterally disposed drums may be secured together, or a single drum may be secured to a frame or support member by the use of a screw fixing, a drop-pin or the like. Furthermore the aperture may provide the function of a drain-hole to drain water from the channel without weakening the structure of the drum.

An additional feature shown in figure 8 is the inward pressing 60 of the side wall surface 6, which in this instance bears upon the undersurface of the top 2 along line 61. By providing such an inward pressing it is possible to produce a structure by means of which a

filled drum may be handled without deformation.

5 Figure 9 shows a detail of the lower seam 7, i.e. the seam at the lower edge of the side wall 6. In this variant of the invention, a handle 20 is pressed into the side wall 6 above the seam. As an alternative or in addition, a similar handle may be provided as an inward pressing of the side wall below the upper seam 5.

10 Figure 10 shows a section through a drum according to the present invention taken along a diagonal, with added ribs 21 provided to further strengthen the side wall surfaces 6. The added ribs are shown in a 'St. Andrew's Cross' formation but other formations such as diagonal vertical or horizontal corrugations may be employed. As a yet further alternative, the 'St. Andrew's Cross' formation may extend over at least one entire face of a polyhedral drum, in a manner with which the 'Jerry Can' may be considered analogous.

20 Figure 10 also shows a drop-down handle 34 attached to the side wall surface by mountings fixedly attached to the surface.

Figure 11, shows a section through one foot 9 of a drum according to the present invention with a variant of the shoe 22 attached by spot welding at points 23. It should be noted that this shoe does not follow the

contour of the foot over its entire outer surface and thus forms an energy absorbing member, both to give added mechanical protection to the drum in handling and to overcome the effects of environmental shock or vibrations during storage and transportation.

Figure 12, shows the upper part of a drum according to the present invention, provided with a lid 25, in the top 2. The lid 25 may be located centrally or offset. A dependent flange 24 forms a fixing point for a bag 27, which is held in place by a ring 28 provided with an over-centre clasp means 29. The lid may be secured in place by a sealing ring 26 which may have deformable lugs to hold the lid in place, in the event of a shock.

Figure 13 shows a modified shoe 40 attached to a foot 49 which has a rolled step 41. A further optional feature is shown in the figure, wherein a D-ring 48 is passed through the central void 42 of the rolling, thereby enabling the drum to be more easily handled.

Figure 14 shows a modified shoe 43 attached to a foot 50, provided with a corresponding aperture 44 to an inward pressing of the foot 48, whereby a slinging hook or the like (not shown) may enter the inward pressing of the foot and thereby enable the drum to be lifted.

Figure 15 shows a modified foot 45, provided with a

corresponding inward pressing 46 which substantially follows the contour of the inward pressing 47 of the shoe 51, whereby a slinging hook or the like (not shown) may enter the inward pressing of the shoe and thereby enable the drum to be lifted. In either of the two cases outlined above, as illustrated in figures 14 and 15, the aperture adapted to receive the slinging hook or the like may be threaded, or otherwise provided with means to lock a carrying means in place. Furthermore, the floor 8 of the drum is provided with at least one inward pressing (of which only one 57 is shown) which acts as a purchase for carrying and/or handling of the drum.

Figure 16 shows in profile a further variant on the present invention, wherein the foot 54 is adapted to fit within a shoe 53 provided with a pressed step 55. A cable or wire 56 is passed through a void between the foot 54 and the shoe 53, thereby enabling the drum to be more easily handled.

C L A I M S

1. Polygonal stackable drum comprising:
 - a) a top having an upraised perimetral rim with one or more apertures formed with a channel immediately inward from the rim, with an aperture for a lid,
 - b) a base portion having a plurality of feet to be received within the channel of an identical drum stacked thereon, wherein each foot is provided with an outwardly projecting step to rest upon the perimetral rim of said identical drum, and
 - c) a side wall surface with pressed ribs, the perimetral rim extending upwardly from the side wall; characterised in that at least one foot is provided with a shoe attached thereto, in that the shoe has a dependent flange to close the aperture of the top, the aperture being provided with a rolled edge inward from the drum so as to retain a bag for inner lining the drum, and in that the apertures of the perimetral rim are provided with an inner lining sleeve extending through the aperture and flanged to be retained.
2. Polygonal stackable drum according to claim 1, wherein the drum is a preferably quadrangular prism.
3. Polygonal stackable drum according to claim 1, wherein the foot provided with the shoe is shorter than the rest, so that it coincides with the height of the shoe.
4. Polygonal stackable drum according to claims 1 and 3, wherein the projecting step of each foot

for stacking fits into the respective shoe.

5. Polygonal stackable drum according to claim 4, wherein the shoe has a carrying handle.

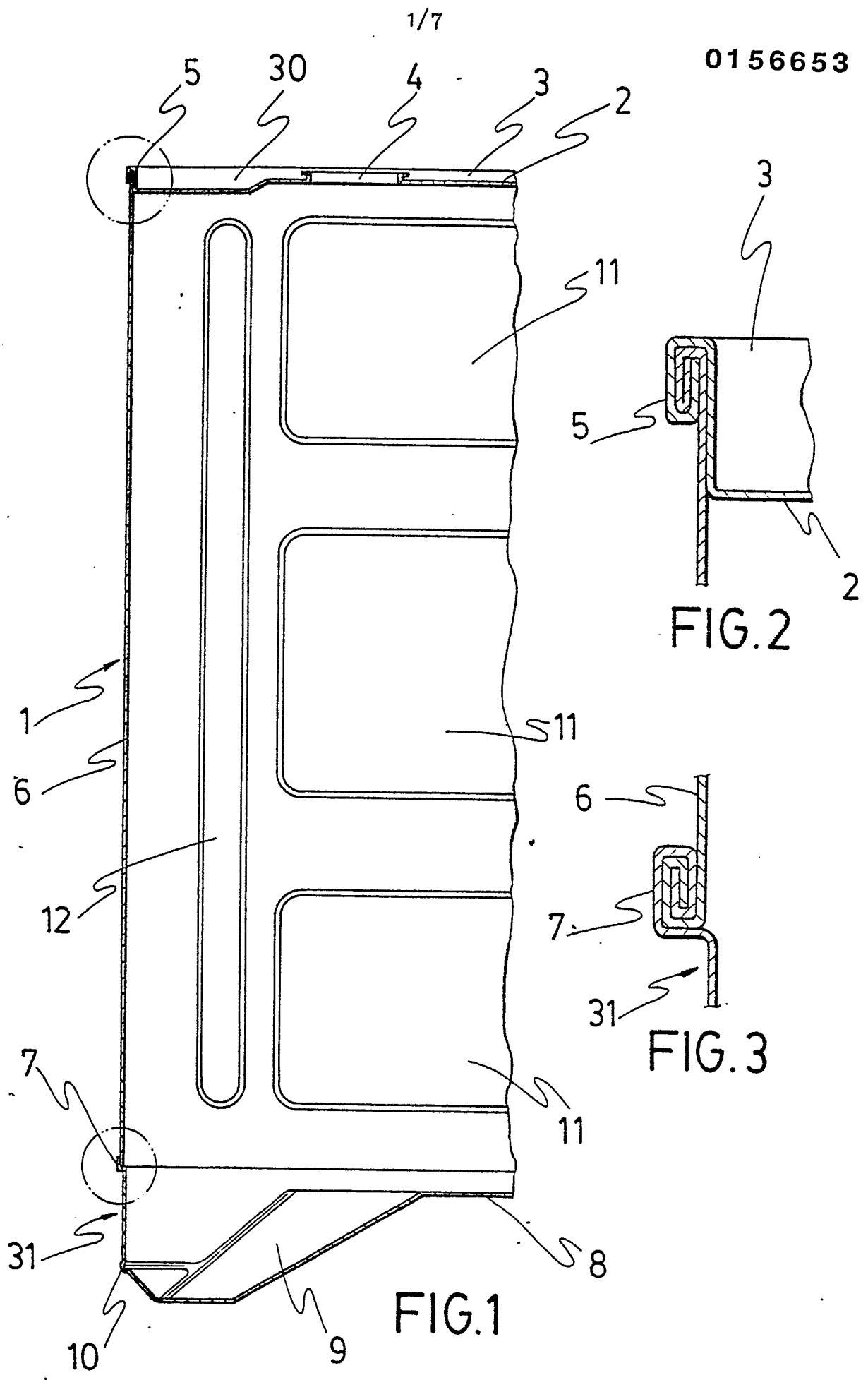
6. Polygonal stackable drum according to claim 5, wherein the sole of at least one foot provided with a shoe is further provided with an inward pressing following that of the shoe.

7. Polygonal stackable drum according to claim 1, wherein the side wall surface is provided with at least one inward pressing forming a horizontal channel for the carrying handle.

8. Polygonal stackable drum according to claim 1, wherein the apertures of the perimetral rim are adapted to receive a carrying handle.

9. Polygonal stackable drum according to claim 1, wherein at least one substantially vertical rib is provided in the side wall surface as a strut.

10. Polygonal stackable drum according to claim 9, wherein the said ribs are formed in pairs disposed adjacent some or all the vertical edges of the drum.



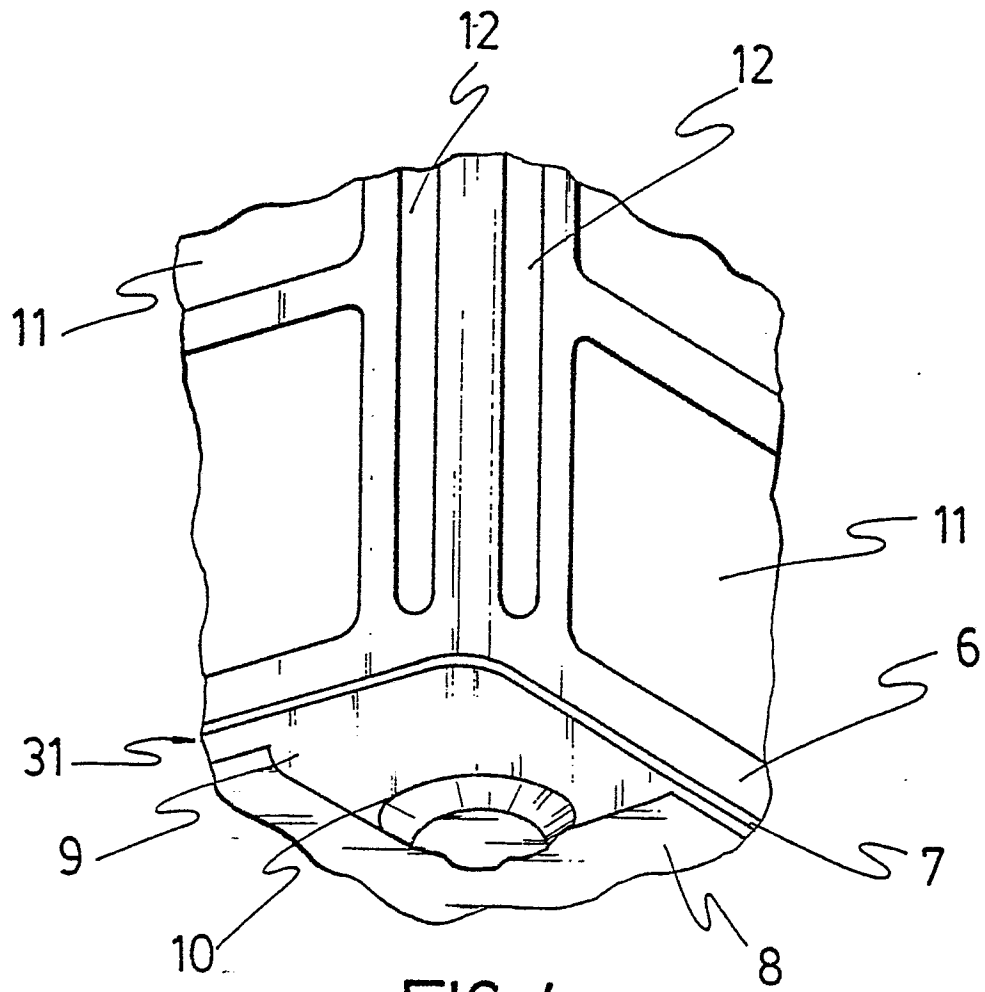


FIG. 4

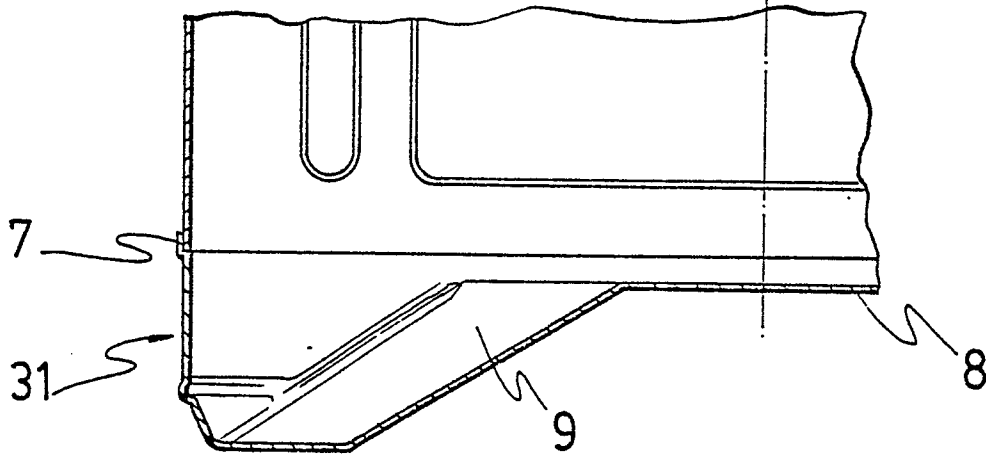


FIG. 5

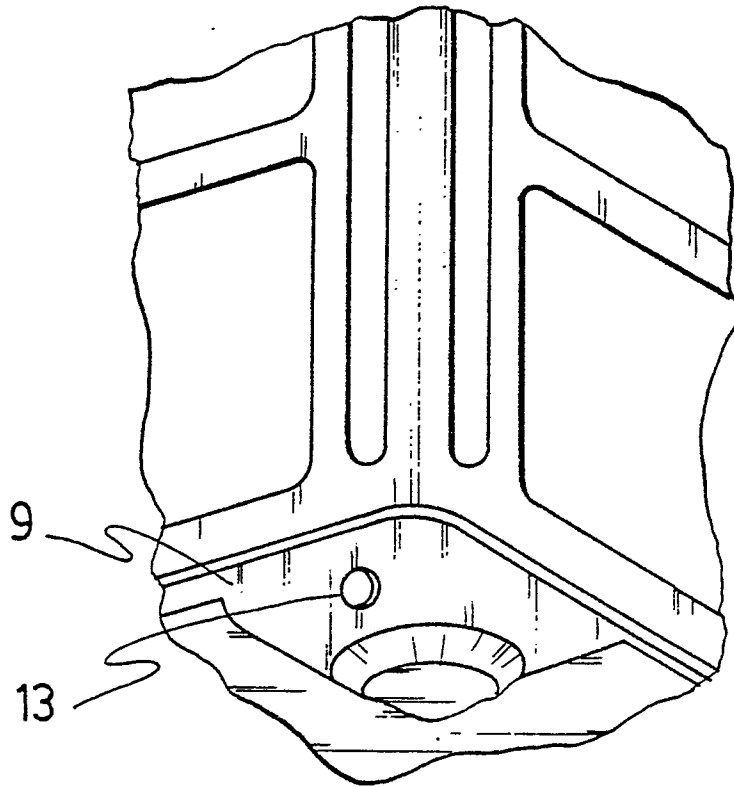


FIG. 6

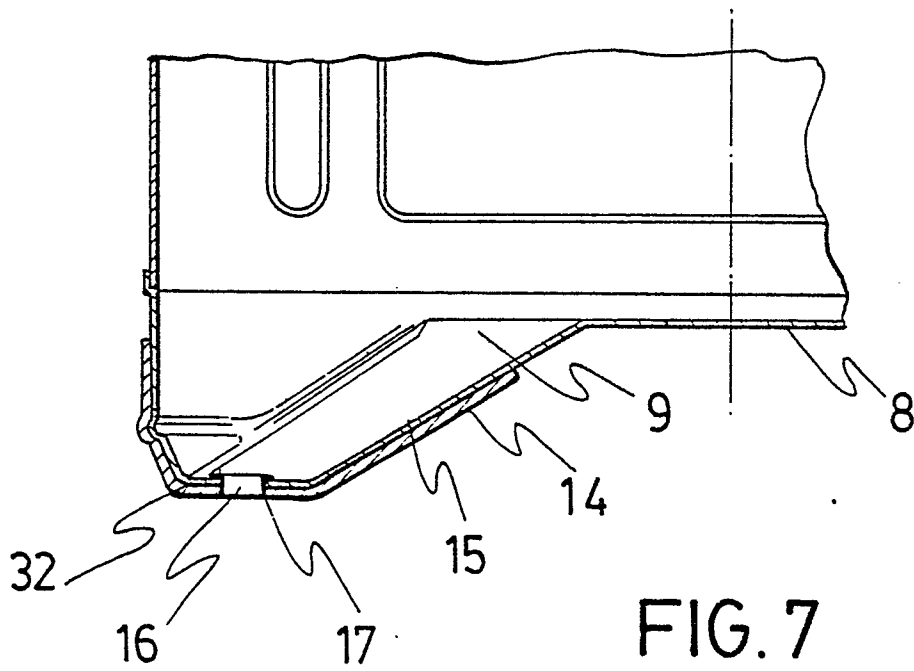


FIG. 7

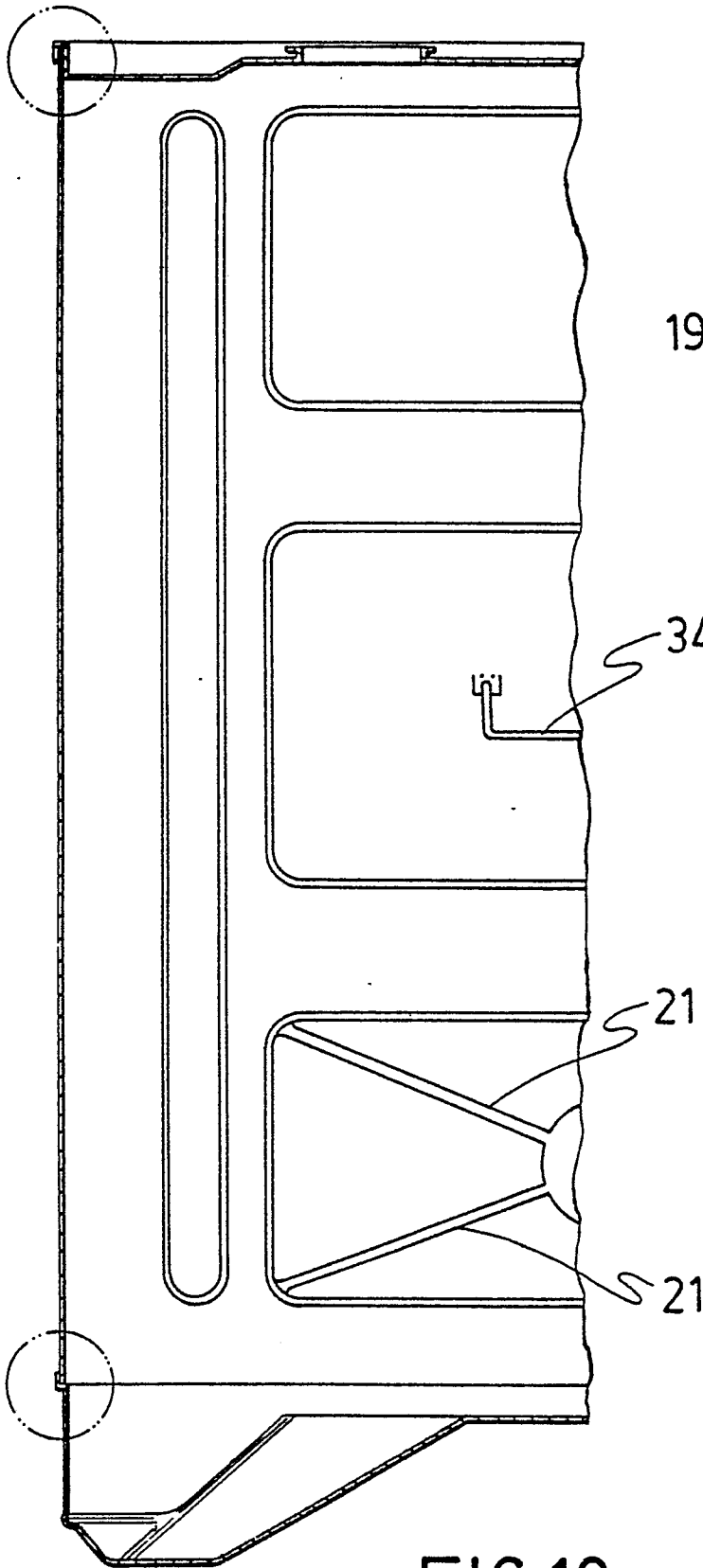


FIG. 10

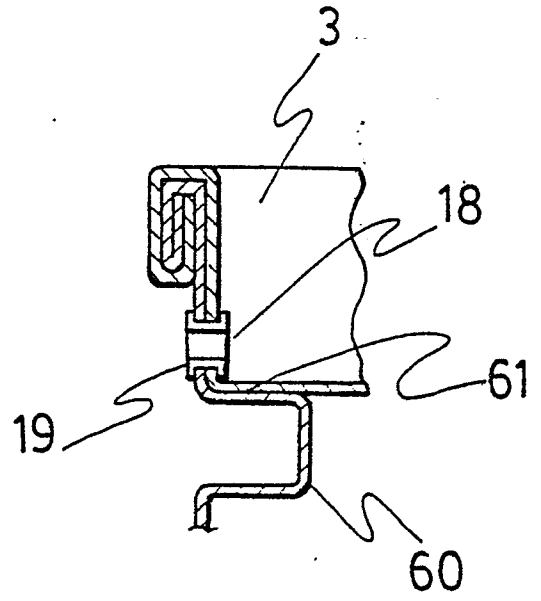


FIG. 8

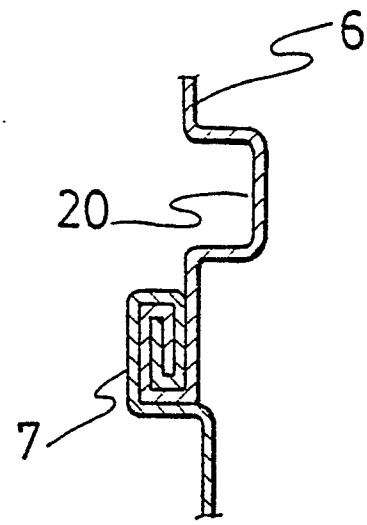


FIG. 9

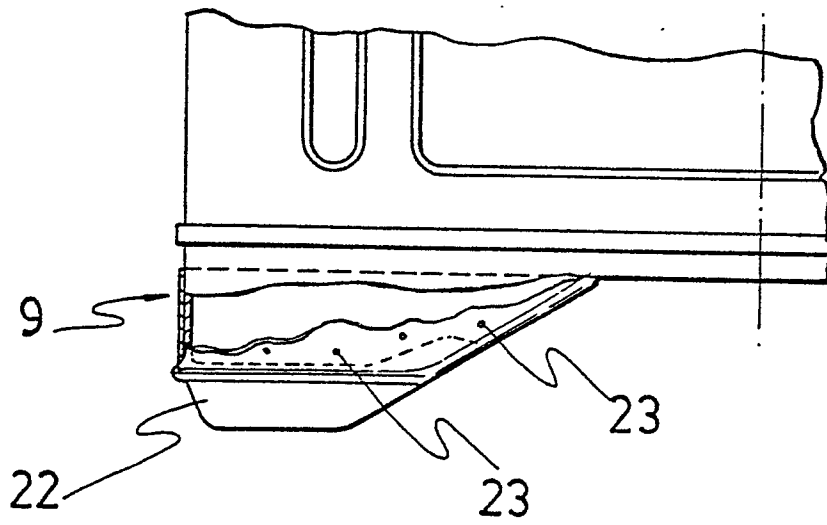


FIG.11

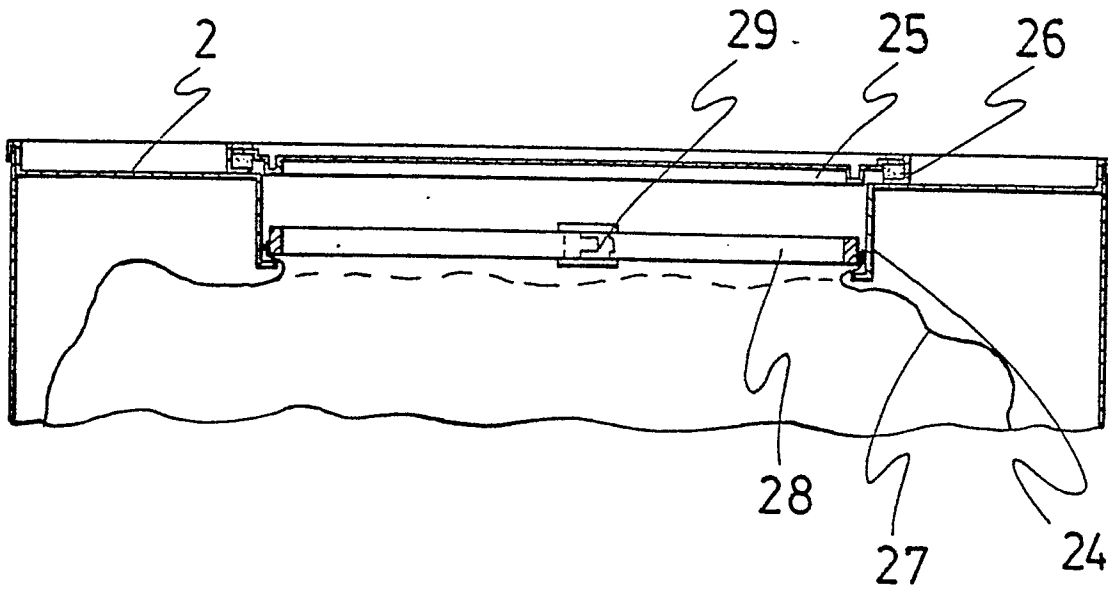


FIG.12

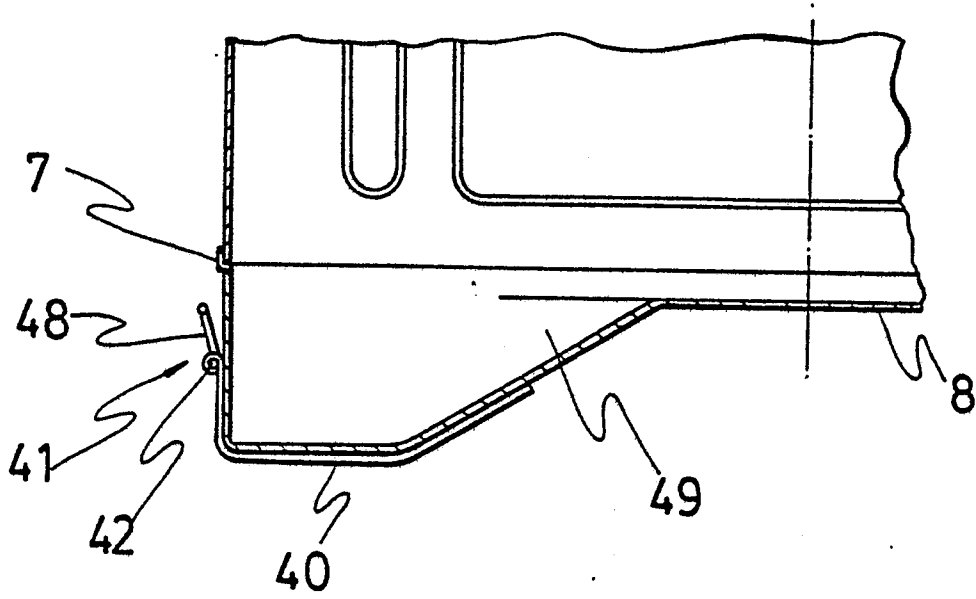


FIG. 13

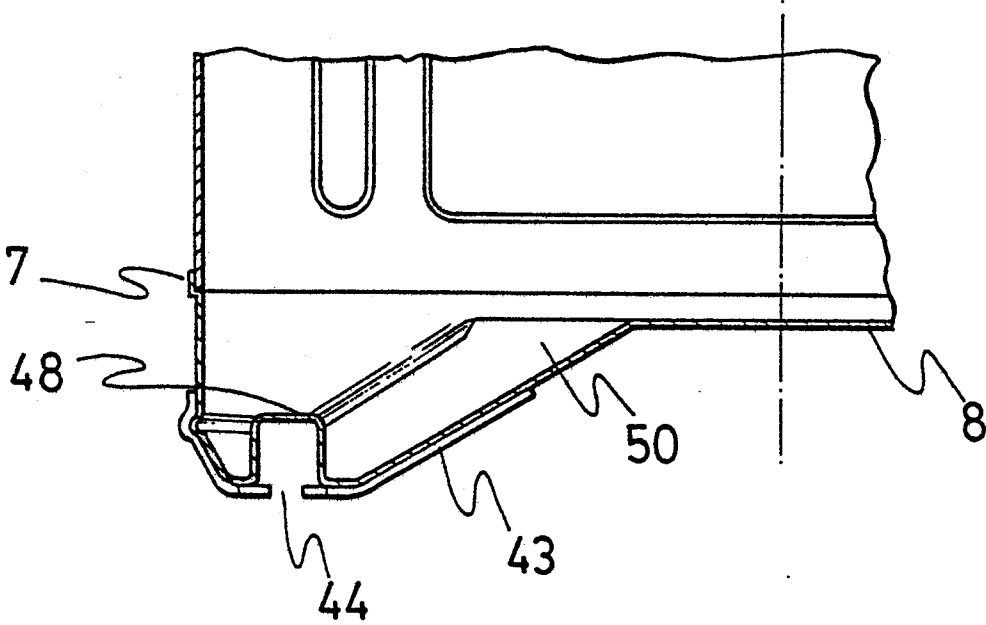


FIG. 14

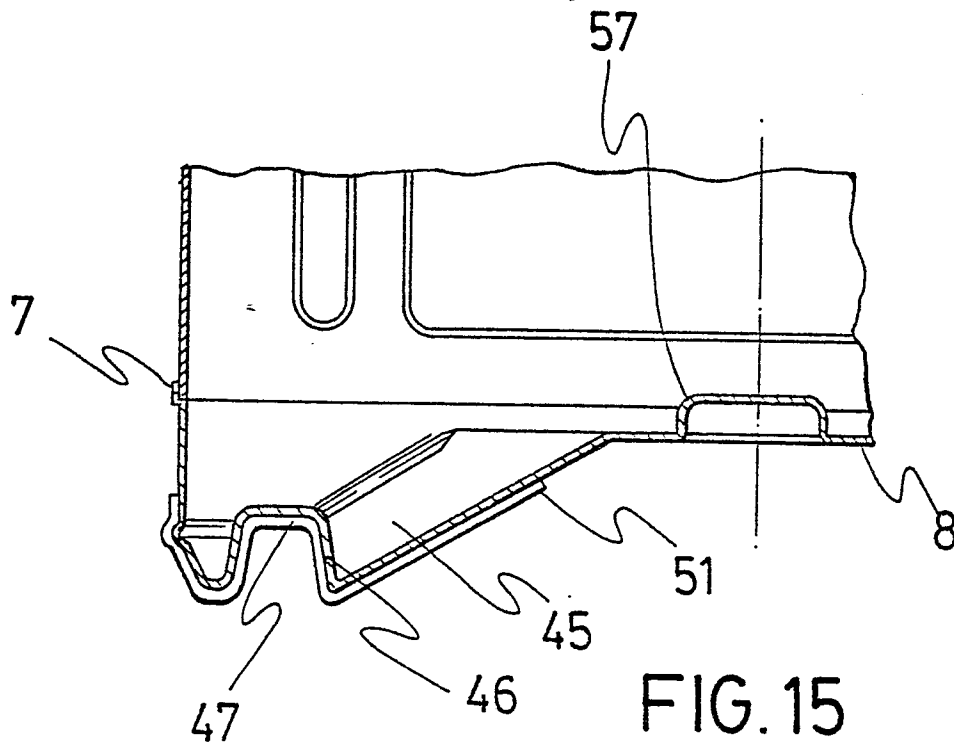


FIG. 15

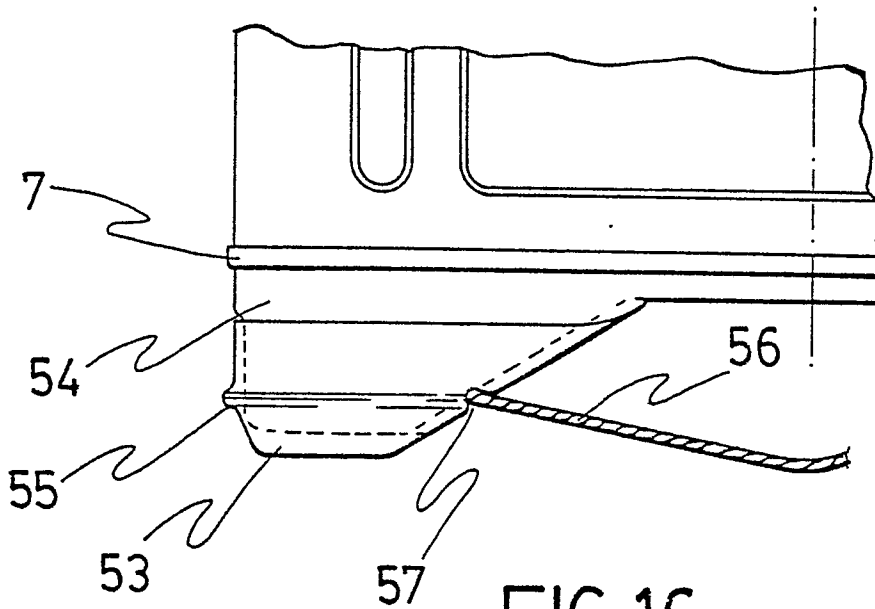


FIG. 16