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(54) APPARATUS FOR RECOVERY OF ESCAPED OIL

(71) We, MITSUBISHI JUKOGYO KABUSHIKI KAISHA, a Japanese body corporate, of 5-1, Marunouchi 2-chome, Chiyoda-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an apparatus for recovery of oil escaping over the surface of the body of water.

Heretofore, following measures have been taken in order to prevent pollution caused by oil escaping over the surface of a body of water (or fresh sea water).

(1) Diffusion of oil into water by utilising oil processing agent.

(2) Adsorption treatment of oil using absorbent.

(3) Recovery of oil manually by scooping up the oil with ladles.

However, such measures have the following disadvantages:

(1) Diffusion of oil by oil processing agent:

This measure merely causes oil to be diffused into water together with the processing agent, and secondary pollution necessarily occurs giving adverse influence against fish and shellfish. Therefore, this measure cannot be said to be appropriate for avoiding pollution caused by oil.

(2) Adsorption treatment of oil by adsorbent:

(a) Adsorption efficiency is low for oils having high viscosity such as heavy oil.

(b) A large quantity of adsorbent is required for treating a large quantity of oil escaping over the surface of a body of water, thereby resulting in a high cost for the treatment.

(c) Recovery of adsorbent per se after treatment is very troublesome.

(d) A high cost is required for treating or burning the adsorbent used for the treatment.

ment.

(e) Recovery of oil for reuse thereof or reproduction of oil is difficult.

(3) Recovery of oil by using ladles:

(a) A large number of people are required thereby rendering the cost for recovery high.

(b) A long time is required for the processing of a large quantity of oil escaping over the water.

(c) This measure can only be taken in regions accessible from a quay or from small ships.

(d) A long time is required to collect people while the oil is spreading wider over the surface of the body of water, thereby delaying the oil recovery operation to render the recovery more difficult.

As described above, the heretofore adopted measures for the recovery of oil escaping over the surface of a body of water cannot be said to be effective, and the development of effective apparatus has long been desired for the prompt recovery of oil escaping over the surface of a body of water and which can be transported and operated easily to recover continuously a large quantity of oil escaping over the surface of body of water without discharging water contaminated with oil into the ambient body of water causing secondary pollution.

According to the present invention there is provided apparatus for recovering oil escaping over the surface of a body of water, which apparatus comprises:

a water tank;

a first oil-water separating tank to receive oil and water from the region where oil is lying over the body of water and to allow gravitational separation of the oil from the water, the lower portion of the first oil-water separating tank communicating with the water tank to allow the water separated from the oil to pass to the water tank;

an oil tank, communicating with the first

oil-water separating tank at the upper portion thereof, for permitting the oil separated from the water in the first oil-water separating tank to overflow into the oil tank together with residual water entrained therein, the oil tank having an oil discharge pipe which opens at one end thereof into the oil tank to discharge oil from the oil tank;

10 a second oil-water separating tank communicating with the oil tank at the lower portion thereof so as to receive from the oil tank the residual water together with entrained oil and so constructed as to permit 15 the residual water to be separated from the oil, the second oil-water separating tank having an outlet for discharging the separated water to the ambient body of water and having means for inhibiting oil from being 20 discharged with the separated water;

a conduit communicating at one end thereof with the first oil-water separating tank;

oil pick-up means communicating with the 25 other end of the conduit and adapted to be placed in the body of water where oil is lying so as to collect oil with water from the surface of the body of water; and

means for pumping oil from the oil pick-up means and into the conduit thereby to 30 permit oil-water mixture to be collected through the oil pick-up means and to be received in the first oil-water separating tank.

35 Preferably, the second oil-water separating tank contains an oil absorbent material for inhibiting the discharge of oil with the separated water.

Further, the means for pumping oil may 40 comprise a jet pump provided in the conduit and actuated by a water pump so as to recirculate water from the water tank through the jet pump, the conduit, and the first oil-water separating tank to the water tank.

45 The oil tank may communicate with the second oil-water separating tank by means of a residual water transfer pipe which opens into the lower portion of the second oil-water separating tank, which pipe includes a further jet pump driven by the 50 water from the water pump to permit the residual water entrained with the oil to be introduced into the second oil-water separating tank.

55 A further pipe may be provided, one end of which opens into the water tank and the other end of which opens into the conduit, which further pipe has provided therein another jet pump driven by the water from the 60 water pump to permit any oil introduced into the water tank to be returned to the conduit for further processing.

Another pipe may be connected to the 65 water pump, which said another pipe is adapted to communicate with the ambient

body of water, the apparatus including a valve to permit the water pump to be selectively switched to communicate either with the water tank for the recirculation of water through the conduit or with said another 70 pipe for receiving a quantity of water from the ambient body of water for enabling the starting-up of the apparatus.

For a better understanding of the present invention and to show more clearly how it 75 may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:—

Fig. 1 is a general perspective view showing the main components of an embodiment 80 of the apparatus constructed in accordance with the present invention;

Fig. 2 is a schematic side view showing the embodiment of Fig. 1 as mounted on a 85 truck; and

Fig. 3 is a schematic side view showing the embodiment of Fig. 1 as mounted on a ship.

Referring now to Fig. 1, the apparatus in accordance with the present invention comprises a water tank 12, a first oil-water 90 separating tank 10 for coarse separation of oil from water received therein by means of gravity as will be described later and which communicates through an opening 95 formed in the partition of the first separating tank 10 at the lower portion thereof with the water tank 12 for introducing water into the water tank, a grating 11 being provided at the opening of the partition for preventing 100 introduction of foreign materials into the water tank 12, an oil tank 16 adjacent to the first separating tank 10, the partition between the first separating tank 10 and the oil tank 16 being provided with a cut out 105 portion 17 at the upper portion thereof so as to allow oil separated from water in the tank 10 to overflow through the cut out portion 17 into the oil tank 16, and a second oil-water separating tank 23, the lower 110 portion of the oil tank 16 communicating with the lower portion of the second separating tank 23 through a pipe 19 and a pipe 19' connected by a jet pump 20 which is to be described later so as to transport the residual water introduced into the tank 16 together with oil and existing at the bottom 115 of the tank 16 to the second separating tank 23 by the action of the jet pump 20.

The oil tank 16 is provided with a discharge pipe 25 opening into the interior of the tank 16 so as to discharge oil out of the oil tank 16 for the recovery thereof, while an oil adsorbent 24 is provided in the second separating tank 23 so as to capture 125 oil introduced into the tank 23 and a discharge pipe 26 is connected to the tank 23 so as to permit water separated from oil in the tank 23 to be discharged into the ambient body of water, the concentration 130

of oil included into the discharged water being kept equal to or lower than a predetermined value.

In order to collect oil escaping over the surface of the body of water together with water entrained therewith from the region where such oil escapement occurs, sucking means 1 comprising a suction mouth mounted on floats and thus adapted to float on water where oil is present is connected by a sucking hose 2 through a jet pump 4 to a conduit 7 adapted to transport the oil-water mixture therethrough to the first oil-water separating tank 10.

The sucking means 1 is provided with a water supply through a hose 3 from a water pump 5 so as to facilitate the collection of the oil-water mixture through the hose 2. The hose 2 is connected to the suction side of the jet pump 4 which is supplied with water from the water pump 5 so as to positively urge the collected oil-water mixture through the conduit 7 to the first separating tank 10. The suction side of the pump 5 is connected to a pipe through a valve as well as to a pipe 13 communicating with the water tank 12 through a further valve. The pipe 6 is adapted to be placed in the ambient body of water so that the pump 5 may be supplied with water from the ambient body of water or permits the recirculation of water from the tank 12 through the pump 5, the conduit 7, and the first separating tank 10 to the water tank 12 by the appropriate operation of the valves.

A discharge box 8, provided with a filter 9, is arranged above the first separating tank 10 and the conduit 7 is connected to the box 8 so that the oil-water mixture flowing through the conduit 7 is discharged into the tank 10 while foreign materials are collected by the filter 9 and may be manually removed therefrom.

The discharge side of the water pump 5 is connected through piping to the suction side of the previously described jet pump 20 as well as to the suction side of a jet pump 15, the discharge side of which is connected through a pipe 14' to the conduit 7. The suction side of the jet pump 15 is connected to a pipe 14 opening at the upper portion of the water tank 12 for sucking oil eventually existing in the tank 12 as well as to a pipe connected to a receiver 22' adapted to receive oil-water mixture discharged from cocks 21, 22 located in the wall of the oil tank 16, so that the oil-water mixture from the pipe 14 and the receiver 22' is urged through the pipe 14' to the conduit 7 for the further processing thereof. The cocks 21, 22 are provided at different levels so as to ensure that only oil separated from water in the oil tank 16 can be discharged through the discharge pipe 25 by investigating the level of oil-water interface by draining the

contents in the tank 16.

The operation of the apparatus as described above is as follows:

First, the water pump 5 is driven so as to suck water through the pipe 6 from the ambient body of water by appropriate switching of the valves so that the tanks 10 and 12 are filled with water through the conduit 7.

Then, the valves are switched so as to form a closed cycle or recirculation of water from the tank 12 through the pipe 13, the pump 5, the conduit 7 and the first separating tank 10, while the sucking means 1 is placed in the region from where oil-water mixture is to be sucked.

The flow of water through the jet pump 4 causes the oil-water mixture to be urged from the sucking means 1 through the conduit 7 to the discharge box 8 so that it is supplied to the tank 10 together with carrier water from the pump 5 while foreign materials are removed by the filter 9. The water separated from the oil in the tank 10 is introduced in the tank 12 through grating 11 for the recirculation thereof through the conduit 7.

Thus, the oil-water mixture is efficiently sucked by the sucking means 1 by the medium of the carrier water from the pump 5. The supply of water into the sucking means 1 through the hose 3 facilitates the suction of oil-water mixture by the sucking means 1.

Oil introduced into the first separating tank 10 together with water is separated from water by the action of gravity and overflows through the cut-out portion 17 into the oil tank 16. At this time, the quantity of oil entrained by water is the same as that sucked by the sucking means 1.

Oil eventually introduced into the tank 12 moves upwardly and floats on top of the water in the tank 12 and is removed therefrom through the pipe 14 by the action of the jet pump 15 and returned to the conduit 7 for further processing thereof.

The oil entrained with water and introduced into the oil tank 16 is further subjected to gravity separation and the oil separated is discharged through pipe 25 for the recovery thereof while the water with contaminant oil included therein in the tank 16 is fed to the second separating tank 23 through pipes 19, 19' by the action of the jet pump 20. Oil is adsorbed onto the adsorbent 24 in the tank 23 so that only water having a concentration of oil lower than a predetermined value can be returned to the ambient body of water through the discharge pipe 26.

The adsorbent may be interchanged when it becomes depleted.

By investigating and adjusting the level of oil-water interface in the oil tank 16

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by opening the cocks 21, 22, discharge only of separated oil from the tank 16 through the pipe 25 is ensured, while only water with contaminant oil included therein is fed to the second separating tank 23, the drained water-oil through the cocks 21, 22 being gathered in the receiver 22' so as to be returned to the conduit 7 by the action of the jet pump 15 together with oil removed from the tank 12 through the pipe 14.

The above described apparatus can be assembled in a compact size within a box-like enclosure, thereby permitting the assembly to be mounted on a truck or a ship so that it can be easily transported to any places where such an apparatus is required for the recovery of oil escaping over the surface of a body of water.

Fig. 2 shows the apparatus of the present invention as mounted on a truck 30 so that it can be transported and operated at a quay where the recovery oil is required.

The oil recovered by the apparatus is received through the pipe 25 in a vacuum tank 32 mounted on a vacuum car 31. The water processed in the tank 23 is discharged to the ambient body of water.

Since the present invention utilizes jet pumps and a single water pump for driving the same for the recovery of oil, the efficiency and capacity of the recovery is far greater than can be effected manually. Further, since the water pump can be driven by a portable engine without requiring electric power or other particular power source and the operation is effected in a closed cycle of recirculation of water, a small volume of the carrier water suffices to effectively operate the apparatus while only a small volume of water is returned to the ambient body of the water and the concentration of oil included therein is low, to thereby positively prevent occurrence of secondary pollution.

Further, the use of jet pumps makes it possible to easily process oils having a high viscosity and low flowability thereby eliminating failure of the operation of the apparatus.

The use of hoses connecting the sucking means to the water conduit permits easy movement of the sucking means to any place requiring the recovery of oil, so that a large area can be treated by the apparatus of the present invention.

The use of the jet pumps makes it possible to enlarge the transportation range of oil in comparison with an apparatus utilising a vacuum pump.

In the present invention, other appropriate means may be used to eliminate oil in the second oil-water separating tank in place of the adsorbent.

As described above, the present invention provides an apparatus which makes it possible

to recover a large quantity of oil escaping over the surface of the body of water in a short time period while secondary pollution is positively prevented.

WHAT WE CLAIM IS:—

1. Apparatus for recovering oil escaping over the surface of a body of water, which apparatus comprises:

a water tank;

a first oil-water separating tank to receive oil and water from the region where oil is lying over the body of water and to allow gravitational separation of the oil from the water, the lower portion of the first oil-water separating tank communicating with the water tank to allow the water separated from the oil to pass to the water tank.

an oil tank, communicating with the first oil-water separating tank at the upper portion thereof, for permitting the oil separated from the water in the first oil-water separating tank to overflow into the oil tank together with residual water entrained therewith, the oil tank having an oil discharge pipe which opens at one end thereof into the oil tank to discharge oil from the oil tank;

a second oil-water separating tank communicating with the oil tank at the lower portion thereof so as to receive from the oil tank the residual water together with entrained oil and so constructed as to permit the residual water to be separated from the oil, the second oil-water separating tank having an outlet for discharging the separated water to the ambient body of water and having means for inhibiting oil from being discharged with the separated water;

a conduit communicating at one end thereof with the first oil-water separating tank; oil pick-up means communicating with the other end of the conduit and adapted to be placed in the body of water where oil is lying so as to collect oil with water from the surface of the body of water; and means for pumping oil from the oil pick-up means and into the conduit thereby to permit oil-water mixture to be collected through the oil pick-up means and to be received in the first oil-water separating tank.

2. Apparatus as claimed in claim 1, wherein the second oil-water separating tank contains an oil adsorbent material for inhibiting the discharge of oil with the separated water.

3. Apparatus as claimed in claim 1 or 2, wherein the means for pumping oil comprises a jet pump provided in the conduit and actuated by a water pump so as to recirculate water from the water tank through the jet pump, the conduit, and the first oil-water separating tank to the water tank.

4. Apparatus as claimed in claim 3, wherein the oil tank communicates with the

by opening the cocks 21, 22, discharge only of separated oil from the tank 16 through the pipe 25 is ensured, while only water with contaminant oil included therein is fed to the second separating tank 23, the drained water-oil through the cocks 21, 22 being gathered in the receiver 22' so as to be returned to the conduit 7 by the action of the jet pump 15 together with oil removed from the tank 12 through the pipe 14.

The above described apparatus can be assembled in a compact size within a box-like enclosure, thereby permitting the assembly to be mounted on a truck or a ship so that it can be easily transported to any places where such an apparatus is required for the recovery of oil escaping over the surface of a body of water.

Fig. 2 shows the apparatus of the present invention as mounted on a truck 30 so that it can be transported and operated at a quay where the recovery oil is required.

The oil recovered by the apparatus is received through the pipe 25 in a vacuum tank 32 mounted on a vacuum car 31. The water processed in the tank 23 is discharged to the ambient body of water.

Since the present invention utilizes jet pumps and a single water pump for driving the same for the recovery of oil, the efficiency and capacity of the recovery is far greater than can be effected manually. Further, since the water pump can be driven by a portable engine without requiring electric power or other particular power source and the operation is effected in a closed cycle of recirculation of water, a small volume of the carrier water suffices to effectively operate the apparatus while only a small volume of water is returned to the ambient body of the water and the concentration of oil included therein is low, to thereby positively prevent occurrence of secondary pollution.

Further, the use of jet pumps makes it possible to easily process oils having a high viscosity and low flowability thereby eliminating failure of the operation of the apparatus.

The use of hoses connecting the sucking means to the water conduit permits easy movement of the sucking means to any place requiring the recovery of oil, so that a large area can be treated by the apparatus of the present invention.

The use of the jet pumps makes it possible to enlarge the transportation range of oil in comparison with an apparatus utilising a vacuum pump.

In the present invention, other appropriate means may be used to eliminate oil in the second oil-water separating tank in place of the adsorbent.

As described above, the present invention provides an apparatus which makes it pos-

sible to recover a large quantity of oil escaping over the surface of the body of water in a short time period while secondary pollution is positively prevented.

WHAT WE CLAIM IS:—

1. Apparatus for recovering oil escaping over the surface of a body of water, which apparatus comprises:

a water tank;

a first oil-water separating tank to receive oil and water from the region where oil is lying over the body of water and to allow gravitational separation of the oil from the water, the lower portion of the first oil-water separating tank communicating with the water tank to allow the water separated from the oil to pass to the water tank.

an oil tank, communicating with the first oil-water separating tank at the upper portion thereof, for permitting the oil separated from the water in the first oil-water separating tank to overflow into the oil tank together with residual water entrained therein, the oil tank having an oil discharge pipe which opens at one end thereof into the oil tank to discharge oil from the oil tank;

a second oil-water separating tank communicating with the oil tank at the lower portion thereof so as to receive from the oil tank the residual water together with entrained oil and so constructed as to permit the residual water to be separated from the oil, the second oil-water separating tank having an outlet for discharging the separated water to the ambient body of water and having means for inhibiting oil from being discharged with the separated water;

a conduit communicating at one end thereof with the first oil-water separating tank;

oil pick-up means communicating with the other end of the conduit and adapted to be placed in the body of water where oil is lying so as to collect oil with water from the surface of the body of water; and

means for pumping oil from the oil pick-up means and into the conduit thereby to permit oil-water mixture to be collected through the oil pick-up means and to be received in the first oil-water separating tank.

2. Apparatus as claimed in claim 1, wherein the second oil-water separating tank contains an oil adsorbent material for inhibiting the discharge of oil with the separated water.

3. Apparatus as claimed in claim 1 or 2, wherein the means for pumping oil comprises a jet pump provided in the conduit and actuated by a water pump so as to recirculate water from the water tank through the jet pump, the conduit, and the first oil-water separating tank to the water tank.

4. Apparatus as claimed in claim 3, wherein the oil tank communicates with the





- second oil-water separating tank by means of a residual water transfer pipe which opens into the lower portion of the second oil-water separating tank, which pipe includes a further jet pump driven by the water from the water pump to permit the residual water entrained with the oil to be introduced into the second oil-water separating tank.
- 10 5. Apparatus as claimed in claim 3 or 4, wherein a further pipe is provided, one end of which opens into the water tank and the other end of which opens into the conduit, which further pipe has provided
- 15 therein another jet pump driven by the water from the water pump to permit any oil introduced into the water tank to be returned to the conduit for further processing.
- 20 6. Apparatus as claimed in claim 3, 4 or 5, wherein another pipe is connected to the water pump, which said another pipe is adapted to communicate with the ambient body of water, the apparatus including a
- 25 valve to permit the water pump to be selectively switched to communicate either with the water tank for the recirculation of water through the conduit or with said another pipe for receiving a quantity of water from the ambient body of water for enabling the 30 starting-up of the apparatus.
7. Apparatus for the recovery of oil substantially as hereinbefore described with reference to, and as shown in, Figures 1 and 2 of the accompanying drawings. 35
8. Apparatus for the recovery of oil substantially as hereinbefore described with reference to, and as shown in, Figures 1 and 3 of the accompanying drawings.
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