June 9, 1959 R. C. STEIN 2,889,642

CLAM SHELL DREDGING DEVICE

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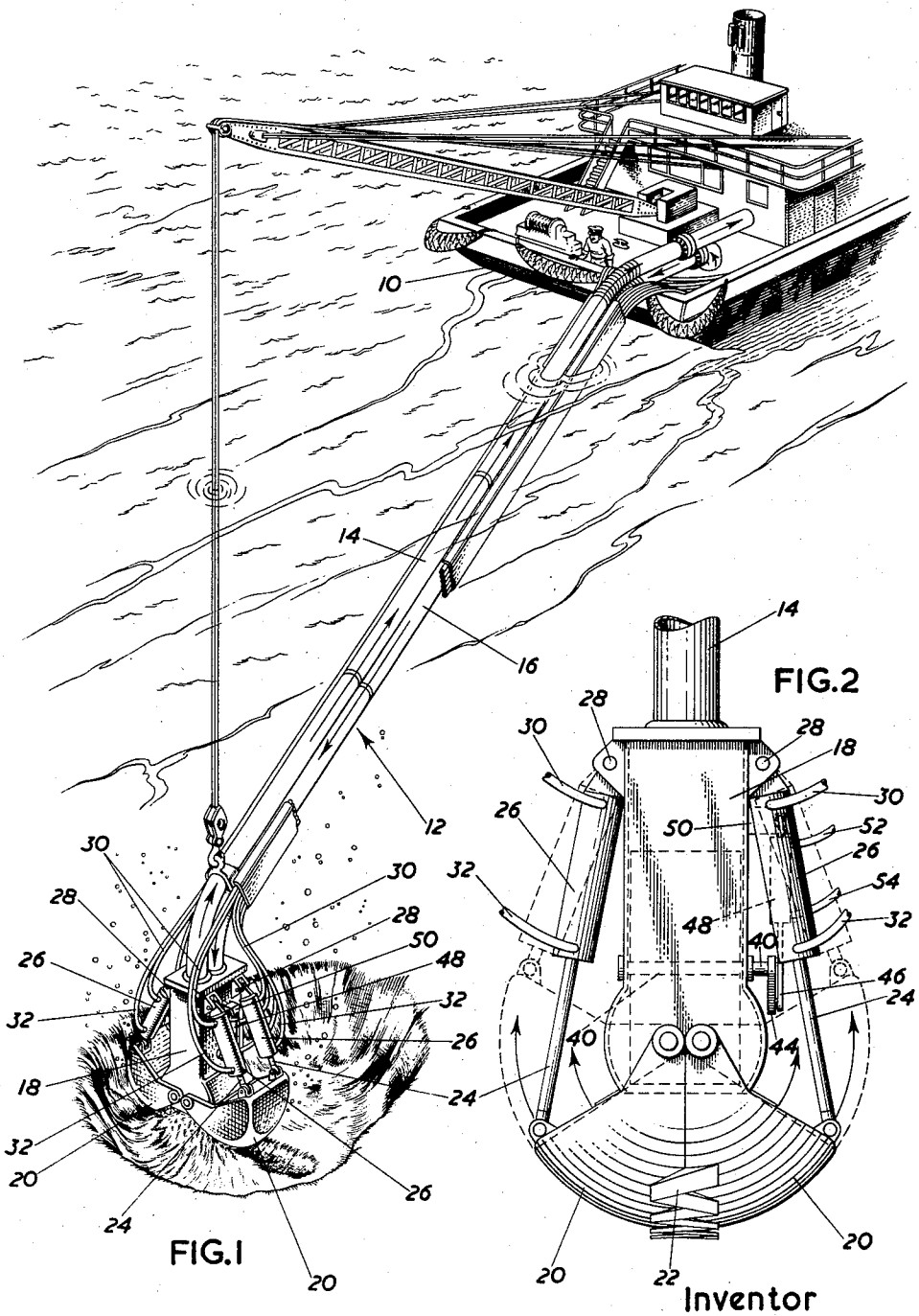


FIG.1

FIG.2

Inventor

RICHARD CARL STEIN

By~ Featherstonhaugh & Co.

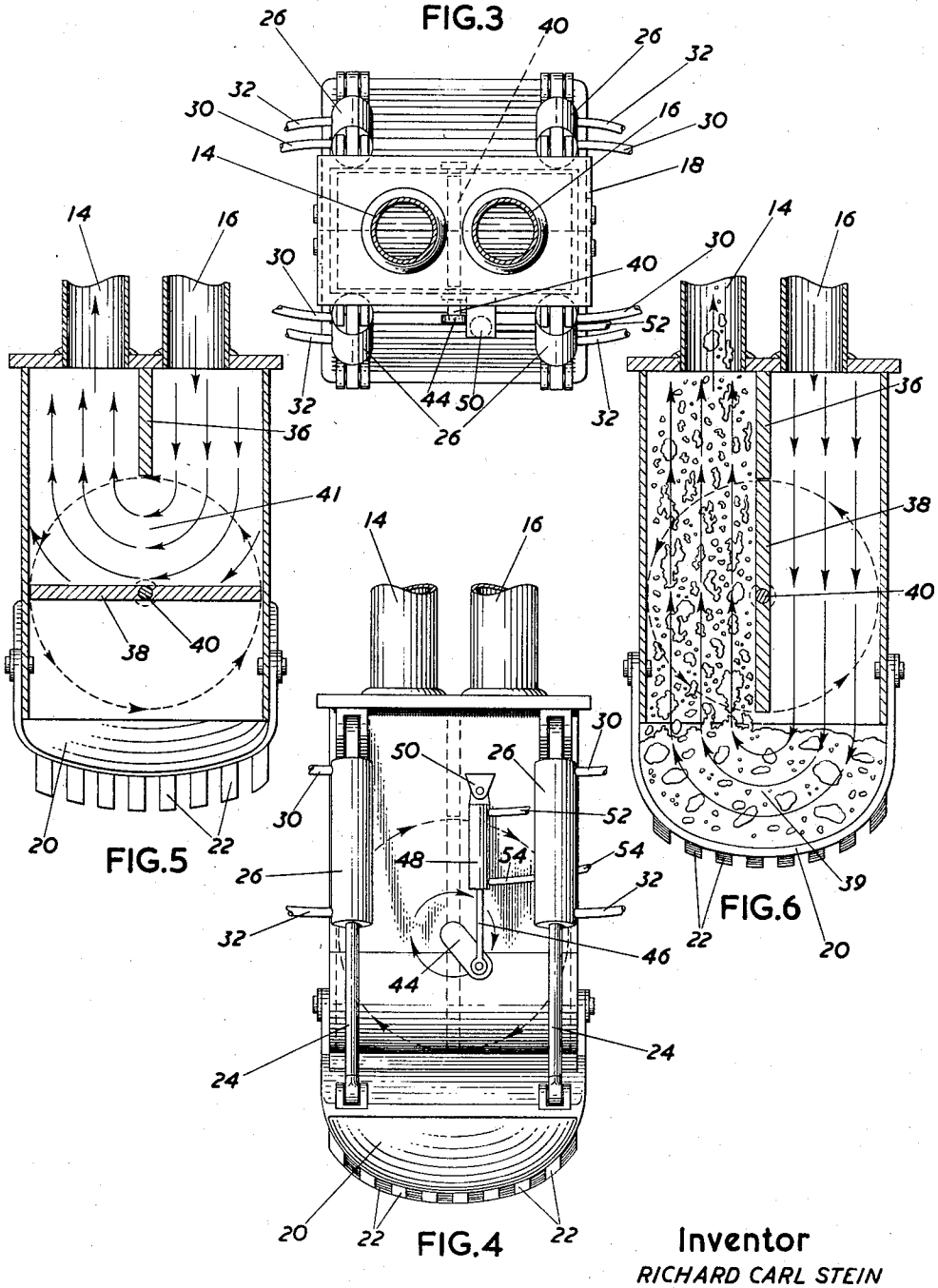
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CLAM SHELL DREDGING DEVICE

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FIG.3



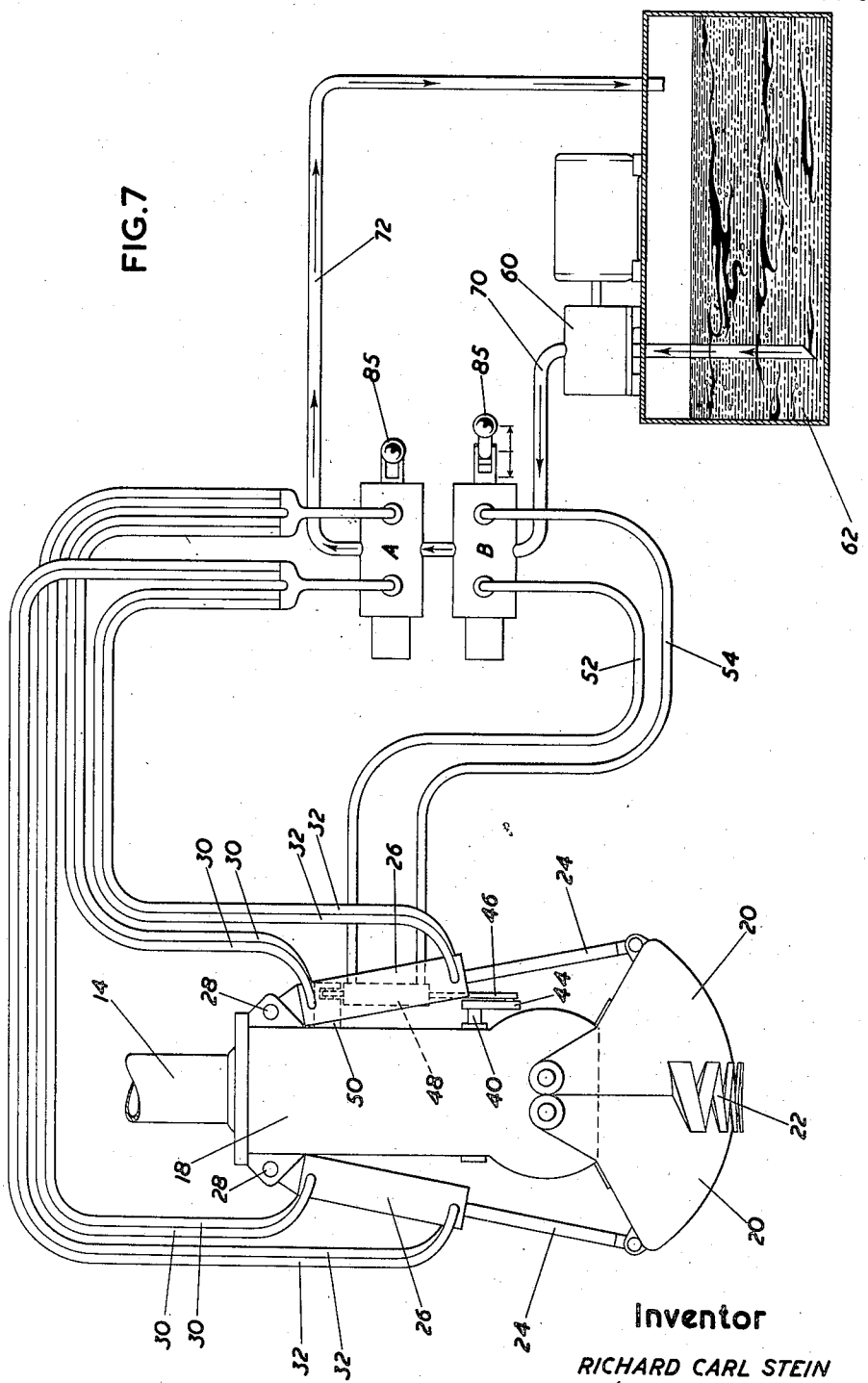
Inventor
RICHARD CARL STEIN
By Featherstonhaugh & Co.
Atty's.

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CLAM SHELL DREDGING DEVICE

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FIG.7



Inventor

RICHARD CARL STEIN

By~ Featherstonhaugh & Co.

Atty's.

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CLAM SHELL DREDGING DEVICE

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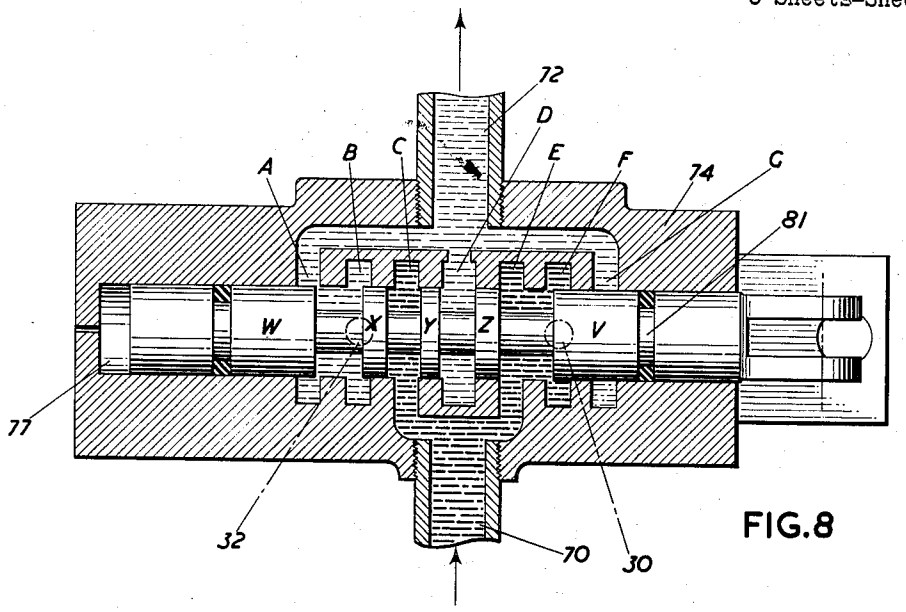


FIG.8

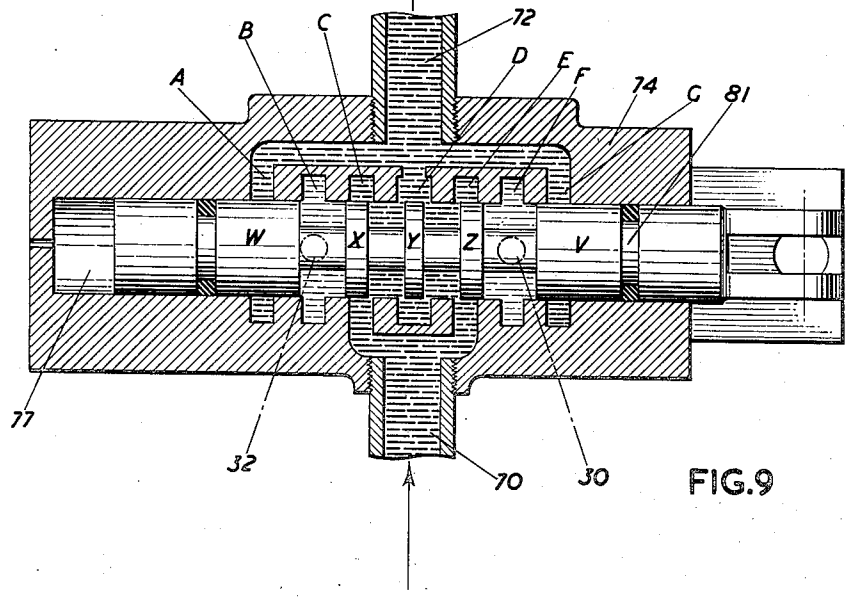


FIG.9

Inventor

RICHARD CARL STEIN

By- Fetherstonhaugh & Co.

Att'ys

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CLAM SHELL DREDGING DEVICE

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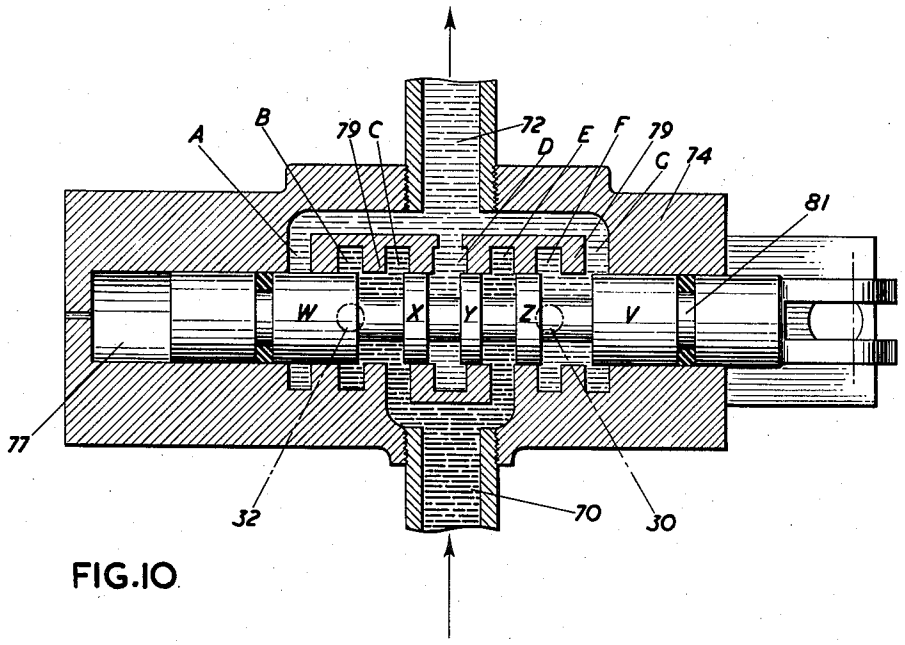


FIG.10

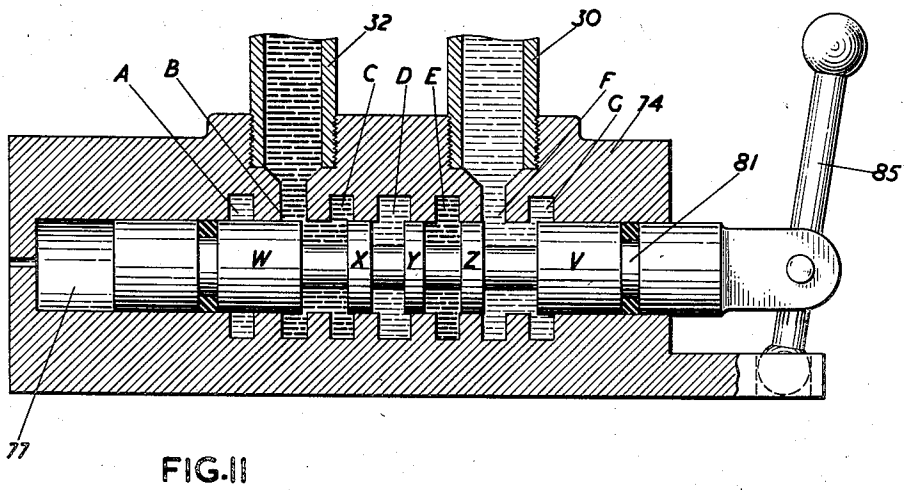


FIG.11

Inventor

RICHARD CARL STEIN

By-Fetherstonhaugh + Co.

Att'ys

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2,889,642

CLAM SHELL DREDGING DEVICE

Richard C. Stein, Calgary, Alberta, Canada

Application March 1, 1956, Serial No. 568,881

6 Claims. (Cl. 37—54)

This invention relates to a new means for excavating and dredging with construction equipment wherein a jaw or shovel type surface makes intermittent cuts out of the earth or other material being excavated to remove it from one location to another.

With such equipment, whether in excavating or dredging, it has in the past been necessary to first separate the earth by a cutting-like movement of the shovel-like member so that some of the earth is lifted or separated from the surface being excavated. It is then necessary by the appropriate controlled movements of the construction equipment to lift the material so separated still contained in the shovel-like member out of the way to a disposal location so that the cutting-like instrument which may be a clam or a shovel or similar apparatus may be returned to the excavation or dredging area for a further cycle as described above.

The necessity of lifting and transporting the separated material in the shovel member between shovelling movements has required a power and time expenditure which is avoided by this invention.

Other than by the previously mentioned method, excavation is and was accomplished in the past by suction dredging; i.e. to pump material from the surface to be excavated with all the excavated material passing thru the pump, causing severe wear and abrasion on the interior walls and rotating parts of the pump which is avoided by this invention.

This invention provides apparatus wherein the shovel-like member or pair of shovel-like members, as in a clam, form an openable lower relatively liquid tight closure for an hydraulic chamber. To this hydraulic chamber are connected an inlet water line and an outlet water line with the provision that the inlet water shall be under pressure, and the inside of the chamber is so constructed that when the water under pressure is applied, the material separated in the just preceding cut by the shovel-like member may be pumped out of the chamber and out the outlet line, the above operation taking place when the shovel-like member is closing the chamber. To avoid wastage of water from the pressure source means are provided for intermediately closing the chamber during such period as the shovel-like member is so moving as to open one end thereof. With such a closure as described above it is desirable that the excavated material pumped out into the outlet line be kept in constant motion and therefore a by-pass is provided whereby the movement of the matter out the outlet line continues when the chamber is intermediately closed off.

The invention also provides control apparatus whereby the shovel-like member is opened and closed when the chamber is intermediately closed by the closure member and whereby the chamber is intermediately closed or opened when the shovel-like member is closed.

The invention also provides means for excavating or dredging wherein a portion of material to be excavated is separated from the remainder and is then relatively

enclosed in a liquid-tight chamber from which it is hydraulically removed to a disposal area. The enclosure is then opened while the hydraulic movement of the first separated material is continued and during such movement a further portion of said material is separated to repeat the above cycle of operation.

In drawings which illustrate a preferred embodiment of the invention:

Figure 1 illustrates a dredge with which the inventive apparatus and method could be used.

Figure 2 illustrates a set of clam jaws and cooperating hydraulic chamber in accord with the invention.

Figures 3 to 6 illustrate the operation of the hydraulic chamber connected with such clam jaws.

Figure 7 illustrates the hydraulic control for the clam jaws and the intermediate chamber closure.

Figures 8 to 11 illustrate the control valves which effect the hydraulic operation of the jaws and pumping means.

In Figure 1 is shown a dredging craft **10** provided with a dredging boom **12** comprising mainly two water conduits **14** and **16** to be referred to in detail hereafter. Rigidly connected to the lower end of the conduits is a hydraulic chamber **18** which may be seen in more detail in Figure 2 and the hydraulic chamber forms at its lower end a pivotal mounting for a pair of clam jaws **20**. The clam jaws **20** are provided with dredging teeth **22** and jaws and teeth are designed to close the lower extremity of the hydraulic chamber in the position shown in Figure 2, the lower extremity of the chamber being open when the jaws are open in the position shown in Figure 1. The jaws **20** are opened and closed by hydraulic piston rods **24**, there being preferably two piston rods to operate each jaw, the piston rods each riding in a cylinder **26** and being provided inside the cylinder with pistons (not shown). To provide for the necessary rotary movement of the cylinder in operating the jaws the cylinder **26** is at its upper end pivotally mounted on the upper end of the hydraulic cylinder as illustrated at **28**. Operation of the piston to extend and retract the rods **24** and to open and close the jaws is provided in the case of each cylinder **26** by a pair of reversible hydraulic lines **30** and **32**, whose operation will be described hereafter. The hydraulic chamber is shown in greater detail in Figures 3 to 6 and it will be seen by reference to Figure 6 a view taken parallel to the pivotal axis of the jaws that the hydraulic chamber is divided by a wall **34** comprising a stationary portion **36** and a rotatable portion **38**. It should be noted that the wall **34** extends from the wall of the chamber remote from the clam jaws **20** to divide those portions of the chamber which are adjacent respectively the inlet and the outlet water lines. The wall **34**, including the rotatable portion **38**, extends toward the openable end of the chamber but stops short to allow a liquid passage **39** about the lower end and to be clear of the range of movement of the clam jaws.

The movable portion **38** is pivotally mounted on the chamber walls by a shaft **40** and is provided with a range of movement so that it may assume the position illustrated in Figure 5 so that it extends laterally with respect to the chamber body. The major dimensions of the movable wall **38** are designed so that when extending laterally as shown in Figure 5 the movable wall intermediately closes the hydraulic chamber to separate that portion adjacent the jaws **20** from that portion adjacent the inlet and outlet lines **14** and **16**. It should also be noted that movement of the wall **38** to provide an intermediate closure leaves a by-pass **41** thereabove for a water flow between the inlet and outlet lines.

Referring now particularly to Figure 4 it will be seen that an arm **44** rigidly laterally extending from the shaft

20 is pivotally connected to a piston rod 46 at the other end of which is provided a piston (not shown) which rides in the cylinder 48. The cylinder is adapted to hydraulically operate the piston to move arm 44 and therefore movable wall 38 to its position as a wall extension as shown in Figure 6 and to its position as an intermediate chamber closure as shown in Figure 5. To provide for the necessary pivotal movement in performing this operation the cylinder is pivotally connected to the wall of the hydraulic chamber as illustrated at 50. Means to reversibly operate the piston are provided by hydraulic lines 52 and 54 to hydraulic control means to be described hereafter.

It is believed that a better understanding of the invention will be achieved if the operation of the apparatus so far is described.

It must be assumed that the requisite hydraulic controls are available to perform the operations described and these controls will be described hereafter. Assume that the dredge is in the position as shown in Figure 1 with the clam jaws 20 open and that the rotatable wall is oriented laterally to form an intermediate closure for the chamber as illustrated in Figure 5. It will be seen that by the necessary operation of the cylinder 26 the rods 24 may be extended and the clam jaws 20 closed, and the clam jaws as they close will cut or claw the bed to remove a portion of the material therefrom. When the jaws close, as illustrated in Figure 2 or 6, this material will be contained in the hydraulic chamber now closed by the jaws 20. On closure of the jaws 20 therefore, hydraulic pressure is supplied to piston cylinder 48 to rotate the movable wall 38 so that it forms an extension in the wall 36, that is it assumes position illustrated in Figure 6. Water pressure is being continuously applied through the inlet line 16 and the flow takes place down one side of the intermediate wall 34 around the bottom thereof and up the other side and out the outlet line 14 causing removal of the dredged material from the chamber. It should be noted for reference to the complete cycle of operation that the flow down the inlet line into the chamber and out the outlet line was continuous and therefore while the dredging movement was being performed the flow was taking place in the inlet line and through the by-pass 41 created by the location of the wall 38 in the position shown in Figure 5 and out the outlet line. Therefore the passage 41 between shaft 40 and the lower extremity of the stationary wall 36 acts as a by-pass line while jaws 20 are open. Returning now to the evacuation of the material in the position shown in Figure 6 and up the outlet line 14, the outlet line extends to any desired disposal area (not shown) for dumping the material. When the material is completely evacuated from the walled chamber 18, wall 38 is again rotated by operation of cylinder 48 to the position shown in Figure 5, whereby it forms an intermediate closure for the chamber 18 and divides the chamber 18 laterally whereby the inlet and outlet lines are not open to the dredging area when the clam jaws 20 are open. With the wall so closing off the chamber a second dredging movement is performed, the cylinders 26 being now operated to open the clam jaws 20 for a further "bite" and then to close them. With the jaws closed and further dredged material in the chamber the above cycle is repeated. It will be noted that the removal of the first dredged material up line 14 continues uninterrupted by the presence of intermediate closure 38 the water under pressure to continue such movement now flowing through by-pass 41.

There will now be described the hydraulic operating means for the clam jaws 20 and for the rotatable wall 38. Referring first to Figure 7, there is shown a schematic illustration wherein clam jaws cylinder 26 and the cylinder 48 for operating the rotatable wall 38 are shown supplied with hydraulic lines extending from three-way valves A and B, while a hydraulic pumping source 60 is shown using oil from a tank 62 which actuates the control system. A pair of control levers 85 on the valves A and B respectively operate the clam jaws 20 and the rotatable wall 38 respectively. Figures 8 to 11 illustrate the internal operation of either of the valves, the two valves being identical in structure.

In the drawings the pressure line is shown in heavy shading and the return line in light shading. Figures 8 to 10 are views illustrating a cross-section of a valve (either A or B) taken along a plane including the hydraulic inlet and outlet lines 70 and 72, while Figure 11 illustrates a valve taken along the supply lines for either the jaw cylinder or the rotating wall cylinder and for example the supply lines 30, 32 are shown. It will be seen that the valve 74 comprises a body tapped for an internal chamber 77 and that the chamber 77 is provided with seven annular recesses which lettered from left to right are A, B, C, D, E, F and G. Internally extending ribs 79 separate these recesses, while adapted to make a close sliding contact with these ribs are five plates W, X, Y, Z and V, going from left to right on a shaft 81. It will be seen that annular chambers A and G are always open to the return line from the valve while annular chambers C and E are always open to the inlet line. It will be seen that one of the supply lines 30 for, say, the clam cylinder is connected to annular chamber B and the other supply line 32 to annular chamber F. Turning first to Figure 9 it will be seen that the central plate member Y is symmetrical with respect to the annular chambers and this is the neutral position whereby no operation on the clam cylinders is performed since it will be seen that the inlet line chambers C and F are connected to the outlet chamber D, while plates X and Z block chambers C and E from chambers B and F, the operating cylinder chambers. Moreover, cylinders W and V block the same chambers B and F from the outlet chambers A and G. Thus in this position and with the lever in the neutral position, the flow from the oil source goes directly through the valve and has no effect upon the operation of the jaws. It will be noted that if piston 48 for the rotatable wall 38 were being operated at this time that the operation of valve B would be effected with valve A in such neutral position. Assuming line 32 when energized will open the jaws 20 and that this is the operation desired, then the operating cylinders by means of the lever 85 are moved to the position shown in Figure 10 whereby it will be seen that cylinders X and Y prevent connection of inlet chambers C and E with outlet chamber D, but that inlet chamber C is hydraulically connected to operating chamber B and outlet chamber G is connected to operating chamber F. Thus in this position oil from the source flows out the transfer line 32 to operate the cylinders in one direction to (say) open the jaws. It will thus be seen that when it is desired to close the jaws the lever is moved through the neutral position to the converse position which is illustrated in Figure 8 wherein the inlet and outlet chambers are separated by cylinders X and Z, while the inlet chamber E is connected to the operating chamber F and the outlet chamber A is connected to the operating chamber B. Thus the operation will be reversed from that indicated in Figure 11 and the clam jaws will be allowed to close.

A similar operation for the valve B will be obvious and thus it is desired to describe in general the sequence of operations of the valves A and B.

It will be noted from the operating sequence described heretofore that the sequence of operation is as follows:

(1) Open jaws 20 (with the rotating wall 38 extending laterally across the chamber 18 to divide it).

(2) Close jaws 20.

(3) Rotate wall 38 to position where it forms an extension of the fixed wall 36 (while the evacuation of the dredged material is achieved).

(4) Rotate wall 38 to again laterally divide cylinder.

(5) (1) Open jaws for further bite.

Let it be assumed therefore that valve A operates the clam jaws **20** and valve B operates the wall **38**. Let it also be assumed that the left hand position of the lever **85** of valve A opens the jaws and the left hand position of the similar lever of valve B rotates the wall **38** to lateral dividing position. Again passing through the steps outlined above:

(1) Open the jaws **20**, then it will be seen that during such operation the rotating wall **38** is stationary in the position in Figure 5 and therefore valve B is in the neutral position while lever A is to the left causing the jaws to open.

(2) When the jaws are open, the valve B remains unchanged but valve A is moved to the right hand position causing the jaws to close.

(3) When the jaws are closed, valve A is returned to the neutral position allowing free flow of oil through the valve A without any operating effect. To rotate the wall to the vertical position, valve B is moved (say) to the right until the rotation is performed.

(4) When the evacuation of material from chamber **19** is completed, valve B is moved to the left hand position to rotate the wall **38** to intermediately close the cylinder by moving the lever to the left, the lever A still remaining in the neutral position.

(5) (1) When it is desired to make a further dredging bite then the valve B is moved to the neutral position leaving the wall **38** intermediately closing the chamber and later the valve A is moved to the left to open the jaws and to the right to close the jaws as before.

The invention has been described with relation to a dredge working under water. It will be obvious that a similar operation could be performed in accord with the invention with an excavating clam having a pair of clam jaws working in a gravel pit or other excavation operation. Moreover it will be obvious that the invention is equally operable with one instead of two movable jaws. Thus a construction wherein a walled chamber is closed by an excavating bucket may equally be designed in accord with the invention and is intended to be included within the scope of the claims.

I claim:

1. Dredging means comprising: a pair of clam jaws at the lower extremity of a walled chamber and in their closed position forming a closure for said chamber, a wall longitudinally dividing said walled chamber along a portion of its length and extending between opposed walls thereof but leaving a connecting portion between said divided portion adjacent the clam jaws, a liquid inlet conduit connected to one of said portions and a liquid outlet connected to the other of said portions.

2. A walled chamber, a wall dividing said chamber into two separate portions with a connecting gap for the two separate portions adjacent one end of said chamber, at least one dredging jaw movably connected to the remainder of said walled chamber and forming an openable closure therefor, an area of said wall adjacent said gap being shaped to correspond to the cross-sectional shape of the chamber walls laterally thereabout and pivotally connected to the chamber walls to pivot to a position at right angles to the remainder of the walls to close off the chamber from the portion adjacent said jaw and consequently to provide a second connecting gap between the two divided portions on the other side of such pivoted portion from said jaws, a pressure inlet to one divided portion and a pressure outlet from the other.

3. Dredging means comprising a walled chamber terminating at its lower extremity in a pair of clam jaws which form the lower closure for said chamber and are pivotally mounted on the remainder of said lower chamber, means for opening and closing said jaws, a liquid inlet port to said walled chamber and means for supplying liquid thereto, a liquid outlet port from said chamber and means for disposing of liquid passing through such outlet port, means for directing liquid from said inlet port to said outlet port through said chamber along a path adjacent said jaws when forming said lower closure and for closing off a portion of said chamber connecting both said ports from the opening caused by the opening of said clam jaws.

4. Dredging means comprising a walled chamber terminating at its lower extremity in a pair of clam jaws which form the lower closure for said chamber and are pivotally mounted on the remainder of said walled chamber, means for opening and closing said jaws, said walled chamber being provided with a dividing wall extending from the jaw-remote end thereof but terminating short of said pivotally mounted jaws and their range of movement, the lower portion of said wall being pivotally mounted and shaped to rotate and divide said chamber into jaw-remote and jaw-adjacent portions, control means for reversibly rotating said pivotal portion, hydraulic supply and disposal lines connected to the interior of said chamber at inlet and outlet ports respectively, said inlet and outlet ports being so located that one is located on each side of said pivotal portion when acting as part of said dividing wall extending from the jaw remote end and so that they are both located on the jaw remote side of said pivotal portion when the latter divides said chamber into jaw-remote and jaw-adjacent portions.

5. A hydraulic dredging unit comprising: walls defining one end and the sides of a chamber, water supply and water outlet means adjacent said one end of said chamber; a pair of clam jaws defining the other end of said chamber, adapted to be opened and closed and adapted when closed to form with said one end and sides a relatively liquid tight chamber; means for bridging said jaws into contact with the surface to be dredged; means for opening and closing said jaws to bring material from such surface into said chamber; means operable when said jaws are closed for causing circulation in such chamber, whereby said chamber may be evacuated of dredged material; and means operable during the period said jaws are open to close off a portion of said chamber to which said water supply means and said water outlet means are connected from the portion of said chamber defined by said jaws when closed.

6. Dredging means comprising a wall chamber terminating at its lower extremity in a pair of clam jaws which form the lower closure for said chamber and are pivotally mounted on the remainder of said lower chamber, means for opening and closing said jaws, a liquid inlet port to said wall chamber and means for supplying liquid thereto, a liquid outlet port from said chamber and means for disposing of liquid passing through said outlet port, means for directing liquid from said inlet port to said outlet port through said chamber along a path adjacent said jaws when forming said lower closure and for closing off a portion of said chamber connecting both said ports from the opening caused by the opening of said clam jaws, wherein said liquid directing means comprises a pivotally mounted baffle wall adapted in combination with a stationary wall and in one position to divide the chamber into two sub-chambers between the inlet and outlet ports and to allow communication between said sub-chambers only adjacent the position of said jaws when closed and in the other position to close off a part of the chamber opening into said inlet and outlet port from the part of the chamber defined by the jaws when closed.

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