

Oct. 31, 1944.

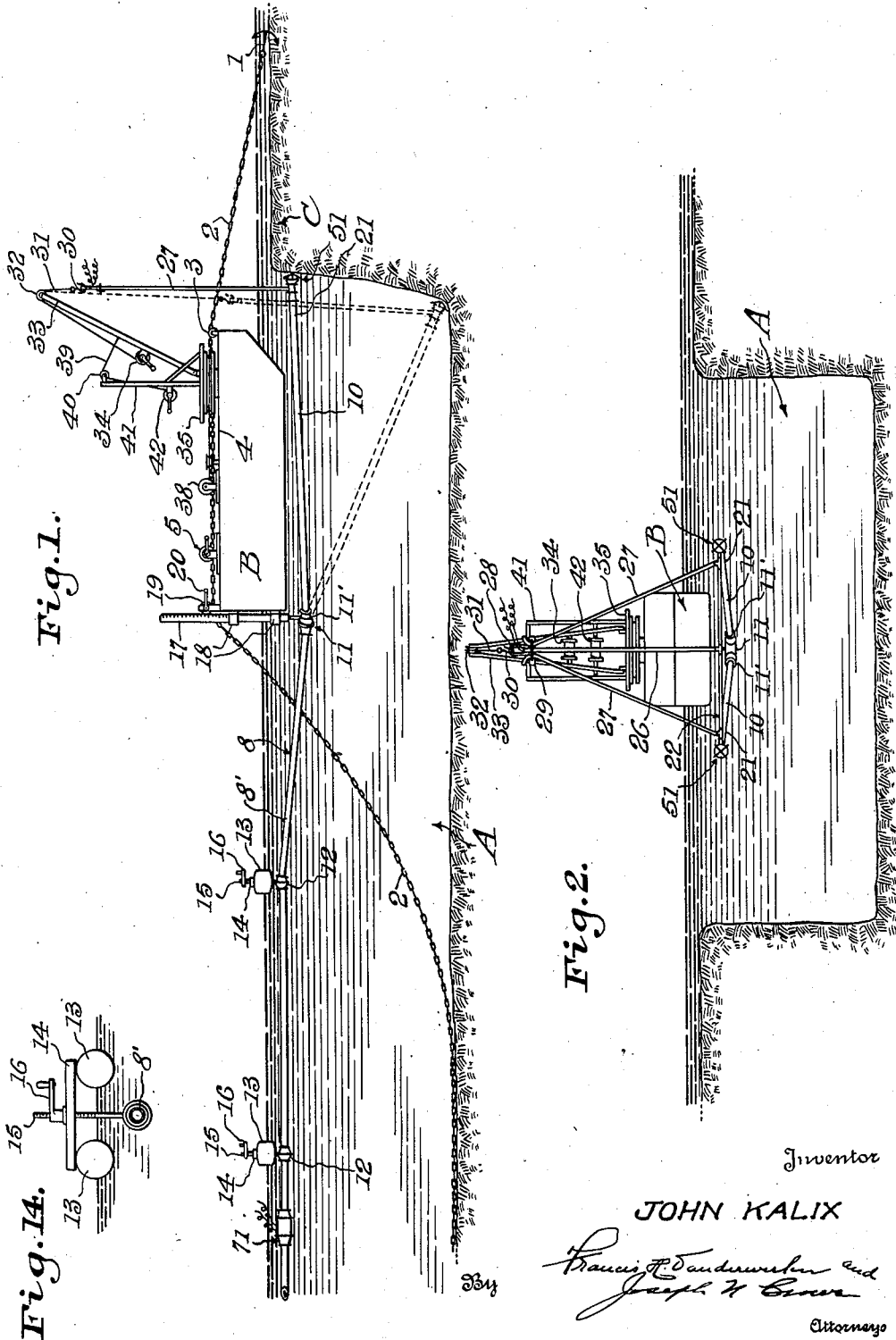
J. KALIX

2,361,404

APPARATUS FOR EXCAVATING SUBAQUEOUS MATERIAL

Filed Oct. 26, 1943

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APPARATUS FOR EXCAVATING SUBAQUEOUS MATERIAL

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Fig. 3.

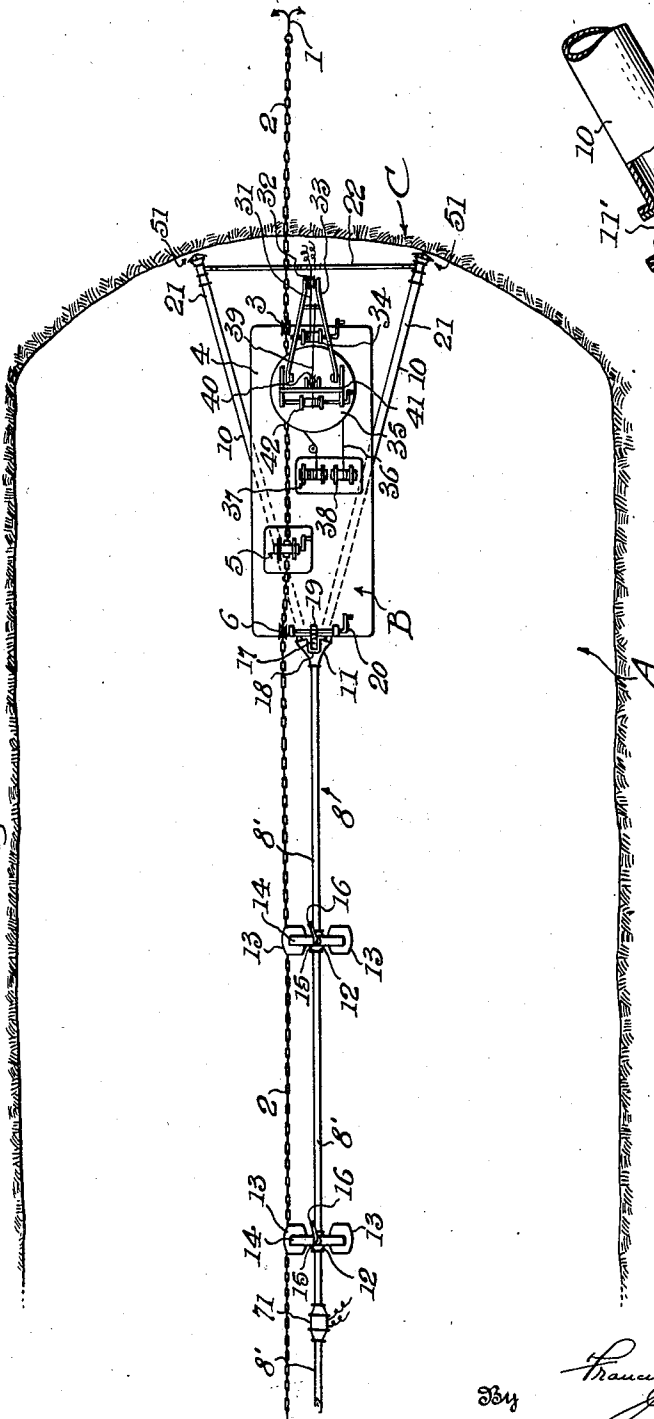


Fig. 12.

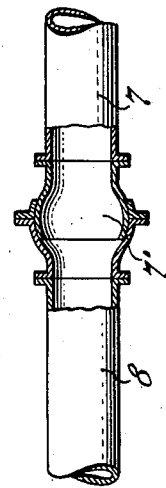
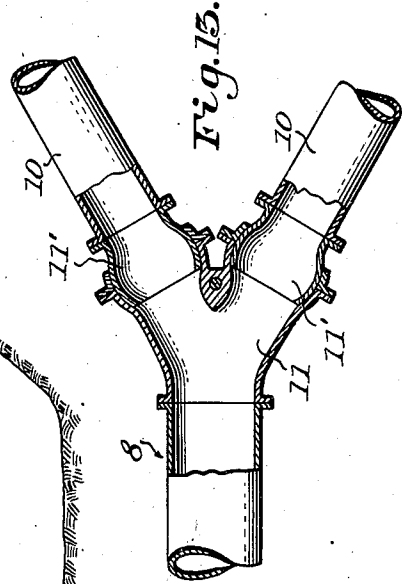


Fig. 13.



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Fig. 4.

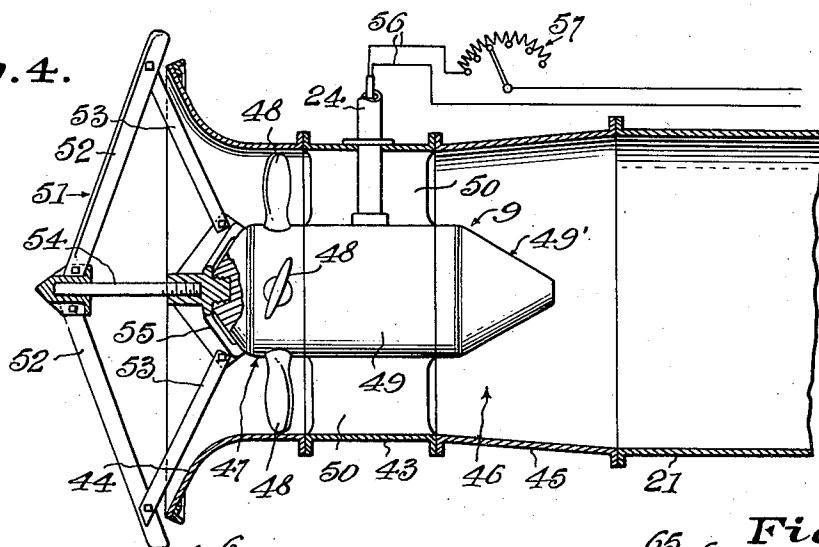


Fig. 5.

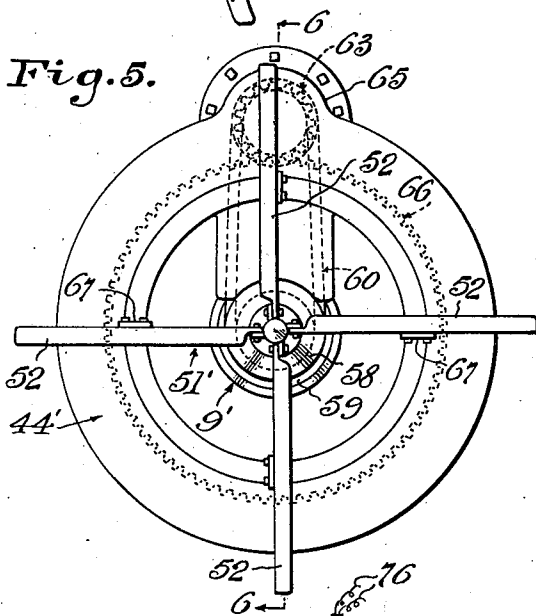


Fig. 6.

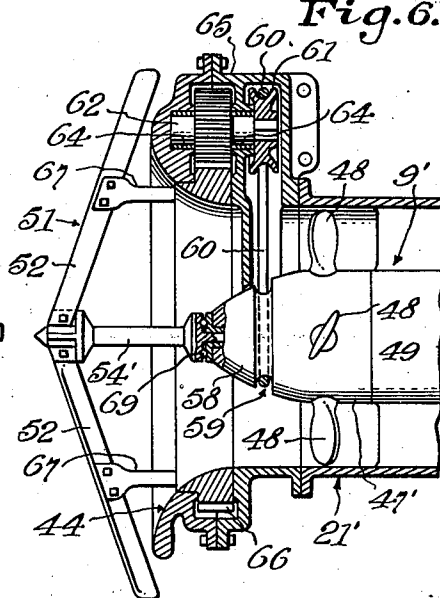
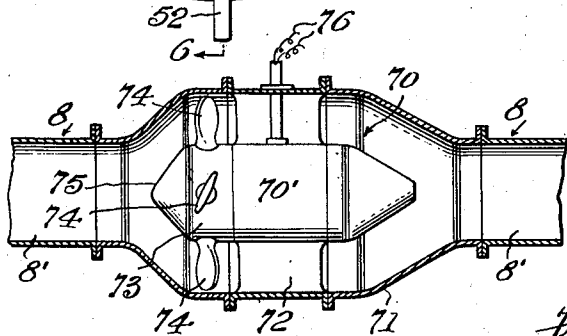


Fig. 7.



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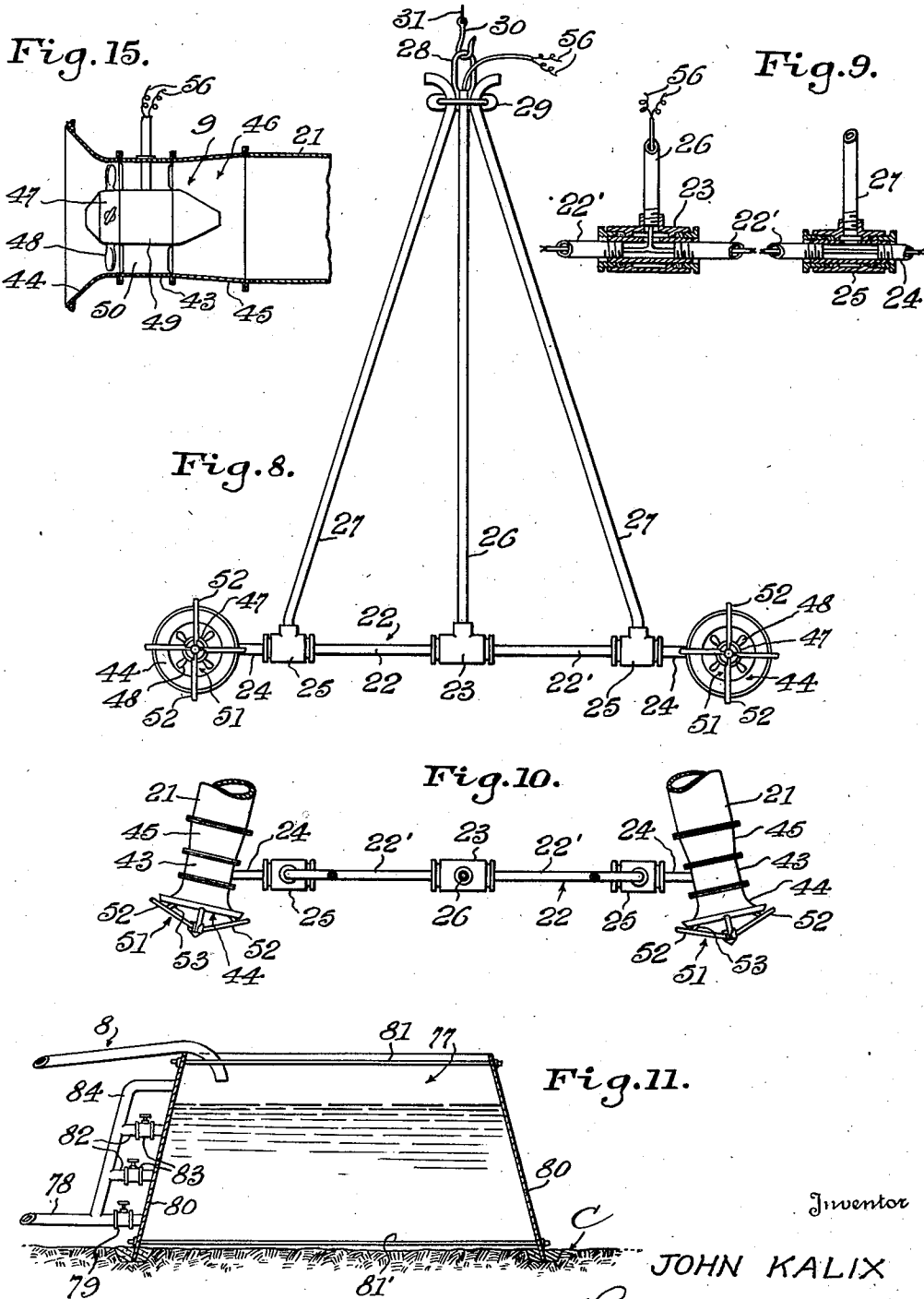
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APPARATUS FOR EXCAVATING SUBAQUEOUS MATERIAL

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UNITED STATES PATENT OFFICE

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APPARATUS FOR EXCAVATING SUB-AQUEOUS MATERIAL

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Application October 26, 1943, Serial No. 507,663

6 Claims. (Cl. 37-67)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

*The invention described herein may be manufactured and used by or for the Government for governmental purposes, without payment to me of any royalty thereon.

This invention relates to the art of dredging and more particularly it is directed to a submarine excavator for removing said, gravel, mud, silt or the like from canals, lakes, rivers and other bodies of water.

One of the objects of the invention is to provide a submarine excavator for removing subaqueous material from canals, harbors, or the like, also to restore the storage capacity of silted flood control dams and to make inlets into dry land from waterways.

Another object of the invention is to provide an improvement in the art of hydraulic dredging wherein means are provided for producing a continuous one-way excavation of subaqueous material from canals or other waterways and depositing the excavated material at an exceedingly rapid rate into collapsible sectional forms for building up embankments, walls, abutments, dikes, and levees or the like to a predetermined level.

Another object of the invention is to provide a method of excavating subaqueous material from bodies of water for deepening purposes and the like, which consists of loosening and breaking up the subaqueous material, creating a suction at the suction mouth of a suction pipe, causing the broken subaqueous material to be sucked through the suction mouth and drawn through a Venturi opening in the suction pipe, pumping the subaqueous material through the suction pipe to a discharge pipeline, creating a suction in the discharge pipeline and depositing the excavated subaqueous material for building up, adding to or strengthening a shore, levee and the like.

Another object of the invention is to provide a hydraulic dredge including dual suction pipes, swivelly mounted at one end of each to one end of a delivery pipeline and having a suction pump and a motor for operating the pump mounted within one of each of the other ends of the suction pipes and cutterheads mounted to be rotated by the suction pumps whereby subaqueous material may be broken up by the cutterheads, sucked up through the suction pipes by the suction pumps and discharged through the delivery pipeline to any place desired.

Another object of the invention is to provide a hydraulic dredge including a suction pipe having a Venturi opening formed therein adjacent to a suction mouth at one end thereof, a delivery pipeline connected to the other end of the suc-

tion pipe, an impeller driven motor mounted within the suction pipe at the Venturi opening, a cutterhead mounted at the suction mouth of the suction pipe and means for automatically transferring the torques from the motor to between the impeller and cutterhead whereby subaqueous material may be broken up by the cutterhead, sucked through the suction mouth and pumped through the Venturi opening and suction pipe into the delivery pipeline by the impeller for discharge to any place desired when the cutterhead is working in hard material or the like.

Another object of the invention is to provide a hydraulic dredge including dual suction pipes, each swivelly joined at one end to one end of a delivery pipeline, said dual suction pipes and delivery pipeline suspended beneath the dredge by means of a vertically adjustable rack, motor driven suction pumps, one of each of which motor driven suction pumps being mounted within one of each of the suction pipes adjacent to the other free ends thereof, cutterheads mounted at the free ends of the suction pipes and connected to be actuated by said motor driven suction pumps, a pipe connecting the free ends of the suction pipes and holding them in spaced relation with each other and means connected to actuate said suction pipes upwardly and downwardly or in a horizontal arc about their swivel connection with the delivery pipeline whereby the cutterheads may be directed at any portion of subaqueous material in canals or other body of water for excavating the material.

In hydraulic dredges of the suction type for excavating subaqueous material at present in use, a main suction pump is provided on the dredge to create a suction in a suction pipe, whereby the subaqueous material is drawn up through the suction pipe and discharged by the main suction pump to a delivery pipeline. The main suction pump is limited in its operation by certain natural laws such as so-called entrance losses and in creating any necessary lift of the subaqueous material from the bottom of a body of water to the main suction pump.

It is therefore the aim and purpose of this invention to eliminate the necessity of using a main suction pump on the dredge by providing a suction pump and a motor for driving the pump within a Venturi opening formed in a suction pipe adjacent the suction mouth thereof and causing subaqueous material to be drawn into the suction mouth and forced by the motor driven suction pump through the Venturi opening and suction pipe into a discharge pipeline having a

booster pump mounted therein for creating a suction within the discharge pipeline, whereby a continuous uninterrupted one-way excavation of the subaqueous material from bodies of water is provided, which subaqueous material may be deposited into collapsible forms provided on a shore for producing an embankment or the like.

With the above and other objects and advantages in view, the invention consists of certain features of construction and operation of parts which will hereinafter be described and shown in the accompanying drawings, in which:

Fig. 1 is a fragmentary side elevation of a dredge having the improved dredging apparatus mounted thereon;

Fig. 2 is an end view of the same;

Fig. 3 is a top plan view thereof;

Fig. 4 is a fragmentary longitudinal sectional view of one end of a suction pipe having a motor driven suction pump mounted therein, with a cutterhead directly driven by the suction pump;

Fig. 5 is a front end view of a modification of the same;

Fig. 6 is a fragmentary longitudinal sectional view taken on the line 6-6 of Fig. 5;

Fig. 7 is an enlarged sectional view of a portion of a discharge pipeline having a suction booster mounted therein used in carrying out the invention;

Fig. 8 is a front end view of dual suction pipes having the improved motor driven suction pumps mounted therein and supported by a pipe frame including a transversely extending pipe having additional pipes rotatably mounted thereon;

Fig. 9 is an enlarged fragmentary detail sectional view partly in elevation illustrating the manner of rotatably mounting the additional pipes on the transversely extending pipe of the pipe frame;

Fig. 10 is a fragmentary top view of the front ends of the dual suction pipes and supporting frame;

Fig. 11 is a vertical sectional view of a collapsible settling basin which may be used in carrying out the invention;

Fig. 12 is an enlarged fragmentary detail sectional view, partly in elevation, illustrating the manner of swivelly connecting one end of a single suction pipe to a discharge pipeline;

Fig. 13 is an enlarged fragmentary detail sectional view partly in elevation illustrating the manner of connecting the ends of dual suction pipes to the discharge pipeline;

Fig. 14 is an enlarged view of a pair of floating members and their connected parts used in carrying out the invention;

Fig. 15 is a fragmentary longitudinal sectional view of the end of a suction pipe having a motor driven suction pump mounted therein, with a cutterhead removed therefrom.

Referring to Fig. 1, A designates a river, canal, or other body of water from which subaqueous material is to be excavated and B is a dredge on the body of water adjacent to a bank or shore C. The dredge B is propelled forwardly or rearwardly by means of an anchor 1 which engages the shore C and from which a chain 2 passes over a pulley 3 on the front end of the deck 4 of the dredge and thence to any suitable type of actuating device 5 which engages the chain. From the actuating device 5 the chain 2 passes over a pulley 6, Fig. 3, mounted on the rear end of the deck 4 and is then laid in the bed of the body of water A.

The apparatus for excavating the subaqueous

material may comprise a single suction pipe 7, Fig. 12, swivelly connected by a universal joint 7', at one end to one end of an elongated discharge or delivery pipeline 8, Figs. 1 and 3, and having a suction pump 9 as illustrated Figs. 4 and 15 or a modification 9' thereof, Figs. 5 and 6, mounted in an inlet end thereof, but the apparatus preferably comprises dual suction pipes 10, each swivelly connected at one end to a Y-shaped end 11 of the discharge pipeline 8 by universal joints 11', Fig. 13. The discharge pipeline 8 is made of a plurality of sections 8', Fig. 3, having their ends swivelly joined together at 12 and submerged in the body of water A. The pipe sections 8' are carried by pairs of airtight floats 13 in the form of barrels arranged on opposite sides of the discharge pipeline 8. The pairs of floats 13 are mounted on opposite ends of transversely extending supporting bars 14 threadedly mounted on vertically extending rods 15 anchored at their lower ends to the universal joints 12 of the pipe sections 8' shown in detail in Fig. 14. A crank 16 is threadedly mounted on the upper end of one of each of the rods 15 for a purpose which will hereinafter appear.

A vertically extending rack 17 is slidably mounted in brackets 18 mounted on the rear end of the deck 4 of the dredge, which rack 17 is connected at its lower end to the Y-shaped end 11 of the discharge pipeline 8, Fig. 13. A pinion 19 mounted on a crank 20, rotatably supported on the deck 4 of the dredge engages the upper end of the rack 17, whereby upon turning the crank 20 the dual suction pipes 10 may be raised or lowered under the dredge as the work of excavation proceeds.

The outer free ends 21 of the dual suction pipes 10 are held in spaced relation to each other by means of a transversely extending pipe 22 made of a pair of sections 22' joined together at one end of each by a T-shaped coupling 23 and nipples 24 joined to the other ends of the sections 22' by T-shaped couplings 25, which nipples 24 extend through the free ends 21 of the dual suction pipes into the suction pumps, Figs. 8, 9 and 10. The couplings 23 and 25 are rotatably mounted on the pipe 22, with the couplings 25 being closely adjacent to the free ends 21 of the suction pipes 10 and the coupling 23 being in the middle of the pipe 22. A supporting conduit 26 and a pair of air conduits 27 are mounted on the couplings 23 and 25 respectively, with the supporting conduit 26 having a clevis 28 mounted thereon adjacent to its upper end. The air conduits 27 are bent inwardly with their upper ends open to the atmosphere and held in abutting engagement with the clevis 28 on the upper end of the supporting conduit 26 by a retaining clamp 29 or the like, Figs. 2 and 8.

The clevis 28 on the upper end of the supporting conduit 26 is engaged by a hook 30 on one end of a rope 31 which passes through a sheave 32 mounted on the upper end of a boom 33 on the deck 4 of the dredge and thence to a winch or drum 34 mounted on the boom 33. The lower end of the boom 33 is pivotally connected to a turn-table 35 rotated by a rope 36 adapted to be wound from a winch 37 onto another winch 38 or from the winch 38 to the winch 47. A rope 39 is also connected at one end to the boom 33, which rope 39 passes through a sheave 40 on the upper end of a mast 41 mounted on the turn-table 35. From the sheave 40 the rope 39 passes to a winch or drum 42 mounted on the mast 41. The free end 21 of each of the dual section

pipes 10 is formed with a portion 43 of least cross-section having a bell-shaped suction mouth 44 mounted on an outer end thereof and a frusto-conical shaped section 45 mounted on its inner end whereby a substantially Venturi-shaped passage 46 is provided in which the suction pump 9, Figs. 4 and 15, or the suction pump 9', Figs. 5 and 6, may be mounted. The suction pump 9 is preferably of the propeller type including an impeller 47 having blades 48 mounted thereon operable within the suction mouth 44 and directly driven by any suitable type of electric motor 49 centrally mounted on ribs 50 within the Venturi-shaped passage 46.

A cutterhead 51 having blades 52 removably mounted thereon is operable in front of the bell-shaped suction mouth 44 and is directly connected to the motor driven impeller 47 by arms 53 and a central rod 54 mounted on a bracket 55 secured to the outer end of the impeller, whereby the cutterhead 51 is driven at the same speed and in the same direction as the motor driven impeller. The electric motor 49 has a rearwardly extending streamline portion 49' and the electric motor in the free end of the single suction pipe 7 or the free ends 21 of the dual suction pipes 10 are connected by electric conductors 56, the conductors 56 for the electric motors in the dual suction pipes extend through the transversely extending pipe 52 and up through the supporting conduit 26 where they are adapted to be connected to a suitable source of electric supply (not shown) mounted on the dredge B. In order to regulate the speed of operation of the electric motors, a rheostat 57, Fig. 4, may be connected in circuit with the conductors 56.

In Figs. 5 and 6, the cutterhead 51' is driven indirectly by the suction pump 9' in order to obtain greater efficiency and larger torque from the electric motor 49. The outer end 58 of the impeller 47' is elongated and provided with a circular groove 59 engaged by a belt 60 therein, which drives a pulley 61 mounted on one end of a shaft 62 for a pinion 63 which shaft 62 is rotatably mounted in bearings 64 formed in a housing 65 mounted on the free end 21' of a suction pipe 10 and adjacent to a bell-shaped suction mouth 44'. The pinion 63 drives a ring gear 66 rotatably mounted within the suction mouth 44'. The blades 52 of the cutterhead 51' are connected to the ring gear 66 by means of arms 67 and the inner end of the central rod 54' is rotatably mounted on the outer end of impeller 47' by ball bearings 69 or the like. The blades 48 of the impeller 47, Figs. 4 and 15, or the blades 48 of the impeller 47', Figs. 5 and 6, may be adjustably mounted to provide a variable pitch by any suitable conventional means.

In Fig. 15 is shown the suction pump 9 having the cutterhead 51 removed therefrom. It will be understood that the cutterhead 51 may be individually rotated in front of the suction mouth of the suction pipe by any of the conventional driving means if desired.

In order to provide a suction in the long discharge pipeline 8 for transporting material such as oil or sludge to a shore or other place desired, a suction booster pump 70, illustrated in detail in Fig. 7, is mounted in an enlarged pipe section 71 provided in the discharge or delivery pipeline 8. The booster pump 70 comprises an electric motor 70' mounted on ribs 72 and adapted to drive an impeller 73 having blades 74. The motor 70' and impeller 73 extend longitudinally within the center of the enlarged pipe section

71 and are shaped to conform to the contour of the enlarged pipe section, with the front end 75 of the impeller 73 being streamlined. Conductors 76 connect the electric motor 70' to a suitable source of electrical supply (not shown) which may be on the dredge B. It will be readily understood that any suitable number of booster pumps 70 may be provided in the discharge pipeline 8.

The excavated subaqueous material from the dredge may be directed by the discharge pipeline 8 into a settling basin 77 provided on the shore or levee C for forming a boundary wall by which the subaqueous material is confined to permit a separation of the water from the solid particles contained in the subaqueous material whereby the shore or levee C may be built up, added to or strengthened. The settling basin 77, Fig. 11, is made in the form of a knockdown or collapsible frame structure having a main conduit 78 containing a valve 79 and extending from one of the walls 80 of the settling basin, which walls 80 are mounted at their lower ends in the shore C and held in place by upper and lower separator rods 81 and 81', respectively. The water in the subaqueous material contained in the settling basin 77 is adapted to enter additional conduits 82 leading from the settling basin at different heights and having valves 83 provided thereon. The water in the conduits 82 feeds into a common conduit 84 extending at its upper end into the settling basin adjacent to the upper end thereof and connected to the main conduit 78, whereby upon opening the valves 79 and 83 the water in the settling basin is adapted to flow from the settling basin through the main conduit 78 and to flow back into the body of water A. After the water has been withdrawn from the subaqueous material and the settled residue has reached a predetermined height, the settling basin is knocked down with the bottom separator rod 81' left in place. Additional settling basins (not shown) may be erected on the shore C while the water is being withdrawn from the settling basin 77.

The electric motors employed for driving the impellers are now available for normal operation under water and adequate protection of equipment and personnel from the effects of possible short circuits can be provided. By submerging the electric motors, the water has a cooling effect thereon and in order to provide an additional cooling thereof the air conduits 27 are opened at their upper ends to the atmosphere whereby air may enter the conduits 27 and pass through the conduit 22 to the nipples 24 and thence to the electric motors 49.

In operation, assuming that the dual suction pipes 10 have been lowered until the free ends 21 thereof have engaged the subaqueous material within the body of water A and that the electric motors 49 have been connected to a suitable source of electric supply (not shown); upon actuating the rheostat 57 the electric motors 49 may be rotated at any speed desired thus driving the impeller 47, Fig. 4, or the impeller 47', Figs. 5 and 6. In using the form of suction pump 9 shown in Fig. 4, the cutterhead 51 directly connected to the impeller 47 and driven at the same speed loosens the subaqueous material while the blades 52 of the cutterhead and the blades 48 of the impeller break up the subaqueous material into smaller pieces, thereby increasing the carrying capacity of the water in the subaqueous material. The broken subaqueous material is then sucked up through the suction mouth 44 by the suction cre-

ated by the impeller 47 which pumps the subaqueous material through the Venturi opening 46 and the suction pipes into the discharge pipeline 8. The suction booster pump 70, by creating a suction in the discharge pipeline 8, draws the subaqueous material therethrough and pumps it to any place desired such as into the settling basin 77, Fig. 11.

In the form of construction illustrated in Figs. 5 and 6, the cutterhead 51 is rotated at a slower speed than the high velocity motor driven impeller 47' and the reaction of the cutterhead 51 to subaqueous material at its center is taken up by the ball bearings 69 on which the inner end of the central rod 54' is mounted, while the reaction of the cutterhead to the subaqueous material toward the ends of its blades 52 is taken up by the ring gear 66 through the arms 67. The bearings 64 for the pinion shaft 62 are preferably made of bronze and may be provided with any suitable means to prevent the necessity of oiling the same. The cutterhead 51' is driven in an opposite direction to the motor driven impeller 47' whereby the reaction of the cutterhead to the subaqueous material is counteracted, which results in less vibration. In homogeneous material the available motor torque is divided or split between the cutterhead 51' and the blades 48 of the impeller 47', whereby when a hard layer of subaqueous material is met and more power is necessary the electric motor 49 will take up the additional load, particularly when a series wound motor is used. Upon the cutterhead 51' being stopped by a boulder or other large object, the belt 60 driven by the motor driven impeller 47' will slide on the pulley 61, whereby the motor 49 may continue to rotate the impeller 47' without damage thereto.

By winding the rope 31 on the drum 34 on the boom 33, the free ends 21 of the dual suction pipes 10 may be either raised or lowered in a vertical direction and directed onto the material to be excavated. By winding the rope 39 on the winch 42 the boom may be raised or lowered to also move the free ends 21 of the suction pipes 10 having the suction pumps therein to any vertical position and, by winding the rope 36 from the winch 37 onto the winch 38, or from the winch 38 to the winch 37 the turn-table 35 may be rotated to move the boom 33 to thus move the free ends 21 of the suction pipes 10 in a horizontal arc.

When crank 20 is turned pinion 19 is rotated so that the rack 17 may be actuated to either raise or lower the suction pipes 10 including the end of the discharge pipeline 8 swivelly connected thereto away from or toward the bottom of the dredge 13 when desired. Should it become necessary to repair any damage to the discharge pipeline 8, the cranks 16, Figs. 1 and 14, are rotated on the threaded rods 15 in a clockwise direction whereby the rods are moved upwardly on the bars 14 pulling the portion of the discharge pipeline 8 to be repaired upwardly with it toward the floats 13 until the discharge pipeline is clear of the top of the body of water A. After the repairs to the discharge pipeline 8 have been made, the cranks 16 are rotated in a counter-clockwise direction on the rods 15 thereby causing the repaired discharge pipeline to be pushed down into the body of water away from the floats 13.

The apparatus has been particularly shown and described as including the dual suction pipes 10, but it will be readily understood that the single suction pipe 7, Fig. 12, having the excavating devices illustrated in Figs. 4 and 15 or the device illustrated in Figs. 5 and 6, may be moved up-

wardly, downwardly, or in a horizontal arc about its swivel connection with the discharge pipeline 8 by the same tackle used in actuating the free ends 21 of the dual suction pipes 10.

5. It will thus be seen that there is herein provided a novel and efficient form of dredging apparatus which is well adapted for all the purposes indicated. Even though there has herein been shown certain features of construction and operation of parts, it is nevertheless to be understood that various changes may be made therein if the changes do not depart from the spirit or scope of the claims.

Having thus described my invention, what I claim as new and wish to secure by Letters Patent is:

1. The combination with a hydraulic dredge including dual suction pipes having a suction mouth at one end of each and a delivery pipeline swivelly connected at their other ends, a suction pump operatively positioned within one of each of the suction mouth ends of the suction pipes, electric motors, one of each of the electric motors driving one of each of the suction pumps and operatively mounted within the suction pipes, a transversely extending pipe including nipples holding the suction mouth ends of the suction pipes in spaced relation with each other, a supporting conduit and air conduits connected in communication at one end each with the transversely extending pipe, said air conduits opened to the atmosphere at their other ends and said nipples extending into the suction pipes and to the interior of the electric motors whereby air may enter said air conduits, pass through the transversely extending pipe and nipples and enter the electric motors for cooling the same, and means for swinging the suction pipes upwardly or downwardly or in a horizontal arc about their swivel connection with the delivery pipe.

2. The combination with a hydraulic dredge including dual suction pipes having a suction mouth at one end of each and a delivery pipeline swivelly connected at their other ends, a suction pump operatively positioned within one of each of the suction mouth ends of the suction pipes, electric motors, one of each of the electric motors driving one of each of the suction pumps and operatively mounted within the suction pipes, cutterheads connected to be actuated by said suction pumps, a transversely extending pipe including nipples holding the suction mouth ends of the suction pipe in spaced relation with each other, a supporting conduit and air conduits connected in communication at one end of each with the transversely extending pipe, said air conduits opened to the atmosphere at their other ends and said nipples extending into the suction pipes and to the interior of said motors whereby air may enter said last-mentioned conduits, pass through the transversely extending pipe and nipples and enter the motors for cooling the same and means for swinging the suction pipes upwardly or downwardly or in a horizontal arc about their swivel connection with the delivery pipeline.

3. The combination with a hydraulic dredge including dual suction pipes having a suction mouth at one end of each and a delivery pipeline swivelly connected at their other ends, a suction pump operatively positioned within one of each of the suction pipes, electric motors, one of each of the electric motors driving one of each of the suction pumps, a suction booster operatively mounted in said delivery pipeline, a transversely extending pipe including nipples holding the suc-

tion mouth ends of the suction pipes in spaced relation with each other, a supporting conduit and air conduit connected in communication at one end of each with the transversely extending pipe, said air conduits opened to the atmosphere at their other ends and said nipples extending into the suction pipes and to the interior of said motors, whereby air may enter said last-mentioned conduits, pass through the transversely extending pipe and nipples and enter the motors for cooling the same and means for swinging the suction pipes upwardly or downwardly or in a horizontal arc about their swivel connection with the delivery pipeline.

4. The combination with a hydraulic dredge including dual suction pipes having a suction mouth at one end of each and a delivery pipeline swivelly connected at their other ends, a suction pump operatively positioned within one of each of the suction mouth ends of the suction pipes, electric motors, one of each of the electric motors driving one of each of the suction pumps, a transversely extending pipe including nipples holding the suction mouth ends of the suction pipes in spaced relation with each other, a supporting conduit and air conduits connected in communication at one end of each with the transversely extending pipe, said air conduits opened to the atmosphere at their other ends and said nipples extending into the suction pipes and to the interior of said motors, whereby air may enter said last-mentioned conduits, pass through the transversely extending pipe and nipples and enter the electric motors for cooling the same, means adjustably mounted on the dredge and connected to the suction pipes, said means adapted to be actuated to raise or lower the suction pipes as the work of excavation proceeds and means for swinging the suction pipes upwardly or downwardly or in a horizontal arc about their swivel connection with the delivery pipe.

5. The combination with a hydraulic dredge including dual suction pipes having a suction mouth at one end of each and a delivery pipeline swivelly connected at their other ends, a suction pump operatively positioned within one of each of the suction mouth ends of the suction pipes, electric motors, one of each of the electric motors driving one of each of the suction pumps, cutter-

heads connected to be actuated by said suction pumps, an electrically operated suction booster mounted in said delivery pipe line, a transversely extending pipe including nipples holding the suction mouth ends of the suction pipes in spaced relation with each other, a supporting conduit and air conduits connected in communication at one end of each with the transversely extending pipe, said air conduits opened to the atmosphere at their other ends and said nipples extending into the suction pipes and to the interior of said motors, whereby air may enter said last-mentioned conduits, pass through the transversely extending pipe and nipples and enter the electric motors for cooling the same and means for swinging the suction pipes upwardly or downwardly or in a horizontal arc about their swivel connection with the delivery pipeline.

6. The combination with a hydraulic dredge including dual suction pipes having a suction mouth at one end of each and a delivery pipeline swivelly connected at their other ends, a suction pump operatively positioned within one of each of the suction mouth ends of the suction pipes, electric motors, one of each of the electric motors driving one of each of the suction pumps, cutterheads connected to be actuated by said suction pumps, a suction booster operatively mounted in said delivery pipeline, a transversely extending pipe including nipples holding the suction mouth ends of the suction pipes in spaced relation with each other, a supporting conduit and air conduits connected in communication at one end of each with the transversely extending pipe, said air conduits opened to the atmosphere at their other ends and said nipples extending into the suction pipes and into the interior of said motors, whereby air may enter said last-mentioned conduits, pass through the transversely extending pipe and nipples and enter the electric motors for cooling the same, means adjustably mounted on the dredge and connected to the suction pipes, said means adapted to be actuated to raise and lower the suction pipes as the work of excavation proceeds and means for swinging the suction pipes upwardly or downwardly in a vertical direction or in a horizontal arc about their swivel connection with the delivery pipeline.

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