March 14, 1950 B. A. COGSWELL 2,500,400

AXIAL FLOW PUMP

Filed Oct. 25, 1946 3 Sheets-Sheet 1

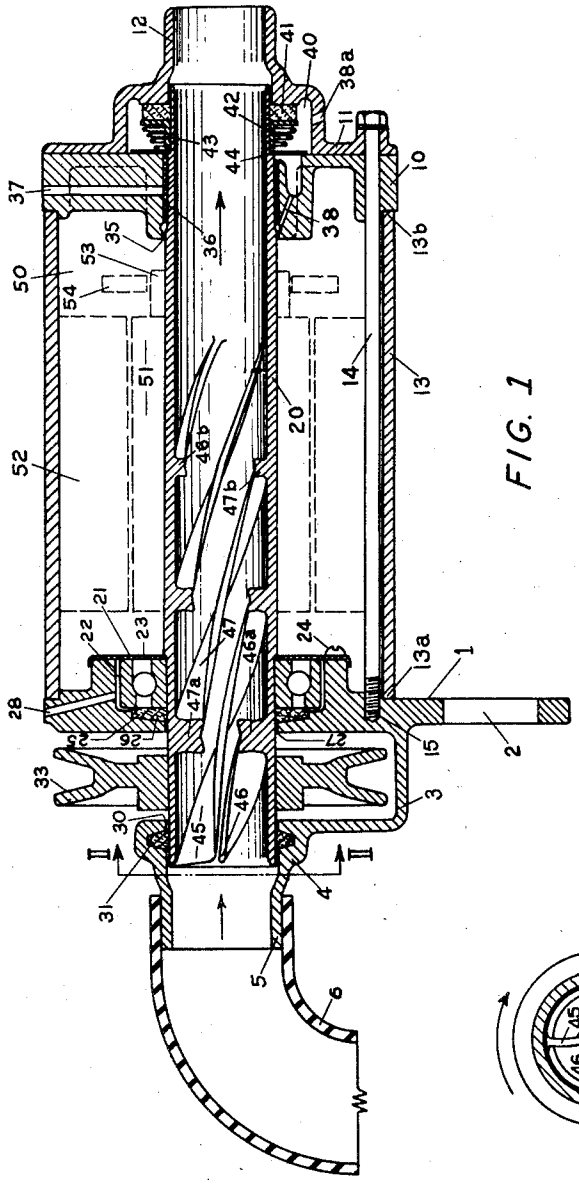

FIG. 1

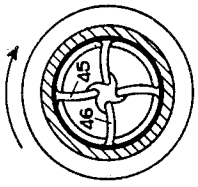

FIG. 2

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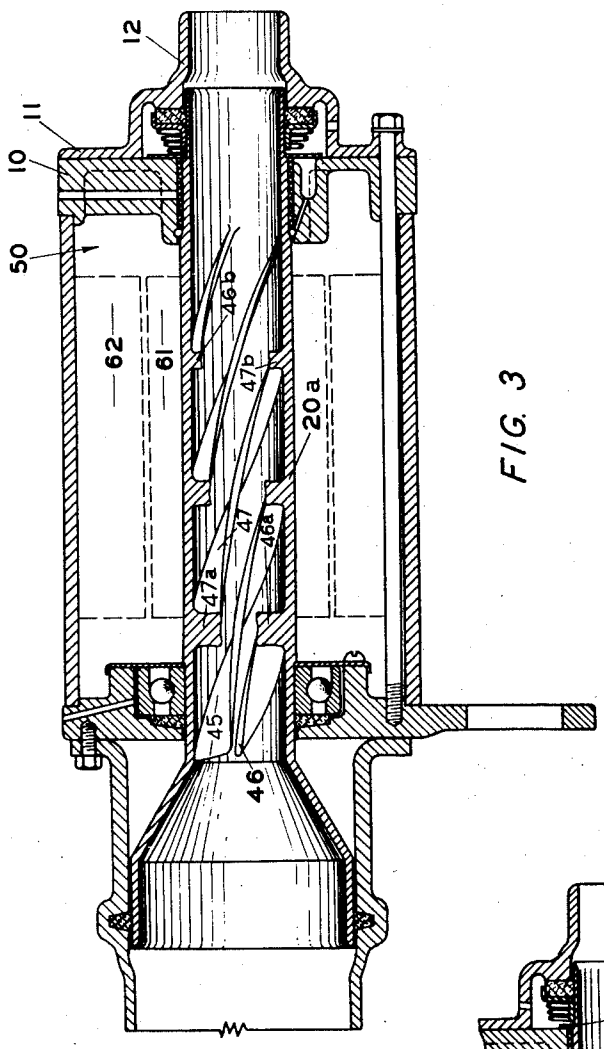

FIG. 3

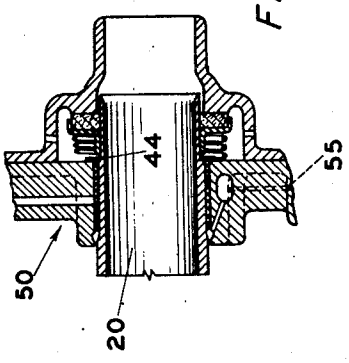

FIG. 5

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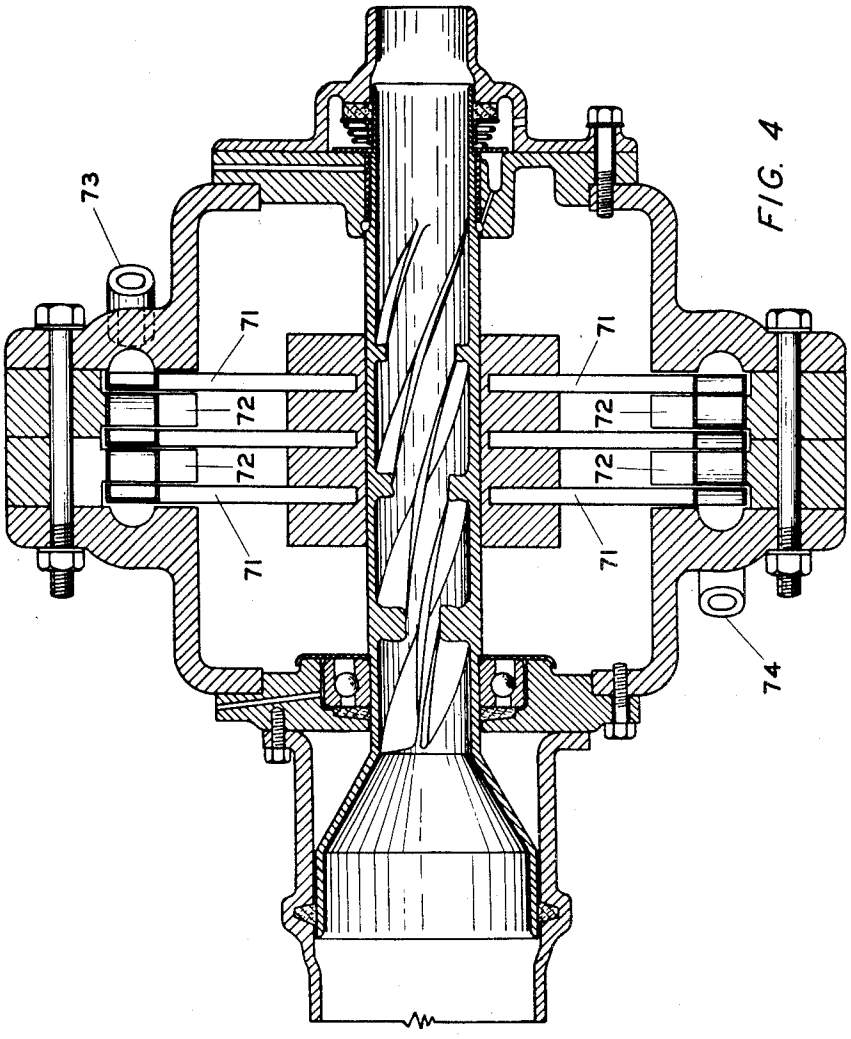

FIG. 4

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AXIAL FLOW PUMP

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Application October 25, 1946, Serial No. 705,620

8 Claims. (Cl. 103—87)

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This invention relates to an axial flow type pump and particularly to a type thereof in which the rotating pumping member is a part of the rotor of associated driving or driven means.

In the manufacture of automobile engines it is well known that cost of fabrication and assembly, and economy of space are extremely important factors. In conventional, automobile engine construction, as currently practiced, it is customary to provide an electrical generator as one unit and a water pump as another unit which two units are then driven by any convenient means. Often, for purposes of convenience, both units are driven from a common shaft, which may itself be driven by any convenient gear, pulley or other arrangement, but the units still comprise two independent units with corresponding cost and space requirements.

It is accordingly desirable to provide means by which a generator and a water pump applicable to an automobile engine may be sufficiently integrated as a single unit to involve original cost of equipment, installation cost and space requirements substantially less than are currently customary for the conventional independent units.

It is also common in machinery for pumping fluids, primarily liquids, to provide a pair of independent means, one thereof effecting the desired pumping and the other thereof constituting a prime mover. Each of these units is expensive and each requires appropriate space for mounting or housing.

In a variety of situations, such as irrigation pumping, it is possible to supply the required space only by relatively expensive and inconvenient means and accordingly it is desirable to provide a type of pumping mechanism in which the pumping unit and the prime mover therefor are integrated into a single mechanism which can be placed in a minimum of space and can at the same time effect a larger volume of pumping than conventional means.

With the infinite number of uses for pump and pumping mechanism a wide variety of other situations will be readily apparent wherein it will be highly advantageous to provide such mechanism at a substantial saving in space requirements, as well as cost of fabrication and/or installation.

Accordingly, a major object of the invention is to provide a pumping mechanism wherein the fluid impelling means and the prime mover therefor are integrated into a single mechanism with such completeness as to effect a substantial

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reduction in space requirements over conventional equipment.

A further object of the invention is to provide a pump-generator assembly applicable to use with an automobile engine which will be so integrated in its parts that it will involve substantially less cost and mounting space than comparative requirements for conventional equipment.

A further object of the invention is to provide devices as aforesaid in which the pump is of the axial flow type.

A further object of the invention is to provide devices as aforesaid in which the pump is capable of greater efficiency than is now currently known.

A further object of the invention is to provide a pumping mechanism as aforesaid in which there is within said mechanism a minimum of obstruction to the passage of fluid being pumped.

A further object of the invention is to provide devices as aforesaid in which the pump is of the axial flow type and constitutes the rotor of the associated driving or driven means.

A further object of the invention is to provide devices as aforesaid which will be economical to construct and maintain.

A further object of the invention is to provide devices as aforesaid which will be sturdy and reliable and not subject to high maintenance cost.

A further object of the invention is to provide devices as aforesaid which may be widely and readily varied within the general concept of the invention to make the mechanism adaptable to a wide variety of fluids to be pumped and a wide variety of pumping situations.

Other objects and purposes of the invention will be apparent to persons acquainted with equipment of this general type upon inspection of the accompanying drawings and reading of the following disclosure.

In providing a mechanism meeting the objects and purposes above stated, I have provided a pump of the axial flow type wherein the impelling vanes are placed on the radially inner surface of a rotating tube into which the fluid to be pumped is introduced and such rotating tube carried on its radial exterior means incident to its function as the rotating portion of whatever desired driving or driven means may be associated therewith. Thus the rotating internally vaned tube may comprise the armature of either an electrical generator or an electric motor or it may constitute the vane carrying shaft of a liquid or gas driven turbine. By supporting the rotating tube on externally applied bearings, the entire interior of the tube is freed

of obstructions and is hence made available to pass the fluid being pumped with minimum interference.

In the drawings:

Figure 1 represents a partially schematic central section of the invention embodied in a pump-generator mechanism of general applicability but designed primarily for automotive use.

Figure 2 is a section taken on the line II—II of Figure 1.

Figure 3 shows the invention as a motor-pump combination and shows also a modification of the rotating tube.

Figure 4 is a central section of a turbine-pump embodiment of the invention.

Figure 5 is a fragmentary view showing a further modification of a detail of the invention.

Referring now to the drawings and particularly to Figure 1 there is shown in general a central pumping tube having internal vanes, which tube is rotatably mounted as the armature of a suitable electrical generator. The tube is rotated by an appropriate pulley, or other suitable driving means, which thus effects both pumping action and operation of the generator.

Throughout the following description it will be understood that fluid being pumped, here assumed to be water, is received at the leftward end of the device and passes in the direction of the arrows shown within said tube rightward and is discharged from the rightward end of the tube as the same appears in Figure 1. Accordingly, hereinafter the term "forward" or "forwardly" will be understood as referring or relating to the leftward end of the device as appearing in Figure 1, and the term "rearward" or "rearwardly" will be understood as referring or relating to the rightward end of the device as appearing in Figure 1.

As illustrated in said Figure 1 there is provided a forward end frame member 1 having a suitable opening 2 therein for mounting same to an appropriate part of the automobile engine or other supporting means.

Extending forwardly from the forward frame end 1 is a housing 3 partially surrounding the pulley 33 hereinafter described in more detail and supporting a hose connection 4. Such hose connection 4 is terminated by a nipple 5 to which is attached the hose 6 leading from any appropriate source of fluid supply, such as, in the automobile application, from the bottom of the radiator. At the rearward end of the device is another frame end 10, which for convenience may be designated the rearward frame end, to which is affixed, as by bolting, a cap member 11 which terminates in the nipple 12. To said nipple may be attached a hose similar to the hose 6 for conducting the discharged fluid to any desired means, such as into the water jacket of an engine block.

The facing sides of the frame ends 1 and 10 are suitably cut at 13*a* and 13*b* respectively for the reception of a cylindrical casing member 13. A plurality of long bolts, of which one is shown at 14, extend through suitable openings in the rearward frame end 10 and its cooperating cap member 11 and are threaded, as at 15, into the forward frame end 1, thereby holding the entire frame assembly together firmly, but remaining readily accessible.

Passing centrally through the parts thus far described is the tubular rotor 20. This tubular rotor is rotatably supported within the forward frame member 1 by any convenient bearing assembly 21, which is here shown as a ball bearing assembly but may be any ordinary and convenient bearing construction. As here illustrated the bearing assembly is received within a suitable recess 22 in said frame member which recess may be closed and the bearing assembly held in place by a plate 23 itself held in place by a plurality of screws of which one is shown at 24. A further recess 25 is provided within the forward frame member 1 for the reception of packing 26 by which the lubricating oil for the bearing is held against escape between the exterior surface of the tubular rotor 20 and the walls of the opening 27 within the forward frame member 1 through which said rotor extends. Any suitable means such as the passageway 28 may be provided for introducing lubricating oil under pressure or gravity feed into the bearing 21.

The hose connection member 4 has a rotor receiving opening 30 extending therethrough within which is supported a rotor engaging packing 31.

The tubular rotor 20 extends into said hose connection 4 a distance sufficient to effect the engagement by this extended portion of its exterior periphery with the said packing 31 by which to prevent the fluid being pumped from escaping between the exterior of the tubular rotor and the walls of the opening 30 in the said frame part 4. Said packing will be of any type and size appropriate to the purpose according to conventional practice. A driving pulley 33 of any convenient and conventional type is mounted within the partial housing 3 on the tubular rotor 20 in any convenient manner at a point as close as practicable to the bearing assembly 21 (Figure 1). This pulley is driven in any conventional manner, as by a driver mounted on the crank shaft of the automobile engine as is now done in conventional practice.

The pulley 33 is illustrated in Figure 1 as the means for driving the attached mechanism. However, it will be understood that the pulley is merely one of several possible means for transmitting the required power. These various means, as gears, are well known to the art and therefore do not require detailed treatment. Throughout this description it will be understood that the pulley is referred to illustratively as one of several possible means and that such specific reference is not intended to limit the mechanism in any way.

At the rearward end of the mechanism there is provided an opening 35 through the rearward frame member 10 which is lined with suitable journal bearing material 36 for the reception and support of the rearward end of the tubular rotor 20. Any suitable means, as the passageway 37, is provided for admitting lubrication into the bearing and other suitable means, as the passageway 38, is provided for effecting its discharge out from the bearing assembly. However, any other conventional means providing lubrication is fully acceptable.

Within the rearward cap member 11 is provided a chamber 40 which contains a packing ring 41 by which the lubricating fluid within said chamber is held against escape into the fluid being pumped. This packing may be conveniently backed by a thimble 42 supported by a spring 43 which spring may be backed by any convenient means such as a plate 44, which rests against the rearward face of the rearward frame end 10.

This plate 44 may be perforated to permit free

passage of oil from the passageway 38 to the chamber 40 and hence out through the opening 38a in the end cap 11. Under some circumstances, however, as shown in Figure 5 this plate 44 may be secured to the tubular rotor 20 so to act as a baffle plate and thereby provide an additional safeguard against leakage of the fluid, being pumped through the tubular rotor 20, into the chamber 50 where its presence is not desirable. In such case other outlet 55 for the lubricating fluid will be provided to replace the passageway.

Within the tubular rotor 20 is a plurality of helical vanes. As shown in Figure 2, the forwardmost ends of the vanes 45 and 46 extend radially inward from the inner surface of the tubular rotor to a position relatively close to the center line of the tube. As shown in Figures 1 and 3 by the sections of the vane 46, namely, 46a and 46b, and the vane 47, namely 47a and 47b, the radial extension of the several vanes here illustratively shown decreases progressively as they spiral rearwardly through the tube. The purpose of this is to reduce the effects of turbulence and resistance to the free flow of the liquid through the tube as it increases its velocity with respect thereto. The exact number and form of these vanes will be subject to wide variations to fit whatever variations of operating conditions and liquid applications may be desired. Since many of these variations will be according to present knowledge, elaboration thereof is not required. Hence, it may be noted that while the present invention includes the specific form of vanes shown it is not limited thereto. The helical pitch of these vanes will be a function of factors including the speed of rotation of the tubular rotor 20 and the desired speed of the liquid being pumped. This, however, is also well known to the present art and hence needs no further detailing.

Surrounding the tubular rotor 20 and between the forward frame end member 1 and the rearward frame end member 10 in Figure 1 is located the generator assembly indicated schematically by the numeral 50. This comprises any conventional armature assembly 51 mounted on the exterior of the tubular rotor 20 in the same manner as it would normally be mounted upon a solid shaft, and surrounded by field windings 52 in the same manner as is now customary for conventional generators. The commutator 53 and brushes, of which one is indicated schematically at 54, are all provided according to conventional practice around the said tubular member in the same manner as is now conventional with a solid shaft.

It will be thus apparent that I have provided a mechanism not materially larger, nor materially more expensive to make, than a conventional generator which will function as both a generator and water pump, which may be driven from a single source, and which will not occupy materially more space than is now occupied by a conventional generator alone.

Turning now to Figure 3 there is shown a modification of the foregoing assembly illustrated in Figure 1 in which the generator is replaced by a driving motor. The mechanism is much the same as described with respect to Figure 1, as indicated by those of the several numerals applied thereto which are identical to those numerals applied to Figure 1. In this form, however, it will be apparent that the central rotor tube 20a is of Venturi form by which the shape of the tube is better accommodated to the volume requirements of the fluid as its rate of travel therethrough is increased. The drive means 33 attached to said tube 20 shown in Figure 1 is eliminated together with the housing parts associated therewith. The support and packing, however, for the intake end of the pumping tube is substantially the same as above described in connection with Figure 1 but is in this case mounted directly onto the forward side of the forward frame member. The parts occupying the chamber 50, which in Figure 1 comprise the generator assembly, are in Figure 3 an electric motor assembly including an armature 61 and stator 62 by which the rotor tube 20a is caused to be rotated at a selected speed.

It will be appreciated that if said motor means are built with water-proof characteristics, then the entire device may be submerged in the liquid being pumped, and a number of special advantages thereby obtained in addition to pumping action alone. For example, for pipe line or other pressure boost purposes, the entire fluid impelling assembly may be enclosed within a conduit of suitable characteristics and pre-assembled at the factory as a unit. It can then be fastened into the general conduit structure without the usual complex problems incident to the construction of a pumping station in which one or more pumps and prime movers therefor are provided and housed as separate units.

In Figure 4 there is shown a further modification of the invention in which rotating turbine blades 71 replace the armature 61 shown in Figure 2 and stationary turbine blades 72 replace the stator 62 shown in Figure 2. Conventional conduits 73 and 74 provide for inlet and outlet, respectively, of the turbine operating fluid according to common practice.

Other modifications of the invention as above disclosed may be made without departure from the scope of the invention as the same is defined in the hereinafter appended claims.

I claim:

1. An axial flow pump comprising: a frame, a tubular member rotatably mounted within said frame; a plurality of circumferentially spaced helically arranged vanes extending radially inward from the internal surface of said tubular member having a pitch of at least twice the internal diameter of the tubular member, said vanes being of progressively decreasing radial extent from the inlet end of said tubular member toward the outlet end thereof; means causing rotation of such tubular member; means conducting fluid to one end of said tubular member and receiving fluid from the other end of said tubular member.

2. An axial flow pump comprising: a frame; a tubular member rotatably mounted within said frame; a plurality of circumferentially spaced helically arranged vanes extending radially inward from the internal surface of said tubular member having a pitch of at least twice the internal diameter of the tubular member, said vanes being of progressively decreasing radial extent from the inlet end of said tubular member toward the outlet end thereof; means causing rotation of such tubular member; means conducting fluid to one end of said tubular member and means receiving fluid from the other end of said tubular member; power converting means within said frame and operatively associated with said tubular member.

3. In an axial flow pump the combination comprising: a frame end member having an opening centrally therethrough and supporting a bearing structure surrounding said opening: a conduit receiving nipple supported by one side

of said end member; an opening through said nipple; packing supported within said opening and operatively associated with the hereinafter mentioned rotating tubular member; a second frame end member spaced from the first frame end member and having an opening centrally therethrough; a bearing supported within said opening; means extending from one side of said second frame end member providing a nipple having an opening therethrough; packing supported within said last named opening and operatively associated with the hereinafter mentioned rotatable tubular member; both of said nipples being respectively placed oppositely to each other on said respective frame end members; a casing connecting said frame end members and enclosing a space between same and the hereinafter mentioned rotatable tubular member; a hollow rotatable tubular member extending through the central openings in said frame end members and operatively associated with said bearings, extending at least partially into each of said nipples and operatively associated with the said packings; a helical vane extending radially inward from the inner surface of said rotatable tubular member and being of progressively decreasing extent from the intake end thereof toward the discharge end thereof; energy converting means having rotating and non-rotating parts within said space, and having its rotating parts supported exteriorally on said rotatable tubular member and its non-rotating parts supported on other than said rotatable tubular member; means supplying energy to one of said rotatable tubular members and said energy converting means for effecting rotation of said rotatable tubular member.

4. In an axial flow pump and generator unit the combination comprising: a frame end member having an opening centrally therethrough and supporting a bearing structure surrounding said opening; a housing extending from one side of said end member and supporting a conduit receiving nipple, an opening through said nipple; packing supported within said opening and operatively associated with the hereinafter mentioned rotating tubular member; a second frame end member spaced from the first frame end member and having an opening centrally therethrough; a bearing supported within said opening; means extending from one side of said second frame end member providing a nipple having an opening therethrough; packing supported within said last named opening and operatively associated with the hereinafter mentioned rotatable tubular member; both of said nipples being respectively placed oppositely to each other on said respective frame end members; a casing connecting said frame end members and enclosing a space between same and the hereinafter mentioned rotatable tubular member; a hollow rotatable tubular member extending through the central openings in said frame end members and operatively associated with the said bearings, extending at least partially into each of said nipples and operatively associated with the said packings; driving means operatively associated with said rotatable tubular member and at least partially within said housing for driving same; a helical vane extending radially inward from the inner surface of said rotatable tubular member and being of progressively decreasing extent from the intake end thereof toward the discharge end thereof; generator rotating members mounted exteriorally on said rotatable tubular member within said space; generator non-rotating members also mounted within said space and operatively cooperating with said generator rotating members, whereby rotation of said driving means will effect both the pumping of a fluid through and by said rotatable tubular member and the operating of said generator to provide an electrical potential.

5. In an axial flow pump the combination comprising: a frame end member having an opening centrally therethrough and supporting a bearing structure surrounding said opening; a conduit receiving nipple extending from one side of said end member; an opening through said nipple; packing supported within said opening and operatively associated with the hereinafter mentioned rotating tubular member; a second frame end member spaced from the first frame end member and having an opening centrally therethrough; a bearing supported within said opening; means extending from one side of said second frame end member providing a nipple having an opening therethrough; packing supported within said last-named opening and operatively associated with the hereinafter mentioned rotatable tubular member; both of said nipples being respectively placed oppositely to each other on said respective frame end members; a casing connecting said frame end members and enclosing a space between same and the hereinafter mentioned rotatable tubular member; a hollow rotatable tubular member extending through the central openings in said frame end members and operatively associated with said bearings, extending at least partially into each of said nipples and operatively associated with the said packings; a plurality of circumferentially spaced helical vanes extending radially inward from the inner surface of said rotatable tubular member each being of progressively decreasing extent from the intake end thereof toward the discharge end thereof; motor rotating members mounted exteriorally on said rotatable tubular member within said space; motor non-rotating parts also mounted within said space and operatively cooperating with said motor rotating parts; means supplying electrical energy to said motor parts, whereby actuation of said motor parts will effect pumping of fluid through said rotatable tubular member.

6. In an axial flow pump the combination comprising: a frame end member having an opening centrally therethrough and supporting a bearing structure surrounding said opening; a conduit receiving nipple extending from one side of said end member; an opening through said nipple; packing supported within said opening and operatively associated with the hereinafter mentioned rotating tubular member; a second frame end member spaced from the first frame end member and having an opening centrally therethrough; a bearing supported within said opening; means extending from one side of said second frame end member providing a nipple having an opening therethrough; packing supported within said last named opening and operatively associated with the hereinafter mentioned rotatable tubular member; both of said nipples being respectively placed oppositely to each other on said respective frame end members; a casing connecting said frame end members and enclosing a space between same and the hereinafter mentioned rotatable tubular

member; a hollow rotatable tubular member extending through the central openings in said frame end members and operatively associated with said bearings, extending at least partially into each of said nipples and operatively associated with said packings; a helical vane extending radially inward from the inner surface of said rotatable tubular member and being of progressively decreasing extent from the intake end thereof toward the discharge end thereof; turbine rotating members mounted exteriorally on said rotatable member within said space; turbine non-rotating parts also mounted within said space and operatively cooperating with said turbine rotating parts; means associated therewith supplying driving energy to sa'd turbine parts, whereby actuation of said turb'ne parts will effect pumping of fluid through said rotatable tubular member.

7. In an axial flow pump the combination comprising: a frame end member having an opening centrally therethrough and supporting a bearing structure surrounding said opening; a conduit receiving nipple extending from one side of said end member; an opening through said nipple; packing supported within said opening and operatively associated with the hereinafter mentioned rotating tubular member; a second frame end member spaced from the first frame end member and having an opening centrally therethrough; a bearing supported within said opening; means extending from one side of said second frame end member providing a nipple having an opening therethrough; packing supported within said last named opening and operatively associated with the hereinafter mentioned rotatable tubular member; both of said nipples being respectively placed oppositely to each other on said respective frame end members; a casing connecting said frame end members and enclosing a space between same and the hereinafter mentioned rotatable tubular member; a hollow rotatable tubular member extending through the central openings in said frame end members and operatively associated with said bearings, extending at least partially into each of said nipples and operatively associated with said packings; a plurality of circumferentially spaced helical vanes extending radially inward from the inner surface of said rotatable tubular member each being of progressively decreasing extent from the intake end thereof toward the discharge end thereof; driving means rotating members mounted exteriorally on said rotatable tubular member within said space; driving means non-rotating parts also mounted within said space and operatively cooperating with said driving means rotating parts; means associated therewith supplying driving energy to said driving means parts, whereby actuation of said driving means parts will effect pumping of fluid through said rotatable tubular member.

8. An axial flow pump comprising: a frame; a tubular member rotatably mounted within said frame; a plurality of circumferentially spaced helically arranged vanes extending radially inward from the internal surface of said tubular member having a pitch of at least twice the internal diameter of the tubular member each being of progressively decreasing radial extent from the one end thereof toward the other end thereof; means causing rotation of such tubular member; means conducting fluid to one end of said tubular member and means receiving fluid from the other end of said tubular member.

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