Dec. 7, 1971 M. H. DOYLE 3,624,932

APPARATUS FOR HARVESTING MOLLUSKS

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FIG. 1

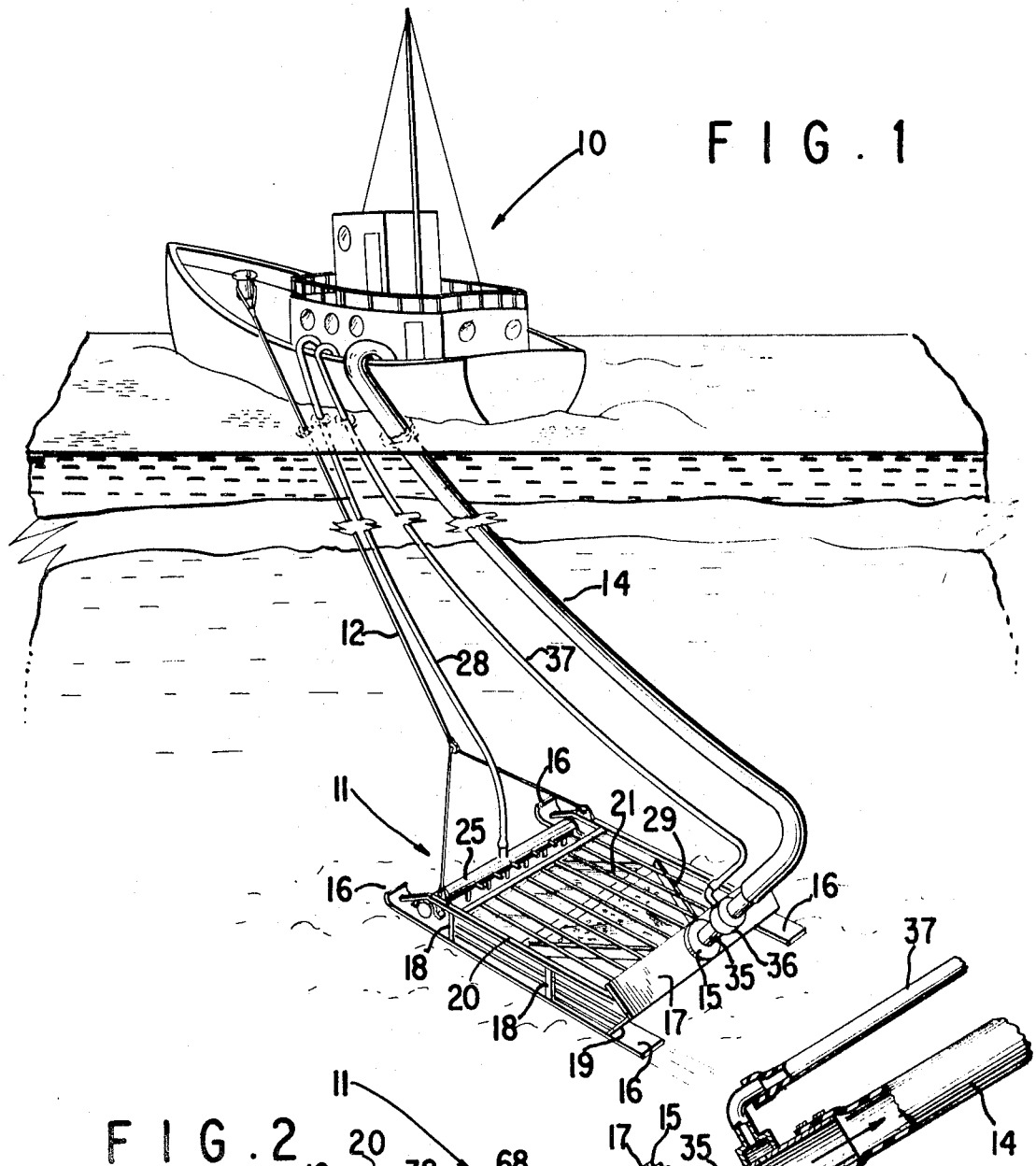
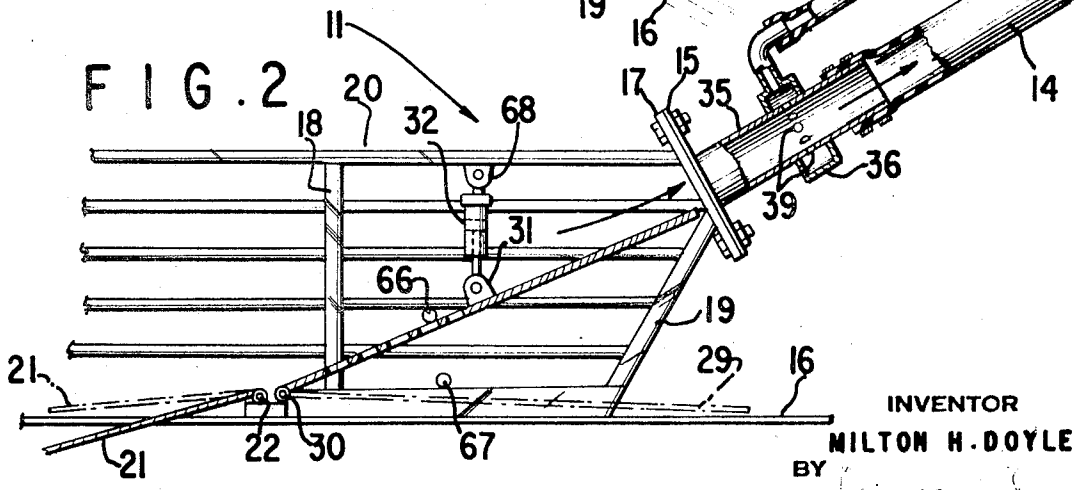


FIG. 2



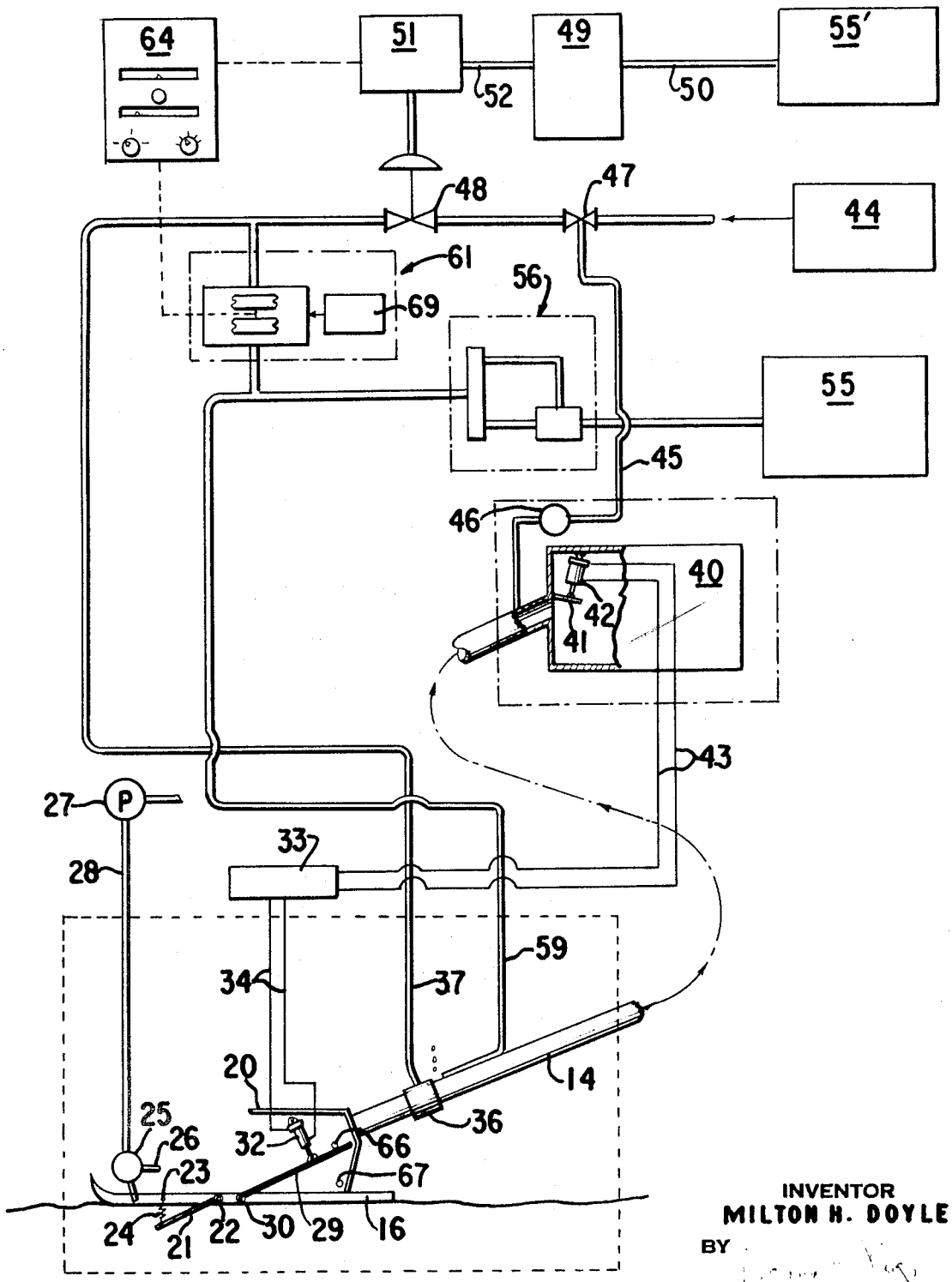
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FIG. 3



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APPARATUS FOR HARVESTING MOLLUSKS

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Continuation-in-part of application Ser. No. 680,705, Nov. 6, 1967. This application Apr. 6, 1970, Ser. No. 25,687

Int. Cl. A01m 25/00

U.S. Cl. 37—55 6 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for harvesting mollusks or the like comprising a dredge for gathering said mollusks; a tube refining a path of travel for said mollusks open at one end adjacent and, secured to said dredge; a gas supply for directing gas under pressure into said tube adjacent the dredge to induce movement of the mollusks thereinto; equipment for measuring the pressure differential between the gas in said tube and the ambient pressure surrounding the dredge, and equipment operatively associated with the gas supply and measuring equipment to control the supply of gas in order to maintain a predetermined pressure differential.

This application is a continuation-in-part of co-pending application Ser. No. 680,705, filed Nov. 6, 1967 and now abandoned.

BACKGROUND OF THE INVENTION

Heretofore, various apparatus have been used to harvest mollusks or the like from the ocean floors and beds at varying depths. These apparatus have generally provided a tube or other means which is connected to a dredge dragged along the ocean floor for carrying the collected mollusks, shellfish, claims, sponges, scallops, etc. to the boat towing the dredge. Generally, the movement of mollusks through the tube member is effected by supplying a gas under pressure to lift the mollusks to the boat towing the dredge. This apparatus has for the most part proven unsatisfactory, due to the lack of control which may be exercised over the rate of flow if the contents traveling through the tube. It has been found that the flow rate through a tube is proportional to the pressure differential between the ambient pressure about the tube entry and the gas supply to the tube used to lift the mollusks. Accordingly, the absence of an adequate degree of control over this pressure differential will result either in an excessive amount of pressure which will result in an exceedingly high rate of flow of the contents or conversely an insufficient amount of pressure which will not prove strong enough to elevate the mollusks from the ocean floor. In the instance of an excessive rate of flow, the mollusks frequently will be damaged, and thus be rendered unfit for processing. Moreover, the subject pressure differential is a rapidly fluctuating parameter because the numerous dips and ridges in the ocean floor over which the dredge passes cause frequent changes in the ambient water pressure about the dredge.

Still another problem encountered in ocean bed harvesting is the frequency in which foreign matter and undesirable objects are encountered and tend to clog the passage through the tube to the boat, thereby rendering the system inoperative and resulting in great wastage of time and effort to clear the tube and commence harvesting again.

SUMMARY OF THE INVENTION

The present invention overcomes the heretofore set forth problems encountered with apparatus used for harvesting mollusks, and has for its primary object the provision of an apparatus which will at all times control the rate of flow of the mollusks through the channel means to the boat by maintaining a constant pressure differential between the gas supply to the channel means and the ambient pressure about the dredge means. Therefore, any change in the level of the ocean bed which will vary the ambient pressure about the dredge means will automatically be compensated for by the instant invention to insure and maintain the constant pressure differential as aforesaid. Additionally, the invention contemplates a unique device for clearing any clog-up in the channel means which might occur due to the presence of foreign matter or the like being encountered by the dredge means and injected into the channel means.

Briefly stated, the present invention comprises a dredge means adapted to gather the mollusks on the ocean floor, a channel means for conveying the mollusks away from the dredge means, means for supplying gas under pressure to the channel means to induce movement of the mollusks therethrough, means for measuring the pressure differential between the gas supply to the channel means and the ambient pressure about the dredge means, and means operatively associated with the gas supply means and measuring means to control the supply of gas in order to maintain a pre-determined pressure differential.

BRIEF DESCRIPTION OF THE DRAWINGS

The various features of the apparatus of this invention will become apparent from the following detailed description set forth in connection with the accompanying drawings which relate to the preferred embodiment of the present invention and are given by way of illustration.

FIG. 1 is a perspective view illustrating a towing vessel drawing the mollusk harvesting apparatus of the present invention.

FIG. 2 is a side perspective view partially broken away to show the features of the present invention.

FIG. 3 is a schematic illustration of the various parts utilized in the mollusk harvesting apparatus of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, wherein is set forth the environment of the present invention, there is illustrated a towing vessel or ship **10** which drags therebeneath along the ocean floor a dredge means **11**. Tow line **12** is connected to the vessel and dredge means in such a manner that the latter remains in vertical alignment with the former throughout the towing and harvesting operation. Interconnecting the dredge means with the towing vessel is a large diameter tube or channel means **14** through which the mollusks and other matter gathered by the dredge means **11** are passed on board the ship. The dredge means comprises a pair of runners **16** suitable for sliding along the ocean floor and onto which are mounted various bracing means, such as upright braces **18** and inclined braces **19**. Horizontal braces **20** are spaced above and parallel to the runners **16**, as is best seen in FIG. 2. Forwardly of the dredge means **11** is a blade **21** having a knife-like edge hingedly connected at point **22** and swingable between an inoperative position shown in phantom lines and an operative position shown in phantom lines beneath the runners **16** for skimming the ocean bed and directing the flow of matter there encountered upwardly along the blade, as will be hereinafter more specifically set forth. The blade is illustrated between two positions in FIG. 2, the solid line position indicating the operative position. Bolts **23** suitably secured to the runners **16** pass through the sides of the blade **21** and maintain it in the operative position between runners **16**. Washers or other spacing elements **24** about the bolts are used to vary the depth of cut of the blade

in the ocean floor. Forwardly of the knife-like edge of the blade **21** and also mounted on the dredge means **11** is a water jet assembly **25** including outwardly projecting jet portions **26** which are adapted to supply water under pressure to the ocean bed immediately adjacent the knife edge of the blade **21** for agitating the surface of the ocean bed to facilitate skimming by the blade. A pump **27** on board the vessel supplies water under pressure via the conduit **28** to the water jet assembly **25**.

Rearwardly of the blade **21** on the dredge means **11** is a ramp **29** which may partly comprise of a grating or other foraminous material, as shown in FIG. 2, allows sand and undersized mollusks to sift therethrough and directs the movement of the larger mollusks upwardly and rearwardly of the dredge means for passage to the vessel, as will be hereinafter explained. The ramp is pivotally mounted at hinge **30** adjacent the point of pivotal connection of the blade **21**, as is best seen in FIG. 2, and is elevatable by means of a hydraulic assembly comprising a piston and cylinder arrangement **32**, which is pivotally connected between ears **31** and **68** mounted on horizontal brace **20** and the edge of the ramp **29**. A plurality of hydraulic rams may be used to swing the ramp upwardly adjacent the suction means of the present invention depending on the weight of the material being collected by the blade. A source of hydraulic fluid **33** communicates with the hydraulic ram **32** by way of the conduit **34**, best seen in FIG. 3.

Focusing now on the means for elevating the material collected by the dredge to the vessel, and more particularly to the tube **14** of the present embodiment which is mounted on the rearwardly inclined brace **19** of the dredge **11**, there is illustrated a flange **15** suitably secured to plate **17**, which in turn is secured to the dredge by means of braces **19** and **20**. The tube **14**, as previously mentioned, is of a large diameter to facilitate the passage of larger mollusks or the like collected and to permit a large volume of these mollusks to pass on board the vessel within a short space of time. A cylindrical portion **35** is affixed to the flange **15** in conventional manner and includes a mouth or opening in the flange adjacent the upper edge of the ramp **29**. The rearward end of portion **35** is received in the tube **14** and sealingly retained therein in a well-known manner. Concentric with portion **35** is a manifold **36** which is communicable via a conduit **37** to a compressor **55** on board the ship and which receives a gas, as for example, air, under pressure therein. The manifold **36** communicates with the interior of the tube **14** through angularly disposed apertures **39** which direct the flow of gas upwardly through the tube and away from the dredge means, thereby creating a sphere or area of suction at the mouth of portion **35** adjacent the upper edge of the ramp **29**. The pressure, the velocity and the buoyancy of the gas injected through the apertures **39** is sufficient to lift or elevate the mollusks collected on the ramp **29** upwardly and on board the vessel **10**. Upon movement onto the vessel the mollusks are received in a separator where they are further handled and collected for processing in a manner known to the art and not a part of the instant invention. The separator includes a closure member or door **41** hingedly mounted therein at a point adjacent the connection of the tube **14** to the separator and which is movable to a position to seal off the tube from the separator by means of a piston-cylinder arrangement **42**, the latter best seen in FIG. 3. The hydraulic source **33** communicates with cylinder **42** via conduits **43** to actuate the cylinder and effect sealing off the tube from the separator for purposes hereinafter to be set forth.

The elevating or lifting of the contents through the tube **14** is effected by main compressor **44** which supplies gas, in this case air, under pressure to the manifold **36** by way of conduit **37**. The main compressor **44**, such as Model 600 manufactured by Jaeger, can supply air at 600 ft.^{3}/min. at about 125 p.s.i. The air from the main compressor is used to blow the clams up through tube **14**

and to also unclog tube **14** at its upper end by blowing air through line **45** into the tube **14**, as will be described. Connected through valve **47** in conduit **37** is an alternate conduit **45** which communicates with the interior of the tube **14** adjacent the separator **40**. A valve **46** is provided in conduit **45** near the inlet to tube **14**. As evident from FIG. 3, the conduit **37** is provided with a valve **47**, which may be turned to direct the flow of gas from the compressor **44** to the alternate conduit **45**. It should thus be apparent from the embodiment described, that in the event that clogging occasioned by the presence of foreign matter collected in the tube **14** should occur, that blow-back may be effected to clear the tube of this foreign matter by moving closure **41** to the position to seal off passage of the contents from the tube **14** to the separator **40**, turning valve **47** to stop the flow of gas under pressure to the manifold **36** thus preventing further lift of the mollusks through the tube **14**, and opening the valve **46** to direct the gas under pressure to the tube **14** at the point adjacent the separator thus supplying a blow-back force in the tube **14** to induce the foreign matter or clogging refuse to move back into the ocean from whence it came. In operation, it has been found that the gas from compressor **44** has proven ample to overcome any clogging which occurs in the tube **14**. It should further be appreciated that a conduit to pump **27** might be provided which supplies water under pressure to the tube **14** adjacent the separator **40** so that a fluid media might be used in lieu of a gaseous media from the compressor **44** to unclog the tube. Consequently, a considerable saving in time and expense is effected, since generally, any clogging of the tube connecting the dredge on board the ship, involves detaching same from the tube and cleaning the latter out manually.

Air from the small compressor **55**, which delivers about 1 ft.^{3}/min. of filtered air at about 100 p.s.i., is fed into the constant flow regulator or bubbler **56** which expels air at a constant volume through line **59** at a point adjacent the dredge in form of bubbles, as shown in FIG. 3. Compressor **55** is a small commercial unit which delivers clean air to the constant flow regulator **56**. A duplicate compressor **55'** or the same compressor **55**, if desired, can deliver clean air to the pressure reducer **49**, as will be later described. The constant flow regulator **56**, such as No. 62 VA Model manufactured by Moore, consists of a valve with a pair of diaphragms which permit a constant stream of air or bubbles to travel down a small line **59**, i.e., ¼", to the dredge. Change in pressure in line **59** is due solely to changes in depth that the dredge is pulled.

The air in line **59** also communicates with one of the stainless steel bellows in the pressure transmitter **61**. The other stainless steel bellows in the pressure transmitter **61** is connected into line **37** which carries air from the main compressor **44**. Pressure transmitter **61**, such as the M-Line Differential Pressure Transmitter manufactured by Leeds and Northrop, includes a pair of stainless steel bellows, as already noted. One bellows is pneumatically connected into line **59** to sense the change in pressure in line **59** due to the change in depth at which the dredge is pulled; while the other bellows is pneumatically connected into line **37**, which delivers great quantity of air at high pressure to the manifold **36**. Power for operating the pressure transmitter **61** is supplied by a power source **69**, such as battery or generator. By means of electrical contacts and a small amplifier, an electrical signal from pressure transmitter **61** is delivered to the deviation controller **64**. The value of this signal depends on the physical distention of the two bellows. The deviational controller **64** interprets the signal received from the pressure transmitter **61** and transmits another electrical signal to electro-pneumatic controller **51** which either pneumatically closes or opens valve **48**. The pneumatic power required to operate valve **48** is supplied from compressor **55'** through pressure reducer **49** by means of lines **50**, **52**.

The deviation controller **64**, such as M-Line Model C.A.T. Indicating Controller manufactured by Leeds and Northrop, has dial control station with dial controls, adjustments and meters to indicate position of valve **48**, a pre-set differential pressure and deviation from the pre-set pressure. The deviation controller **64** is especially useful during manual operation of the dredge. The operator would set the differential pressure at about 6 to 15 p.s.i. One meter would show to what extent valve **48** need be open to deliver the required air while another meter would indicate the speed at which the valve is being actuated to meet the pre-set value. When the operation is automatic, the meters are of a minor interest only.

Electro-pneumatic controller **51**, an example of which is Model 657 GR manufactured by Fisher, receives an electrical signal from deviation controller **64** and pneumatically operates the valve **48** with air delivered from compressor **55'** through pressure reducer **49**. The sole purpose of pressure reducer **49** is to provide a small amount of clean air for pneumatic operation of valve **48**. Model 67 FRTC, made by Fisher, is a suitable unit for purposes described herein.

When operating the apparatus described herein, one should know that each foot of depth in the ocean equals approximately ½ p.s.i. Therefore, if the dredge is pulled into a depression in the ocean floor of about 14 feet, the pressure of the air delivered to the clam hose manifold should be increased by 7 p.s.i. to maintain proper operation of the air lift of the clams. The adjustment is automatically made in the following manner: When the dredge descends into the depression, pressure in line **59** increases and expands one of the bellows in the pressure transmitter **61**. Physical distention of the bellows changes the electrical signal delivered to the deviation controller **64** which received the signal, analizes it and transmits another electrical signal to the electro-pneumatic controller **51**. The electrical signal received by controller **51** from the deviation controller **64** actuates pneumatic opening of valve **48** to compensate for the greater depth by allowing more air under pressure to enter manifold **36**. As valve **48** is opened, more air rushes through line **37** into manifold **36** and also more air enters the other bellows to partially off-set the physical distention of the first bellows. These changes occur incrementally with the result that in a short period of time, valve **48** would be opened sufficiently to balance the system. It should be understood that if the dredge is pulled onto a crest of the ocean floor, then the system would compensate for the change in depth by partially closing valve **48**.

One additional feature of the dredging embodiment of the present invention is the apparatus which is used to apprise the operator of the position of the ramp **29** during the dredging operation. Proximity switches **66** and **67** are mounted on the side of the dredge means **11** at the two extreme positions of pivotal movement of the ramp **29** and are contacted in these positions. Suitable signaling apparatus on board the vessel indicate the position of the ramp when the proximity switches are contacted, so that in the event a heavy obstacle or other foreign matter rides up onto the ramp and moves near the mouth of the tube **14**, the ramp may be swung down by actuating the hydraulic rams **32** to allow the material to pass off the ramp and behind the dredge. Moreover, the foreign matter blown back from the tube **14** during the blow-back operation herein set forth will generally be removed from the dredge onto which it is blown by actuating the ramp downwardly to the extreme lower position to allow the material to pass out the rear of the dredge means **11**.

Although one embodiment of the present invention has been herein illustrated and described, it will be evident to those skilled in the art that various modifications may be incorporated into the details of production without departing from the principles herein set forth.

What is claimed is:

1. Apparatus for harvesting mollusks or the like comprising dredge means adapted to gather said mollusks on an uneven ocean bed, channel means defining an enclosed path of travel for said mollusks connected to said dredge means, means for supplying gas under pressure to said channel means at a point adjacent said dredge means whereby the buoyancy and velocity of said gas induce movement of said mollusks through said channel means, means for measuring the pressure differential between the gas supplied to said channel means and the ambient pressure of the dredge means, means operatively associated with said gas supply means and said measuring means to control the supply of gas in order to maintain a predetermined pressure differential whereby said mollusks will be moved at a controlled rate in the channel means irrespective of the ambient pressure.

2. Apparatus according to claim **1**, wherein said dredge means includes a blade, a pivotally mounted ramp and motor means adapted to move said ramp.

3. Apparatus according to claim **1**, including a receptacle adapted to receive the mollusks conveyed through said channel means, said channel means being a flexible hose.

4. Apparatus according to claim **1**, wherein said gas supply means incudes a manifold concentric with said channel means, said manifold having apertures communicable with the interior of said channel means and angularly disposed therewith to direct the gas into the channel means away from the dredge means.

5. Apparatus according to claim **1**, wherein said measuring means includes means for supplying gas at a predetermined rate of pressure to the area surrounding said dredge means, and means interposed between said gas supply means to said channel means and said gas supply means to said dredge means to sense and transmit the difference in pressure to said control means.

6. Apparatus according to claim **1**, wherein said control means includes a valve associated with said gas supply means, means to adjust said valve to limit or increase the flow of gas, pressure differential maintaining means operatively associated with said adjustment means and responsive to said measuring means whereby a constant pressure differential is maintained.

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U.S. Cl. X.R.

37—62; 56—9; 119—4