



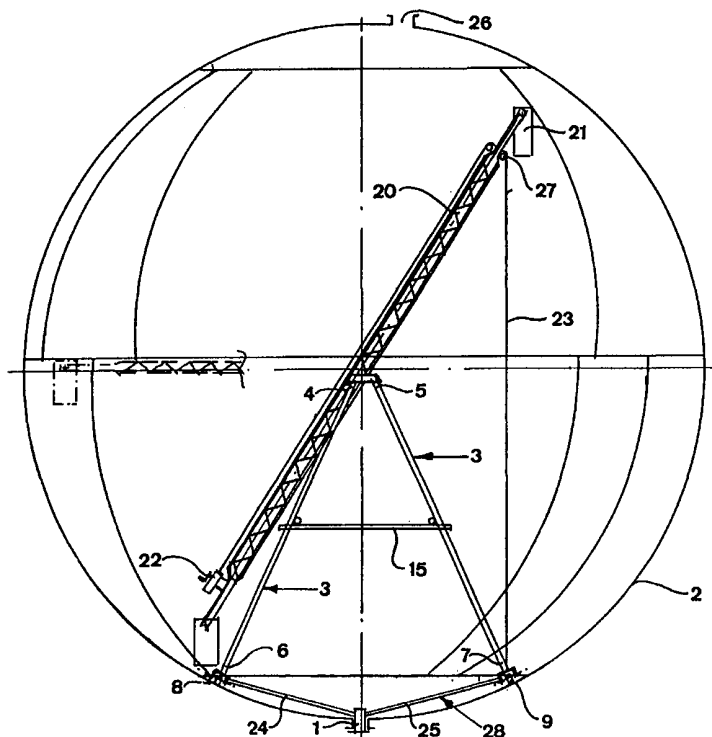
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(54) Title: A DEVICE FOR INTERIOR MAINTENANCE IN AN ESSENTIALLY SPHERICAL VESSEL

(57) Abstract

A device for interior maintenance in an essentially spherical vessel (2), comprising a supporting rack (28) and a bar (20) connected thereto, which bar is pivotally provided and arranged to extend from a hinge member (19), about which it is pivotally provided, to the area of an inner wall of the vessel (2). The bar (20) is arranged to extend in opposite directions from the hinged member (19).



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**A device for interior maintenance in an essentially spherical vessel**

## THE BACKGROUND OF THE INVENTION AND PRIOR ART

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The present invention refers to a device for interior maintenance in an essentially spherical vessel, comprising a supporting rack and a bar connected thereto, which bar is pivotally provided and arranged to extend from a hinge member, about which it is pivotally provided, to the area of an inner wall of the vessel.

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It is previously known that it is difficult, in connection with maintenance, such as inspection, cleaning or painting of spherical or at least essentially spherical vessels of significant size, to reach all parts of the inner wall of the vessel. The problem arises in particular in connection with maintenance of very large vessels, with a diameter of about 15 m, which are used to store gases. Therefore, some type of a rack is required which may be rigged inside the vessel and which makes it possible to reach said parts of the inner wall of the vessel. However, such a rack should not be too complicated and/or be too space-requiring since vessels of said type often are provided with only a relative small opening through which the rack as a whole or in parts may be introduced before it may be rigged in the latter.

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In the American patent document US-A-4 165 799 a rack or a device is described, which is provided with two anchor members arranged to be anchored to the bottom and the top, respectively, of the vessel. It may be appreciated that the inlet opening is located at the top of the vessel. Two arms are provided which extend from the respective anchor member and are rotatably connected to each other in the centre of the vessel. Rotatable bars pivotally arranged

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extend from said centre, in the outer ends of which baskets are arranged to house people. Large forces are needed in order to achieve the torques, which are required for the rotation of the individual bars. Furthermore, a disadvantage of this device is that it  
5 requires the double anchoring in opposite areas of the vessel, which may be difficult to achieve since the inlet opening is displaced and not provided diametrically opposite to the location in the bottom of the vessel where suitably one of the anchor members is anchored. Furthermore, the device is relatively complicated and  
10 requires long time to set-up, in particular due to the complexity and the size of the bars and the driving devices of the bars.

In the Japanese patent document JP 1-192956 an other device is shown for interior maintenance of an essentially spherical vessel.  
15 This device is constructed in such a way that it only requires one anchor member, which is anchored in the bottom of the vessel. From this member an arm or a mast extends substantially vertically upwards, wherein said arm in the area of the centre of the vessel is connected to a relatively complicated bar device, which is  
20 horizontally pivotally provided about the axis formed by the arm or the mast. Furthermore, the bar device comprises a number of hinges about which a bar may be pivoted in such a way that a basket provided in the end of the latter is moved in a substantially vertical direction along the inner wall of the vessel. The complicated  
25 structure of the bar device is a disadvantage of the device, which makes the device unnecessarily heavy and requires a relative large opening for introducing the device into the vessel. This is a disadvantage since such large openings not always are available of present vessels. Nor is the device such that it guarantees a good  
30 stability since it utilises a simple anchoring and a significant bending moment may be expected of the arm, which extends from the anchor member and the purpose of which is to carry the whole bar device.

## SUMMARY OF THE INVENTION

An object of the present invention is to obtain a device for interior maintenance in an essentially spherical vessel, which device shows good stability, when it is provided in such a vessel, and features which makes it possible to design the device in such a way that it is space-saving, i.e. may be introduced into the vessel via a relatively small opening. Furthermore, such a device which in a simple and quickly manner may be rigged inside the vessel.

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This object is achieved by a device of the initially defined type, which is characterized in that the bar is arranged to extend in opposite directions from the hinge member.

15 Thereby, it becomes possible to achieve a natural balancing of the bar so that its centre of gravity will be located within the area of the hinge member. In particular, this is important when the vessel has a very large diameter and very large bending moment would arise at the hinge member if the bar only would extend in one direction from the hinge member which is the case with previous technique. A weaker supporting rack and consequently a supporting rack being more easy to handle may be used in order to carry the bar than if the bar would have been arranged in a traditional manner. Furthermore, the pivoting of the bar is significantly facilitated when it is allowed to be balanced in this way.

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According to a preferred embodiment, the bar is arranged to extend a distance, which is substantially the same in both directions from the hinge member. Thereby, it becomes possible to arrange the device in the centre of a spherical vessel and to permit the opposite ends of the bar to extend to diametrically opposed areas of the inner wall of the vessel, whereby it becomes possible from one and the same bar to perform maintenance in the vessel at two diametrically opposed areas at the same time, which of course may be time-saving in some cases. Furthermore, a very good balancing of the bar about the hinge member may be achieved, which in turn favour a usage of a simple and not necessarily heavy and strong

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supporting rack and enables pivoting of the bar with a small effort and simple equipment.

5 According to a further preferred embodiment, the supporting rack comprises an anchor member, arranged to be attached to the vessel at a determined location. Furthermore, the supporting rack may advantageously comprise at least one arm, which in a first end is attached to said anchor member, and a pair of leg members, which are connected to each other and to the bar and in a  
10 respective end arranged to be supported against the inner wall of the vessel, wherein the arm in a second end is connected to at least one of the leg members. Thereby, the leg members, the arm and the anchor member may be made relatively weak without a too strong negative influence on the stability of the device. This favours  
15 a simple introducing of the device into the vessel and quick and simple rigging. The anchor member is preferably arranged to be anchored in the centre of the bottom of the vessel, and the leg members are preferably arranged to be met and be connected to each other vertically, right above the anchor member, in the area of  
20 the centre of the vessel since the latter is essentially spherical.

According to a preferred embodiment, each one of the leg members is connected to a roller member via which the leg members are supported by the vessel, and at least one of the leg members is  
25 connected to a pair of roller members provided at a distance from each other in their roller direction. The roller members are preferably arranged to roll in a direction such that their path describes a circle in the centre of which the anchor member is provided. Due to the fact that one of the leg members, according to  
30 the manner mentioned above, is provided with a pair of roller members a larger stability of the device is guaranteed.

According to a further preferred embodiment, the arm is arranged to be turned or rotated about a rotation axis (x), which extends from  
35 the anchor member in a direction towards and through the area, where the leg members are connected to each other and perpendicular to the hinge member about which the bar is pivotally

provided. Thereby, it is possible by rotation of the arm and the leg members about said rotation axis, and by pivoting the bar about the hinge member to bring the end or the ends of the bar to a desired area of the inner wall of a spherical vessel in which the devices is  
5 arranged.

According to a further preferred embodiment, the leg members are pivotally connected to each other and arranged in such a way that their length is adjustable. Thereby, the distance from the anchor  
10 member to the area, where the leg members are connected to each other and where, preferably, the hinge member of the bar is provided, be adapted to vessels of different sizes. Furthermore, this feature enables a simple folding of the rack to a narrow size when it is to be introduced into or removed from the vessel via a relatively  
15 small opening.

According to a further preferred embodiment, the arm is pivotally provided to and from said rotation axis. Thereby, it is also possible to rotate the arm in such a way that this contributes to make the  
20 device narrow, and thereby facilitate the introduction into or removal from the vessel. Furthermore, the pivotability of the arm contributes to make the device adaptable to vessels of different sizes and/or with an inner contour which diverge somewhat from the spherical.

25 According to a further preferred embodiment, the arm is provided in such a way that its length is adjustable. Thereby, the extension of the base of the device, or the diameter of the circle which the roller members are arranged to follow during rotation of the arm about the  
30 rotation axis may be adapted to vessels of different sizes.

According to a further preferred embodiment, the device comprises two opposite leg members, each of which comprises two legs, which extend from the area where the leg members are connected  
35 to each other to a respective roller member, and at least two arms, which extend from the anchor member to a respective leg member. Thereby, the device becomes very stable at the same time as its

geometry still is relatively simple and it comprises few components, which are easy to assemble.

5 According to a further embodiment of the invention, the supporting rack also comprises a supporting member, which extends substantially vertically from the anchor member to the hinge member. By such an embodiment of the supporting rack, the assembly of the device is facilitated and in particular the introduction of the same into the vessel.

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According to a further embodiment of the invention, the bar comprises a first bar portion, which extends in one direction from the hinge member and a second bar portion, which extends in the other opposite direction from the hinge member, wherein the first bar portion is somewhat longer than the second bar portion. Thereby, the supporting rack advantageously has such a length that the hinge member is positioned just above a centre point of the substantially spherical vessel.

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20 Further advantages with and features of the invention will be disclosed in the following description and the remaining dependent claims.

#### BRIEF DESCRIPTION OF THE DRAWINGS

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The device according to the invention is now in an exemplifying but not in a limiting way to be described with reference to the attached drawings, in which

- 30 Fig 1 is a side view which shows a first embodiment of the device arranged in an essentially spherical vessel,  
Fig 2 is a view similar to the one in Fig 1, showing an anchor member, arms and leg members of the device from a first direction,  
35 Fig 3 is a view perpendicular to that in Figs 1 and 2, showing a leg member with roller members connected thereto,



- Fig 4 is a perspective view of the device according to Figs 2 and 3,  
Fig 5 is a view from above of arms, roller members and an anchor member of the device, and  
5 Fig 6 is a detailed view, showing the hinge member and the area where the leg members are connected to each other.  
Fig 7 is a side view which shows a second embodiment of the device.

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

15 From a general point of view, the device comprises a supporting rack 28 and a bar 20 pivotally connected thereto. Thereby, the device comprises an anchor member 1, preferably a pin, which is arranged to be assembled in a centre hole in the bottom of a wall of an essentially spherical vessel 2.

20 Furthermore, the device comprises two leg members 3, which in one end 4, 5 are connected to each other and in respective opposite ends 6, 7 are connected to wheel members 8, 9, arranged to be supported by the inner wall of the vessel 2. Each leg member 3 is connected to a pair of wheel members 8 and 9, respectively,  
25 which are provided at a distance from each other, seen in their roller direction. They are connected to each other via an intermediate piece 10, such as is shown in Figs 3 – 5.

30 Each leg member comprises a pair of legs 11, 12, which in their one end are connected to each other via supporting members 16, 17 and in their other end are connected to opposite ends of the intermediate piece 10. They are provided at a distance from each other at the intermediate piece 10 which distance is larger than the distance at the supporting members 16, 17.

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Furthermore, a support element 14 is provided between the legs 11, 12 and fixed to the both legs 11, 12 of the respective leg member 3.

The support element 14 is provided substantially at the middle of the length of the legs 11, 12. At the same level is a support element 15 provided between and attached to opposite legs 11 of the respective leg member 3.

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At least one of the leg members, in this case both, comprises at least one, according to this embodiment two elongated supporting members 16, 17, which in their one end are attached to the intermediate piece 10 and extend to the area where the leg members 3 are connected to each other. They extend substantially between the legs 11, 12 of the respective leg member 3. They are preferably pivotally attached to or abut the connection pieces 13 in the area of the end 4, 5 which is opposite that at which they are attached to the intermediate piece 10. The supporting members 16, 17 of both the leg members 3 are connected to each other at said opposite end 4, 5 via a hinge member 19, which preferably includes a shaft and which connects the connecting pieces 13. The supporting members 16, 17 are designed as ladders.

20 The hinge member 19, which consequently connects the leg members 3 to each other, also constitutes a joint about which an elongated bar 20 is arranged to pivot. The bar 20 extends from the hinge member 19 in both directions outwardly towards the inner walls of the vessel 2. In both ends of the bar a basket 21 is arranged to receive a person who works with maintenance, such as inspection, reparation or painting of the inner walls of the vessel 2. A drive device for pivoting the bar 20 about the hinge member 19 is also arranged. According to this embodiment, the drive device comprises a cable drive, which includes a winch 22 provided at one end of the bar 20, and a cable 23, which extends from the winch to a block 27, arranged at the opposite end of the bar 20 and from there to an adjacent leg member to which it is attached. By controlling the winch 22, suitably from the adjacent basket 21, it is consequently possible to pivot the bar 20 and thereby achieve a displacement of the basket device 21 vertically along the inner wall of the vessel 2. The bar 20 is preferably arranged in such a way

that its length may be adjusted in accordance with the inner diameter of the vessel 2.

5 Furthermore, two arms 24, 25, are in their one end attached to the anchor member 1 and extend in opposite directions towards the respective opposite leg members and are connected to the latters via the respective intermediate pieces 10. The arms 24, 25 are turnably or rotatably arranged about a rotation axis x which extends from the anchor member 1 towards and through the area where the  
10 leg members 3 are connected to each other. Such a turning or rotation may be achieved either by the anchor member 1 being rotatably guided in the centre hole 2 or by the arms 24, 25 being turnably provided on the pin 1, for example by a sleeve or a bearing to which they are attached.

15 Advantageously, the leg members 3 are arranged in such a way that their length may be adjusted, and rotatably in response to each other so that their mutual angle may be changed. Thereby, it is possible to adapt the height of the device, or more closely the  
20 position of the hinge member 19, to the inner diameter of the vessel in which the device is arranged. The components of the leg members 3, i.e. the legs 11, 12 and the supporting members 16, 17 may thereby be telescopically provided. Furthermore, in order to achieve the rotatability, guiding members, not more closely shown,  
25 are preferably provided in the connecting members 13, to which the hinge leg members 11, 12 are rotatably connected.

30 Furthermore, in order to adapt the position of the wheel members to different vessel diameters, the arms 24, 25 are suitably arranged in such a way that their length may be adjusted. For example, they are designed as telescopic arms. They are preferably also pivotally provided to and from the above defined rotation axis x. They are also preferably detachably connected to and/or pivotally connected  
35 to the intermediate pieces 10 in order to enable a simple folding of the whole device when this is to be introduced into or removed from the ceiling via a outlet opening 26.

In order to rotate the whole device about the rotation axis, which extends from the anchor member 1 and to the area of the hinge member 19, the device comprises a drive device, not more closely shown, for driving at least any of the roller members 8, 9. Suitably, such a drive device is controlled from a control member provided at one end or both ends of the bar 20 within the reach of a person who is in one of the basket devices.

According to a second embodiment, shown in Fig 7, the supporting rack 28 comprises a supporting member 29, which extends substantially vertically in the direction of the rotation axis x between the anchor member 1 and the hinge member 19, which permits the pivotability of the bar in a vertical plane. The hinge member 19 may also be provided to permit rotation of the bar in the horizontal plane, i.e. about the rotation axis x. According to an alternative embodiment, this rotation in the horizontal plane may also be permitted with the aid of a bearing at the anchor member 1. The supporting member 29, in the shown embodiment, comprises, as the bar 20, a framework structure, which may be light and have a high strength.

According to a further embodiment, which also is illustrated in Fig 7, the bar 20 comprises a first bar portion 20', which extends in one direction from the hinge member 19 and a second bar portion 20'', which extend in the other opposite direction from the hinge member 19. Such as is shown in Fig 7, the first bar portion 20' is somewhat longer than the second bar portion 20''. Furthermore, the supporting member 29 has such a length that the hinge member 19 is positioned just above a centre point in the essentially spherical vessel 2, which results in the first longer bar portion 20' being intended for work in the lower half of the vessel 2 and the second shorter bar portion 20'' being intended for work in the upper half of the vessel 2. It is to be noted that this embodiment of the bar 20 also may be combined with the first embodiment and that the embodiment of the bar, which is shown in the first embodiment may be combined with the second embodiment.

Of course a number of modifications and variants of the device according to the invention will be obvious for a person skilled in the art without departing from the scope of the invention, such as it is defined in the following claims.

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For example, it is obvious that the support members 14, 15 are attached to the leg members 3 or their legs 11, 12 in a detachable and displaceable way so that their position relative the leg members 3/ the legs 11, 12 may be adapted as the angles between these by

10 mutual pivoting are changed.

### Claims

1. A device for interior maintenance in an essentially spherical vessel (2), comprising a supporting rack (28) and a bar (20) connected thereto, which bar is pivotally provided and arranged to extend from a hinge member (19), about which it is pivotally provided, to the area of an inner wall of the vessel (2), characterized in that the bar (20) is arranged to extend in opposite directions from the hinge member (19).
2. A device according to claim 1, characterized in that the bar (20) is arranged to extend a distance, which is substantially the same in opposite directions from the hinge member (19).
3. A device according to any one of the claims 1 and 2, characterized in that supporting rack (28) comprises an anchor member (1), arranged to be attached to the vessel (2) at a determined location.
4. A device according to claim 3, characterized in that supporting rack also comprises
- at least one arm (24, 25), which in a first end is attached to said anchor member (1), and
  - a two leg members (3), which are connected to each other and to the bar (20) and in a respective end (6, 7) arranged to be supported by the inner wall of the vessel (2), wherein the arm (24, 25) in a second end is connected to at least one of the leg members (3).
5. A device according to claim 4, characterized in that the leg members (3) are connected to roller members (8, 9) via which the leg members are supported by the vessel (2).
6. A device according to claim 5, characterized in that at least one of the leg members (3) is connected to a pair of roller members (8, 9), which are provided at a distance from each other in their roller direction.

7. A device according to claim 6, characterized in that the leg member (3) which is connected to said pair of roller members (8, 9) comprises two elongated legs (11, 12), which extend at a distance from each other from an area (18), where the leg members (3) are  
5 connected to each other, to the area of a respective roller member (8, 9) of the pair of roller members.
8. A device according to any one of the claims 4 – 7, characterized in that the arm (24, 25) is arranged to be turned or rotated about a  
10 rotation axis (x), which extends from the anchor member (1) in a direction towards and through an area (18), where the leg members (3) are connected to each other, and perpendicular to the hinge member (19) about which the bar (20) is pivotally provided.
- 15 9. A device according to any one of the claims 4 – 8, characterized in that the leg members (3) are pivotally connected to each other.
10. A device according to any one of the claims 4 – 9, characterized in that the leg members (3) are arranged in such a way that their  
20 length is adjustable.
11. A device according to any one of the claims 8 – 10, characterized in that the arm (24, 25) is pivotally provided to and from said rotation axis (x).  
25
12. A device according to any one of the claims 4 – 11, characterized in that the arm (24, 25) is arranged in such a way that its length is adjustable.
- 30 13. A device according to any one of the claims 3 – 12, characterized in that the supporting rack (28) comprises two opposite leg members (3), each of which comprises two legs (11, 12), which extend from an area (18) where the leg members are connected to each other to a respective roller member (8, 9), and at  
35 least two arms (24, 25), which extend from the anchor member (1) to a respective leg member (3).

14. A device according to claim 3, characterized in that the supporting rack (28) also comprises a supporting member (29), which extends substantially vertically from the anchor member (1) to the hinge member (19).

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15. A device according to any one of the preceding claims, characterized in that the bar (20) comprises a first bar portion (20'), which extends in one direction from the hinge member (19) and a second bar portion (20''), which extends in the other opposite  
10 direction from the hinge member (19), wherein the first bar portion (20') is somewhat longer than the second bar portion (20'').

16. A device according to claim 15, characterized in that the supporting rack (28) has such a length that the hinge member (19)  
15 is positioned just above a centre point of the substantially spherical vessel (2).



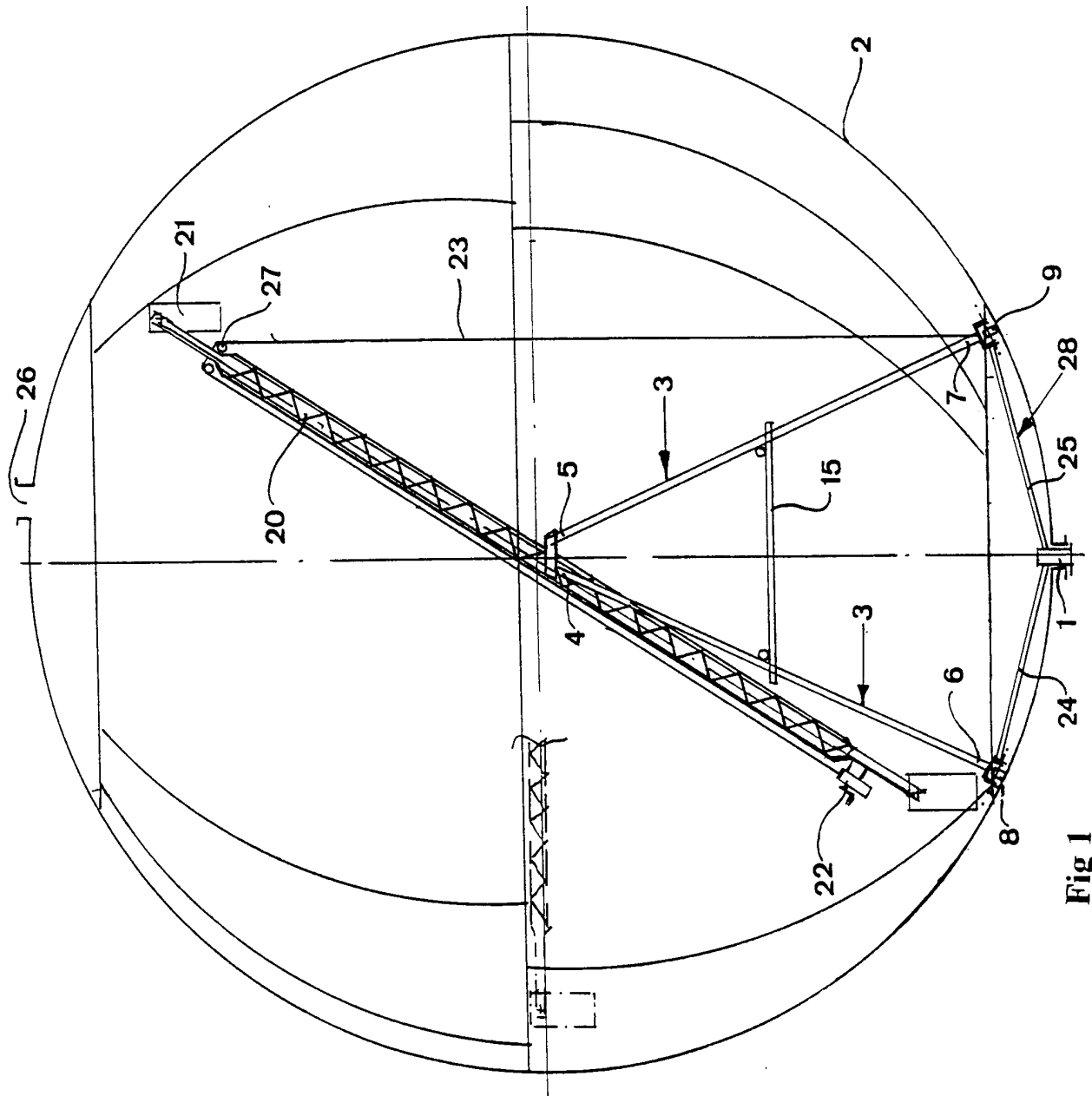


Fig 1

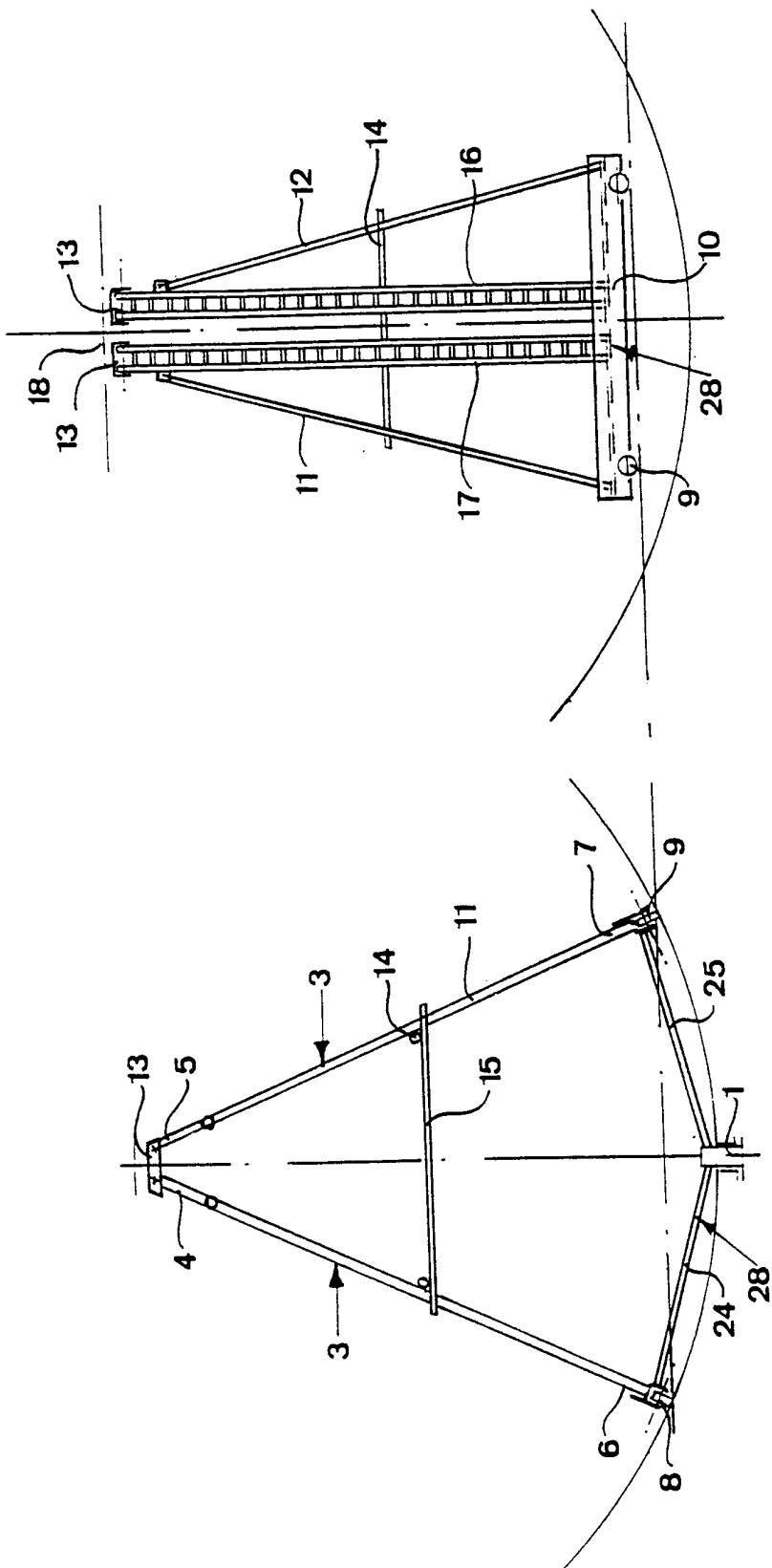


Fig 3

Fig 2

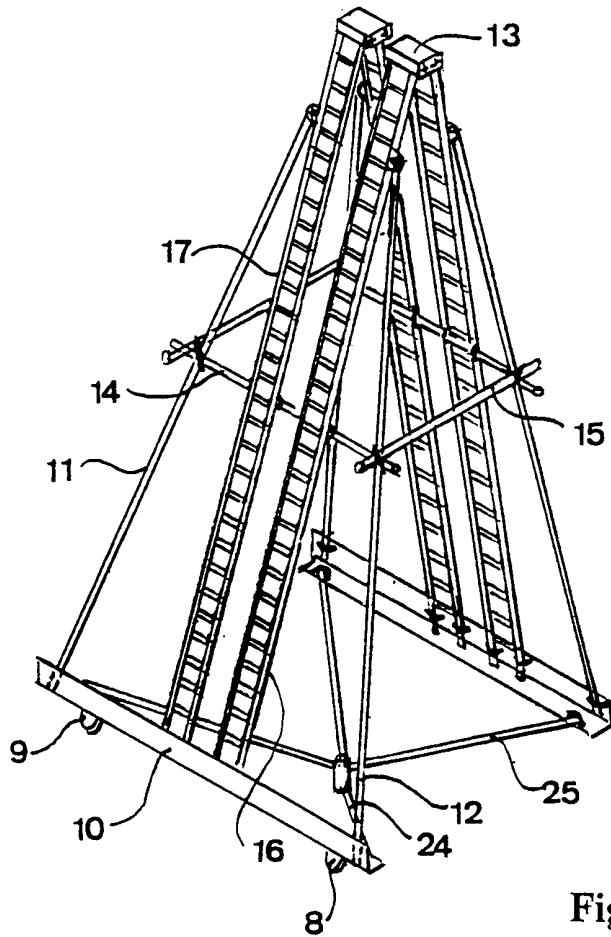


Fig 4

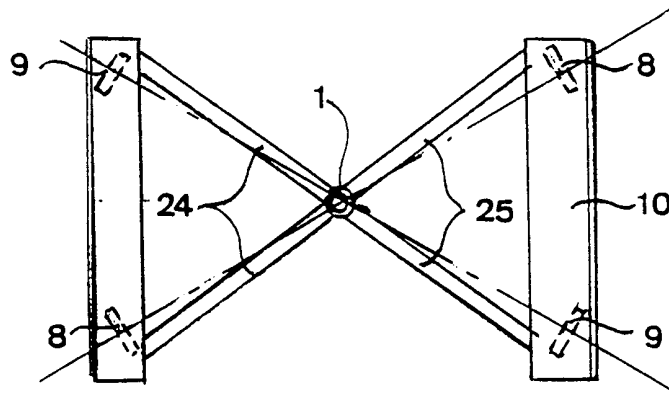


Fig 5

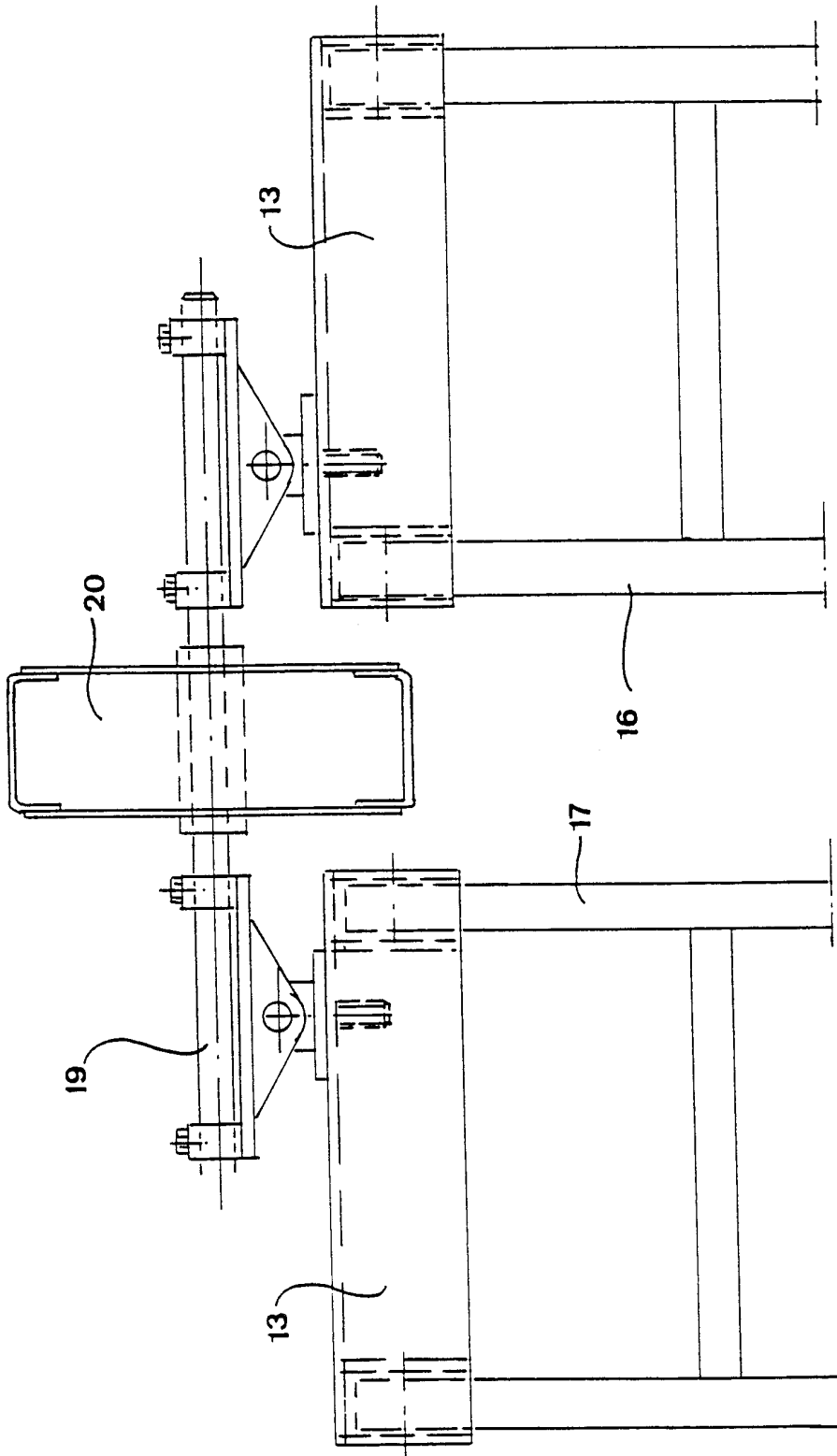


Fig 6

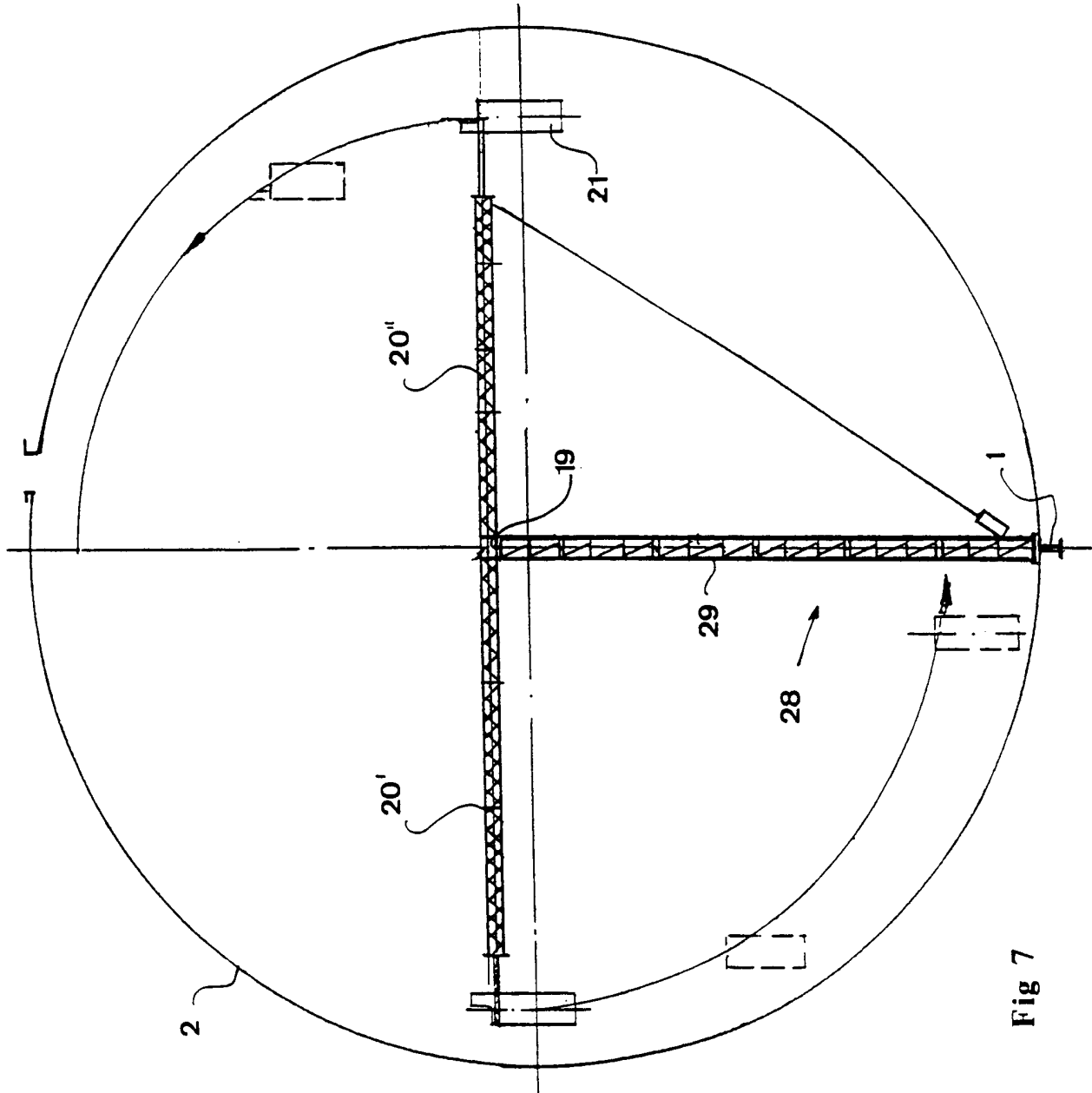


Fig 7

# INTERNATIONAL SEARCH REPORT

International application No.

**PCT/SE 99/00224**

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>		
<p><b>IPC6: E04G 1/36</b>          According to International Patent Classification (IPC) or to both national classification and IPC</p>		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols)		
<p><b>IPC6: E04G, B08B</b></p>		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
<p><b>SE,DK,FI,NO classes as above</b></p>		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
<p><b>EPODOC, WPI, PAJ</b></p>		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
D,A	US 4165799 A (G.R. MUNOZ), 28 August 1979 (28.08.79), figure 1, abstract  --	1-16
D,A	JP 1192956 (SHIMIZU CORP) 1989-08-03 (abstract) (online)(retrieved on 1999-05-26). Retrieved from: EPO PAJ Database. Figure 1  --	1-16
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A	US 3306396 A (J.B. GOSS), 28 February 1967 (28.02.67)  --	1-16
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
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26 May 1999		19 -06- 1999
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

03/05/99

International application No.

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