C. B. ASKEW.

HYDRAULIC EXCAVATOR.

APPLICATION FILED SEPT. 16, 1908.

934,031.

Patented Sept. 14, 1909.

3 SHEETS—SHEET 1.

Fig. 1.

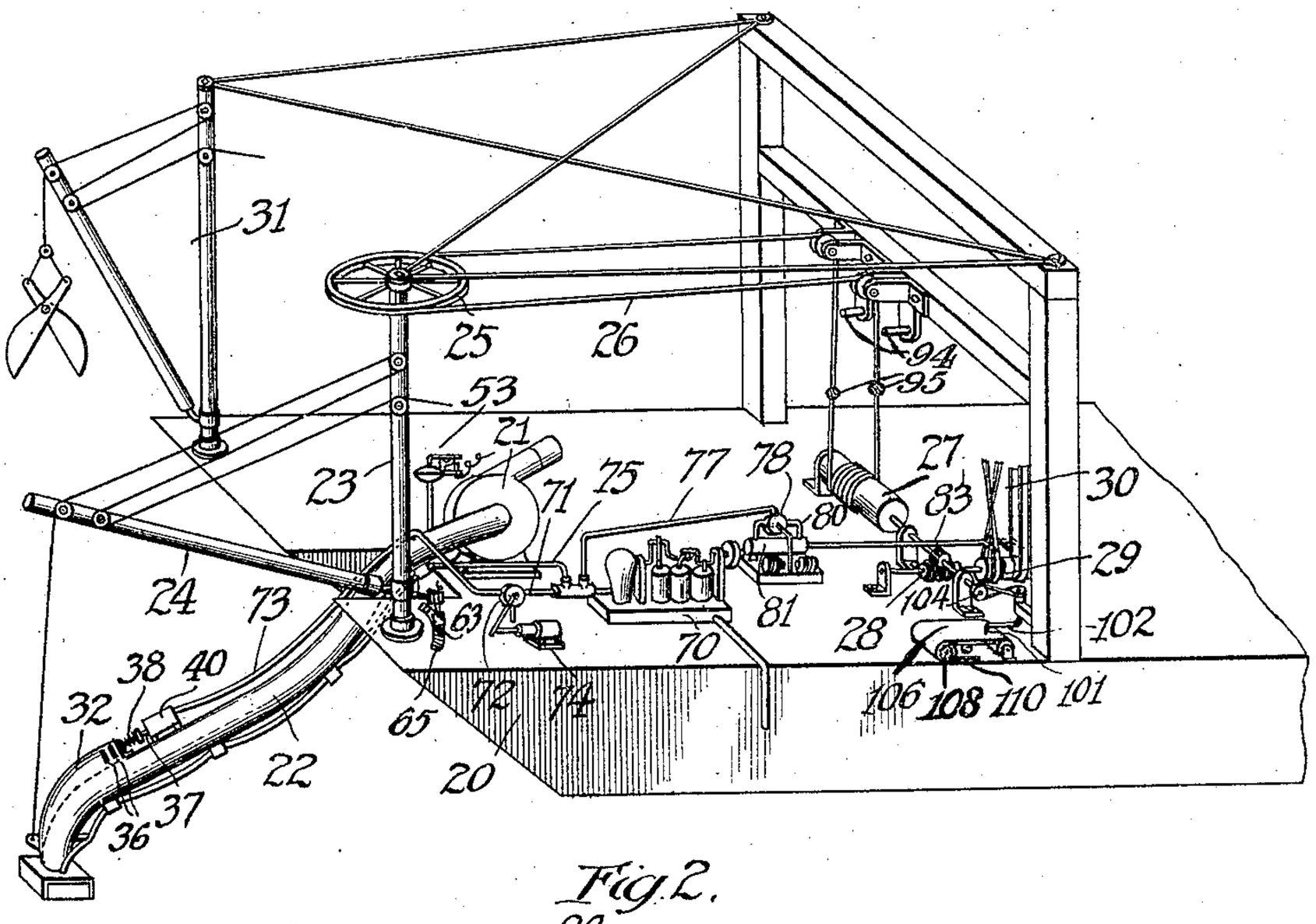


Fig. 2.

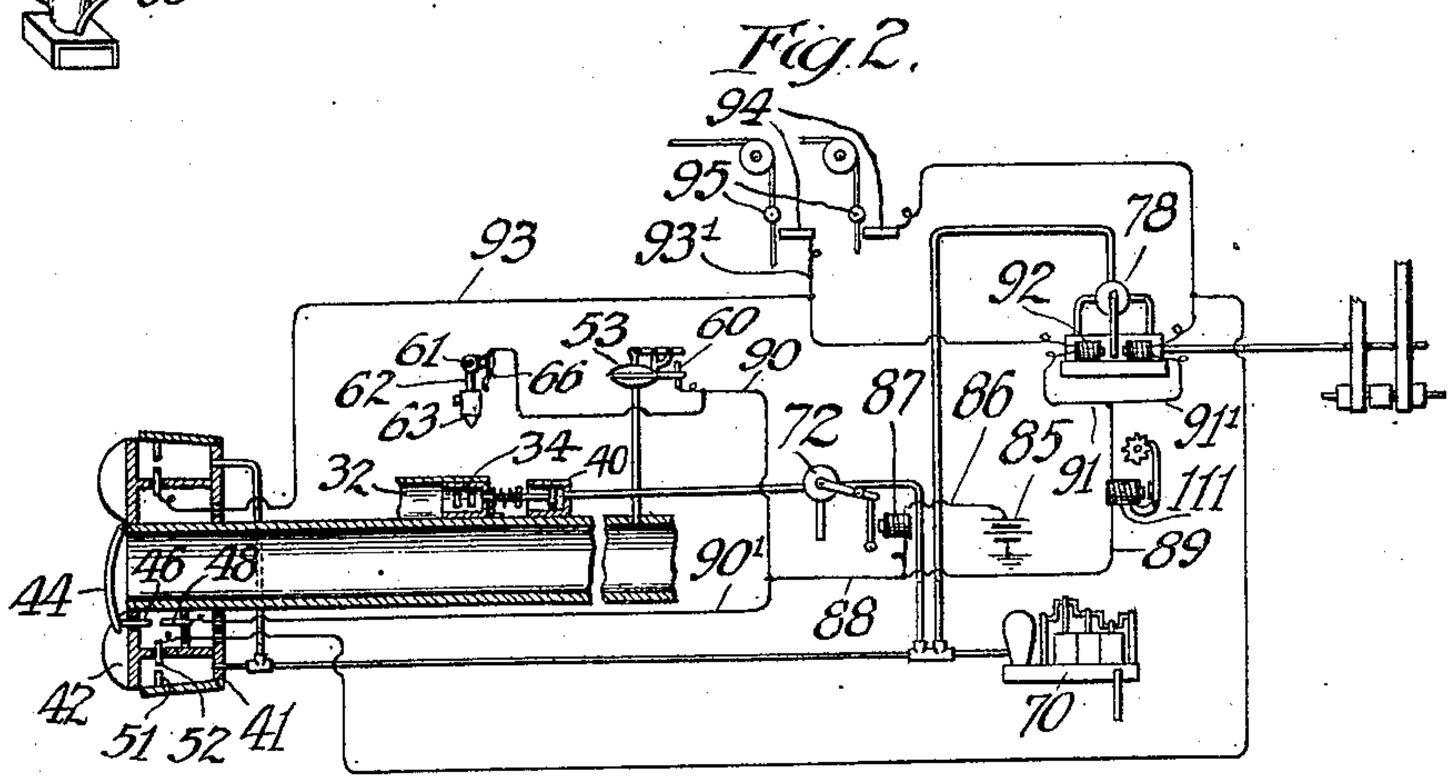


Fig. 3.

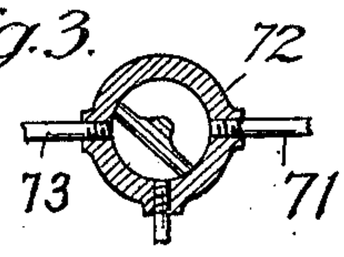
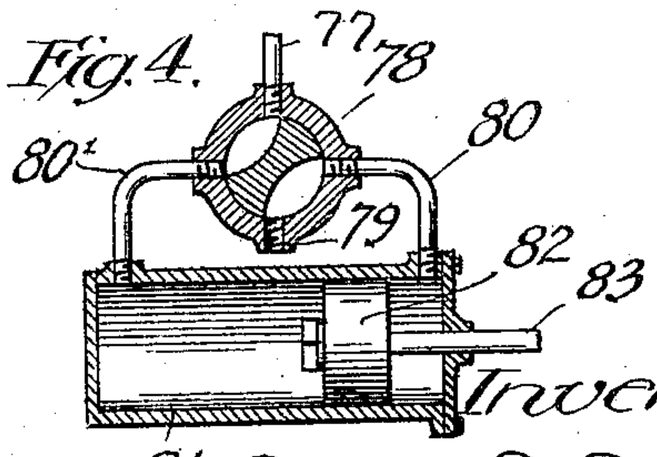


Fig. 4.



Witnesses

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H. R. L. White

Inventor

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3 SHEETS—SHEET 2.

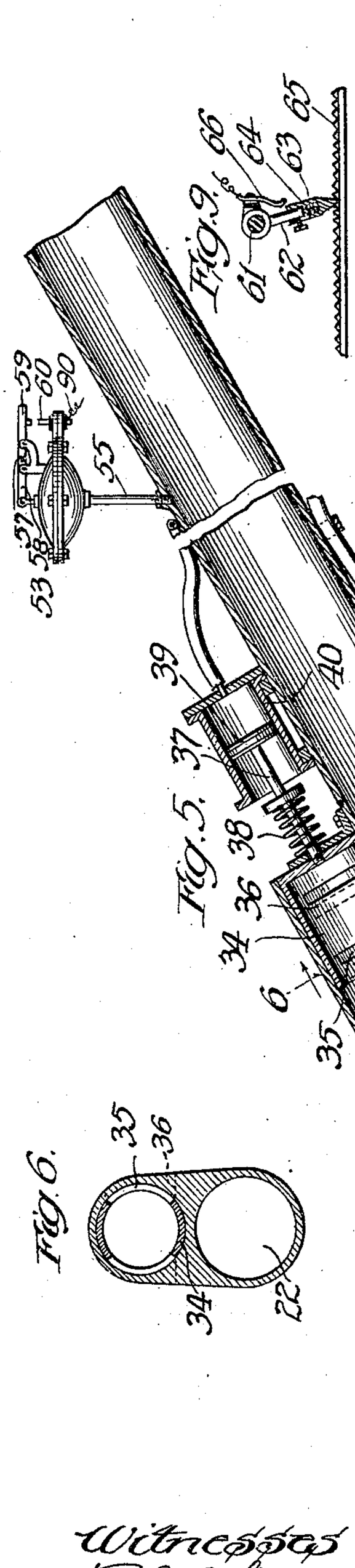

Fig. 5.

Fig. 8.

Fig. 7.

Fig. 6.

Witnesses
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3 SHEETS—SHEET 3.

Fig. 10.

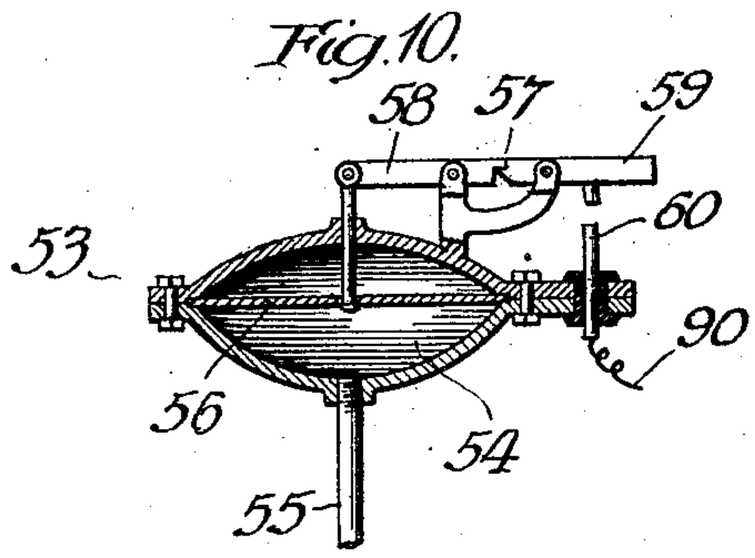

Fig. 11.

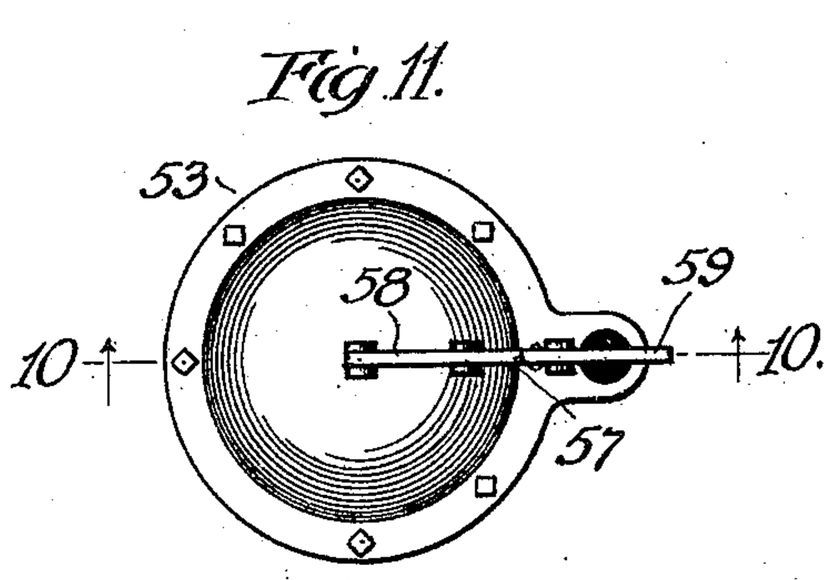

Fig. 12.

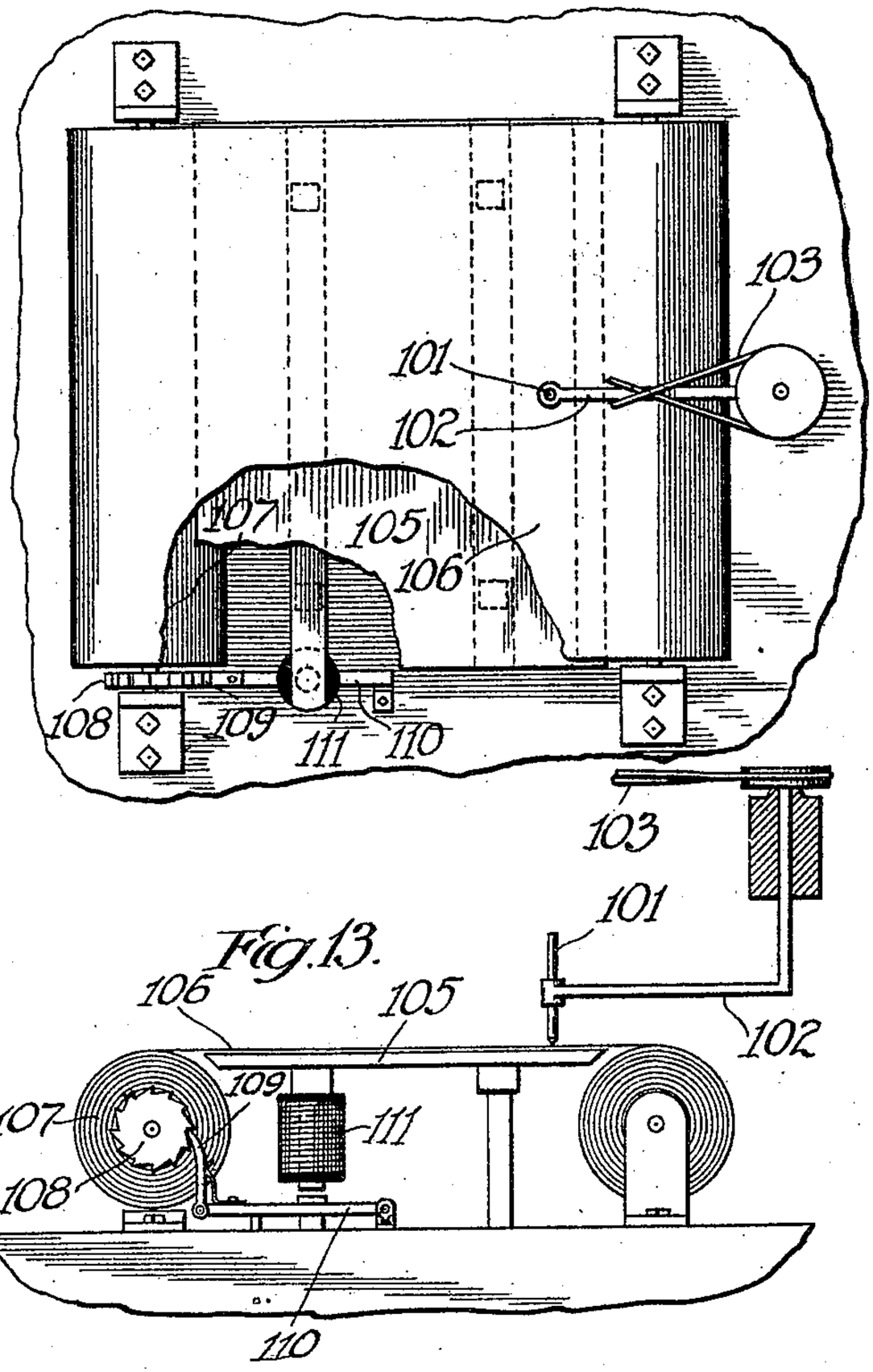

Fig. 13.

Witnesses
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UNITED STATES PATENT OFFICE.

CHARLES B. ASKEW, OF CHICAGO, ILLINOIS.

HYDRAULIC EXCAVATOR.

934,031. Specification of Letters Patent. **Patented Sept. 14, 1909.**

Application filed September 16, 1908. Serial No. 453,362.

To all whom it may concern:

Be it known that I, CHARLES B. ASKEW, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Hydraulic Excavators, of which the following is a specification.

My invention relates to improvements in hydraulic excavators, and more particularly to hydraulic suction dredges in which there is provided a pump or exhauster acting on a suction pipe or trunk, which is movable over the area to be dredged, and provided at or adjacent its head or suction mouth with a closable relief orifice, by which water may be permitted to enter the pipe through its side adjacent the suction mouth.

Among the features of my invention are the provision of means for automatically operating the relief valve to admit water to the suction pipe above the normal suction mouth at any time that the suction pipe becomes clogged; or when the suction pipe meets with an obstruction to its progress; or at any time that the direction of movement of the suction pipe is reversed, or at all such times; likewise the provision of automatic means whereby the contact of the suction mouth with any serious obstruction causes a reversal of the direction of movement of said suction mouth, and further the provision of means whereby the traverse of the suction pipe is recorded.

Other objects and features of novelty of my invention will become apparent from the following description taken in conjunction with the accompanying drawings, wherein I have illustrated, in a form exaggerated in parts for purposes of full disclosure, an embodiment of my invention.

In the drawings; Figure 1 is a perspective view of a portion of a dredging scow equipped with an embodiment of my invention. Fig. 2 is a diagrammatic view particularly illustrating the electric circuits by which certain objects of my invention may advantageously be attained; Figs. 3 and 4 are details of valves; Fig. 5 is a cross-section of a fragment of the suction pipe or trunk; Fig. 6 is a section on line 6—6 of Fig. 5; Figs. 7 and 8 are transverse sections at an end elevation of a suction head embodying features of my invention; Fig. 9 is a detail of a contact device; Figs. 10 and 11 are sectional and plan views of a pressure responsive diaphragm construction, and; Figs. 12 and 13 are respectively plan and side views of a recording apparatus.

In the embodiment of my invention I preferably employ a scow or float 20, on the hull of which is mounted a suction pump or exhauster 21, having connected with the inlet thereof a suction pipe or trunk 22, which may be flexible throughout its middle portion or otherwise arranged so that its head or suction mouth may be moved transversely with respect to the scow in the dredging operation. The particular character and mounting of the suction pipe or trunk, *per se*, forms no part of my invention, which may be applied to widely variant forms and constructions of suction devices.

As a preferred means for moving the suction pipe I provide a crane 23, having a boom 24, by means of which the end of the suction pipe may be adjusted vertically in any suitable fashion, the upright of the crane being rotatable and provided, for purposes of its rotation, with a wheel 25 around which passes the actuating cable 26, wound also around the winding drum 27, supplied with power from any suitable source, as by means of a worm gear 28, connected by fast and loose pulleys, 29, and a double belt arrangement 30, for reversible connection with any suitable power shaft (not shown). I also prefer that a suitably constructed and operated grapple 31, of any known or desired character, be mounted upon the hull for operation, when necessary, in conjunction with the suction devices.

It will be apparent that in the construction shown rotation of the winding drum 27 either way will rotate the wheel 25 and consequently the crane, in one direction or the other, thereby causing the head of the suction pipe to sweep transversely across an area of operation the depth of which is determined by the vertical adjustment of the head by the boom 24.

One well known disadvantage of the suction dredge for many uses is liability of clogging of the suction pipe. This disadvantage may in a measure be minimized by the provision of mechanical means for preventing large unitary bodies of material entering the suction pipe, and it has heretofore further been sought to overcome such objection by the provision of a relief orifice adjacent the suction nozzle, by the opening of which water may be introduced through the side of the pipe above the normal mouth.

Both of these means of minimizing the difficulty of clogging of the suction pipe I employ, but in novel and advantageous manner. I provide in connection with the suction pipe a relief valve operable automatically, as by pressure supplied from a suitable source on the hull of the dredge, arranged to apply power to open the relief valve only when its action is initiated by devices associated with the suction pipe or trunk. Thus, I preferably provide in connection with the end or normal mouth of the trunk a mechanical construction arranged to impede the entrance into the trunk of any boulder or other large, unitary formation which might clog the trunk, arranged to yield under the pressure of such object toward the mouth of the trunk, and by its yielding to initiate the operation of the relief valve opening means, so that when a boulder or other body is drawn toward the suction mouth and pressed against the mechanical obstruction to its ingress into the trunk, the relief valve is opened, the suction at the mouth lessened by the opening of the relief, and the suction trunk permitted to pass on without carrying with it the boulder or like body. Further I preferably provide in conjunction with the trunk a pressure responsive device sensible to the rarefaction normally existing within the trunk, and responsive to a further reduction of pressure in the trunk, to initiate the activity of the relief valve operating means.

I have found that when the suction trunk is clogged by the entrance therein of a mass of clay, or the like, which fills or nearly fills its entire cross-sectional area at some point, there is a momentary reduction of pressure within the trunk to a degree below normal, due possibly to the momentum of the body of water and material in transit through the trunk. From whatever cause, however, the phenomenon arises, such temporary decrease in pressure to a sub-normal condition is noticeable and available, and is an inseparable concomitant of the clogging of the pipe, so that by the provision of a pressure responsive device sensitive to such sub-normal pressure condition and arranged under such condition to initiate the activity of the relief valve operating means, I am enabled to insure the opening of the relief valve wherever a clog within the suction pipe actually occurs. I also find it desirable to open the relief valve automatically whenever the direction of motion of the suction pipe is changed, as by reversal of its direction of movement at the ends of its desired path of travel, or at other times, as such reversal always takes an appreciable time, and the maintenance of the strong suction in the pipe during such interval of time causes the suction apparatus to make a hole in the bed of the water body in which it is operating, instead of maintaining an even depth of operation throughout. I likewise find it advantageous to provide means for causing automatic reversal of the direction of traverse of the suction trunk, whenever the mouth of the trunk meets with any obstruction which would prevent its easy traverse for its full normal sweep, and I so arrange the means for accomplishing such reversal that they also occasion the operation of the relief devices in the same manner as occurs when the travel of the suction trunk is reversed at the end of its traverse under ordinary conditions. To facilitate the removal of such obstructions I find it advantageous to arrange means for automatically charting the traverse of the suction trunk, so that by the chart the exact location of any obstacle may readily be determined. A construction for attaining these results I will now describe.

The suction trunk 22 is provided adjacent its mouth, or its end, with a superposed conduit 32 communicating through a number of openings 33 with the interior of the trunk 22. The upper end of conduit 32 is provided with a valve 34 slidingly arranged and having made therein orifices 35 arranged to be brought into or out of register with corresponding orifices 36 in the conduit 32. A valve stem 37 is acted on by a spring 38 to normally maintain the valve closed, and is provided with a piston 39 working in a cylinder 40, mounted upon the suction trunk, and having connection with a source of pressure supply, such as a water pump, upon the hull, in a manner to be described, so that whenever pressure is imparted to the cylinder 40 the piston is pushed downward to open the valve, and admit water through conduit 32 and openings 33 with the trunk 22, above its mouth.

The suction head, generally indicated at 41, is preferably in the form of a box-like structure suitably secured upon the end of the suction trunk, providing on its face radial ribs 42, and on opposite sides providing suitable compartments 43 and 43′ respectively, bridged by walls or braces to support the electrical parts, springs and the like, herein shown and described. Across the open mouth of the suction trunk 22, I provide a guard 44 pivoted as at 45 at one extremity, and at its other extremity carrying a pin 46 which projects through the face of head 41 into compartment 43 and is yieldingly held outward as by a spring 47, so that inward pressure on the guard 44 forces the pin 46 into contact with an electrical contact 48. The opposite side members 49, 49′ of the head are preferably in the form of pivoted explorers, which are pressed outwardly by springs 50 and each of which carries a pin 51 arranged when the explorer is pressed inwardly to engage an electrical contact 52.

To prevent dirt and muddy water from entering the compartments 43 and 43′, I provide means for constantly passing a stream of fluid, such as clear water, under pressure therethrough.

At some suitable point in the suction pipe, preferably adjacent its connection with the pump, I provide a pressure responsive device 53, which is best shown in Figs. 10 and 11, is preferably a diaphragm chamber 54 having open communication by a pipe 55 with the interior of the suction pipe 22, the diaphragm 56 being connected by a link 57 with a lever 58, which operates as a trigger for a drop 59, arranged when released by the trigger 58 to fall into contact with an electric contact point 60.

For making an electric contact, whenever the motion of the suction trunk is reversed, any suitable means may be provided, a simple device being illustratively shown in Fig. 9. 61 is a rod on the post of the crane carrying a swinging arm 62, on which is mounted for limited sliding movement a pawl 63, pressed downward by spring 64 to drag on a rack 65 on the deck of the scow. Said head constitutes a movable contact, which during each reversal of movement of the crane and trunk, is pressed upward into contact with a finger 66 insulated from the frame.

The closure of either of the electric contacts 59—60, of the pressure responsive device, or the parts 46—48 of the guard device, or the parts 63—66, on the crane should only open the relief valve to admit water to the suction pipe through the relief opening, whereas the closure of the contacts 51—52, of either side member of the suction head should both open such relief valve and cause the reversal of the direction of movement of the suction pipe. The illustrated means for accomplishing these results comprises a hydraulic pump 70 of suitable character, preferably having three outlet connections, viz: a connection 71, leading to a valve 72, which has a connection with pipe 73 extending to the cylinder 40, and also a drain connection 74; a second constantly open connection 75, extending down to the suction head and having open extremities 76 leading into the compartments 47 and 48 to constantly supply them with water under a desired, relatively high pressure; and a third connection 77 leading to a valve 78 which has a drain orifice 79 and two alternative connections 80 and 80′ to opposite ends of a cylinder 81, containing a piston 82 operatively connected to a belt shifter 83 which controls the shiftable belts 30, by which the winding drum 28 is driven in either direction. As best shown in Figs. 3 and 4 the valve 72 normally stands with the pipe 73 draining and the pipe 71 cut off, while the four-way valve 78 normally stands with one of its connections 80 and 81 draining, and its opposite connections receiving water under pressure from the supply pipe 77.

For establishing operative connection between the valves and the initiating devices described, I preferably provide an electrical circuit and electro-magnetic valve operating devices. In the diagrammatic illustration shown in Fig. 2, 85 indicates a battery, having one terminal grounded, and its other terminal connected to wire 86, which includes an electro magnet 87, preferably in the form of a solenoid, which when energized operates the spring-held valve 72 to connect pipe 73 with the supply pipe 71. Beyond the solenoid 87 the circuit is divided into two branches 88 and 89, the first said branch having parallel connections 90 and 90′, one to the contacts 60 and 66 and the other to contact 48. The branch 89 is likewise divided into two legs 91 and 91′ each of which includes an electro-magnet 92 operating when energized to draw one away from the other, the handle of valve 78, which controls the entry of fluid under pressure into the belt shifting cylinder. Beyond the magnet 92 the circuit branch 91 is divided, one branch 93 extending to one of the contacts 52 of the suction head, and the other branch 93′ extending to and making contact with a brush 94 arranged to receive a contact 95 carried by the cable 27 of the crane moving mechanism. The branch 91′ of the circuit has exactly similar connections to the remaining contact points 52 of the head, and a duplicate brush 94′ for receiving the contact on the other leg of the cable.

It will be understood that all of the moving contacts are adequately grounded, and it will now be apparent from the diagrammatic view that whenever either of the contacts 48, 60 or 66 receives its grounded contact a circuit is established from ground to battery through wire 86, solenoid 87, branch 88, the appropriate parallel branch 90, 90′ and the closed contacts to ground again, so causing the operation only of the valve 72, whereas should either a contact 94 or a contact 52 receive its opposing movable contact the current will flow from the battery through the solenoid 87, the wire 89, one of the magnets 92, the appropriate circuit branch to the closed contact and ground, thereby causing the appropriate setting of valve 78 as well as the operation of valve 72. Thus, whenever the suction head in its traverse reaches the point where it should reverse, as by reason of its reaching its predetermined limit of travel, or meeting an obstruction, the closing of the contacts for the appropriate magnet 92 causes a throwing of the valve 78 to turn pressure into the cylinder 81, to cause the shifting of the belt and the reversal of the direction of traverse of the suction trunk.

It will be observed that the operation of valve 72 by the solenoid under the influence of the guarding device 44 will continue only so long as said guarding device is pressed inward, which will, of course, be during the period of time the boulder or other impediment remains in contact with such guard. When the contact is automatically broken the solenoid is released and the valve allowed to go back to normal position, so that the spring action of the relief valve will close said valve. When a real clog occurs in the pipe however, the reduction of pressure which causes the operation of the diaphragm 63 is momentary only, while the duration of the clog is sometimes a matter of minutes, so that it is my preference to have the shutter 66, when released by the trigger, remain in contact with its point 67 until it is manually reset, as the attention of the operator to the action of the pump should be given whenever a real clog occurs in the pipe.

For charting the location of obstacles which may cause the reversal of the suction pipe, I provide a recording pen 101, mounted upon a bell crank arm 102, suitably geared as by a belt 103 to a pinion 104 on the shaft of the winding drum 28, so that whenever the direction of motion of said winding drum is reversed the direction of oscillation of the marking pen is reversed. Below the pen I arrange a table 105 over which passes a strip of paper 106, arranged to draw forward upon a roll 107 by the action of a ratchet 108, operated by a pawl 109, carried by the armature 110 of an electro magnet 111, which is preferably located in the circuit branch 89 of the circuit described, so that whenever an impulse occasions the energization of the magnet controlling the belt shifter valve, the magnet 111 is energized and feeds the paper forward one step. Thus whenever a reversal or two occurs by reason of the suction head meeting with an obstruction in its travel the chart shows definitely the location thereof with respect to the sweep of the suction head and the grapple may be employed to remove the obstruction, if desired.

While I have herein described in some detail an emodiment of my invention herein shown in simple form for purposes of a full disclosure, it will be apparent to those skilled in the art, that my invention might be carried into effect by means differing widely in construction from those herein described within the spirit and scope of the appended claims, and I do not desire to be understood as limiting myself to the particular construction herein illustrated and described further than as specified in the claims.

Having described my invention, what I claim and desire to secure by Letters Patent, of the United States, is;

1. In an hydraulic excavator, the combination of a suction pump, a suction-pipe provided with a relief-valve, and means for automatically opening said relief-valve in response to abnormal decrease in pressure in said suction pipe.

2. In an hydraulic excavator, the combination of a suction pump, a suction-pipe provided with a relief-valve, and means responsive to the momentary decrease in pressure accompanying clogging of the pipe, for automatically opening said relief-valve.

3. In an hydraulic excavator, a suction-pipe provided with a relief-valve, actuating means for said relief-valve, pressure-responsive means associated with the pipe controlling said valve-actuating means.

4. In an hydraulic excavator, the combination of a suction-pipe provided with a relief-valve, actuating means for opening said relief-valve, and pressure-responsive means controlling said actuating means, comprising a diaphragm movable in response to abnormal change in pressure in the suction-pipe.

5. In an hydraulic excavator, the combination of a suction-pipe provided with a relief-valve, normally-closed, pressure-responsive means for opening said relief-valve, a source of pressure supply, a controlling valve governing the communication of said pressure-responsive device with the source of pressure supply, and means responsive to the clogging of the suction-pipe for automatically controlling the last said valve.

6. In an hydraulic excavator, a suction-pipe provided with a normally-closed relief-valve, means for opening said relief-valve, a diaphragm device having communication with the interior of the suction-pipe to respond to decrease in pressure in said pipe below normal, and means whereby such response of the diaphragm initiates the operation of the relief-valve-opening means.

7. In an hydraulic excavator, a suction pipe provided with a normally-closed relief-valve, means for opening said relief-valve, a yielding guard at the suction mouth arranged when forced inward toward the suction mouth to initiate the operation of the valve-opening means.

8. In an hydraulic excavator, a movable suction-pipe provided with a relief-valve, means for moving said pipe in opposite directions, and automatic means for opening the relief-valve during each reversal of movement of the suction-pipe.

9. In an hydraulic dredge, a suction-pipe provided with a relief-valve, means for moving said suction-pipe within predetermined limits, means for automatically reversing the movement of said suction-pipe at its limits, and means for automatically opening the relief-valve during each such reversal of movement of the suction-pipe.

10. In an hydraulic dredge, the combina-

tion of a suction-pipe, provided with a relief-valve, normally-closed, pressure-responsive means for opening said relief-valve, a source of pressure supply, a valve controlling the communication of the pressure-responsive device with the source of pressure supply, means for moving said suction-pipe in opposite directions, and means for moving said pressure-controlling valve to cause the opening of the relief-valve during each reversal of movement of the suction-pipe.

11. In an hydraulic excavator, a movable suction pipe, means for moving said suction pipe in opposite directions, explorers associated with the mouth of said suction pipe, and automatic means responsive to the functional operation of said explorers for reversing the direction of movement of said suction pipe.

12. In an hydraulic excavator, the combination of a suction pipe provided with a relief-valve, means for moving said suction pipe in opposite directions, explorers associated with the mouth of said suction pipe, and automatic means responsive to the functional operation of said explorers, for reversing the direction of movement of the suction pipe and opening the relief valve.

13. In an hydraulic excavator, a suction pipe provided with a relief valve, pressure operated means for opening said relief valve, means for moving said suction pipe in opposite directions, pressure operated means for reversing the direction of movement of the suction pipe, a source of pressure supply for said pressure operated relief valve controlling and reversing means, means controlling the connections of said reversing and valve opening means with the source of pressure supply, explorers operatively associated with the mouth of the suction pipe, and operative connections between the said explorers and said pressure controlling means, whereby the functional operation of an explorer occasions the reversal of the direction of movement of the suction pipe and the opening of the relief valve.

14. In an hydraulic excavator, a suction pipe provided with a relief valve, pressure operated means for opening said relief valve, means for moving said suction pipe in opposite directions, pressure operated means for reversing the direction of the suction pipe, a source of pressure supply for said pressure operated valve controlling and reversing means, means controlling the connection of said reversing and valve opening means with the source of pressure supply, explorers operatively associated with the mouth of the suction pipe, and operative electrical connections between the said explorers and said pressure controlling means, whereby the functional operation of an explorer occasions the reversal of the direction of movement of the suction pipe.

15. In an hydraulic excavator, a suction pipe, a chamber adjacent the head of the suction pipe, electrical contact devices arranged for actuation from the exterior of the chamber located therein, and means for maintaining within the chamber a fluid pressure greater than the pressure outside of said chamber.

16. In an hydraulic excavator, a suction pipe, a head mounted at the end of said pipe providing a chamber, a movable explorer partially closing said chamber, provided with an electric contact part, a companion contact part within the chamber, electro responsive means controlled by said contact part, and means for constantly maintaining an outward pressure of fluid within said chamber in excess of the pressure surrounding the chamber.

17. In an hydraulic excavator, a suction pipe, means for moving the suction pipe in either direction, and means for automatically reversing the direction of movement of said suction pipe wherever said pipe encounters an obstruction to its progress.

In testimony whereof I hereunto set my hand in the presence of two witnesses.

CHARLES B. ASKEW.

In the presence of—

FORÉE BAIN,

MARY F. ALLEN.