

Sept. 22, 1931.

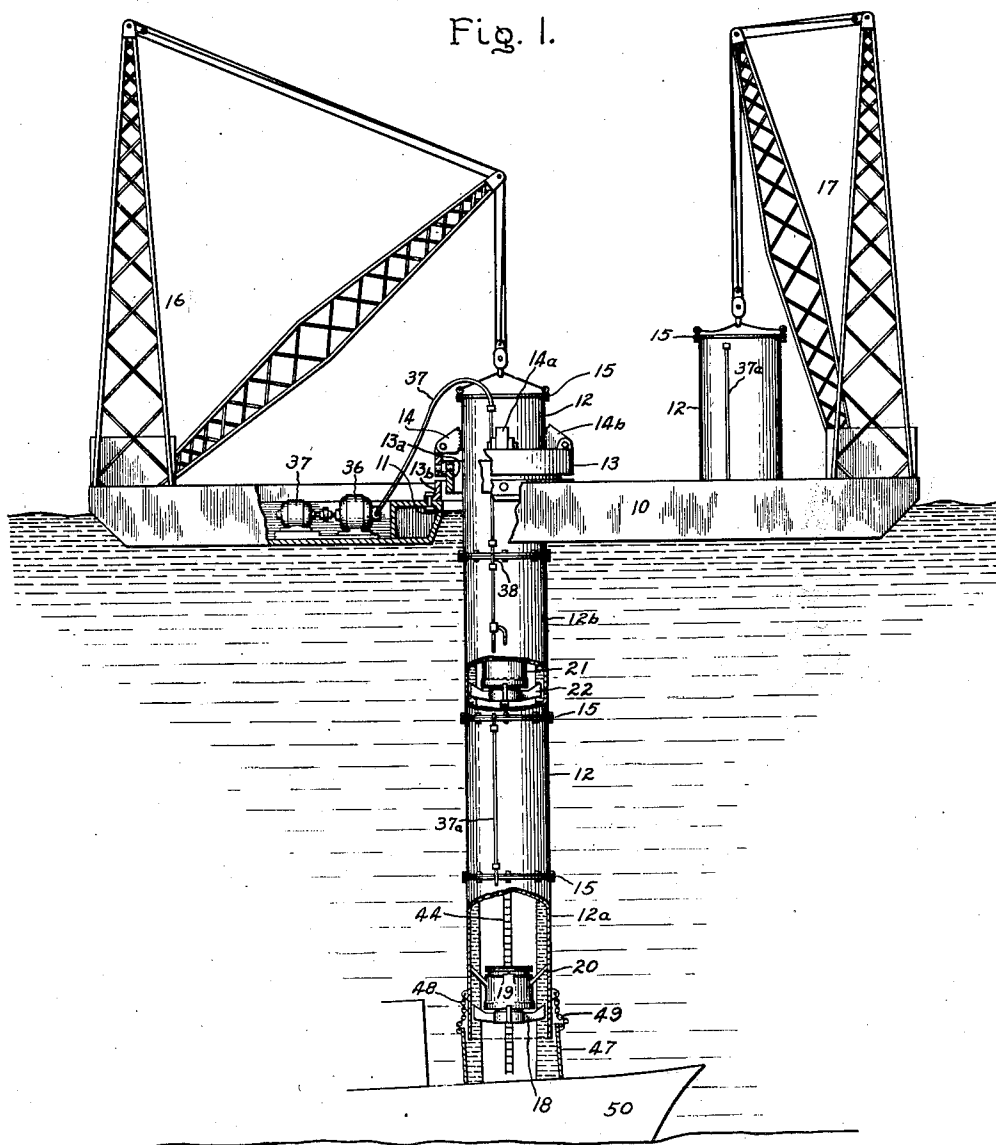
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METHOD OF AND APPARATUS FOR HYDRAULIC PROSPECTING

Original Filed June 25, 1929 2 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

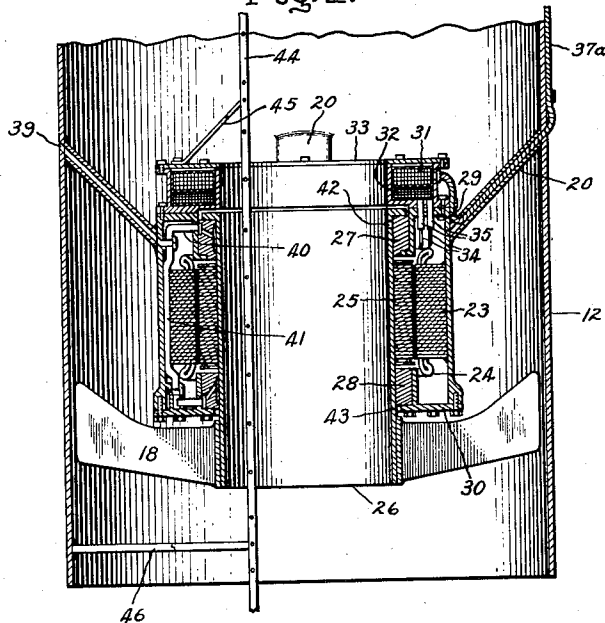
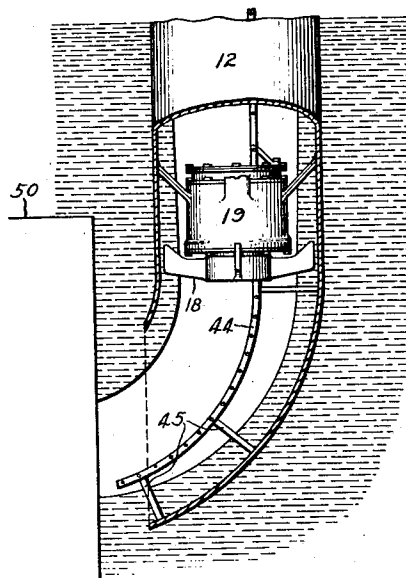


Fig. 3.



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UNITED STATES PATENT OFFICE

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METHOD OF AND APPARATUS FOR HYDRAULIC PROSPECTING

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This invention relates to hydraulics, and more particularly to the performance of operations beneath the surface of hydraulic bodies.

5 In the past sub-surface operations have been carried out mainly by the several methods of diving. Although the method of diving is entirely operative, it entails the serious disadvantage, that even at comparatively
10 moderate depths, the person of the diver is subjected to enormous pressures and chilling temperatures which decrease the efficiency of his activities, limit the period for which he may remain beneath the surface, and very
15 often result in serious permanent injury to his health.

Accordingly, an object of this invention is the provision of a simple, reliable and effective method for providing communication
20 between the surface and points beneath the surface of an hydraulic body, in which persons engaged in operations beneath the surface will not be subjected to hydraulic pressures, together with a reliable and efficient
25 form of apparatus for carrying this method into effect.

In illustrating my invention in one form thereof, I have shown it as embodied in an apparatus particularly adapted for providing
30 access from the surface of the sea to a sunken submarine.

In carrying my invention into effect in one form thereof, I cause an open ended tubular enclosing wall to be secured in position
35 extending from the surface to the point beneath the surface where operations are to be carried on, and then cause the liquid within the enclosing wall to be rotated at a speed sufficient to cause a vortex to be formed
40 therein, affording communication from the surface to the point of operations.

For a better and more complete understanding of the invention, reference should
45 now be made to the following specification and to the accompanying drawings in which Fig. 1 is a view in elevation, partly in section, of a form of apparatus suitable for carrying my method into effect; Fig. 2 is an
50 enlarged view in section of a part of the

apparatus shown in Fig. 1; and Fig. 3 is a modification.

Referring now to the drawings, a barge 10 is provided with a centrally disposed opening formed therein by the cylindrical wall 11. As shown, the opening extends entirely
55 through the barge, and is of a size sufficient to permit the sections of tubing 12 to be lowered into the water beneath the barge.

In order that the tubular enclosing wall 12 may remain in an upright or vertical position substantially unaffected by the roll or pitch of the barge 10, the enclosing wall 12 is universally supported with respect to the barge 10 in the gimbal mounting comprising the annular rings 13, 13a and 13b. As shown
60 the ring 13b is provided with a flange which is secured to the barge, and ring 13a is pivoted with respect to ring 13b to permit of its rotation about a horizontal axis, whilst ring 13
65 is pivoted with respect to ring 13a to permit of rotation of ring 13 about a transverse horizontal axis.

The tubular enclosing wall 12 is supported within the annular ring 13 by means of clamping dogs 14, 14a and 14b, etc., with
75 which the ring is provided.

As thus constructed the rings 13, 13a and 13b constitute a universal mounting or support between the barge 10 and the tubular
80 enclosing wall 12, permitting the latter to be suspended from the former after the fashion of a plumb bob, substantially unaffected by rolling or pitching motion of the barge.

The extremities of each section of tubing 12
85 are provided with outwardly extending annular flanges 15, to permit of the sections being secured together by any suitable fastening means, such for example as by the bolts shown passing through the flanges.
90

In order to facilitate the handling of the tubular section 12, cranes or derricks 16 and 17 are provided upon the barge 10, and serve to lift and place the sections of tubing 12, end to end to be fastened together and then to
95 lower the tubular enclosing wall 12 through the opening in the barge into the water beneath.

The sections of tubing 12 may be constructed of any suitable material and are of such
100

dimensions as will best be suited to their being rapidly and easily handled. The lowermost section 12a of the tubing, i. e., the first section to be lowered through the barge is provided with a suitable liquid impelling means such for example as the paddle wheel 18, together with a suitable means for rotating the same such for example as the electric motor 19, the stator member of which is secured to the tubing 12 by struts or braces 20 which may be formed integrally with the wall of the tubing or may be secured thereto by suitable fastening means.

Additional motors and liquid impelling means spaced from each other by suitable intervals may be secured to intermediate sections of the tubular enclosing wall, as illustrated by the motor 21 and impeller 22 supported within the tube section 12b. The number of paddle wheels and electric driving motors will, of course, depend upon the depth of the point beneath the surface at which operations are to be carried on.

The construction of the electric motors for driving the paddle wheels and the manner in which they are supported will best be understood by reference to Fig. 2. As shown in that figure the motor is in alternating current induction motor and comprises a stator frame 23 upon the punchings of which a distributed polyphase winding 24 is wound, and a rotor member 25 which may be of any suitable type such for example as the wound rotor, or the more rugged squirrel cage type. The rotor winding is fixedly mounted on a hollow shaft 26, which also carries the liquid impeller 18.

The rotor member 25 of the motor is rotatably mounted with respect to the stator member 23 by upper and lower annular bearing blocks 27 and 28 supported by upper and lower stator end shields 29 and 30 respectively. Any suitable fastening means such as the bolts shown in the drawings may be employed to secure the end shields 29 and 30 tightly to the stator frames. The annular bearing blocks 27 and 28 may be made of any suitable material, but are preferably made of lignumvitæ, which is a very hard wood particularly adapted for bearings located in water, such for example as the packing bearings for ship propeller shafts.

It will be seen from the above description that the stator frame 23, end shields 29 and 30, lignumvitæ bearings 27 and 28 and hollow shaft form a water tight casing for the stator and rotor windings and punchings of the motor, and it is desirable, though not absolutely essential, that water should be excluded from the current carrying windings of the motor.

As an added precaution against the possible harmful effects due to the possibility of water gaining access to the rotor and stator

windings, the motor is preferably designed as a low voltage high current motor.

In order that alternating current of a suitably low potential may be available for supplying the motor, a step down transformer comprising a primary winding 31 and a secondary winding 32 is provided in a water tight annular shaped casing 33 located above and secured to the upper end shield 29 of the motor by any suitable fastening such as the bolts illustrated in the drawings. The terminals of the secondary winding of the transformer are connected by conductors 34 to the stator winding 24 of the motor, and as shown these conductors pass through the end shield 29 and are insulated therefrom by insulating bushings 35.

Alternating current of a suitable voltage and frequency is supplied to the primary winding 31 of the transformer from a suitable source of supply such for example as the alternating current generator 36 located on the barge 10. Alternator 36 may be driven by an suitable driving means such for example as the electric motor 37 supplied from the ship's mains (not shown).

The terminals of generator 36 are connected to the primary winding 31 of the transformer by means of a cable 37. As shown in the drawings, each section of the tubular enclosing wall 12 is provided with a section of submarine cable 37a suitably secured to the wall 12. As the sections 12 of the tubing are assembled, connections are made between the cable sections by suitably insulated connectors 38.

One of the supporting arms 20 is hollowed and communicates with the surrounding liquid by means of an orifice 39 provided in the tubular enclosing wall 12. Water for lubricating the bearings is thus admitted through the orifice 39 and through tube 20 to the interior of the motor whence it is distributed to upper and lower lignumvitæ bearing blocks 27 and 28 by means of tubular passages 40 and 41 respectively, provided within the stator frame. After passing through the bearing blocks, the water is discharged from parts 42 and 43 located in the bottom shaft 26 and in the lower end shield 30 respectively.

The blades of paddle wheel 18 may be welded or otherwise suitably secured to hollow shaft 26. As shown they extend radially outward from the shaft toward the tubular enclosing wall 12; sufficient clearance being left between their extremities and wall 12 to permit of their being rotated with respect thereto.

The hollow shaft 26 is preferably of a diameter sufficient to enable a man to pass therethroughout without coming into contact with it. If desired, a guard of suitable construction may be provided to prevent contact with the rotating parts. To enable

a man to descend the tubular enclosing wall 12 a ladder 44 runs the entire length of tubular wall 12 and through hollow shaft 26, and is supported within the tubular enclosing wall by supports 45, 46, arranged at suitable intervals along the interior of tubular wall 12.

The supports 20 for the motors, as well as the supports 45, 46, etc., are preferably stream lined to present the least possible resistance to rotary motion of water within the tube.

The lowermost section of the tube may be provided with a loose fitting collar member 47 of a diameter slightly larger than the tubular member 12, and is loosely secured thereto by a suitable fastening means such as the chains 48 and 49. The collar 47 serves as an extension of tubular member 12, and is particularly advantageous in extending the tubing 12 into engagement with surfaces of submerged bodies lying at an angle with the horizontal. It is also advantageous for maintaining a continuous enclosing wall between the surface and the point of operations despite vertical or slight swinging motion of the tubular enclosing wall, as will be the case when the surface is rough.

In the modification of the invention shown in Fig. 3, all of the elements are the same as those already described with respect to Figs. 1 and 2 with the exception that the lowermost section of the tubular enclosing wall 12 and the ladder 44 are curved. The motor 19 in this section is preferably supported so that the liquid impeller 18 is in the straight part of the tube just above the point where the curve begins. In this modification of the invention, no particular degree of curvature is required but a gradual curve is more to be preferred than a sharp curve.

With the above understanding of the parts and elements comprising an apparatus suitable for the practice of my invention, the operation and method will readily be understood.

The barge 10 may be towed to the point where salvaging or other sub-surface operations are to be carried on, for example to the point above a sunken vessel, such as the submarine 50 shown in the drawings, and there anchored against movement by winds and tides and against rotary movement, by suitable anchoring means, (not shown).

The clamping dogs 14, 14a, 14b, etc., will then be raised to permit of the lowermost section of tubular enclosing wall 12 containing driving motor 19 and impeller 18 to be lowered through the centrally disposed opening 11 in the barge 10 by either of the cranes 16, 17. The clamping dogs may then be set to clamp the section of the tubular member while another section is raised by the cranes and placed upon the first or lowermost section

and fastened thereto by bolts passing through the circumferential flanges 15. Electrical connections are then completed between the cable sections 37a by connectors 38. When this step is completed the clamping dogs are again raised and both sections of the tube are lowered a distance equal to a tube section and the clamping dogs are again set to retain the assembled sections while another section is fastened to those already assembled.

In this manner the tube is assembled section by section until enough sections have been assembled to afford communication from the surface to the point of operations beneath the surface, e. g., the submarine 50. When the tube is finally assembled, the electrical connections between the motors 19, 21, etc., are completed and the motor generator set 37, 36 is started up to supply alternating current to the primary windings 33 of the transformers and thence to the stator windings 24 of the motors. The motors 19, 21, etc., will then rotate at a speed dependent upon the frequency of the current supplied to its stator and the liquid impellers, i. e., the paddle wheels 18, 22, etc., mounted upon the shafts of the motors will likewise be rotated the result of which will be to set the water within the enclosing wall 12 into rotation. At a critical speed, a clean vortex will be formed therein, communicating from the surface to a point beneath the lowermost liquid impeller.

Any suitable means may be employed for varying the speeds of the motors 19, 21 but this will preferably be accomplished by varying the speed of the motor 37 which drives the supply generator 36, by any suitable methods of speed control as is well understood in the electrical art. In this manner, the driving motors may be run at the speed most suitable for maintaining a perfect vortex between the surface of the liquid body and the point of operations. In practice it has been found that speeds between 900 R. P. M. and 1500 R. P. M. are most suitable for maintaining a vortex.

After the vortex has formed and has become steady, operatives may then descend the ladder 44, passing through the hollow shafts 26 of the motors to the point of operations and carry on the necessary work without being subjected to any added pressure, other than that due to the added column of air between the sub-surface point and the surface and without being subjected to the chilling temperature of the sea water.

The collar 47 might be secured to the submarine, and after suitable communication having been made with the interior of the submarine, as by drilling, air might be supplied to the interior thereof either from the air column within the vortex, or from a hose communicating with a source of compressed air on the barge.

By fitting the collar 47 over the conning tower of the submarine or over any suitable aperture provided for the purpose, and then creating a vortex within the tubular enclosing wall in the above described manner, the conning tower hatch or aperture may be opened and the crew permitted to escape without being subjected to the enormous hydraulic pressures existing at the depth at which the submarine is submerged.

Operations on the side of a submerged body may be carried on by employing the curved section of Fig. 3 as the lowermost section of the tubular enclosing wall 12.

Although the invention has been explained in connection with a tubular enclosing wall extending from the surface to the point of operation, I would have it understood, that a tubular enclosing wall is not essential, since a vortex may be created by simply rotating an impeller at the point of operations. The vortex formed in open water is, however, not so easily controlled as the vortex formed within a smooth tubular enclosing wall.

I would have it understood that my invention is not limited to the salvaging of submarines or the rescue of entrapped crews, since obviously any sub-surface operation may be carried out by this method. It is also to be understood that this invention is not limited to sub-surface operations initiated at and carried on from the surface since obviously similar operations may be initiated at and carried on from the point of operations, for example from a sunken or submerged submarine.

Although, in accordance with the provisions of the patent statutes, I have described my invention as embodied in concrete form, I would have it understood that the invention is not limited thereto, since modifications, alterations and equivalent arrangements will readily suggest themselves to skilled workers in the art without departing from the true spirit of the invention or from the scope of the annexed claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The method of prospecting below the surface of a body of a liquid that comprises creating a vortex in the liquid in the region to be prospected.

2. The method of salvaging bodies submerged beneath the surface of a liquid that includes setting the liquid above the body into rotation, and in maintaining the speed of rotation at a value sufficient to cause a vortex to be formed in said liquid.

3. The method of providing air to animate beings entrapped beneath the surface of a liquid body, that includes rotating the liquid above the point of entrapment at a speed sufficient to cause a vortex to be formed therein.

4. The method of sub-sea prospecting that

consists in setting the water into rotation at a point beneath the surface of the sea, and in thereafter maintaining the water in rotation at a speed of rotation sufficient to cause an opening to be formed therein between said point and the surface.

5. The method of providing access to the surface of an hydraulic body from points beneath the surface that comprises the step of rotating an impeller in said body of water at said point at a speed sufficient to effect an opening between the surface and said point.

6. A method of exploring beneath the surface of a body of water that comprises enclosing a portion of said body within a wall, and in rotating the portion so enclosed at a speed sufficient to form an opening in said body communicating between the surface and a point beneath the surface.

7. The method of admitting air to a point beneath the surface of a body of water that includes placing an enclosing cylinder in said body of water in a substantially upright position, and in rotating an impeller within said cylinder at a speed sufficient to form an opening in said body of water extending from the surface to a point beneath the surface.

8. A device for exploring beneath the surface of hydraulic bodies comprising an open ended tubular enclosing wall, means for supporting said enclosing wall in position to extend from the surface of an hydraulic body to a point beneath the surface, and means supported within said enclosing wall at the lower extremity thereof for rotating the liquid within said enclosing wall at a speed sufficient to cause a vortex to be formed within said tube.

9. A submarine prospecting device comprising in combination a cylindrical enclosing wall consisting of a plurality of sections, means for supporting said wall in a substantially upright position in an hydraulic body against rotation, a plurality of impellers located at spaced intervals from each other within said tube and supported thereby, and means for rotating said impellers at a speed sufficient to cause a vortex to be formed in the liquid within said enclosing wall to afford communication between the surface and a point beneath the surface.

10. Apparatus for providing access to points beneath the surface of hydraulic bodies including in combination, a tubular enclosing wall, means for supporting said enclosing wall against rotation in position to afford communication from the surface to a point beneath the surface, a liquid impelling means for rotating the liquid within said enclosing wall, and an electric motor comprising a stator secured to said enclosing wall, and a rotor secured to said impelling means for rotating said impelling means, said rotor be-

ing provided with an axial opening to permit access to points beneath said motor.

11. Apparatus for providing access between the surface of an hydraulic body and
5 points beneath the surface comprising an open ended tubular enclosing wall, means for supporting said wall against rotation in a substantially upright position in an hydraulic body, an electric motor having a stator se-
10 cured to said enclosing wall, a rotor, bearings for said rotor supported by said stator, a liquid impelling means secured to said rotor for setting the liquid enclosed within said wall in rotation, said rotor being pro-
15 vided with an axially disposed opening to permit communication from one side thereof to the other.

12. Means for providing communication from the surface of a liquid body to a point
20 beneath the surface, comprising in combination a tubular enclosing wall, means for securing said wall against rotation in a substantially upright position in said liquid, an alternating current induction motor secured
25 to said wall, said motor being provided with a hollow shaft, a liquid impelling means mounted on said shaft, and a variable frequency source of alternating current for supplying said motor.

13. An hydraulic exploring device comprising in combination, a tubular member consisting of a plurality of sections, means for securing said member in a desired position in an hydraulic body, a plurality of elec-
35 tric motors disposed at intervals along the inner wall of said member, means for securing the stators of said motors to said member, a liquid impelling means secured to the rotor of each of said motors, a source of
40 power for said motors, and means for adjusting the speed of rotation of said motors, the rotors of said motors being provided with axially disposed passages to permit communication therethrough.

14. A device for providing communication from the surface of an hydraulic body to a submerged body comprising an open ended tubular member, a liquid impelling means supported at the lower extremity of said
50 member, a variable speed electric motor supported within said member for rotating said impelling means at a speed sufficient to create a vortex in the liquid within said tube, and a collar member loosely surrounding the
55 lower extremity of said member and attached thereto, to provide for relative movement between said collar and said tubular member.

In witness whereof, I have hereunto set my hand this 22d day of June, 1929.

60 EDWARD A. ADLER.