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Pogonowski

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[54] **WATER SURFACE SKIMMER WITH CHECK VALVE**

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

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

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

[56] **References Cited**

UNITED STATES PATENTS

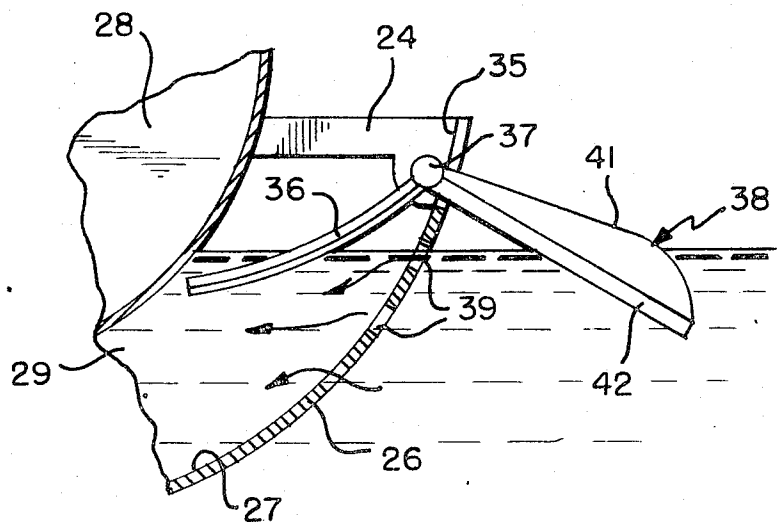
2,330,508 9/1943 McColl.....210/DIG. 21

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Attorney—Thomas H. Whaley et al.

[57] **ABSTRACT**

The invention relates to a skimmer device for use on the surface of a body of water. The skimmer is actuated by a vacuum source to promote a flow of a lighter than water coating material floating at the water's surface, through the skimmer by way of a submerged inlet. Valve means provided in the skimmer is so positioned to assure unidirectional flow through the skimmer to maintain the integrity of the vacuum source even though the skimmer be inadvertently raised from the water such that air would otherwise enter the vacuum system, and cause fluids to drain.

10 Claims, 5 Drawing Figures



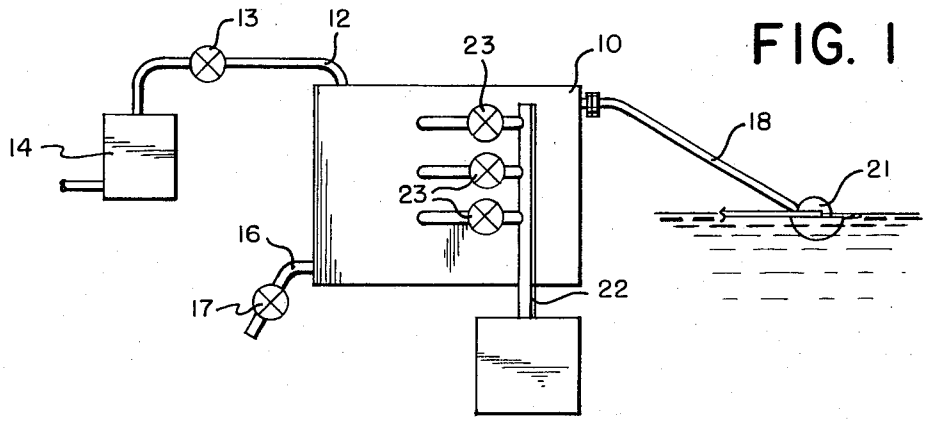


FIG. 1

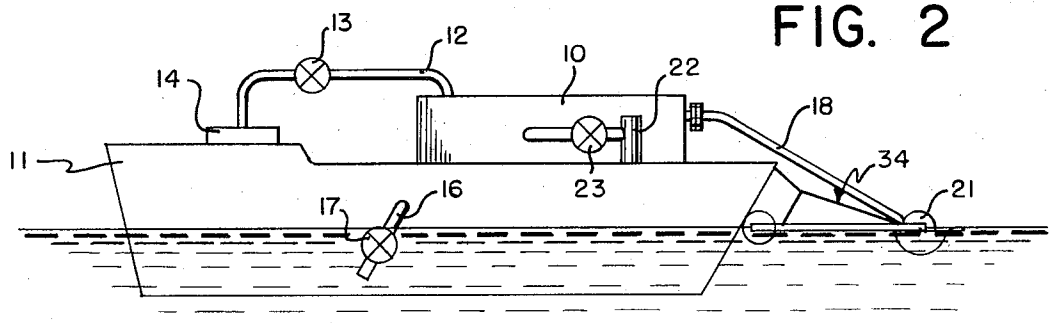


FIG. 2

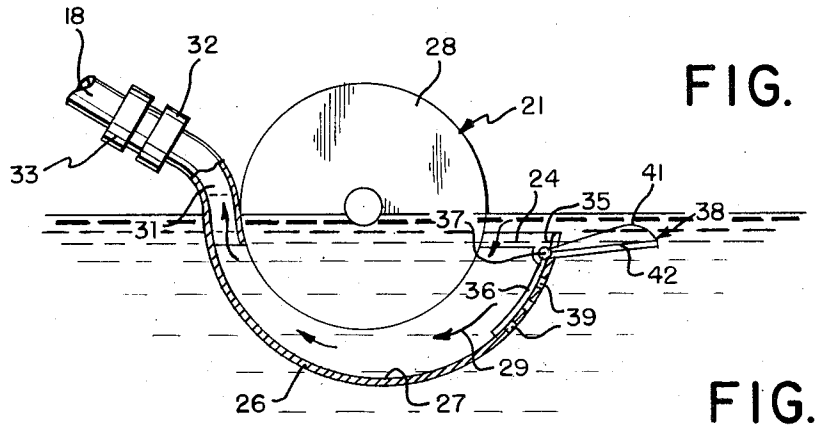


FIG. 3

FIG. 4

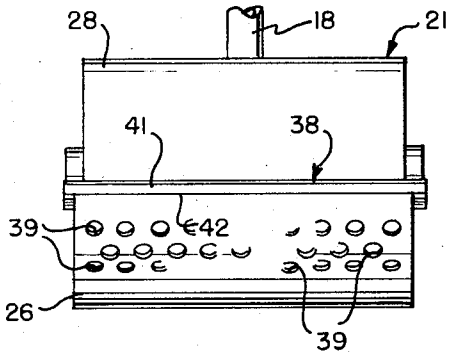
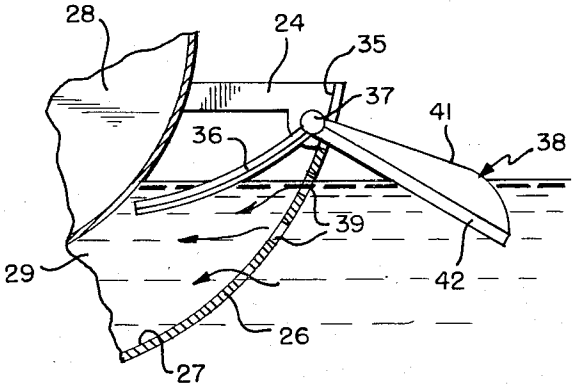


FIG. 5



WATER SURFACE SKIMMER WITH CHECK VALVE

BACKGROUND OF THE INVENTION

The inadvertent or accidental deposit of floating materials, whether liquid or solid, onto a water's surface poses a constant pollution threat to much of the world's tidelands and waterways. Considerable effort has been devoted toward providing means for not only avoiding such pollution, but toward the subsequent rapid and efficient cleaning up operation after the polluting material has been turned loose.

In the instance of the petroleum industry, many schemes, devices and processes have been tested and provided toward efficiently removing the upper floating surface from a body of water upon which an oil slick has been inadvertently formed. Such a slick can result from an uncontrollably flowing well, a ruptured ship, or a damaged storage means which permit the uncontrolled escape of the lighter than water petroleum base fluid. The latter, within the meaning of the instant invention can include crude or refined oil, as well as other forms of petroleum products.

The depth of such an oil slick or layer can vary, depending on the rapidity of its deposition on the water's surface, upon the viscosity of the fluid, and upon general weather conditions. In either instance, the layer will tend to spread and form a thinner film, covering however a greater area and thereby becoming a greater polluting threat.

One of the most promising means of cleaning up such spills subsequent to their occurrence is to attempt to remove or skim the thin upper surface consisting of only the water coating elements, and minimize the amount of water actually removed. It is appreciated however that it will be a virtual impossibility to remove a microfilm of oil from a body of water without simultaneously removing substantial quantities of water itself. Thus, the means normally resorted to is to remove by a skimmer arrangement, a quantity of both the oil and the water, and to thereafter separate the two in some processing system.

Regardless of the particular system utilized for gathering a slick of oil coated water, one detriment toward minimizing the effectiveness of the system is the roughness or turbulence of the water. While the layer of oil on the water's surface will tend to in general calm the latter, under the influence of high winds and turbulent seas, the water even though coated, will nonetheless be disturbed. Thus, it can be appreciated that under such circumstances, where the coated water has been driven into a turbulent or choppy condition, any form of skimming device will be tossed about. The skimmer will be forced above or below the water depending on its weight whereby to minimize the collector skimmer's effectiveness.

One means found to be relatively efficient in powering a water skimming device consists of a basically vacuum actuated system. Such a system functions on the principal that if one maintains a sufficiently great vacuum at one end of a collector tube or nozzle, as the latter is brought into contact with the water's surface a limited amount of water together with the undesirable coating fluid will be drawn into the system. Thereafter, the collected liquid can be separated by gravity or otherwise, the water returned to its source and the polluting matter or oil separately collected for further use or disposal.

One such vacuum actuated water skimmer system is disclosed by applicant in a co-pending application Ser. No. 102,814, dated Dec. 30, 1970, entitled "Oil Skimmer Apparatus and Method". The latter system comprises in essence a central collecting tank which is communicated with a source of vacuum. The tank is further communicated through a collector with the water's surface whereby some water, and the coating material, will be carried into the collecting tank. Thereafter, by a gravity separation of water from the lighter coating material, a degree of vacuum can be maintained in the tank whereby the system tends to perpetuate itself. Periodically the oil is removed from the collecting tank and stored or otherwise disposed of.

Toward improving the performance of applicant's above noted system, the present water skimmer or sweeper nozzle is provided, being operable to maintain itself at the water's surface for collecting both water and oil through a main opening. In the instance where the turbulence of the surface is such as to disturb the normal static position of the water skimmer the latter is provided with check valve means operable in response to the vertical movement of the skimmer. Thus, said check valve is automatically operated as the skimmer is inadvertently urged to a position above the water's surface where it would ordinarily permit air to be drawn into the vacuum system through the inlet means. Said check valve further communicates the skimmer with a source of water through an alternate set of supplementary openings whereby to in effect maintain the flow of liquid into the skimmer and preclude entrance of air to the latter.

DESCRIPTION OF THE DRAWINGS

In the drawings,

FIG. **1** illustrates schematically a vacuum system adapted for sweeping a surface of a body of water whereby to collect both water and a surface coating material.

FIG. **2** is an elevation view of a water borne barge or vessel embodying the system shown in FIG. **1** together with conduit means which extends from the vessel into the water, and carries a skimmer at the remote end thereof.

FIG. **3**, and also FIG. **5**, is an enlarged segmentary view in cross section, of the skimmer portion of the system shown in FIG. **2**.

FIG. **4** is a front view of the water skimmer shown in FIG. **3**.

Referring to FIG. **1**, the vacuum system under which the instant skimmer preferably although not exclusively functions, includes a collecting tank **10** which is normally carried on a vessel **11** or other floatable craft as shown in FIG. **2**. Collecting tank **10** is communicated through a conduit **12** having a valve **13** therein, with a source of vacuum **14** such as one or more vacuum pumps. Said collecting tank **10** is further provided at the lower end with a discharge conduit **16** whereby water collected in tank **10** can be passed therefrom at a regulated rate through manipulation of a discharge valve **17**.

Under normal operating conditions a vacuum will be maintained in collecting tank **10** such that the upper

end thereof will be maintained at a relatively constant, reduced pressure. Tank **10** will while operating, collect both water and a coating material such as oil by way of a conduit **18** communicated with the tank. Said conduit is illustrative with respect to the present system and can be embodied in a plurality of conduits all of which are communicated with and depend from collecting tank **10** such that the latter will be provided with fluid from a number of sources.

Each conduit **18** however is provided at the remote end thereof with a water skimming device or sweeper nozzle **21** to admit a stream of water as well as the water coating liquid. Water, and the lesser density material, such as oil, are carried into collector tank **10**. By virtue of one or more phases of separation the lighter than liquid oil will tend to float to the top of the body of water accumulated in tank **10**.

As mentioned above, collected water is discharged through the conduit **16** at a regulated rate. This rate will be in accordance with, and to sustain the degree of vacuum maintained in the tank **10** upper end, and with the rapidity of the incoming flow of fluid through the one or more sweepers **21** at the water level.

As the water level is lowered in tank **10**, there will be a continued increase in the amount of oil collected in said tank. Therefore, the latter is periodically drawn from the collecting tank through a manifolding system illustrated by the manifold pipe **22** having a plurality of inlet valves **23** connected thereto whereby oil may be drawn from the collecting tank at a desired level. Tapped off oil will be accumulated in a storage vessel, which can be a separate tank, barge or any other repository suitable to holding a quantity of the lighter than water fluid.

Referring to FIG. **3**, water skimmer **21** is shown floatably positioned at the water's surface to receive a flow of water and oil by way of the skimmer inlet **24**. It is appreciated that skimmer **21** at the conduit **18** lower end is representative of a number of such skimmer units. The latter are segmented and cooperatively disposed adjacent to each other as to sweep a predetermined front as vessel **11** is moved into an oil slick, or as the slick moves toward the skimmer assembly.

Toward clarification of the instant description, it will suffice to say that a number of similar such sweeper or skimmer units in essence are connectable into a skimmer assembly. This is true regardless of the number of such units employed and their relative disposition with respect to each other and with respect to the vessel **11**.

Referring again to FIG. **3**, skimmer unit **21** comprises an elongated, rigid casing **26**, normally formed of a metallic material such as sheet metal which defines a general arcuate lower surface **27**. The upper side of the casing is open and provided with a main float mechanism **28** here illustrated in a generally cylindrical cross section. Float **28** is fixedly positioned with respect to the skimmer and within casing **26** to define a liquid flow passage **29** at the float underside. Said passage will be generally arcuate in configuration between the float walls, and the inner wall of said casing **26**. Casing **26** is further provided with an exhaust port **31** having a flange **32**. The latter is adapted to removably connect to conduit **18** by way of a similar flange **33** together with bolting means and sufficient sealing gaskets disposed between the respective flanges to provide an air tight connection.

Inlet **24** to skimmer **21** defines a generally elongated opening lying in a horizontal plane and formed by the side wall of float **28**, which is spaced from the upper rim **35** of casing **26**. Said inlet **24** is rectangular in shape and receives a constant stream of water and oil. As shown in FIG. **3**, the normal disposition of skimmer **21** with respect to the water's surface is adjusted such that skimmer inlet **24** is slightly below the water's surface and preferably arranged to admit a minimum quantity of water in contrast to the amount of oil.

Toward maintaining the fixed position of skimmer **21** with respect to the water's surface, the skimmer can be provided with supplementary support means as shown in FIG. **2**. The latter can consist for example of spring biased support cables or arms **34** which depend from vessel **11**. In any event, the preferred position of skimmer **21** is such that inlet **24** is submerged immediately adjacent the water's surface and will consequently permit a continuous flow of water into said inlet. The liquid flow is thereafter directed through underpassage **29** and thence into the conduit **18** and up to the main collector tank **10**.

As above mentioned, occasion will arise during operation of the skimmer apparatus when, in accordance with the weather and other operating conditions, the skimmer will be forced from its preferred position. Thus, inlet **24** will be raised beyond the water's surface. Ordinarily under such circumstances, air rather than water entering inlet **24**, will cause a diminution of the degree of vacuum in the system thereby impairing or lessening the integrity of the latter.

Toward overcoming any propensity of the skimmer to decrease the vacuum's effectiveness through such air leakage, skimmer **21** is provided with valve means which is automatically operable to maintain a flow of water and oil into liquid passage **29**, even though the skimmer itself is beyond the water's surface.

Skimmer **21** is thus provided with a check valve arrangement comprising a flapper plate **36** which is hingedly connected through an elongated hinge joint **37** with a generally horizontally projecting actuator **38** depending from the skimmer's forward side. Said valve member comprises the generally arcuate flapper plate **36**, which conforms substantially in contour to the arcuate configuration of the inner wall of casing **26**.

The forward wall of the latter as shown in FIG. **4**, is provided with a plurality of discretely positioned supplementary openings **39**. Said openings **39** are formed in the lower wall of the casing wall, and normally beneath the water's surface. The openings thereby provide an alternate inlet for water normally contacting the casing **26** outer surface. However, an influx of water through supplementary openings **39** occurs only at such time as flapper plate **36** is displaced from its normal position contiguous with the casing **26** inner wall. In said normal position, the flapper **36** will substantially cover the respective supplementary openings **39** and preclude flow therethrough.

Toward promoting efficiency of liquid flow control through said openings **39**, the latter can be provided individually or cooperatively with gasketing means. The latter will comprise a resilient sealing member disposed

about each opening, or a gasket carried at the periphery of the flapper plate **36** whereby to form a fluid tight engagement with the inner surface of casing **26** wall when the flapper plate **36** is urged into a closed position.

While flapper plate **36** and the contiguous casing well portion are shown in the instant figures as being generally arcuate in configuration the exact contour is of course of a relatively minor nature. The casing wall may for example be flat, or even of an appropriate curvature which would permit the desired supplementary flow into the fluid flow chamber at the proper time.

The actuator mechanism **38** functions such that flapper plate **36** can be either held in its closed position against the respective supplementary openings **39**, or displaced from the latter. Said flapper plate **36** is thus provided with an outwardly extending arm which in turn supportably carries float actuator **38**.

The latter comprises essentially a buoyant element whereby to normally stabilize the position of flapper plate **36**. Since actuator **38** is at least partially buoyant, it is responsive to variations in the water level caused by waves, and the like. Thus, since in its normal operating position actuator **38** is submerged, it exerts an upward torque through hinge **37**, on the entire flapper plate **36**, the latter is urged into its closed position.

Said actuator **38**, while being buoyant, is further provided with a curved upper surface defined by a top plate **41**. Said plate connects with lower plate **42** along a forward bead, and terminates to the rear adjacent hinge **37**. A preferred configuration of said top plate is such that the latter defines an aerodynamic surface possessing curvature characteristics. Thus, a rapid flow of water and oil passing across the actuator upper surface, and prior to entering the skimmer inlet **24**, will create a sufficient lifting force across said surface that actuator **38** will be urged into an upward disposition.

In contrast, as actuator **38** is raised to clear the water's surface due to the skimmer rising thereabove, passage of liquid across the actuator top plate **41** will terminate. The uplift force at said plate upper surface will thereby be reduced to zero. Concurrently, the buoyant effect of actuator **38** is reduced such that the latter will fall. Plate **36** will be thereby displaced to fully expose supplementary openings **39** along the casing **26** forward wall.

In such a condition, the water will enter the supplementary openings to in effect maintain the flow of liquid to fluid passage **29**. This supplementary liquid introduction will preclude the entrance of an appreciable amount of air to the latter.

Other modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. A water skimmer for removing a floating layer of liquid from the surface of a body of water, said skimmer being communicated with a vacuum source whereby to induce a flow of water and said floating liquid into said skimmer, the latter comprising,

a. a casing defining a closed chamber having a main inlet opening for receiving a stream of said water and floating liquid, and a discharge port communicated with said vacuum source to maintain said chamber at a pressure less than atmospheric,

b. support means engaging said skimmer to normally maintain said main inlet opening adjacent to and submerged immediately beneath the water's surface, and

c. a means forming a supplementary opening in said casing at a point lower in elevation than said main inlet opening to receive an inflow of water at such time as said main opening is elevated beyond the water's surface.

2. In a water skimmer as defined in claim **1**, including a displaceable valve cover means adapted to form a closure across said supplementary opening means to prevent passage of water therethrough, when said main inlet opening is disposed beneath the water's surface.

3. In a water skimmer as defined in claim **2**, including; actuator means engaging said cover means whereby to displace the latter from said supplementary opening and communicate said closed chamber with the body of water, when said main inlet opening is elevated beyond the water's surface.

4. In a water skimmer as defined in claim **3**, wherein said actuator means is at least partially buoyant and positioned with respect to said casing to urge said cover means into sealing engagement with said supplementary opening when said main inlet opening is disposed beneath the water's surface.

5. In a water skimmer as defined in claim **1**, wherein said means forming a supplementary opening in said casing includes; at least one port transversing a forward wall of said casing thereby communicating said closed chamber with said body of water.

6. In a water skimmer as defined in claim **2**, wherein said cover means includes; a flapper plate operably connected to said casing and extending into said closed chamber, being disposed contiguous with said casing wall, to form a closure across said supplementary opening.

7. In a water skimmer as defined in claim **2**, including; resilient sealing means disposed intermediate said cover means and said supplementary opening, to form a liquid seal therebetween when said cover means is urged into a closed position across said supplementary opening.

8. In a water skimmer as defined in claim **1**, wherein said means forming a supplementary opening in said casing includes; a plurality of ports formed in the forward wall of said casing whereby to communicate said closed chamber with said body of water.

9. In a water skimmer as defined in claim **3**, wherein said actuator means includes; a buoyant member pivotally carried on said casing and extending outwardly therefrom in the path of liquid entering said main opening.

10. In a water skimmer as defined in claim **9**, wherein said actuator means includes; a curved upper surface extending outwardly from said main opening whereby to contact a stream of liquid entering said main opening.

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