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(54) Title: METHOD AND APPARATUS FOR CLEANING UP SURFACE WATER		
(57) Abstract Method and apparatus to be used in open water for removing an oil layer by towing a generally V-shaped and floating catching means (1, 2, 3) through the water, one arm (3) consisting of a barge comprising a driven pump (13) for sucking the oil collected near the apex of the catching means (2, 3) and for discharging this oil/water mixture into the barge (2); the water collected near the bottom of the barge (2) is removed until the barge is mainly filled with oil; hereafter the filled barge is substituted by an empty one and the sweeping action may be continued.		

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METHOD AND APPARATUS FOR CLEANING UP SURFACE WATER.

BACKGROUND OF THE INVENTION

1. Field of the invention

The invention relates to a method for removing an oil layer floating on water by means of towing sweeping arms which enclose a mutual diverging angle of less than 180° seen in the towing direction and wherein near a collecting place of oil a sucking and pressing away of oil is performed.

Such an method is very urgent in case of accidents with oil tankers and as a result of which an environmental catastrophe by pollution cannot, or only partly be prevented.

In case of an accident with a super tanker very large quantities of oil may come free and will be uncontrollable spoiled into the sea.

2. Description of the Prior Art.

In applying the methods known uptill now in some way a quantity of oil can be removed upto a maximum of 100 to 2000 m^3 per hour. This limitation relates in general not only to a small area capacity (m^2/h) depending on the apparatus to be used but also to circumstances that there are no possibilities for storing large quantities of oil owing to which the cleaning activities (the method) always have to be interrupted for pumping over or for removing the collected oil.

It has also been proposed to store the collected oil in flexible containers, however this appears not only costly



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but will be also difficult. Besides there is the important problem of safety because oil on sea belongs to fuels (imco code II) having a flame point below 60°C.

In order to transport or handling such flammable liquids aboard of the work vessel a number of safety measures are to be provided relating to the storing of oil respect to the crew accommodation and to the engine room.

SUMMARY OF THE INVENTION

In the first place it is an object of the invention to procure a method which solves the above described problem or at least results in the provision of a considerable improvement of such a method.

According to the invention this obtained in that a floating barge or scow is applied as one of the sweeping arms in combination with a sweeping arm connected thereto and use is made of a towboat which is fastened to the scow as well as to the sweeping arm by means of a tow cable, a mobile power unit being present on the scow for driving a pump near one end of the sweeping arm which sucks the reclaimed oil and pumping it into the scow whereas water separated from the oil is discharged from the lower part of the scow.

By the provision of a floating scow adapted for use on sea the new process needs only the most simple vessel that can be towed in an inclined position by the towboat.

This sea gowing scow is equipped with a mobile power unit that means a displacable power unit, mostly a so called hydraulic power pack which can be obtained on the market. Further the new method needs only one sweeping arm and a so called plunge pump. By the aid of this sweeping arm and the long lateral side of the applied scow the oil floating on the water is swepted to the collecting place. The pump (mostly hydraulically driven) positioned at this place presses the collected oil/water mixture to a tank on the sea gowing scow.

A separation of oil and water takes place in this tank



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after which the under lying water is pumped over board by means of a plunge pump. As soon as the tank is filled with oil a stand by new scow can be fastened and the filled scow either in combination with preceding scows can be returned to a nearby harbour. The mobile power unit which was present on the just disconnected scow is then transferred to the new scow.

As indicated above the method according to the invention provides the possibility of an almost uninterrupted cleaning up of the polluted surface of the sea with very simple means. A further advantage consists in that the invention permits to keep standby a number of elements on the most threatened places along the coast which can be immediately put in operation after receiving an oil alarm of large extent. For such an operation only one sea going scow is necessary which can be kept under contract whereas a towboat is mostly always available.

This towboat brings the scow with the sweeping arm and equipment which has been arrived in the meantime to the location of the pollution by oil. Concerning this it is to be remarked that several systems are available for getting a sweeping arm at the local place. Such an arm can be towed behind a sea going scow or be placed aboard of this scow and thereafter it can be launched by means of davits. A sweeping arm can be launched by a helicopter at the local place. At the location of pollution by oil the scow is manoeuvred under an angle such that a considerable width of sweeping area occurs. The sweeping arm is positioned from the scow in such a manner that the oil guided along the front lateral side of the scow can be collected. A pressure hose which has been connected to the pump at the collecting place can be put in the tank of the scow via a manhole and it can be gastight connected by means of an especial shaped manhole lid. After starting the mobile power unit the collection of oil from the



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surface of the sea can be started.

The method according of the invention is preferably performed in such a manner that the scow moves under an angle of 60° with respect to the towing direction and with a velocity of about 1 m/sec whereas the sweeping arm is moved also under an angle of about 60° owing to which the arms encloses a mutual angle of about 120° .

Further the invention relates to an apparatus for performing the method indicated above, comprising a towboat, at least two sweeping arms and a liquid pump. According to the invention this apparatus is characterized in that one of the sweeping arms is formed by a floating scow which is provided with means for connecting to a tow boat and to a sweeping arm whereas a driving unit for the liquid pump is present on the scow and the sweeping arm has been provided with a collection place for the oil to be collected.

DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a diagrammatic plan view of the important elements of the apparatus in their mutual arrangement and cooperation.

Fig. 2 is a perspective view of an embodiment of the sweeping arm partly shown in a open condition.

Fig. 3 and 4 are plan faces and front faces of the sweeping arm according to fig. 2;

Fig. 5 shows a plan view of the collecting place for the collected oil;

Fig. 6 is a cross-section on an enlarged scale according to the line VI-VI in fig. 5; and

Figs. 7-11 show different situations near a collecting place according to fig. 6 under definite circumstances of sweeping speed, wave conditions and the thickness of an oil layer.



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DESCRIPTION OF A PREFERRED EMBODIMENT

As can be seen in fig. 1 the apparatus according to the invention comprises a tow boat 1, a sea going scow 2, a sweeping arm 3 and a mobile power unit 4 (driving unit). The scow 2 is connected to the tow boat 1 by the tow cables 4 and 5 in such a manner that the long lateral side of the scow 2 maintains an angle of about 60° with respect to the tow direction V. In the embodiment shown the sizes of the scow 2 is equal to $60 \times 20 \text{ m}^2$ and the total width of sweeping area B across the tow direction V is equal to 56 m.

As appears from figures 2 to 4 the sweeping arm 3 comprises a vertical wall 7 having a floating body 8 at one end which floating body is directed ahead in a deviated manner. The wall 7 is reinforced by means of a frame construction 9 forming the beam of the sweeping arm. An inner floating body 10 projects ahead at a nearly right angle at the other end of the wall 7. A collection space has been arranged herein in which collecting space the reclaimed oil or oil/water mixture can be collected. The outer floating body 8 and the inner floating body 10 each are connected to the scow 2 (see fig. 1) by a cable 12. A separate suction and pressure pump 13 with its pressure line 14 is also visible in fig. 2. The pump 13 is driven by oil under pressure via lines 15 from a power unit 4.

At its front side the collecting case 11 has been covered by a coarse grate 16 as shown in the fig. 2 to 5. This grate forms a part of a hopper shaped entry to a first space 17 of the case 11. This case is limited by a bottom 18 and by a overflow wall 19. A pivotable segment 20 has been positioned in the space 17 in such manner that the curved side 21 is in alignment with an upwardly curved part of the bottom 18. By this arrangement the side 21 forms an overflow wall W and the position of which is adjustable by means of a float 22. As appears from fig. 6 this float is connected to the segment 20 by means of an arm 23 and is adjustable with respect to the overflow wall 21.

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The pivotable segment 20 has been provided with a float 22 at both of its ends which floats are housed in a lateral compartment of the collecting case 11.

The vertical sturdy wall 19 forms in a way a second overflow wall which follows on the curved side 21 of the segment 20 which acts as a first overflow wall. An inclined sieve grate 24 has been arranged above the upper edge of the wall 19 which sieve grate is considerably finer than the coarse grate 16.

The upper end of the sieve grate 24 is connected to a vertical plunge wall 25 which leaves a passage 26 along the bottom 18. A second space 27 of the collecting case 11 is present between the walls 19 and 25 whereas after the passage 26 a third space 28 is formed in which the plunge pump 13 is lowered.

Figs. 7 to 11 show a simplified view of the situation during performing the method according to the invention. Figs. 7 to 10 show the presence of a thin oil layer and fig. 11 shows the presence of a thick oil layer. In the situation according to fig. 7 the tow boat 1 has little speed of about 1,8 km/h. Fig. 8 shows an elevated water surface with a three times higher speed of the tow boat 1 of about 5,4 km/h. The first overflow wall 21 remains always in the same position with respect to the water level.

In fig. 9 and 10 the situation of the presence of wave has been shown whereas fig. 9 shows the situation in a wave dept and fig. 10 shows the situation of a wave crest. In this situations the overflow wall 21 follows the alternating water level as result of the connection with the two floats 22.

When the method has to be performed for handling a thick oil layer the position of the floats 22 respect to the segment 20 is adjusted as appears from fig. 11 with regard to the preceding figs. 6 to 10. This adjustment can be made by shifting each float 22 with respect to the arm 23 (indicated by the

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arrow H in fig. 6), or by adjustment of the angular position of the arm 23 with respect to the segment 20 (see arc A in fig. 6). This possibility of adjustment of the floats 22 with respect to the segments 20 allows to maintain the function of the first overflow wall 21 owing to which the wall can follow the alternations in the water level. The oil collected in the third compartment 28 of the collecting case 11 or the mixture of oil and water is removed by the pump 13 and the pressure line 14 and transported to a tank or tanks (not shown) of the scow 2. When receiving a violent oil alarm the invention allows the following procedure.

A sea going scow which is available at that very moment is put under contract. Further by means of a tow boat which is mostly always available the scow and the sweeping arm which in the meantime has arrived and the power unit with further equipment are transported to the location of the oil pollution. It is to be remarked that the sweeping arm can be transported as well on board of the towing vessel as on the scow or it can be towed behind the scow. At the location the cables 5 and 6 and the tow cables 12 are positioned in such a manner that the arrangement according to fig. 1 is obtained. The power unit 4 is started and the pressure line 14 is positioned from the pump 13 within the collecting case 11 to the scow 2 for debouching in the tank within the scow. At this moment the removing of the oil layer floating on the water can be started.

It will be evidently that the method according to the invention allows to keep the operational costs as low as possible because practical no expensive elements are to be kept stand by. Several types of sea going scows can be used in the method according to the invention and only one or more sweeping arms, one or more hydraulic power units and some hoses are to be centrally stored and kept in maintainance in order to be available for a quick operation in case of calamities. The operation of the apparatus according to the



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invention can be world wide and the required equipment can be transported easily by aeroplane. Sea going scows and tow boats are mostly available along the most coastal areas. The speed of the tow boat during the process is limited to that extent where the oil will start to flow below the scow or below the sweeping arm. For an upstream wall position under an angle this speed is in the direction V higher as the angle between the scow and the sailing direction will be sharper. In practice an angle of 60° with respect to the sailing direction V appears to be favourable. Under such a sweeping angle the minimum speed can be 0,5 m/sec. and maximum of 1,5 m/sec. and a practical speed is 1 m/sec. which is equal to two knots per hour.

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What is claimed is:

1. A method for removing an oil layer floating on water by means of towing sweeping arms enclosing a mutual diverging angle of less than 180° seen in the towing direction and wherein near a collecting place of oil a sucking up and pressing away of oil is performed, characterized in that, a floating scow is applied for one of said sweeping arms in combination with a sweeping arm fastened thereto and use is made of a tow boat which is fastened to the scow as well as to the sweeping arm by means of a tow cable and that a mobile power unit is present on the scow for driving a pump near one end of the sweeping arm which pump sucks the reclaimed oil and pumping it into the scow, whereas water separated from the oil is discharged from the lower part of the scow.
2. A method according to claim 1, characterized in that, the scow is moved under an angle of 60° with respect to the tow direction and with a speed of about 1 m/sec. and the sweeping arm is also towed under an angle of about 60° owing to which the arms enclose an angle of about 120° .
3. An apparatus for performing the method according to claim 1 or 2 comprising a tow boat, at least two sweeping arms and a liquid pump, characterized in that, one of the sweeping arms is formed by a floating scow (2) which has been provided with means for fastening to a tow boat (1) and otherwise to a sweeping arm (3) whereas a driving unit (4) is present on the scow for the liquid pump (13) and the sweeping arm has been provided with a collecting space (11) for the collected oil.
4. Apparatus according to claim 3, characterized in that, the sweeping arm (3) consists in a reinforced vertical wall (7) having a outer floating body (8) at one end which floating body projects in a declined position ahead and which sweeping arm at its other end possesses an inner floating body (10) rectangularly

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projecting ahead and containing a collecting case (11) for the reclaimed oil.

5. Apparatus according to claim 4, characterized in that, the collecting case (11) has been provided with a segment shaped overflow wall (21) which is pivotably supported along the entire entry of the case and that a float (22) is present which has been adjustably coupled to this wall in order that the wall can follow the alterations in the level of the water surface.

6. Apparatus according to claim 4 or 5, characterized in that, a stationary vertical second overflow wall (19) has been situated on the bottom (18) of the case (11) from which wall the upper edge is connected to the lower edge of an inclined sieve grate (16) whereas the upper edge of this grate has been connected to a vertical plunge wall (25) leaving a passage (26) at the bottom of the case.

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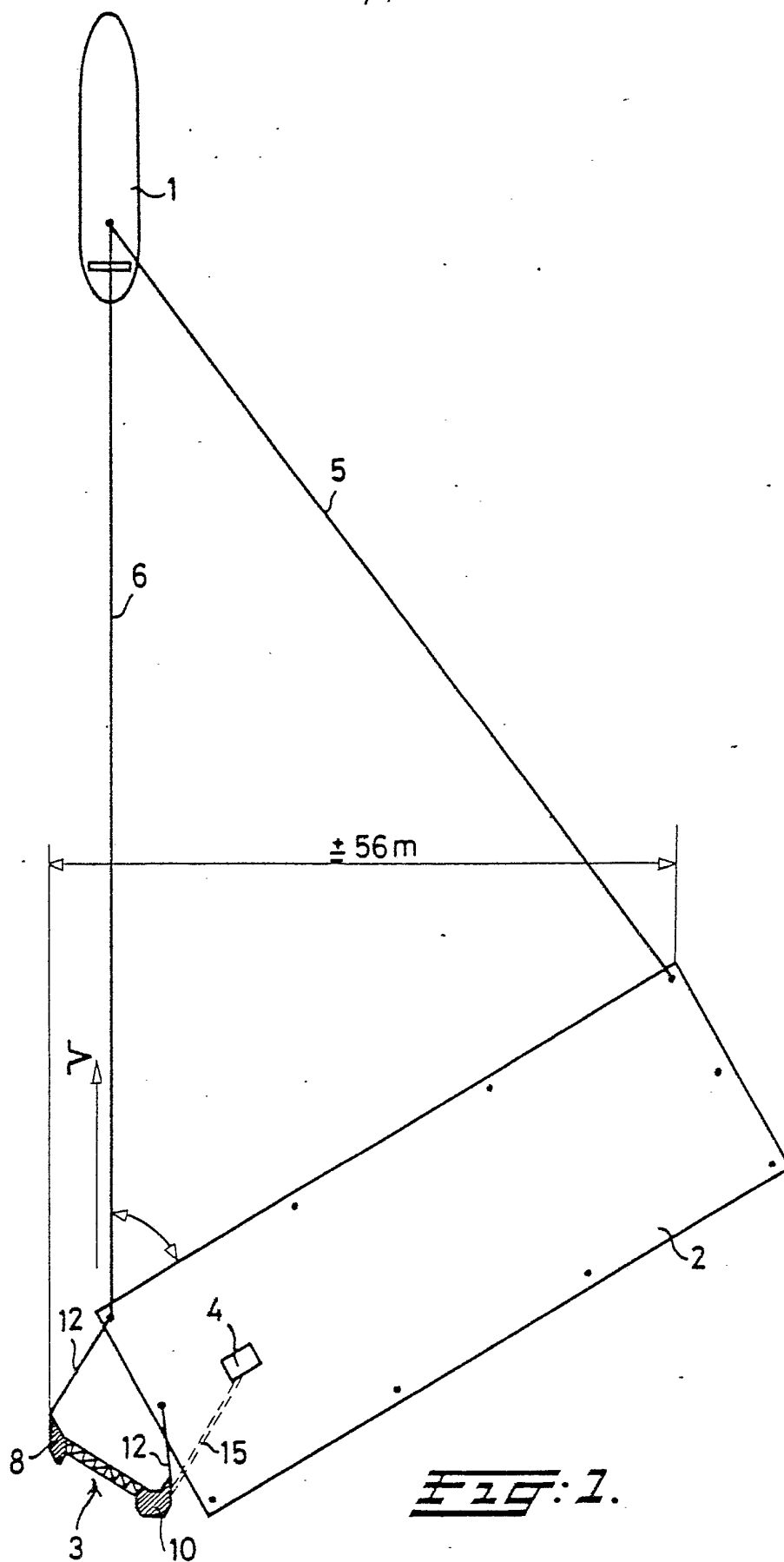
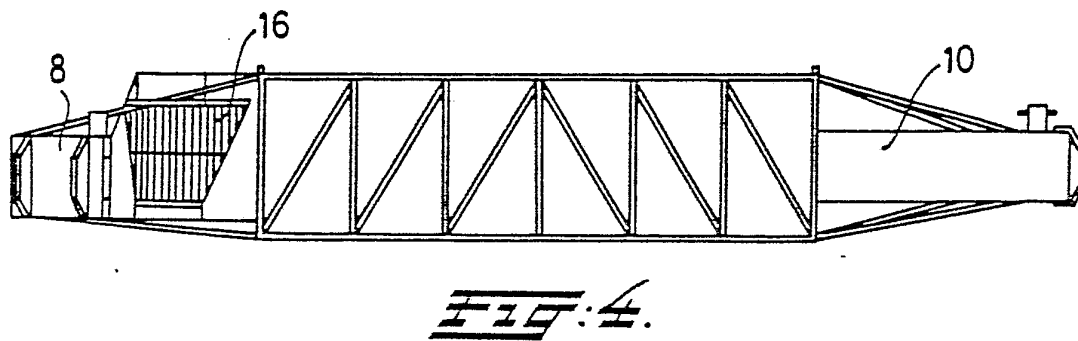
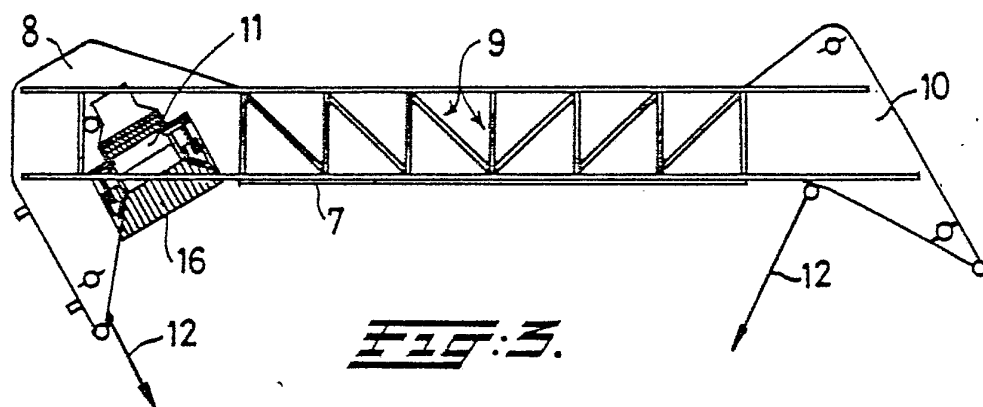
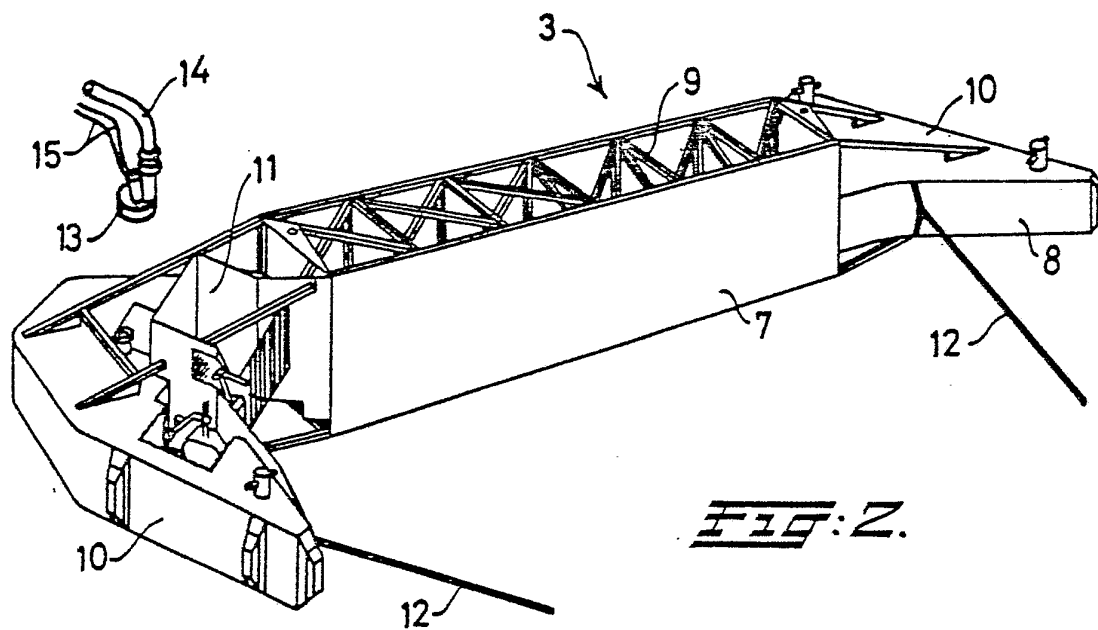
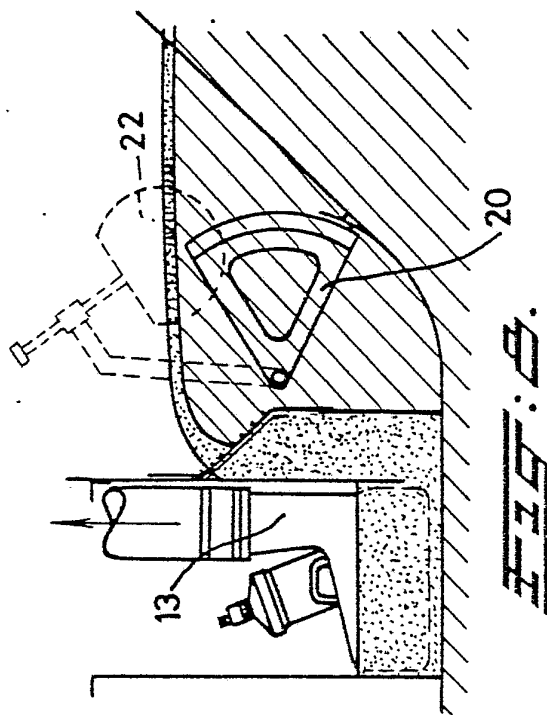
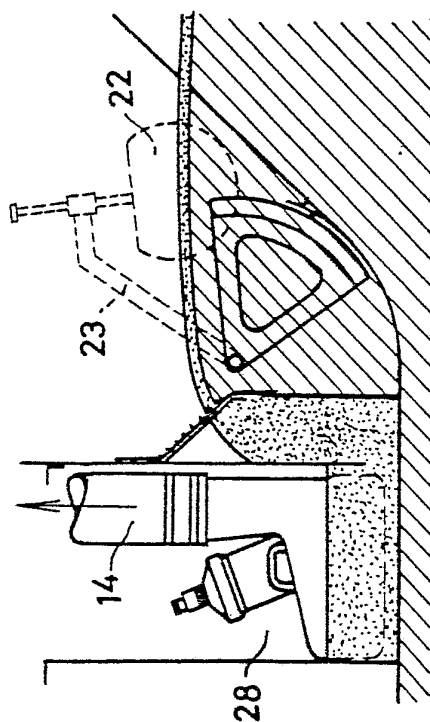
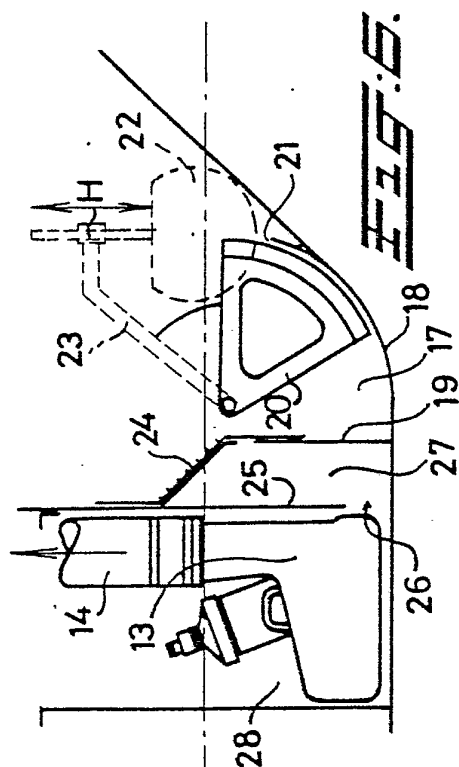
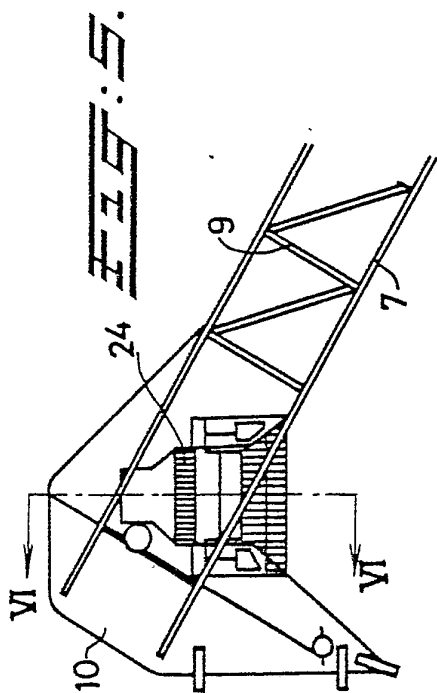


FIG. 1.

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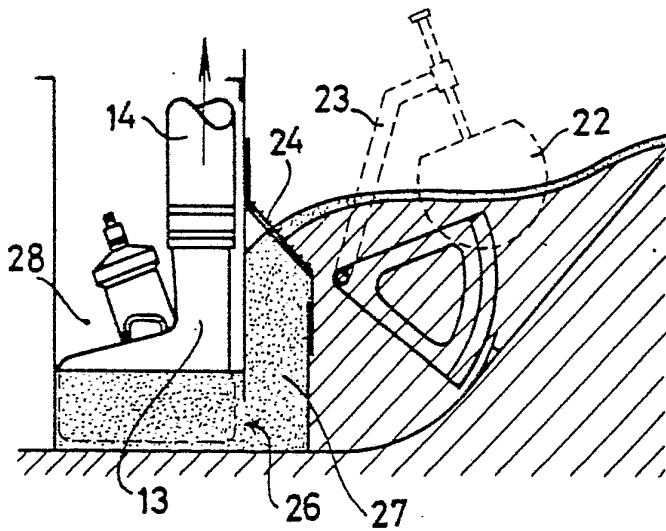


FIG. 9.

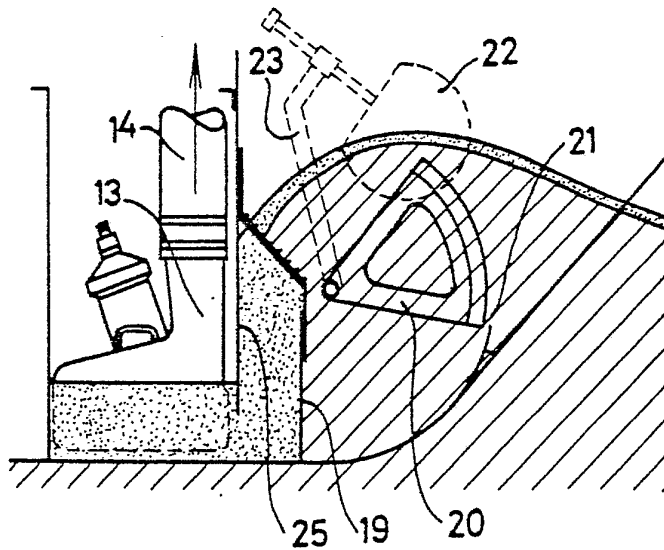


FIG. 10.

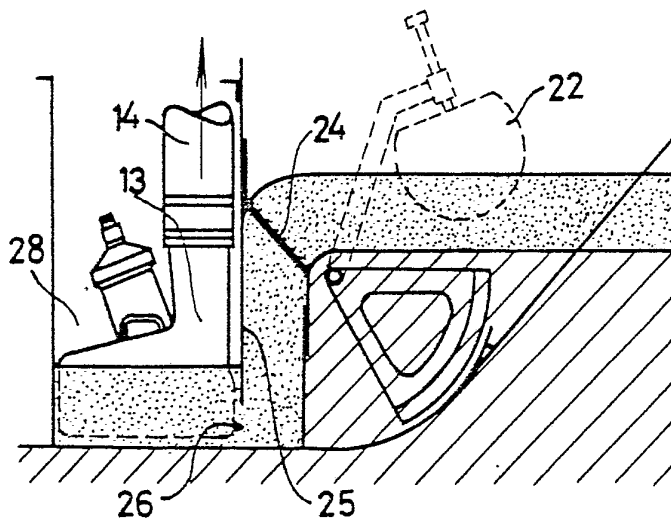


FIG. 11.

INTERNATIONAL SEARCH REPORT

International Application No PCT/EP 81/00072

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³ According to International Patent Classification (IPC) or to both National Classification and IPC Int.Cl. ³ : E 02 B 15/04																				
II. FIELDS SEARCHED Minimum Documentation Searched ⁴ <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%; padding: 5px;">Classification System</td> <td style="padding: 5px;">Classification Symbols</td> </tr> <tr> <td style="padding: 5px;">Int.Cl.³:</td> <td style="padding: 5px;">E 02 B</td> </tr> </table> Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵			Classification System	Classification Symbols	Int.Cl. ³ :	E 02 B														
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III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴ <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; padding: 5px;">Category *</th> <th style="width: 60%; padding: 5px;">Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷</th> <th style="width: 30%; padding: 5px;">Relevant to Claim No. ¹³</th> </tr> <tr> <td></td> <td>US, A, 3661263, published May 9, 1972 see column 2, lines 37-75; column 3, lines 1-72; figure 1; Peterson --</td> <td>1,2,3</td> </tr> <tr> <td></td> <td>US, A, 4014795, published March 29, 1977 see column 2, lines 52-68; column 3, lines 1-60; column 5, lines 1-40; figures 1,8,9; In 't Veld --</td> <td>1,3,4,5</td> </tr> <tr> <td></td> <td>US, A, 3701430, published October 31, 1972 see column 2, lines 19-67; column 3, lines 1-16; figure 2, Tuttle --</td> <td>1,3</td> </tr> <tr> <td>A</td> <td>US, A, 4056472, published November 1, 1977 see figures 2,4, Teasdale --</td> <td>1,3,6</td> </tr> <tr> <td>A</td> <td>FR, A, 2061978, published June 25, 1971 see page 2; figures 1-4, Millot -----</td> <td>1</td> </tr> </table>			Category *	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹³		US, A, 3661263, published May 9, 1972 see column 2, lines 37-75; column 3, lines 1-72; figure 1; Peterson --	1,2,3		US, A, 4014795, published March 29, 1977 see column 2, lines 52-68; column 3, lines 1-60; column 5, lines 1-40; figures 1,8,9; In 't Veld --	1,3,4,5		US, A, 3701430, published October 31, 1972 see column 2, lines 19-67; column 3, lines 1-16; figure 2, Tuttle --	1,3	A	US, A, 4056472, published November 1, 1977 see figures 2,4, Teasdale --	1,3,6	A	FR, A, 2061978, published June 25, 1971 see page 2; figures 1-4, Millot -----	1
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* Special categories of cited documents: ¹⁵ "A" document defining the general state of the art "E" earlier document but published on or after the international filing date "L" document cited for special reason other than those referred to in the other categories "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but on or after the priority date claimed "T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention "X" document of particular relevance																				
IV. CERTIFICATION <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;"> Date of the Actual Completion of the International Search ¹ 2nd September 1981 </td> <td style="width: 50%; padding: 5px;"> Date of Mailing of this International Search Report ¹ 16th September 1981 </td> </tr> <tr> <td style="width: 50%; padding: 5px;"> International Searching Authority ¹ EUROPEAN PATENT OFFICE Branch at The Hague P.O.Box 5818 Patentlaan, 2 2280 HV RIJSWIJK (ZH) The Netherlands </td> <td style="width: 50%; padding: 5px;"> Signature of Authorized Officer ²⁰ G.L.M. Kruidenberg </td> </tr> </table>			Date of the Actual Completion of the International Search ¹ 2nd September 1981	Date of Mailing of this International Search Report ¹ 16th September 1981	International Searching Authority ¹ EUROPEAN PATENT OFFICE Branch at The Hague P.O.Box 5818 Patentlaan, 2 2280 HV RIJSWIJK (ZH) The Netherlands	Signature of Authorized Officer ²⁰ G.L.M. Kruidenberg														
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