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Markel et al.

[11] **3,722,689**

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[54] APPARATUS FOR EXTRACTING OIL OR THE LIKE FROM THE SURFACE OF THE SEA

[75] Inventors: **Arthur L. Markel**, Miami; **Robin F. Wirsching**, Summerland Key, both of Fla.

[73] Assignee: **Reynolds Submarine Services Corporation**, Miami, Fla.

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[21] Appl. No.: **143,105**

[52] **U.S. Cl.** **210/242**, 210/DIG. 21

[51] **Int. Cl.** **C02b 9/02**

[58] **Field of Search** .....210/242, 83, DIG. 21

[56] **References Cited**

UNITED STATES PATENTS

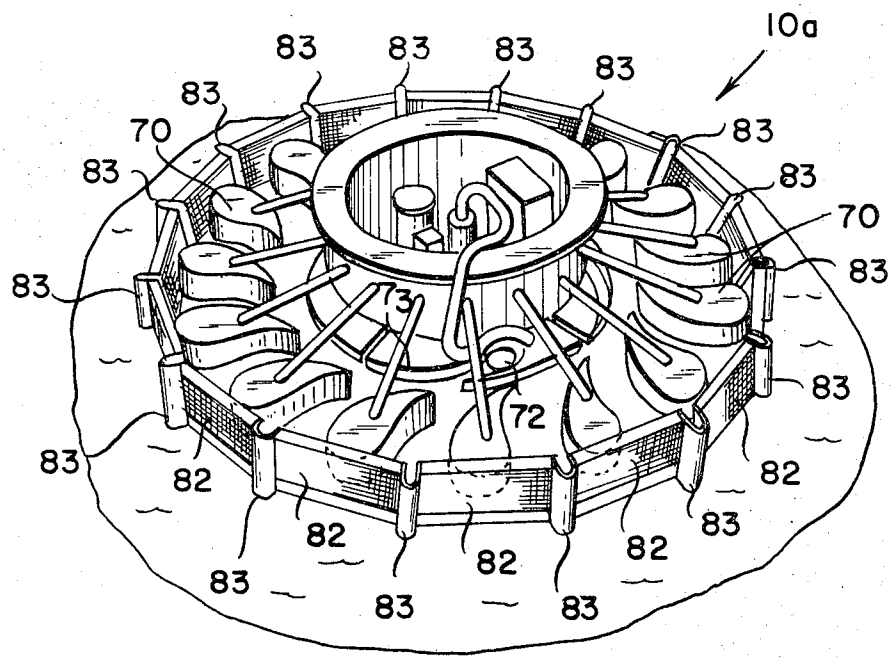
3,635,342 1/1972 Mourlon et al. 210/242

Primary Examiner—Samih N. Zaharna
Assistant Examiner—T. A. Granger
Attorney—Low & Matthews

[57] **ABSTRACT**

Apparatus for extracting oil or the like from the surface of the sea. A centrally disposed ballast chamber is surrounded by a sump compartment which is sufficiently large so as to obtain deceleration of flow of the liquids which pass over an articulated weir member. The latter is connected to arm members which are provided with a substantially universal connection to the ballast chamber. A flexible skirt member forms an exterior wall portion of the sump compartment and is connected to the lips which constitutes an upper edge of the outer weir member. In this manner a pressure differential across the skirt member is communicated to an individual weir segment member in order to vary its elevation in a self-compensating manner. In a preferred form of the invention, the float members form vanes so arranged as to impart a vortex or circular swirl to the fluids passing over the outer weir. An inner weir means is used to collect oil floating on the surface within the sump which has accumulated adjacent the wall of the centrally disposed ballast chamber.

11 Claims, 6 Drawing Figures



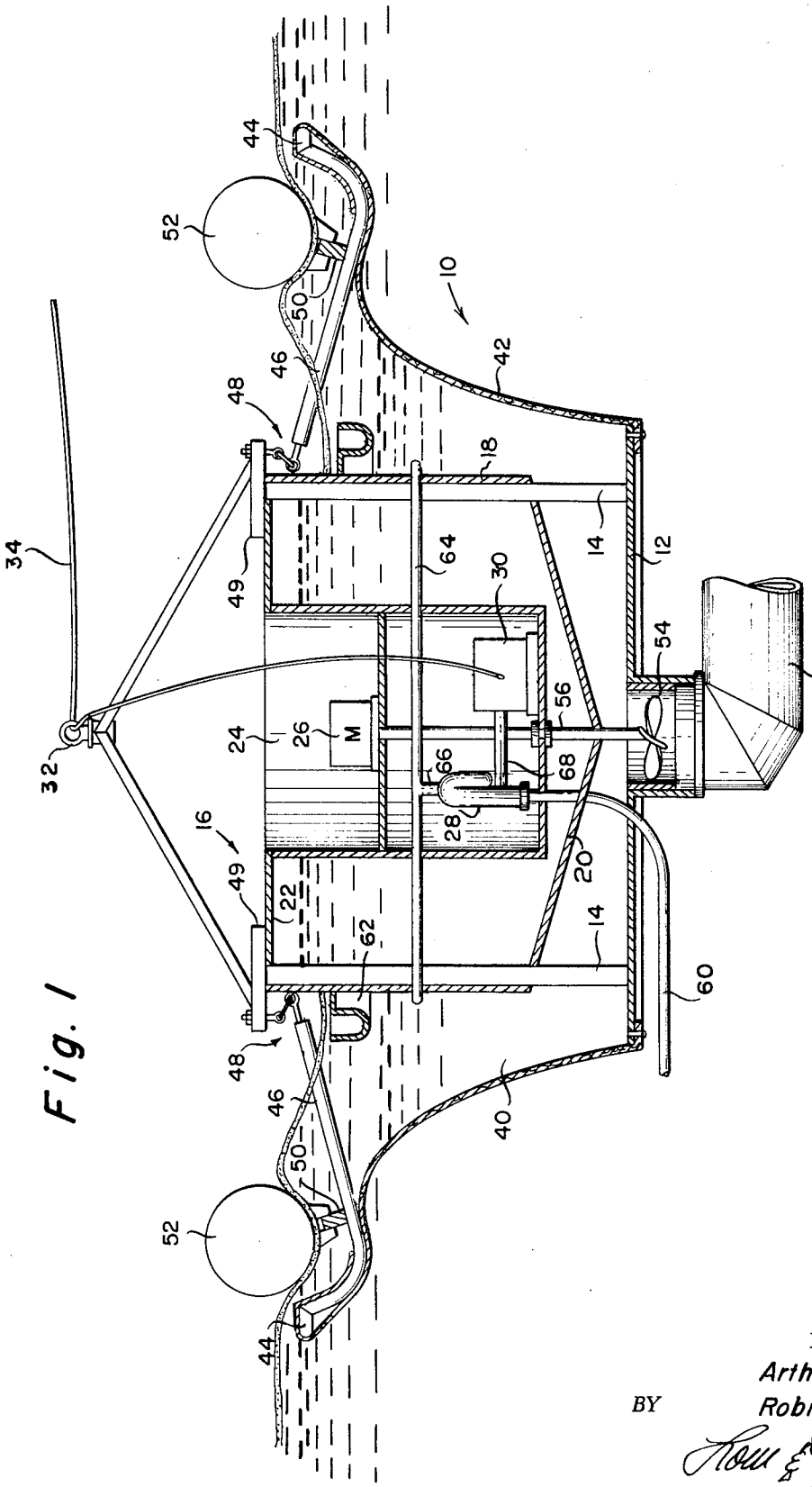


Fig. 1

INVENTORS
Arthur L. Markel
Robin F. Wirsching

BY

Rowe & Matthews
ATTORNEYS

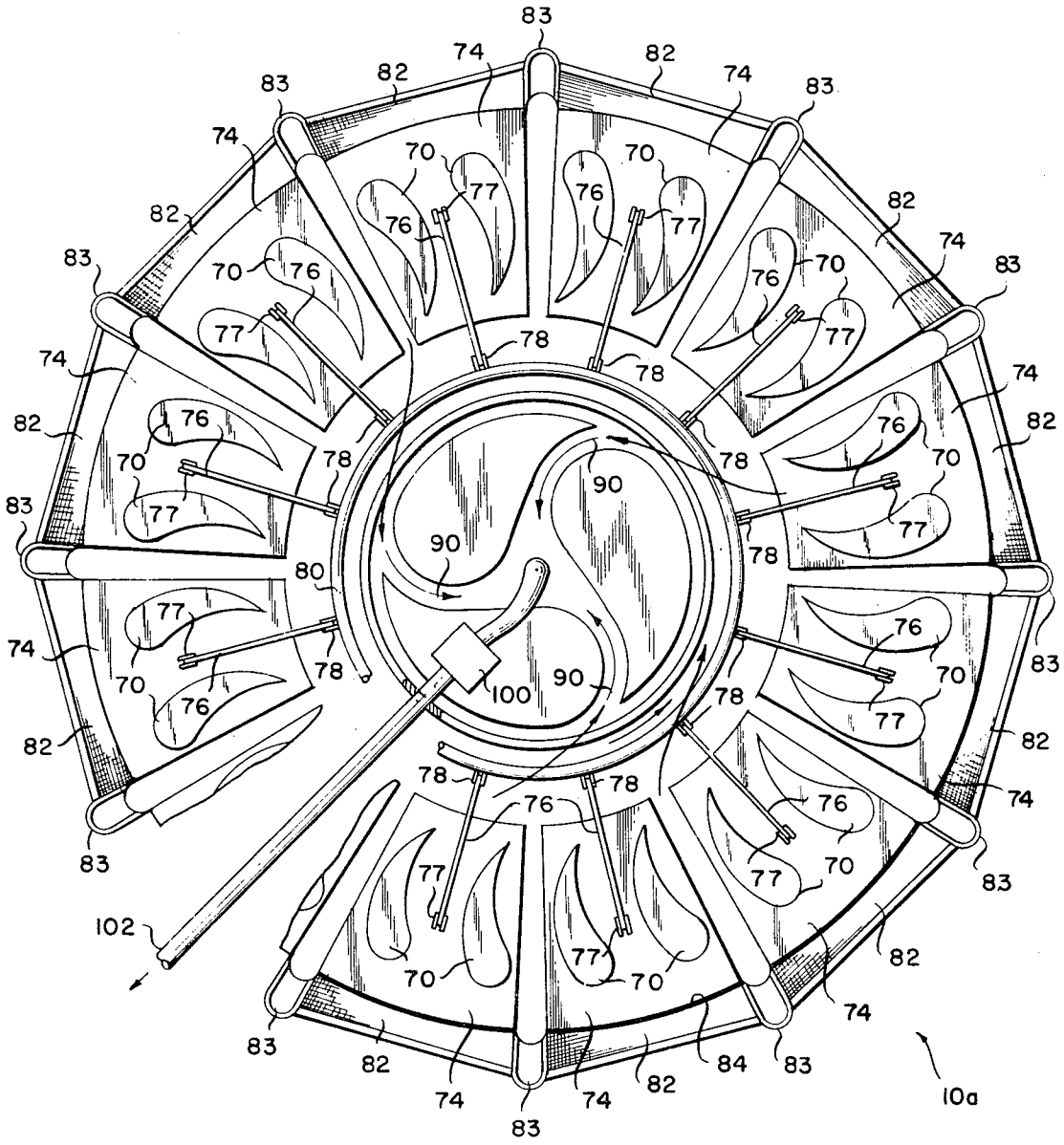


Fig. 2

INVENTORS
Arthur L. Markel
Robin F. Wirsching

BY Rowe & Matthews

ATTORNEYS

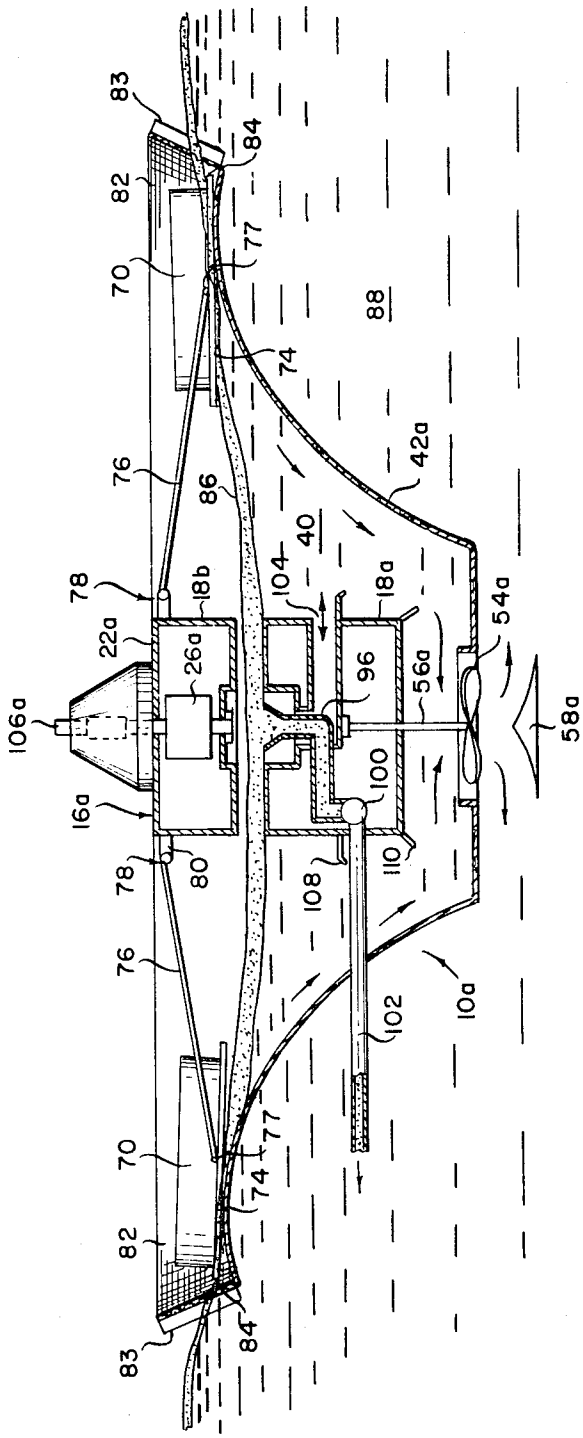


Fig. 3

INVENTORS
Arthur L. Markel
Robin F. Wirsching

BY

ATTORNEYS

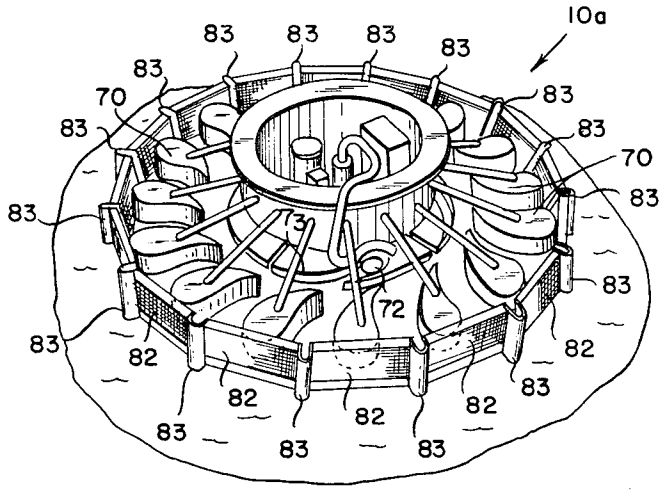


Fig. 4

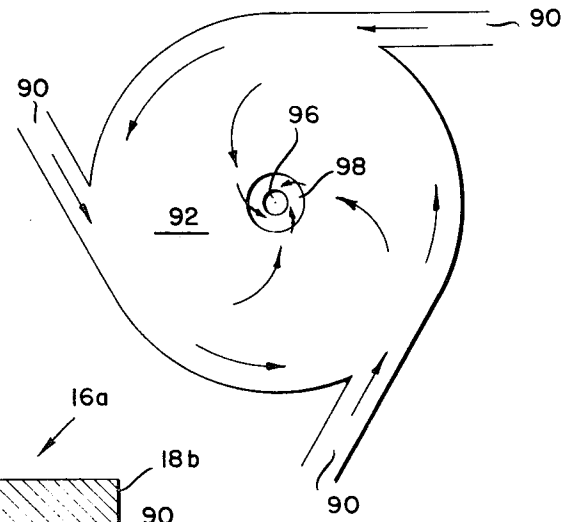


Fig. 5

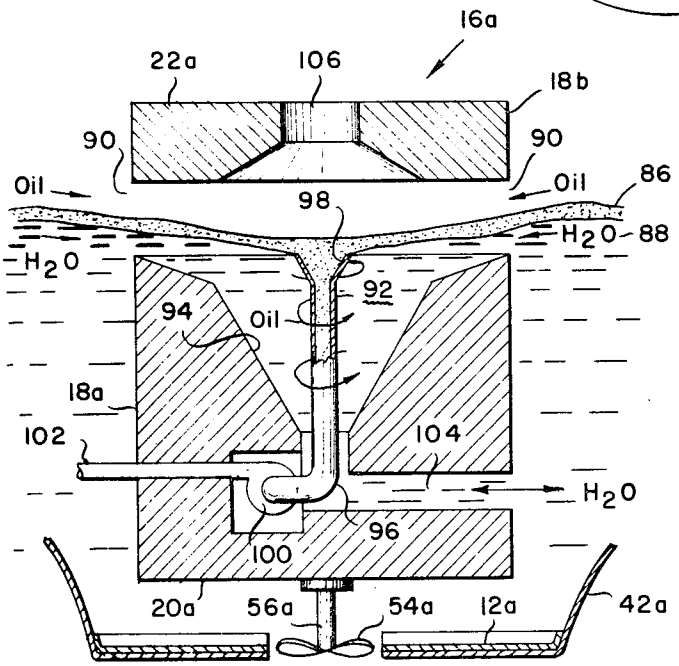


Fig. 6

INVENTORS
Arthur L. Markel
Robin F. Wirsching
BY
ATTORNEYS

APPARATUS FOR EXTRACTING OIL OR THE LIKE FROM THE SURFACE OF THE SEA

This invention relates to apparatus for extracting oil or the like from the surface of the sea, and more particularly to such an apparatus wherein a relatively large sump compartment is utilized together with cooperating vanes to achieve separation of oil and water.

This invention utilizes a self-compensating weir arrangement disclosed in the co-pending application of Robin F. Wirsching, filed concurrently herewith. In the self-compensating weir construction shown in the aforementioned patent application, a surface layer extractor or skimming apparatus carries its own ballast chamber substantially centrally of the apparatus itself. A flexible skirt is employed to form a wall portion of a sump compartment which substantially surrounds the ballast chamber. The flexible skirt provides means for communicating a pressure differential to the lips of a floating weir member in order to vary the elevation or articulated portions thereof.

In accordance with the present invention, the sump compartment is made sufficiently large so as to obtain deceleration of the flow of liquids which pass over the weir member. Vanes are employed in order to obtain a vortex within the sump compartment. The latter is made large enough so that a quiescent condition is obtained for the liquids therein and in one form of the invention the vortex concentrates the oil substantially adjacent the central ballast chamber whereby the oil may be removed with the aid of an inner weir member positioned adjacent the central ballast chamber. Selectively controlled pump means is used to pump the oil obtained from the inner weir member to a collecting vessel and ensures that a large ratio of water to oil, a deficiency of many present day skimmers, is avoided. Therefore, it is no longer necessary to employ enormous collecting tanks or vessels in order to obtain separation of oil and water.

In another form of the present invention, a central swirl chamber is employed whereby oil may be skimmed from the surface of a body of water and delivered substantially centrally of the unit where acceleration forces are minimized. Furthermore, in this embodiment, the oil may be extracted from the central location.

The inherent advantages and improvements of the present invention will become more readily apparent upon considering the following detailed description of the invention and by reference to the drawings in which:

FIG. 1 is an elevational view of one form of a skimmer-separator apparatus of the present invention;

FIG. 2 is a top plan view, with parts broken away, of another form of a skimmer-separator apparatus of the present invention;

FIG. 3 is an elevational view, schematic in nature, of a skimmer-separator apparatus such as is shown in FIG. 2;

FIG. 4 is a perspective view, drawn to a smaller scale, of the skimmer-separator apparatus of FIg. 2;

FIG. 5 is a schematic representation, in top plan view, to illustrate the circulation of fluids in the apparatus of FIG. 2; and,

FIG. 6 is a fragmentary view taken in vertical cross section illustrating a central swirl chamber of the apparatus of FIG. 2.

Referring now to FIG. 1, there is shown a skimmer-separator apparatus indicated generally at **10**. A base for the skimmer-separator apparatus is shown at **12** with support posts **14** extending thereabove in order to support a centrally located ballast chamber indicated generally at **16**. Ballast Chamber **16** has substantially cylindrical side walls **18**, a bottom wall **20** and a top wall **22**.

A hollow central portion **24** within ballast chamber **16** provides a suitable housing for a main motor **26**, pump **28** and auxiliary drive motor **30** for pump **28** to be described in greater detail hereinafter. The entire unit may be lifted by means of lift ring **32** and a power line **34** provides a remotely controlled drive for motor **30** whereby the pump **28** is driven selectively as will be described hereinafter.

An open-topped sump compartment **40** surrounds the central ballast chamber **16** with wall **18** of the central ballast chamber **16** providing an inner wall for the sump compartment and a flexible curtain **42** provides an outer wall thereof. Flexible wall **42** also provides means for communicating a differential pressure to the lips **44** of an outer weir whereby the height thereof may be controlled. This feature of the invention is described and claimed in copending application of Robin F. Wirsching, filed concurrently herewith. The flexible curtain **42** is attached to base **12** which constitutes a lower edge for the flexible weir member.

The lips **44** collectively constitute an upper edge of the weir. These lips are provided at the end of weir arms **46** which are universally mounted to the central ballast compartment at **48**. Such a universal mounting may be provided by means of shackle bolts or the like attached to support members **49** of the central ballast chamber **16**. Attached to the weir arms **46** as at **50** are a plurality of float members **52** whereby the skimmer-separator unit **10** may float in a body of water.

Motor **26** drives a propeller **54** through the intermediary of shaft **56** whereby liquids which pass over the variable height lips **44** of the outer weir into sump compartment **40** are exhausted therefrom. These liquids are pumped out through an exhaust pipe or manifold **58**. Similarly, pump **28** driven by motor **30** is provided with an outlet manifold **60** in order to remove oil which accumulates in the vicinity of an inner weir **62** by the quiescent flow within sump compartment **40**. Conduit **64** interconnected to the inner weir **62** conveys the oil to conduit **66** and then to pump **28**. A shaft **68** is the drive shaft between motor **30** and pump **28**.

Referring now to FIGS. **2–3**, there is shown a modified form of a skimmer-separator indicated generally at **10***a*. In this form of the invention, float members are vane-shaped as indicated at **70** and suitably affixed to a metal backing member **74**. The weir arms **76** are hingedly pivoted at **47** and are universally pivoted as indicated generally at **78** to a support ring **80**. A plurality of sections of debris screens **82** are interconnected by flexible interconnecting members **83** as seen best in FIG. 4 in order to prevent floating debris from passing over the ends **84** of the metal backing members **74** which provide a weir lip or upper edge **84** over which oil and water may pass. As seen best in FIG. **3**, the oil is shown to be floating at **86** atop water **88**.

In this form of the invention, means such as conduits **90** are provided for conveying the oil **86** which passes over the weir lip or upper edge **84** in a quiescent

manner inwardly toward the center of the ballast chamber **16***a*. The oil is thereby presented for extraction by passage over a central weir located within the central ballast chamber **16***a*. Thus there is provided a swirl chamber **92** as seen in FIG. **6** defined by substantially conical inner surface **94** of the central ballast chamber **16***a*. As can be seen in this FIG. **6**, the outer wall of the central ballast chamber **16***a* is designated at **18***a* for the lower portion and at **18***b* for the upper portion which is suitably supported thereabove.

An inner weir **96** having an outwardly flared upper portion **98** facilitates the separation of oil **86** from water **88** whereby the oil may be pumped by pump **100** through a flexible tube **102** to a suitable collection means, not shown. The central ballast compartment has a lower conduit **104**, as seen best in FIGS. **3** and **6**, for reception of the excess fluid, principally water, back into the sump compartment **40**. Means such as a vent **106** in FIG. **6** or a pipe **106***a* in FIG. **3** are used to provide a vent for the conduits **90** leading into the swirl chamber **92** in FIGS. **5** and **6**.

As seen in FIG. **4**, a vortex inducer means **72** is provided consisting of a hole or exit port at the end of a vane **73** which is closely adjacent to the exterior wall of the central ballast chamber. A hose, not shown, interconnects each exit port of the vortex inducer means **72** with the suction end of pump **100**. Thus it is possible with the use of outer vanes at **70** and inner vanes such as at **73** and a vortex inducer at **72** that the oil builds up adjacent the central ballast chamber in a quiescent manner whereby extremely good concentrations of oil are obtained. In addition, baffles may be used on the central ballast chamber such as at **108** and **110** in FIG. **3** to further insure that the oil build-up occurs in a quiescent manner.

Skimmer units made in accordance with the present invention have been made with processing rates from 100 gallons to 10,000 gallons per minute. Thus it is economical for these units to meet the needs of extremely small marinas up to sizes required for massive off-shore oil spills. Since the weir has a variable depth, the oil and water is captured around the entire circumference of the unit and moves the oil into a wave-protected inner sump area where it is concentrated and collected. The water enters over the weir and flows smoothly downwardly as is indicated by the arrows in FIG. **3** to be discharged by propeller **54***a* with or without the aid of a baffle **58***a*.

Since the oil is concentrated effectively with the use of inner weirs such as are shown at **62** in FIG. **1** and at **96** in the embodiment of FIGS. **2–6**, the present invention permits the collection of considerably more oil and less water. Therefore, it is possible to operate the pumps **28** (FIG. **1**) and **100** (FIGS. **2–6**) periodically and from a remotely controlled position. The baffle **58***a* permits the water to be discharge overboard in a horizontal direction with respect to the skimmer-separator unit itself. A relatively shallow draft of 4.5 feet is all that is required for the skimmer-separator of the present invention. Each of the weir segments is provided with independent two-dimensional articulation for each of the outer concentric weir segments. With each segment connected to a fabric skirt **42** or **42***a*, the unit seeks a constant weir depth independent of the water surface shape. The collective effect of the circumferential weir segments produces a constant depth skimming action.

While presently preferred embodiments of the invention have been illustrated and described, it will be recognized that the invention may be otherwise variously embodied and practiced within the scope of the claims which follow.

What is claimed is:

1. An apparatus for skimming the surface layer of a body of water comprising:

a. a ballast chamber,

b. an open-topped sump compartment exterior to and encircling said ballast chamber,

c. a flexible weir member having an upper edge and a lower edge encircling said sump compartment, said upper edge being constructed and arranged so that a plurality of float members connected thereto provide articulation with respect to the surface of said body of water, said lower edge of said flexible weir member being connected to a lower edge of said sump compartment,

d. means provided in said sump compartment comprising an inlet to a pump means for removing the surface layer of liquid collected in said sump compartment,

e. means in fluid communication with the lower region of said sump compartment for removing additional liquid therefrom, and

f. said float members being constructed and arranged as flow guiding vanes which direct the flow of liquids over said upper weir edge into said sump in a spiral direction corresponding to the whorls of fluid around a vortex.

2. An apparatus for skimming the surface layer of a body of water as defined in claim **1** wherein said float members are attached to arm members with said arm members having a substantially universal connection to said ballast chamber.

3. An apparatus for skimming the surface layer of a body of water as defined in claim **1** including an inner weir member surrounding said central ballast chamber.

4. An apparatus for skimming the surface layer of a body of water as defined in claim **1** including means for establishing a swirl chamber within said central ballast chamber.

5. An apparatus for skimming the surface layer of a body of water as defined in claim **4** including an inner weir member contained within said ballast chamber.

6. An apparatus for skimming the surface layer of a body of water as defined in claim **1** wherein said ballast chamber is provided with conduit means for directing liquids received in said sump compartment inwardly toward the center of said ballast chamber.

7. An apparatus for skimming the surface layer of a body of water as defined in claim **1** wherein said ballast chamber is provided with an inner surface a portion of which is conical in cross section to define an inner swirl chamber to facilitate the separation of oil from water.

8. An apparatus for skimming the surface layer of a body of water as defined in claim **7** including an inner weir member contained within said central ballast chamber.

9. An apparatus for skimming the surface layer of a body of water as defined in claim **1** wherein said ballast chamber is provided with an outer wall which serves as

an inner wall for said sump compartment, said wall of said ballast chamber being provided with a plurality of conduit means for directing liquids received in said sump compartment inwardly toward the center of said ballast chamber, and means for venting said conduit means.

10. An apparatus for skimming the surface layer of a body of water as defined in claim **9** wherein said ballast chamber is provided with an inner surface a portion of which is conical in cross section to define an inner swirl chamber to facilitate the separation of oil from water.

11. An apparatus for skimming the surface layer of a body of water as defined in claim **10** including an inner weir member contained within said central ballast chamber.

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