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54 APPARATUS FOR FACILITATING NEW CONSTRUCTION AND THE INTERNAL INSPECTION AND REPAIR OF LARGE VESSELS, SUCH AS RECOVERY BOILERS AND TANKS

57 ABSTRACT (NOT MORE THAN 150 WORDS)

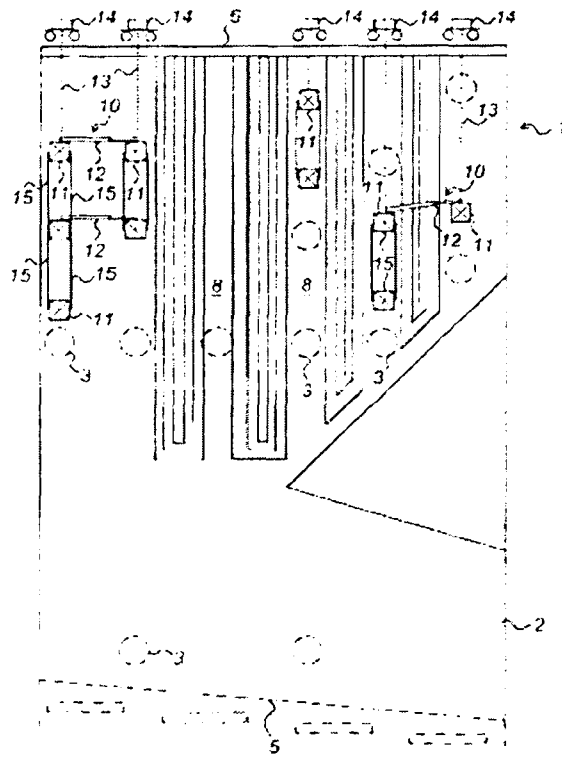
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If no classification is finished, Form P.9 should accompany this form.
The figure of the drawing to which the abstract refers is attached.

ABSTRACT

An apparatus for new construction as well as internal inspection and repair of large vessels (1), such as recovery boilers and tanks, comprises a platform (10) which is vertically adjustably suspended by means of suspension cords (13) hanging down from a roof (6) of the vessel (1). The platform (10) is built from at least two parallel spaced-apart girders (11), to which the suspension cords (13) are attached, and at least one plank (12) is arranged perpendicular to the girders (11) and interconnecting the same, the plank resting on the girders (11) and at least partly covering the same. The girders (11) are individually vertically adjustable first lattice girders, which have flat upper sides forming a footboard, on which it is possible to walk and operate safely. The plank (12), on which it is also possible both to walk and work, has a certain overlength, which allows the girders (11) to be individually movable in the vertical direction and sideways within certain limits, thereby significantly increasing the applicability of the platform (10).



APPARATUS FOR FACILITATING NEW CONSTRUCTION AND THE
INTERNAL INSPECTION AND REPAIR OF LARGE VESSELS,
SUCH AS RECOVERY BOILERS AND TANKS

Field of the Invention

The present invention relates to an apparatus for facilitating new construction and internal inspection and repair of large vessels, such as recovery boilers and tanks. The apparatus comprises a platform which is vertically adjustably suspended by means of suspension cords hanging down from a roof of the vessel, the platform being built from at least two parallel spaced-apart girders, to which the suspension cords are attached, and at least one plank being arranged perpendicular to the girders and interconnecting the same, the plank resting on the girders and at least partly covering the same.

Background Art

When large vessels, such as recovery boilers and tanks, are to be built and internally inspected and possibly repaired, the large dimensions thereof always make it necessary to use some kind of scaffold or platform, from which the work can be performed in a safe way. Then there is frequently the problem that the parts included in this scaffold or platform must be inserted through relatively small manholes in the walls or roof of the vessel. Another problem is that the above-mentioned large dimensions require the use of a large number of scaffold or platform parts so that all parts of the vessel can be reached. A further problem is that the parts inside the vessel must frequently be mounted under difficult circumstances, such as high heat inside a boiler. Finally, especially in boilers, there is also the problem that on the one hand some parts of the vessel can be difficult to reach because of what is referred to as a nose which is

to be found in certain boilers, i.e. a projecting portion on one of the side walls of the boiler, and on the other hand that it may be necessary to inspect or repair superheaters which are suspended from the roof of the boiler and which between them form narrow passages.

US-A-5,007,501 discloses an apparatus, which is especially intended for the boiler in a thermal power station and which eliminates some of the problems occurring in the same. More specifically, a smaller number of parts are required for the known apparatus than for a traditional scaffold which is erected standing on the bottom of the large vessel. However, the mounting of the prior-art apparatus is still based on initial mounting from the bottom of the large vessel, still comprises a large number of parts that must be assembled, and does not solve all the problems of accessibility in a satisfactory manner.

Japanese Published Application JP-A-2000-054618 discloses an apparatus as stated by way of introduction, which eliminates at least one of the problems with the solution according to US-A-5,007,501. The apparatus according to the Japanese publication thus solves the problem with the initial mounting from the bottom of the vessel, but at the same time its applicability is limited significantly by the fact that the footboard, which is formed of said at least one plank, extends only perpendicular to the girders. This greatly limits the applicability and safety of the apparatus when, because of an obstacle, a gap must be left between two neighbouring planks.

Object of the Invention

In view hereof, the object of the invention is to improve the known apparatus according to JP-A-2000-054618 in such a manner that the remaining problems with this apparatus are eliminated and moreover a considerably more flexible and safer apparatus is provided, which for new

construction, inspection and repair is universally applicable to all types of large vessels.

Summary of the Invention

5 According to the invention, this is achieved by an apparatus of the type mentioned by way of introduction, said apparatus being characterised in that the girders are individually vertically adjustable first lattice girders, to which the suspension cords are attached and
10 which have flat upper sides forming a footboard.

 By the apparatus according to the invention comprising individually vertically adjustable lattice girders, which have a built-in plank for walking, there is provided, in contrast to JP-A-2000-054618, a safe floor surface
15 also along the girders. The lattice girders are insertable in a hanging manner through manholes in the vessel at any level without necessitating setting foot upon the bottom of the vessel. Said at least one plank is then arrangeable in any position between two parallel suspended lattice girders. It will thus be possible to inspect,
20 from the thus provided platform, for instance all walls of a recovery boiler, i.e. also those above the above-mentioned nose, or the superheaters of this boiler all the way up to the roof of the boiler. Owing to the over-
25 length of the plank resting on the girders (it is longer than the normal distance between two juxtaposed girders suspended at the same level), it will be possible within reasonable limits on the one hand to individually lower and raise the lattice girders involved and, on the other
30 hand, to follow the contour of the superheaters which in course of time will frequently be very irregular owing to the high temperatures occurring in the operation of the boiler.

 The girders of the apparatus are preferably rectangular in cross-section, and the suspension cords are
35 suitably attached to them by enclosing holders which enclose the respective girders and have an upper side

which has a centrally arranged fastening means for each suspension cord. The advantages of girders that are rectangular in cross-section are that they have an excellent load-carrying capacity, that, if desired, they can easily
5 be connected perpendicular to a corresponding girder of rectangular cross-section, and that outside the vessel they are stackable in an advantageous way.

Said enclosing holders each preferably consist of two essentially C-shaped halves, with the C openings facing one another, said halves having at their upper and
10 lower ends lugs, through which locking cotter pins are movable for locking said halves together. Thus designed holders protect in an advantageous manner the girder construction from being damaged by squeezing especially on
15 the sides and ensure, by extending under the girder, that the entire load-carrying capacity of the girder construction can be utilised.

Preferably, the lugs of the enclosing holders form at the upper ends said fastening means for the suspension
20 cords. It will thus in an advantageous manner be possible to use the same locking cotter pin both for locking together the halves of the enclosing holders and for attaching a suspension cord.

The halves of the enclosing holders are suitably
25 made of a band material of steel bent to the cross-sectional contour of the girders. Steel has the advantage that it is very stable in shape and has great tensile strength and that it is easy to weld, which considerably facilitates the attachment of the lugs for the locking
30 cotter pins.

The apparatus according to the invention may, if desired, comprise at least one additional girder, which is of the same type as said first lattice girders and is suspended under at least one of those at a fixed distance. It will thus be easy to provide a platform with
35 several storeys.

It will be appreciated that the additional girder suitably should be rectangular in cross-section and that it is advantageous if it is suspended by enclosing holders, which enclose the girder and which are suspended
5 from the superposed girder by means of suspension bands arranged on both sides of the girder.

It will also be appreciated in view of that stated above that the last-mentioned enclosing holders preferably each consist of two substantially C-shaped halves,
10 with the openings facing one another, said halves having at their upper and lower ends lugs, through which locking cotter pins are movable for locking said halves together.

It goes without saying that also the last-mentioned enclosing holders suitably consist of halves which are
15 made of a band material of steel which is bent to the cross-sectional contour of the additional girder.

The suspension bands that are used for suspending an additional girder from a superposed girder are preferably steel bands, which at their ends have holes, through
20 which locking cotter pins are movable for locking engagement in corresponding holes in the sides of the enclosing holders of the associated girders. The steel bands are also advantageous because of the good tensile strength of the steel and the fact that the holes formed therein need
25 no extra reinforcement.

It will be appreciated that the apparatus according to the invention can be extended further by at least one additional girder being suspended under two spaced-apart girders at a fixed distance and by at least one telescopic plank, arranged perpendicular to the girders,
30 resting on the additional girders and interconnecting the same.

Said at least one plank is preferably telescopic. The telescopic design makes it easier to adjust the apparatus to different conditions prevailing in the vessel.
35

More specifically, the telescopic plank preferably consists of an outer and an inner mutually telescoping

U section, which have downwardly directed U openings with ends curved inwards and the projection of which is limited by a pullout-limiting means. The advantage of the ends curved inwards is that they contribute to good mutual
5 displaceability of the U sections since a point charge is avoided. The pullout-limiting means is for natural reasons necessary to prevent the two cooperating U sections from unintentionally sliding apart.

Said pullout-limiting means suitably comprises at
10 least one spring-biased pin, which for locking is arranged to be automatically moved from the inner U section through lock openings in the legs of the U-shaped sections. This solution has the advantage that the pin construction is well protected inside the contour of the
15 plank, thereby facilitating the handling of the plank.

Preferably the outer U section has, at an end which is adapted to rest on a girder, at least one vertical hole for insertion of a locking cotter pin, which is arranged to engage in a corresponding hole in the upper
20 side of the girder. This type of securing of the plank relative to the girder is important especially for the outermost girder of a platform construction.

The suspension cords are suitably chains hanging down from electrically operated telfers arranged on
25 the roof of the vessel. Advantages of chains are that, in contrast to wires that are used according to US-A-5,007,501, they cannot be untwined and that they can be handled with greater accuracy by chain telfers than wires which are wound in layers by a wire winch.

30 Finally, the telfers are preferably individually remote controlled from the interior of the vessel. It will thus be easily possible to vertically adjust individual girders inside the vessel.

35 Brief Description of the Drawings

A preferred embodiment of the apparatus according to the invention will in the following be described in more

detail with reference to the accompanying schematic drawings, in which

Fig. 1 is side view with partly broken-away components and illustrates parts of a recovery boiler, in
5 which an apparatus according to the invention is used;

Fig. 2 is a side view and illustrates parts of the long side of a lattice girder;

Fig. 3 is a top plan view and illustrates parts of the upper side of the lattice girder;

10 Fig. 4 is an end view and illustrates three lattice girders arranged one above the other, which are interconnected by means of steel bands arranged on the sides;

Fig. 5 is an end view and illustrates a first enclosing holder with associated locking cotter pins;

15 Fig. 6 is an end view and illustrates a second enclosing holder with an associated locking cotter pin;

Fig. 7 is a top plan view and illustrates parts of the upper side of a telescopic plank;

20 Fig. 8 is a side view and illustrates parts of the long side of the telescopic plank; and

Fig. 9 is a sectional view and illustrates parts of the upper side of the plank.

Description of a Preferred Embodiment

25 Fig. 1 illustrates parts of a pressure vessel 1 for a recovery boiler, in which an apparatus according to the invention is used for inspection and repair purposes. However, it would be possible to use the apparatus for the same purpose also in other types of pressure vessels,
30 such as a bark-fired boiler, or inside a vessel, such as an oil tank. Moreover, it can be used in new construction of such vessels.

The pressure vessel 1 in Fig. 1 has, among other things, walls 2 with man holes 3 formed therein, a
35 so-called nose 4 mentioned by way of introduction, a protective roof 5 and a roof 6, from which a number of superheaters 7 are suspended.

The superheater 7 constitutes one of the parts that are of special interest to be examined in connection with an inspection. However, they make such inspection difficult by forming, between them, narrow vertical passages, which may have a height of several meters and are partly positioned above the nose 4. Some of the passages extend parallel to the plane of the drawing in Fig. 1, and some extend vertically to this plane. The manholes 3 are preferably arranged at least at one end of the passages 8.

The apparatus according to the invention is shown in Fig. 1 to the right and to the left in the form of two platforms 10 with slightly different configurations. A common feature of the two platforms 10 is that the components included therein are identical since they constitute parts of a construction kit which can be extended as desired to be adjusted to the prevailing situation.

Each platform 10 includes lattice girders 11 and telescopic planks 12 as the main components.

Of the girders 11, the uppermost are horizontally suspended parallel to each other both in the passages 8 and outside the same by chains 13 hanging down from electric trolleys 14 mounted on the roof 6 of the vessel 1. The trolleys are remote controlled and can advantageously be used, for instance, in order to initially pull in a girder into the vessel 1 through a suitable manhole 3. The lower girders 11 are suspended from the superposed girders 11 by means of steel bands 15 which are arranged on both sides of the girders 11. The suspension of both the upper and the lower girders 11 will be described in more detail below with reference to Figs 4-6, and the construction of the girders 11 will be discussed below with reference to Figs 2-4.

The telescopic planks 12 shown in Fig. 1 rest on girders 11 hanging at essentially the same level, and extend, seen from above, perpendicular to these girders 11. They are thus arranged perpendicular also to the

passages 8 and can therefore be used to reach the passages (those parallel to the plane of the drawing) which are perpendicular to these passages 8. The construction of the planks 12 will be described in detail below with reference to Figs 7-9.

Fig. 2 is a side view of a part of a lattice girder 11, Fig. 3 is a top plan view of a corresponding part, and Fig. 4 is an end view of a plurality of such girders 11. The girder 11, which is rectangular in cross-section, is made of aluminium and comprises four longitudinal main pipes 16 arranged in the cross-sectional corners. A grid structure of thinner pipes or rods 17, which stabilises the main pipes 16, extends between these main pipes 16 in a zigzag. On top of the two upper main pipes 16, a foot-board plate 18 is attached, which has a grooved anti-skid upper side 19. At the ends of the girder 11, coupling means (not shown) of prior-art type can be arranged for a possible extension of the girder 11 or for connection of a ladder for instance.

For suspension of the girders 11, use is made, as stated above, of chains 13 for the upper girders 11 and steel bands 15 for the lower girders 11. The chains 13 as well as the steel bands 15 are attached, as is evident from Fig. 4, to the girders 11 by enclosing holders 20, 21, of which the holder 20 is intended especially for the upper girders 11 and is shown in more detail in Fig. 5, and the holder 21 is intended for the lower girders 11 and is shown in more detail in Fig. 6.

The holder 20 comprises two essentially C-shaped halves 22, 23 shaped according to the cross-sectional contour of the lattice girder 11, with the openings facing one another, said halves being made of a bent band material of steel. Said halves 22, 23 have lugs 24, 25 at their upper ends and lugs 26, 27 at their lower ends, which at the upper ends consist of vertically upwardly bent portions of the band material and which at the lower ends consist of tubular sleeves which are welded to the

band material. A cotter pin 28 is moved through the lugs 24, 25 for attaching the above-mentioned chains 13, said cotter pin suitably belonging to a shackle 29, into which a hook 30 at the lower end of a chain 14 can be hooked.

5 At the lower ends, the lugs 26, 27 are preferably connected to each other by means of a locking cotter pin 31, which is moved through the tubular sleeves and then locked.

The holder 21 also comprises two essentially
10 C-shaped halves 32, 33 shaped according to the cross-sectional contour of the lattice girder 11, with the openings facing one another, said halves being made of a bent band material of steel. Said halves 32, 33 have lugs 34, 35 at their upper ends and lugs 36, 37 at their
15 lower ends, which at both the upper and the lower ends consist of tubular sleeves which are welded to the band material. The lugs 34-37 are preferably connected to each other by means of locking cotter pins 38 which are moved through the tubular sleeves and then locked.

20 To attach the above-mentioned steel bands 15 to the sides of the girders 11, the steel bands 15 have holes 39 formed at their ends, and both the holder 20 and the holder 21 have holes 40 formed in their sides, through which locking cotter pins 41 can be moved and then be
25 locked.

Fig. 7 is a top plan view of a part of a telescopic plank 12, Fig. 8 is a side view of a corresponding part, and Fig. 9 is a sectional view of a part of the plank 12 corresponding to the situation in Fig. 7. The plank 12
30 consists of an outer and an inner mutually telescoping U section 42, 43, which have downwardly directed U openings with ends 44, 45 curved inwards, which give the telescopic plank 12 a good load-bearing capacity. For reasons of safety, the sections 42, 43 have a grooved
35 anti-skid surface 46, 47 and a pullout-limiting means 48 for limiting the possible projection.

11

The pullout-limiting means 48 comprises two pins 50 which are biased by means of a leaf spring 49 and which for locking are arranged to be automatically moved from the inner U section 43 through lock openings 51, 52 in the legs of the U-shaped sections 42, 43. To allow simple release, the pins 50 are fixedly connected to a cable 53 which is connected to both pins 50 and thus allows simultaneous release of the two pins 50.

The sections 42, 43, preferably the outer section 42, can also, for reasons of safety, at one end which is adapted to rest on a girder 11 have at least one vertical hole for insertion of a locking cotter pin, which is arranged to engage in a corresponding hole in the upper side of the girder 11.

A person skilled in the art will realise that the above-described embodiment of the invention may be varied in many ways within the scope of the claims, and that the above-described platforms 10, depending on the number of planks 12 that are arranged and the number of girders 11 arranged under and next to each other are usable for most operations which are to be performed in the vessels at issue and in which a scaffold is required.

CLAIMS

1. An apparatus for facilitating new construction
5 as well as internal inspection and repair of large vessels (1), such as recovery boilers and tanks, said apparatus comprising a platform (10) which is vertically
adjustably suspended by means of suspension cords (13)
hanging down from a roof (6) of the vessel (1), the plat-
10 form (10) being built from at least two parallel spaced-
apart girders (11), to which the suspension cords (13)
are attached, and at least one plank (12) being arranged
perpendicular to the girders (11) and interconnecting the
same, the plank resting on the girders (11) and at least
15 partly covering the same, characterised in
that the girders (11) are individually vertically adjust-
able first lattice girders (11), to which the suspension
cords (13) are attached and which have flat upper sides
forming a footboard (18).

20 2. An apparatus as claimed in claim 1, character-
acterised in that the girders (11) are rectangu-
lar in cross-section, and that the suspension cords (13)
are attached thereto by enclosing holders (20) which
enclose the respective girders (11) and have an upper
25 side which has a centrally arranged fastening means (24,
25) for each suspension cord (13).

3. An apparatus as claimed in claim 2, character-
acterised in that the enclosing holders (20) each
consist of two essentially C-shaped halves (22, 23), with
30 the C openings facing one other, said halves having at
their upper and lower ends lugs (24-27), through which
locking cotter pins (28-31) are movable for locking said
halves (22, 23) together.

4. An apparatus as claimed in claim 3, character-
35 acterised in that the lugs (24, 25) at the upper
ends form said fastening means.

5. An apparatus as claimed in claim 3 or 4, characterised in that said halves (22, 23) are made of a band material of steel bent to the cross-sectional contour of the girders (11).

5 6. An apparatus as claimed in any one of claims 1-5, characterised in that at least one additional girder (11), which is of the same type as said first lattice girders (11), is suspended under at least one of those at a fixed distance.

10 7. An apparatus as claimed in claim 6, characterised in that the additional girder (11) is rectangular in cross-section, and that it is suspended by enclosing holders (21) which enclose the girder and which are suspended from the superposed girder (11) by means of suspension bands (15) arranged on both sides of the girder (11).

20 8. An apparatus as claimed in claim 7, characterised in that the enclosing holders (21) each consist of two essentially C-shaped halves (32, 33), with the openings facing one another, said halves having at their upper and lower ends lugs (34-37), through which locking cotter pins (38) are movable for locking said halves (32, 33) together.

25 9. An apparatus as claimed in claim 7 or 8, characterised in that said halves (32, 33) are made of a band material of steel bent to the cross-sectional contour of the additional girder (11).

30 10. An apparatus as claimed in any one of claims 2-5 and any one of claims 6-8, characterised in that the suspension bands are steel bands (15), which at their ends have holes (39), through which locking cotter pins (41) are movable for locking engagement in corresponding holes (40) in the sides of the enclosing holders (20, 21) of the associated girders (11).

35 11. An apparatus as claimed in any one of claims 6-10, characterised in that at least one additional girder (11) is suspended under two spaced-

apart girders (11) at a fixed distance, and that at least one plank (12) is arranged perpendicular to the girders (11) and interconnecting the girders (11), said plank resting on the additional girders (11) and at least partly covering the same.

12. An apparatus as claimed in any one of claims 1-11, characterised in that said at least one plank (12) is telescopic.

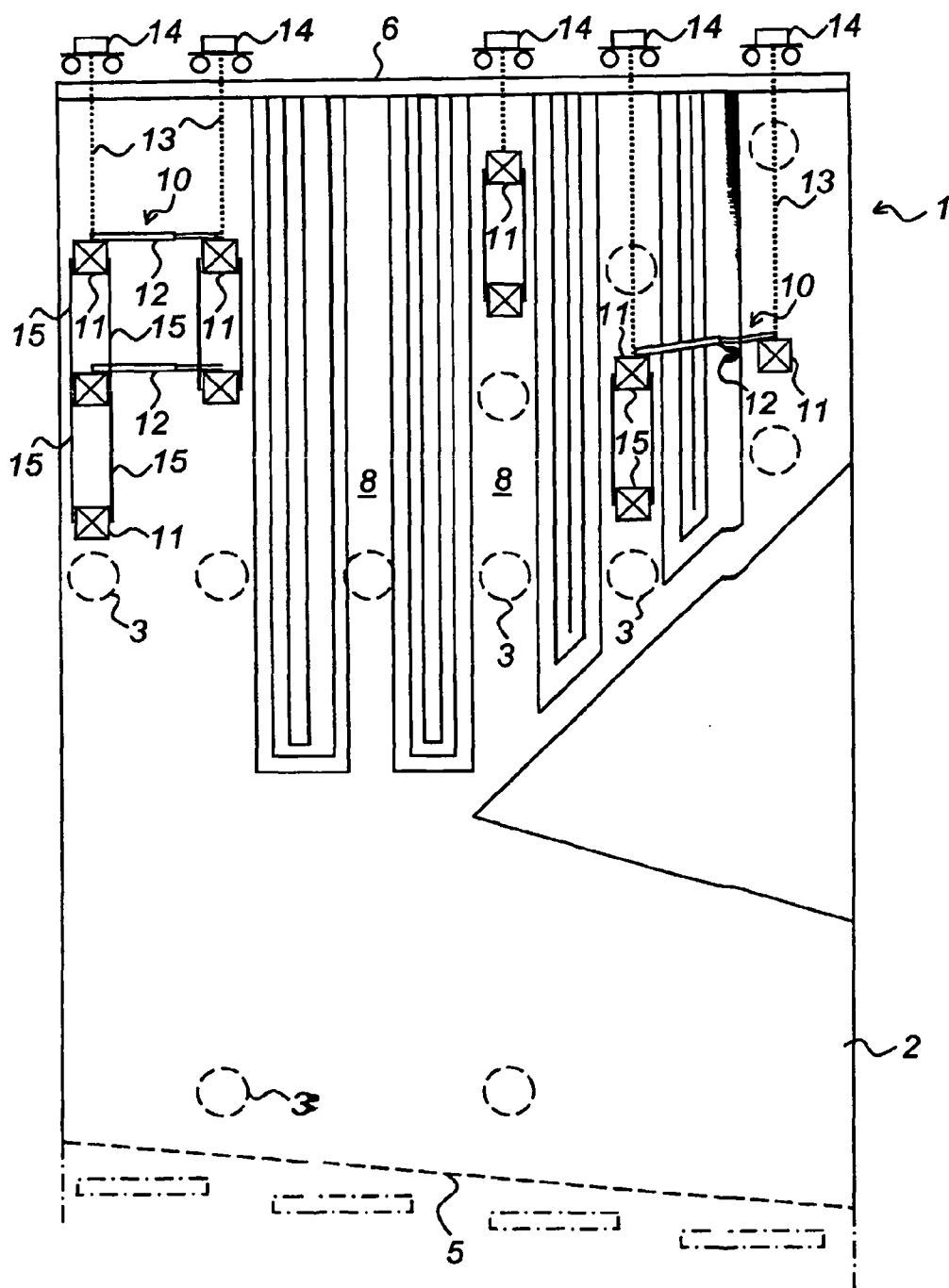
13. An apparatus as claimed in claim 12, characterised in that the telescopic plank (12) consists of an outer and an inner mutually telescoping U section (42, 43), which have downwardly directed U openings with ends (44, 45) curved inwards and the projection of which is limited by a pullout-limiting means (48).

14. An apparatus as claimed in claim 13, characterised in that the pullout-limiting means (48) comprises at least one spring-biased pin (50), which for locking is arranged to be automatically moved from the inner U section (43) through lock openings (51, 52) in the legs of the U-shaped sections (42, 43).

15. An apparatus as claimed in claim 13 or 14, characterised in that the outer U section (42) at an end which is adapted to rest on a girder (11) has at least one vertical hole for insertion of a locking cotter pin, which is arranged to engage in a corresponding hole in the upper side of the girder (11).

16. An apparatus as claimed in any one of claims 1-15, characterised in that the suspension cords are chains (13) hanging down from electrically operated telfers (14) which are arranged on the roof (6) of the vessel (1).

17. An apparatus as claimed in claim 16, characterised in that the telfers (14) are individually remote controlled from the interior of the vessel (1).

1/4**Fig 1**

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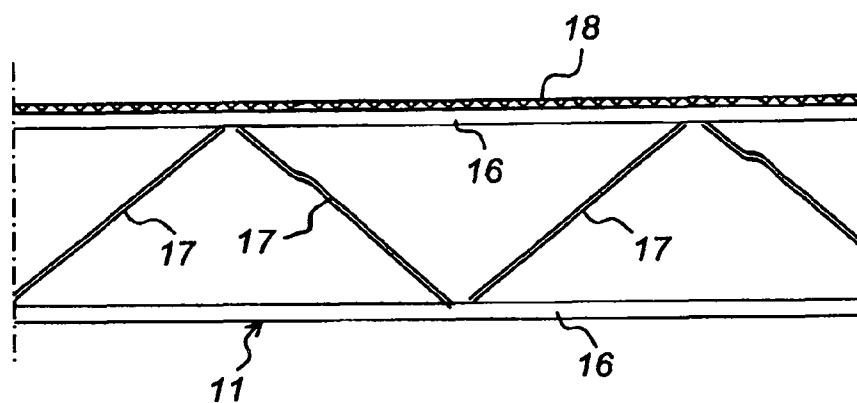


Fig 2

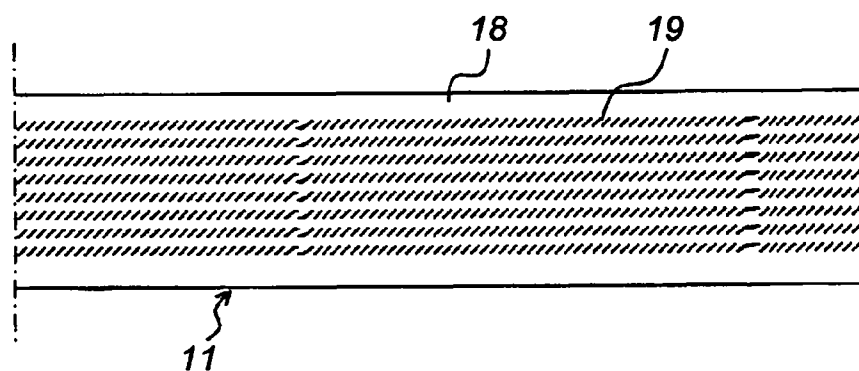
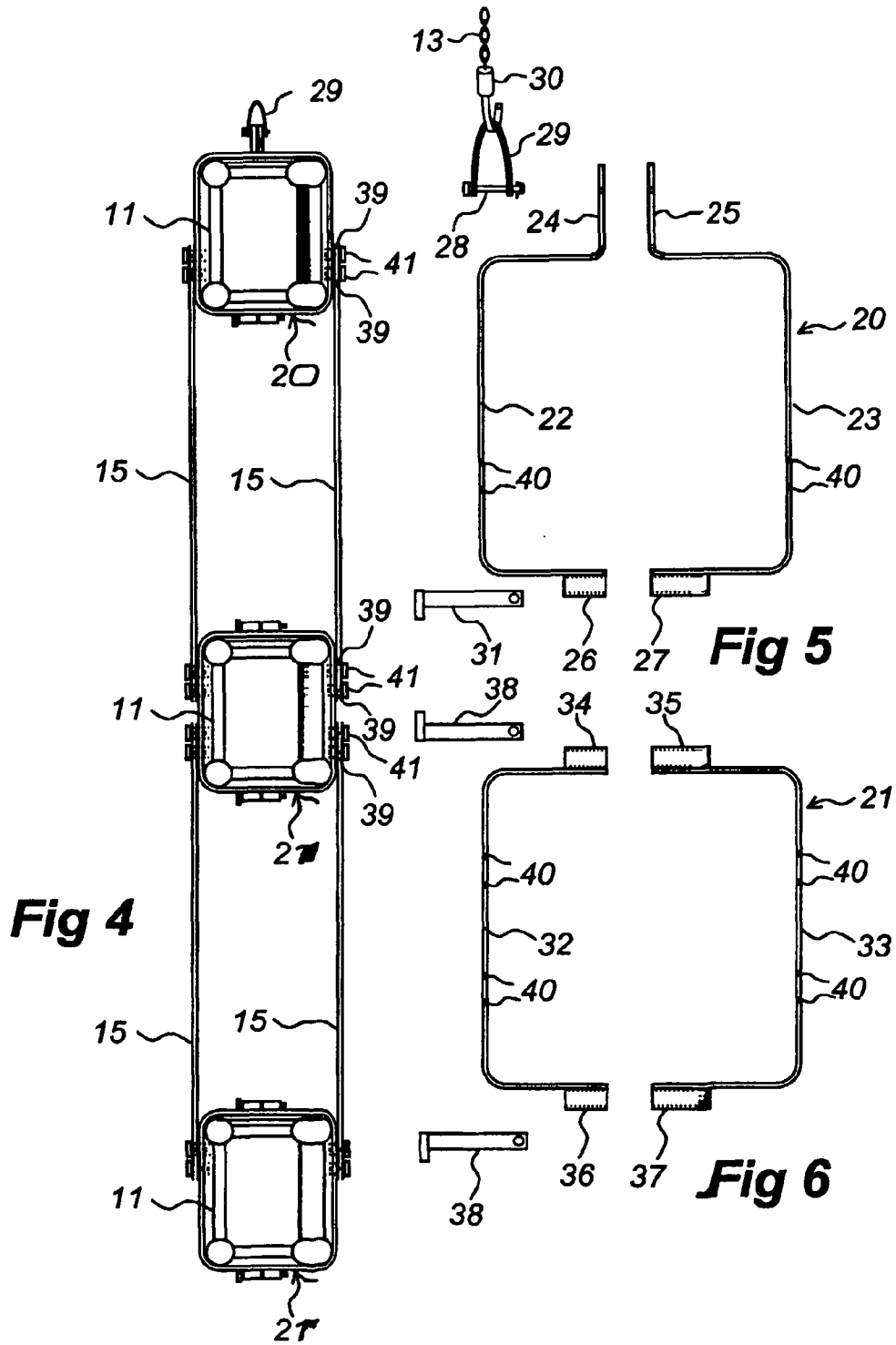


Fig 3

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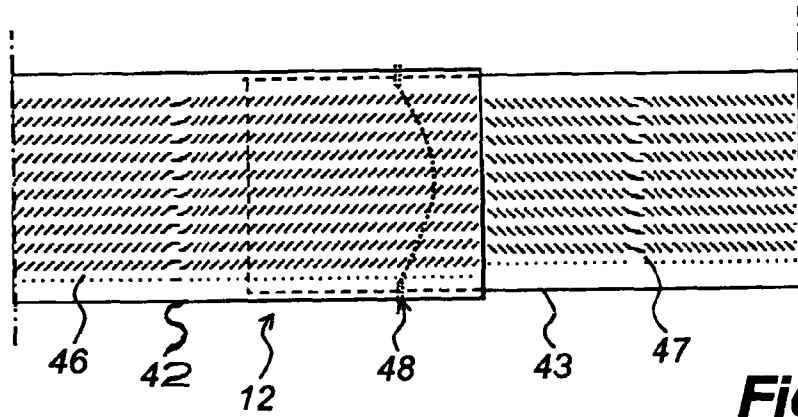


Fig 7

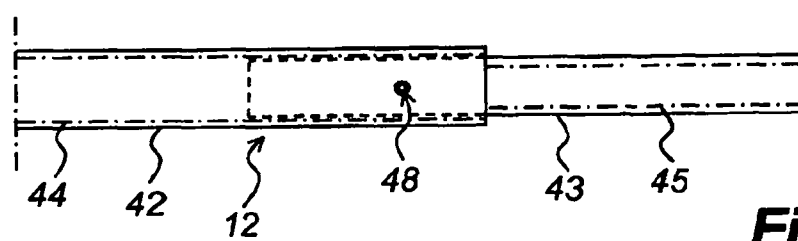


Fig 8

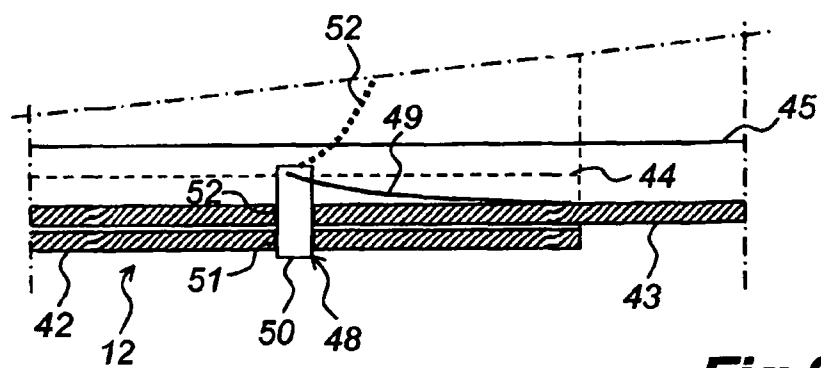


Fig 9