United States Patent [19]

Gee

[11] **3,905,137**

[45] **Sept. 16, 1975**

[54] **UNDERWATER TRACTOR AND IMPLEMENT THEREFOR**

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[73] Assignee: **Caterpillar Tractor Company**, Peoria, Ill.

[22] Filed: **Feb. 21, 1974**

[21] Appl. No.: **444,317**

[52] **U.S. Cl.** ..... **37/56;** 37/66; 37/71; 61/69 R; 180/1 H

[51] **Int. Cl.²** **E02F 3/88**

[58] **Field of Search** ..... 37/56, 71, 66, 54; 180/1 H; 61/69 R, 69 A; 115/1 R

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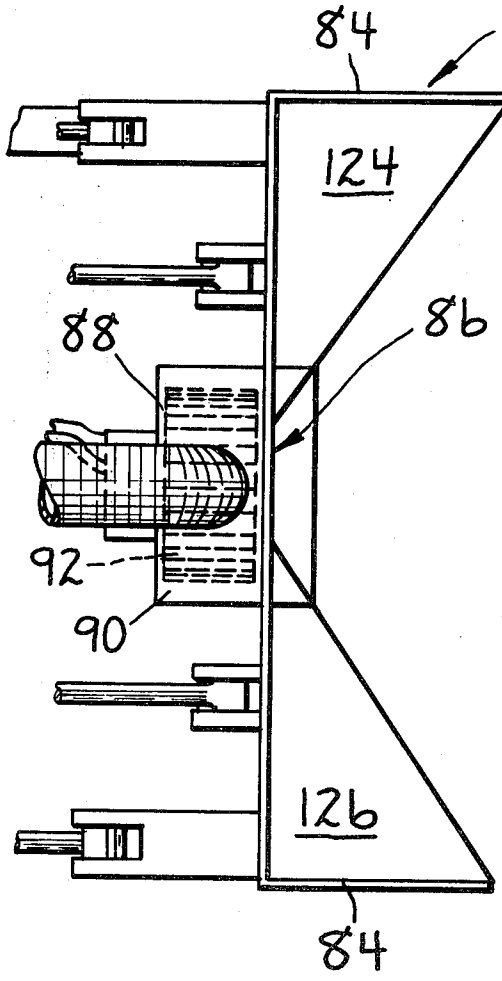
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Primary Examiner—Clifford D. Crowder
Attorney, Agent, or Firm—Phillips, Moore, Weissenberger Lempio & Strabala

[57] **ABSTRACT**

A tractor includes an internal combustion engine and is adapted for underwater operation, with inlet and outlet means extending to above the surface of the water for supplying air to the engine and exhausting combustion gas therefrom. A dredging implement in the form of a blade and auger, directs material from the floor to adjacent one end of a conduit means as the vehicle is transported over the floor. An impeller associated with the conduit means transports the material therethrough and from the other end of the conduit means, which is positioned above the surface of the water. The dredging implement may alternatively take the form of a pair of wing members, each angled upwardly and inwardly in the rearward direction to direct material to adjacent the one end of the conduit means. Means remote from the vehicle, and positionable on shore, are included for operating the submerged tractor.

4 Claims, 3 Drawing Figures



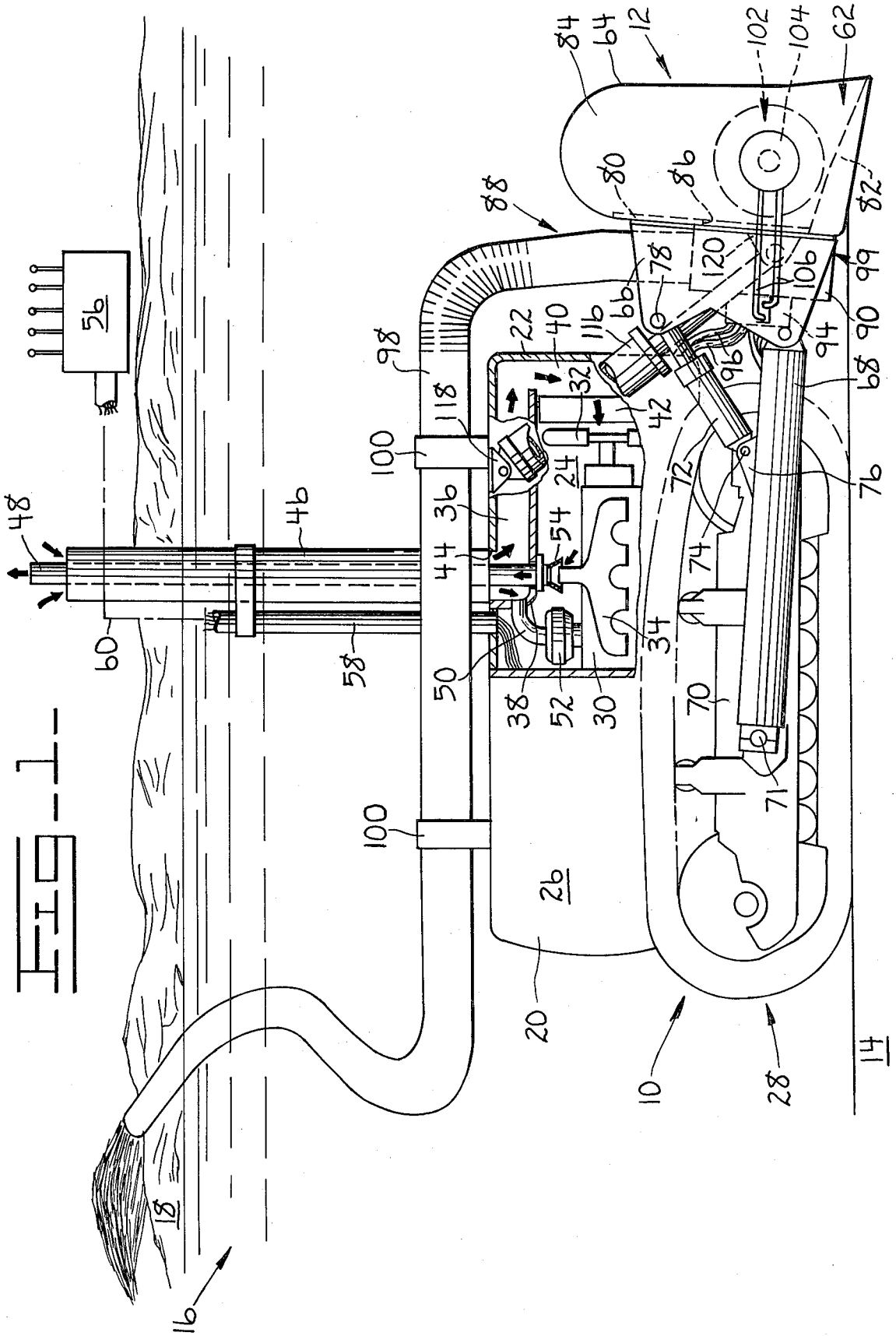
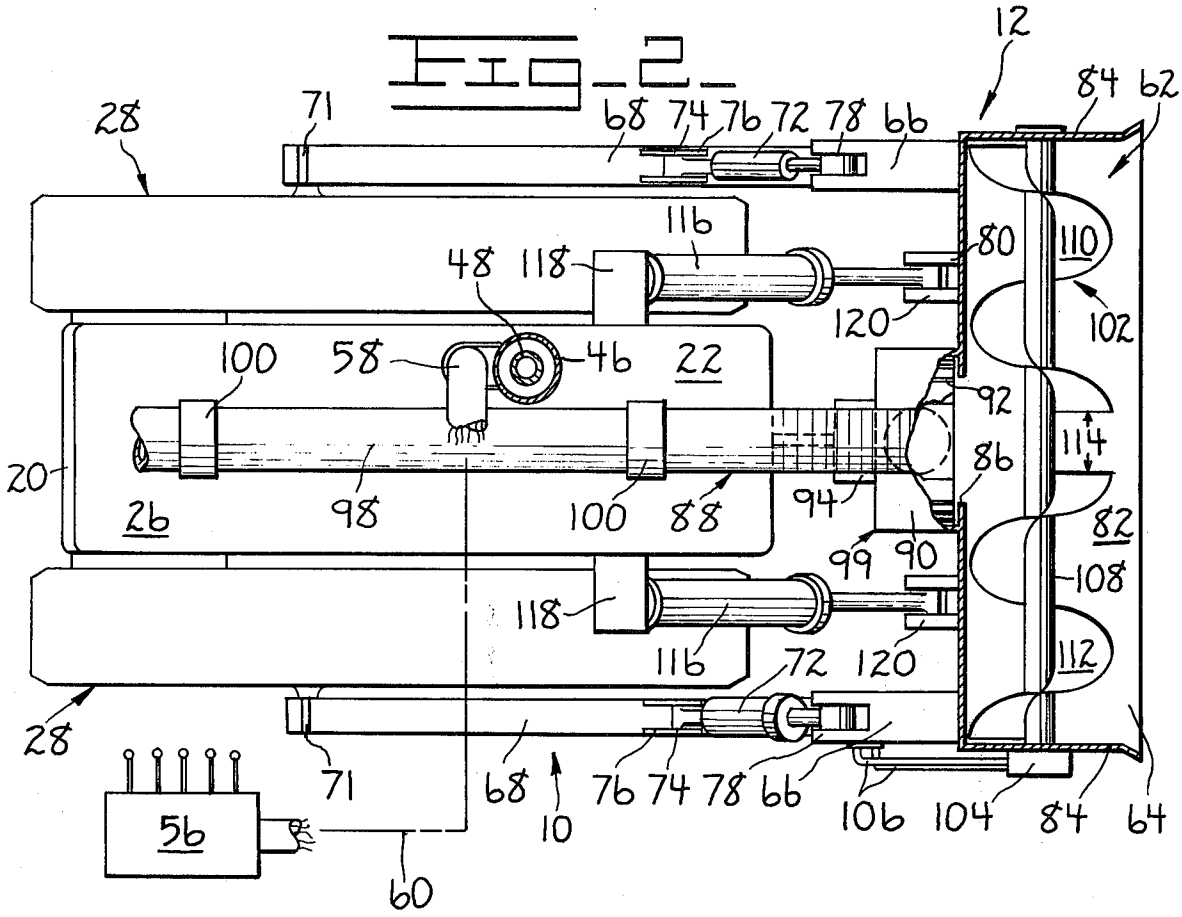

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FIG. 1

Fig_2_


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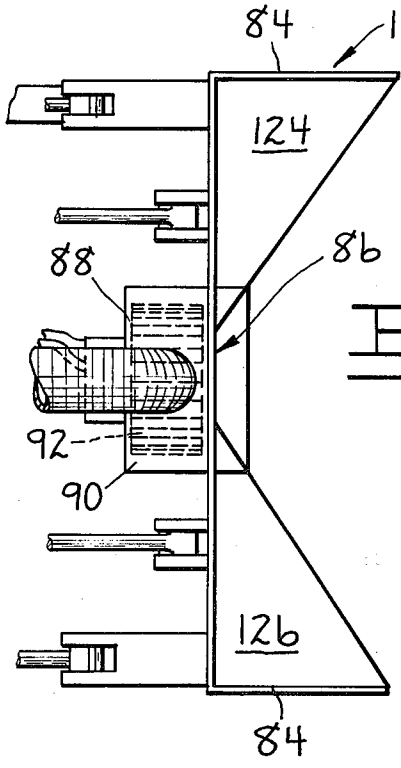

84
122
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92
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126
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Fig_3_

UNDERWATER TRACTOR AND IMPLEMENT THEREFOR

BACKGROUND OF THE INVENTION

This invention relates to underwater vehicle apparatus, and more particularly, to an underwater tractor which includes a dredging implement, and which may be operated from a remote position on land.

Considerable experimentation has been conducted in developing a submersible vehicle for underwater dredging or said reclamation for rebuilding beaches. Most of such experimental equipment is not readily adaptable to cutting a flat-bottomed, relatively wide channel in the bottom of a body of water, such as for cleaning the bottom of canals and the like. Although some tractors capable of operating at limited depths underwater have been developed and equipped with a bulldozer blade or the like (see, for example, U.S. Pat. No. **3,633,530** to Matsudo et al., U.S. Pat. No. **3,680,521** to Muraki et al., and U.S. Pat. No. **3,722,444** to Muraki et al.), it will be seen that the vehicle is not equipped to pick up material from the floor of the body of water and remove it from the body of water for cleaning purposes.

U.S. Pat. No. **3,683,521** to Sloan et al. discloses a submersible dredge of the general type which is the subject of this application. However, the submersible dredge of that reference is designed to be operated by an operator within the submerged vehicle, and not remotely from the shore. In addition, there appear to be no positive means for directing material from the floor to adjacent the area wherein it enters the conduit.

U.S. Pat. No. **3,310,892** to Spannhake et al. discloses a submersible dredge, and inlet and exhaust pipe means which extend to above the surface of the water. However, in such apparatus, the material outlet tubes thereof extend laterally of the vehicle, and are not designed to extend above the surface of the water to remove such material from the body of water.

U.S. Pat. No. **3,521,387** to Degelman, while disclosing a dredging machine, is only of general interest because the vehicle thereof is not submersible, but is designed to operate while floating on the surface of the water.

Another major problem associated with an underwater vehicle of the type disclosed herein is the provision of a sealed engine compartment with the capability of supplying air for consumption by the engine and for cooling thereof, and to allow egress of the exhaust gasses expelled by the engine. See, for example, U.S. Pat. No. **2,390,557** to Scaife, and the above-mentioned U.S. Pat. No. **3,310,892** to Spannhake et al. While such systems are designed to supply such air and allow exit of exhaust gases therefrom, it is to be understood that any increase in efficiency and degree of simplicity is highly desirable. (see also the above-cited U.S. Pat. No. **3,680,521** to Muraki et al., and U.S. Pat. No. **3,722,444** to Muraki et al.).

Of more general interest in this area are U.S. Pat. No. **3,504,943** to Steele et al., and U.S. Pat. No. **3,695,716** to Meyer.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide apparatus for working the floor of a body of water, such apparatus including a submersible vehicle, implement means which work the material, and conduit means

through which the material is transported to above the surface of the water.

It is a further object of this invention to provide apparatus which, while fulfilling the above object, may be operated remotely from the shore adjacent the body of water.

It is a still further object of this invention to provide apparatus which, while fulfilling the above objects, includes means for properly supplying air to an internal combustion engine thereof, and properly allowing exit of exhaust gases therefrom.

It is a still further object of this invention to provide apparatus which, while fulfilling the above objects, is relatively simple in design and convenient in use.

Broadly stated, the invention comprises apparatus for working the floor of a body of water, such apparatus comprising a submersible vehicle positionable on the floor, and means for transporting the vehicle over the floor. Further included are conduit means having one end disposed adjacent the vehicle and the other end positionable above the surface of the water. Means are associated with the vehicle for directing the material from the floor to adjacent the one end of the conduit means. Means are included for transporting the material entering the one end of the conduit means through the conduit means and from the other end thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects of the invention will become apparent from a study of the following specification and drawings, in which:

FIG. **1** is a side elevational view, partially in section, of the apparatus incorporating a first embodiment of implement means;

FIG. **2** is a plan view, partially in section, of the apparatus of FIG. **1**, and

FIG. **3** is a plan view of an alternative implement means for use with the general apparatus of FIGS. **1** and **2**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the drawings, a submersible vehicle in the form of a tractor **10** is illustrated having means **12** associated therewith for picking up material from the floor or bottom **14** of a body of water **16**, such vehicle **10** being positionable on the floor **14**, and expelling such material on the shore **18** adjacent the body of water **16**. The tractor **10** comprises a main body **20**, which is sealed by an outer case **22** therearound to prevent the entry of water into an engine compartment **24** and a drive train compartment **26**. A pair of powered track assemblies **28** are disposed in laterally spaced substantially parallel relation on opposite sides of the body **20**.

A motor or engine **30** for driving the vehicle **10** is of the well known internal combustion type, and is suitably mounted on the engine compartment **24**, and includes a fan **32** and an exhaust manifold **34**. An air inlet chamber **36** is formed by a baffle **38** and terminates in a plenum chamber **40** disposed ahead of a radiator **42**. The air inlet chamber **36** is connected to the atmosphere above the surface of the body of water **16** by way of an opening **44** in the engine compartment housing. A tubular intake pipe **46** of circular cross-section extends vertically from the vehicle **10**, and is sealingly secured to the case **22** around the opening **44**, and ex-

tends a substantial distance above the top of the tractor body **20** so as to protrude above the surface of the body of water **16.** A tubular exhaust pipe **48** of circular cross-section extends vertically from the vehicle **10** and is secured to manifold **34,** and extends through the inlet chamber **36** and within the bore of the intake pipe **46** to a point somewhat above and beyond the extended end of the intake pipe **46.** The tubular pipes **46,48** are positioned with their longitudinal axes substantially coincident. The longer exhaust pipe **48** expels the engine exhaust gases above the extended end of the intake pipe **46,** to avoid mixing of the exhaust gases with the intake air.

With this arrangement, rotation of fan **32,** as driven by the engine **30,** draws air through the pipe **46,** inlet chamber **36,** plenum chamber **40** and initially to radiator **42** for cooling of the engine **30.** Operational air for the engine **30** is taken from inlet chamber **36** by a pipe **50** to the precleaner **52** and to the combustion chambers within the engine in the normal manner. The air pressurized in the engine compartment **24** by the fan **32** is exhausted out pipe **48** with the exhaust gas from the engine by way of an opening **54** around manifold **34.** It also may be advantageous to add a water-to-water cooler exteriorly of the case **22** to obtain proper cooling of the engine **30.**

Control of the tractor **10** and the means **12** is accomplished through a control console **56** which is located on the shore **18** above the surface of the water and remote from the tractor **10,** and connected to the tractor **10** by a control tube **58.** A plurality of suitable electrical wires or hydraulic conduits indicated at **60** are routed from the control console **56** to the vehicle **10** through the tube **58.** The control console **56** includes the normal tractor controls such as throttle, brake, drive, and steering, as well as control of the means **12** as will be described hereinafter.

The means **12** are illustrated as a dredging implement **62** such as a canal cleaner including an elongated blade **64** disposed in laterally extended spaced relation forwardly of the vehicle **10.** The blade **64** includes a pair of laterally spaced rearwardly extending brackets **66** secured adjacent the opposite ends of the blade **64** for pivotal connection to the forward ends of a pair of rearwardly extending push arms **68.** The push arms **68** are disposed in laterally spaced, generally parallel relation on opposite sides of the tractor **10** and are pivotally connected to the track frames **70** by pivotal connections **71.** A pair of tilt jacks **72** are pivotally connected at **74** to brackets **76** secured to the upper surfaces of the push arms **68** and extend upwardly and forwardly to where they are pivotally connected at **78** to the upper rear corners of the brackets **66.** The blade **64** includes a substantially vertical back plate **80** and a forwardly extending floor and cutting edge **82** secured to the lower edge of the back plate **80.** A pair of forwardly extending substantially vertically disposed side plates **84** are individually secured to the outer ends of back plate **80** and floor **82** to provide a scoop-like structure having a substantial material carrying capacity.

An opening **86** in the back plate **80** is centrally disposed therein adjacent the lower edge. Such opening **86** communicates with one end of conduit means **88,** such conduit means **88** including a housing **90** secured to the rear surface of the back plate **80.** As best shown in FIG. **2,** a centrifugal pump impeller **92** is rotatably mounted on the housing **90** and relative to the blade **64,** with the impeller **92** being driven by a hydraulic motor **94** secured to the rear surface of the housing **90.** Hydraulic fluid from a suitable engine driven pump is directed by a suitable control valve (not shown) through a pair of hydraulic hoses **96** for driving the motor **94.**

The conduit means **88,** in addition to housing **90,** further include an elongated, flexible discharge pipe **98** connected to an outlet port of the centrifugal pump **99** (made up of housing **90** and impeller **92**) and extending rearwardly through a pair of support brackets **100** mounted on the top of the tractor **10.** The pipe **98** extends beyond the support brackets **100** a distance sufficient to reach the shore **18** for discharge of materials scooped from the floor **14** of the canal or body of water **16** by the means **12.**

The blade **64** further includes a double auger **102** rotatably mounted thereon forwardly of the vehicle **10** and driven by a hydraulic motor **104** which is supplied selectively from a suitable engine pump (not shown) through a pair of hydraulic lines **106.** The auger **102** includes a shaft **108** having secured thereto opposed screw blades **110,112** of opposite pitch, with the screw blades **110,112** extending inwardly from adjacent the side plates **84** to just short of the center of the shaft **108.**

This construction provides a centrally disposed space indicated by the arrow **114** between the inner ends of the screw blades **110,112** with such space **114** being substantially aligned with the opening **86** in the back plate **80.** A pair of lift jacks **116** are pivotally connected between suitable brackets **118** on the tractor **10** and a pair of brakcets **120** secured to the rear of the back plate **80** for elevational adjustment of the blade **64.**

With this arrangement, with the floor and cutting edge **82** of the blade **64** engaging the bottom or floor **14** of the canal or other body of water **16,** forward movement of the tractor **10** results in the material being scraped up onto the floor **82** for engagement with the auger **102.** Rotation of the auger **102** directs the material on the floor **82** inwardly due to the opposite pitch of the screw blades **110,112,** such that the material is directed to an area immediately forward of the one end of the conduit means **88.** Rotation of the impeller **92** of the centrifugal pump **99** draws water through the opening **86,** and due to the movement of the material into that area by the auger **102,** such dislodged material is drawn by the centrifugal pump **99** into the housing **90.** The impeller **92** then discharges the material from the housing **90,** and transports the material through the pipe **98** and from the other end thereof and for deposit along the shore **18** of the canal **16,** thus effectively removing accummulated material from the bottom of the canal **16** for cleaning purposes.

It will be seen that, through actuation of the cylinders **72,** the blade **64** and auger **102** may be tilted forwardly and rearwardly of the vehicle **10.** Additionally, the blade **64** and auger **102** may be raised and lowered relative to the vehicle **10** through actuation of cylinders **116.** Proper positioning of the blade **64** and auger **102** may thus be achieved for efficient operation of the apparatus.

In FIG. **3** is illustrated an alternate design of apparatus wherein the auger is eliminated and a material directing effect is provided by wing structure **122** including wings **124,126** which extend inwardly from the side plates **84** to the one end of the conduit means **88.** The

wings **124,126** are each angled inwardly and upwardly in the rearward direction of the vehicle, extending from the side plates **84** so that material dislodged by such wings **124,126** is moved laterally inwardly to the opening **86** and into the centrifugal pump housing **90.** Again, as described with respect to FIGS. **1** and **2,** a centrifugal impeller **92** discharges the dislodged material along with water drawn thereinto through the conduit means **88.**

The means for tilting the wing structure **122** forwardly and rearwardly relative to the vehicle and for raising and lowering the wing structure **122** relative thereto, is included in this embodiment also.

What is claimed is:

1. Apparatus for working the floor of a body of water comprising: a submersible vehicle positionable on said floor; means for transporting the vehicle over said floor; conduit means having one end disposed adjacent said vehicle, and the other end positionable above the surface of the water; means associated with the vehicle for directing the material from the floor to adjacent the one end of the conduit means; and means for transporting the material entering the one end of the conduit means through the conduit means and from the other end thereof, wherein the means for directing material from the floor to adjacent the one end of the conduit means comprise angled wing means disposed forwardly of the vehicle and comprising a plurality of wings, each angled upwardly and inwardly in the rearward direction.

2. The apparatus of claim **1** and means interconnecting the vehicle and wing means for providing a degree of movement of the wing means relative to the vehicle.

3. The apparatus of claim **2** wherein the means interconnecting the vehicle and wing means comprise means for tilting the wing means forwardly and rearwardly relative to the vehicle.

4. The apparatus of claim **3** wherein the means interconnecting the vehicle and wing means further comprise means for raising and lowering the wing means relative to the vehicle.

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