United States Patent

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[54] POLLUTION SUCTION WATER SWEEPER

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[52] **U.S. Cl.** **210/242,** 37/58

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

[58] **Field of Search** 37/57, 58; 210/83, 242, 523, 210/DIG. 21

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Assistant Examiner—T. A. Granger
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[57] **ABSTRACT**

A floating power operated vessel designed to collect by suction from the surface of a body of water, as it moves thereover, floating pollutant matter. Adjacent the prow of the vessel is a suction pump compartment and inlet pipes below the water level connected to a suction pump in the compartment. Adjacent the stern of the vessel is a clean water collecting compartment having a discharge pipe adjacent the top thereof and above the water level for discharging the same downwardly onto the surface of the body of water. Between the forward pump compartment and the rear clear water collecting compartment there is provided a series of transversely disposed and longitudinally spaced partitions forming communicating chambers designed to separate by degrees the mass of pollutant matter from the water.

At least one suction swing pipe is pivotally jointed at the prow of the vessel. Formed in the prow is a recess in which the swing pipe is received when raised to its inoperative position. A winch and derrick on the top deck of the vessel is cable connected to the upper free end of the swing pipe. A scoop structure which may be one of a variety of forms and sizes is attached to the upper free end of the swing pipe. The scoop structures are each provided with a forwardly extending blade arranged to lie flat substantially at the surface level of the body of water. Optionally the free end of the swing pipe may be provided with a dredging nozzle and the swing pipe lowered such that the vessel may be converted into a hydraulic suction dredge.

1 Claim, 15 Drawing Figures

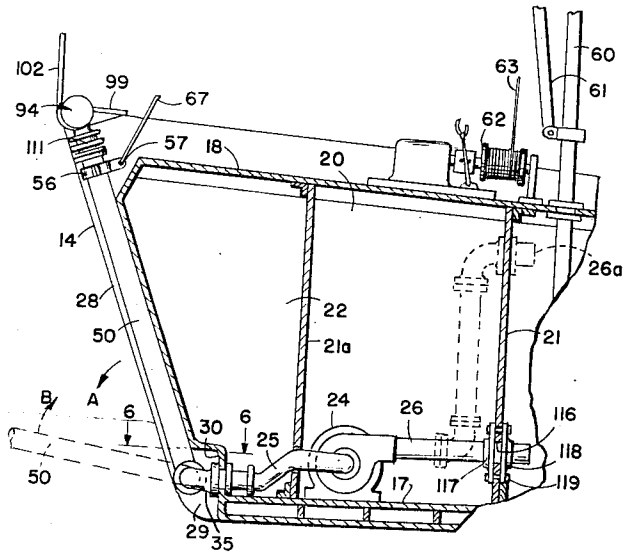


FIG. 1

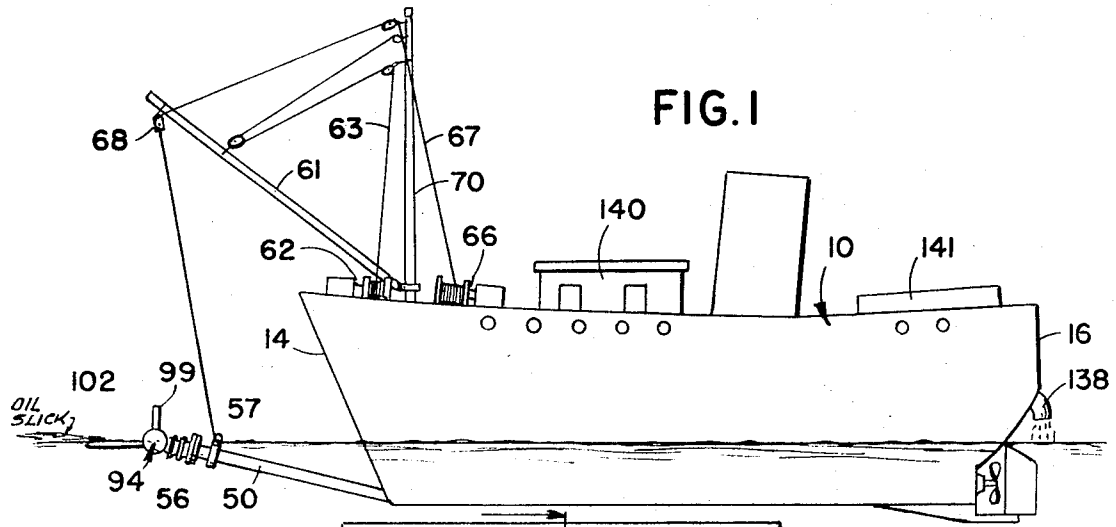
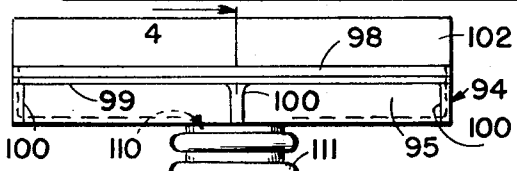


FIG. 3



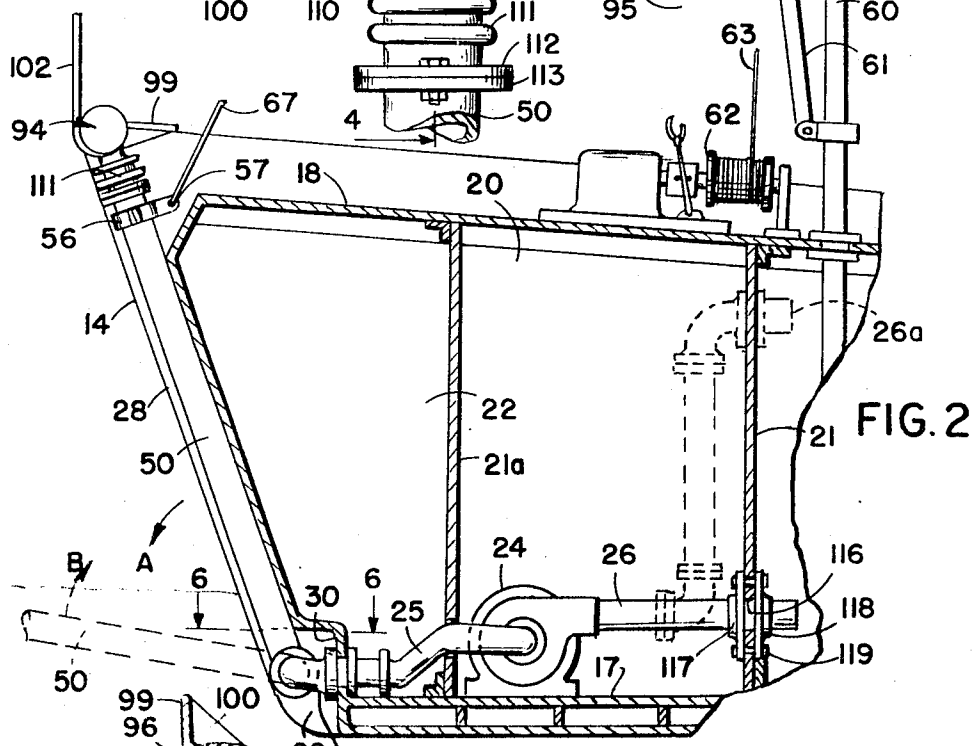
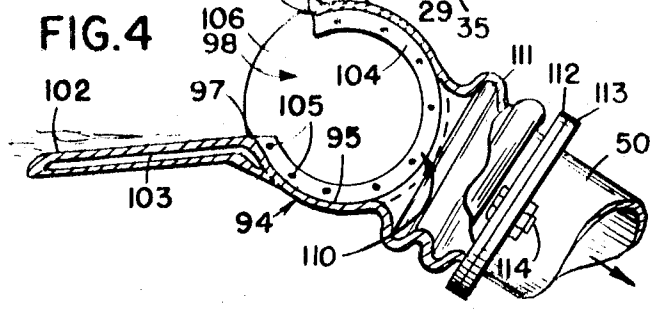


FIG. 2

FIG. 4



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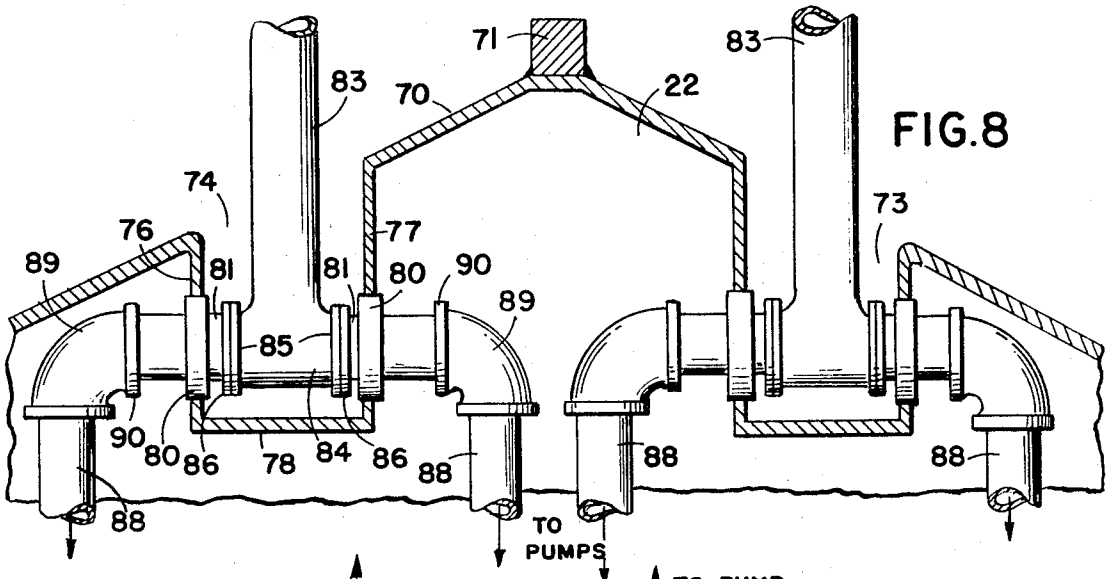


FIG.8

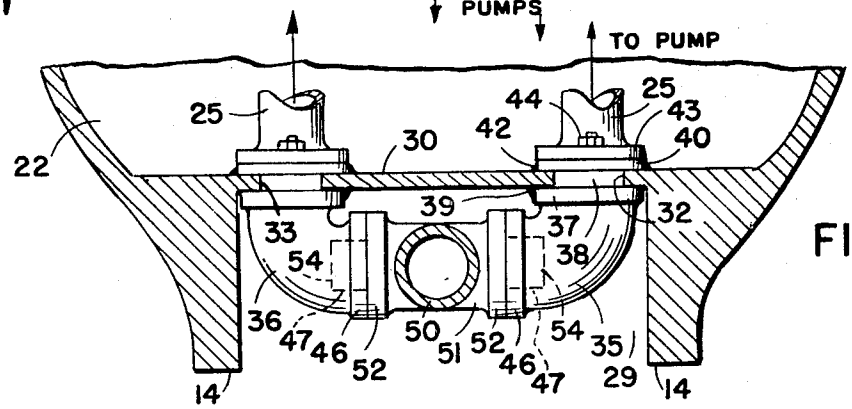


FIG.6

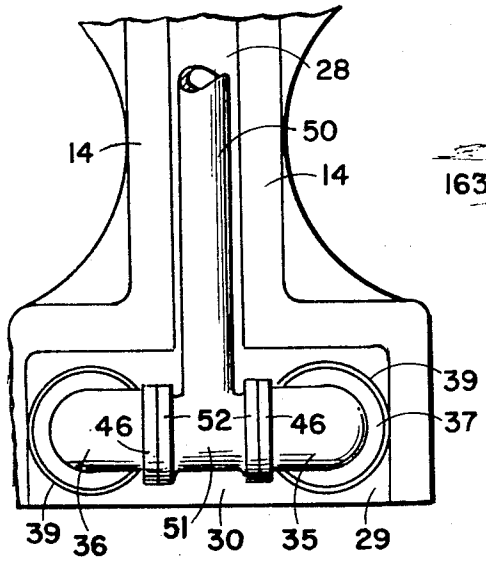


FIG.7

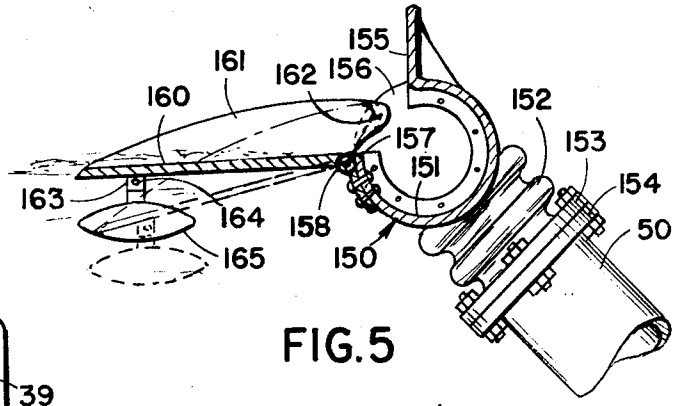


FIG.5

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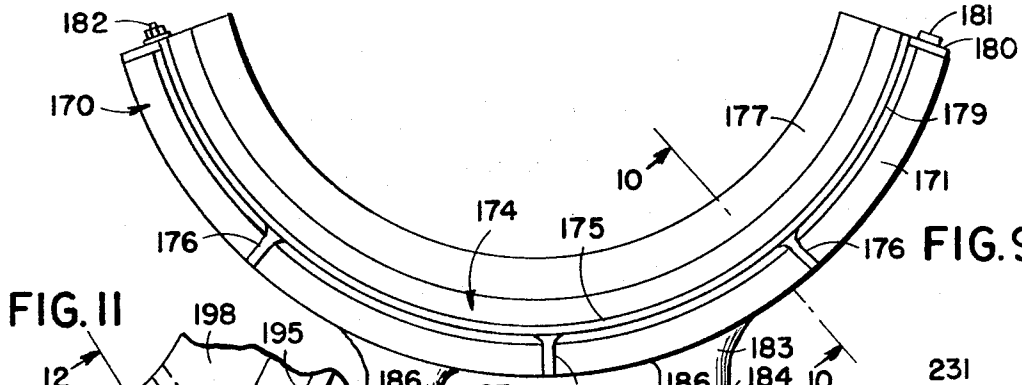
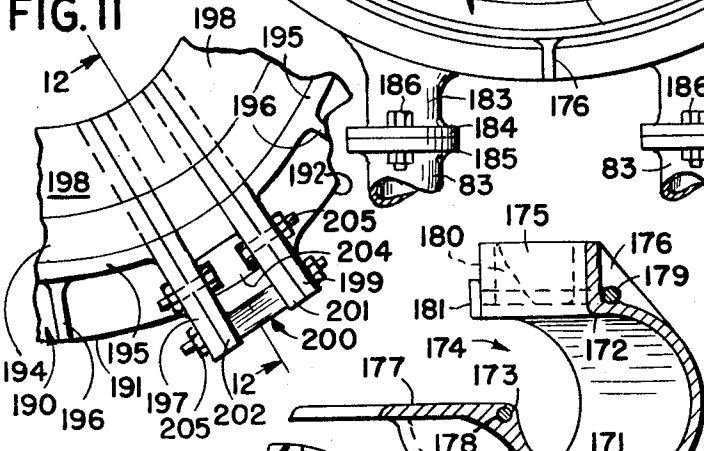


FIG. 9

FIG. 11



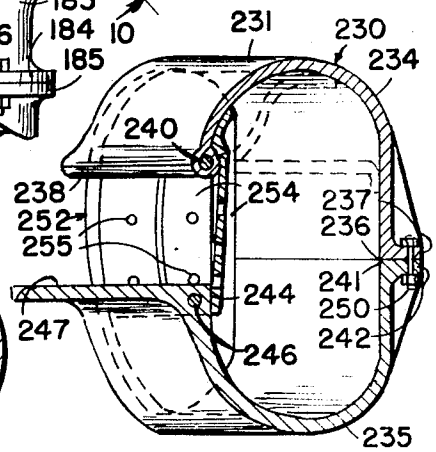


FIG. 15

FIG. 12

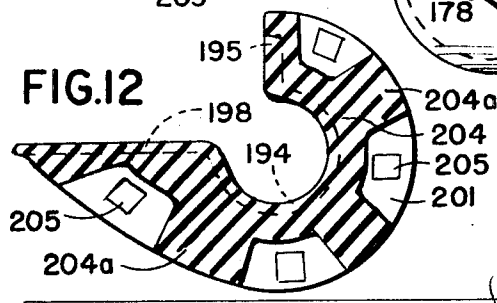


FIG. 10

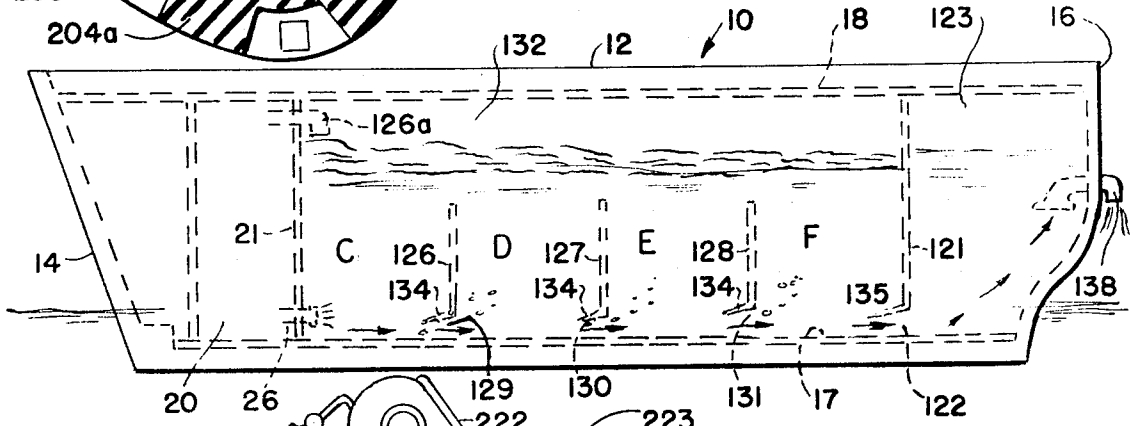


FIG. 13

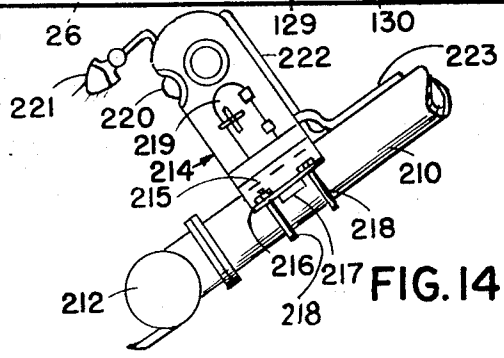


FIG. 14

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POLLUTION SUCTION WATER SWEEPER

This invention relates to an improvement over patent granted to me on invention Suction Dredging Apparatus, patented May 19, 1970, U.S. Pat. No. 3,512,280.

This invention relates to a vessel equipped with a hydraulic suction pollutant collecting matter structure or suction water sweeper which is also adapted to operate as a hydraulic suction dredge.

Bodies of water such as harbors, lakes, rivers and even the oceans are today presenting the problem of increasing pollution arising from oil slicks, debris and other collected matter floating on the surface thereof which renders such fouled bodies of water a menace to mankind and the environmental ecology as well as to navigation and the use of such bodies of water for recreation and commerce. Also, the floating pollutant matter is frequently washed ashore or lies at the shore line spoiling beaches, damaging and/or killing wild life and generally creating a health menace as well as preventing the use by the public of such areas.

Accordingly, the primary object of this invention is to provide a floating vessel with a suction water sweeping apparatus including a swinging boom which is a suction swing pipe having a swivel joint connection to an inlet pipe of a suction pump, both the suction pump and the swivel joint connection being at the bottom deck level of the vessel below the water line; the upper free end of the swing pipe carrying a scoop structure having a direct connection to the swing pipe with the scoop structure disposed at the water level to gather thereinto floating pollutant matter and water which under suction is moved therefrom down through the swing pipe and into the hull of the vessel.

A further object of this invention is to form the scoop structure embodying the blade and channel body portion either rectilinear or arcuate, of rigid or flexible material, in one unitary piece or in connected sections with the connecting collar disposed centrally of the channel body portion.

A still further object of this invention is to form the scoop blade and the channel body portion of the scoop structure as an integral unit.

Yet another object of this invention is to pivotally mount the scoop blade at the forward edge of the channel body portion of the scoop structure and to provide float supports for the scoop blade adjacent in the forward free edge.

Another object of this invention relates to forming the scoop structure of separate sections connected together by flexible expansion joints.

Still another object of this invention is to form at the prow of the vessel a forwardly opening recess for receiving the swing pipe when raised to its inoperative position.

A still further object of this invention is to provide a derrick and winch apparatus on the upper deck of the vessel, cable connected to the swing pipe to raise or lower the same.

Yet another object of this invention is to provide within the hull of the vessel a forward compartment adjacent the prow of the vessel for the suction pump equipment having a rear watertight bulkhead, the swing pipe with its swivel connection to the inlet pipe being at the bottom of the prow recess.

A further object of this invention is to utilize a dual swing pipe arrangement swivel connected to a pair of inlet pipes, each of the latter connected to a separate suction pump and the free end of each swing pipe each connected by a collar to the channel portion of the scoop structure.

Another object of this invention is to provide within the hull of the vessel a series of interconnected pollutant matter separating chambers defined by partition units raised from the bottom deck and each having a forwardly directed and inclined baffle member, the the water with some of the pollutant matter flowing rearwardly successively from one chamber to the other and the separated pollutant matter floating on top of the water above the upper edges of the partitions, the rearmost chamber having a rear bulkhead opening along its lower edge end into a rear clear and/or clean water collecting compartment adjacent the stern of the vessel, the separated pollutant matter accumulating on the surface of the water between

the rear bulkhead of the suction pump compartment and the rear bulkhead of the rearmost chamber.

A further object of this invention is to provide at the top of the stern of the vessel a discharge pipe serving to discharge from the top of the clear water collecting compartment, the clear water back onto the surface of the body of water on which the vessel floats.

A still further object of this invention is to adapt the swing pipe for dredging purposes along the bottom of the body of water, the swing pipe carrying a dredging head or nozzle and having mounted thereon adjacent the dredging hear or nozzle, a water sealed cabin for an operator therein to control by suitable electric controls and communication the movement of the swing pipe and/or the vessel, the cabin being further equipped with the necessary oxygen supply lines and other acoutrements for the supply of the operator.

Further objects of the invention will appear as the description proceeds.

To the accomplishment of the above and related objects, my invention may be embodied in the form illustrated in the accompanying drawings, attention being called to the fact, however, that the drawings are illustrative only, and that changes may be made in the specific construction illustrated and described within the scope of the appended claims.

In the drawings:

FIG. 1 is a side elevational view of a vessel equipped with one form of suction water sweeper.

FIG. 2 is a partial longitudinal cross-sectional view of the forward part of the vessel showing the swing pipe of the suction water sweeper in its inoperative raised position and some of its associated operating mechanism.

FIG. 3 is a plain view of the scoop or head of the suction water sweeper.

FIG. 4 is a cross-sectional view of the scoop taken on line 3—3, FIG. 3, showing details of construction.

FIG. 5 is a cross-sectional view similar to that of FIG. 4 of a modified form of scoop.

FIG. 6 is a detail cross-sectional view taken on line 6—6, FIG. 2, showing the forward recess in the prow of the vessel and the swivel mounting of the single swing pipe to the suction inlet pipe.

FIG. 7 is a lower elevational view of the prow of the vessel showing the forward recess in the prow and the placement of the swing pipe therein.

FIG. 8 is a fragmentary plain view partly in section of a dual suction swing pipe arrangement, the swivel mounting of each to a separate inlet pipe and the dual recesses in the prow of the vessel each receiving a swing pipe therein.

FIG. 9 is a plain view of a suction scoop or head of arcuate shape utilized with the dual suction swing pipe arrangement of FIG. 8.

FIG. 10 is a cross-sectional view taken on line 10—10, FIG. 9 of the arcuate scoop.

FIG. 11 is a detail fragmentary plain view of an arcuate scoop formed in sections showing a flexible expansion joint connecting adjacent sections.

FIG. 12 is a cross-sectional view taken on line 12—12, FIG. 11.

FIG. 13 is an elevational view of the vessel showing in slotted lines the baffle forming chambers and compartment arrangement for separating the collected pollutant matter from the water and the discharge of clear water.

FIG. 14 shows the swing pipe of FIG. 1 provided with a dredging head, and an operator cabin mounted on the swing pipe adjacent the dredging head.

FIG. 15 is a cross-sectional view similar to that of FIG. 10 of a modified form of arcuate scoop.

Referring to the drawings in detail, 10 denotes a dredging vessel of any desired type and size having a hull 12, a prow 14 and a stern 16. Included in the hull 12 is a bottom deck 17 and a top deck 18. Arranged at the forward end of hull 12 is a compartment 20 having a rear bulkhead 21 that is water sealed with respect to the top and bottom decks and the side

walls of the vessel. If desired compartment **20** may be divided by a wall **21***a* to form a separate compartment **22**, that may serve to contain not only connecting sections of the inlet pipes **25**, but also sundry equipment, supplies, etc. Provided in compartment **20** are one or more suction pumps **24** having an intake pipe **25** and an outlet pipe **26**.

The prow **14** of the vessel is provided for its entire extent with a forwardly opening recess **28** for a purpose to be hereinafter described. The lower end of the recess being widened as at **29**, see FIGS. **6** and **7**. The rear wall **30** of the wide lower end **29** of recess **28** is vertical and is provided with a pair of laterally spaced openings **32, 33**, preferably equally spaced from the longitudinal medial vertical center plane of the vessel, see FIG. **6**. Pipe elbows **35, 36** which are identical in shape and size, having rear flanges **37** and integral nipples **38**, are positioned in lower prow recess **29**, the nipples **38** extending into openings **32, 33** with the flanges **37** abutting wall **30** and welded thereto as at **39** in water sealed relation. A collar **40** is securely fitted on each nipple **38** and is in turn welded in water sealed relation to the rear side of wall **30** as at **42**. Each inlet pipe **25** has an end flange **43** which is secured to collar **40** by bolts **44**. Suitable packing or gasket means (not shown) is provided between flange **43** and collar **42** to insure a water tight seal.

The pipe elbows **35, 36** are provided with outer flanges **46** arranged to lie in parallel opposed relation, the elbows and flanges **46** being interiorly machined to form co-axial cylindrical bearing surfaces **47**, see FIG. **6**. A suction swing pipe **50** of elongated length corresponding substantially to that of prow **14**, see FIG. **2**, is formed at its lower end with a T-formation **51** provided with terminal flanges **52** and integral trunnion sleeves **54**. The trunnion sleeves **54** extend into bearing bores **47** of elbows **35, 36** with the flanges **52** abutting the faces of elbow flanges **46**, such that the swing pipe **50** is swivel mounted on the intake pipe elbows **35, 36** for swinging movement about a transverse axis in the directions shown by arrows A, B, see FIG. **2**. As seen in FIGS. **2** and **6**, the swing pipe **50** and is lower swivel connections to the intake pipes **25** are wholly contained within the prow recesses **28, 29** when the swing pipe **50** is in its raised inoperative position; the swing pipe **50** moving downwardly out of the prow recess **28** when lowered to an operating position.

Adjacent the upper free end of the swing pipe **50** is a collar **56** securely clamped thereto and provided with an eye **57**. Mounted on the top deck **18** adjacent the prow **14** is a power operated derrick **60** having a pivoted forwardly directed pivoted boom **61** and a power operated winch **62** for raising or lowering the boom **61** by means of cable **63**. An additional power operated winch **66** through cable **67** which passes through pulley block **68** on the derrick boom **61** and secured to eye **57** of collar **56** operates to raise or lower the swing pipe **50**. It is to be noted that due to the normal rearward inclination of the prow **14** and recess **28**, that the swing pipe **50** in its raised inoperative position is similarly inclined, and that paying out of cable **67** will under gravity action affect a lowering of the swing pipe **50** (the swivel axis thereof lying will behind the connection of cable **67** to eye **57** of collar **56**).

The derrick and dual power operated winch for raising and lowering of the derrick's boom and for raising and lowering the swing pipe is similar to that shown in my copending allowed application for Dredging Apparatus, Ser. No. 675,102, filed Oct. 13, 1967, allowed Dec. 4, 1969, patented May 19,1970, M. S. Pat. No. 3,512,280, Group **337**, Class **037/057**.

The dual inlet pipe arrangement shown in FIG. **8** is similar to the dual inlet dredge pipe construction shown and described in my above referred to co-pending application. In this form of construction the prow of the vessel is widened and constitutes the forward wall **70** of the inlet pipe connection compartment **22** which is provided with a projecting medial bar or rib **71**. The forward wall **70** is formed to provide two laterally spaced suction swing pipe receiving recesses **73, 74** equally spaced from the longitudinal medial vertical center plane of the vessel each somewhat similar to the recess **28, 29** of FIG. **2**. The two swing pipe recesses are identical and each defined by opposed vertical side walls **76, 77** and a rear wall **78**, which walls constitute an integral part of the hull structure. Suitably mounted in each of the recess side walls at the lower ends thereof is a support bearing **80** each rotatively supporting one end of a swivel pipe **81**. A swing pipe **83** (similar to swing pipe **50**) has formed at its lower end a T-formation **84** and is secured by its end flanges **85** and bolts (not shown) to abutting flanges **86** at adjacent outer ends of swivel pipes **81**. Thus raising or lowering of the swing pipes **83** will cause turning of the swivel pipes **81** in their support bearings **80**. The support bearings **80** include a suitable packing structure (not shown) such as is well known in marine construction to prevent entry of water through the bearings into compartment **22**. Each suction swing pipe **83** delivers through swivel pipes **81** to a pair of inlet pipes **88**. Elbows **89** are secured to each inlet pipe, and each elbow at its free end is provided with a bearing flange **90** and bore dimensioned to receive in bearing relation the free end of an associated swivel pipe **81**, in the manner described above with reference to the bearing support of trunion sleeves **54** in elbows **35, 36**, see FIG. **6**. The bearing elbows **89** and inlet pipes **88** are fixedly mounted in any desired manner (not shown) to the bottom deck **17** of the hull. The bearing flanges **90** include a suitable packing construction (not shown) to provide a water tight seal. Both swing pipes **83** are connected at their free ends by a suction scoop structure (to be hereinafter described) and move in unison as a single boom structure. A yoke arrangement (not shown) such as described in my aforesaid copending application is provided to which the cable **67** of winch **66** is secured for raising or lowering the dual swing pipes, **83**.

FIGS. **3** and **4** illustrate one form of suction scoop **94** for use with the single suction wing pipe **50**, the suction scoop **94** may either be formed rigid of a non corrosive metal or it may be formed of a flexible non-metallic material such as plastic impregnated bonded fabric layers, synthetic reinforced rubber, etc., impervious to the effects of salt water and able to withstand heavy usage. In the form shown in FIGS. **3** and **4** the suction scoop **94** is seen to consist of an elongated rear channel portion **95** arcuate in transverse cross-section with an upper free edge **96** and a lower forwardly positioned edge **97**, both edges being parallel and spaced apart a sufficient distance to provide a large elongated forwardly facing opening **98**, permitting the ready entry into the channel portion **95** of a variety of pollutant matter. The upper edge **96** preferably lies rearwardly of the lower edge **97**, and extending upwardly from the upper edge **96** is an integral deflector plate **99** strengthened against rearward movement by transversely spaced integral brace members **100**. Extending forwardly of lower edge **97** of channel portion **95** and integral therewith is a flat scoop blade **102** of any desired width. In the form of scoop structure **94** illustrated the same is shown to be made of a flexible self sustaining material. In order to insure an added degree of rigidity for the blade **102**, the same may be reinforced by metal rods **103** embedded therein which rods may also be somewhat resilient. Each open end of the channel portion is provided with an inwardly directed radial flange **104** to which is secured by rivets **105**, and end closure plate **106**. Centrally of the channel portion **95** and opposite the front opening **98** there is provided a rear circular opening **110**. Extending rearwardly from the end of opening **110** at a downwardly inclined axis and forming a recessed part, integral with or otherwise, os a corrugated neck **111** of short length provided at its rear edge with a radial outer flange **112**. Swing pipe **50** is provided at its upper free edge with a corresponding flange **113**. Bolts **114** (only one being shown) secure flanges **112, 113** together, there being between the same suitable gasket means (not shown). Corrugated neck **111** serves to provide a shock absorbing connection between the suction scoop **94** and the swing pipe **50** as well as providing for angular movement relative to the swing pipe. Thus, in use, the suction scoop **94** is free to give under impact and/or overloads or pressure preventing breakage of the scoop connection and/or damage to the swing pipe **50**.

In the operation of the suction water sweeper, the swing pipe 50 is lowered to the point where scoop blade 102 lies at or slightly below the water level. The vessel 10 may be moving slowly forward. Pollutant matter floating on the surface of the water such as an oil slick, miscellaneous debris, garbage, dead fish, birds, etc., is moved rearwardly with water on the blade 102 through front opening 98 into the channel portion 94 by suction set up by the suction pumps in operation as well as by the forward movement of the vessel as the scoop blade moves into the pollutant matter beneath the same, see FIGS. 1 and 4. Any pollutant matter that striked the deflector plate 99 falls downwardly either into the channel portion or back onto the scoop blade 102. The mixture of pollutant matter and water in channel portion 94 is by suction drawn through rear opening 110 into the neck 111 and downwardly through swing pipe 50 for discharge from the suction pump outlet pipe 26. The terminal end portion of the outlet pipe 26 extends through an opening 116 in rear bulkhead 21 into a chamber to be hereinafter described. Flanged collars 117, 118 rigidly secured by bolts 119 the terminal end of outlet pipe 26 to the bulk head 21 in water sealed relation. Preferably the outlet pipe extends through the lower end of bulk head 21 though in some cases it may be desired to have the same 26*a* extend through the upper end of the bulk head 21 (as shown by the dotted lines, FIG. 2) for discharge of collected pollutant matter such as crude oil and water.

Except for the space required for the operating machinery of the vessel, fuel and storage within the hull 12 (not shown) and which space is sealed off in water tight relation from the remainder of the interior space in the hull, the latter is entirely open (see FIG. 13) spaced forwardly of the stern 16 of the vessel is a bulk head 121 having its lower edge spaced from the bottom deck 17 to form an opening 122, the sides and top edge of bulk head 121 being secured in water tight relation to the side walls and top deck 18 of the hull to form a clear and/or clean water collecting compartment 123.

Dividing the entire interior hull space into separating chambers between front bulk head 21 and rear bulk head 121 are upstanding transverse partition walls 126, 127 and 128 each substantially of the same height with their lower edges spaced from the bottom deck 17, to respectively provide openings 129, 130 and 131. The partition walls are each at least half the height of the bulk heads to provide an uninterrupted collecting space 132 for the pollutant matter which floats on the surface of the water therein. Each partition wall at its lower edge is provided with a forwardly downwardly inclined baffle deflector plate 134. A similar forwardly downwardly inclined baffle deflector plate 135 is provided at the lower edge of rear bulk head 121. The partition walls along with the front and rear bulk heads 21 and 121 provide a series of pollutant matter separating chambers C,D,E and F. Thus the discharge into the first chamber C from outlet pipe 26 of pollutant matter and water, there will be an initial separation between the pollutant matter and the water with the former rising to the top to collect on the surface of the water, the first baffle deflector 134 holding back in chamber C the larger debris and allowing only smaller debris to flow with the water through opening 129, in a like manner each of the succeeding chambers D,E and F will hold back and separate the pollutant matter from the water so that water flowing through opening 122 at the rear bulk head 121 will be substantially entirely free of all pollutant matter and collected in collecting compartment 123 as clear and/or clean water. An outlet water discharge pipe 138 on the stern of the vessel at the upper part of the compartment 123 of inverted U-shape will discharge the collected clear and/or clean water from the compartment 123 downwardly onto the surface of the body of water on which the vessel is operating.

Should the pollutant matter be an oil slick (generally formed by crude oil) it is desirable that the discharge end of suction pump outlet pipe 26 be located at the upper end of front bulk head 21 as at 26*a*, see FIG. 13, to discharge the oil and water into chamber C. There will be successive separation of the oil and water in chambers D, E and F with the oil accumulating on the surface of the water.

When the depth of the accumulated pollutant matter in space 132 reaches the upper edges of the partition walls 126, 127, 128 the suction operation is stopped and the vessel proceeds to a location for receiving the accumulated or collected pollutant matter. The amount of pollutant matter collected in the vessel is considerable and increases with the size of the vessel.

To further insure the collection of clear and/or clean water in compartment 123 it may be desirable to provide a screen (not shown) across the bottom opening 122 of rear bulk head 121.

The crew of the vessel may be housed in cabins 140, 141 located on the top deck 18.

A modified form of suction scoop structure is shown in FIG. 5. In this construction, the scoop 150 includes a rear channel portion 151, corrugated neck 152 with flange connections 153, 154, upstanding deflector plate 155, and circular end closure plates 156, all similar to that of the channel portion of scoop 94 of FIGS. 3 and 4, and formed of a like flexible material. At the forward edge 157 of the channel portion 151 there is provided a hinge connection 158 for a rigid metal scoop blade 160 to provide for up or down pivotal movement of the scoop blade with relation to the channel portion 151. This movement is desirable in view of variations in the positioning of the swing pipe 50, the degree and nature of the pollutant matter and the surface movements of the body of water. At each longitudinal side edge of the scoop blade 160 there is provided an upstanding side wall 161 that tapers towards the front edge of the scoop blade 160 with the rear portion 162 of the side walls extruded rearwardly beyond the front edge 157 of the channel portion in overlapping relation interiorly of the end closure plates. On the underside of the scoop blade 160 and adjacent to the forward edge thereof there is provided at least a pair of depending brackets 163 each disposed adjacent a side wall 161. Pivoted to each bracket 163 as at 164 is a float 165 of any suitable size and configuration such as to maintain the front of the scoop 160 at the water level due to variations in the position of swing pipe 50 when in its operative position, see FIG. 1. The pivotal action of the scoop blade 160 will also accomodate the same under shock and sudden loads of pollutant matter received thereon, thus avoiding stress and strain on the scoop blade if it were fixed to the channel portion as in FIGS. 3 and 4 and thus liable to break the same, as well as stress and strain on the scoop proper, corrugated neck, swing pipe and manipulating cable.

FIG. 9 illustrates an arcuate formation of suction scoop structure for use with the dual swing pipe construction of FIG. 8. As with the suction scoop structure 94, FIGS. 3 and 4, the suction scoop 170 of FIG. 9 may be made of a non-corrosive metal or of a like flexible non-metallic self sustaining construction, and of any desired arcuate shape, in plan, much as part circular or part elliptical. In the constructional form shown the suction scoop 170 is formed as an integral unit of a flexible self sustaining nonmetallic material shaped in transverse cross-section, see FIG. 10 to provide a rear channel portion 171 arcuate or part circular in shape with an upper free edge 172 and a lower forwardly positioned edge 173 to provide a large arcuate forwardly facing opening 174, permitting the ready entry into the channel portion 171 of a variety of pollutant matter. The upper edge 172 which is rearwardly of the lower edge 173 is provided with an upstanding integral deflector plate 175 strengthened against rearward movement by spaced integral brace members 176. Extending forwardly of lower edge 173 of chabnel portion 171 and integral therewith is a flat scoop blade 177 of any desired width. Provided at the juncture of scoop blade 177 with lower edge 173 and embedded therein is a flexible and/or resilient metal rod 178. A similar rod 179 is located rearwardly of the deflector plate 175 at the corner thereof formed with the outer wall surface of the channel portion 171, the rod 179 passing through end brace members 180 and the intermediate brace members 176, the rod 179 having at one end a head 181, and is threaded at its opposite end to receive a nut 182. The rod 179 is formed of a non-corrosive metal and along with the em-

bedded reinforcing rod **178** serves to maintain the arcuate configuration of the suction scoop **170**. If desired (and not shown) there may be embedded in the wall of the channel portion **171** transverse reinforcing rods. Also the open ends of the channel portion **171** may be provided with end closure plates similar to closure plates **106**, see FIG. **4**.

Provided centrally of the channel portion **171** of the suction scoop **170** and extending rearwardly therefrom are a pair of like parallel necks **183** formed integral with the channel portion **171**, the necks **183** opening into the channel portion in the same manner as the neck **111**, FIG. **3**, opens into the channel portion **95**. Each neck **183** is provided at its rear end with a flange **184** to be secured to a corresponding flange **185** provided at the free end of each swing pipe **83** by bolts **186** (only one of which is shown). Suitable gasket means (not shown) are placed between the flanges to provide a water tight connection. The suction scoop **170** and its neck connections **183** is symmetrical with relation to a median plane between the two swing pipes **83**.

The arcuate design of suction scoop **170** will provide for entrapment of the pollutant matter between the terminal ends of the scoop so as to be more readily drawn by suction over the scoop blade **177** and into the channel portion **171** to pass into necks **183** and swing pipes **83**. The arcuate suction scoop is more effective in large scale pollutant matter removal projects.

Due to the large size of the arcuate suction scoop it may be desirable, whether made of a non-corrosive metal or flexible material, the fabricating of the same in separate sections to be connected together. On such construction is shown in FIG. **11** and **12**, wherein the suction scoop **190** shown fragmentized consists of an arcuate center section **191** and two like flanking arcuate end sections **192** (only one of which is shown), the center section **191** and end sections **192** forming an arcuate scoop similar to that shown in FIG. **9**, with the main component parts of each section, i.e., scoop blade **193**, channel portion **194**, deflector plate **195** and bracing members **196** similar respectively to scoop blade **177**, channel **171**, deflector plate **175** and bracing members **176** of the arcuate scoop **170**.

Center section **191** is formed at each end with an integral transverse flange **197** that extrudes outwardly from the outer wall surface of the channel portion **191** beyond the top edge of deflector plate **195** and beneath the scoop blade **198**. The inner end of each end section **192** is formed with a similar corresponding integral transverse flange **199**. To connect the arcuate end sections **192** to the center arcuate section **191** there is utilized a flexible expansion joint **200** formed of spaced metal flanges **201**, **202** to which is bonded or otherwise secured a heavy duty flexible connector **204** of a thickness substantially greater than the thickness of the wall of the channel portion **194**, with radial arm portions **204a** see FIG. **12**. The flanges **201**, **202** of the expansion joint **200** are secured to the flanges **199** and **197**, respectively, by bolts **205**. The forwardly presented surface of the flexible connector **204** is shaped to be flush with the upper surface of the scoop blades of the sections, the inside surface of the channel portion of the sections and the forward surface of the deflector blades of the sections as seen in FIG. **12**. The flexible expansion joints **200** connecting the arcuate end sections to the center arcuate section will serve as shock absorbers and will permit deflecting movement of the end sections **192** incident to shocks of impact, etc., arising when the suction scoop **190** is in operation in masses of pollutant matter, or when striking large or immovable objects.

In order to maintain the dual swing pipes **83** in the same plane and in parallel relation they may be interconnected adjacent their end flanges **185** by suitable cross-bars or braces (not shown). Also yieldable struts and/or guy wires (not shown) may be utilized, connected to selected parts of the arcuate suction scoop **174**, **190** and to parts secured on the swing pipes **83** or to the cross-bars or braces connecting the same and so as to give additional support for the scoop as well as to relieve the flange connection of the necks **183** to the swing pipes **83** of excessive stress or strain that may either damage the same or the swing pipes.

As stated hereinabove the vessel with its swing pipes single or dual may serve as an hydraulic dredge by replacing the suction scoops with a dredging head of any desired type and lowering the swing pipes to bring the dredging heads into operative position. FIG. **14** shows one such arrangement wherein a single swing pipe **210** is provided with a suction dredging head **212**. The swing pipe **210** has mounted thereon an operator's cabin **214** that may be detachably secured thereto. The cabin **214** has an arcuate base **215** shaped to seat on the cylindrical surface of the swing pipe with the flanges **216** thereof engaging an abutment ledge **217** so as to maintain the cabin perpendicular to the longitudinal axis of the swing pipe, and U-Bolts **218** extending through flanges **216** serve to secure the cabin **214** to the swing pipe. The cabin **214** is provided with an entry door **219** viewing windows **220**, exterior search light **221**, and is securely water-tight. The cabin **214** is supplied with oxygen and electric current as at **222**, **223** and is in telephone communication with the operators on deck and/or offices on the vessel's bridge. The cabin **214** includes controls for operating the swing pipe and the dredge head so that the operator in the cabin may both view and control the dredging operation.

The single swing pipe **210** may be made up of telescopic sections (not shown) that are power operated in any suitable manner (not shown) so that the swing pipe may be either extruded or retracted by the operator in the cabin. The operator's cabin **214** may also be utilized in the same manner with a dual swing pipe arrangement.

FIG. **15** shows modified form of arcuate scoop construction wherein the same is formed of a flexible self-sustaining material and may be made in one piece or in sections as desired. The scoop structure **230** is seen to consist of a rear channel body portion **231** formed of an upper section **234** and a lower section **235**. The upper section **234** has a lower rear edge **236** formed with a rearwardly or outwardly directed flange **237** and an upper beaded forward edge **238** provided with an embedded reinforcement rod or cable **240**. The lower section **235** has an upper rear edge **241** formed with a corresponding flange **242** and a lower forward edge **244** having an embedded reinforcing rod or cable **246** and a forwardly extending integral scoop blade **247**. The upper and lower sections **234**, **235** are securely connected together by bolts **250** extruding through the clanges **237**, **242**.

The upper forward edge **238** and the lower forward edge **244** are vertically spaced apart to provide the opening **252** into the channel body portion. Bridging the opening **252** for its entire arcuate extent is a row of separate flexible depending flap members **254** that are positioned closely adjacent each other. The upper ends of the flap members **254** are secured in any desired manner to be inside of the upper section **234** adjacent its forward edge **238**. The flap members **254** extend below the top surface of the scoop blade **247** and normally contact the inside surface of the lower section **235** adjacent its forward edge **244**. Each flap member **254** is formed with a plurality of perforations **255** in the zone of the opening **252**,

The flap members **254** function to permit the entry of debris that will pass through opening **252** when suctioning into the scoop structure liquid pollutant matter such as from an oil slick. At the same time the flap members will serve to trap within the channel such debris to be drawn into the swing pipes along with water and the pollutant matter. The flap members will prevent clogging of the opening **252** and at the same time will enhance the suction effect in drawing the collected pollutant matter water and debris in the channel body into the swing pipes.

While certain novel features of my invention have been shown and described and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes in the forms and details of the device illustrated and in its operation can be made by those skilled in the art without departing from the spirit of the invention.

I claim:

1. A combined vessel and suction apparatus comprising:

a. a floating vessel having a bottom deck, a top deck, prow and stern,

b. a suction pump means within a first compartment adjacent the prow of the vessel,

c. inlet pipe means connected to the suction pump means and extending forwardly through the prow of the vessel,

d. a swing pipe means swivelly connected at its lower end to the inlet pipe means and of a length at least substantially equal to the height of the prow of the vessel,

e. a suction scoop means mounted on the free forward end of the swing pipe means,

f. cable operated means on the vessel top deck connected to the forward end of the swing pipe means for manipulating the same from a raised upstanding inoperative position to a lowered forwardly extending operative position,

whereby,

said swing pipe means may be lowered to a position where the suction scoop means thereon is brought to the surface of the body of water such as to move under suction pollutant matter floating on said water surface along with a quantity of water through said scoop means into said inlet pipe means for discharge from said suction pump means into the interior of the vessel,

including:

g. a forwardly opening recess in the prow of the vessel extending for the full height thereof,

g. said recess at its lower end, both transversaly and longitudinally, being widened to accommodate the swivel connection of the swing pipe means to the inlet pipe means,

i. said recess above its lower widened portion receiving therein said swing pipe means when raised to its inoperative position,

j. said recess being of a depth such that said swing pipe means along with its swivel connection will lie entirely rearwardly of the forward edge surface of the prow of the vessel,

wherein said suction scoop means comprises:

k. a rear elongated channel body portion having a forwardly directed opening defined by parallel upper and lower edges,

l. an upstanding deflector plate at the upper edge of the channel body portion,

m. a scoop blade substantially normal to the deflector plate at the lower edge of the channel body portion and extending forwardly thereof,

n. the lower part of said channel body portion lying below said scoop blade,

o. said channel body portion, deflector plate and scoop blade extending transversely of said swing pipe means,

p. a tubular neck structure centrally of said channel body portion extruding rearwardly therefrom,

q. means detachably connecting said tubular neck structure to the free forward end of said swing pipe means,

whereby,

the combined pollutant matter and water is drawn by suction over the scoop blade into the channel body portion an through the tubular neck into said swing pipe means,

r. said tubular neck structure at its forward end being joined to the rear wall of the channel body portion and forming therewith an opening thereat of a size such as to extend above and below the plane of said scoop blade,

s. the axis of said tubular neck structure being downwardly inclined with relation to said scoop blade when the latter is in its operative position on the surface of the body of water,

wherein said means for detachably connecting the tubular neck structure comprises:

t. a radial flange at the rear end of said tubular neck structure,

u. a corresponding radial flange at the free forward end of the swing pipe means,

v. fastener means for detachably securing said flanges together,

wherein:

w. said scoop structure is rectilinear from end to end thereof,

x. a closure plate secured to each end of the channel body portion,

y. a plurality of brace members extending rearwardly of said deflector plate and connected thereto and to said channel body portion.

z. hinge means secured to the channel body portion at the lower edge thereof,

aa. said scoop blade at its rear edge being connected to said hinge means such as have swinging up or down movement relative to said channel body portion,

bb. a side wall at each side edge of said scoop blade extending upwardly from the upper surface thereof,

cc. a rear portion of each said side wall extending rearwardly beyond the rear edge of the scoop blade in overlapping sliding relation to the inside surface of an adjacent end closure plate,

dd. float means beneath the forward edge portion of the scoop blade, and

ee. means pivotally connecting the float means to the scoop blade,

whereby,

in the operative lowered position of the swing pipe means and the scoop structure, the float means will maintain the moveable scoop blade substantially level with the surface of body of water irrespective of variations in the operative lowered position of the swing pipe means or to variations arising from movement of the vessel.

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