ABSTRACT

An oil skimmer system including a vacuum truck having a pump with a vacuum hose attached at one end to the pump intake port to create a suction at the opposite or intake end of the vacuum hose to which a suction tube is operatively attached at its discharge end, and mounted on an articulating and extendable arm of a backhoe an oil skimmer assembly comprising (a) a skimmer plate having an upper flat surface, (b) a debris guard vertically mounted about the suction tube intake end, (c) the suction tube affixed by one or more struts to extend perpendicularly above the plate upper surface with the suction tube intake end positioned near the plate upper surface, and (d) a connecting adaptor affixed to the suction tube and configured to fixedly attach the oil skimmer assembly to the backhoe arm to enable positioning the oil skimmer assembly into the oil containing surface area of a body of water.
OIL SKIMMER ASSEMBLY AND SYSTEM

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates in general to apparatus for skimming fluids or other material from the surface of a water body, and more particularly to apparatus for skimming oil and other similar fluids from the surface of inland or shallow waters of a lake, bay, cove, port, gulf or ocean.


[0004] One long standing problem with the drilling and transporting of oil has been the spilling of oil into the waterways and water bodies in which the oil drilling and oil transporting take place. In response to this problem various devices, such as oil booms and oil skimmers, have been attached to a variety of boats. However, once the oil reaches the shoreline or beach area those devices that are useful in deep water are generally impractical in shallow water. To skim the oil from the shallow water areas one technique has been the use of a vacuum truck having a long 50'-200' six-inch to ten-inch vacuum hose provided with a suction nozzle operatively attached to the vacuum hose intake end that is carried and dragged by an operator who must manually manipulate the suction nozzle near the water surface to skim the oil from the water.

[0005] Although such prior art skimmers can skim some of the oil from the water they are time consuming and costly to use. In addition, they are highly inefficient, particularly if being used in what that is choppy or effected by tides. They require that the operator physically get in the oil coated water, thus requiring a special hazmat suit and masks to protect him from contact with the oil and the oil vapors. Such a suit is hot to wear and makes the skimming operation more difficult for the operator to perform. Because of the heat conditions, as well as hydrocarbon vapors emitted from the oil polluted water, an operator can only work for short periods of time before the operator must take a break to avoid health and fatigue problems. It is further required that the suit and sections of the vacuum hose that has been dragged through the oily water be cleaned before the suit and hose can be removed from the oil polluted site. Still further these devices are only able to skim small quantities of oil during a given time period. Thus, their use to clean up large oil spills makes cleanup operations labor intensive, time consuming, inefficient, and very expensive. A solution to one or more of these problems would be highly desirable for the oil and gas industry.

OBJECTS AND SUMMARY OF THE INVENTION

[0006] Therefore, one object of this invention is to provide an oil skimmer assembly and system that does not require the operator to be placed in the oil polluted waters.

[0007] Another object of this invention is to provide an oil skimmer assembly and system that does not require the operator to wear special clothing, such as a hazmat suit, when operating the oil skimmer assembly.

[0008] A further object of this invention is to provide an oil skimmer assembly and system that is less labor intensive.

[0009] A still further object of this invention is to provide an oil skimmer assembly and system that can skim much quicker large quantities of oil from water over a given time period.

[0010] Another object of this invention is to provide an oil skimmer assembly and system that optimizes the collection of only the desired skimmed matter from the water, and prevents the collection of undesired debris that may also be in the water.

[0011] Other objects and advantages of this invention shall become apparent from the ensuing descriptions of the invention.

[0012] Accordingly, the oil skimmer system of this invention comprises a pump having a discharge port and an intake port to which the discharge end of an elongated vacuum hose is attachable, and a powered articulating and extendable arm, boom or other similar extension device that is operatively attached to an oil skimmer assembly to position the oil skimmer assembly at a desired location in a water body, wherein the oil skimmer assembly comprises an oil skimmer plate with an upper flat surface, a suction tube having its discharge end operatively connected to the intake end of the vacuum hose and affixed to the oil skimmer plate to extend perpendicularly above the skimmer plate upper surface; a connecting adaptor affixed to the oil skimmer assembly for use to attach the oil skimmer assembly to the extension device to manipulate the oil skimmer assembly plate to the desired location in the water body. In a preferred embodiment of the invention a debris guard extends vertically from the skimmer plate flat surface about the suction tube intake end to prevent debris and other large solid objects from being vacuumed into the suction tube. In another preferred embodiment of the invention one or more camera are mounted to the backhoe, the connecting adaptor or the backhoe extendable arm to permit the operator to observe the oil skimmer plate to optimize the collection of the oil. In a preferred embodiment a video camera is mounted on the vacuum nozzle assembly connector and directed to record and transmit images of the surface area. In this embodiment a monitor is installed in the operator cab to receive and display the images for the operator to view the clean-up process. In a more preferred embodiment a second video camera is mounted to the backhoe at a position to perform recording and transmitting of images of the area located behind the vehicle. In this embodiment these images can be received by the monitor, or if desired a second monitor, to better ensure that the operator does not back over the vacuum hose or accidentally hit another person when the backhoe is being moved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The accompanying drawings and photographs illustrate preferred embodiments of this invention.

[0014] FIG. 1 is a perspective view of one preferred embodiment of the oil skimmer system of this invention utilizing a vacuum truck, backhoe and oil skimmer assembly of this invention.

[0015] FIG. 2 is three-quarter perspective view of one preferred embodiment of the oil skimmer assembly of this invention.

[0016] FIG. 3 is a three-quarter perspective view of an alternate preferred embodiment of the oil skimmer assembly of this invention.

[0017] FIG. 4 is a top view of the oil skimmer assembly of FIG. 3.

[0018] FIG. 5 is a front view of the oil skimmer assembly of FIG. 3.
PREFERRED EMBODIMENTS OF THE INVENTION

[0021] The oil skimmer assembly and system of this invention can be used to skim a wide variety of matter from a fluid surface. This can include skimming particulates or other material from the surface of a sludge pond or waste pit. However, without any intent to limit the scope of this invention, the preferred embodiments of the invention are described making reference to the skimming of oil from a water surface.

[0022] The system includes three basic elements: a pump with an intake hose attached to the intake port of the pump and a discharge hose attached to the discharge port of the pump, an articulating and extendable extension member mounted on vessel or land vehicle, and the oil skimmer assembly affixed to the extension member and operatively attached to the intake hose. If the oil cleanup is to be conducted from the shoreline, in order to obtain maximum operational flexibility and mobility it would be preferred that the pump on a conventional vacuum truck be used and the hydraulically operated backhoe arm having an accessory attachment member be used for the extension member. On the other hand, if the oil cleanup is to be conducted from a vessel such as a barge, then the pump and the extension member would be mounted on the barge and the barge would then be moved to the clean up site where the oil skimmer assembly can be positioned in the polluted water. If desired, the vacuum truck and backhoe could be positioned on the barge deck in order that the barge would not have to be modified to accommodate the cleanup process. Again without limiting the scope of this invention, the preferred embodiments of the invention will be described utilizing a conventional vacuum truck and backhoe combination with the oil skimmer assembly.

[0023] Referring to FIG. 1, the oil skimmer system 1 includes a conventional vacuum truck 2, backhoe 3 and an oil skimmer assembly 4. Mounted on vacuum truck 2 is pump 5 to which vacuum hose 6 has its discharge end 7 operatively attached to the pump intake port. Also mounted on vacuum truck 2 is a storage tank 8 that is operatively connected to pump discharge port to receive waste material, such as oil, that is collected at vacuum hose intake end 9. In an alternate embodiment, the vacuuming system could be mounted on a skid rather than on a truck.

[0024] Backhoe 3 is provided with an operator cab 10 that will be used by the personnel operating the oil skimmer assembly during the oil skimming operation. Cab 10 can be enclosed and air conditioned to provide to the operator personnel an environment safe from the oil and other hydrocarbon vapors, as well as comfortable to minimize tiredness of the operator. It is preferred that backhoe 3 be a long-reach backhoe that will permit the backhoe 3 to be positioned a suitable distance from the shoreline to prevent the backhoe treads 11 from being contaminated from the oil that has washed up on the shoreline. The articulating and extendable arm 12 is hydraulically powered to manipulate the position of the arm 12. At the extending section 13 of arm 12 is an accessory attachment member 14 that permits various accessory devices to be connected to the extending section 13. In a preferred embodiment backhoe 3 has a series of vacuum hose support guides 15 through which vacuum hose 6 is threaded to prevent vacuum hose 6 from being damaged by backhoe 3 when it is being moved and to position vacuum hose 6 for connection to the oil skimmer assembly 4.

[0025] Referring to FIG. 2, in one preferred embodiment oil skimmer assembly 4 includes a skimmer plate 16 having a flat upper surface 17. It is preferred skimmer plate 16 have a square shape, but other shapes can also be used. In a preferred embodiment the shape and size of skimmer plate 16 is constructed to permit quieting of the flow of the oily water on the plate surface 17 to facilitate the removal of the oil from the water by suction tube 18 mounted above the center section of skimmer plate 16. In a preferred embodiment the skimmer plate 16 will be 2’-8” in diameter if it is circular or 2’-8” by 2’-8” if rectangular. This size can be readily maneuvered by the long-reach backhoe 3 and provides for significantly improved recovery of oil from the polluted water. Suction tube 18 is affixed in this position by side struts 19-21 and vertical support plates 22-25 that are welded at one end to suction tube 18 and at their opposite end to flat upper surface 17. Suction tube 18 has an intake end 26 that is set at a predetermined distance from upper surface 17. This distance is determined by the amount of vacuum being generated by vacuum pump 5 and the density, size and/or amount of the material to be skimmed from the water surface. In a preferred embodiment the intake end 26 of the suction tube 18 will be positioned 3”-6” above the upper surface 17 of the skimmer plate 16. This distance allows the oil to be separated and skimmed from the water without an undue amount of water also being vacuums back to the storage tank. This distance will also help prevent large solid objects from being vacuumed into the storage tank. In a preferred embodiment either the suction tube 18, or more preferably, the intake end 26 of the suction tube 18 is constructed to be adjustable to permit this distance to be changed to optimize the oil collection. The desired distance is based on the pump capacity, the vacuum hose size, the consistency of the oil being skimmed, and other factors. The size of the suction tube passageway 18A can vary, but preferably is 6”-10” in diameter. More preferably, the size matches that of the vacuum hose 6.

[0026] Suction tube 18 also has a discharge end 27 to which vacuum hose 6 is attached by clamp 28 or other known attaching devices. Oil skimmer assembly further includes a debris guard 29 positioned about the perimeter area 30 of skimmer plate upper surface 17. Debris guard 29 is constructed primarily to inhibit debris floating in the oily water being skimmed from floating over plate surface 17 where it might then be vacuumed into suction tube 18. Guard 29 includes a top rail 31 and a bottom rail 32 having separated fence members 33 affixed to and extending between rails 31 and 32. Selected fencing members or legs 34 are of greater length and extend below bottom rail 32 and are welded or otherwise affixed to plate upper surface 18 serving to support the debris guard 29 in position on oil skimmer plate 17. In a preferred embodiment horizontal support rod 35 is affixed to the fence members 33 and legs 34 at a position between top rail 31 and bottom rail 32 to provide support to the fence members 33 and legs 34 when struck by debris or during movement of the oil skimmer assembly 4. If desired the spacing between fence members 33 and legs 34 can be increased, and/or the thickness of the top rail and bottom rail increased, and/or the depth of the spacing between bottom rail 32 and plate surface 17...
deceased to aid in the quieting of the oily water flowing across plate surface 17 by serving as dampeners of any wave action of the oily water.

[0027] In an alternate preferred embodiment of the oil skimmer assembly 4 as illustrated in FIGS. 3-5, a grate 36 can be affixed to top rail 31 and extend over some or preferably substantially all of plate surface 17 to inhibit any debris washed over the top rail 31 from being vacuumed into suction tube 18. Grate 36 further serves as a platform that an observer can stand to view the skimming operation.

[0028] FIGS. 6-7 illustrate one embodiment of a connecting adaptor 37 that can be used to operatively affix to the oil skimmer assembly 4 to the backhoe arm 12 via backhoe accessory attachment member 14. In this embodiment L-shaped connector members 38 and 39, each having a first plate 40 and 41, respectively, welded to suction tube 18 to position their extending, separated second plates 42 and 43, respectively, parallel to one another.

[0029] Connecting adaptor 37 is constructed having a plate member 44, tube connecting member 45 affixed to and extending out from adaptor plate surface 44A, and backhoe arm connecting member 46 affixed to and extending out from adaptor plate surface 44B. Tube connecting member 45 is provided with side walls 47 and 48 that are shaped and sized to be secured in position between and substantially flush with second plates 42 and 43. Side walls 47 and 48 are each provided with a series of bolt opening 49A-C and 50A-C, respectively, that can be aligned with a corresponding series of bolt openings 51A-C and 52A-C in plates 42 and 43, respectively. Bolt openings 51A-C and 52A-C are preferably positioned to form a line “L” running at an angle to the vertical axis “A” of tube 18. Tube connecting member 45 is also provided with a conave curved plate 53 extending between side walls 47 and 48 having a radius to allow flush mounting of plate 53 to the surface of tube 18 when bolts 54A-C are extended bolt openings 49A-C, 50A-C, 51A-C and 52A-C and secured by nuts 55A-C.

[0030] A conventional backhoe accessory attachment member 14 is constructed having separated, parallel horizontal threaded rods 56, 57 that are insertable into corresponding openings in the hydraulically extendable arm end section 58 of backhoe arm 12. In this embodiment backhoe connecting member 46 comprises parallel plates 59, 60 that are extending perpendicularly from adapter plate 44. Each plate 59, 60 is provided with a pair of openings 61A, 61B and 62A, 62B, respectively, corresponding to the openings in backhoe end section 58, respectively to permit rods 56, 57 to be inserted into the corresponding openings and secured by conventional means such as nuts, pins, clips or similar securing devices, respectively, thereby affixing backhoe arm end section 58 to connection 46.

[0031] There are many other configurations that connecting adaptor 37 can assume depending on the structure of the backhoe accessory attachment member 14 or the structure of the suction tube connector members 38 and 39. In fact if suction tube connector members 38 and 39 are structured to be directly attached to backhoe accessory attachment member 14, then there would be no need for connecting adaptor 37.

[0032] In operation the vacuum truck 2 and long-reach backhoe 3 are brought to the clean-up site. If the site is near a shoreline the backhoe 3 is positioned on the shoreline whereby when its boom is extended the oil skimmer assembly 4 will be above the water surface to be skimmed. The boom is manipulated (typically hydraulically) to lower the skimmer plate 16 into the water at a depth below the oil that is collected near the water surface. In most cases this will be about 3 inches or less below the water surface. The vacuum truck pump 5 is activated to create the vacuum in vacuum hose 6. The vacuum will cause the oil polluted water to circulate toward the intake end 26 of the suction tube 18. The amount of vacuum is set so that the oil is substantially separated from the water and is sucked into the intake end 26 of the suction tube 18.

[0033] In a preferred embodiment the oil skimmer system further includes a surveillance assembly. The surveillance assembly includes a video camera attached to the mounting adapter at a position to be directed to the oil skimmer plate, a video transmitter operatively attached to the video camera to receive and transmit images from the video camera; and a monitor located inside the operator cab, positioned to be visible to an operator in the operator cab, and operatively connected to the video transmitter to receive and display the transmitted images from the video camera. This embodiment allows the operator to better see if the oil skimming assembly is efficiently vacuuming the oil from the water and to permit him to better see where the oil skimming assembly should be positioned to more efficiently skim the oil. In another preferred embodiment, the surveillance assembly further includes a second video camera mounted to the backhoe at a position to be directed to the area located behind the backhoe, a second video transmitter operatively attached to the second video camera to receive and transmit images from the second video camera, and a second monitor located inside the operator cab, positioned to be visible to an operator in the operator cab, and operatively connected to the second video transmitter to receive and display the transmitted images from the second video camera. This embodiment provides additional safety to prevent the operator accidentally hitting a person while moving the backhoe into the desired position.

[0034] As an alternate embodiment the monitor is electronically structured to receive transmitted images from multiple cameras and simultaneously display the transmitted images separately from each of the multiple cameras and wherein the second monitor is the monitor.

[0035] There are of course many other alternate configurations of the oil skimmer system and assembly that are obvious from the teachings and suggestions contained in the drawings and the written description of the invention. It is the intent of applicant to include these alternate configurations in the claims set forth below.

What I claim is:

1. A fluid skimmer system for use in separating and capturing fluids from the surface area of a body of mixed fluid and water, comprising:
   a. a vacuuming assembly comprising:
      i. a pump having an intake port and a discharge port, and
      ii. a vacuum hose having an intake end and a discharge end, the vacuum hose discharge end operatively connected to the pump intake port;
   b. a fluid skimmer assembly comprising:
      i. a skimmer plate having a flat upper surface, and
      ii. a suction tube having an intake end affixed in operative position above the skimmer plate and a discharge end;
c. a mobile skimmer plate maneuvering assembly comprising:
   i. a power source and
   ii. an articulating and extendable extension member operative connected to the power source to enable the extension member to articulate and telescope; the extension member operative attachable to the oil skimmer assembly to enable movement of the fluid skimmer assembly to a desired position to position the plate flat on the area in or below the fluid and water surface area, wherein activation of the pump creates sufficient vacuum at the suction tube intake end to cause mixed fluid and water to flow over the plate flat upper surface toward the suction tube intake end whereby at least some of the fluid is separated from the water and flows into the suction tube and through the vacuum hose to the pump where the fluid is extruded through the pump discharge port.

2. The fluid skimmer system according to claim 1, wherein the vacuuming assembly is a vacuum truck.

3. The fluid skimmer system according to claim 1, wherein:
   a. the mobile skimmer plate maneuvering assembly is a backhoe having a hydraulic driven articulating and extendable arm provided with an accessory attachment member, and
   b. a connecting adaptor is constructed to be affixed to the accessory attachment member and to the suction tube.

4. The oil skimmer system according to claim 1, wherein the mobile skimmer plate maneuvering assembly is a backhoe and wherein one or more vacuum hose support guides having an opening sized to permit the vacuum hose to pass through, the vacuum hose support guides affixed to the backhoe at positions for preventing constriction of the vacuum hose during movement of the backhoe and the articulating and extendable arm.

5. The fluid skimmer system according to claim 1, wherein the fluid skimmer assembly further comprises a debris guard affixed to the skimmer plate and positioned surrounding the suction tube intake end to inhibit debris from being vacuumed into the suction nozzle intake end.

6. The fluid skimmer system according to claim 5, wherein the debris guard comprises:
   a. a top rail having support legs affixed to the plate, and
   b. fence members extending downward from the top rail a sufficient distance to permit the fluid to pass under the fence members and over the skimmer plate upper surface and to inhibit debris from passing through the fence members.

7. The fluid skimmer system according to claim 6, wherein the debris guard further comprises a grate affixed to the top rail and extending over at least a portion of the oil skimmer plate upper surface.

8. The fluid skimmer system according to claim 4, further comprising a surveillance assembly, the surveillance assembly comprising:
   a. a video camera attached to the mounting adapter at a position to be directed to the excavation site,
   b. a video transmitter operatively attached to the video camera to receive and transmit images from the video camera; and
   c. a monitor located inside the operator cab, positioned to be visible to an operator in the operator cab, and operatively connected to the video transmitter to receive and display the transmitted images from the video camera.

9. The fluid skimmer system according to claim 8, wherein the surveillance assembly further comprises:
   a. a second video camera mounted to the backhoe at a position to be directed to the area located behind the backhoe;
   b. a second video transmitter operatively attached to the second video camera to receive and transmit images from the second video camera; and
   c. a second monitor located inside the operator cab, positioned to be visible to an operator in the operator cab, and operatively connected to the second video transmitter to receive and display the transmitted images from the second video camera.

10. A fluid skimmer system comprising:
    a. a vacuum truck having
    i. an operatively connected pump provided with an intake opening and a discharge opening,
    ii. a vacuum hose attached at one end to the intake opening of the pump, the hose having an intake opening at its opposite end, and
    iii. a receiving tank operatively connected to the discharge opening of the pump, the pump creating a vacuum at the hose intake opening;
    b. a backhoe having an articulating and extendable arm provided with an accessory attachment member, and
    c. a fluid skimmer assembly comprising:
        i. a skimmer plate having an upper flat surface,
        ii. a suction tube affixed to the skimmer plate by one or more struts to extend perpendicularly above the skimmer plate upper surface, the suction tube having an intake end and a discharge end, the suction tube discharge end operatively attached to the hose intake end,
        iii. a debris guard affixed to the skimmer plate upper surface and positioned about the suction tube intake end to inhibit unwanted objects from being vacuumed into the suction tube intake end; and
        d. a connecting adaptor affixed to the suction tube and constructed for attachment to the backhoe arm accessory attachment member.

11. The fluid skimmer system of claim 10 wherein one or more hose support guides having an opening sized to permit the vacuum hose to pass through and affixed to the backhoe at positions for preventing constriction of the vacuum hose during movement of the backhoe and the articulating and extendable arm.

12. A fluid skimmer assembly for use in skimming fluids from the surface area of a body of mixed fluids and water, comprising:
    a. a skimmer plate having a flat upper surface;
    b. a suction tube having a discharge end and an intake end affixed to and in operative position above the skimmer plate; and
    c. a debris guard comprising:
        i. a top rail having support legs affixed to the plate, and
        ii. fence members affixed to and extending downward from the top rail a predetermined distance to permit the fluids to pass under the fence members and over the skimmer plate upper surface and to inhibit debris from flowing to the suction tube intake end.

13. The fluid skimmer assembly of claim 12 wherein the suction tube intake end is positioned a predetermined distance above the plate upper surface to suction fluids passing
underneath suction tube intake end into the suction tube when a predetermined minimum vacuum pressure is created at the suction tube discharge end.

14. The fluid skimmer assembly of claim 13, wherein the debris guard further comprises a grate affixed to the top rail and extending over at least a portion of the fluid skimmer plate upper surface.

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