

[54] **ANCHORS WITH POWERED, MOVABLE FLUKES**

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[51] Int. Cl. .... B63b 21/24

[58] Field of Search ..... 114/206 A, 206 R, 207, 208

[56] **References Cited**

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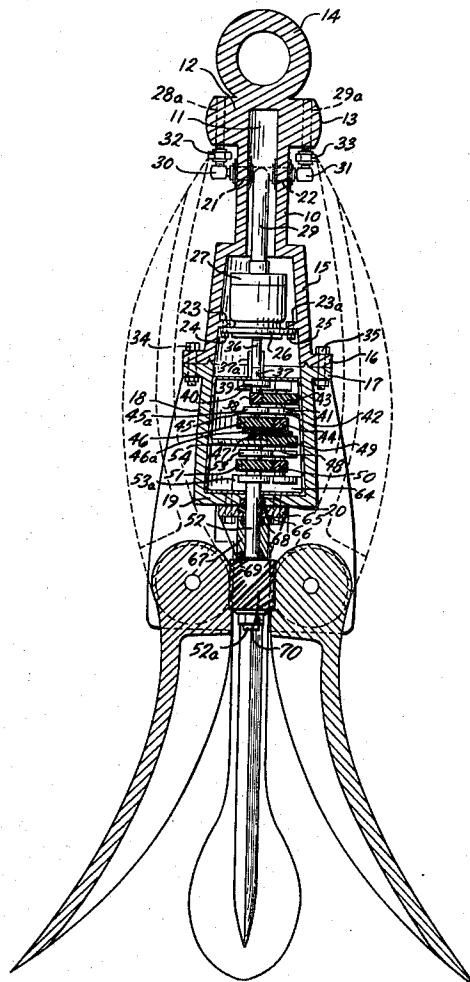
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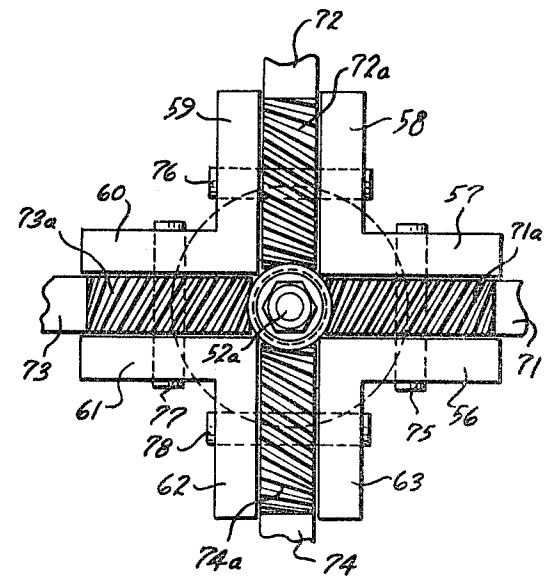
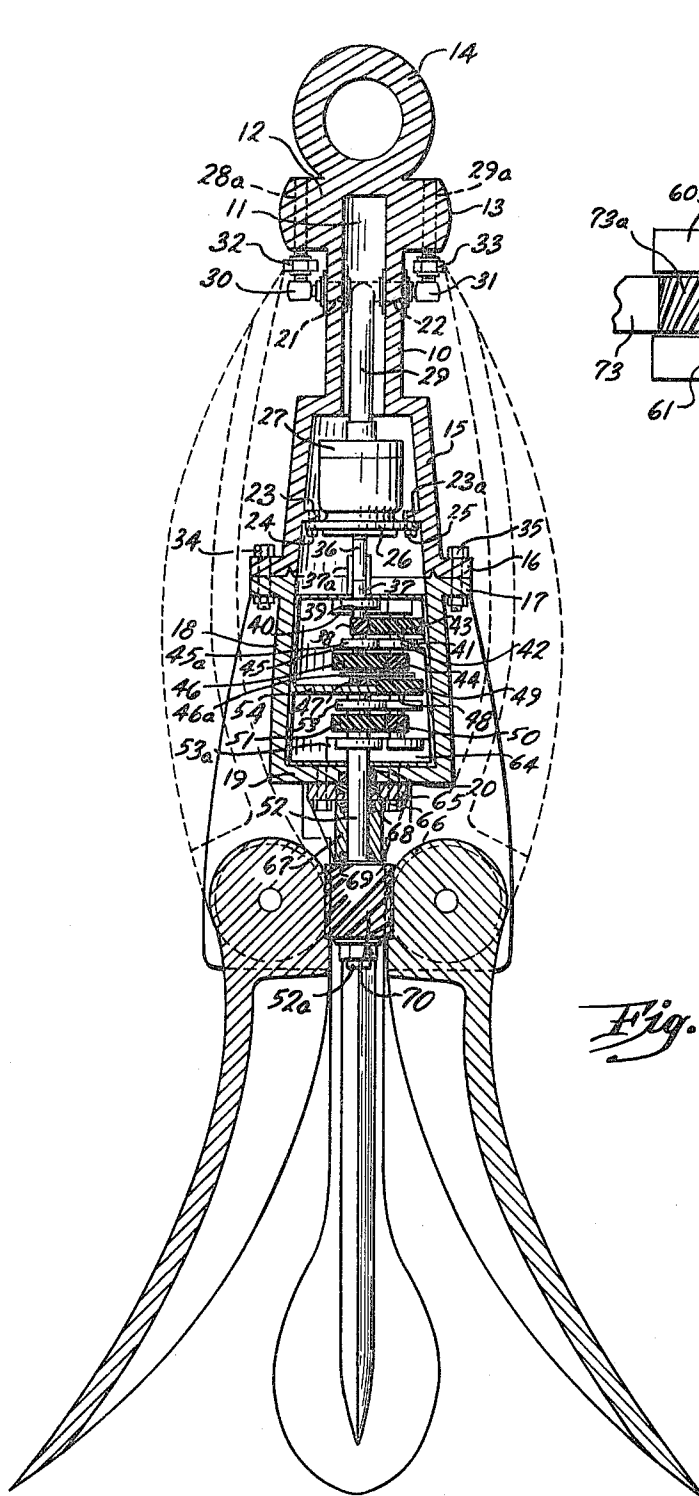
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[57] **ABSTRACT**

Improved anchor constructions; anchors having each a plurality of powered movable flukes; power means for anchors with movable flukes operable to move said flukes from a fluke-stored position (where the flukes lie closely against the shank of the anchor) to an operating position with the flukes extending outwardly at substantially 90° from said shank to a collapsed or fluke-freeing position substantially 180° arcuate position away from the stowed position (whereby the flukes will have essentially no drag upon the bottom) one said power means comprising a hydraulic motor with suitable gearing to transmit power to said flukes; a second said power means comprising an electric motor with power therefrom also transmitted through suitable gearing to the flukes; a third said power means comprising an hydraulic or pneumatic piston with the piston rod directly connected to the pivotal flukes; a next said power means comprising an electric solenoid power source driving a rod directly connected to the said pivotally movable flukes.

8 Claims, 8 Drawing Figures





*Fig. 2.*

*Fig. 1.*

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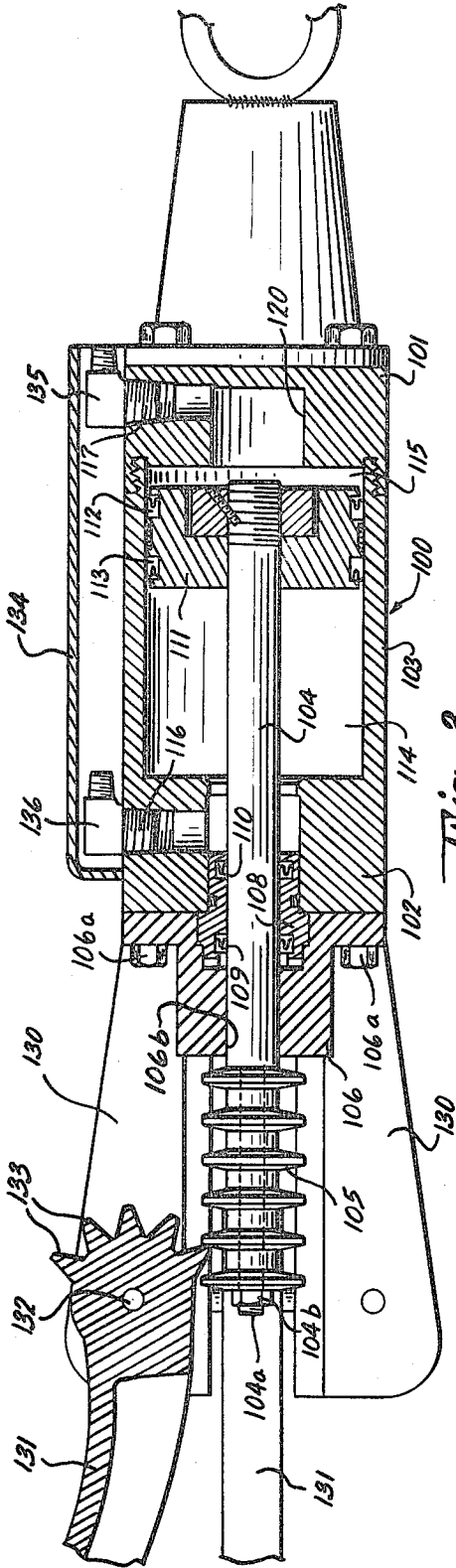


Fig. 3.

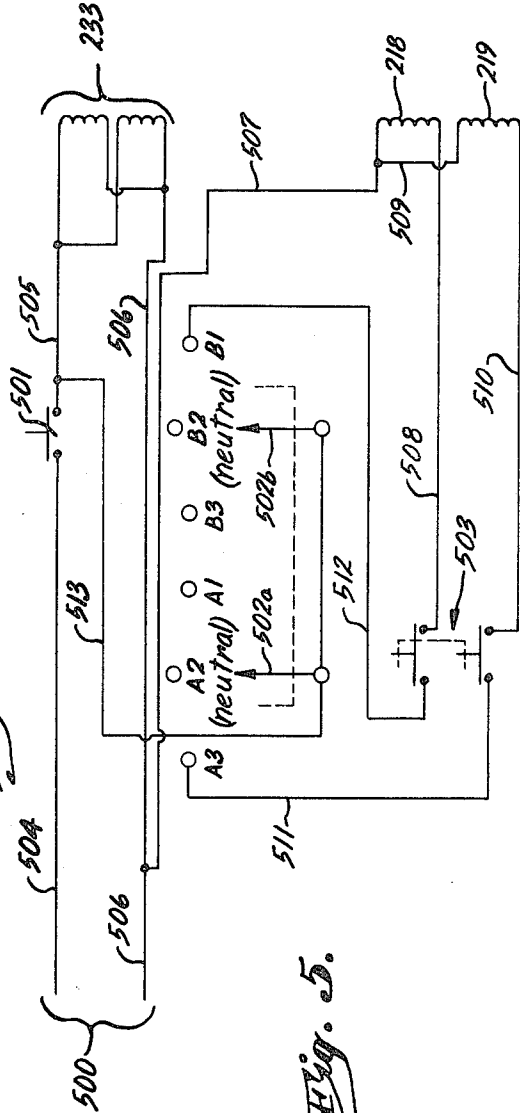


Fig. 5.

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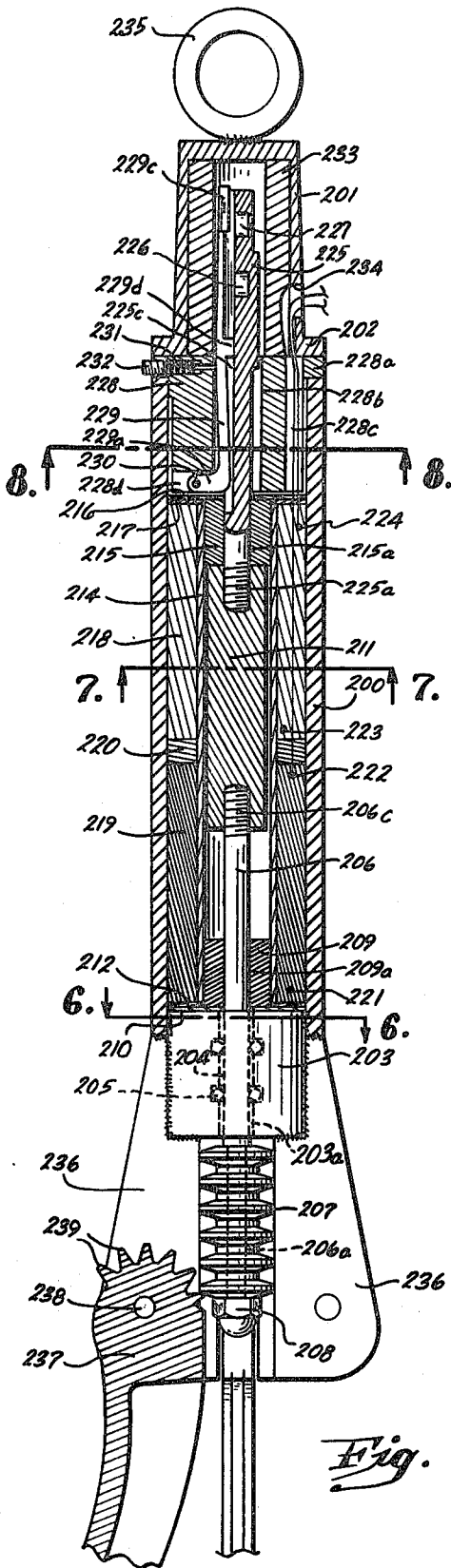


Fig. 4.

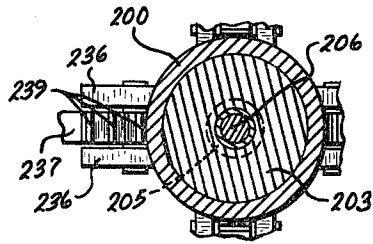


Fig. 6.

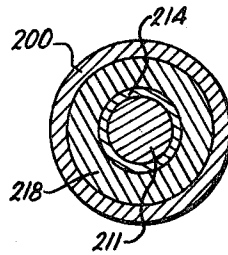


Fig. 7.

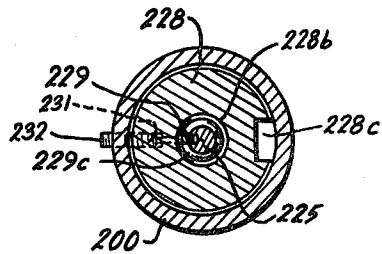


Fig. 8.

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## ANCHORS WITH POWERED, MOVABLE FLUKES

This device represents an improvement over the various movable fluke anchor constructions of: (1) Williams U.S. Pat. No. 3,283,736 "Collapsible Anchor," Nov. 8, 1966; (2) Chard U.S. Pat. No. 3,082,729 "Anchor," Mar. 26, 1963; (3) Swails U.S. Pat. No. 3,021,812 "Releasable Anchor," Feb. 20, 1962; and (4) Doty, Jr. U.S. Pat. No. 2,797,658 "Anti-Fouling Anchor," July 2, 1967. (As well as other like constructions of the prior art).

### BACKGROUND OF THE INVENTION

Dragging anchors rely on weight and some hooking or suction action for their holding power. Among the types of dragging anchors are included the following:

1. Clump anchors, usually comprising a body of concrete or stone with engaging means set therein for anchor rod or chain attachment. The holding power of clumps is approximately 50 percent of their weight in water. When heavily silted in, such holding power is somewhat increased, but generally they are useful only for small holding power because of handling difficulties. They are seldom used.
2. Mushroom anchors usually consist of a bowl shaped base with a slender shank extending upwardly from the center point, being essentially refined clump anchors. A suction effect is created as they silt in, sometimes resulting in a holding power of two to three times the weight of the anchor. When the suction is disrupted, as by pulling from an unfavorable direction, the holding power drops drastically.
3. Kedge anchors, having an elongate shank to which are attached two or more flukes extending substantially at right angles thereto and usually having an upper stock (in the case of a pair of flukes positioned at right angles thereto) usually have holding power about four times its weight for sizes under 500 lb., although design variations can cause ranging from 2 ½ times its weight. Single fluked kedges are sometimes used.
4. Stockless anchors are like the last class, but without a stock and thus the most widely used on large vessels because same can be easily and snugly stowed in the conventional hawsepipe. Because of its limited fluke area (usually two flukes for stowage purposes) in relation to weight and the ease with which it rotates (since there is no stock), the stockless anchor generally has a holding power of only about three times its weight.
5. The northill anchor is essentially a light weight kedge anchor with the addition of a stock at the crown (fluke base) extending at right angles to the flukes. It is used primarily in sizes up to 100 lb. Its large fluke areas in these sizes yield holding powers of 20 to 30 times the weight of the anchor.
6. Grapnels, comprising a shank with a series of radial arcuate spikes extending from one end thereof possess no real holding power. Their primary use is for recovery of objects on the bottom or for hooking into rock bottoms for temporary holding. They are made in many types, including folding varieties.

Burial anchors do not depend on weight, but rather primarily on withdrawal resistance provided by flukes of large area. The holding power of the burial anchor is directly proportional to the projected fluke area of the anchor and the sheer strength of the bottom material and inversely proportional to burial area resistance. (A slight modification of this rule may hold true for screw anchors). Anchor weight is often a handicap, and in many cases a smaller anchor with a more favorable fluke-area weight ratio is more efficient than a heavier one.

Design and manufacturing tolerances are critical. For example, an error of only 1 percent in the function of fluke angle can cause a decrease in holding power of as much as 50 percent. Similarly, burial anchors constructed of inadequate

materials can fail at points far below their maximum design load capability.

Under any conditions, however, burial anchors have a holding power of many times that of dragging anchors. Under ideal conditions, light weight types have provided holding capability as high as 1,000 lb. per pound of anchor weight.

Typical burial anchors are of the spade (wishbone) anchor, a single-fluke burial type anchor, a plow anchor and the lightweight anchors, which are stock-stabilized, pivoting fluke anchors.

Despite the advantages of the burial anchors described, the inventions and improvements described are applicable primarily to dragging type anchors. The relative fluke adjustability brings the instant dragging anchors closer in effectiveness, however, to the burial type anchors.

Coupling anchors to chain usually requires both an anchor shackle and a chain shackle. However, many anchors under 200 lb. are produced with an oblong hole in the end of the shank, so that only a chain shackle is required.

### OBJECTS AND SUMMARY OF THE INVENTION

It is desired to improve anti-fouling anchors to enable the boat owner to more readily free the anchor from sunken logs, rocks or other obstructions which tend to prevent hoisting the anchor.

It is desirable to provide an anti-fouling anchor of simple and practical construction, efficient and reliable in operation, which is also relatively inexpensive to manufacture and which has a long life under heavy service.

In the field of releasable anchors for marine craft, an object is to provide new and improved means for releasing the anchor should one or more of the anchor arms or flukes be fast under an obstruction. This includes such engagements where to pull the anchor directly up in a normal way might impose undesirable stresses on the anchor cable, the craft, or the operator, or otherwise be difficult or impossible to effect.

In the instant improved anchor constructions, when the anchor is in use, the power-pivotable anchor arms are normally held or locked securely in an extended or operative position at substantial right angles to the anchor shank by the power drive means in the shank. Such power drive means engage the inner ends of the flukes only which are received by the framework of the lower shank, thereby to be completely embraced and well protected at all times.

Another object of the invention is to provide effective and dependable power means always directly coupled and connected with the movable and pivotable anchor flukes whereby to force operative to move the anchor flukes (from extended operative position to (a) stowing or storage position or (b) to bottom releasing or freeing position when the anchor becomes fouled) is supplied by said power means contained within a housing in the anchor shank rather than by a release cable or lines in the boat.

Another object of the invention is to provide power means integrally incorporated with an anchor for readily and dependably moving the several flukes of an anchor to any desired annular position with respect to the anchor shank from a parallel stowed position with respect thereto, including to various operating positions at various angles outwardly from the shank and, finally, to a bottom release position where the anchor flukes are essentially parallel extensions of the shank itself.

An object of the invention is to provide, in certain options, internally contained power means and a power train for an anchor with powered flukes, said power means comprising either an electrical motor or an hydraulic motor wherein a minimum of space or volume is required within the anchor shank to receive same.

Another object of the invention is to provide an anchor having a plurality of power movable flukes pivotally attached to one end of the anchor shank, the anchor so constructed and the flukes so powered that the latter may be closely collapsed

around the sides of the shank, thereby to completely enclose the shank housing, the power means and also always protect the connection between the flukes and the power drive from the shank when the anchor is being stored or moved around out of water.

A further object of the invention is to provide a powered, movable fluke dragging anchor utilizing an electrical solenoid power means received within the anchor shank to pivot the flukes between at least three positions, namely, a stowed position wherein the flukes lie along the shank, (2) an operating position wherein the flukes are at substantial right angles to the shank and (3) a bottom released position wherein the flukes extend at substantial 150° to the shank, suitable locking means provided in the operating position to secure the flukes against dragging stress in their engagement with the bottom.

A further object of the invention is to provide a variant power source for the improved anchor with powered movable flukes which is the subject of the instant invention, the said power source comprising an hydraulic piston received within the anchor shank, the piston rod of the hydraulic cylinder or piston being coupled with the pivotable, movable flukes whereby to drive them to the desired position.

Other and further objects of the invention will appear in the course of the following description thereof. In the drawings, which form a part of the instant specification and are to be read in conjunction therewith, embodiments of the invention are shown and, in the various views, like numerals are employed to indicate like parts.

#### DRAWINGS

FIG. 1 is a side sectional view through a first form of anchor of the improved construction, with the power movable flukes shown in released position in full line and in stowed or collapsed position in dotted lines. This form embodies as a power source either an electric motor or an hydraulic motor, either of same powering the pivotable flukes through a gear chain (power train) in reversible fashion. The operating position of the flukes is not seen in this view, but comprises an arrangement where they extend at approximately right angles to the anchor shank, which is vertical in the view of FIG. 1.

FIG. 2 is a view upwardly from below in FIG. 1, but with the anchor flukes shown extended in the operating position. This view is fragmentary with the flukes cut off at the end past the shank construction.

FIG. 3 is a partially sectional view through the shank of an anchor utilizing an hydraulic cylinder as the power source for moving the pivotal flukes. Only one fluke is shown in the view with the hydraulic piston at the uppermost operating position which causes the fluke to be in the downward or bottom release position.

FIG. 4 is a view like that of FIG. 3, but showing, positioned internally of the anchor shank, a solenoid power means for driving the anchor flukes around their pivot point to the various desired positions of stowage, use and bottom release.

FIG. 5 is a schematic circuit diagram for control and operating circuit for the powered anchors of the subject solenoid modification of FIG. 4.

FIG. 6 is a view taken along the line 6—6 in the direction of the arrows in FIG. 4.

FIG. 7 is a view taken along the lines 7—7 of FIG. 4 in the direction of the arrows.

FIG. 8 is a view taken along the lines 8—8 of FIG. 4 in the direction of the arrows.

The structure basically includes an elongate, hollow shank having a longitudinally extending bore formed therein. If there are four flukes, as in the example shown, there are provided four sets of flanges at right angles to one another at the lower end of the shank, each to receive one end of a fluke therebetween. Each fluke is pivotally mounted on a set or pair of flanges with the inner end of each fluke (next the shank) having gear teeth cut therein. A suitable power source of reversible type is rigidly mounted within the upper portion of

said shank and there is provided into such power source suitable electrical power cables or hydraulic or pneumatic lines to drive or actuate same in forward and reverse (or up and down) motion. A drive shaft protrudes from the lower end of said power source and is (alternatively) connected into one end of a chain of gears or directly to the flukes.

#### GENERAL CONSIDERATIONS RE HYDRAULIC AND ELECTRIC MOTOR POWERED ANCHORS

The hydraulic or electric motor type power source trades speed for power in the said gear train, there extending from the other, lower end of the transmission or gear train another power shaft. Mounted on the lower end of this power shaft is a cylindrical enlarged shaft having gear teeth cut therein so as to engage each of the inwardly threaded ends of the flukes. Running of the electrical or hydraulic motor in one direction so as to rotate the lower shaft and its geared lower member in one direction moves the flukes around their pivotal mountings on the shank flanges in one direction, while reversed motion of the motor and the shaft therefrom reverses direction of the shaft from the gear train, thus reversing the action on the flukes.

In the event of a very small scale and light anchor, there may be employed a battery in the anchor, in the case of the use of an electrical motor. Alternatively, power cables are provided going to batteries in the boat itself or, in the case of a large vessel and a large anchor, cables from any suitable electrical power source within the boat. In the case of a hydraulic motor within the anchor shank, there must be provided input and output hydraulic lines for forward and reverse action which come down the anchor cable or chain from the hydraulic power source in the vessel itself.

In the case of an anchor utilizing an electrical power source therein, the anchor elements would include: (1) the hollow shank or shaft, (2) an eyelet on the upper end or one end of the shank to receive an anchor cable, rope or chain, (3) a two-way electrical motor positioned within the upper part of the hollow shank, (4) the power cable (two wires) with a chain ground leading into the upper part of the anchor housing, (5) a sealed electrical motor, reversible, driving a gear train with a master shaft and worm gear thereon as the output of the gear train, and (6) pivotal flukes mounted on the lower end of the anchor shaft and having gear teeth on the inner ends thereof to engage the worm on the master drive shaft.

In the case of a powered fluke anchor utilizing an hydraulic motor power means, the elements would include: (1) the hollowing shaft or shank or housing, (2) an eyelet or eyering at the top or one end of the shank for connection to a chain, cable or rope, (3) a reversible hydraulic motor mounted within the shank, (4) hydraulic power cables connecting into the hydraulic motor for forward and reverse drive (only two cables are required when the means for reversing flow is in the boat), (5) the sealed motor driving a sealed gear train with a master shaft sealed out through the lower part of the housing having a worm gear mounted thereon outside of the housing, (6) a plurality of flukes pivotably mounted on the opposite end of the shank from the eyelet or eyering and having gear teeth on the inward ends thereof adapted to engage the worm gear on the master drive shaft portion extending from the sealed housing.

For a motor powered fluke anchor, it is necessary to provide the following. In the first place, there must be a suitable power source which will deliver sufficient torque for the power sources available at an rpm which is useable. There are available numerous examples of electric motors and hydraulic motors, these of the reversible desirable type which will provide these characteristics. Secondly, there must be provided a plurality of movable flukes which are strongly, yet pivotably mounted on a shank or housing structure which is sufficiently rigid that the gearing on the flukes will be kept aligned, both radially and axially, with the driving gearing from the power source and power train. Yet further, there must be provided a

sealed housing or shank construction which has the following characteristics. In the first place, the housing must be of sufficient volume to receive (1) the electric motor or hydraulic motor therein, (2) the drive shaft extending therefrom, (3) a gear train sufficient to transform velocity into power in the desired and required ratio, (4) and also of sufficient size to seal adequately out therefrom the output drive shaft of the gear train, and finally, (5) there must be sufficient space therein and adequate seals for the input electrical lines or hydraulic lines to power the motor in forward and reverse drive. Preferably, also, the housing is readily openable for access to the motors or gear trains for cleaning, replacement or repair. Finally, there must be provided a continuous, powerful, effective power drive connection between the worm gear and the output drive shaft from the power connecting to the geared or toothed inner ends of the movable flukes. The flukes preferably are removable for access to the inner worm and the seals for the drive shaft thereof into the housing.

Referring to the drawings, FIGS. 1 and 2, which detail the structure of both the electric motor and hydraulic motor forms, will now be specifically described. At 10 is seen a lesser outer diameter cylindrical upper portion of a housing or shank comprising the basic frame or body of the anchor construction to be described. Centrally of elongate portion 10 is an opening 11. A T, having arms 12 and 13, forms the uppermost end of the housing of the anchor construction, to which is attached a bail or eyering 14 operative to receive an anchor chain, cable, shackle, or the like. The next lower portion 15 of the shank or housing is of greater outer diameter than upper portion 10 to receive the power source and power train therewithin. A circumferential flange 16 extends substantially radially to the housing portion 15 at the lower end thereof. This is matched and mated by a like circular flange 17 which encircles the uppermost edge portion of a next lower housing portion of yet enlarged outer diameter 18. Housing portion 18 has a lowermost wall portion 19, through which passes an opening 20, centrally thereof.

A pair of openings 21 and 22 extend laterally outwardly through upper shank portion 10 and have suitable seals therewithin for conduits which pass therethrough. An inwardly extending pair of flanges or extensions 22 and 23 fixed to the inner wall of housing portion 15 receive bolts 24 and 25 which also engage the mounting flange 26 of a conventional hydraulic drive motor 27 of reversible drive type. This power source may alternatively be a reversible electric motor with suitable electrical cable connections, but the hydraulic motor power source will be first described. A pair of hydraulic fluid input and outlet lines 28 (not seen) and 29 connect to the upper end of the casing of hydraulic motor 27 and serve to convey power fluid thereto and therefrom. Lines 28 and 29 pass out through openings 21 and 22, respectively, into elbows 30 and 31, then leading up through connector unions 32 and 33 into and through the arms 12 and 13 of the T as seen at 28a and 29a. These passages open out of the upper surfaces of T arms 12 and 13 where conventional connections to hydraulic fluid lines (which will parallel and go up the anchor cable, chain, rope or the like) are made. Thus, the upper ends of passages 28a and 29a may be internally threaded.

Bolts 34 and 35 removably engage flanges 16 and 17 of housing portions 15 and 18 with suitable gasketing or sealing means therebetween to make a pressure- and watertight connection therebetween. Drive shaft 36, extending downwardly in the view from hydraulic motor 27 connects into a power train of gears as follows.

Shaft 36 is coupled to reduction gear shaft 37 by couplings 37a. Shaft 37 has a first helical drive member or gear 38 on the lower end thereof, shaft 37 passing through bearing 39 which is received in bearing housing 40. Gear 38 is small diameter. A second shaft 41 passes through bearing 42 and carries gear 43 on the upper end thereof and gear 44 on the lower end thereof. Gear 43 is large diameter and gear 44 is small diameter. Shaft 45 carries large diameter gear 46 on the upper end thereof and small diameter gear 47 on the lower end thereof.

Bearings 45a and 46a carry shaft 45. Fourth shaft 48 in the gear train carries large diameter gear 49 on the upper end thereof and lesser diameter gear 50 on the lower end thereof. Bearings above and below gear 49 carry shaft 48. Gear 50 drives greater diameter gear 51 which is itself mounted on the final or lower drive shaft 52 of the power train which passes out opening 20 in lower wall 19 of housing portion 18. Shaft 48 is carried in bearings above and below gear 50 and shaft 52 is received in bearings above and below gear 51.

Thus, the power drive from shaft 36 is coupled to shaft 37 by coupling 37a. A lesser diameter helical drive gear 38, mounted on the lower end of shaft 37, couples with and drive shaft 41 through larger diameter gear 43 thereon and thus also lesser diameter gear 44. Greater diameter helical drive gear 46 on shaft 45 couples with and is driven by gear 44 thereby driving helical drive gear 47 of lesser diameter gear 47 in turn, couples with and drives larger helical gear 49 on shaft 48. Shaft 48 has small gear 50 on the lower end thereof which couples with and drives greater diameter gear 51 mounted on shaft 52. The latter is received in bearings 53 and 53a. The various bearings carrying the shafts mounting the drive gears are connected to or received in suitable bearing housings (not seen) whereby the power train is a rigid braced array of drive shafts and interengaging gears. The housings for the intermediate gears are mounted on shelf 54.

Because of the increased power (torque), the diameter of shaft 52, passing the power out of the gear train or reduction gears, is increased over the diameter of the input shafts 36 and 37.

Looking at FIG. 2, integrally formed with or connected to the lower end of lower housing portion 18 are four pairs of flanges 56 and 57, 58 and 59, 60 and 61 and 62 and 63. Bearing housing 65 is removably bolted to lower wall 19 of housing 18 and carries suitable sealing means 66 centrally thereof. Housing 65 serves as the upper floor for bearing race 67 mounted thereon which encircles shaft 52 and has roller bearings and seals at 68 and 69. Removably mounted on a lower portion of shaft 52 for rotation therewith is gear 70 which engages and powers the movable flukes.

Turning to the anchor flukes, in the construction shown, there are four pivotable flukes 71, 72, 73 and 74. These flukes are pivotally mounted on respective sets of flanges as seen in FIG. 2 by removable shafts or pins 75-78, inclusive. While the outer ends of the flukes are enlarged in width as may be seen in FIG. 1, the inward ends thereof have parallel sides with gearings 71a-74a, inclusive, cut into the metal thereof or formed integrally therewith whereby to engage, in power drive fashion, the gear 70. The fit of each fluke inner end between its set of flanges, say the inner end portion 71a of fluke 71 between flanges 56 and 57, is a sliding, frictional fit which yet permits pivotal motion of the fluke in the desired pivotal action. The depth of the gearing in both the inward ends of the flukes and the gear 70 is of sufficient depth that there is constant engagement between the gear 70 and the respective geared portion 71a-74a, inclusive, this juxtaposition maintained by pins 75-78, inclusive.

In operation, assuming that the flukes are in the downward position as seen in full lines in FIG. 1, rotation of the shaft 52 in a counterclockwise direction in FIG. 2 will tend to raise all of the flukes. On the other hand, if the flukes are in the position seen in dotted lines in FIG. 1, the opposite direction of rotation of shaft 52 and gear 70 will tend to lower the flukes. If the flukes are in an intermediate position, then they may be moved alternatively a greater or lesser distance by forward or reverse activation of the hydraulic or pneumatic motor. (A pneumatic fluid (air) driven motor is a third alternative for FIG. 1 to drive the gear train in reversible action).

A reversible electric motor may be conveniently substituted for hydraulic motor 27 with either a pair of power lines going into the housing portion 10 analogous to lines 28a and 29a of the hydraulic construction shown or, optionally, and preferably because of sealing problems, a single cable carrying the required power connections going into a single opening in

the housing leading to the motor and then running parallel with the anchor cable, rope or chain to the power source in the boat. There is preferably a connector eyelet or a spring wire wrapping on the electrical cable as it enters the anchor body to keep from short circuiting the electrical wiring.

Examples of reversible hydraulic power units suitable for the application and use described are found in the devices of Hydreco, a unit of General Signal Corporation, Kalamazoo, Michigan, 49003. Parallel shaft speed reducers suitable for installation and use in the reduction gearing or power train shown are also conventionally available, such as those produced by the Dodge Manufacturing Corporation of Mishawaka, Indiana.

Reduction gears can be worm and spur-pinion type gearing, beveled type gears or other type reduction gearing to furnish the required torque necessary for the required force to pivot the flukes.

FIG. 3 shows a modification of the subject powered anchor construction wherein an hydraulic cylinder or pneumatic cylinder is employed as the power source to move the flukes from engaging position to a downward releasing position or an upward storing position, as the case may be. Usable air and hydraulic equipment installable within the housing or body of the anchor for this purpose as a power source may be seen in the Akin Engineering Company, Inc. brochure or catalog entitled "Cylinders/Valves Hydraulic and Pneumatic Components" copyrighted 1967 Alcon Products Corporation, Wayne, New Jersey. The Akin Engineering Company is located at 8906 Rosehill Road, Lenexa, Kansas 66215.

The modification of the hydraulic power means seen in the drawing comprises a Series B cylinders utilizing 250 psi air to 2,500 psi oil, seen and described on pages 10 and 11 of the Alcon (Akin) catalog above noted. Alcon Products Corp. is located at 25 Power Avenue, Wayne, New Jersey.

Referring, then, to FIG. 3, fluid cylinder 100 has end caps 101 and 102 which are secured at each end to an intermediate cylindrical body 103. Cap 102 journals a piston rod 104, one end 104a thereof projecting from cap 102 for attachment to or mounting of the means to be operated or moved by the cylinder 100. The latter here is gear body 105 which is received on the lesser diameter end portion 104a and secured thereon by nut 104b which engages the externally threaded secured end of portion 104a of piston rod 104. A lower bearing head 106 is removably bolted onto the end cap 102 by bolts 106a and carries mounted thereon or fixed thereto a plurality of sets of spaced flanges generally designated 107. These are similar in arrangement to those seen in FIG. 2 with pairs of spaced flanges set 90° from one another. Within bearing head 106 and cap 102 there is received a journal bushing 108 having pressure responsive seal members 109 and 110 for engaging portions of rod 104 to prevent leakage past the rod from the interior of the cylinder. Rod 104 is slidably received in passage 106a in member 106.

Piston 111 is mounted on rod 104 adjacent the internal end thereof for reciprocating movement within the cylinder body 103. Piston 111 carries pressure responsive seal members 112 and 113 for effecting a seal between the periphery of the piston and the interior wall surface of the cylinder body 103 upon admission of a pressure fluid into the cylinder body 103 for driving the piston. Pressure fluid is admitted to chambers 114 and 115 alternately through ports 116 and 117 in the end caps 101 and 102. Each of the ports 116 and 117 also serves as an exhaust orifice for evacuating a chamber 114 or 115, respectively, during one-half of a cycle.

The foregoing description is directed to a standard or conventional hydraulic fluid cylinder wherein a piston is moved to and fro by input of hydraulic fluid on one side of the piston and withdrawal of hydraulic fluid on the other side thereof.

The construction shown is a typical high quality power cylinder for heavy duty air service, or medium pressure hydraulic service, up to 2,500 psi depending on bore size. The design shown permits the same cylinder to be used with air or oil without modification. The previous description generally

follows that of U.S. Pat. No. 3,247,767, "Fluid Cylinder," issued Apr. 26, 1966, inventor W. Aslan. However, therein is shown a cushioning system, details of which have been omitted from the instant description. This cushioning system may be used, if desired, but is optional. Therefore, it has not been disclosed or described in detail. The disclosure of the said Aslan patent is herewith incorporated by reference as showing an hydraulic cylinder or piston construction operable as an hydraulic power source to move the anchor flukes to the various described positions. Other, higher pressure cylinders of conventional type may also be employed.

Referring to FIG. 3, the function of the hydraulic or pneumatic piston device of this figure (FIG. 3) comprises flowing hydraulic or pneumatic fluid under pressure into either chamber 115 or chamber 114 to reciprocate piston 111 within cylinder 100 thereby to move the pivotable flukes from the disengaging position seen in the view to a position essentially 90° therefrom for ground or bottom engaging and a position over 120° therefrom for storage purposes. With piston 111 in the view at substantially its highest point with respect to chamber 115, hydraulic or pneumatic fluid has been passed in through channel 116 into chamber 114, while hydraulic or pneumatic fluid has been simultaneously withdrawn from chamber 115 through outlet 120 and passage 117. Shaft 104 is nearly at its uppermost position with spur gear carrying element 105 closely adjacent end piece 106.

A plurality of flanges generally designated 130 are paired and spaced at 90° arcuate positions from one another with anchor flukes generally designated 131 pivotally mounted by shafts or pins 132 between pairs of said flanges. Flukes 131 have spur teeth 133 to engage the spur gear teeth on member 105 mounted on shaft 104. When hydraulic or pneumatic fluid is input through port 117 and passage 120 into chamber 115 while same is withdrawn through passage 116 from chamber 114, piston 111 can move to a substantially intermediate position with chambers 114 and 115 being of equal size. This will position spur gear carrying member 105 in its intermediate position below end cap 106, positioning flukes 131 at substantial right angles to shaft 104. The pressure balance of hydraulic or pneumatic fluid between the two chambers through openings 116 and 117 will hold the piston in said intermediate position. A shroud or hood 134 may be fixed to the outer surface of cylinder 103 to protect the hydraulic or pneumatic lines which connect to angle connections 135 and 136. This also protects these lines and the fittings 136 and 135 from the flukes when they are in raised position.

When the piston 111 is in its lowermost position with chamber 115 at its greatest volume and chamber 114 at its least volume, shaft 104 extends downwardly out of the cap 106 as far as possible, with the spur gear teeth on member 105 pivoting the flukes around pins 132 to a position over 120° displaced from the position seen in FIG. 3. Thus the hydraulic piston form can achieve the basic three desired positions, first, with the fluke ends up close to the anchor shank or housing, the stowed position; second, the flukes projecting at right angles or substantial right angles to the anchor shank or housing, and third, with the flukes in the position of FIG. 3 substantially parallel to the shank or housing for the disengaging position. In this modification, it is also possible for the flukes to project at any desired position in their arcuate range by metering the hydraulic or pneumatic fluid between the two chambers 115 and 114 from the surface.

Referring to FIG. 4, therein is shown a modification of the inventive powered fluke anchor wherein electromagnetic coils or solenoid construction employed to reciprocate a shaft linked with the pivotable anchor flukes. The circuit diagram of FIG. 5 shows schematically the electrical power circuit or wiring diagram for this modification.

An elongate hollow cylindrical shell 200 is capped at its upper end by lesser diameter head portion 201 having lower circumferential flange 202 which may be screwed or bolted (not seen) to the upper end of cylindrical body portion 200 through the flange of a plug to be described. The lower end of

housing 200 is plugged by a cylindrical block 203 having passageway 204 centrally therethrough with circumferential O-ring recesses or grooves 205 therein.

An elongate shaft 206 is slidably received through passage 204 and has mounted on the lower end thereof for reciprocatory movement therewith spur gear carrying member 207. The lower end 206a of shaft 206 is of lesser outer diameter than the upper portion thereof, whereby gear member 207 slides thereon up to the greater diameter portion and then is fixed removably thereagainst by nut 208 which is received on the lowermost portion 206b of shaft 206 which is externally threaded.

At 209 there is seen a cylindrical steel core of magnetic material (such as 421 stainless steel) which has a central passage 209a therethrough to receive shaft 206 in sliding reciprocatory motion. The lower surface of core 209 has fixed thereto a circular flange 210 of like magnetic material which overlies the upper surface of block or member 203. Removably threaded on the externally threaded upper portion 206c of shaft 206 is magnetic plunger or slug 211 also of magnetic material such as 421 stainless steel. At 212, overlying flange 210, is a suitable insulator disc made of material such as a phenolic resin.

Concentric to shaft 206, core 209 and slug or plunger 211 is field insulator tube or sleeve insulator 214 within which plunger 211 moves in sliding reciprocation. A magnetic core 215 having magnetic flange 216 fixed to one end thereof and passageway 215a therethrough extends into the upper end of tube 214 in the same manner that core 209 extends into the lower end of said tube 214. A phenolic insulator disc 217 is positioned between said tube and said disc 214. Tube 214 is typically of phenolic composition.

An upper field 218 comprising a suitable member of windings of current carrying wire is positioned within the annulus defined between the two insulators 212 and 217. A lower coil or field designated 219 is wrapped around sleeve or tube 214. A disc separator and insulator 220 divides and electrically separates fields 218 and 219. The coils comprising the fields 218 and 219 are wrapped circumferentially to electrically insulate them from housing 200. Suitable electrical connections are made to the coils as at 221 and 222 for coil 219 and 223 and 224 for coil 218.

Lines 221 and 223 are the negative connections, while lines 222 and 224 join in a common positive ground. An elongate rod or shaft 225 is externally threaded on its lower end 225a whereby to threadably engage the upper end of slug 211 in an internally threaded recess centrally of the upper end thereof. Rod 225 extends slidably through passage 215a in magnetic core 215. Intermediate the upper end of rod 215 and the lower end thereof, same is enlarged circumferentially as at 225b. An elongate slot or groove 225c is formed in one side of rod 225 extending out the upper end thereof, said slot or groove being of greater depth at two spaced positions 226 and 227 along the length thereof.

Plug 228 has a circular circumferential upper flange 228a which overlies the upper edge of cylinder 200 and has a circular or cylindrical central passage 228b extending vertically therethrough to receive rod or shaft 225. Plug 228 is also laterally relieved as at 228c to pass the electrical wiring from the lower coils therepast. An elongate key 229 has a lower foot 229a received in slot 228d in the very bottom of plug 228 and pivotally mounted therein on pin 230. At the upper end of key 229 is arcuate guide 229c and intermediate of the length thereof is an extending tab or projection 229d adapted to fit into slots 226 and 227. Resilient means are provided as at 231 sealed by set screw 232 to normally bias key 229 in a counterclockwise direction around pivot 230 in the view of FIG. 4. The upper fields or top coils for the lock release are generally designated at 233 within head portion 201 with the electrical connections therefor passing out opening 234 in cap 201 with the electrical lines from the lower fields or coils. Fixed to the top of cap 201 is bail or eyering 235.

Looking at the lower portion of the drawing of FIG. 4, generally designated 236 are the fluke carrying flanges which are paired 90° apart and welded or otherwise fixedly attached to block 203 and the lower end of housing 200. Flukes generally designated 237 are pivotally mounted on pins 238 and have spur teeth 239 to engage the spur gear teeth on member 207.

The material of housing 200, as well as cap 201 may be aluminum, bronze or stainless steel. Flange mounting plug 203 may be of the same material as body 200 (stainless steel, aluminum or bronze) and carries bearing sleeve 203a of bronze with nylon or neoprene O-rings. Insulators 212, 220 and 217 are typically phenolic. The coils are wrapped in suitable insulation of plastic nature. Tube 214 is typically plastic or phenolic insulation. Flanges 210 and 216 of cores 209 and 215, as well as the cores themselves, are magnetic stainless (421). Slug 211 is likewise stainless magnetic 421. Shafts 206 and 225 are also stainless steel, but non-magnetic 316.

All of the anchor shanks or housings of FIGS. 1 (hydraulic or electrical motors with a gear reduction train), FIG. 3 (hydraulic or pneumatic cylinder) and FIG. 4 (solenoid) must be water sealed for the depths and pressures to be employed. This is true not only for the outlet power connection such as shaft 52 in FIG. 1, shaft 104 in FIG. 3 and shaft 206 in FIG. 4, but also of the power input lines and fittings such as the electrical or hydraulic fluid inlets 28a and 29a in FIG. 1, the pneumatic or hydraulic fluid inlets 135 and 136 in FIG. 3 and opening 234 for the egress of the electric power connections to unlocking coil 233 and upper and lower power coils 218 and 219 in FIG. 4.

Non-corrosive materials must be used to the greatest extent possible. Water service is particularly hard on sealed cylinders and housings of the types shown and described. Wide variations in water conditions throughout the country makes it difficult to devise only one approach to water-fitted housings and cylinders that would be equally satisfactory for all conditions. Preservation of finish is of high importance in housing life, corrosion of tubing and shafting, electrolysis and mineral deposits become critical. Water fitted cylinders and housings may be furnished with extra heavy chrome plating of tubing and shafting and cadmium plating of non-wearing parts.

Referring to FIG. 4, and prior to the delineation of the circuit diagram of FIG. 5 and its operation, magnetic slug 211 is shown in its uppermost position abutting the under surface of plug 215. This is accomplished by the energization of upper power coil 218. It is to be noted that neither slot 226 nor slot 227 is engageable with tab 229d whereby spur gear carrying member 207 would be locked in its relative position. (It is possible to construct a solenoid device with sufficient field and coils to provide locking at each of the three major positions, but the instant device illustrated, for simplicities sake, merely shows locking at (1) the working position with the flukes at substantial right angles to the shank and (2) at the stowed position with the flukes over 120° from the position of FIG. 4). Thus, while resilient means 231 are urging key 229 clockwise around pivot 230, there is nothing in which projection or tab 229d may engage. Both the lower portion of key 229 and tab 229d are within slot 225c, however. The force maintaining slug 211 in its upper position with shaft 206 in its uppermost position, as well as shaft 225, is the magnetic flux in upper coil 218 plus the gear friction and weight of the flukes 237 as they hang parallel to the shank 200.

The drawing of FIG. 4 is not quite to scale with respect to the size of the elements movable within the chamber in which slug 211 reciprocates. However, the principles of operation may be described. From the position of FIG. 4, to move the flukes around their pivots 238 to a position substantially 90° to the shank, the lower coil 219 is energized. As slug 211 moves downwardly, tab or projection 229d slides in trough or groove 225c and, driven by resilient means 231, passes into slot 225. This locks the anchor flukes in working position. Alternatively, if release coil 233 were energized whereby to attract key 229, particularly arcuate cap 229c, energization of lower coil

219 would cause slug 211 to move downwardly all the way without projection 229d engaging in slot 226. Then, when slug 211 reached the bottom of its travel with its lower face abutting the top surface of plug 209, release of the energization of release coil 233 permits the tab 229d to fall into upper slot 227. This locks the flukes in stowed or upper position, approximately greater than 120° arcuate travel from the position of fluke 237 seen in FIG. 4.

To remove the flukes from the locked upper position with tab 229d in slot 227, release coil 233 would have to be again energized whereby to remove tab 229 from slot 227. Thereafter energization of upper power coil 218 will move slug 211 either to the uppermost position of FIG. 4 again with the flukes in disengaging position or, depending upon electrical manipulation of the coils, to be described, slug 211 will be moved to the intermediate position with tab 229d engaged in slot 226.

Finally, it remains to describe the mode of operation when tab 229d is engaged with slot 226, that is, the flukes locked at right angles to the shank. In such case, to go to the position of FIG. 4, uppermost locking coil 233 must be energized to disengage projection 229d from slot 225 and upper power coil 218 energized, whereby to move to the position of FIG. 4. Alternatively, to go from the position where projection 229d is in slot 226 to engagement in slot 227, the uppermost locking coil must be energized to disengage tab 229d from slot 225, then the lowermost power coil 219 energized whereby to move the slug to the lowermost position whereby tab 229d can fall into slot 227.

Referring to FIG. 5, therein is shown a wiring or circuit diagram for the solenoid operated modification of FIG. 4. At 500 is seen a DC power source such as a 12 volt 45 ampere battery. Push button 1, the lock release push button, is indicated at 501. A ganged shaft operation selector switch is generally designated 502. A second push button, double pole, with ganged action is generally designated 503. The lower power coil 219 of FIG. 4 and the upper power coil 218 of the same view are schematically designated in the lower right hand of the diagram, while the uppermost lock release coil 233 of FIG. 4 is seen in the upper right hand of the circuit diagram. Line 504 from one pole of the DC power source connects to one side of push button 501 (normally open push button). Line 505 connects from the other pole of push button 501 to the top end of coil 233. Coil 233 is divided into two parts, optionally, as may be seen. The other pole of the power source 500 is connected by line 506 to the lower end of coil 233.

The upper end of upper coil 218 is connected to line 506 by line 507. The lower end of upper coil 218 is connected by line 508 to the upper pole of one-half of the push button 503. The upper end of lower coil 219 is connected by line 509 to line 507 from the upper end of upper coil 218. The lower end of lower coil 219 is connected by line 510 to one pole of the lower side of push button 503. (In order to improve the polarity and effective force of the coils 218 and 219, each of them could be divided coils as in the manner of coil 233, but for simplicities sake, the coils are as illustrated). Line 511 connects one pole designated A3 of one side of the shaft selector switch 502 to the free pole of the lower half of push button 503 to connect with line 510 when the push button 503 is actuated. Line 512 connects a pole designated B1 of the selector switch 502 with the free pole of the upper portion of push button 502 to connect with line 508 when push button 503 is actuated. The selector arms 502a and 502b are ganged to act together so that, when arm 502a is turned to pole A1, arm 502b connects to pole B1. Poles or positions A2 and B2 are neutral positions. Line 513 connects line 505 with the selector switch arms 502a and 6502b.

Without selecting any given starting position, the procedure for utilizing the circuit diagram of FIG. 5 with the structure of FIG. 4 comprises:

1. Put arms 502a and 502b in neutral position, that is, connecting to poles A2 and B2;

2. Activate push button 501 whereby power flows from the power source 500 through lines 504, 505 and 506 to energize coil 233. This serves to move key 229 in a counterclockwise direction around pivot 230 in the view of FIG. 4 against resilient means 231, if tab 229d should be in either slot 226 or 227;
3. Thereafter set shaft operations selector switch 502 on one of the active positions, that is, with arm 502a in contact with pole or connector A3 (502b on B3) or, alternatively, arm 502b on connector or pole B1 (arm 502a on A1);
4. Thereafter push push button 503. (If arm 502a is on pole A3, then power will go into the lower coil 219. Alternatively, if arm 502b is on pole B1, then the power will pass into the upper coil 218. (On activation of push button 503)).

Referring to the operation of the circuit diagram with the structure of FIG. 4 (solenoid operation), the procedure and operation from the different starting positions will now be described. First, assuming the slug 211 to be in the position of FIG. 4 which results in the spur gear carrying element 207 being at its uppermost position with respect to the anchor shank 200, as previously noted, the tab 22d, while in slot 225c, is not in either slot 226 or 227. To move the anchor flukes 237 from the disengagement position of FIG. 4 to operating position extending substantially at right angles to the anchor shank, the following procedure is employed:

1. Put the selector switch 502 to neutral position (A2) and (B2);
2. Push push button 501;
3. Set the selector switch with arm 502a pointing to A3 (and B3);
4. Push push button 503.

This will flow power to coil 219. As the slug 211 moves downwardly under the attraction of coil 219, the tab 229d, under the continuous spring load of resilient element 231, will slide into or fall into slot 226, thus stopping the anchor flukes at the intermediate or operating position.

To then progress from the operating position just reached, to the stowage or fluke uppermost position, the following actions are taken:

1. Put the shaft selector switch 502 in neutral;
2. Push push button 501; (Lock release)
3. Set the selector switch 502 on poles A3 and B3;
4. Push the push button 503.

This will flow power into the lowermost power coil 219 while the uppermost coil 233 is holding tab 229d out of slot 226. The attraction of the coil for the magnetic slug 211 then moves the slug downwardly to its lowermost position with its lowermost face resting on the top of core 209. Release of the push button 501 permits the resilient element 231 to force the tab 229d into slot 227.

To move from the stowed position back to the fluke operating position, the following procedure is used:

1. Put the selector switch at neutral;
2. Push push button 501; (this moves tab 229d out of slot 227 by activating the upper release coil 233);
3. Set the selector switch on A1 and B1;
4. Push push button 503 (this powers the upper coil 218).

Energization of the upper coil moves the slug 211 upwardly, thus pivoting the flukes around their pins 238 (in a counterclockwise direction for the fluke seen in FIG. 4). If the upper field 233 is not energized, the resilient means 231 will push the tab 229d into slot 226 to stop at the intermediate position. On the other hand, if the upper field remains energized, the slug 211 will go all the way to the position of FIG. 4.

From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations.

As many possible embodiments may be made of the invention without departure from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

- 1. An anchor having power driven movable flukes comprising, in combination:
  - an elongate anchor shank,
  - a plurality of flukes pivotably attached at one end thereof to one end of said shank,
  - power means associated with said shank and having drive connection to the inner ends of each of said flukes, whereby to pivot said flukes with respect to said shank over an arc of at least substantially 90°,
  - said power means received in waterproof fashion within said shank,
  - said power means further received in an upper portion of said shank (when said flukes are in a downward position), the drive connection from the power means to said inner ends of said flukes including a shaft extending out of a sealed opening in the lower portion of said shank communicating at the upper end thereof with said power means and at the lower end thereof with said fluke inner ends.
- 2. An anchor having power driven movable flukes comprising, in combination:
  - an elongate anchor shank,
  - a plurality of flukes pivotably attached at one end thereof to one end of said shank,
  - power means associated with said shank and having drive connection to the inner ends of each of said flukes whereby to pivot said flukes with respect to said shank over an arc of at least substantially 90°,
  - said power means including a reversible hydraulic motor and a reduction gear train both received in waterproof fashion within said shank.
- 3. An anchor having power driven movable flukes comprising, in combination:
  - an elongate anchor shank,
  - a plurality of flukes pivotably attached at one end thereof to one end of said shank,
  - power means associated with said shank and having drive connection to the inner ends of each of said flukes whereby to pivot said flukes with respect to said shank over an arc of at least substantially 90°,
  - said power means comprising a reversible electric motor and a reduction gear train both received in waterproof fashion within said anchor shank.
- 4. An anchor as in claim 1 wherein said flukes may be pivoted over an arc of greater than 120°.
- 5. An anchor having power driven movable flukes comprising, in combination:
  - an elongate anchor shank,
  - a plurality of flukes pivotably attached at one end thereof to one end of said shank,
  - power means associated with said shank and having drive connection to the inner ends of each of said flukes whereby to pivot said flukes with respect to said shank over an arc of at least substantially 90°,

- said power means including magnetic coils positioned within said shank and cooperating with a reciprocable shaft linked at one end thereof with the inner ends of each of said pivotable flukes.
- 6. An anchor having power driven movable flukes comprising, in combination:
  - an elongate anchor shank,
  - a plurality of flukes pivotably attached at one end thereof to one end of said shank,
  - power means associated with said shank and having drive connection to the inner ends of each of said flukes whereby to pivot said flukes with respect to said shank over an arc of at least substantially 90°,
  - said power means including an hydraulic or pneumatic piston received within said shank,
  - the external end of the piston rod of the hydraulic or pneumatic cylinder linking with the inner ends of each of said flukes,
  - whereby reciprocatory motion of the piston within the cylinder rotates the flukes with respect to said shank.
- 7. An anchor construction including power driven movable flukes comprising, in combination:
  - an elongate hollow anchor shank having means for attaching a chain or cable at one end thereof,
  - a plurality of elongate flukes pivotably attached at one end thereof to the other end of said shank from said chain or cable receiving means,
  - power means received within said anchor shank operable to drive in rotation a drive shaft extending from the lower end of said shank and between the inward ends of said flukes adjacent their attachment to said shank,
  - said latter shaft having a spur gear thereon in power drive engagement with the mating gear carrying inward ends of said pivotable flukes whereby to pivot said flukes with respect to said shank.
- 8. An anchor construction including power driven movable flukes comprising, in combination:
  - an elongate hollow anchor shank having means for attaching a chain or cable at one end thereof,
  - a plurality of elongate flukes pivotably attached at one end thereof to the other end of said shank from said chain or cable receiving means,
  - power means received within said anchor shank operable to drive in reciprocatory motion a rod or shaft extending from the lower end of said shank and between the inward ends of said flukes adjacent the attachment to said shank,
  - said latter shaft having a gear thereon in power drive engagement with mating gear carrying inward ends of said pivotable flukes,
  - said power means received in waterproof fashion within said shank,
  - said power means further received in an upper portion of said shank (when said flukes are in a downward position), the shaft drive connection from the said power means to the said inward ends of said flukes extending out of a sealed opening in the lower portion of said shank, communicating at the upper end thereof with said power means and at the lower end thereof with the said gear carrying inward ends of said pivotable flukes.

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