

United States Patent

Craggs et al.

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[54] FLOATING OIL SKIMMER

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

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

[58] Field of Search **210/51, 83, 242, DIG. 21**

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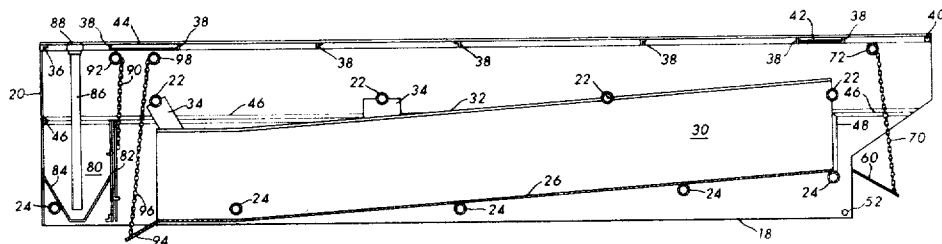
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[57]

ABSTRACT

A floating oil skimmer for recovering oil from the surface of a body of water is disclosed. The skimmer is comprised of an elongated, box-like skimming unit having an open front equipped with an adjustable inlet lip, an oil and water separation zone, adjustable oil overflow weir, an oil collection sump, and a water outlet gate. A buoyant pontoon section is removably attached at each side of the skimming unit to render the apparatus buoyant. The pontoon sections are easily detachable to facilitate land transport of the device.

8 Claims, 16 Drawing Figures



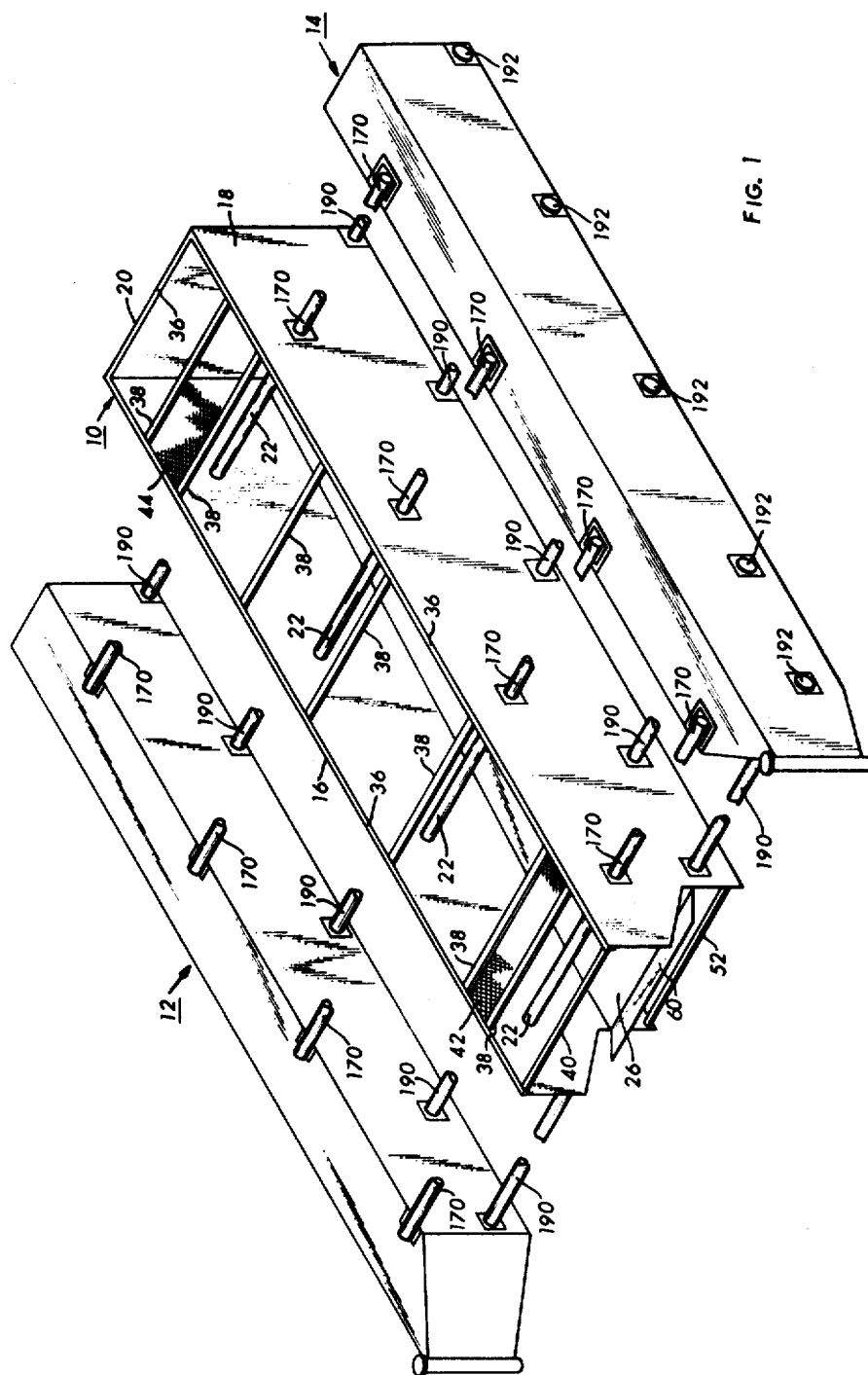


FIG. 1

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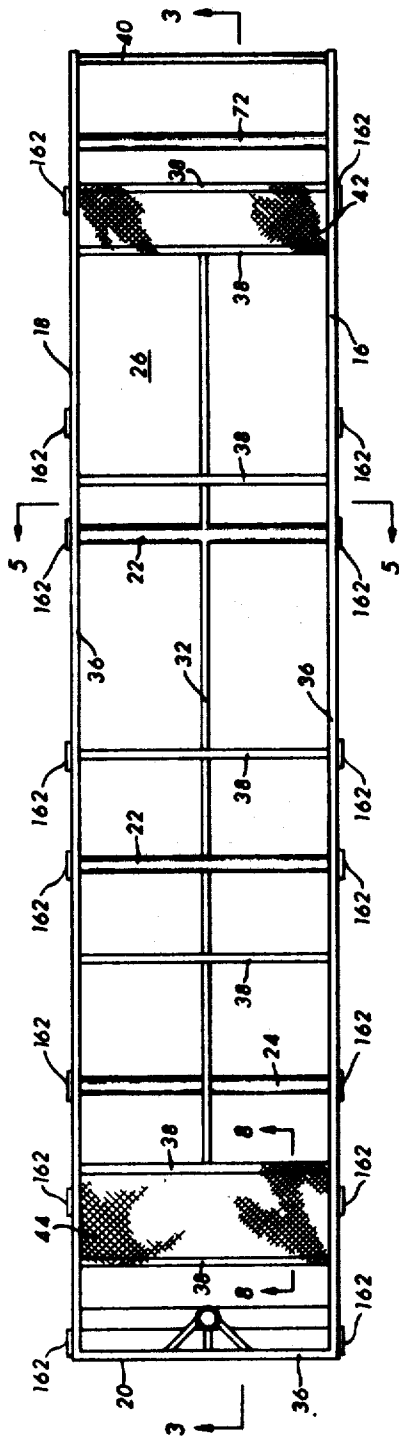


FIG. 2

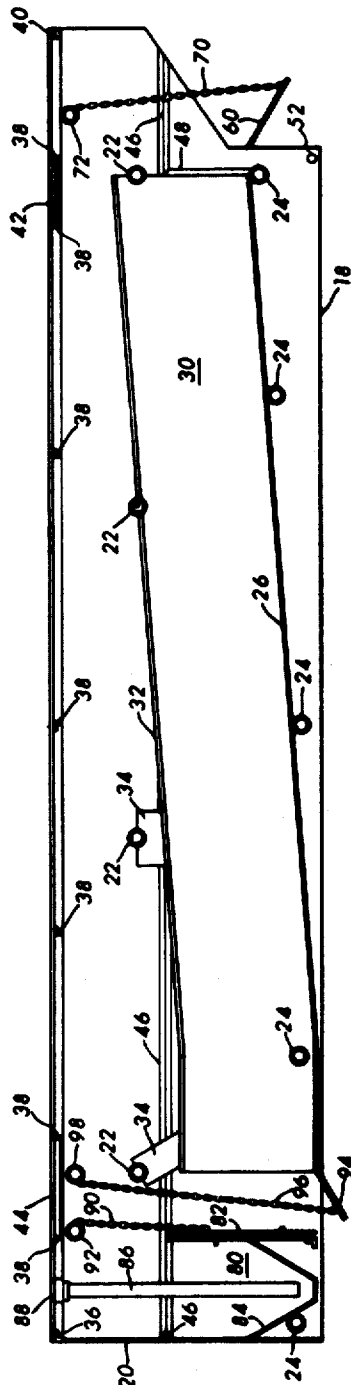


FIG. 3

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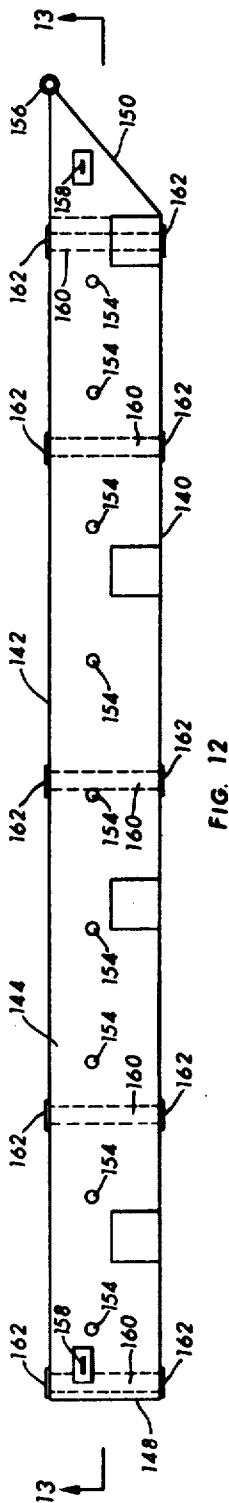


FIG. 12

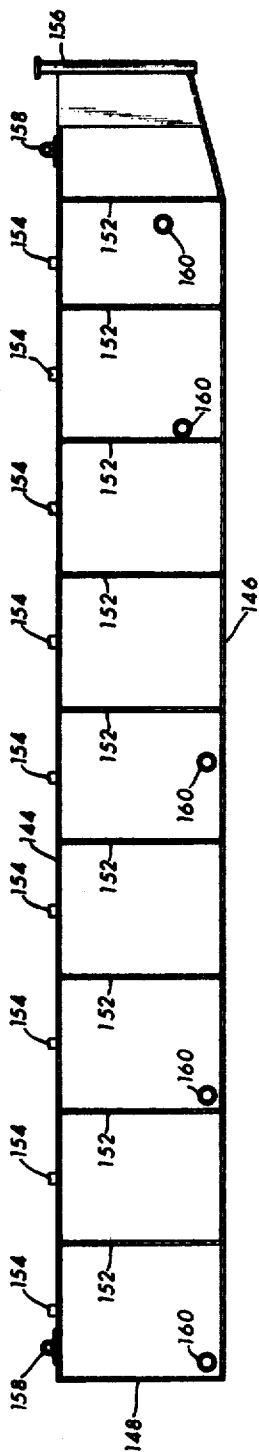


FIG. 13

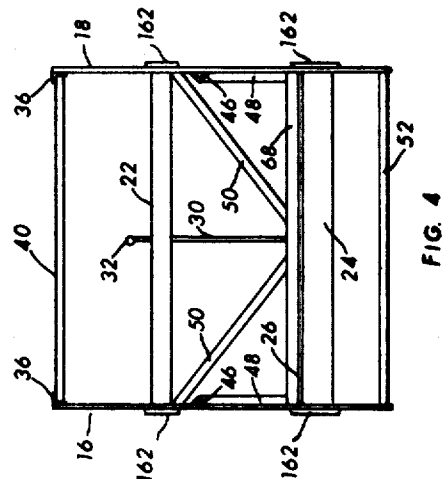


FIG. 4

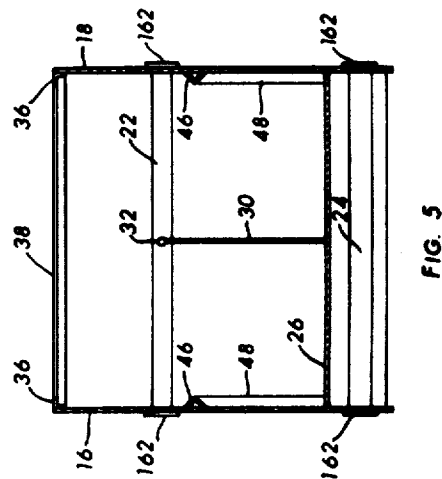
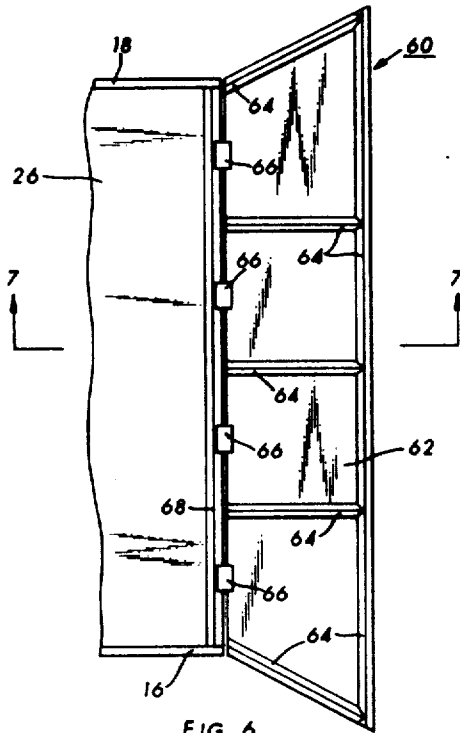
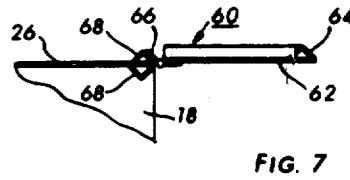
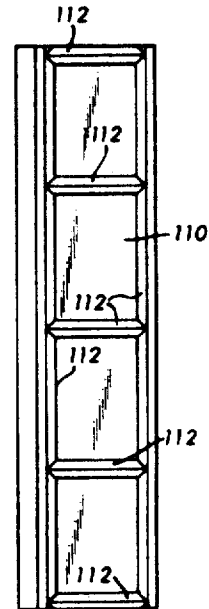
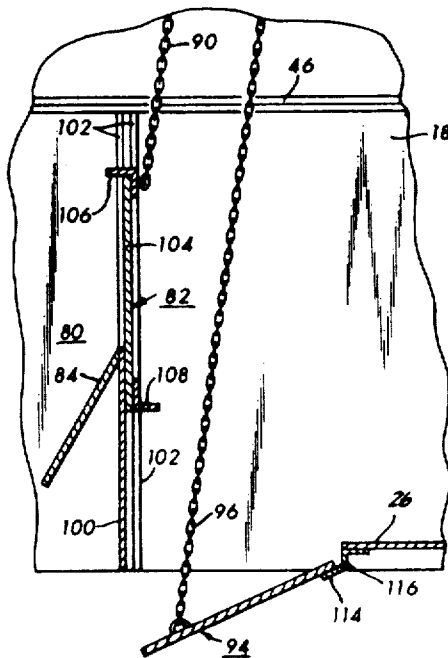


FIG. 5

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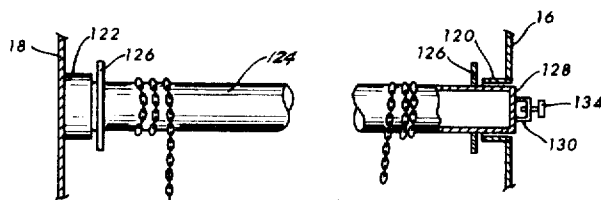


FIG. 10

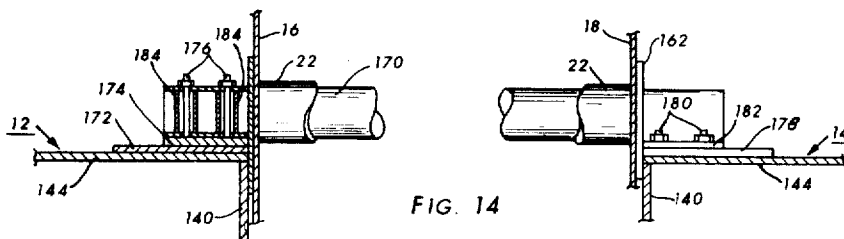


FIG. 14

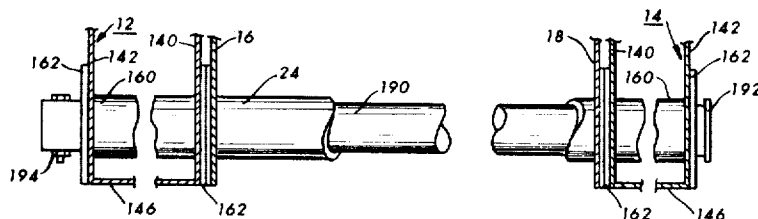


FIG. 15

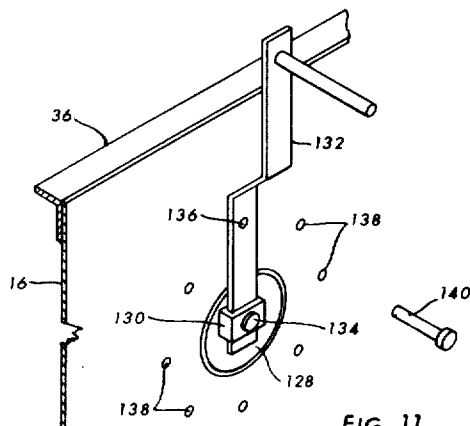


FIG. 11

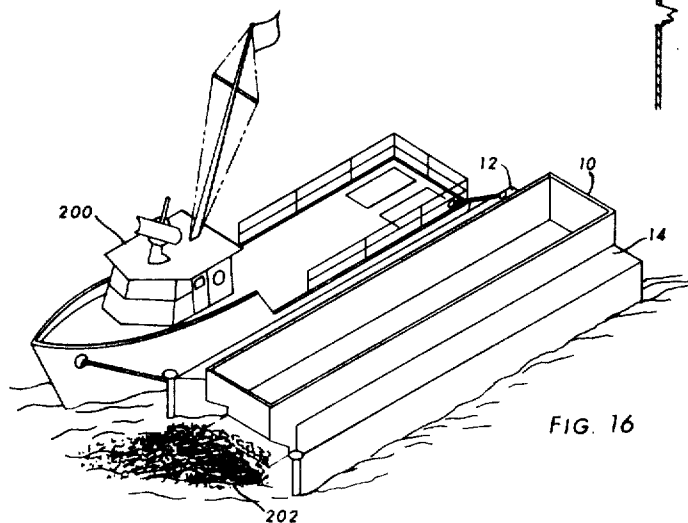


FIG. 16

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FLOATING OIL SKIMMER

This invention relates to apparatus for recovering oil from the surface of a body of water, and more particularly to floating skimmer for recovering oil from a water surface.

With the advent of increased marine transportation of oil and off-shore oil production operations, the likelihood of serious spills of oil onto the surface of a body of water is increased. Also, oil can be discharged onto a water surface from a broken submarine pipeline, and from maloperations and accidents occurring in land based facilities, such as petroleum refineries and chemical plants, tank farms and land pipelines. Also, oil spills have been known to occur during the loading and unloading of tankships and other marine oil carriers. Although the frequency of accidents that discharge any substantial quantity of oil onto the surface of a body of water are relatively low, nevertheless, because of the large quantity of oil potentially releasable from a tanker accident, and particularly from an accident involving a modern supertanker, or from a submarine pipeline or off-shore well blowout, or from a land based operation adjacent a body of water, such incidents can release large quantities of oil onto the surface of a body of water which can foul beaches, shores and harbors, and cause damage to boats and vessels and to the marine ecology.

Where such discharges of oil do occur, it is advantageous to remove the oil from the surface of the water as rapidly as possible to prevent its spread to beaches and inhabited areas, and to minimize or avoid damage to the marine ecology. While various devices have been proposed for recovering oil from the surface of a body of water, such devices have not been altogether satisfactory, particularly in relatively heavy seas encountered on the open ocean and in some of the larger lakes. Hence, need exists for a relatively inexpensive, seaworthy, sturdy device that will economically and quickly remove oil from the surface of a body of water, and particularly that will recover oil that is spread in a relatively thin layer over a large water surface.

Accordingly, it is a principal object of this invention to provide apparatus for recovering oil from the surface of a body of water. Another object of the invention is to provide a relatively inexpensive, durable, seaworthy apparatus for economically and rapidly removing oil from the surface of a body of water. Still another object of the invention is to provide apparatus for efficiently removing a relatively thin layer of oil from a large water surface. A further object of the invention is to provide an oil skimming device that can be readily disassembled into its component parts for transport, and then easily reassembled at its point of use. Other objects and advantages of the invention will be apparent to those skilled in the art from the following detailed description and the appended drawings, wherein like numerals corresponding parts throughout, and in which:

FIG. 1 is an exploded perspective view of the center skimming unit and outer pontoon sections of the apparatus of this invention;

FIG. 2 is a top view of the center skimming unit;

FIG. 3 is a vertical sectional view of the center skimming unit taken along the line 3—3 of FIG. 2;

FIG. 4 is a front elevation view of the center skimming unit;

FIG. 5 is a vertical sectional view of the center skimming unit taken along the line 5—5 of FIG. 2;

FIG. 6 is an enlarged top view of the hinged cutting lip located at the front of the center skimming unit;

FIG. 7 is a vertical sectional view of the hinged cutting lip taken along the line 7—7 of FIG. 6;

FIG. 8 is an enlarged vertical sectional view of the adjustable weir and hinged bottom door taken along the line 8—8 of FIG. 2;

FIG. 9 is an enlarged top view of the hinged bottom door;

FIG. 10 is an enlarged detail view showing a typical chain winch;

FIG. 11 is an enlarged perspective view showing a typical cranking means for operating the chain winches;

FIG. 12 is a top view of one of the pontoon sections;

FIG. 13 is a vertical sectional view of the pontoon taken along the line 13—13 of FIG. 12;

FIG. 14 is an enlarged detail view partially in section showing a typical top pin and support member;

FIG. 15 is an enlarged detail view partially in section showing a typical bottom pin and support member; and

FIG. 16 is a perspective view showing the apparatus of this invention in operation skimming oil from the surface of a body of water.

Referring now to FIGS. 1 through 5, inclusive, of the drawings, there is shown a floating oil skimmer comprised of a center skimming unit 10, a detachable right, or starboard, pontoon section 12 and a similar detachable left, or port, pontoon section 14. Center skimming unit 10 is an elongated rectangular box-like structure having closed sidewalls 16 and 18 and rear wall 20. As will be hereinafter more fully described, sidewalls 16 and 18 are maintained in spaced relationship and structural support for center skimming unit 10 provided by a plurality of horizontal upper tubular members 22 spaced at intermediate locations along the length of center skimming unit 10 and a plurality of lower tubular members 24 spaced at intervals near the bottom of the center skimming unit. Preferably, the more forward of the tubular members 24 are elevated above the more rearward members to provide support for bottom member 26, which slopes from the front of the apparatus downwardly towards the rear of the device. A vertical baffle 30 extends longitudinally substantially the length of center skimming unit 10, dividing the skimming unit into two elongated compartments. Baffle 30 abutts bottom member 26 along its lower edge, and is attached thereto by welding, or the like. Baffle 30 is provided with a small diameter tubular member 32 along its upper edge to provide lateral stiffening, and is supported along its upper edge of either direct attachment to upper tubular members 22, or by means of brackets 34 attached to these members. The upper edges of sidewalls 16 and 18 and rearwall 20 are outlined with angle members 36, and lateral angle members 38 are spaced at intervals between the parallel angle members attached to the sidewalls. Lateral tubular members 40 and 52 are provided between the sidewalls at the front of center skimming unit 10. Metal grating platforms 42 and 44 are located, respectively, near the front and rear of center skimming unit 10 to provide access to the operating areas of the skimmer. Additional stiffening is provided by intermediate lon-

gitudinal angle members 46 attached along the inside of each sidewall and the rear wall, and by vertical angle members 48 attached to the inside of the sidewalls and extending between bottom member 26 and longitudinal angle members 46. Vertical members 48 are generally located below each of the tubular members 22. Also, cross braces 50 are provided at the front of the skimming unit to provide additional lateral support.

The front, or bow, of skimming unit 10 is open to permit entry of oil and water into the unit, and is provided with hinged lip 60 that regulates the depth of cut of water admitted into the skimming unit 10. The details of construction of lip 60 and its attachment to the front of the skimming unit are more particularly illustrated in FIGS. 6 and 7. Lip 60 is comprised of a flat plate 62 having a flared shape, wider at the front than at the rear. The plate is stiffened by angle members 64 attached to its upper surface. Lip 60 is attached to the front edge of bottom member 26 by hinges 66. Preferably, the front edge of bottom member 26 is strengthened by lateral angle members 68 attached to the upper and lower surface of the bottom member so as to extend across the front opening of center skimming unit 10. Hinged lip 60 is raised or lowered to control the depth of cut by means of chain 70 and winch 72.

Oil collection sump 80 is provided at the rear, or stern, of the skimming unit to collect oil and water overflowing adjustable weir 82. Sump 80 is defined by formed member 84, sidewalls 16 and 18, rear wall 20, and by weir 82. Suction pipe 86 is equipped at its upper terminus with quick connection coupling 88 to facilitate the connection of a suction hose for pumping oil from the sump. Weir 82 is raised or lowered by means of chain 90 and winch 92 to control the amount of overflow into sump 80. An opening is provided between the rear edge of bottom member 26 and the transverse weir to permit exit of substantially oil-free water from the skimming section. The flow rate of water exiting through this opening is controlled by the position of hinged bottom door 94. Bottom door 94 is opened and closed by means of chain 96 and winch 98.

The construction and mounting of adjustable weir 82 and bottom door 94 is more particularly illustrated in FIGS. 8 and 9. The rear of the skimming unit is closed below weir 82 by transverse bulkhead 100 that is formed integrally with or welded to member 84. Weir 82 is constructed of a flat plate 104 having top angle 106 and bottom angle 108 attached thereto, and the weir slides in a pair of vertical rails 102 attached to the inside surface of sidewalls 16 and 18. Bottom door 94 is constructed of a flat plate 110 stiffened by angle members 112 attached to its upper surface, and is pivotally attached at the rear edge of bottom member 26 by hinges 114. Bottom member 26 is strengthened along its rear edge by transverse angle member 116 attached to the lower surface of the bottom member.

Cutting lip 60, adjustable weir 82 and bottom door 94 are operated by means of winches 72, 92 and 98, respectively. A typical winch assembly is illustrated in FIG. 10, and is comprised of sockets 120 and 122 mounted in suitable apertures in sidewalls 16 and 18, respectively, and a cylindrical drum 124 adapted to fit within sockets 120 and 122. Drum 124 and sockets 120 and 122 can be constructed from pipe spools of suitable

length. Retainer plates 126 are provided adjacent either end of drum 124 to retain the chain in the center section of the drum and to retain the drum in the sockets. The end of drum 124 is closed by plate 128 having crank handle receiver 130 attached thereto. As more particularly illustrated in FIG. 11, crank 132 is fitted into receiver 130 and secured by bolt 134 which threadably engages a tapped hole, not shown, in the crank handle receiver. Crank handle 132 is apertured at 136 and a plurality of matching apertures 138 are provided in a circular pattern in sidewall 16, the apertures being adapted to receive locking pin 140 that maintains drum 124 locked in a fixed position.

A typical pontoon section 14 is illustrated in FIGS. 12 and 13, it being recognized that pontoon section 12 is substantially a mirror image of the illustrated unit. The pontoon sections are closed, hollow, elongated structures comprised of an inner sidewall 140, outer sidewall 142, top deck 144, bottom 146, rear wall 148 and front wall 150. Bottom 146 is inclined upwardly at the forward end of the unit, and the front wall is inclined outwardly to a pointed prow. Mooring post 156 is provided at the prow. Also, lifting eyes 158 are provided to afford means for hooking a crane or other device to the structure. When assembled the outwardly inclined prows of the pontoon units tend to direct oil floating on the water surface inwardly toward center skimming unit 10.

The elongated pontoon structure is provided with a series of transverse walls or bulkheads 152 that divide the structure into a series of separate, longitudinally disposed compartments. In the illustrated device, the pontoon unit is divided into ten internal compartments by nine bulkheads. Threaded bullplugs 154 are provided in top deck 144 to provide access into each of the internal compartments for ballasting. Also, a series of transverse tubular members 160 are provided that correspond in orientation to lower tubular members 24 of center skimming unit 10. Tubular members 160 pass through the pontoon unit and are fluid-tightly sealed, by welding or otherwise, to sidewalls 140 and 142 so as to render the compartments through which they pass fluid tight. Reinforcing pads 162, which are apertured to receive tubular members 160, are provided on the exterior of sidewalls 140 and 142 adjacent the ends of the tubular member. Similar reinforcing pads 162 are provided on the exterior of sidewalls 16 and 18 of center skimming unit 10 at the termini of tubular members 22 and 24.

As more particularly illustrated in FIG. 14, pontoon unit 12 having an inner sidewall 140 and a top deck 144 is provided with base plates 172 and mounting pads 174. A pair of studs 176 project upwardly from each mounting pad. A similar base plate 178 is attached to top deck 144 of pontoon unit 14. Upwardly projecting studs 180 secured to base plate 178 mate with apertures in foot plate 182 attached to tubular pin 170. Thus, tubular pins 170 pass through each of the upper tubular members 22 in center skimming unit 10 and are removably attached at their ends, respectively, to pontoon units 12 and 14. Tubular inserts 184 are provided in tubular pin 170 to receive studs 176.

As illustrated particularly in FIG. 15, the center skimming unit and pontoon assemblies are secured at their bottom by pins 190 which are inserted through

the tubular members 160 in pontoon unit 14, through lower tubular members 24 in the center skimming unit, and through tubular members 160 in pontoon unit 12. Pins 190 are provided at one end with flange 192 which restricts their passage through tubular members 160, and the pins are apertured at the other end to receive bolts 194 which lock the assembly together.

Center skimming unit 10 and pontoon sections 12 and 14 are assembled by arranging the pontoons side by side in properly spaced relationship. Tubular pins 170 are inserted through tubular members 22 and center skimming unit 10 lowered between the pontoons so that the apertures in pin 170 and foot plate 182 receive studs 176 and 180, respectively. Tubular pins 190 are then inserted through tubular members 160 of pontoon section 14, lower tubular members 24 of center skimming unit 10, and tubular members 160 of pontoon section 12. The component parts are then bolted together. If desired, tubular pins 190 can be inserted from the opposite direction to avoid projections on the starboard side to accommodate a towing vessel.

To place the floating oil skimmer in operation, the component parts are transported to a convenient launching site near the location of an oil spill. The skimmer is assembled as heretofore described and launched, and the trim adjusted by adding water to one or more of the ballast compartments. As illustrated in FIG. 16, the assembled skimming unit 10 and pontoon units 12 and 14 are towed to the site of the oil spill and moved through the spill by a tug or work boat 200. Usually the pumping equipment and oil receiving tanks will be located on the work boat and connected to suction pipe 86 by a hose, not shown.

Lip 60 is adjusted by means of winch 72 to cut just below the surface of the water. Normally, the lip will be adjusted to cut from about 2 to 12 inches below the surface, the depth of the cut depending upon the smoothness of the water surface and the thickness of the oil layer, it being desired to admit substantially all of the floating oil and as little water as possible into center skimming unit 10. In normal seas encountered in the open ocean in coastal regions, it has been found that satisfactory operation can be obtained by setting the lip from about 2 to 6 inches below the surface. The vertical position of weir 82 is adjusted so that the floating oil and a minimum amount of water flows over the weir and into sump 80, from which it can be pumped to a suitable receiving tank on the work boat. Substantially oil-free water exists the skimming unit through the bottom opening. Bottom door 94 is adjusted so that the flow of water from the skimming unit is substantially unrestricted.

As the floating oil skimmer moves over the surface of a body of water having a layer of oil 202 floating thereon, the oil and some water enters the front of the skimming unit over lip 60 and passes into the two quiescent zones on either side of center baffle 30. The oil and water slowly move to the rear of the device as additional oil and water enter the skimming unit, the oil floating to the surface and eventually passing over weir 82 and the substantially oil-free water being discharged through the bottom opening. It will be recognized that the floating oil skimmer of this invention operates without moving parts, other than the pumping equipment located on the work boat, and the oil accumula-

tion is effected by the velocity that the skimmer is moved with respect to the water surface, and by the proper adjustment of the cutting lip, overflow weir and bottom outlet door. Alternatively, where the body of water from which oil is to be recovered is moving at sufficient velocity, the floating oil skimmer of this invention can be moved into a fixed position and the velocity of the moving body of water utilized to effect oil recovery. Also, floating booms can be employed to contain the oil within a defined area, and to increase the width of sweep as the skimmer passes over the surface of the water. In this latter application, the floating booms are attached at the front of each of the pontoon sections so as to extend outwardly and away from the skimmer, thus facilitating the movement of oil towards the skimmer.

While particular embodiments of the invention have been described, it will be understood, of course, that the invention is not limited thereto since many modifications can be made and it is intended to include within the invention such modifications as are within the scope of the claims.

The invention having thus been described, we claim:

1. A floating oil skimmer for recovering oil from the surface of a body of water, which comprises:
 - an elongated rectangular structure having imperforate side and rear walls and an imperforate bottom member defining a partially enclosed, open-fronted compartment, said bottom member sloping downwardly from the front of said compartment to the rear;
 - a cutting lip pivotally attached at the front edge of said bottom member so as to project outwardly therefrom, said cutting lip being adjustably pivotable about a transverse horizontal axis so that the leading edge of said cutting lip can be positioned below the surface of said body of water to control the thickness of water cut admitted into said compartment;
 - means to adjust the position of said cutting lip about said horizontal axis;
 - a vertical transverse weir near the rear of said compartment;
 - means to adjust the height of said weir;
 - an oil collection sump immediately to the rear of said weir to receive liquid flowing over said weir;
 - a transverse outlet opening in the bottom of said compartment immediately in front of said weir through which substantially oil-free water is discharged;
 - a pair of pontoons; and
 - means to removably attach one of said pontoons at each side of said structure.
2. The apparatus defined in claim 1 including a vertical longitudinal baffle extending substantially the length of said compartment.
3. The apparatus defined in claim 1 wherein said cutting lip has a flared shape, the front edge of the lip being wider than its rear edge.
4. The apparatus defined in claim 1 including a bottom door pivotally attached to said structure at said outlet opening.
5. The apparatus defined in claim 4 including means to adjust the position of said bottom door about a horizontal transverse axis to control the flow of water through said outlet opening.

6. The apparatus defined in claim 1 wherein each of said pontoons has a plurality of closed internal compartments.

7. The apparatus disclosed in claim 1 wherein said means for removably attaching said pontoons to said structure include:

- a plurality of first horizontal transverse tubular members extending through said compartment at an upper level;
- a plurality of second horizontal transverse tubular members extending through said compartment at a lower level;
- a plurality of third horizontal transverse tubular members extending through each of said pontoons, said third tubular members being positioned for axial alignment with said second tubular members; first tubular pin means inserted through said first tubular members and removably attached at either end to said pontoons; and
- second tubular pin means inserted through said second and said third tubular members and removably fixed therein to secure said pontoons to said structure.

8. A floating oil skimmer for recovering oil from the surface of a body of water, which comprises:

- an elongated rectangular structure having closed side and rear walls and a bottom member defining a partially enclosed, open-fronted box-like compartment, said bottom member sloping downwardly from the front of said compartment to the rear and terminating near the rear of said structure to provide a transverse rectangular outlet opening in the bottom of said structure extending substantially the width thereof through which substantially oil-free water is discharged;
- a vertical longitudinal baffle at the center line of said structure extending substantially the length of said bottom member;
- a flared cutting lip having a front edge wider than its rear edge pivotally attached at its rear edge to the front of said bottom member so as to project outwardly in front of said structure, said cutting lip being adjustably pivotable about a transverse horizontal axis so that the leading edge of said cutting lip can be positioned below the surface of

said body of water to control the thickness of water cut admitted into said compartment; means to adjust the position of said cutting lip about said horizontal axis;

a vertical transverse weir immediately to the rear of said outlet opening and extending substantially the width of said compartment;

means to adjust the height of said weir;

an oil collection sump immediately to the rear of said weir to receive liquid flowing over said weir;

a standpipe for withdrawing liquid from said oil collection sump, said standpipe being adapted for connection to a pump suction;

a bottom door pivotally attached at the rear of said bottom member, said door being pivotally adjustable about a horizontal transverse axis to control the flow of water through said outlet opening;

means to adjust the position of said door about said horizontal axis;

a plurality of first horizontal transverse tubular members extending through said structure at an upper level thereof;

a plurality of second horizontal transverse tubular members extending through said structure at a lower level thereof;

a pair of pontoons, each of said pontoons comprising an elongated tank of rectangular cross-section having a plurality of closed internal compartments, one of said pontoons being adapted for placement at each side of said structure, said pontoons projecting outwardly beyond said structure, and the front of the pontoons being slanted inwardly toward said structure;

a plurality of third horizontal transverse tubular members extending through each of said pontoons, said members being positioned for axial alignment with said second tubular members;

first tubular pin means inserted through said first tubular members and removably attached at either end to said pontoons; and

second tubular pin means inserted through said second tubular means in said structure and said third tubular means in each of said pontoons and removably fixed therein to secure said pontoons to said structure.

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