



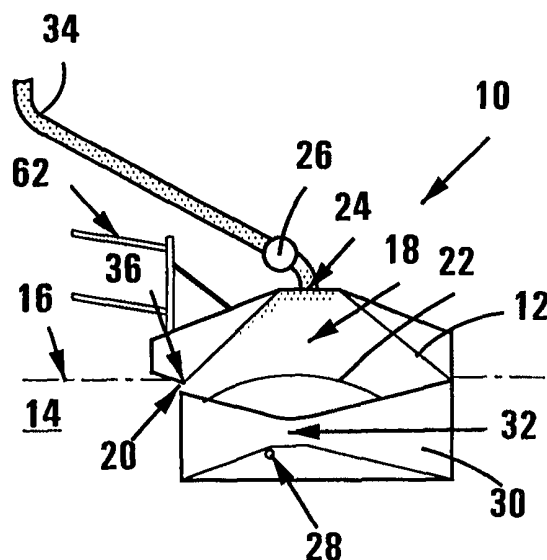
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(54) Title: SKIMMER APPARATUS

(57) Abstract

A skimmer apparatus (10) for separating an oil layer from a body of water (14) comprises a body (12) defining a separation chamber (18) and an inlet mouth (20) which is positionable with respect to the body of water (14) in a position that will permit a layer of water having an oil layer floating thereon and without any air accompanying the oil and water (14), from the body of water, to be guided into chamber (18) by relative displacement of the body (10) and the body of water (14). The body (10) defines also a first outlet (24) leading from the top region of the separation chamber (18) for displacing oil from the chamber (18) and a second outlet leading (28) from the bottom region of the chamber (18) and which communicates with a venturi formation (30). Water flow through the venturi formation (30) induces water flow from the separation chamber (18) at a sufficient rate to permit the required water and oil layer to enter the chamber (18) via the inlet mouth (20).



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SKIMMER APPARATUS

THIS INVENTION relates to a skimmer apparatus.

The invention relates particularly to a skimmer apparatus whereby oil, or the like, can be skimmed from a body of water, to prevent or reduce oil pollution.

Although reference is made hereinafter particularly to the skimming of an oil layer floating on a body of water, it must be understood that the skimmer apparatus of the invention can be used also for skimming any other substance or matter from a body of water, or other liquid, on which the substance or matter is floating. Also, where reference is made hereinafter to the water level or the level of the body of water, this must be interpreted to mean the level of the body of water including the oil layer floating thereon.

According to the invention there is provided a skimmer apparatus for separating oil from a body of water on which the oil is floating, which comprises

a body defining a separation chamber, an inlet mouth which is located and profiled to provide, in use of the apparatus, for a layer of water, having an oil layer floating thereon and without any air accompanying the layer, from a body of water, to be guided into the chamber by the relative displacement of the body with respect to the body of water and with the chamber being defined partially above and partially beneath the water level, at least one first outlet leading from the operative top region of the chamber and through which, in use, oil in the top region of the chamber can be displaced from the chamber, and at least one

second outlet leading from the operative bottom region of the chamber and through which, in use, water can be displaced from the chamber; and

a venturi formation located on the body in a location in which, in use, it is disposed beneath the water level and communicates with the second outlet in a configuration in which water flow through the venturi formation induces and enhances the displacement of water from the chamber through the second outlet.

It is apparent that the operation of the skimmer apparatus of the invention requires the relative displacement of the body with respect to a body of water in which the apparatus is to function, as well as the passage of water through the venturi formation. As such, the skimmer apparatus either can be used within a moving body of water in which case the body of the skimmer apparatus will be securely positioned with respect to the moving body of water, or can be used within a stationery body of water in which case the body of the skimmer apparatus can be mounted on or form a part of a vessel whereby the body of the skimmer apparatus can be displaced with respect to the body of water. In both cases the relative displacement of the body of the skimmer apparatus with respect to the body of water also will provide for the passage of water through the venturi formation, which is mounted in a suitable location on the body of the skimmer apparatus. The venturi formation, in use, ensures that water is displaced from the separation chamber at a sufficient rate to permit the required layer of water, having oil floating thereon, to enter the separation chamber.

Particularly for a skimmer apparatus which is provided for use in a moving body of water, the body of the skimmer apparatus may comprise an elongate structure that can span at least a portion of the width of the moving body of water and the inlet mouth may define an inlet slot-like formation extending along the width of the body. Such a skimmer apparatus may include a float arrangement for retaining the body in a required configuration with respect to a body of water from which an oil layer is to be separated.

Alternatively, or in addition, such a skimmer apparatus may include a support structure that can extend across the moving body of water and support the body in its required configuration with respect to the moving body of water.

5 For a skimmer apparatus which is provided for use in a stationery body of water, the body may include a mounting structure for mounting it on a displaceable vessel in a configuration in which the inlet mouth defined by the body, in use of the apparatus, faces in the direction of forward displacement of the vessel in a location in which a layer of water, having an oil layer floating thereon and without any air accompanying the layer, can be guided into the
10 chamber during forward displacement of the vessel.

In use, with the separation chamber defined by the body of the skimmer apparatus, in its operative skimming configuration, being disposed partially above the surrounding water level and partially beneath the surrounding water level, the inlet mouth will be disposed in a configuration in which the
15 bottom edge will be disposed beneath the said water level, particularly by a distance determined by the thickness of the layer of water and oil to be skimmed from the body of water.

For both the above embodiments of the invention, the skimmer apparatus may include a baffle formation defined within the body in the region
20 of the inlet mouth, the baffle formation depending from the operative top side of the mouth in a configuration in which, in use, it serves to trap water and oil displaced into the separation chamber via the mouth, to prevent air from entering into the chamber and to reduce turbulence and hydraulic jump in the flow of oil and water entering the chamber.

25 Further according to the invention the skimmer apparatus may include a liquid displacement means connected in line with the first outlet, for displacing oil from the top region of the separation chamber, in use of the apparatus.

One particular embodiment of the invention provides for the skimmer apparatus to include a sealed vacuum tank located operatively above the body, the vacuum tank defining an upstream end connected in line with the first outlet defined by the body and an operatively higher downstream end connected in line with the liquid displacement means via a flow line which extends from the downstream end of the vacuum tank to the liquid displacement means via a location disposed, in use of the apparatus, beneath the level of the body of water in which the apparatus is operating. The flow line extending from the vacuum tank to the liquid displacement means may have a shut-off valve located in line therewith.

For this embodiment of the invention, the skimmer apparatus may include a second venturi formation connected in communication with the operative lower point of the vacuum tank at the upstream end thereof, the second venturi formation being supported, in use, to be disposed beneath the level of the body of water in which the apparatus is operating, in a configuration in which water flow through the second venturi formation will induce flow of water contained in the vacuum tank from the vacuum tank and thereby enhance the flow of oil from the separation chamber to the vacuum tank. The water contained in the vacuum tank will be water separated from oil displaced from the separation chamber to the vacuum tank during the operation of the skimmer apparatus.

The body of the skimmer apparatus of the invention also may define at least two second outlets and, as such, the apparatus may include a venturi formation associated with each second outlet.

The overall configuration of the skimmer apparatus of the invention is greatly variable while still incorporating the principles of the skimmer apparatus as defined above and the invention extends also to such alternative configuration skimmer apparatus which still incorporates these principles.

Further features of the skimmer apparatus of the invention, including the mode of operation thereof, are described hereinafter with reference to two examples of the skimmer apparatus, illustrated by way of the accompanying diagrammatic drawings. In the drawings:

5 Figure 1 shows a schematic cross-sectional side view of a first embodiment of a skimmer apparatus for skimming an oil layer from a body of water, in accordance with the invention;

 Figure 2 shows a schematic end view of the skimmer apparatus of Figure 1;

10 Figure 3 shows a schematic cross-sectional side view of the skimmer apparatus of Figure 1, including an arrangement for displacing separated oil;

 Figure 4 shows the skimmer apparatus of Figure 3, having a modified arrangement for displacing separated oil;

15 Figure 5 shows a schematic cross-sectional side view of a second embodiment of a skimmer apparatus for skimming an oil layer from a body of water, in accordance with the invention; and

 Figure 6 shows a schematic plan view of the skimmer apparatus of Figure 5.

20 Referring initially to Figures 1 to 4 of the drawings, a first embodiment of a skimmer apparatus for skimming an oil layer from a body of water, in accordance with the invention, is designated generally by the reference numeral 10. The skimmer apparatus 10 is provided particularly for use in a moving body of water and comprises a body 12 which is positionable within the moving body of water 14, the required water line of the body of water 14 in the operative configuration of the skimmer apparatus 10 being illustrated by the
25 dotted line 16.

 The body 12 defines a separation chamber 18 which, in the operative configuration of the skimmer apparatus 10 as shown, is disposed partially above the water line 16 and partially beneath the water line 16.

The body 12 defines also an inlet mouth 20 which comprises an elongate slot-like opening which, in practice, will extend across a substantial portion of the width of the moving body of water 14 from which an oil layer is to be separated, preferably along substantially the entire width of the moving body of water. The inlet mouth 20 has an operative height between the top and bottom edges thereof which will permit a layer of water, having an oil layer floating thereon and without any air accompanying the layer, to be guided into the chamber 18 via the inlet mouth 20, by the relative displacement of the moving body of water with respect to the body 12. Particularly, with the inlet mouth effectively spanning the entire width of the moving body of water, the layer of water to be guided into the chamber 18 will have substantially the entire oil layer to be separated floating thereon. As such, within the chamber 18, the oil will take up the space in the operative top region of the chamber, whereas the water will take up the space in the bottom region of the chamber.

The body 12 defines further a first outlet 24 which leads from the operative top region of the chamber 18, permitting oil from the top region of the chamber 18 to be displaced from the chamber by any suitable liquid displacement means, such as by a pump, or the like. A valve 26 is provided in the location illustrated for the purpose described hereafter.

The body 12 defines still further a second outlet 28 which is defined in the operative bottom region of the chamber 18, the outlet 28 communicating with a venturi formation 30 which is disposed in a configuration in which the relative displacement of the moving body of water with respect to the body 12 will provide for water to flow through the venturi formation 30. It will be understood that an accelerated water flow will occur within the narrower region 32 of the venturi formation where the second outlet 28 is located and that water flow through the venturi formation will in effect induce the outflow of water from the chamber 18 through the second outlet 28. By inducing this outflow of water from the chamber 18, a low pressure within the chamber 18 is induced and this in turn will induce the flow of water having oil floating thereon into the

chamber 18 and, thereby, enable the effective operation of the apparatus 10. Water entering the venturi formation 30 via the second outlet 28 clearly is released back into the body of water from which it was separated upon entering the chamber 18. In this regard, as the water/oil layer enters the chamber 18 the oil will rise to the top of the chamber and the water will collect in the lower region of the chamber to permit it to exit via the second outlet 28.

It must be understood that the rate of flow of water from the chamber 18, as induced by the venturi formation 30, must be such that the required inflow of the water layer, having oil floating thereon, into the chamber 18 is permitted. If this is not the case, the flow velocity of water entering the chamber will be reduced relative to the flow velocity of water passing beneath the body and this will induce oil to 'escape' by passing beneath the body. A diffuser plate 22 further is located in the chamber 18 relative to the inlet mouth 20 in a position in which it ensures that the outflow of water via the outlet 28 will not result in oil flowing directly from the mouth 20 to the outlet.

For a configuration of the apparatus 10 where the first outlet 24 is connected in line with an oil line 34 which is connected in line with a pump (not shown), oil separated from water and collected within the chamber 18 can be displaced from the chamber 18 to a desired location, e.g. a storage tank, or the like, which is located remote from the apparatus 10. The said pump and storage tank also can form a part of the skimmer apparatus of the invention.

The apparatus as described in Figures 1 and 2 of the drawings, in its operative configuration therefore will provide for the body 12 to extend across the width of a moving body of water, e.g. a river, a stream, a channel, a canal, or the like, with the inlet mouth 20 being disposed transversely to the direction of water flow. As described, this configuration of the inlet mouth will provide for a layer of water, which has a layer of oil floating thereon and without water accompanying the later, to enter the chamber 18. A baffle formation 36 is disposed in this inlet mouth region of the body, depending effectively from the

top side of the mouth 20. The baffle formation 36 is configured to prevent "hydraulic jump" of liquid entering into the chamber as a result of the fast moving incoming layer of liquid, including the water layer and the oil layer, merging with the near stationery liquid in the chamber, thus preventing liquid turbulence in this region and thereby reducing mixing of the oil and water entering into the chamber 18. The baffle formation also serves as a trap for ensuring that reverse flow through the inlet mouth cannot occur and also that air cannot enter the chamber.

It must be understood that the displacement of oil from the chamber 18 also will induce a negative/low pressure within the chamber, the chamber thus effectively acting as a vacuum chamber which will permit the required inflow of water, having an oil layer floating thereon, into the chamber for oil separation purposes. As envisaged above, separated oil can be displaced by any suitable pump to a required storage facility.

Referring to Figure 3 of the drawings, instead of having the first outlet 24 connected directly to a pump, the outlet 24 is connected to a pump 40 via a vacuum tank 42 which has an upstream end 44, where oil from the chamber 18 will enter the vacuum tank 42, and an operatively higher downstream end 46, from which oil from the vacuum tank will be displaced by the pump 40 via a flow line 48 which defines a segment 50 which is disposed beneath the water level 16 as shown. A flexible flow line connects the outlet 24 to the upstream end 44 of the tank 42, the flexibility of the flow line serving to accommodate movement of the body 12. A valve 52 can open and shut the oil line 48. This oil displacement arrangement clearly constitutes a completely sealed arrangement which, after effective priming thereof, will ensure the efficient operation of the complete apparatus 10 and particularly the efficient separation of oil from a body of water, in the manner described above. The location of the segment 50 of the flow line 48, in use of the apparatus, clearly provides for the required sealed arrangement as described, Also, the valves 26 and 52 facilitate the required priming of the arrangement.

Insofar as a water component may still exist within the oil separated from the chamber 18, this water will separate from the oil while retained within the vacuum tank 42, where it will be retained in the operative lower region thereof. A drainage aperture therefore may be provided for draining water from the tank 42 when required. The vacuum tank 42 also has a filler point 54 which will permit effective priming of the complete apparatus prior to initiating use thereof, particularly to eliminate air within the system.

Referring particularly to Figure 4 of the drawings, the upstream end 44 of the vacuum tank 42 may have a drainage outlet 56 associated therewith which communicates with a second venturi 58 disposed beneath the water level 16, the venturi 58 in effect creating a negative pressure for inducing the outflow of water from the tank 42 and simultaneously improving the efficiency of the apparatus 10 for separating a floating oil layer from a body of water. A baffle plate 59 is located within the vacuum tank 42 for separating oil and water and ensuring that only water will be drained from the tank in use of the apparatus 10.

In order to provide for the required location of the apparatus 10 with respect to a moving body of water and, particularly, the required location of the inlet mouth 20, the body 12 has buoyancy tanks 60 associated therewith which will provide for the apparatus 10 to float in its required configuration with respect to the moving body of water. In addition, a support structure 62 is provided to secure the location of the apparatus 10, particularly where it is to fulfil a permanent function.

It will be appreciated that the exact configuration of the apparatus of the invention as described with reference to Figures 1 to 4 is greatly variable, both in relation to the construction, and the operation thereof. Alternative possible arrangements are not described in further detail herein.

Referring particularly to Figures 5 and 6 of the drawings, a second embodiment of a skimmer apparatus, in accordance with the invention, is designated generally by the reference numeral 100. With like parts being designated by similar reference numerals as before, the skimmer apparatus 100 again includes a body 112. The body 112 is adapted to be mounted on a displacement vessel 102 which is illustrated most clearly in dotted lines in Figure 6. Suitable mounting means (not shown) are associated with the apparatus 100 for mounting it on the vessel 102, the vessel 102 typically comprising a motorized boat, e.g. a ski-boat, or the like, with the skimmer apparatus 100 thus being adapted particularly for use in separating an oil layer from a stationary body of water. The vessel 102 thus provides for the required relative displacement of the apparatus 100 with respect to a body of water, the inlet mouth defined by the body 112 of the apparatus 100, in use, facing transversely to the direction of forward displacement of the vessel 102, so that by the displacement of the vessel a layer of liquid can be induced to enter the chamber 118, while the displacement also can provide for water flow through an associated venturi formation 130 of the apparatus 100. It is envisaged in particular that the oil component of the liquid layer entering the chamber 118 will be pumped from the chamber via an oil line 134 via first outlets 124, whereas the water will be re-introduced into the body of water via a second outlet 128 associated with the venturi formation 130. Clearly, two or more venturi formations may be located on the body 112, it being envisaged in particular that a separate venturi formation 130 may be located on each side 104 of the body 112.

It must be understood that the operation of the apparatus 100 will be equivalent to that of the apparatus 10. The required relative displacement between the apparatus and the body of water will be provided by the displacement of the apparatus 100 by the vessel 102, which will in turn provide for the separation of an oil layer from the stationary body of water in the manner described. The vessel 102 clearly can provide for the apparatus 100 to traverse the stationary body of water along a path which will provide for oil floating on

the body of water to be separated therefrom. Oil separated will be displaced to a suitable storage facility with the aid of a pump, or the like, which can be located in any suitable location with respect to the apparatus 100, it being envisaged in this regard that a suitable storage facility can be provided as part of the apparatus 100.

It is envisaged also that the apparatus 100 can be provided in combination with a dedicated vessel which in effect will form a part of the apparatus and the invention accordingly extends to such a vessel which incorporates a skimmer apparatus as herein envisaged as a part thereof. As such, the apparatus of the invention is effectively motorized and many have different configuration motorized versions of the apparatus for different applications are envisaged.

Where the skimmer apparatus of the invention is used in a permanently positioned situation where it extends across a waterway, continuous liquid flow through the apparatus is provided for. Where oil pollution has occurred, the oil floating on the water will separate in the manner described and the apparatus of the invention may then be rendered operable so that only when a predetermined volume of oil is identified within the separation chamber, a pump will be triggered for displacing the oil from the separation chamber to an oil storage tank, or the like. This can then also trigger an oil spillage warning alarm for warning that an oil spillage along the waterway has indeed occurred. The skimmer apparatus of the invention can be adapted also for various other specific applications in relation to situations where oil spillages can potentially occur.

CLAIMS

1. A skimmer apparatus for separating oil from a body of water on which the oil is floating, which comprises

5 a body defining a separation chamber, an inlet mouth which is located and profiled to provide, in use of the apparatus, for a layer of water, having an oil layer floating thereon and without any air accompanying the layer, from a body of water, to be guided into the chamber by the relative displacement of the body with respect to the body of water and with the chamber being defined partially above and partially
10 beneath the water level, at least one first outlet leading from the operative top region of the chamber and through which, in use, oil in the top region of the chamber can be displaced from the chamber, and at least one second outlet leading from the operative bottom region of the chamber and through which, in use, water can be displaced from the chamber; and

15 a venturi formation located on the body in a location in which, in use, it is disposed beneath the water level and communicates with the second outlet in a configuration in which water flow through the venturi formation induces and enhances the displacement of water from the chamber through the second outlet.

20 2. A skimmer apparatus as claimed in Claim 1, which is provided for use in a moving body of water and in which the body comprises an elongate structure that can span at least a portion of the width of the moving body of water and the inlet mouth defines an inlet slot-like formation extending along the width of the body.

25 3. A skimmer apparatus as claimed in Claim 2, which includes a float arrangement for supporting the body in a required configuration with respect to a body of water from which an oil layer is to be separated.

4. A skimmer apparatus as claimed in Claim 2 or Claim 3, which includes a support structure that can extend across the moving body of water and support the body in its required configuration with respect to the moving body of water.

5. A skimmer apparatus as claimed in Claim 1, which is provided for use in a stationery body of water and in which the body includes a mounting structure for mounting it on a displaceable vessel in a configuration in which the inlet mouth defined by the body, in use of the apparatus, faces in the direction of forward displacement of the vessel in a location in which a layer of water, having an oil layer floating thereon and without any air accompanying the layer, can be guided into the chamber during forward displacement of the vessel.

6. A skimmer apparatus as claimed in Claim 5, which includes the vessel as part thereof.

7. A skimmer apparatus as claimed in any one of the preceding claims, which includes a baffle formation located within the body in the region of the inlet mouth, the baffle formation depending from the operative top side of the mouth in a configuration in which, in use, it serves to trap water and oil displaced into the separation chamber via the mouth, to prevent air from entering into the chamber and to reduce turbulence and hydraulic jump in the flow of oil and water entering the chamber.

8. A skimmer apparatus as claimed in any one of the preceding claims, which includes a liquid displacement means connected in line with the first outlet for displacing oil from the top region of the chamber, in use of the apparatus.

9. A skimmer apparatus as claimed in Claim 8, which includes a sealed vacuum tank located operatively above the body, the vacuum tank defining an upstream end connected in line with the first outlet defined by the body and an operatively higher downstream end connected in line with the liquid displacement means via a flow line which extends from the downstream end of the vacuum

tank to the liquid displacement means via a location, disposed in use, beneath the level of the body of water in which the apparatus is operating.

10. A skimmer apparatus as claimed in Claim 9, in which the flow line extending from the vacuum tank to the liquid displacement means has a shut-off valve located in line therewith.

11. A skimmer apparatus as claimed in Claim 9 or Claim 10, which includes a second venturi formation connected in communication with the operative lower point of the vacuum tank at the upstream end thereof, the second venturi formation being supported, in use, to be disposed beneath the level of the body of water in which the apparatus is operating, in a configuration in which water flow through the second venturi formation will induce flow of water contained in the vacuum tank from the vacuum tank and thereby enhance the flow of oil from the separation chamber to the vacuum tank.

12. A skimmer apparatus as claimed in any one of the preceding claims, in which the body defines at least two second outlets and the apparatus includes a venturi formation associated with each second outlet.

13. A skimmer apparatus substantially as described in the specification with reference to and as illustrated in the accompanying diagrammatic drawings.

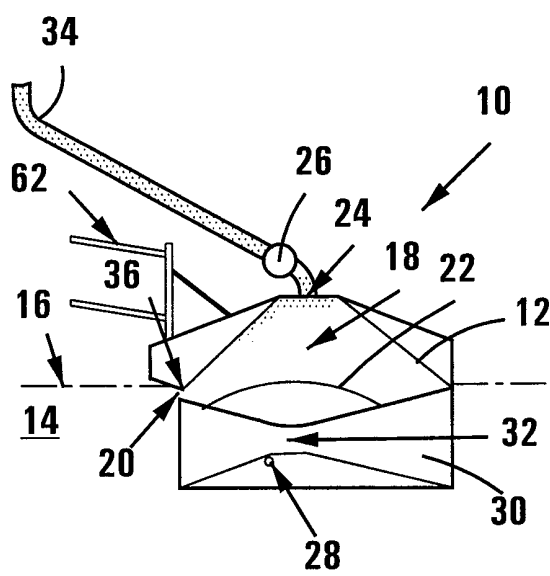


FIG 1

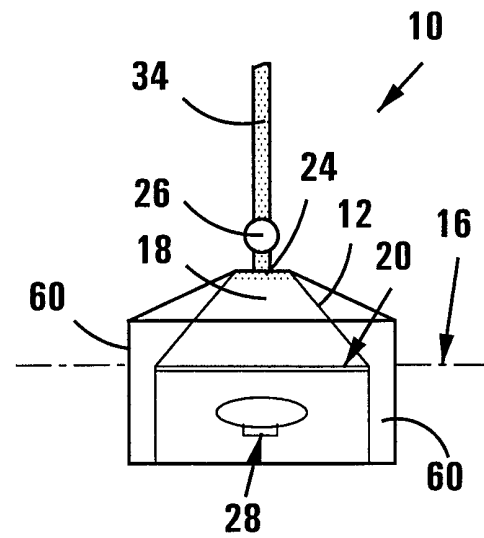


FIG 2

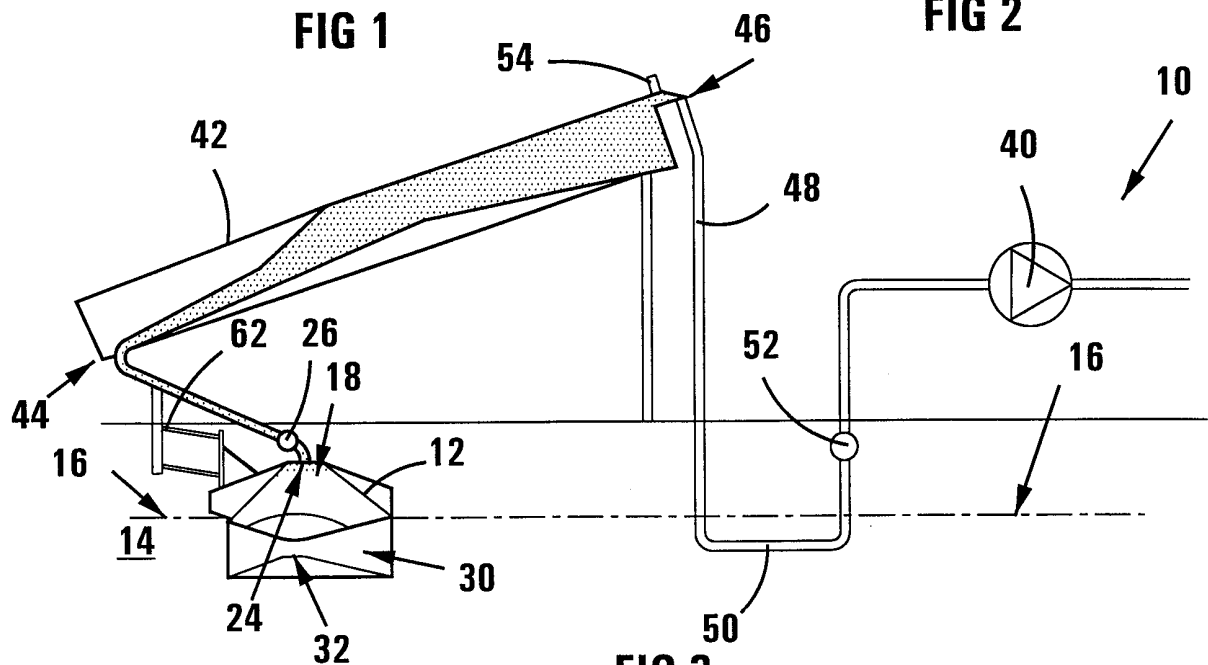


FIG 3

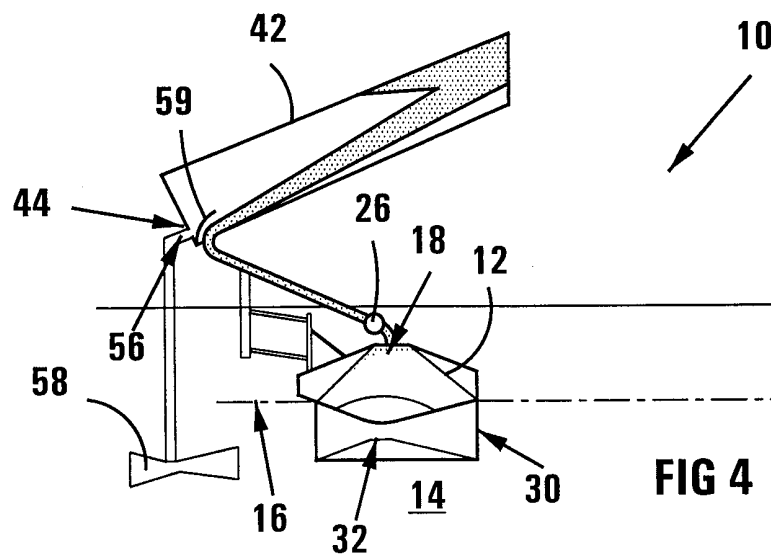


FIG 4

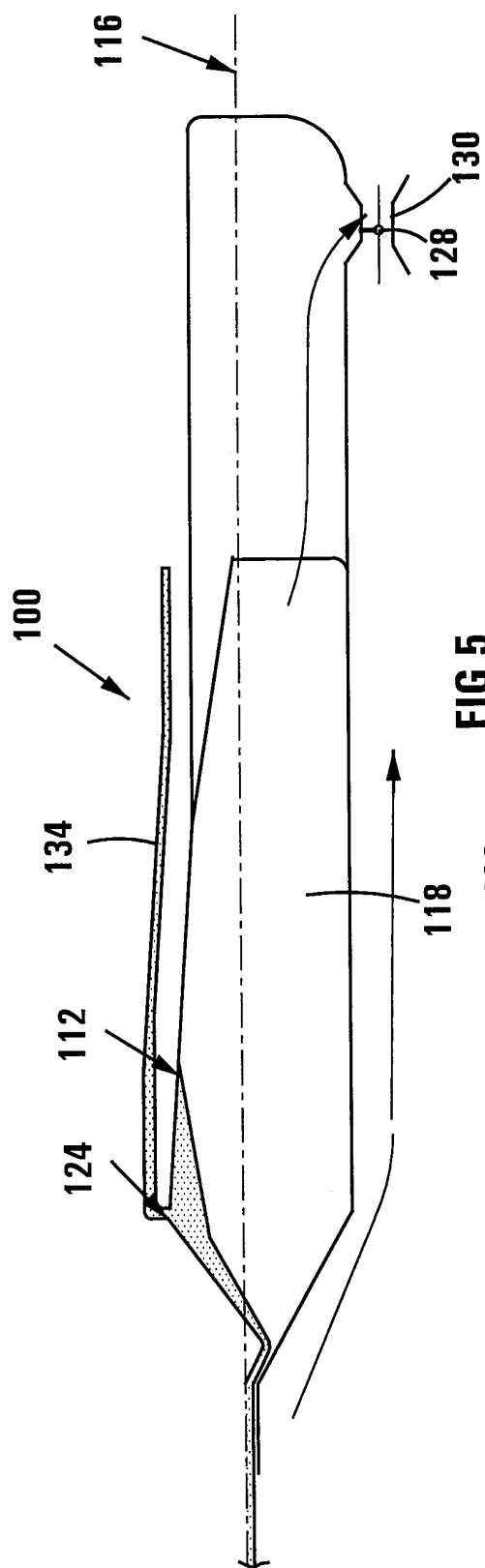


FIG 5

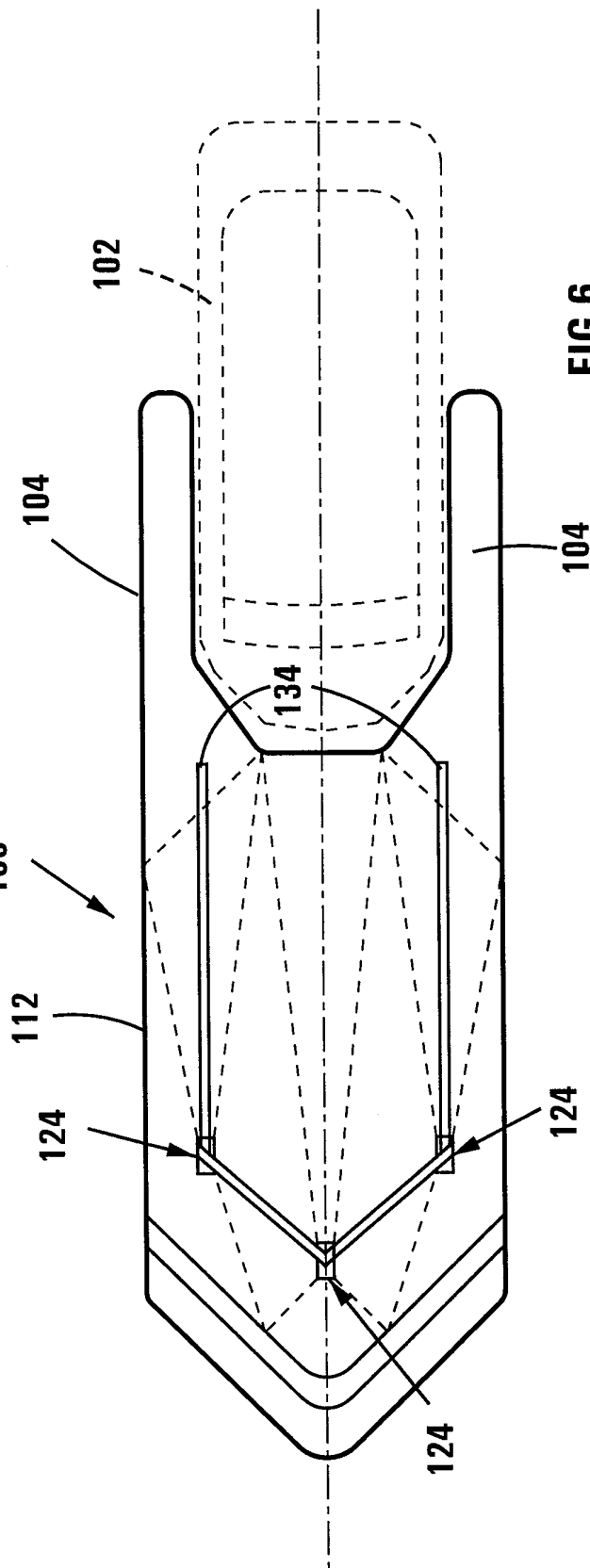


FIG 6

INTERNATIONAL SEARCH REPORT

Internal Application No

PCT/IB 99/01257

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 E02B15/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E02B B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 966 615 A (PETCHUL SIGVALD L ET AL) 29 June 1976 (1976-06-29) column 2, line 47 -column 3, line 28 figure 1 ---	1,5-8
A	US 3 929 644 A (FLETCHER GEORGE M) 30 December 1975 (1975-12-30) column 2, line 42 -column 4, line 9 column 4, line 33 -column 5, line 6 figures 1-3 ---	1,5,6,8
A	US 4 151 081 A (ASPER JEAN-JACQUES ET AL) 24 April 1979 (1979-04-24) column 6, line 60 -column 7, line 35 figure 13 --- -/--	1,5,6,8

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

30 September 1999

Date of mailing of the international search report

07/10/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

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Urbahn, S

INTERNATIONAL SEARCH REPORT

International Application No

PC1/IB 99/01257

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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