United States Patent

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[54] **OIL LEAKAGE BARRIER**
4 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **210/87,** 61/1, 210/242
[51] **Int. Cl.** **E02b 15/04,** C02c 01/38
[50] **Field of Search** ..... 61/1, 5; 210/83, 242, 538, 542, (Oil-water Digest), (Inquired), 85, 87

[56] **References Cited**

UNITED STATES PATENTS

1,004,718	10/1911	Wieland	61/5
2,682,151	6/1954	Simpson et al.	61/1
3,221,884	12/1965	Muller	210/242
3,369,664	2/1968	Dahan	61/1X
3,389,559	6/1968	Logan	61/1

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ABSTRACT: A light weight, elongated, flexible, tubular structure is provided for use in confining leaking oil and other lighter-than-water substances to a predetermined area. At an offshore location the ends of the structure are drawn together to create a closed figure surrounding the point where oil is surfacing. The structure is divided into two chambers, one of which is filled with a liquid having at least the specific gravity of the liquid in which the structure floats. The second chamber of the structure is adapted to be distended such that a barrier is created extending above and below the surface producing a surface interlock with the liquid below the floating substance to prevent the substance from shipping beneath the barrier.

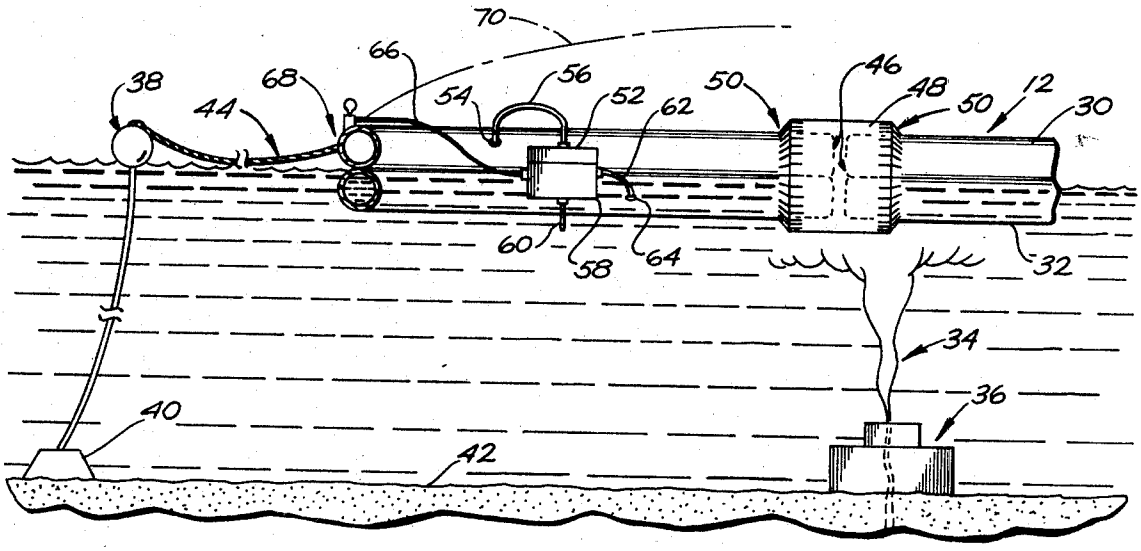


FIG. 1

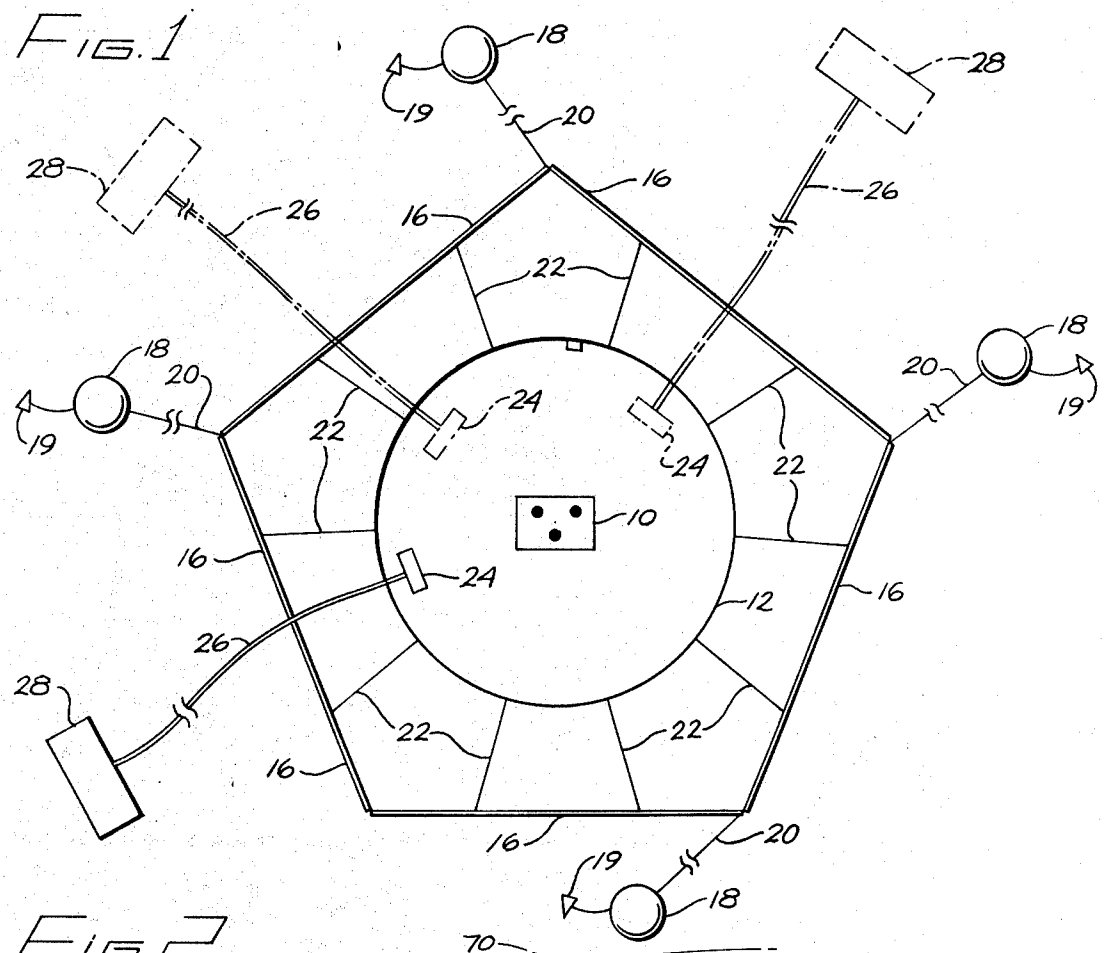


FIG. 2

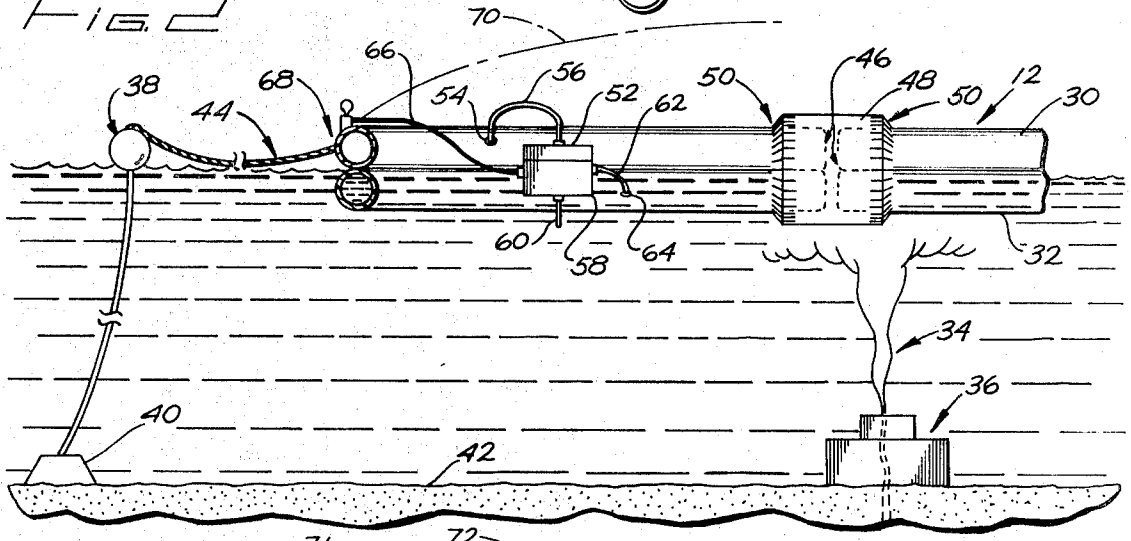
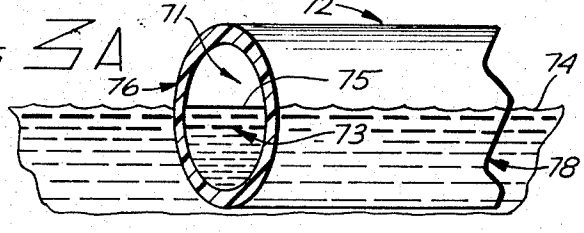


FIG 3A



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FIG. 4

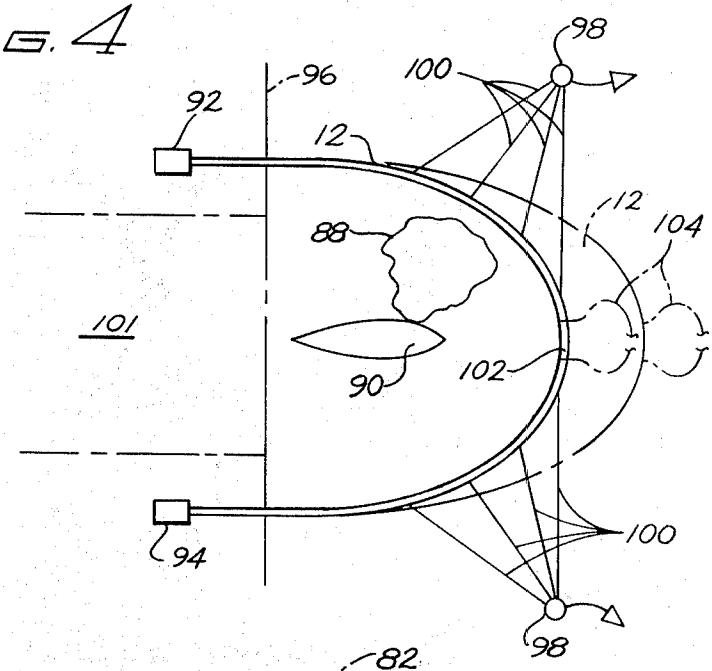
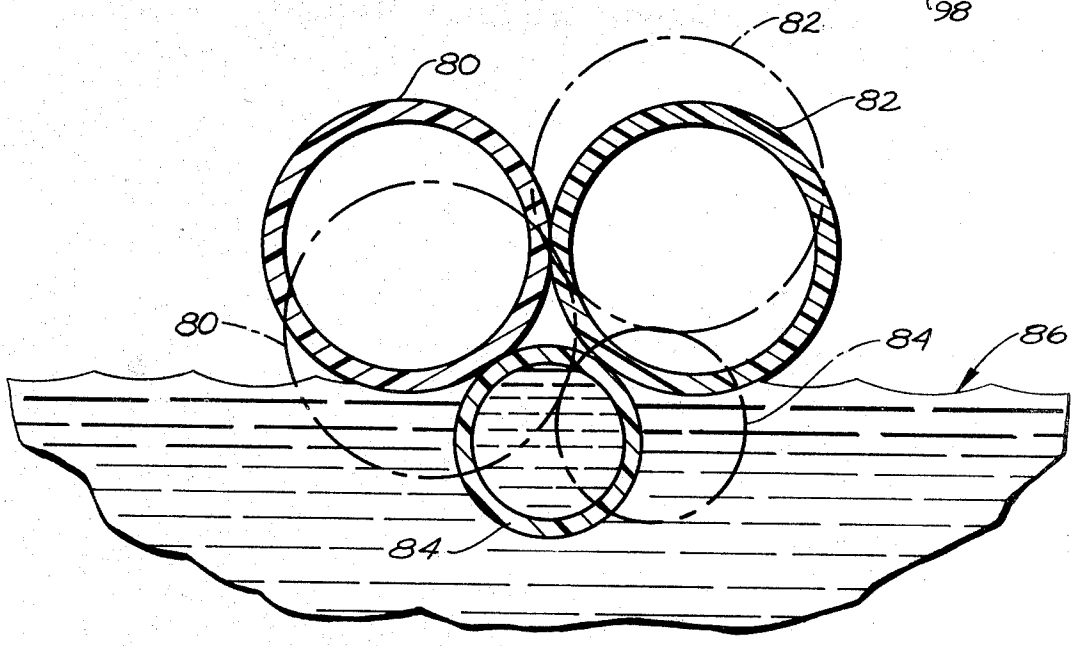


FIG. 3B



OIL LEAKAGE BARRIER

BACKGROUND OF THE INVENTION

The present invention relates to lightweight, flexible, closed tubular structures and in particular structures adapted to ride partially above and below the surface of a body of liquid to create a movable catch basin for fluids and other material floating on the surface of the body.

With the constantly expanding need being encountered by the industrial nations of the world to locate and develop additional mineral reserves, exploration for such minerals, particularly oil and gas, in offshore locations has dramatically expanded in recent years. As producing wells are brought in and connected to shore by pipeline, the probability of blowouts during drilling and leakage, both at the well head and along the length of connecting pipeline, has likewise increased and has resulted in situations which are considered major disasters. Similarly, the chance of oil and gasoline tanker vessels running aground and suffering a ruptured hull is likewise increasing as the tanker population and petroleum products shipping increases.

Whereas dry land blowouts are naturally confined to the immediate area circling the drilling location, the same is not true of offshore drilling operations nor grounded vessels. Because of the specific gravities of the liquids involved, the potential for damage and destruction due to a blowout or leak is magnified inordinately. In certain situations in the past where such hazards have occurred, encircling structures such as log booms have been utilized in an attempt to create a barrier to the flow of oil floating up and onto the water surface. Such structures have been ineffective in accomplishing their purpose because of their inability to adapt to the wave pattern of the body of water in which they are situated.

SUMMARY OF THE INVENTION

The present invention overcomes the problem just recited and provides an apparatus for confining a fluid of a first specific gravity in a predetermined area on the surface of a second liquid substance of a second greater specific gravity. The invention comprises an elongated hollow structure defining a first and a second chamber extending longitudinally of the structure interior, the structure being fabricated from a flexible material. Means for securing the ends of the structure so as to define a boundary of the predetermined area is provided as is means for creating a buoyant distention in the first chamber of the structure. Means for introducing the second substance or a substance of a specific gravity at least as great as said second substance into the second chamber is provided whereby the structure is caused to float at the surface of the second liquid substance with a transverse portion of the structure extending a predetermined distance below the surface thereof and the remaining transverse portion of the structure extending a predetermined distance above the surface thereof to create a barrier to the first substance.

By virtue of its flexibility over its entire longitudinal extent, the present invention is adaptable to the wave and swell pattern created on the body of water in which the barrier floats and hence rises and falls with the ebb and flow of such waves to confine a substance such as leaking oil in the interior of the structure.

A primary application of the apparatus of the present invention is to prevent the spread of leaking oil and other liquid petroleum products on the surface of a body of water. In addition to providing a structure which is lightweight and flexible throughout its length, the confining function of the apparatus, particularly in offshore ocean locations, is enhanced by the dampening effect which such products have on wave action. The increase in surface tension in the area surrounded by the barrier reduces waves to swells at the lee side of the barrier preventing the occurrence of waves which would tend to break over the barrier and throw oil, etc. out of the confined area.

In a particular embodiment of the invention it is contemplated that a weir can be provided in the apparatus for location at the downwind or lee side of the apparatus arranged such that the top of the weir is level with the surface of the body of water in which the apparatus floats. By attaching a bag or container of suitable capacity to the exterior of the structure at the weir location, the weather and wave action can be utilized to "pump" the oil into the container for storage and later retrieval.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other features of the invention will be better understood by reference to the following FIGS. in which:

FIG. **1** is a plan view of an embodiment of the barrier apparatus of the present invention in position surrounding an offshore oil drilling platform;

FIG. **2** is a cross-sectional view of the barrier taken in elevation;

FIG. **3A** is a cross-sectional view taken in elevation showing a first alternate embodiment of the barrier shown in FIG. **2**;

FIG. **3B** is a cross-sectional view taken in elevation showing a second alternate embodiment to the barrier shown in FIG. **2**; and

FIG. **4** is a plan view of an alternate embodiment of the barrier apparatus of the present invention maintained in position around a grounded vessel by an alternate mooring system.

DESCRIPTION OF A SPECIFIC EMBODIMENT

In FIG. **1** is shown a plan view of an offshore oil drilling platform **10** surrounded by an oil leakage barrier **12** which is in turn surrounded by an encircling log boom **14** consisting of a plurality of logs **16** lashed together end to end. The log boom is held in position by a plurality of buoys **18** which are connected to it by cables **20**. The buoys **18** are in turn connected to anchors **19** to fix the position of the entire assembly. A second plurality of cables **22** extend between the log boom **14** and barrier **12** to maintain the barrier in position in a generally circular relationship with respect to platform **10**, with the platform being located at approximately the center of the circle.

A buoyant pump **24** is located within the area bounded by the platform and the barrier **12** and is connected by a hose **26** to a scavenger barge or tanker vessel **28**. The function of pump **24** is to draw oil or other liquid substance leaving a specific gravity less than 1.0 floating on the surface of the water enclosed within the perimeter of the barrier through line **26** to the barge **28**. The position of barge **28** and pump **24** is also shown in phantom at several other locations indicating its mobility and the possibility of using additional pumps, where the leakage rate is sufficiently high to necessitate it.

In operation one or more barriers are placed on an offshore oil and gas well drilling platform, tanker vessel, Coast Guard vessel, etc. When an oil leak develops from a well, pipeline, vessel, ocean floor fissure, etc., the barrier is ready for rapid deployment around the location of the oil as it surfaces. As will be discussed in more detail in connection with FIG. **4**, the arrangement of the barrier apparatus can be varied depending on the type and specific location of the leak. For protecting against leaks developing at well heads located directly below a drilling platform, the circular configuration of FIG. **1** in which the diameter of the circle is approximately 200 feet is normally satisfactory.

Further structural details of the barrier of the present invention are discussed in connection with FIG. **2** immediately below. An important aspect of the present invention is that the containment function of the barrier is fulfilled with lightweight, flexible materials such that the barrier need not weigh in excess of 5 or 10 pounds per linear foot and normally may weigh as little as 2 to 3 pounds per linear foot. Thus, where the barrier encircles an area having a diameter of 200 feet, the total weight of the barrier may be as low as about 1,200 pounds and certainly need not exceed approximately

6,000 pounds. In this manner the barrier can be rapidly transferred to a vessel for transportation to the location of a leak and subsequent easy placement in a surrounding relationship relative to the location of oil surfacing from the leak. Materials satisfying these requirements include vinyl and polyethylene.

FIG. 2 illustrates a cross-sectional view of an embodiment of the barrier 12 of the present invention. As shown therein, the barrier comprises two tubes 30 and 32 vertically disposed relative to one another and joined together at the point of tangency. This is accomplished by a fused junction where the tubes are extruded as a unitary structure or by encircling clamps or cables to maintain the tubes in the proper relative orientation. It is a prime requirement of the present invention that the tubes be maintained in a fixed relationship so that the lower tube 32 extends beneath the surface 34 of the water in which the barrier floats to create a water surface interlock while the upper tube 30 extends a predetermined distance above the surface to create a catch basin encircling an oil leak 34 from a well head 36. The barrier 12 is maintained in position by an anchor buoy 38 which is attached by a cable 39 to a weight 40 resting or secured to the ocean floor 42. A line or cable 44 extending from the buoy 38 is attached to barrier 12.

In storage the two tubes 30 and 32 are stacked or coiled in a flat, deflated condition. The opposite ends 46 of each tube are sealed to make each tube a closed airtight chamber. When being deployed in an offshore location, the barrier is placed in the water in the pattern of a closed geometric figure surrounding the point where the oil leak is surfacing. In relatively quiet water with slow subsurface currents, a vertical projection downward from the periphery of the closed figure normally surrounds the location of the oil leak on the ocean floor. The end portions 46 are brought together and secured in an end to end relation by means of a sleeve 48 which is adapted to be slipped over and attached to each end of the barrier at a point slightly removed from the actual ends thereof by means of laces 50 which are drawn tightly together to complete the closure of the geometric figure. Other means of securing the ends of the barrier together will also be apparent to those skilled in the art.

The upper tube 30 is then distended with air by means of a compressor 52 which is connected to a valve 54 in the wall of tube 30 by an air hose 56 or by other buoyant means. Subsequently a pump 58 draws water through tube 60 from the body of water in which the barrier is located and pumps it through hose 62 and valve 64 into lower tube 32 until it is filled with water. Filling tube 60 with a liquid of the same specific gravity as the body in which it is located causes the barrier to settle in the water until the point of juncture between the two tubes is approximately level with the surface of the water. The compressor 52 and pump 58 can also be arranged to function in an "on demand" mode such that if an air or water leak should develop in tube 30 or 32 respectively, the loss of pressure is immediately sensed, calling the compressor or the pump into operation to maintain a sufficient outward pressure to prevent the collapse of either of the tubes, particularly tube 30, until repairs can be effected. An electrical connection 66 to a signalling device 68 energizes the device when the "on demand" capacity of either the compressor or the pump is called into operation.

It is also contemplated that a blower can be utilized in place of compressor 52 for filling and maintaining positive pressure in tube 30. In this embodiment the blower would operate in a continuous mode and eliminate the need for an "on demand" feature. Where the barrier is used to surround the area of a leak from a fissure or subsurface well head where no drilling platform is present, it is also contemplated that a hood or canopy 70 attached to the barrier in an airtight manner (shown in phantom) can be provided to create a dome which can be used to capture and hold natural gases bubbling up from the leak until an accumulator can be positioned adjacent the barrier or protector to recover the collected gases.

An alternate embodiment of the barrier of FIG. 2 is shown in FIG. 3A wherein a large diameter tube 72 of generally elliptical cross section, fabricated from a flexible, airtight material, is provided which is divided into two chambers 71, 73 divided by an impermeable membrane 75. The upper half of tube 72 (chamber 71) is first filled with air to extend it to its inflated cross section. Water is introduced into the lower half (chamber 73) from body 74 to again provide an apparatus in which a portion 76 of the barrier extends below the surface of the body to create a surface interlock and the remaining portion 76 extends above the portion of the surface to create a catch basin.

Still another embodiment of the barrier of the present invention is shown in FIG. 3B. This embodiment comprises two tubes 80 and 82 of the first diameter adapted to be filled with air, and a third tube 84 having a second diameter smaller than said first diameter disposed in an inverted pyramid arrangement relative to tubes 80 and 82. Again it is contemplated that tube 84 is to be filled with water from the body 86 in which the barrier is located so as to create a structure extending above and below the surface of the water. Shown in phantom is an alternate position of the barrier of FIG. 3B to illustrate the advantage of this particular embodiment. As an accumulation of oil (not shown) builds up in the closed figure defined by the side of tube 82 opposite tube 80, it is contemplated that an outward pressure will be exerted by the oil on tube 82 tending to raise it above its normal position forcing tube 80 into the water and rotating tube 84 toward the interior of the closed figure. This configuration has the advantage of raising the height of the barrier presented to the oil leak which it is encircling to give it additional capacity and additional buoyancy in the event emergency conditions may prevent immediate pumping of the accumulation captured within the periphery of the barrier.

In another application of the barrier 12 of the present invention where it is to be used, for example, to contain leaking petroleum products 88 from a grounded vessel 90, the ends of the barrier are attached to blocks 92 and 94 which are located onshore. The boundary between land and water is indicated by line 96. By equipping a tanker vessel such as vessel 90 with the barrier of the present invention it is a relatively simple matter to place the barrier in the water encircling the ship and cast the ends onto the beach where they can be secured to anchoring means such as the blocks shown. In addition, anchor buoys 98 can also be located offshore and connected to barrier 12 by cables 100 in bridle fashion to prevent wave and tide action from causing the barrier to be pushed toward shore.

FIG. 4 also indicates in phantom a river 101 emptying into a body of water, for example, a lake. In situations where a pollutant such as a floating petroleum product has gotten into the stream and is in danger of being discharged into the body of water, the barrier 12 can be deployed so as to encircle the mouth of the stream and create a means for confining the pollutant to an area adjacent the stream mouth. In such an embodiment a weir 102 (a water level obstruction defining a gap in the barrier) can be provided in which the upper surface of the weir is positioned at the level of the body of water thus causing the oil etc. to be forced over the weir into a container 104 such as a 10,000 gallon bag which is attached to the notch defined by the weir. Under the pressure of the water being discharged from the mouth of the stream it is expected that the barrier 12 will be distended to the phantom position shown in FIG. 4. In addition to providing a weir in the barrier as shown in FIG. 4, it is contemplated that a similar modification can be made where the barrier is used in other locations such as at an offshore ocean location. In such an application the weir is located at the down-weather side of the barrier such that wind and wave action tends to force the floating material toward the opening defined by the weir and then into a container which is attached to the opening exteriorly of the barrier.

The dimensions of the barrier vary according to the quantity of material to be confined. Where circular tubes are used as the upper and lower chambers, a typical diameter for each of the two tubes is 6 inches. Depending on the depth of the slick and other environmental conditions to which the barrier is to be subjected, smaller and larger diameter tubes are utilized. All have the advantage that penetration of the surface of the water, etc. in which the barrier floats is nominal, i.e., on the order of 6 inches. Hence, in comparison with more deeply penetrating structures, the structure of the present invention is not subject to subsurface currents to any significant degree.

I claim:

1. A barrier for confining oil floating on water to a predetermined area comprising:

a first, second and third closed, elongated, hollow cylinder extending longitudinally of one another, each of said cylinders being fabricated from a flexible material, at least one of said cylinders being inflated with air and at least one of said cylinders being inflated with water;

means for securing the three cylinders tangentially with respect to one another in a pyramid relationship;

means for securing and maintaining the apparatus in a predetermined position extending through the air-water interface;

blower means for maintaining air pressure in said air inflated tubes;

water supply means for maintaining water pressure in said water inflated tubes; and

pumping means communicating with the oil confined by the barrier for removing and delivering said oil to a collection point.

2. Apparatus according to claim 1 including signalling means mounted on said barrier for indicating the operating condition of the blower means and supply means.

3. Apparatus according to claim 1 including hood means connected in an airtight relation to said barrier to retain said oil in the space between the surface of the water and the interior of the hood means.

4. A barrier for confining oil floating on water to a predetermined area comprising:

a first, second and third closed, elongated, hollow cylinder extending longitudinally of one another, each of said cylinders being fabricated from a flexible material, at least one of said cylinders being inflated with air and at least one of said cylinders being inflated with water;

means for securing the three cylinders tangentially with respect to one another in a pyramid relationship;

means for securing and maintaining the apparatus at a predetermined location relative to the oil to be confined, said securing and maintaining means being arranged so as to permit the barrier to extend through the air-water interface;

blower means for maintaining air pressure in said air inflated tubes;

water supply means for maintaining water pressure in said water inflated tubes;

weir means joining two ends of said cylinders; and

collection means connected to the barrier at the weir means location for receiving oil passing over the weir means to the exterior of the barrier.