Sept. 11, 1956 L. BELL 2,762,136

HYDRAULIC DREDGE LADDER

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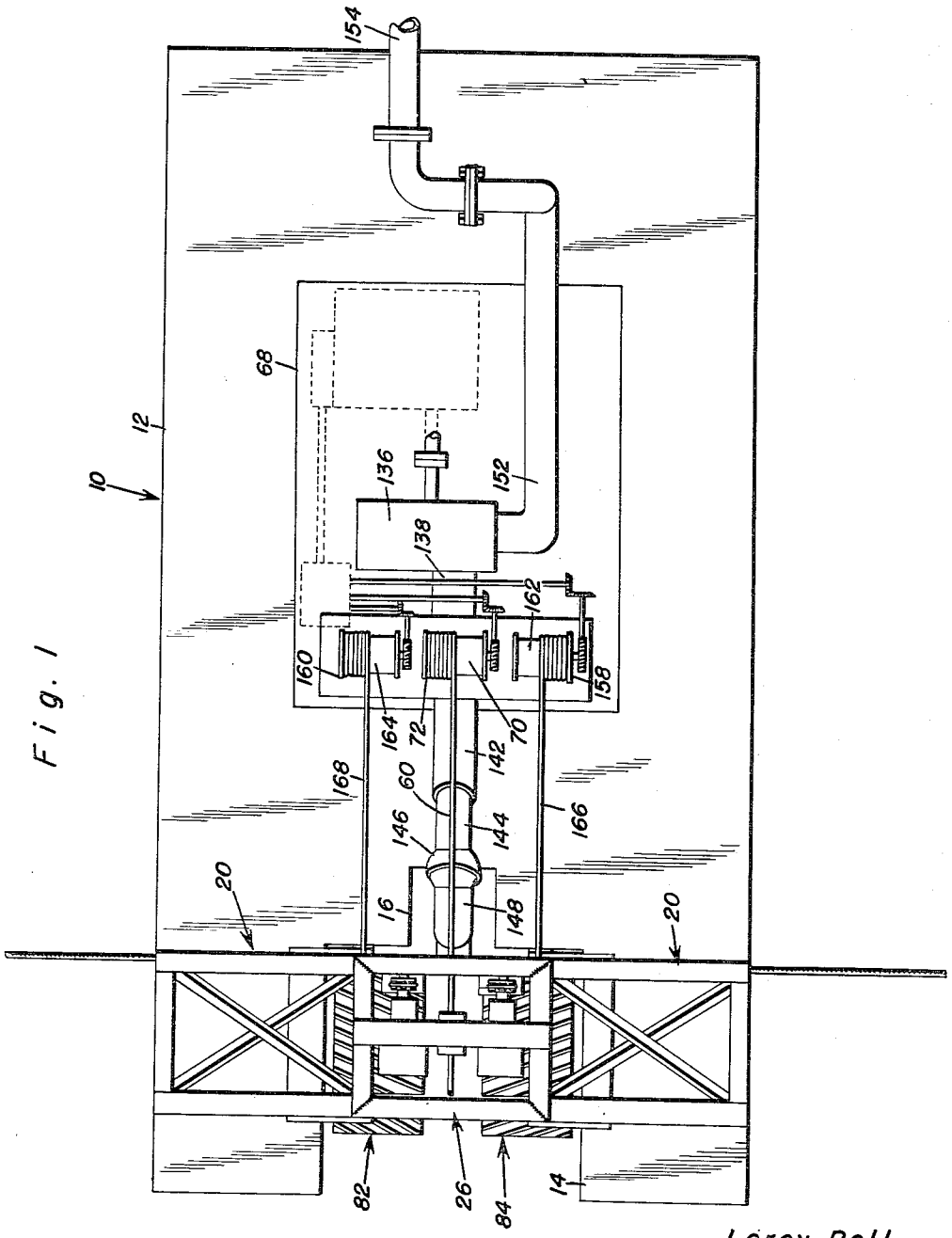


Fig. 1

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HYDRAULIC DREDGE LADDER

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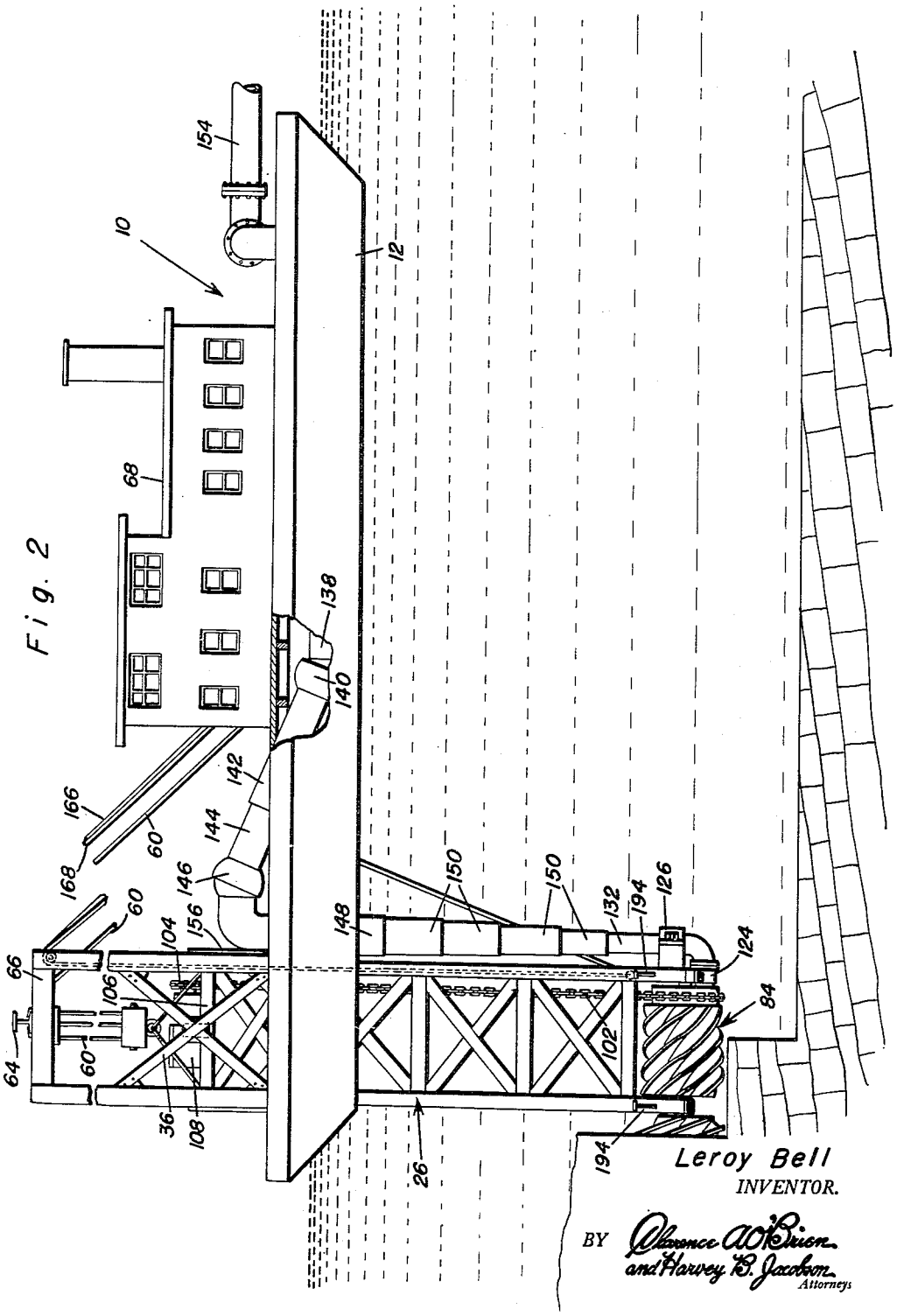


Fig. 2

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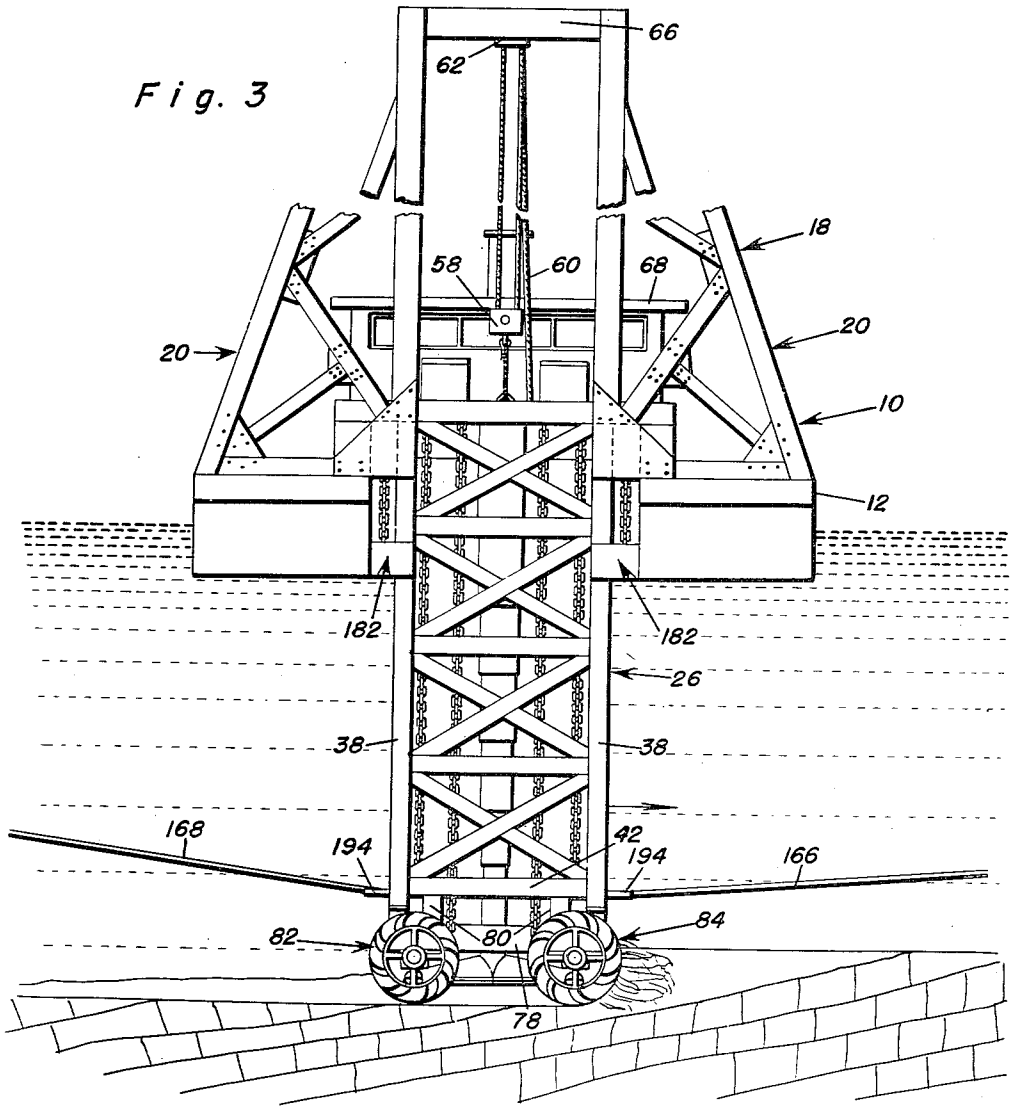
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HYDRAULIC DREDGE LADDER

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Fig. 3



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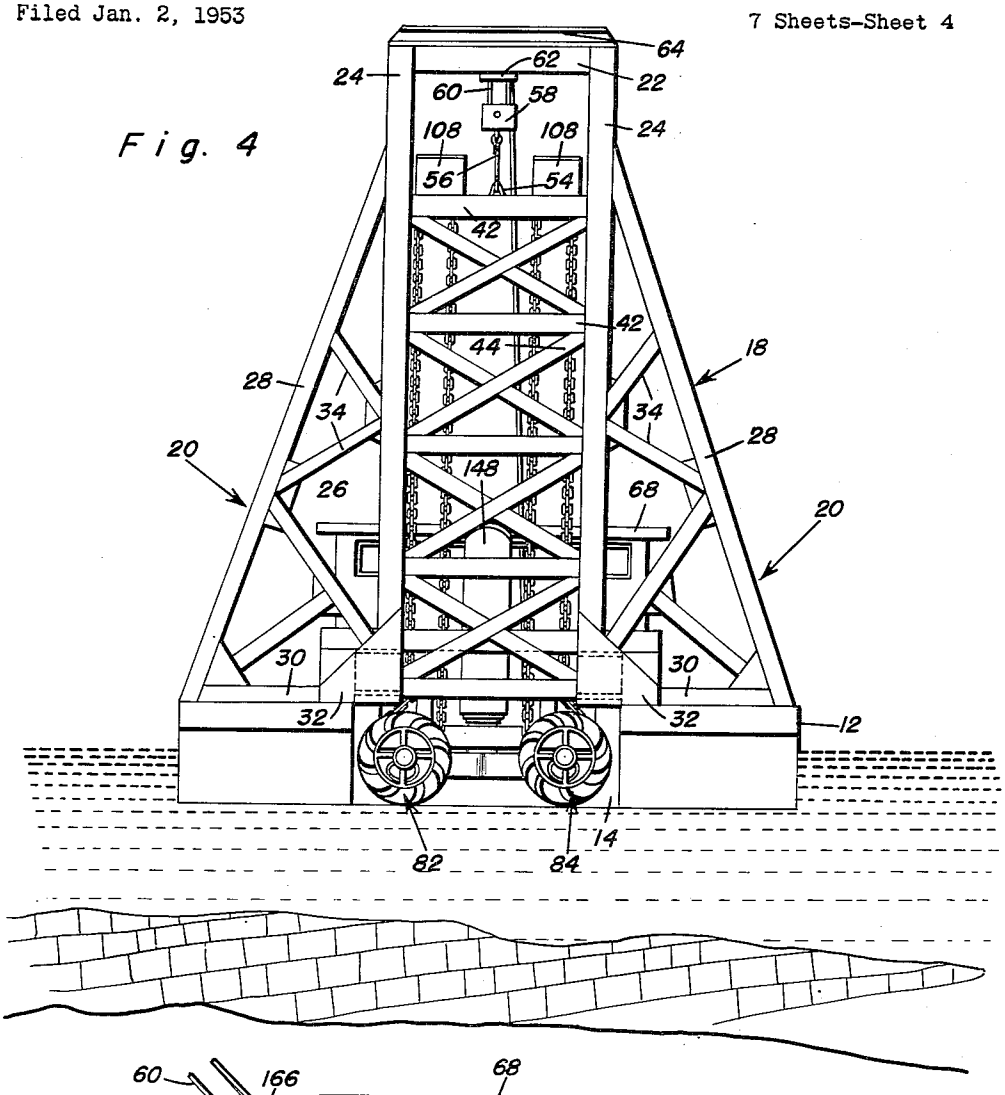
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HYDRAULIC DREDGE LADDER

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Fig. 4



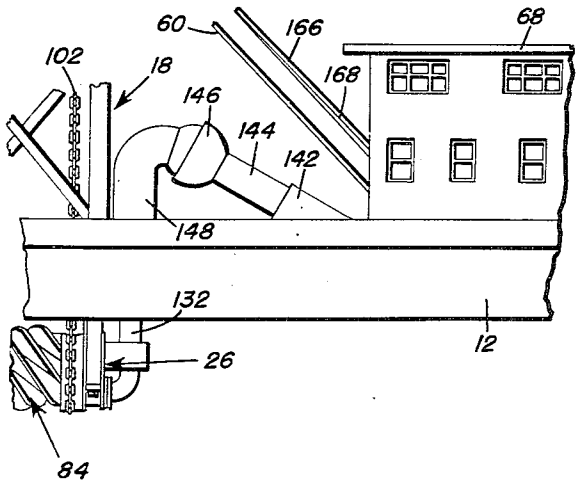


Fig. 11

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Fig. 5

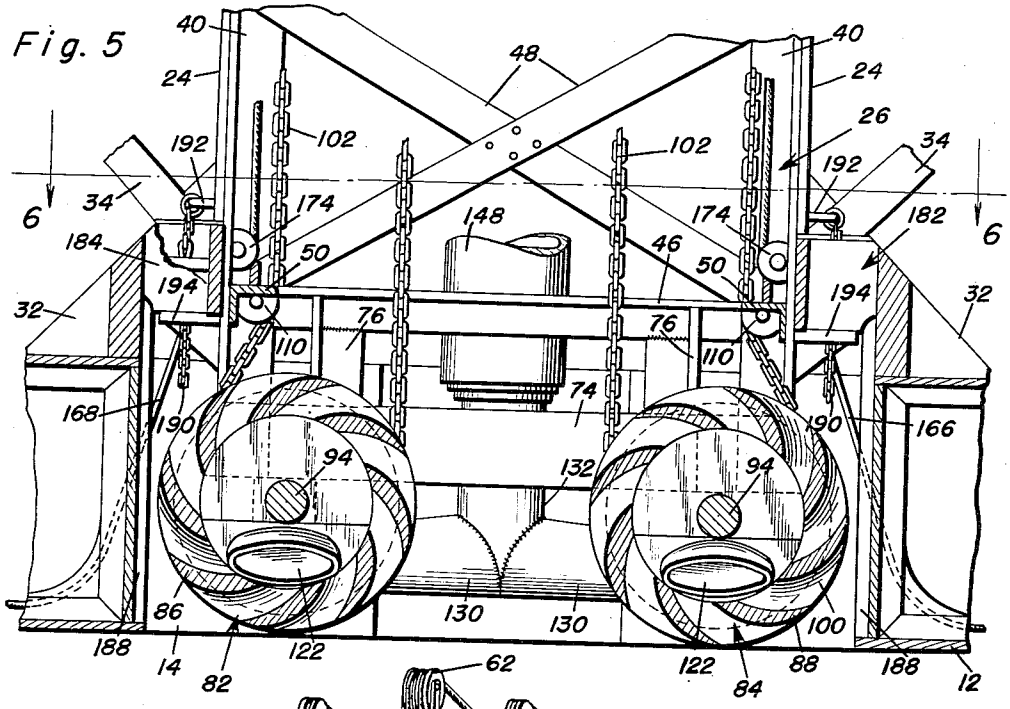


Fig. 7

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Fig. 6

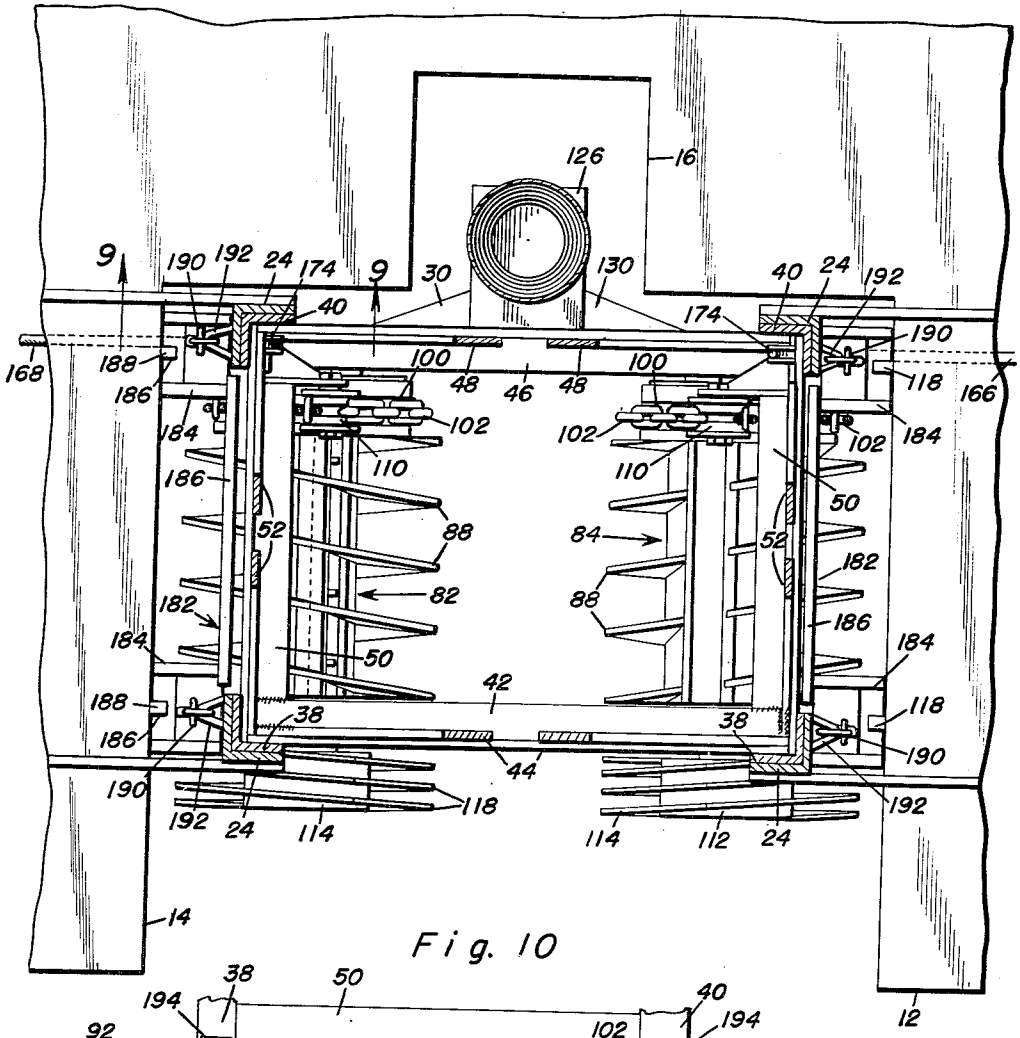
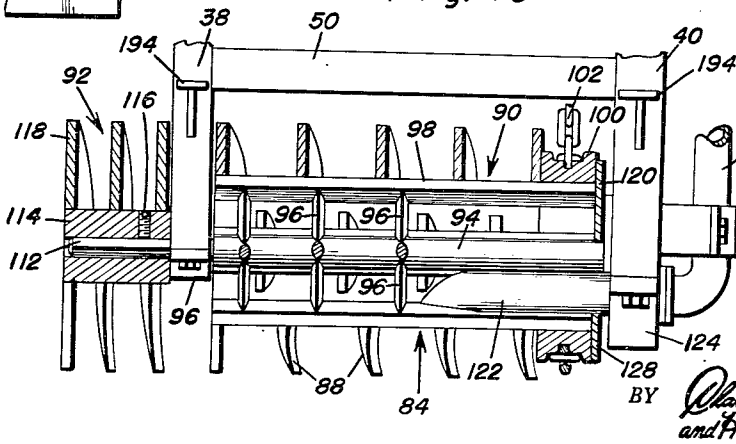


Fig. 10



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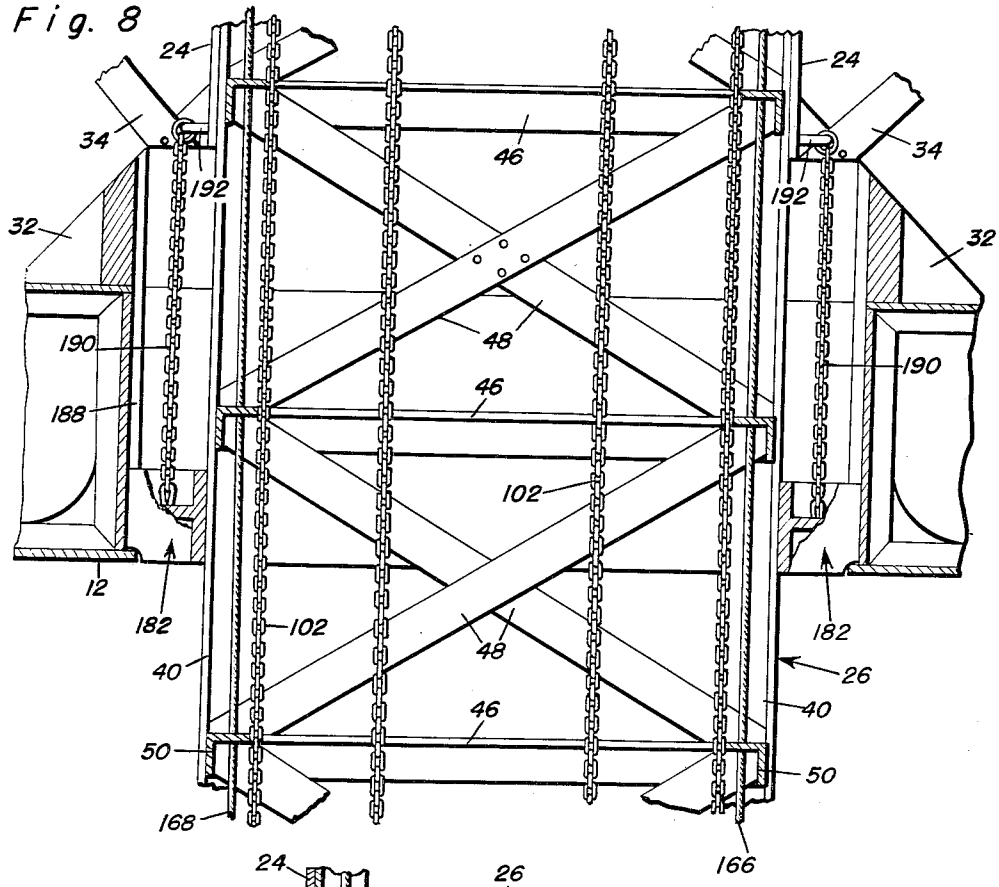
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HYDRAULIC DREDGE LADDER

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Fig. 8



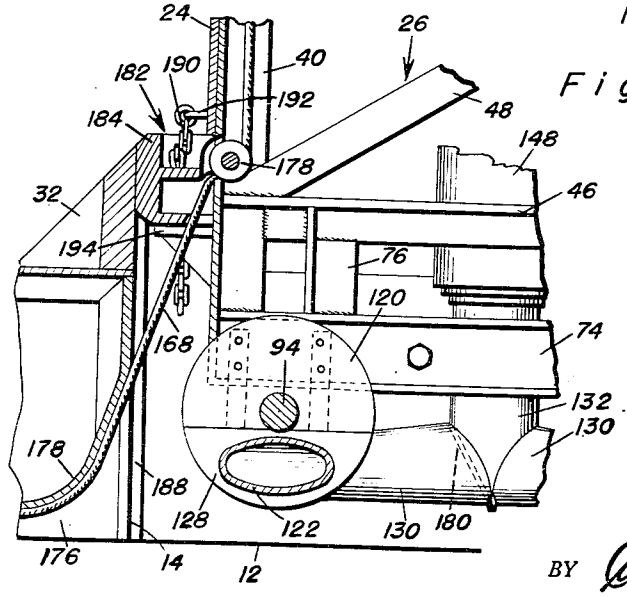


Fig. 9

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HYDRAULIC DREDGE LADDER

Leroy Bell, Fort Lauderdale, Fla.

Application January 2, 1953, Serial No. 329,213

2 Claims. (Cl. 37—67)

This invention relates in general to dredges, and more specifically to a hydraulic dredge ladder construction.

At the present time, the hydraulic dredges in use consist of a dredge hull which has mounted at the forward end thereof an A-frame from which extends forwardly a hydraulic ladder. The hydraulic ladder is supported at its rear end by the A-frame and during a cutting operation, the outer end thereof is primarily supported by a cutter head of the same. This arrangement is disadvantageous inasmuch as the entire weight of the dredge ladder may not be placed on the cutter head to facilitate the cutting of rock and the like, the dredge ladder extends forwardly from the supporting A-frame with the result that a cantilever action takes place when the dredge hull is swung during a dredging operation by swinging cables attached to the dredge hull, and the arrangement of the cutter head on conventional dredge ladders is such that the cutter head cuts only when the dredge is being swung in one direction. tI is therefore the primary object of this invention to provide an improved hydraulic dredge ladder arrangement which will overcome all of the above mentioned disadvantageous features.

Another object of this invention is to provide an improved hydraulic dredge ladder construction which includes a vertical A-frame mounted at the forward end of a dredge hull and being constructed to have a dredge ladder movable vertically therethrough, a dredge ladder mounted within the A-frame for vertical movement whereby the entire weight of the dredge ladder may be placed directly upon cutter heads carried thereby.

Another object of this invention is to provide an improved hydraulic dredge ladder construction in which the dredge ladder remains substantially within the confines of the dredge hull and to which swinging cables are connected whereby side thrust is imparted directly to the dredge ladder adjacent the cutter head thereof so as to eliminate bending and other stresses in the dredge ladder and its associated support.

Another object of this invention is to provide an improved dredge ladder which may be lifted vertically through a well in the dredge hull, said dredge ladder and said well being so arranged whereby the cutter head carried by the dredge ladder may be raised up onto the confines of the dredge hull within said well so that the dredge hull may be floated into position.

A further object of this invention is to provide an improved hydraulic dredge ladder construction which includes first and second cutter heads, said cutter heads being designed to rotate in opposite directions so as to cut when the dredge is being swung in opposite directions, said cutter heads permitting a dredging action regardless of the direction in which the dredge is being swung.

A still further object of this invention is to provide an improved dredge ladder construction which includes a support and a vertically adjustable dredge ladder, said support and dredge ladder having associated therewith a vertically movable guiding framework which is telescoped over the dredge ladder and which is positionable within the confines of a well in a dredge hull through which the dredge ladder passes in order to properly support the dredge ladder against transverse movement.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like reference numerals refer to like parts throughout, and in which:

Figure 1 is a top plan view of a hydraulic dredge and shows the general arrangement of the improved dredge ladder construction, other portions of the hydraulic dredge being shown in schematic;

Figure 2 is a side elevational view of the dredge of Figure 1 and shows the dredge ladder in a lowered position with the cutter head thereof in the middle of a dredging operation, a portion of the dredge hull being broken away and shown in section in order to clearly illustrate a universal joint of suction piping, an intermediate portion of a supporting frame for the dredge ladder being omitted;

Figure 3 is a front elevational view of the hydraulic dredge of Figure 1 and clearly shows the details of the improved hydraulic ladder and its two cutter heads, also shown is the relationship between the hydraulic ladder and its associated supporting frame, an intermediate portion of the supporting frame being omitted;

Figure 4 is a front elevational view similar to Figure 3 and shows the dredge ladder in its uppermost position within its supporting frame to permit movement of the hydraulic dredge from one place to another through relatively shallow water;

Figure 5 is an enlarged fragmentary transverse vertical sectional view taken through the lower portion of the dredge ladder and shows its general construction and the relationship of the same to the dredge hull when it is in its uppermost position;

Figure 6 is a fragmentary transverse horizontal sectional view taken substantially upon the plane indicated by the section line 6—6 of Figure 5 and shows the general cross-section of the hydraulic ladder and a central portion of its supporting frame;

Figure 7 is a schematic diagram of the means for controlling a dredging operation of the hydraulic dredge of Figure 1;

Figure 8 is a fragmentary vertical sectional view taken through the dredge ladder in the vicinity of the dredge hull when the dredge ladder is in a lowered position and shows the relationship of a vertically movable supporting framework telescoped over the dredge ladder for supporting the lower portion thereof within a well in the dredge hull through which the dredge ladder extends;

Figure 9 is an enlarged fragmentary vertical sectional view taken substantially upon the plane indicated by the section line 9—9 of Figure 6 and shows the general construction of a rear portion of one of the cutter heads and the arrangement of suction piping connected to the same, also shown is the arrangement of one swinging cable and the manner in which it is connected to a lower portion of the dredge ladder;

Figure 10 is an enlarged fragmentary longitudinal view through one of the cutter heads and shows the general construction of the same; and

Figure 11 is a fragmentary side elevational view of the dredge ladder similar to Figure 2 and shows the relationship of the dredge ladder and its associated suction piping to the dredge hull when the same is in a raised position.

Referring now to the drawings in detail, it will be seen that there is illustrated a hydraulic dredge which

is referred to in general by the reference numeral 10 and which includes a dredge hull 12. The dredge hull 12 has the general configuration of conventional dredge hulls with the exception that the forward end of the same is provided with an enlarged well 14 which is best illustrated in Figure 6. Communicating with the large well 14 at the rear end thereof is a centrally located smaller well 16 whose purpose will be set forth in more detail hereinafter.

Rigidly secured to the front portion of the dredge hull 12 and extending upwardly therefrom in overlying relation to the well 14 is a supporting frame which is of the A-frame type and which is referred to in general by the reference numeral 18. The supporting frame 18 includes a pair of identical halves which are referred to in general by the reference numeral 20 and which are joined together at their upper ends by transverse frame members 22. Each of the frame halves 20 includes a pair of longitudinally spaced angle members 24 which form the main frame members of the frame halves 20 and which also function as guide members for a dredge ladder which is carried by the supporting frame 18, the dredge ladder being referred to in general by the reference numeral 26 and will be described in more detail hereinafter.

Each frame half 20 also includes a pair of diagonal frame members 28 which slope upwardly and inwardly and which are secured to their respective angle members 24 adjacent the upper ends thereof. The lower ends of the diagonal frame members 28 are secured to the lower ends of the angle members 24 by a horizontal frame member 30 and a supporting gusset construction 32. It will be understood that the horizontal frame member 30 lies directly on the deck of the dredge hull 12 and is rigidly secured to the dredge hull to support the associated angle member 24 in cantilever relation overlying the well 14. Also connecting together the angle members 24 and their associated diagonal frame members 28 are diagonal braces 34 and longitudinal bracing 36, the longitudinal bracing being best illustrated in Figure 2.

The dredge ladder 26 is generally rectangular in cross-section and is formed by front and rear pairs of vertical frame members 38 and 40, respectively, which are in the form of angle members internested within the angle members 24 so as to be guided thereby for vertical movement. Connecting together the front vertical frame members 38 at vertically spaced intervals are front horizontal frame members 42 which have disposed therebetween diagonal bracing 44. The rear vertical frame members 40 are also connected together by similar horizontal frame members 46 and diagonal bracing 48.

The dredge ladder 26 also includes horizontal side frame members 50 which connect together adjacent front and rear vertical frame members 38 and 40. Interconnecting vertically spaced side frame members 50 are diagonal braces 52.

Carried by uppermost horizontal frame members 42 and 46 are longitudinally aligned pad eyes 54 which have connected thereto lower ends of lifting bars 56. The upper ends of the lifting bars 56 are connected to a hook of a traveling block 58 which is connected by an elongated cable 60 to a crown block 62. The crown block 62 is suspended from a cross beam 64 resting upon and secured to upper horizontal side frame members 66 which connect together the upper ends of the angle members 24 of each frame half 20. A free end of the cable 60 extends into a deck house 68 of the hydraulic dredge 10 and is reeled upon a drum 70 of a winch 72 of the hydraulic dredge 10.

Extending between the rear vertical frame members 40 of the dredge ladder 26 and secured to the same adjacent their lower ends is an enlarged transverse frame member 74. The transverse frame member 74 is braced by a pair of intermediate vertical frame members 76 whose upper ends are secured to the lowermost rear horizontal frame member 46 intermediate the ends thereof.

Referring now to Figure 3 in particular, it is seen that extending between and connecting together lower ends of the front vertical frame members of the dredge ladder 26 is a transverse frame member 78 which is identical to the transverse frame member 74 and is in longitudinal alignment therewith. The transverse frame member 78 is also braced intermediate its ends by depending vertical frame members 80 which are secured to the lowermost front horizontal frame member 42.

Carried at the lower end of the dredge ladder 26 and supported by the transverse frame members 74 and 78 are cutter heads 82 and 84. Referring now to Figure 5 in particular, it is seen that the two cutter heads 82 and 84 are identical, with the exception that their individual cutting blades 86 and 88, respectively, are curved in different directions and are designed to cut effectively when the cutter heads 82 and 84 are rotated in opposite directions. The purpose of the difference in the blading of the two cutter heads will be explained in more detail hereinafter.

Inasmuch as the two cutter heads 82 and 84 are identical except for the arrangement of their blades, only one of the cutter heads, the cutter head 84 will be explained in detail. As is best illustrated in Figure 10, the cutter head 84 includes a rear main cutter 90 and a forward auxiliary cutter 92. The rear main cutter 90 includes a longitudinally extending supporting shaft 94 which is rotatably journaled in suitable pillow blocks 96 detachably secured to the lower side of the transverse frame members 78 and 80, the pillow block secured to the transverse frame member 78 not being illustrated. The main cutter 90, which is disposed between the transverse frame members 74 and 78, includes a plurality of longitudinally extending blade supports 98 which are secured to the shaft 94 by a plurality of longitudinally spaced spokes 96. It will be noted that the spokes 96 are disposed only in the forward half of the main cutter 90. Carried by the blade supports 98 are suitable spiral cutter blades 88 which have been described in more detail above.

In order that the main cutter 90 may be conveniently rotated, there has been rigidly secured to the rear portions of the blade supports 98 a drive pulley 100. The drive pulley 100 has entrained thereover a drive chain 102 whose upper end is entrained over a drive pulley 104 which is carried by a drive shaft of a reduction gear box 106. The reduction gear box 106 is upwardly connected to a power source, such as an internal combustion engine 108, the reduction gear box 106 and the internal combustion engine 108 being supported by uppermost frame members of the dredge ladder 26. Inasmuch as the drive pulley 100 is disposed slightly outwardly of the confines of the dredge ladder 26, there is carried by an associated lowermost side frame member 50 an idler pulley 110. As is best illustrated in Figure 5, the idler pulley 110 urges the drive chain inwardly as it comes off its associated drive pulley 100 so as to be disposed within the confines of the dredge ladder 26.

The forward end of the shaft 94 is reduced and polygonal in cross-section as at 112. Rigidly mounted on the reduced portion 112 of the shaft 94 for rotation therewith is a hub 114, the hub 114 being secured on the reduced portion of the shaft 112 by a locking member 116. The hub 114 is part of the auxiliary cutter 92 and has supported thereby spiral cutter blades 118.

Secured to the front face of the transverse frame member 74 in a manner best illustrated in Figure 10 is a rear plate 120 which encloses the upper portion of the main cutter 90. Extending into the lower portion of the main cutter 90 rearwardly of the rearmost spokes 96 is a suction inlet pipe 122 which is supported by remov-

able yokes 124 and 126 secured to the bottom and rear of the transverse frame member 74, respectively. Carried by the inlet suction pipe 122 and closing the bottom portion of the rear of the main cutter 90 is a lower plate 128 which has passing therethrough the inlet suction pipe 122.

Referring now to Figures 5 and 6 in particular, it is seen that each of the inlet suction pipes 122 includes a horizontally disposed section 130 which are connected together with a vertical suction pipe 132 to form a Y-fitting. While the yoke 126 does aid in the support of the suction inlet fittings 122, it will be noted that it is actually connected to the suction pipe 132 for retaining the same in a vertical position.

Referring now to Figures 1 and 2 in particular, it will be seen that mounted within the deck house 68 is a suitable rotary pump 136 which is provided with an inlet 138. The inlet 138 is connected by a universal joint 140 to a first generally horizontal suction pipe 142. Telescoped within the first horizontal suction pipe 142 is a second horizontal suction pipe 144. The second horizontal suction pipe 144 is connected by a universal fitting 146 to an L-shaped upper end of a vertical suction pipe 148. The vertical suction pipe 148 is connected by a plurality of intermediate telescope vertical suction pipes 150 to the suction pipe 132. The rotary pump 136 also includes a discharge pipe 152 which may be connected to suitable discharge pipes 54 which extend over the stern of the dredge hull 12 and may either lead to the shore or other points of discharge.

When it is desired to elevate the dredge ladder 26 so that the cutter heads 82 and 84 thereof are disposed within the well 14, it will be seen that it will be necessary to telescope the suction pipes 148, 150 and 132. Inasmuch as the length of the pipes when extended, as compared to their combined length when telescoped, is by construction greater than that of the extended length of the dredge ladder 26 as compared to its elevated projecting length, it will be seen that it is necessary for the upper suction pipe 148 to be elevated in order that the dredge ladder 26 may be elevated to its uppermost position. In order to assure vertical movement of the upper suction pipe 148, it is connected to a suitable guide way 156 carried by the rear portion of the supporting frame 18. Vertical movement of the upper vertical suction pipe 148 necessitates the universal fittings 140 and 146 as well as the telescoping suction pipes 142 and 144.

As is best illustrated in Figures 1 and 7, the hydraulic dredge 10 has also mounted in its deck house 68 a pair of winches 158 and 160 which include drums 162 and 164. The drums 162 and 164 have reeled thereon ends of swinging cables 166 and 168, respectively. The swinging cables 166 and 168 extend from the opposite sides of the hydraulic dredge 10 and have their other ends anchored to suitable dolphins 170 and the like.

The swinging cables 168 and 170 extend upwardly from their respective drums 162 and 164 and are entrained over suitable sheaves 172 carried by an upper rear portion of the supporting frame 18. The cables 166 and 168 then pass downwardly through the supporting frame 18 and the dredge ladder 24 and are entrained over lower sheaves 174 carried by the rear vertical frame members 40 adjacent the lower ends thereof.

Inasmuch as it may be undesirable to disengage the cables 166 and 168 from their respective sheaves 174 while moving the hydraulic dredge 10, the dredge hull 12 has been provided with suitable recesses 176 in the bottom and inner side portions thereof adjacent the well 14. The upper portions of the recesses 176 include curved plates 178 over which the cables 166 and 168 pass to facilitate sliding of the same.

In the normal operation of a hydraulic dredge, one of the swinging cables will be payed out while the other is taken in at the same rate. This causes the swinging of the entire hydraulic dredge in one direction. Inasmuch as the cutting blades of the cutter head of the hydraulic dredge should be drawn into the material being dredged, and since a cutter head can only cut in one direction, it will be seen that during a dredging operation with a conventional dredge that the dredging will be done in one direction only. This results in a loss of time by reversing the paying out and taking in of the cables to swing the dredge in an opposite direction to start the dredging operation over.

In the present hydraulic dredge, the hydraulic dredge 10, the provision of two cutter heads 82 and 84 which are designed to rotate in opposite directions permit the hydraulic dredge 10 to perform a dredging operation regardless of the direction in which it is being swung. When the hydraulic dredge 10 is swung to the right, as viewed in Figure 1, the cutter head 82 engages the material to be moved and the same is drawn rearwardly through its associated inlet suction pipe 122 due to the action of the rotary pump 136. During this time the swinging cable 168 is being taken in while the swinging cable 166 is being payed out. When the end of the cut is reached, the dredge ladder 26 is lowered the desired depth through the use of the winch 70. The cutter head 82 is then stopped and the cutter head 84 is rotated simultaneously with the taking in of the swinging cable 166 and the paying out of the swinging cable 168. In order that material cut by the cutter head 84 may be drawn into the rotary pump 136, a valve 180, which is best illustrated in Figure 9, controlling the flow of material into the lower vertical suction pipe 132 from the pipes 130 has its position reversed to communicate the inlet suction pipe 122 of the cutter head 84 with the rotary pump 136.

Inasmuch as the cutter heads 82 and 84 extend outwardly of the confines of the dredge ladder 26, it will be seen that the well 14 has a width greater than the width of the dredge ladder 26 to provide clearance for the cutter heads 82 and 84. In order that the dredge ladder 26 may be supported against bending movement at the extreme bottom of the dredge hull 12, there is provided a framework which is referred to in general by the reference numeral 182 at each side of the dredge ladder 26 and the sides of the well 14. Each framework 182 includes a vertical guide member 184 disposed adjacent the front and rear corners of the dredge ladder 26 at its respective side. The vertical guide members 184 of each framework 182 are connected by a horizontal member 186. It will be noted that each of the guide members 184 includes a vertical guide way 187, in which is disposed a vertical guide member 188 carried by an adjacent side of the well 14 and projecting inwardly thereof. It will be seen that the guide members 188 guide the frameworks 182 in their vertical movement.

When the dredge ladder 26 is in a lowered position, as is best illustrated in Figure 8, the frameworks 182 are disposed adjacent the bottom of the dredge hull 14 and are suspended from cables 190 connected to eyes 192 carried by the angle members 24 of the supporting frame 18. However, when the dredge ladder 26 is in its uppermost position, as is best illustrated in Figure 9, the frameworks 182 are raised upwardly out of the well 14 to provide clearance for the cutter heads 82 and 84. In order that the frameworks 182 may be moved upwardly upon upward movement of the bottom of the dredge ladder 26 into the well 14, there is carried by the vertical frame members 38 and 40 adjacent their lower ends outwardly projecting stop members 194. The stop members 194 engage beneath each of the vertical guide members 184 and urge the frameworks 182 upwardly to the positions best illustrated in Figure 9. Thus, it will be seen that the dredge ladder 26 may be supported the full depth of the dredge hull 12, and at the same time, there will be provided sufficient clearance for the cutter heads 82 and 84 of the dredge ladder.

Referring now to Figure 6 in particular, it will be seen

that the well **16** is of a sufficient size to permit the passage of the various sections of the suction pipe connecting the cutter heads **82** and **84** to the rotary pump **136**.

From the foregoing, it will be seen that there has been disclosed an improved hydraulic dredge construction which includes a dredge ladder which is vertically movable and which extends in a vertical direction whereby the full weight of the dredge ladder may be placed upon the cutter heads of the same to provide more efficient cutting. Also, it will be seen that the swinging cables of the hydraulic dredge are connected directly to the dredge ladder adjacent its lower end so that the sideward thrust upon the cutter heads will be imposed almost directly at their points of support so as to eliminate bending stresses in the dredge ladder other than those imposed by resistance of the dredge hull to sideward movement through the water. Also, by providing two cutter heads instead of the customary one, it is seen that a dredging operation may be continued regardless of the direction in which the dredge is being swung.

In the actual operation of one of the cutter heads, the auxiliary cutter **92** thereof will penetrate the deepest into a rock or the like formation and urge particles of the same back to the main cutter **90** which operates in a normal manner. The main cutter **90**, which is provided with a hollow center, will then direct the cuttings into the inlet suction pipe **122** associated therewith. In the case of a rock formation, it will be seen that no rock will be cut in the space between the main cutter **90** and the auxiliary cutter **92**. Inasmuch as this rock would be engaged by one of the front vertical frame members **38**, it will be seen that in the case of a relatively soft rock, the front vertical frame member will cause the narrow portion of rock left between the two cutters to break off and pass into the main cutter **90**. However, in the case of extremely hard rocks, the pressure exerted by the front frame member **38** may not be sufficient to break off the rock formation. In this case, it may be necessary to provide outwardly projecting teeth (not shown) on the front vertical frame member to cause a lifting action upon the rock formation to break the same up.

It will be understood that the controls for the improved hydraulic dredge which has been disclosed above will be substantially the same as that of conventional dredges and only minor changes will be necessary in hydraulic dredges now in use to convert them to the type disclosed.

From the foregoing, the construction and operation of the device will be readily understood and further explanation is believed to be unnecessary. However, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction shown and described,

and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the appended claims.

What is claimed as new is as follows:

1. A hydraulic dredge comprising a dredge hull, a dredge ladder mounted at one end of said dredge hull, a cutter head at the lower end of said dredge ladder, said ladder extending vertically, said ladder passing through an open well in said dredge hull, a framework telescoped over said dredge ladder positioning said dredge ladder within said well, said ladder being mounted in a vertical frame carried by said dredge hull, said framework being suspended from said vertical frame, stop means on said dredge ladder with said framework in an upper position of said dredge ladder for elevating said framework with said dredge ladder.

2. A hydraulic dredge comprising a dredge hull, a dredge ladder mounted at one end of said dredge hull, a cutterhead supported by the lower end of said dredge ladder, said ladder extending vertically, a well in said dredge hull opening through one end of said dredge hull, said ladder passing through said open well, a framework telescoped over said dredge ladder positioning said dredge ladder within said well, a vertical frame carried by said dredge hull, said ladder being mounted in said vertical frame, said framework being suspended from said vertical frame, stop means on said dredge ladder engaging said framework in an upper position of said dredge ladder for elevating said framework with said dredge ladder, means for vertically adjusting said dredge ladder, pump means carried by said dredge hull, suction piping connecting said pump means to said cutterhead, said piping including vertically telescoping sections extending within said ladder, a lowermost of said sections being rigidly secured to said cutterhead, an uppermost of said sections being guidingly connected to said vertical frame.

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