Aug. 16, 1949. H. I. JOHNSON 2,479,119

PROPELLER DRIVE UNIT WITH AUTOMATIC DEPTH REGULATION

Filed July 30, 1943 2 Sheets-Sheet 1

Fig. 1.

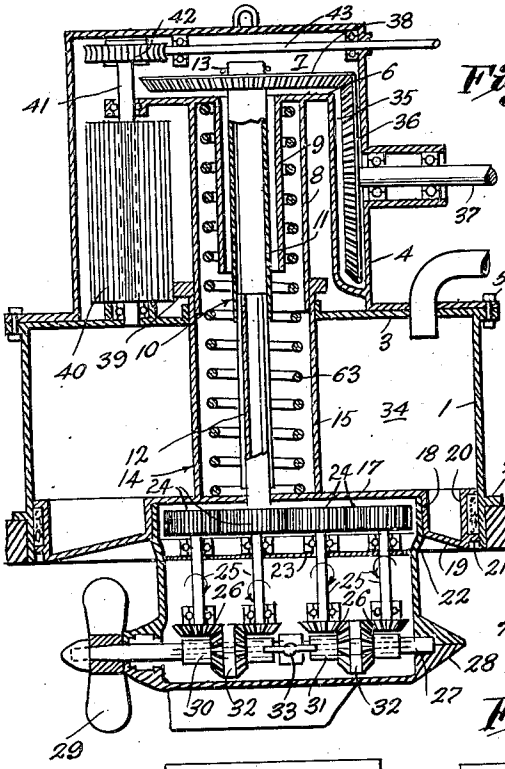


Fig. 3.

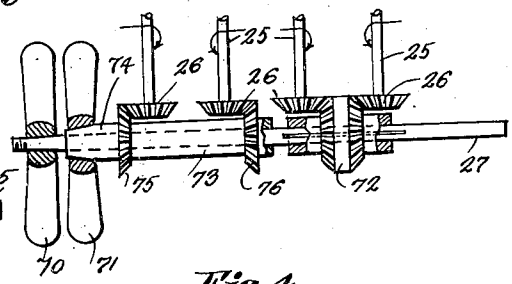


Fig. 4.

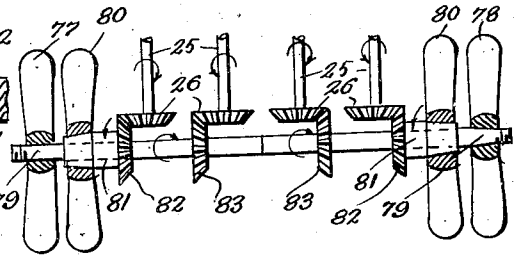
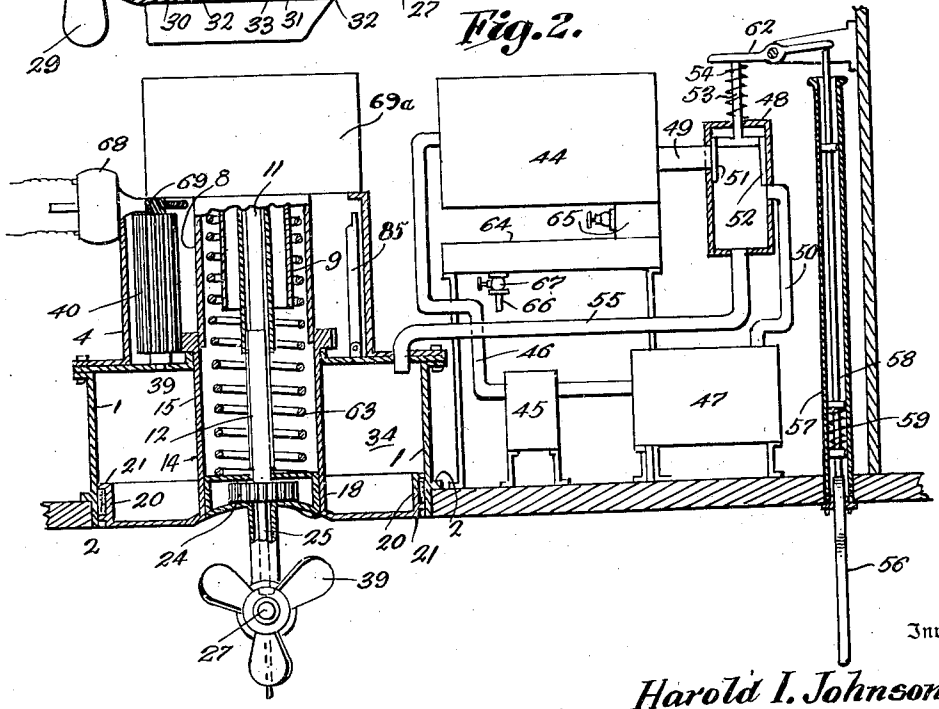


Fig. 2.



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PROPELLER DRIVE UNIT WITH AUTOMATIC DEPTH REGULATION

Filed July 30, 1943 2 Sheets-Sheet 2

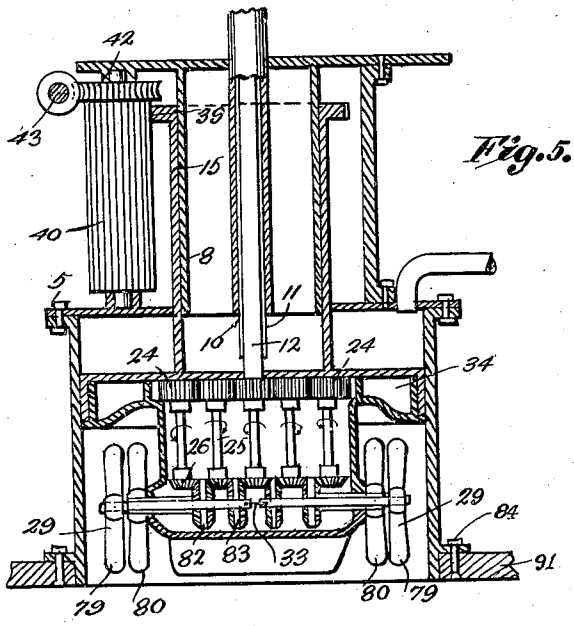


Fig.5.

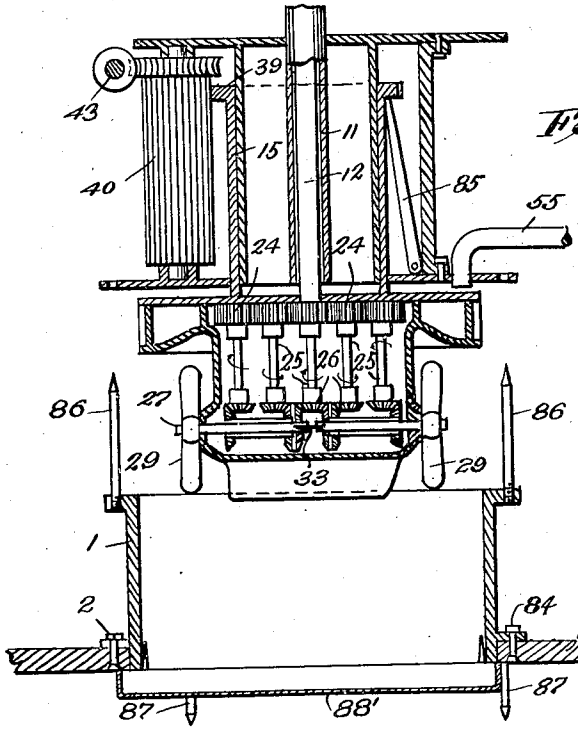


Fig.6.

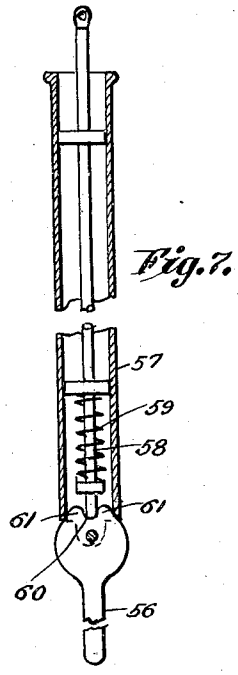
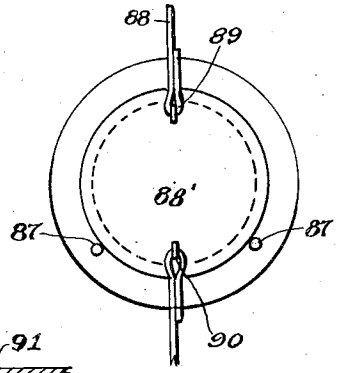


Fig.7.

Fig.8.



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2,479,119

PROPELLER DRIVE UNIT WITH AUTOMATIC DEPTH REGULATION

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Application July 30, 1943, Serial No. 496,773

16 Claims. (Cl. 115—41)

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This invention is directed to an improvement in propeller drive units, designed more particularly for marine propulsion, but not necessarily limited thereto.

The primary object of the invention is the provision of a propeller drive unit wherein the propeller shaft is in line with the slip stream and without shaft angle, to increase efficiency regardless of location.

A further object is the provision of a multi-gear drive in the propeller shaft assembly to provide increased power delivery with relatively small housing.

A further object is to mount the drive unit for automatic retraction to a degree to prevent propeller damage, and to permit the complete removal of the unit as such for replacement without necessitating the dry-docking of the vessel.

A further object is to provide for rotative adjustment of the unit to provide for reverse drive without substantial loss of power effect, or to provide for steering or sidewise movement of the vessel through appropriate adjustment of the unit.

A further object is the utilization of a multi-gear assembly for propeller drive, and the convenient adaptation of that assembly for the use of a single propeller, pusher or puller, the use of two propellers of opposite rotation mounted to avoid torque strain, or the use of four propellers in pairs of opposite rotation to avoid torque, without adding to the gear assembly.

A further object of the invention is the provision of a contact guard or guards located in advance of the propeller and designed to protect the propeller or propellers against damage, the guard when meeting an object being deflected and acting to set in motion automatic means to retract the propeller assembly to a protected position within its well.

A further object is that additional retractable units can be mounted on the sides of deep draft ships so that the bow side units will pull the water from the bow creating a vacuum for the bow to enter, and the stern side units would force the water behind causing a pressure at the stern to help force the ship ahead, instead of the present condition of pressure on the bow and a vacuum at the stern.

A further object is that this invention fits the modern trend of using a multiple of small interchangeable motors, combining the propellers and shafts into the interchange motor units, which can be assembled at the motor factory and save installing time at the ship-yard, and can be installed in vessels that were not built for power or ships that want to add power.

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The invention will best be understood from a consideration of the following detailed description taken in connection with the accompanying drawings forming a part of the specification, with the understanding, however, that the invention is not to be confined to any strict conformity with the showing of the drawings but may be changed or modified so long as such changes or modifications mark no material departure from the salient features of the invention as expressed in the appended claims.

In the drawings:

Fig. 1 is a vertical sectional view, partly in elevation showing the use of a single propeller and the parts in operative positions.

Fig. 2 is a similar view showing the propeller adjusted to sidewise drive position, and showing the means for controlling the retraction of the unit and the arrangement and operation of the contact guard.

Fig. 3 is a view in elevation showing the unit adapted for two propellers at one end of the propeller shaft.

Fig. 4 is a similar view showing the unit adapted for the use of a pair of oppositely acting propellers at each end of the propeller shaft.

Fig. 5 is a view in section, partly in elevation, showing the unit in retracted position.

Fig. 6 is a similar view showing the unit removed from the well as an entirety.

Fig. 7 is an enlarged sectional detail, showing the contact guard in normal operative position and the mechanism controlled in the contact movement of such guard.

Figure 8 is a view of the underside of the well cover plate showing such plate in operative position.

The invention in the preferred form illustrated, includes a well 1, circular in section, designed to be secured at 2 in an appropriate opening in the vessel and to be provided with a removable cover plate 3. A casing 4, removably secured by bolts or cap screws 5 to the cover plate 3 is formed in detail to accommodate various parts of the structure, as will develop during the further description.

The casing is formed with a transverse partition wall 6, spaced from the top of the casing to define a gear chamber 7. A cylindrical guide wall 8, depends from the partition and terminates immediately above the top 3, the guide wall being open at the bottom. An inner tubular wall 9, is arranged within and concentric with the

guide wall 8, the wall 9 terminating short of the top 3, and the partition 6 being open at the upper end of the wall 9.

A telescopic drive shaft 10 is operative axially of the tubular guide 9, and includes an upper section 11 and a lower section 12 slidable within the section 11, the respective sections being non-circular in cross section to prevent independent rotation. The section 11 extends above and below the wall, having appropriate antifriction bearing at 13, while the lower section 12 extends through and below the cover 3, for driving function, as will later appear.

A propeller shaft assembly housing 14 is mounted for movement in the well 1, and includes an upper cylindrical guide 15, the housing at the lower end of the guide 15 being laterally enlarged at 17, then extended downwardly at 18, and then further extended laterally at 19. The periphery of the portion 19 joins the upstanding circular flange 20 which is formed to provide an outwardly opening channel 21 to receive suitable packing to form a leak-proof engagement with the inner surface of the well 1.

Below and substantially in line with the lateral portion 17 of the housing 14, the housing is extended below the lateral portion 19 and formed to provide a hollow gear box 22, divided in its upper portion by a partition 23. A series of meshing gear pinions 24 are mounted in alinement transversely of the gear box, such pinions having bearing above the partition with suitable antifriction bearings, and each having a shaft 25, fixed to its gear and depending through the partition 23. The section 12 of the drive shaft 10 is directly secured to one of said pinions, so that operation of the drive shaft will operate all gear pinions simultaneously and similarly as to speed.

The lower ends of the shafts 25 are respectively provided with bevel gears 26, spaced apart and independent of one another. A propeller shaft 27 is mounted in the lower end of the gear housing, extending transversely of the housing and having proper antifriction support. The lower end of the gear housing is extended diametrically in line with the propeller shaft 27, and gradually narrowed in all directions to avoid resistance to the water, as indicated at 28.

In the form shown in Fig. 1 a single propeller is secured on one end of the propeller shaft 27, this propeller 29 being of any desired type and form according to the function to be performed. Keyed on the propeller shaft 27 within the operative plane of the bevel gears 26, are sleeves 30 and 31. A double-faced bevel gear 32 is secured on each sleeve 30 and 31, and cooperates with two adjacent bevel gears 26. As the sleeves are keyed on the propeller shaft for sliding movement it is apparent that the pressure on the bevel gears 26 will be equalized, while equalizing bars 33 connect the adjacent ends of the sleeves 30 and 31 to equalize the pressure on the double-faced gears 32. Obviously the shaft 27 may be extended at the opposite end from the propeller 29 and formed to receive an additional propeller using the same driving means.

It will be understood that there is a chamber 34 between the portions 17 and 19 of the propeller housing 14, and the top 3 of the well, and this chamber is of sufficient depth to permit the propeller housing and propeller to be withdrawn therein. The guide 15 encircles and slidably fits over the guide wall 8, permitting relative vertical guided movement of the propeller assembly. The casing 4 is formed at one side with a chamber 35 in which is mounted a power gear 36 carried by a power driven shaft 37 leading through the casing to the source of power. A second gear 38, secured on the end of section 11 of the drive shaft 10, and operating in the chamber 7 is in driving mesh with the gear 36, to thereby drive the gears of the propeller assembly.

An annular gear 39 is fixed externally to the upper end of the guide 15 and meshes with an elongated gear cylinder 40, supported on the cover 3, with its shaft 41 extending through the partition wall 6. Secured on the end of shaft 41, within the chamber 7 is a worm gear 42, cooperating with a worm on a shaft 43, which is led through the casing 4 for steering-control operation.

Through the drive described the propeller or propellers will be driven, and by means of the steering shaft 43 the propeller housing 14 may be turned for steering, or given a quarter turn for sidewise driving, or given a half turn for reverse driving, the steering shaft acting through the worm drive 42, the gear cylinder 40, the annular gear 39 and the guide 15.

It is an important feature of the present invention that the propeller be protected against damage through contact with an object in the water, and to provide for this result there is provided a contact guard or guards, set in advance of the propeller assembly, to immediately detect by contact the presence of the object, and to act under such contact to automatically withdraw the propeller.

In specific provision, and with particular reference to Fig. 2, the unit includes an appropriately mounted vacuum tank 44, open to the exhaust of a pump 45, through pipe 46, the pressure side of the pump leading to a pressure tank 47. A valve casing 48 is mounted adjacent the tanks, and is in communication with the vacuum tank 44 by a pipe 49 and with the pressure tank 47 by a pipe 50. A valve controls the inlet from tank 44, as at 51, a second valve 52 controlling the inlet from the tank 47. The valves 51 and 52 are oppositely set, so that when one is open the other is closed, and both valves are simultaneoulsy operated by a stem 53, extending upwardly through the casing 48, and spring biased by spring 54 to hold valve 51 normally closed and valve 52 normally open. A conduit 55 is in open communication with the valve casing 48 and leads to and opens into chamber 34, into which the propeller assembly moves when retracted.

A contact guard 56 is supported at the lower end of a tube 57, mounted adjacent a bulkhead, or other convenient position, sufficient in advance of the propeller to permit the desired operation. A rod 58 extends longitudinally in and is freely movable within the tube, being biased in the downward direction by a spring 59. The upper end of the contact guard 56 is formed with a central depression 60 in which the rod 58 is normally seated, and on opposite sides of the depression with upwardly-rounded surfaces 61, lying transversely of the guard in normal position. The upper end of rod 58 underlies one end of a lever 62, the opposite end of which overlies the stem of composite valves 51 and 52.

Normally valve 52 is open when the guard 56 is in normal depending position, and hence pressure is admitted to the chamber 34 to maintain the propeller assembly in lowered operative po-

sition, assisted by a spring 63 arranged within the cylindrical guide and guide wall and bearing against the partition 6 and upper portion of the propeller assembly. In the event the guard, or guards, for any necessary number in different positions may be used, encounters an obstruction, it is swung on its pivotal connection and one or the other of the surfaces 61 forces the rod 58 upwardly. This operates lever 62 and operates the valves to close valve 52 and open valve 51. The vacuum pull of tank 44 is thus directed to chamber 34, and the propeller assembly is drawn upwardly into such chamber 34, and the propeller protected against damage.

The propeller assembly is, through the packing at 21, designed to prevent entry of water into the chamber, but in order to insure against collection of water therein, a separate vacuum tank 64 has valved connection at 65 with vacuum tank 44, and has a conduit 66 leading to the chamber 34, controlled by a valve 67. In the event of water accumulating in chamber 34, the valve 65 is opened to induce a vacuum pull in tank 64, following which valve 65 is closed and valve 67 opened to withdraw the water, if any, from chamber 34 into tank 64, from which it may be discharged through an appropriate outlet.

Fig. 2 also shows an electric steering motor 68 connected through a worm drive 69 to gear cylinder 40 for steering purposes. There is also provided a prime mover 69a for the propeller drive, such prime mover may be an electric, steam, Diesel, or gasoline engine.

The propeller shaft may carry one propeller at one end, or a propeller at each end as previously referred to, and as shown in Fig. 3, two propellers, indicated at 70 and 71 may be on one end of the shaft. In this arrangement the propellers rotate oppositely, and the shaft proper is driven through a double-faced gear 72 keyed on the shaft and cooperating with two of the bevel gears 26. A sleeve 73 is rotatable on the shaft and has an extension 74 on which the second propeller is mounted. The sleeve 73 has its ends formed as opposite, outwardly facing gear rings 75 and 76 which cooperate with opposite faces of two adjacent bevel gears 26.

In Fig. 4 there is shown a double torpedo-type drive, in which each propeller 77 and 78 has its own shaft 79, there being two propellers on each end. One propeller of each pair, as 80, is mounted on a sleeve 81 free on its shaft, and having a bevel gear 82 cooperating with one of the bevel drive wheels 26. The shaft is provided with a fixed bevel pinion 83, cooperating with an adjacent bevel gear 26. In this arrangement any provision for gear pressure equalization is not required.

A desirable characteristic of the improvement is the capability of the complete removal of the propeller assembly as a unit, when required for repair or replacement. If the bolts 5, used in securing the cover 3 in place are removed, the entire propeller assembly can be moved upwardly free of the well. In carrying out this operation, the propeller assembly is first retracted into the chamber 34, and locked in this position by a latch 85 engaging beneath the annular gear 39. A long guide pin 86 is placed in each of the bolt holes to guide the propeller assembly during removal and the propeller assembly lifted free.

If the water line is higher than the top of the well, provision is made to prevent entry of water in the absence of the propeller assembly. Two of the securing bolts or lugs 84, used to secure the well to the hull 91, are removed from the bottom of the well flange and are replaced by long studs 87, a cable 88 is passed around beneath the vessel and connected at its ends to a flanged cover plate 88' of buoyant material as indicated at 89 and 90. The cover is then slid down the outside of the hull by pulling on one end of the cable and slackening the other end and in this way the cover plate may be brought into contact with the studs 87, when such cover plate owing to its buoyancy will float into place and close the open lower end of the well. The cover plate will be forced from its sealing position in replacing the propeller assembly and may then be recovered through use of either cable 89 or 90.

From the above description it will be apparent that the propeller unit is subject to automatic retraction of the propeller assembly to position the propeller beyond damage under conditions otherwise tending to such damage; that when retracted sufficient load is maintained on the prime mover to prevent racing; that the propeller assembly may be readily turned and maintain full operation for steering function, for reverse propulsion, or for sidewise propulsion; that the propeller shaft is in line with the slip stream and without shaft angle tending to retard efficiency; that the propeller assembly can be removed for repair or replacement without drydocking the vessel; that the propeller assembly construction serves to prevent the propeller-displaced water from rising to the surface, through provision of a vacuum arch by which the displaced water is caused to move rearwardly without induced resistance to propeller action; that the specific construction presents in a single unit selective combinations of one propeller, pushing or pulling, two propellers having the same rotation, one pushing, one pulling, or either one right hand and one left hand rotation, on opposite ends of the shaft, or four propellers, two at each end of the shaft in counterbalanced relation as to torque and vibration.

It is to be pointed out that the forward units can be set to compensate for windage or drift, or connected to the regular steering gear while on voyage.

Having thus described the invention, what is claimed as new, is:

1. A propeller unit, means to mount the unit for rotative movement and vertical movement along the axis of the rotative movement, manually-operable means to control the rotative movement, means for selectively applying vacuum and fluid pressure to automatically compel the selective vertical movement of the unit, and an obstruction contact guard to govern the functioning of the vacuum and pressure applying means.

2. A propeller unit including a fixed well, a propeller assembly rotatable and slidable in said well, the propeller assembly comprising a portion coacting with the well to form a chamber into which the assembly is vertically movable, and means for selectively creating a vacuum and building up a pressure in said chamber to compel the said vertical movement of the assembly.

3. A propeller unit including a well, a propeller assembly vertically movable in said well, said assembly having a portion defining with the well an assembly-receiving chamber, a vacuum tank, a pressure tank, a conduit forming means through which communication may be established between the chamber and said tanks, and means responsive to an obstruction in the path of travel of the assembly to selectively establish through said

conduit communication between the chamber and the said vacuum and pressure tanks.

4. A construction as defined in claim 3, wherein said means includes a contact guard to be displaced by an obstruction and a valve to be operated by said guard, said valve being connected in said conduit between the chamber and the vacuum and pressure tanks.

5. A propeller unit including a well, a casing removably secured to and above the well, a propeller assembly movable in the well, said assembly including a cylindrical guide, a guide wall in the casing to receive and direct the cylindrical guide in the movement of the assembly, a propeller shaft in the assembly, a propeller on the shaft, a plurality of spaced gears in said assembly, a plurality of gears on the propeller shaft and each having toothed connection with at least two of the spaced gears, and a driving means for the spaced gears extending through the guide wall and cylindrical guide.

6. A propeller unit including a well, a casing removably secured to and above the well, a propeller assembly movable in the well, said assembly including a cylindrical guide, a guide wall in the casing to guide the cylindrical guide in the movement of the assembly, a propeller shaft in the assembly, a propeller on the shaft, a gear train in said assembly including meshing gear pinions, spaced gears each operated by one of said pinions, a plurality of gears on the propeller shaft, each mating with at least two of the spaced gears, and power means extending through the guide wall and cylindrical guide and directly operating one of the gear pinions.

7. A construction as defined in claim 5, wherein the driving means includes telescopically-related sections cooperating for free rotative longitudinal movement while fixed against relative rotary movement.

8. A construction as defined in claim 5, including an annular gear on the cylindrical guide, and means in the casing cooperating with said annular gear and operable to rotate the cylindrical guide and thereby the propeller assembly at will.

9. A retractable and rotatable propeller structure comprising a circular well having a top wall and an open bottom, a body forming closure wall for and disposed in said well bottom and having a fluid sealing contact with the well wall for axial and rotary movement therein, a propeller assembly carried by said closure wall for movement therewith into and out of the well, means for turning the assembly on the longitudinal axis of the well, means for driving the propeller assembly, and means for reducing the pressure within the well above said wall to effect retraction of the wall and assembly into the well.

10. A retractable and rotatable propeller structure comprising a circular well having a top wall and an open bottom, a body forming closure wall for and disposed in said well bottom and having a fluid sealing contact with the well wall for axial and rotary movement therein, a propeller assembly carried by said closure wall for movement therewith into and out of the well, means for turning the assembly on the longitudinal axis of the well, means for driving the propeller assembly, means for reducing the pressure within the well above said wall to effect retraction of the wall and assembly into the well, and means for introducing fluid under pressure into the well to force the said wall and assembly outwardly.

11. In a retractable and rotatable propeller assembly, a well having an open bottom, a closure wall in the well having sliding contact with the well wall for axial movement therein between the top and bottom of the well, a telescopic power shaft lying in the axial center of the well and passing through said wall, a propeller shaft having a length less than the diameter of the well and supported perpendicular to the power shaft, a propeller on the propeller shaft, a gear connection between the power shaft and the propeller shaft which is so constructed and arranged that driving power is applied to the propeller shaft at at least two positions therealong, means for drawing the wall, propeller shaft, propeller and gear connection into the well, means for applying driving power to the power shaft, and means for turning the propeller shaft and propeller on the axis of the power shaft.

12. A propeller assembly as set forth in claim 11, wherein the said means for applying driving power and the means for turning the propeller and propeller shaft on the said axis is operable when the propeller and propeller shaft are within the well as well as outside thereof.

13. A retractable propeller structure, comprising a well having a top wall and an open bottom, a wall partitioning the well having sealing contact about its periphery with the surrounding wall of the well and movable axially of the well, a propeller assembly suspended from the underside of said partitioning wall and movable therewith for retraction into the well, means for applying driving power to the assembly, means for reducing the pressure in the well above the wall to effect movement of the wall and propeller assembly inward, means for introducing fluid under pressure into the well to move the wall and propeller assembly outward, a movable obstacle contacting means supported to extend below the plane of the open bottom of the well, and means controlled by said obstacle contacting means for selectively setting into effect the pressure reducing means and the fluid introducing means.

14. A propeller structure, comprising a well having an open bottom, a wall within and closing said open bottom and having peripherial contact with the well wall for movement axially of the well, a gear box carried by and extending downwardly from the underside of said wall and having a length extending diametrically of the wall, a propeller shaft supported in and extending lengthwise of the lower part of the box, a propeller supported upon an end of the shaft outside the box, a series of spur gears supported in driving relation in the upper part of the box, a shaft extending downwardly from each spur gear, a gear coupling between each of said last shafts and the propeller shaft, means for coupling a prime mover with one of the spur gears for driving the gears, means for effecting the retraction of said wall, the gear box, propeller and shaft into the well, and means for turning the wall, gear box, the gear assembly in the box, propeller shaft and propeller on the longitudinal axis of the wall.

15. A propeller structure as set forth in claim 14, in which the means for transmitting driving power to the said one spur gear comprises a telescoping housing consisting of a fixed portion and a movable portion and a telescoping power shaft extending through the telescoping housing, the movable portion of the telescoping housing being connected with said partition wall and extending axially through the well.

16. A propeller structure as set forth in claim 14, in which the means for transmitting driving

power to the said one spur gear comprises a telescoping housing consisting of a fixed portion and a movable portion and a telescoping power shaft extending through the telescoping housing, the movable portion of the telescoping housing being connected with said partition wall and extending axially through the wall, and the said means for turning the partition wall, gear box and the gear assembly therein, the propeller shaft and propeller on the longitudinal axis of the well, including a ring gear secured around the said movable portion of the telescoping housing outside of the well, a relatively long gear supported for rotation on an axis paralleling the axis of the telescoping power shaft and having toothed connection with the ring gear, and means for turning said relatively long gear.

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