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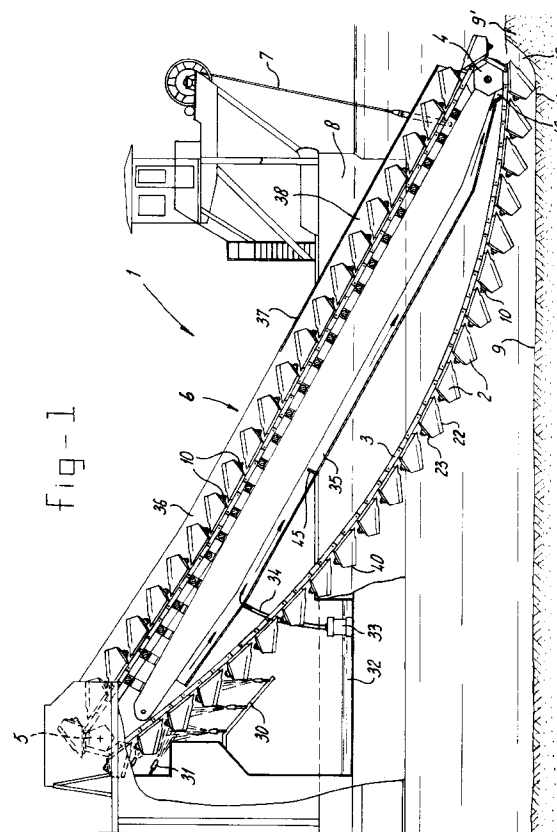
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(54) **Method for dredging using a bucket dredger, and bucket dredger and scoop element therefor.**

(57) The invention relates to a method and installation for excavating a bed (9) which is located underwater with the aid of a bucket dredger (1) provided with bucket-like scoop elements (2). The scoop elements are provided with venting means (10) to remove the air therefrom before scooping. Removal of the air preferably takes place as the scoop element (2) is being brought into the water. The venting means (10) are arranged on the bucket base and/or bucket wall(s).



The invention relates to a method for excavating a bed which is located underwater with the aid of a bucket dredger provided with bucket-like scoop elements, with which method a scoop element is, successively, introduced into the water, filled underwater with spoil, brought back above water filled with spoil and emptied above water.

A method of this type is generally known and has the great advantage that, by this means, a uniform, flat and accurate bottom profile can be obtained, and that bulky refuse causes little inconvenience to a bucket dredger which has bucket-like scoop elements. However, when a bucket dredger is used, the buckets cause the water to become very cloudy because, inter alia, fine soil particles are brought into suspension, which particles then disperse through the water and settle again elsewhere. This is undesirable when dredging sludge contaminated with heavy metals and other hazardous substances, since pollutants have the tendency to adhere to fine soil particles in particular and will therefore disperse through the water when this is clouded.

For the above reasons, when contaminated sludge is dredged, in practice it is not bucket dredgers which are used, but suction dredgers or grab dredgers, which in theory should cause little turbidity. Suction dredgers have the disadvantage that, because water is sucked up as well, a large volume has to be dealt with, that bulky refuse can cause the suction device to seize or malfunction and that the accuracy and flatness of the bottom profile obtained leaves something to be desired. With grab dredgers too it is very difficult to obtain an accurate and flat bottom profile and where there is bulky refuse, such as a block of wood, the jaws do not always close completely, with the result that spoil, such as sludge, can flow out of the jaws and the contamination can disperse.

US-A-3,736,677 discloses a scraper which is pulled by a vessel and has a top wall, side walls and a rear wall but no front wall or bottom wall. The front and base are thus open. This scraper is intended to

- a) drag sludge over the bottom to the bank and dump it on the bank or
- b) to bring sludge into motion and thus to suspend it in the water, after which the current carries away the suspended sludge.

Holes are made at the rear of the scraper in the rear wall and top wall, so that water displaced by sludge scraped up by the scraper can escape from the latter.

DE-A-2,417,545 discloses a conveyor installation for conveying buckets filled with ores, minerals and other fluid-containing materials upwards along a ladder. The conveyor buckets are provided with holes along the ladder and in the base, so that the material conveyed is dewatered during conveying. This conveyor installation is not used in water, and any fine material present will flow out of the buckets through the holes.

For dredging harbours and navigation channels, stringent requirements are applied in respect of the flatness and accuracy of the bottom profile, whilst the sludge is often severely contaminated and contains a large amount of bulky refuse. In these cases the use of bucket dredgers is therefore desirable, but the production of turbidity must be counteracted.

The aim of the present invention is to provide a method of the type mentioned in the preamble, with which method the production of turbidity is counteracted in order thus to prevent dispersal of contaminated sludge.

This aim is achieved according to the invention in that air is removed from the bucket-like scoop element before said scoop element is filled with spoil. Removal of the air present in the bucket-like scoop element from the latter before scooping prevents said removal occurring during or after scooping. This prevents the sludge being brought into motion by the escape of air trapped in the bucket, whilst the efficiency is also increased, since spoil which is taken up in the scoop element is no longer "blown" out of the scoop element as a consequence of the escape of air bubbles.

If the bucket-like scoop element is brought into the water with its scoop opening essentially facing downwards, said removal of air according to the invention advantageously essentially takes place whilst the scoop is being brought into the water. In this way the bubble of air present in the bucket-like scoop element is driven out as the scoop element is lowered into the water by the water which rises up relative to the scoop element, so that bubbling up from the water of air originating from the bucket-like scoop element is completely prevented. If necessary, any residual air can still escape as the scoop element is brought to the bottom. It is also conceivable that all air escapes only after the scoop element is completely under water.

The invention also relates to a bucket dredger comprising an endless conveyor provided with at least one bucket-like scoop element having a bucket base, a scoop opening and wall(s). According to the invention, with this arrangement a venting device is arranged on the bucket base and/or walls of the scoop element. Many venting devices known per se from the prior art, such as a housing attached to the bucket base and/or wall of the scoop element, with a shut-off element arranged in the chamber formed in the housing, inlet means and an outlet orifice which can be closed by the shut-off element, can be used for a venting device of this type.

According to an advantageous embodiment of the invention, the shut-off element is arranged in the chamber so that it is freely movable and the specific gravity of the shut-off element is essentially higher than that of water, the outlet orifice essentially facing away from the scoop opening of the scoop element. In this way use is advantageously made of gravity for

operation of the shut-off element. As the bucket-like scoop element is lowered, the shut-off element will expose the outlet orifice, whereas when the scoop element filled with spoil is raised the outlet orifice will be closed by the shut-off element, so that no spoil can flow out of the bucket.

To ensure a good closure between shut-off element and outlet orifice, it is advantageous, according to the invention, if the shut-off element is covered with a pliable material. A pliable material of this type, such as rubber, will be somewhat compressed by the weight of the shut-off element and improve the closure as a result.

To prevent refuse, such as branches, from being able to come between the shut-off element and the outlet orifice, as a result of which the latter can no longer be closed completely, it is advantageous, according to the invention, if the inlet means comprise an inlet orifice and a plate which is movable backwards and forwards along a guide, said plate being movable between a position which closes the inlet orifice and a position which exposes the inlet orifice. In the exposing position, the plate leaves a sufficiently large passage for air open, whereas during scooping the plate is pushed into its closing position by the spoil scooped from the bottom, as a result of which the chamber, with the shut-off element therein, is shut off from the bucket and, therefore, no refuse can come between shut-off element and outlet orifice.

The invention also relates to a bucket-like scoop element, such as an element for a dredger installation, in particular a bucket dredger.

The invention will now be explained in more detail below with the aid of an illustrative embodiment shown in the drawing. In the drawing:

Figure 1 shows a diagrammatic side view, partially in cross-section, of part of a bucket dredger according to the invention.

Figure 2 shows a cross-section of a bucket-like scoop element according to the invention, with the venting device in the closed position, and

Figure 3 shows a cross-section of a bucket-like scoop element according to the invention, with the venting device in the open position.

Figure 1 shows part of a bucket dredger 1, comprising a platform 8 on which a ladder 6 with bucket-like scoop elements 2 (designated buckets below) is installed. The buckets 2 are fixed to an endless chain 3, which runs round a hexagon 4 at the excavating end of the ladder and round a pentagon 5 at the discharge end of the ladder. At the excavating end the ladder is suspended on ladder wires 7, with the aid of which the dredging depth is adjustable.

The operation of a bucket dredger of this type is generally known. The buckets are conveyed round anticlockwise (seen according to Figure 1) with the aid of the chain. Successively, they are brought, with their scoop opening 22 essentially facing downwards,

into the water at 40, an air bubble being present in the bucket, conveyed further to 41, where they scrape over the excavated part of the bottom 9, and then, while turning around the hexagon 4 at 42, scoop up spoil from that part of the bottom 9' still to be excavated. In the case of the installations disclosed in the prior art, the air bubble present in the buckets 2 will essentially escape from the buckets 2 during scraping and scooping. This escape of the air bubble leads to appreciable turbidity, especially when the spoil is fine, and consequently to dispersal of fine spoil. Moreover, this escape of air has an adverse effect on the efficiency since spoil which has been scooped up escapes from the bucket when air escapes. After scooping, the filled buckets are conveyed upwards to pentagon 5, where they are emptied, usually shaking, into, for example, a chute (not shown). The emptied buckets 2 are then guided downwards again, into the water and to the bottom 9, 9'. Using a bucket dredger of this type, the bottom to be dredged is generally worked in strips by moving the bucket dredger backwards and forwards, essentially perpendicular to the plane of the drawing in Figure 1, with the aid of anchored cables.

In accordance with the invention a venting device 10 is fixed to the bucket base 23 of each bucket 2, which bucket base is located essentially opposite the scoop opening 22. Many of the venting devices disclosed in the prior art are usable per se for a venting device of this type. To counteract turbidity, and thus dispersal of relatively fine sludge particles, it is important that the venting device allows the air contained in the bucket to escape therefrom before the bucket is filled with spoil, such as sludge, at the bottom 9, 9'. Venting preferably takes place as the bucket comes into the water at 40, since this then prevents air bubbles originating from the bucket from rising in the water. An advantageous embodiment of the venting device will be described in more detail below in connection with Figures 2 and 3.

After the buckets have been scooped full, material will fall out of the buckets as so-called "spill" as they are raised. Said spill, which comprises a large amount of fine spoil, causes turbidity if it comes into the water. As explained above, this is undesirable in the case of, inter alia, contaminated sludge. This can be prevented by means of the spill collection means described in NL-A-93.00482 and a corresponding European Patent Application filed at the same time as the present Application (both Applications are in the name of the present Applicant). In order to counteract this turbidity caused by spill, a gutter 35 is arranged beneath the ladder 6, between the ascending and descending parts of the chain. Said gutter 35 collects the spill and carries the spill away towards the excavating end of the ladder, where the spill returns to the bottom at the hexagon. In this way turbidity of the water column above that part of the bottom 9 which has

already been excavated is counteracted and the spill flowing back to the bottom at the hexagon 4 can be dredged up again by the buckets. This re-dredging can occur either immediately or when a subsequent strip ("cut") is dredged.

To prevent spill falling outside the gutter 35, on the ascending part of the chain the buckets are enclosed between side plates 36 fixed to the ladder 6. Said side plates 36 extend essentially over the entire ladder length, from near the pentagon 5 located at the discharge end to near, or even alongside, the hexagon 4 located at the excavating end. At their tops, the side plates 36 are provided, at least insofar as said plates are located in the water during dredging, with a cover 37 which joins the side plates 36 to one another, so that in the water the filled buckets are conveyed upwards as it were through a tunnel 38 enclosed by the gutter 35, the side plates 36 and the cover. This substantially prevents spill from being able to disperse in the water. All spill is returned to the excavating end, where it is deposited on the bottom, after which the spill can be dredged up again.

When the filled buckets are emptied at the pentagon 5, there will be residual spoil adhering in and to the buckets. To prevent said spoil from being washed off the buckets 2, and causing turbidity, as the buckets 2 are brought through the water to the bottom 9, 9', the buckets are rinsed clean with the aid of water under high pressure. To this end, injection nozzles 31 and 30 are fitted, to spray the buckets clean from the outside and from the inside respectively. The rinsing water is collected in a trough 32 and pumped by means of a pump 33 via pipe 34 into the gutter 35. Via gutter 35, the rinsing water is fed, with spoil and spill, to the hexagon 4 in the manner described above.

Figure 2 shows a bucket 2 according to the invention, as the bucket 2 is rising through the water. At this point the venting device 10 is in the closed position. Figure 3 shows a similar bucket 2 as the bucket 2 is being lowered through the water to the bottom 9, 9'. The air can escape from the bucket, for example as indicated by arrows 50. The venting device 10 is now in the open position. The venting device 10 comprises a housing 11 which is fixed to the bucket base 23 and has a chamber 24, in which a shut-off element 18 is fitted. Inlet means 13 are arranged on the bucket side of the housing 11 and an outlet orifice 12, which can be closed by means of the shut-off element 18, is arranged on the opposite side (that is to say facing away from the scoop opening 22 (Figure 1) of the bucket).

The shut-off element 18, in the form of a ball, is fitted so that it is freely movable in the chamber 24, so that when the bucket turns round said ball 18 can move by itself from the position shown in Figure 2 into the position shown in Figure 3, and vice versa. By this means the outlet orifice 12 is closed automatically when the bucket 2 turns around hexagon 4 during scooping and opened automatically when bucket 2

turns around pentagon 5 during discharge. To ensure reliable operation underwater with this arrangement, the ball must have a specific gravity higher than that of water. So that the ball is easily guided towards the outlet orifice 12 as the bucket 2 tilts upwards around the hexagon 4, the chamber 24 is narrowed, preferably tapered (housing section 21) towards the outlet orifice and terminates in a dome-like curvature 20 which faces outwards with respect to the chamber. In cross-section, perpendicular to the plane of the drawing in Figures 2 and 3, the chamber 24 is preferably circular. However, other shapes are also conceivable. A good seal is ensured by covering the ball 18 with an elastic material 19, such as rubber.

The inlet means 13 comprise a plate 14 which is movable along guides 15. The guides 15 are formed by pins, which are inserted through holes 17 in the plate 14. The stops used for the plate 14 are, on one side, nuts 16 screwed on the pins 15 and, on the other side, the bucket base 23 and/or edges of the housing 11. The plate moves under the influence of gravity in the same direction as the shut-off element 18. What is achieved by this means is that as the outlet orifice 12 is exposed by the ball, the inlet means expose a passage 26 for air. The width b of said passage 26 depends on the chosen length of the pins 15. A suitable choice of width prevents coarser articles, or pieces of spoil, from being able to pass into the chamber and impede good closure of the outlet orifice. As soon as the bucket is filled with spoil, said spoil will press against the plate 14 and, as a result, close the passage 26. With suitable positioning and sizing of the venting device 10, said closure of the passage 26 can take place before the shut-off element 18 closes off the outlet orifice 12.

The operation of the venting device according to Figures 2 and 3 is as follows:

When the bucket 2 is brought into the water at 40 (Figure 1) the scoop opening 22 thereof is essentially facing downwards and the outlet orifice 12 of the venting device 10 is essentially facing upwards. As a result of gravity, the shut-off element 18 and the plate 14 will have been lowered down to a suitable stop, which in Figures 2 and 3 respectively is formed by the plate 14 and the nuts 16. As the bucket 2 is lowered into the water, the air contained in the bucket 2 can then be driven out of said bucket by the water, which is rising with respect to the bucket 2. As the bucket fills with spoil, the plate 14 can be pushed back by said spoil, as a result of which passage 26 closes. At the end of filling the bucket is turned over around hexagon 4, after which the scoop opening 22 essentially faces upwards. The outlet orifice 12 now faces downwards and the shut-off element 18 will now close off the outlet orifice 12 under the influence of gravity, the covering 19 ensuring a good seal because of its pliability. As soon as the bucket is emptied at pentagon 5, the shut-off element 18 and the plate 14 will drop against

the plate 14 and the nuts 16, respectively, under the influence of gravity as the bucket tilts downwards and the outlet orifice will be exposed.

It will be clear that many types of venting devices are conceivable for the venting device without going beyond the essence of the invention. Venting of scoop elements can, in accordance with the invention, also be used with other types of dredging. It will also be clear that bucket-like scoop element or bucket is to be understood to mean any bin-shaped body which can be used in particular for dredging. It is also conceivable that all or part of the venting device is fixed to a wall 44 of the bucket.

Claims

1. Method for excavating a bed which is located underwater with the aid of a bucket dredger (1) provided with bucket-like scoop elements (2), with which method a scoop element (2) is, successively, introduced into the water, filled underwater with spoil, brought back above water filled with spoil and emptied above water, characterised in that air is removed from the bucket-like scoop element (2) before said scoop element (2) is filled with spoil.
2. Method according to Claim 1, wherein the bucket-like scoop element (2) is brought into the water with its scoop opening (22) essentially facing downwards, characterised in that the removal of air essentially takes place as the scoop is being brought into the water.
3. Bucket dredger comprising an endless conveyor (3) provided with at least one bucket-like scoop element (2) having a bucket base (23), a scoop opening (22) and wall(s) (44), characterised in that a venting device (10) is arranged at the bucket base (23) and/or bucket wall(s) (44) of the scoop element (2).
4. Bucket dredger according to Claim 3, characterised in that the venting device (10) comprises a housing (11) attached to the bucket base (23) and/or bucket wall (44), with a shut-off element (18) arranged in the chamber (24) formed in the housing (11), inlet means (13) and an outlet orifice (12) which can be closed by the shut-off element (18).
5. Bucket dredger according to Claim 4, characterised in that the shut-off element (18) is arranged in the chamber (24) so that it is freely movable and in that the specific gravity of the shut-off element (18) is essentially higher than that of water, the outlet orifice (12) essentially facing away

from the scoop opening (22) of the scoop element (2).

6. Bucket dredger according to either of Claims 4 and 5, characterised in that the shut-off element (18) comprises an essentially spherical body and in that the chamber (24) is essentially tapered towards the outlet orifice (12) and at the outlet orifice terminates in a curvature (20) which faces outwards with respect to the chamber.
7. Bucket dredger according to one of Claims 4 - 6, characterised in that the shut-off element (18) is covered with an elastic material (19), such as rubber.
8. Bucket dredger according to one of Claims 4 - 7, characterised in that the inlet means (13) comprise an inlet orifice (26) and a plate (14) which is movable backwards and forwards along a guide (15), said plate (14) being movable between a position which closes the inlet orifice and a position which exposes the inlet orifice.
9. Bucket dredger according to one of Claims 3 - 8, characterised in that the venting device closes and opens automatically under the influence of gravity, the venting device being opened when the scoop element moves downwards and closed when the scoop element moves upwards.
10. Bucket-like scoop element, such as for a dredging installation, according to one of Claims 3 - 9.

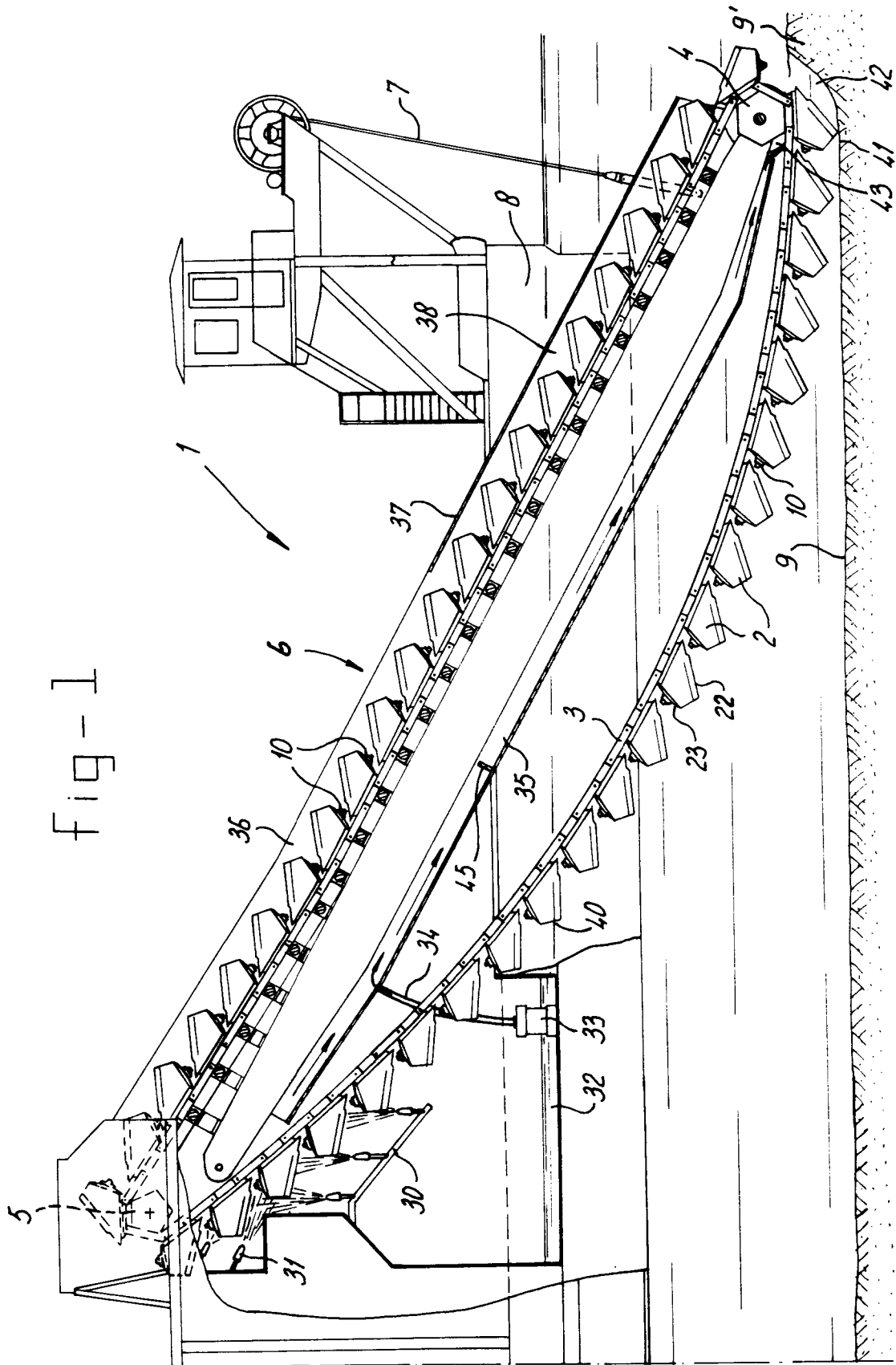


fig-2

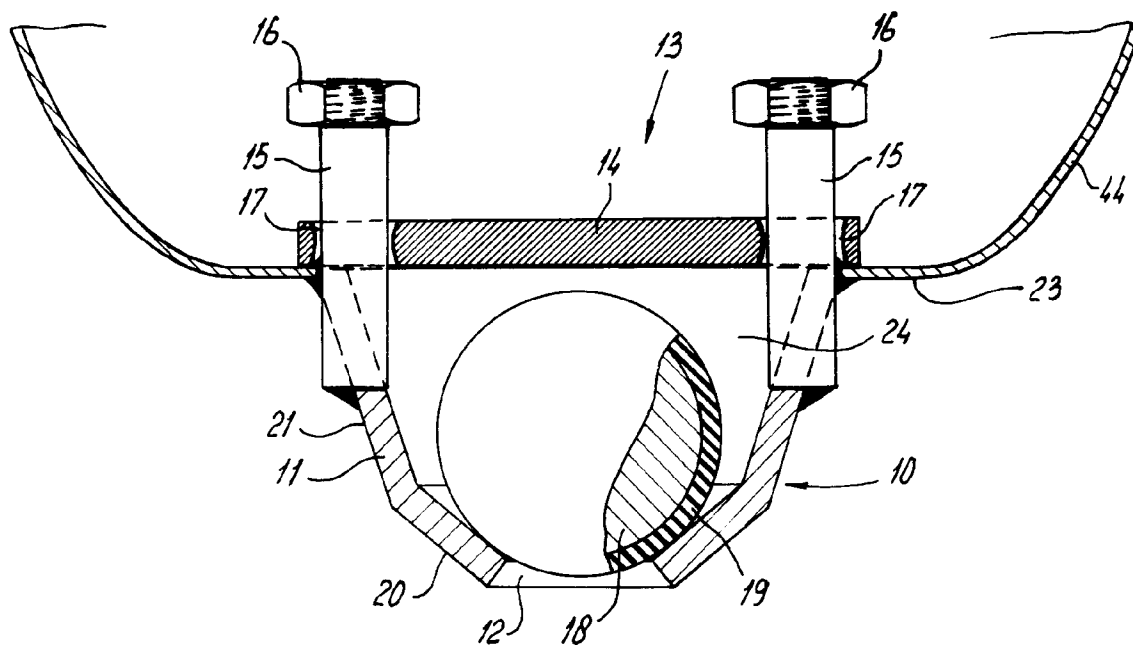
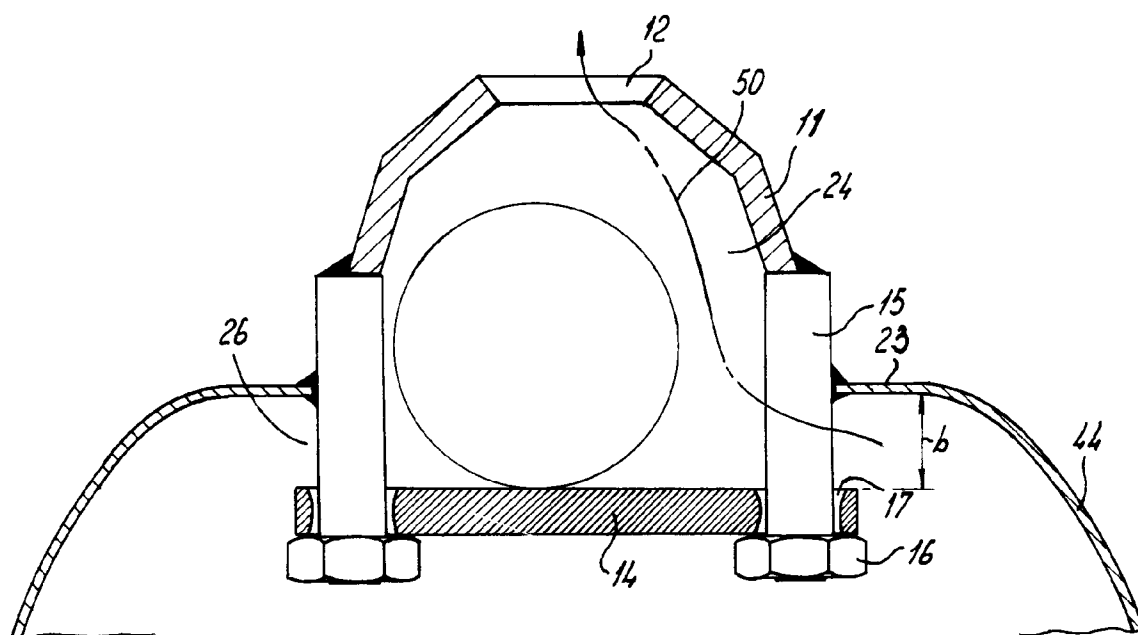


fig-3





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 94 20 0708

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A,D	US-A-3 736 677 (LOY) * column 4, line 9 - line 16 * * figures 1,3 * ---	1-3,10	E02F3/08 E02F3/14
A,D	DE-A-24 17 545 (KLÖCKNER-HUMBOLDT-DEUTZ AG) * page 4, last paragraph * * page 7, paragraph 1 * * figure 1 * ---	3,9	
A	GB-A-M10815 (C.BENNEFELD) &GB-A-10815 A.D. 1912 * the whole document * -----	3-8	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			E02F F16K B60K
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 6 June 1994	Examiner Estrela y Calpe, J
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