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(71) Applicant: **"Dredging International"**
**Scheldedijk, 30**
**B-2070 Zwijndrecht(BE)**

(72) Inventor: **Labus, Michel**
**Dennengaardelaan 28**
**B-3668 As(BE)**

(74) Representative: **Pieraerts, Jacques et al**
**GEVERS Patents,**
**Rue de Livourne 7,**
**Boîte Postale 1**
**B-1050 Bruxelles (BE)**

## (54) Apparatus for dredging underwater bottoms, and dredge head for such an apparatus.

(57) The apparatus according to the invention comprises a ladder (2) mounted on a base structure or pontoon (1), means for laterally displacing this ladder (2) and means (3) for adjusting the inclination of the ladder (2). On the free extremity of the ladder (2) is mounted a dredge head (7) comprising at least one scraper for scraping together materials over the underwater bottom (10) during the lateral movement of the ladder (2), more particularly towards at least one suction opening to enable the material scraped together to be sucked up. Compared to the existing cutter heads, such a dredge head offers the advantage of stirring up the material much less into the water and also of diluting this material to a less extent.

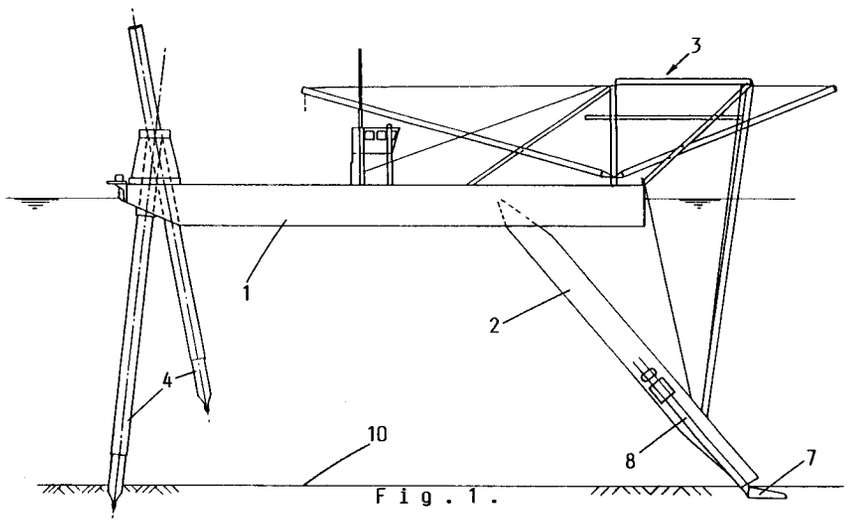


Fig. 1.

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This invention relates to an apparatus for dredging underwater bottoms, in particular of waterways, which apparatus comprises a ladder mounted on a base structure, means for laterally displacing this ladder in the transverse direction thereof, both to the left and to the right, means for adjusting the inclination of the ladder, and a dredge head mounted on the free extremity of this ladder and arranged for loosening up during said left and right lateral movement of the ladder materials which are sedimented on the underwater bottom and for removing these materials through at least one suction tube connected to said dredge head.

Such an apparatus is known from the practice. This known dredging apparatus, a so-called suction dredger, is equipped with a so-called cutter head consisting of a rotating cutting screw which churns the materials to be dredged so that they can be sucked up by the suction tube. A drawback of such a cutter head consists in that this head mixes the sludge with the surrounding water or in other words stirs this sludge up into the water so that, on the one hand, the turbidity of this water is considerably increased, resulting, on the other hand, in a strong dilution of the sludge to be dredged.

It will be clear that an important increase of the water turbidity is not desired, especially for ecological reasons. Further, a general objective is to achieve in the removed water/sludge quantities a sludge percentage which is as high as possible to use the volume of the dumping site as much as possible for an effective sludge storage.

As to the problem of stirring up and diluting the sludge, the use of trailing hopper suction dredgers provided with a so-called trail head offers already an improvement but still not satisfying solution since the hopper dredges while sailing with the trail head completely submerged into the sludge so that in this case also a large amount of sludge is stirred up. Moreover, due to a number of technical and economical reasons, the use of a trailing hopper suction dredger is not appropriate in some cases :

1. An effective dredging is only achieved during a small portion of the dredging cycle. A considerable fraction of said cycle is taken in by sailing and pumping the already dredged material on land.
2. The depth and the location of effective dredging cannot be controlled very accurately so that a very uneven bottom is obtained.
3. The trailing hopper suction dredger passes inevitably several times over the sedimented material so that this material is kneaded and diluted by the trail head submerged therein, whereby a sludge concentration decrease in the dredged water/sludge mass is soon observed. The reduction of the sludge density in the dredged mass is harmful both from an economical and ecological environtechnical point of view.
4. In an entrance channel to a sluice or in small long-term docks, a trailing hopper suction dredger has to manoeuvre continuously. Consequently, much time is lost while the many manoeuvres involve several technical and nautical problems.

An object of the invention is therefore to provide a dredging apparatus of the hereabove indicated stationary type which enables to reduce mixing of the dredged material in the surrounding water during the dredging operation.

To this end, the dredging apparatus according to the invention is characterised in that said dredge head comprises at least one scraper arranged for scraping said materials together, during said lateral movement of the ladder, over the underwater bottom towards at least one suction opening of said suction tube to enable the suction tube to suck up the material scraped together.

In contrast to the existing cutter heads, the scraper from the apparatus according to the invention scrapes the material to be dredged only together so that this material can be sucked up without mixing it actively with the water. In contrast to the dredge head from the apparatus according to the invention, the existing trail heads, which are trailed for example by trailing hopper section dredgers and which have to dredge consequently only into one direction, are not appropriate for dredging into two directions. Hence, in other words, it is not possible to use the existing trail heads on a stationary dredger of the swinging-ladder type, such as a cutter suction dredger.

In a preferred embodiment of the apparatus according to the invention, the dredge head comprises a cap arranged for screening off during the dredging operation, together with the scraper, the material scraped together in front of the suction opening by this scraper from the surrounding water and for guiding this material towards the suction opening.

In this way is avoided that a too large quantity of water is sucked into the suction tube together with the sludge.

In an effective embodiment, said cap is provided with openings for supplying water to the material scraped together, means being preferably provided for controlling the water supply through these openings.

This embodiment offers the advantage of allowing to control the density or in other words the fluidity of the dredged material by adjusting the water supply through said openings, either by the right dimensioning of these openings or for example by means of an adjustable valve.

The invention further relates to a dredge head for a stationary dredger provided with a ladder

which is movable in alternative lateral directions and with a suction tube ending via at least one suction opening in the dredge head. The dredge head according to the invention is characterised in that it comprises at least one scraper arranged for scraping together materials over an underwater bottom, in particular of a waterway, during a lateral movement of the ladder towards said suction opening in a manner so as to enable the suction tube to suck up the material scraped together.

As explained already hereinabove, such a dredge head, which can be used on a stationary dredger, enables a reduction of the stirring up of sludge during the dredging operation compared to the usual cutter heads.

Further particularities and advantages of the invention will become apparent from the following description of some possible embodiments of an apparatus and in particular of a dredge head according to the invention. This description is only given by way of example and is not intended to limit the invention. The used reference numerals relate to the annexed drawings wherein :

figure 1 shows schematically a general view of a dredging apparatus according to the invention ;

figure 2 shows schematically a top plan view of the apparatus of figure 1 wherein a number of components have however been omitted for clarity's sake ;

figures 3, 4 and 5 show schematically some dredging movements which can be performed with the dredger according to figure 1 or with a variant dredger ;

figures 6, 7 and 8 show schematically a top plan view and a cross-sectional view according to line VII-VII and line VIII-VIII in figure 6 of a first embodiment of the dredge head according to the invention ;

figures 9, 10 and 11 show schematically a top plan view and a cross-sectional view according to line X-X and line XI-XI in figure 9 of a second possible embodiment of the dredge head according to the invention ;

figures 12, 13 and 14 show schematically a top plan view and a cross-sectional view according to line XIII-XIII and line XIV-XIV in figure 12 of a third possible embodiment of the dredge head according to the invention ;

figure 15 shows schematically a longitudinal section through a preferred embodiment of the dredge head according to the invention ;

figure 16 shows a cross-sectional view according to line XVI-XVI in figure 14 ;

figures 17 and 18 show schematically the two different operative positions of the scrapers from the dredge head according to figures 15 and 16 ; and

figure 19 shows schematically a side elevational view of the free extremity of the ladder and of the dredge head according to figures 15 and 16 mounted thereon.

In these different figures, the same reference numerals relate to the same or to analogous elements.

In general, the present invention relates to an apparatus for dredging underwater bottoms, for example of waterways, watercourses, lakes, etc., more particularly to a so-called stationary dredger. The general structure of the apparatus according to the invention corresponds to the general structure of the known cutter suction dredgers and will consequently be described hereinafter only in broad outline.

Like the known cutter suction dredgers, the apparatus shown in figure 1 comprises a base structure 1 composed of a floating pontoon, a ladder 2 mounted thereon, means 3 for adjusting the inclination of this ladder 2, and means for laterally displacing the ladder 2 both to the left according to arrow 6 and to the right in the transverse direction of the ladder 2. These latter means may comprise for example cables and anchor winches, not shown in the drawings, for effecting lateral swinging of the entire dredger usually about spuds 4.

Two possible dredging movements are shown by way of example in figures 3 and 4, respectively for a stationary dredger which is provided with a so-called tilting spud as shown in figure 1 or for a dredger provided with a spud carriage which is not shown in the figures and for a stationary dredger which is on both lateral sides provided with a fixed spud 4.

In additional to these two systems for moving stationary dredgers, other systems are known including the one which is shown schematically in figure 5. According to the movement shown in this figure 5, the dredger 1 swings under a certain swing angle about a bower anchor 5 with a circular cut. The bow line is indicated in figure 5 with reference 26 while the so-called bow barge is indicated with reference 27. No further description of these movements is given here since they are known by the man skilled in the art. For this skilled man it will also be clear that still other movements are possible.

A stationary dredger, such as the known cutter suction dredgers, offers the advantage that the movements of the dredge head 7 fitted onto the free extremity of the ladder 2 can be accurately controlled. The material sedimented on the underwater bottom will therefore not be disturbed by a repeated passing of the dredge head 7 over the same position. The dredging depth can further also be controlled accurately.

The existing cutter suction dredgers offer however the drawback of having a dredge head which mixes the sedimented material actively with the surrounding water so that it can be sucked up through a suction tube 8. It is clear that a high turbidity is created hereby in the water and that the dredged material has a high water content.

In order to obviate this drawback, the dredge head according to the invention comprises at least one scraper 9 which is arranged for scraping the sludge together along the underwater bottom 10 during the lateral movement of the ladder 2 towards at least one suction opening 11. The material which has been scraped together can thus be sucked up through this opening 11 without having to mix the material actively with the water. The scraper 9 extends in particular substantially in the longitudinal direction of the ladder 2.

Figures 6, 7 and 8 show a first possible embodiment of the dredge head 7 according to the invention. In this embodiment, the dredge head 7 comprises only one scraper 9 which extends in the longitudinal direction of the suction tube 8. In the dredge head 7, the suction tube splits up by means of a substantially funnel-shaped cavity 12 so as to end both in front of and behind the scraper 9 through a suction opening 11, 11'. During the left lateral movement (according to arrow 6), the material which is scraped together is sucked up through the second suction opening 11' while the first suction opening 11 is closed off by means of a schematically shown valve 13 and, vice versa, the second suction opening 11' can be closed off by means of a valve 13' when the sludge is sucked off through the first suction opening 11 during the right lateral movement.

On both sides of the scraper 9, a cap 14, 14' is provided arranged for screening off, during the dredging operation, the material which is scraped together from the surrounding water and for guiding this material to the respective suction opening 11, 11'. This cap 14, 14' and the scraper 9 define preferably a passage for the material, which passage narrows in the direction away from the suction opening 11, 11'. The presence of such a cap enables to prevent an undesired amount of water to be sucked up together with the dredged material.

In the embodiments shown in the figures, the cap 14, 14' is each time provided with openings 15, 15' for supplying water to the material which is to be sucked up and for making this material, if necessary, sufficiently fluid. Preferably, means are provided for adjusting the fluid flow rate through these openings 15, 15', for example control valves 17, 17' disposed in the supply channels 16, 16' of the openings 15, 15'. In this way, the water content or in other words the density of the dredged material can be controlled during the dredging operation.

Figures 9, 10 and 11 show schematically a second possible dredge head according to the invention wherein the suction tube 8 splits up also in two alternatively used suction opening 11, 11' but wherein use is made of two scrapers 9, 9'. Both the first 9 and the second scraper 9' are hingedly fitted onto the dredge head 7 between an operative and in inoperative position. During the left lateral movement (according to arrow 6), the first scraper 9 is folded out and the second scraper 9' is situated in the inoperative position wherein it closes off the second suction opening 11' in such a manner that the suction tube 8 sucks up the material which is scraped together by the first scraper 9 through the first suction opening 11. During the right lateral movement, the situation is reversed. In this embodiment also, water supply openings 15, 15' and supply channels 16, 16' are provided in the cap 14, 14'.

In the variant embodiment according to figures 12, 13 and 14, the first 9 and second scraper 9' are fitted to the dredge head 9 in an up and downwards slideable way. In this embodiment, the suction tube 8 is further not branched but debouches via one suction opening 11 between both scrapers 9, 9'. Consequently, this embodiment does not require an alternate opening and closing of the suction openings. As it appears clearly from figures 12 and 14, the water supply openings 15 in the cap 14 are situated substantially in the middle of this cap 14.

A particularly effective embodiment of the dredge head according to the invention is shown in figures 15 and 16. In this embodiment, the suction tube 8 is connected through a substantially funnel-shaped cavity 12 to the suction opening 11. A flange 18 is provided around this suction opening 11, both scrapers 9, 9' being swingably mounted around this flange by means of a ring 19. Both scrapers 9, 9' form in particular one unit which has a substantially circular cross-section and which narrows conically in the direction away from the suction opening.

By swinging the scraper unit 9, 9' about the axis 20 between the two extreme positions shown in figures 16 and 17, dredging can be effected both in the left (arrow 6) and the right lateral direction. The dredge head 7 comprises hereto further a motor or analogous means which are not shown and which enable to achieve this swinging motion.

At its upper side, the dredge head 7 comprises an outer casing 21 fixed to the suction tube 8 and extending around the scraper unit 9, 9'.

At the front of the outer casing 21, centrally opposite the suction opening 11, the conical scraper unit 9, 9' is swingably mounted around a shaft 22 to provide an additional support for these scrap-

ers.

Within the conical scraper unit 9, 9', a longitudinal water supply channel 16, 16' containing the water supply openings is provided opposite the outer casing 21. In the preferred embodiment shown in figures 14 and 15, this supply channel consists of a double supply channel 16, 16' but, on the other hand, use could also be made of a single water supply channel. Each of the supply ducts 23, 23' to the supply channels 16, 16' comprises preferably a control valve which is not shown in the figures and which may for example be opened and closed alternately. In this way, the necessary water can be supplied exclusively through the supply channel 16 situated above the first scraper 9 during the left lateral movement (according to arrow 6) and vice versa through the supply channel 16' during the right lateral movement (figure 18) so as to obtain a better fluidisation compared to the situation wherein the water supply is effected evenly through both channels 16, 16'.

Figure 19 shows schematically how the hereinabove described dredge head 7 is mounted onto the free extremity of a ladder 2. It can be seen that the dredge head is hinge-connected to the bottom of the ladder 2, more particularly to a rigid portion of the suction tube 8, by means of a double rod system 24, on both sides of the suction tube 8. In order to be able to adjust the angle between the dredge head 7 and the ladder 8, the top of the dredge head is fixed to the top of the free extremity of the ladder 2 by means of a connecting construction 25 whose length is adjustable. Such a construction enables to position the dredge head under the desired angle, for example horizontally, and this independent of the dredging depth.

From the hereinabove given description of some embodiments of the apparatus and the dredge head according to the invention it will be apparent that the present invention is not limited to the described embodiments but that all kinds of modifications can be applied thereto without leaving the scope of the present patent application.

It is for example possible to spray pressurized water through the openings in the cap in front of the scrapers so as to enhance the fluidisation of the material without creating however too much turbidity in the water.

Further it is for example also possible to arrange an Archimedean screw in front of the scraper to contribute in conveying the dredged material towards the suction opening

## Claims

1. An apparatus for dredging underwater bottoms (10), in particular of waterways, which apparatus comprises a ladder (2) mounted on a base structure (1), means for laterally displacing this ladder in the transverse direction thereof, both to the left and to the right, means for adjusting the inclination of the ladder (2), and a dredge head mounted on the free extremity of this ladder and arranged for loosening up during said left and right lateral movement of the ladder (2) materials which are sedimented on the underwater bottom (10) and for removing these materials through at least one suction tube (8) connected to said dredge head (7), characterized in that said dredge head comprises at least one scraper (9, 9') arranged for scraping said materials together, during said lateral movement of the ladder (2), over the underwater bottom (10) towards at least one suction opening (11, 11') of said suction tube (8) to enable the suction tube to suck up the material scraped together.

2. An apparatus according to claim 1, characterized in that the dredge head (7) comprises a cap (14, 14') arranged for screening off during the dredging operation, together with the scraper (9, 9'), the materials scraped together by this scraper (9, 9') in front of the suction opening (11, 11') from the surrounding water and for guiding this material towards the suction opening (11, 11').

3. An apparatus according to claim 2, characterized in that said cap (14, 14') is provided with openings (15, 15') for supplying water to the material scraped together, means (17, 17') being preferably provided for controlling the water supply through these openings.

4. An apparatus according to claim 2 or 3, characterized in that said cap (14, 14') and said scraper (9, 9') define a passage for the material towards the suction opening (11, 11'), which passage narrows in the direction away from the suction opening.

5. An apparatus according to any one of the claims 1 to 4, characterized in that the suction tube (8) ends via at least a first (11) and a second suction opening (11') in the dredge head (7), during said lateral movement respectively in front of and behind the scraper (9), means (13) being provided for closing off the first suction opening (11) during said left lateral movement and means (13') being provided for closing off the second suction opening (11') during said right lateral movement.

6. An apparatus according to any one of the claims 1 to 4, characterized in that the dredge head (7) comprises at least a first (9) and a second scraper (9') movably fitted onto this dredge head between an operative and an inoperative position, said dredge head further comprising means for keeping the first scraper (9) during said left lateral movement in the operative position and the second scraper (9') in the inoperative position and vice versa for keeping the first scraper (9) during said right lateral movement in the inoperative position and the second scraper (9') in the operative position.

7. An apparatus according to claim 6, characterized in that the first (9) and the second scraper (9') are disposed in their operative position to scrape said material to one and the same suction opening (11).

8. An apparatus according to claim 6 or 7, characterized in that the first (9) and the second scraper (9') are hinge-connected to the dredge head (7), more particularly around a hinge axis extending substantially in the longitudinal direction of the ladder (2).

9. An apparatus according to claim 6 or 7, characterized in that the first (9) and the second scraper (9') are fitted to the dredge head (7) in an up and downwards slidable way.

10. An apparatus according to claim 9, characterized in that the first (9) and the second scraper (9') have a substantially circular cross-section.

11. An apparatus according to claim 10, characterized in that the first (9) and the second scraper (9') narrow conically in the direction away from said suction opening.

12. An apparatus according to claim 10 or 11, characterized in that the first (9) and the second scraper (9') form one unit which is swingable about a swing axis (20) extending opposite said suction opening (11), in the longitudinal direction of the dredge head.

13. An apparatus according to any one of the claims 1 to 12, characterized in that said dredge head (7) is mounted under an adjustable angle onto the free extremity of the ladder (2), with means (24, 25) being provided for adjusting this angle between the ladder (2) and the dredge head (7) before and/or during the dredging operation.

14. A dredge head for a stationary dredger provided with a ladder (2) which is movable in alternative lateral directions and with a suction tube (8) ending via at least one suction opening (11, 11') in the dredge head (7), characterized in that it comprises at least one scraper (9, 9') arranged for scraping together materials over an underwater bottom (10), in particular of a waterway, during a lateral movement of the ladder, in particular of a waterway, towards said suction opening in a manner so as to enable the suction tube to suck up the material scraped together.

15. A dredge head according to claim 14, characterised in that said scraper (9, 9') extends substantially in the direction of said suction opening (11, 11').

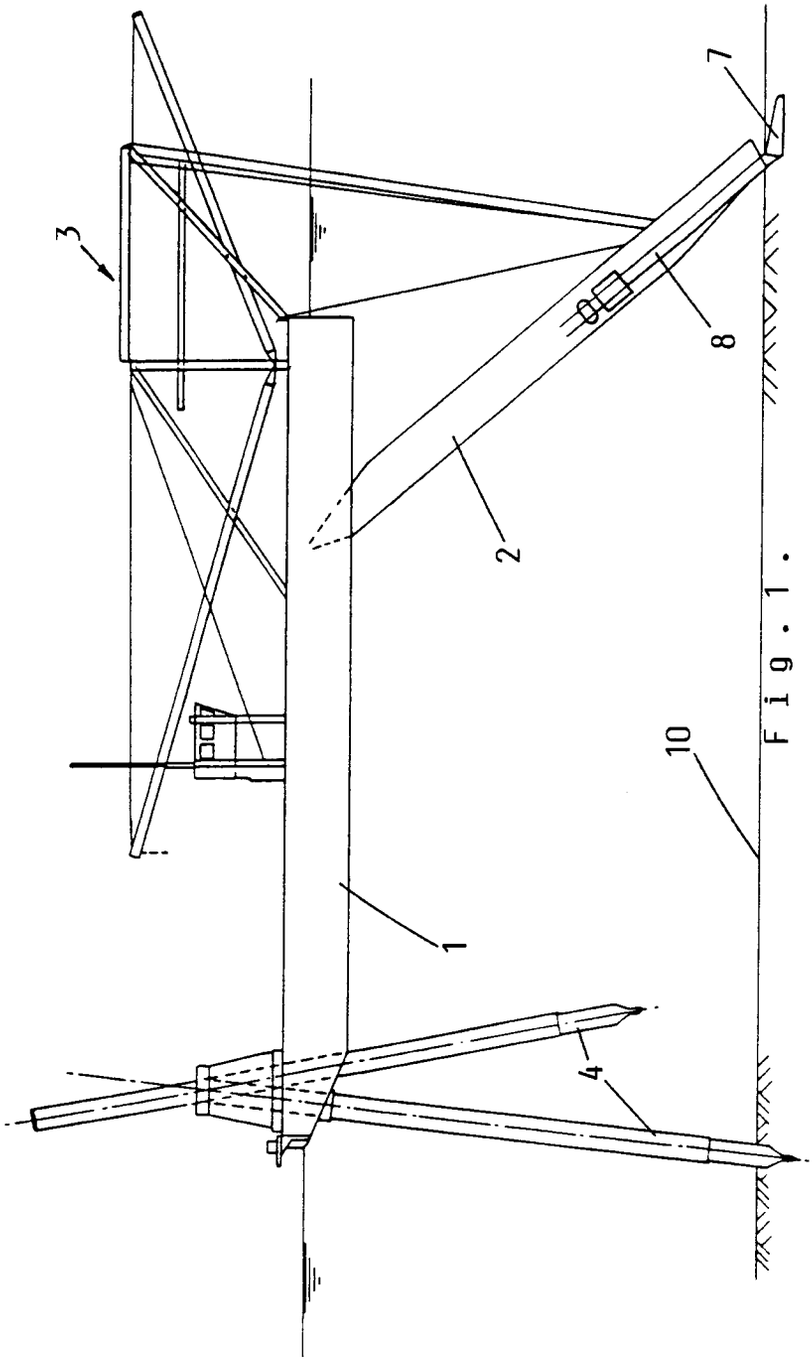



Fig.1.

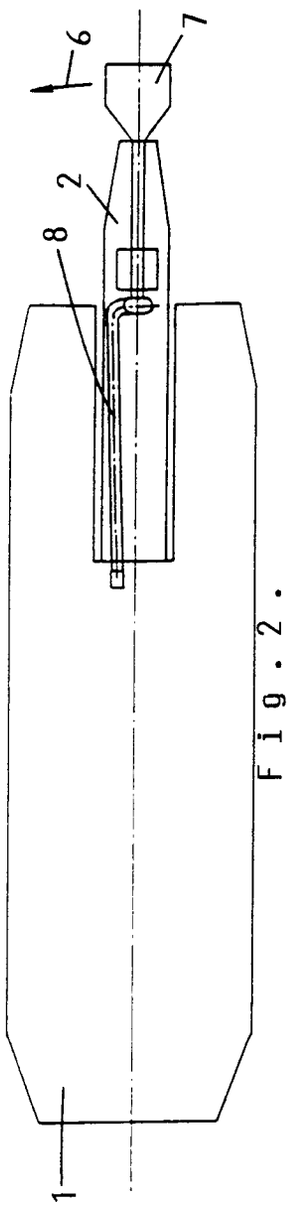



Fig.2.

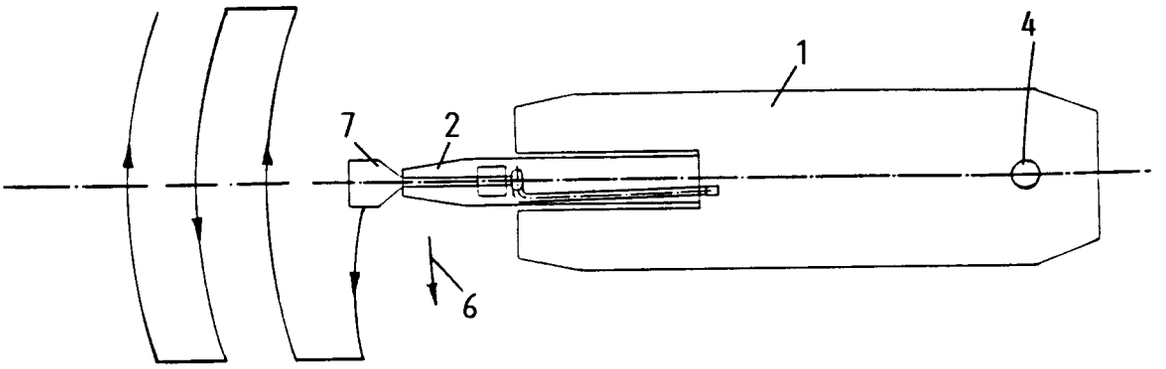



Fig. 3.

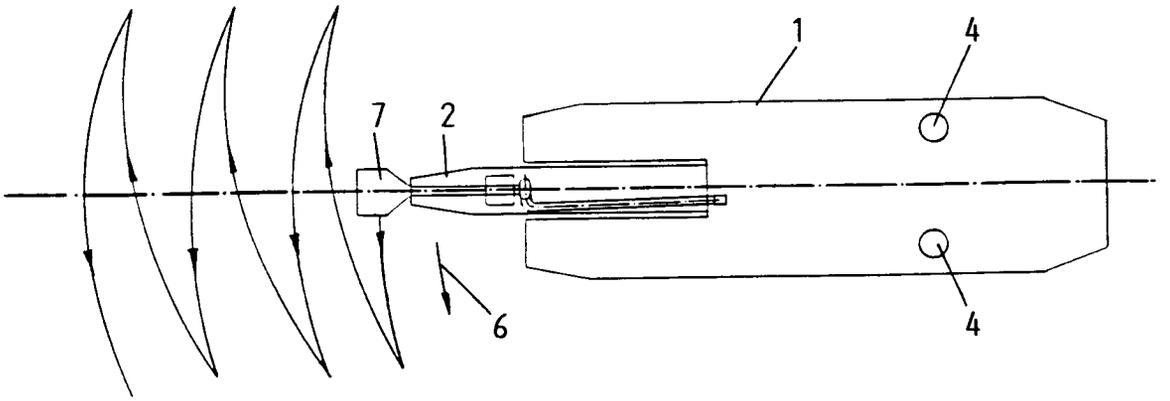



Fig. 4.

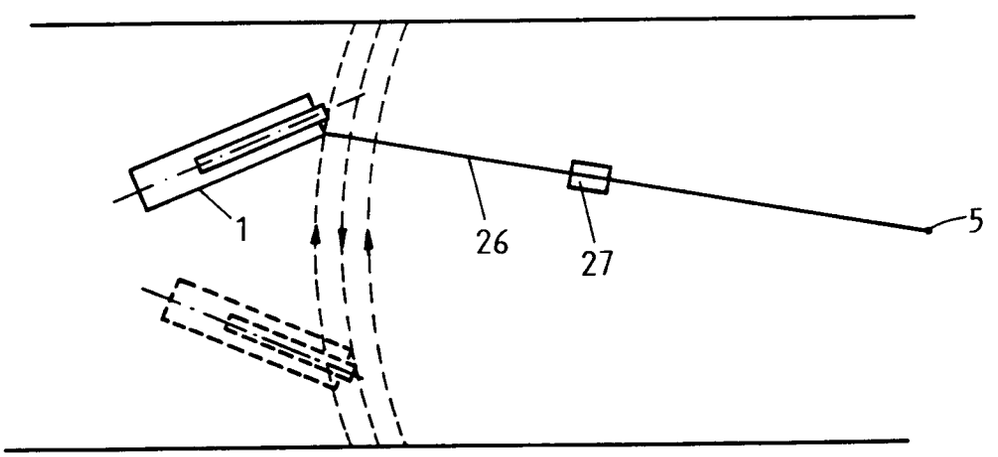



Fig. 5.

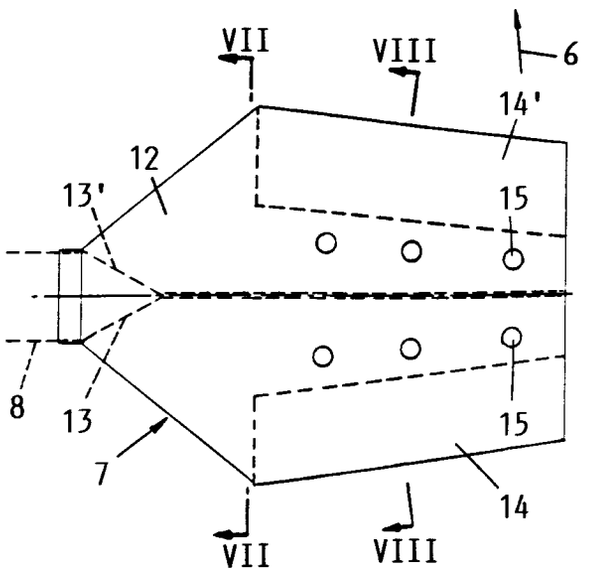



Fig. 6.

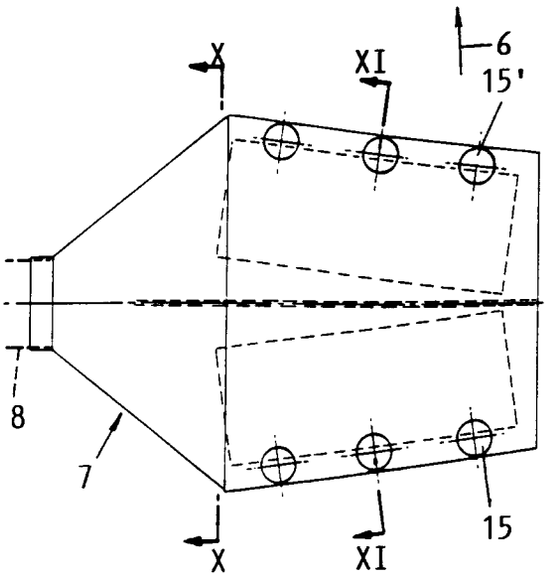



Fig. 9.

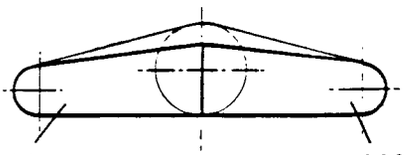



Fig. 7.

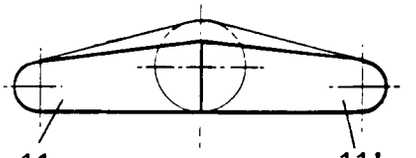



Fig. 10.

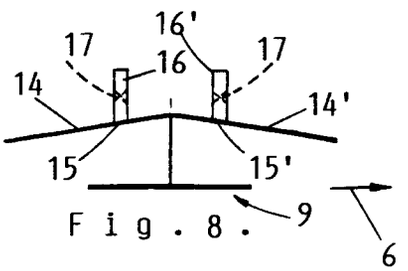



Fig. 8.

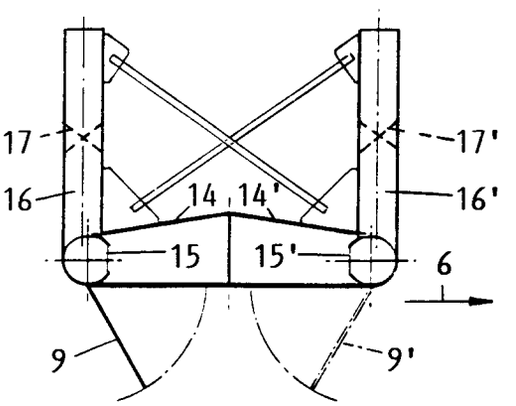



Fig. 11.

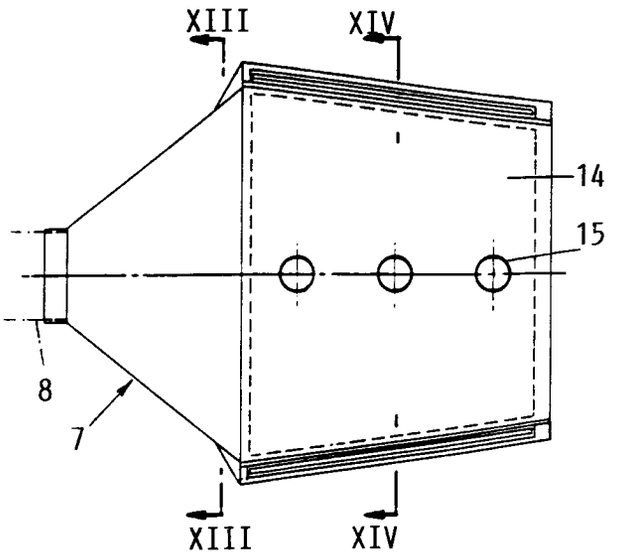



Fig. 12.

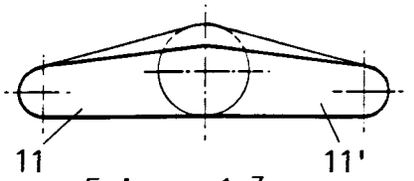



Fig. 13.

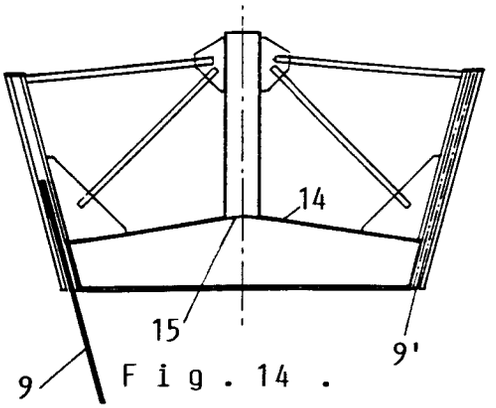



Fig. 14.

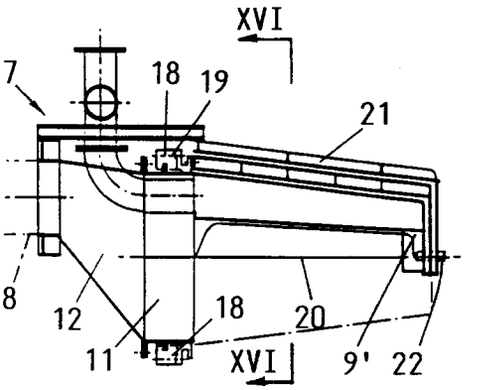



Fig. 15.

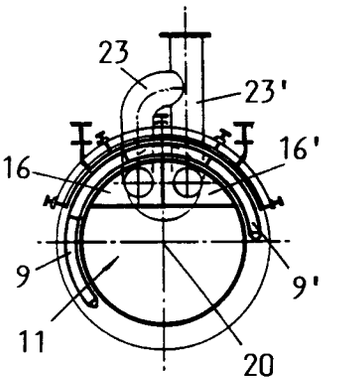



Fig. 16.

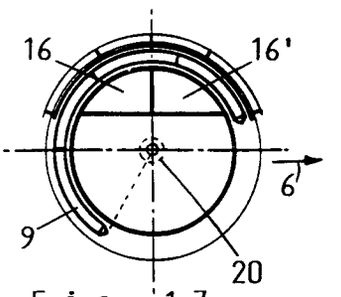
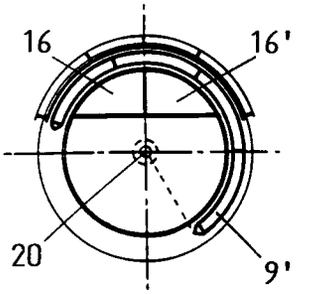



Fig. 17.

Fig. 18.



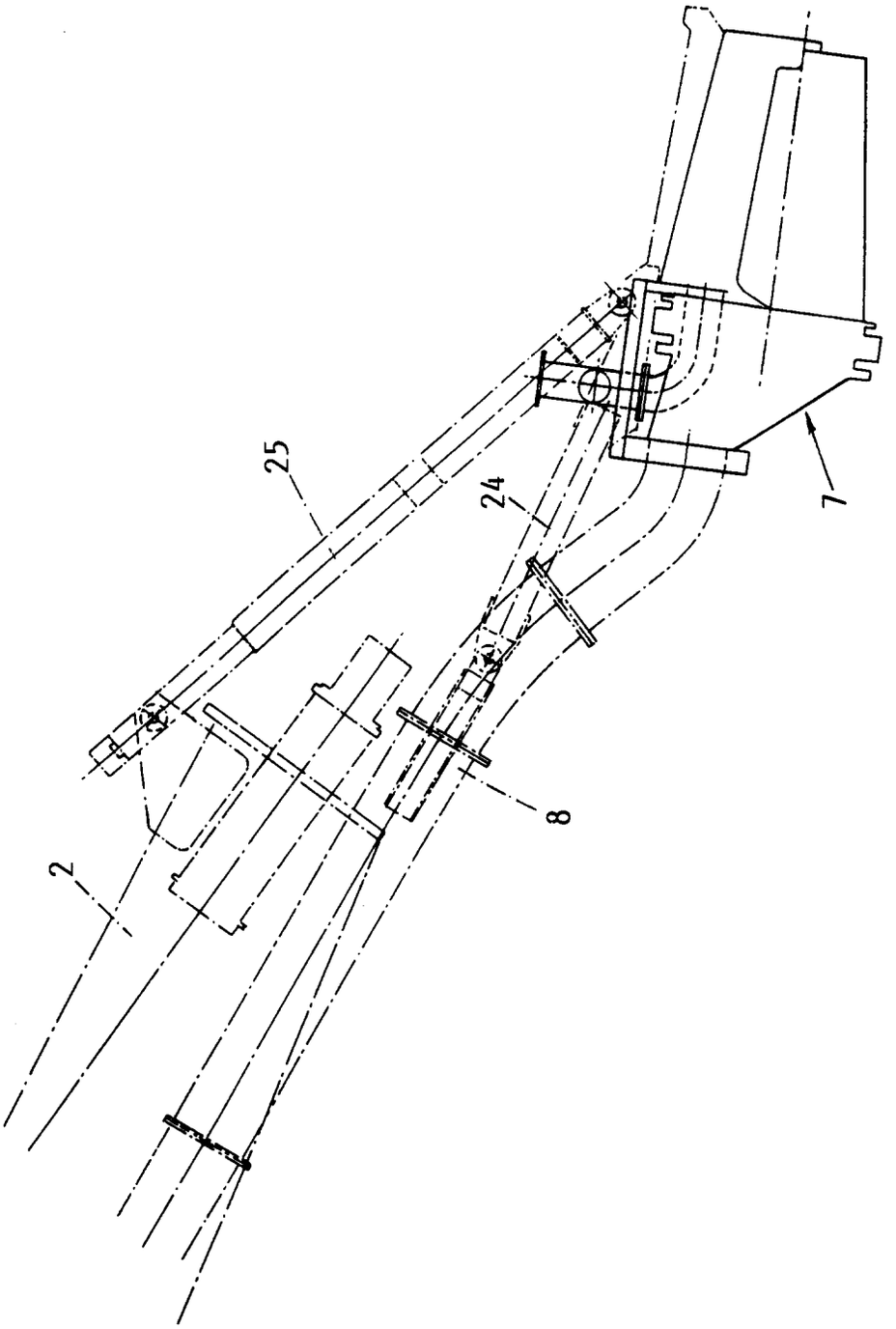



Fig. 19.

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 93 87 0221

## 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) |
|---|---|---|---|
| Y | US-A-4 146 982 (NORISUGI) | 1-3,5-7, 9,10, 12-15 | E02F3/90 E02F3/92 |
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| Y | FR-A-909 831 (P.A. GILLE) | 1-3,5-7, 9,10, 12-15 | |
| | * page 2, line 63 - line 87 * * figures * | | |
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| | * figures * | | |

| TECHNICAL FIELDS SEARCHED (Int.Cl.5) |
|---|
| E02F |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 10 February 1994 | Estrela y Calpe, J |

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