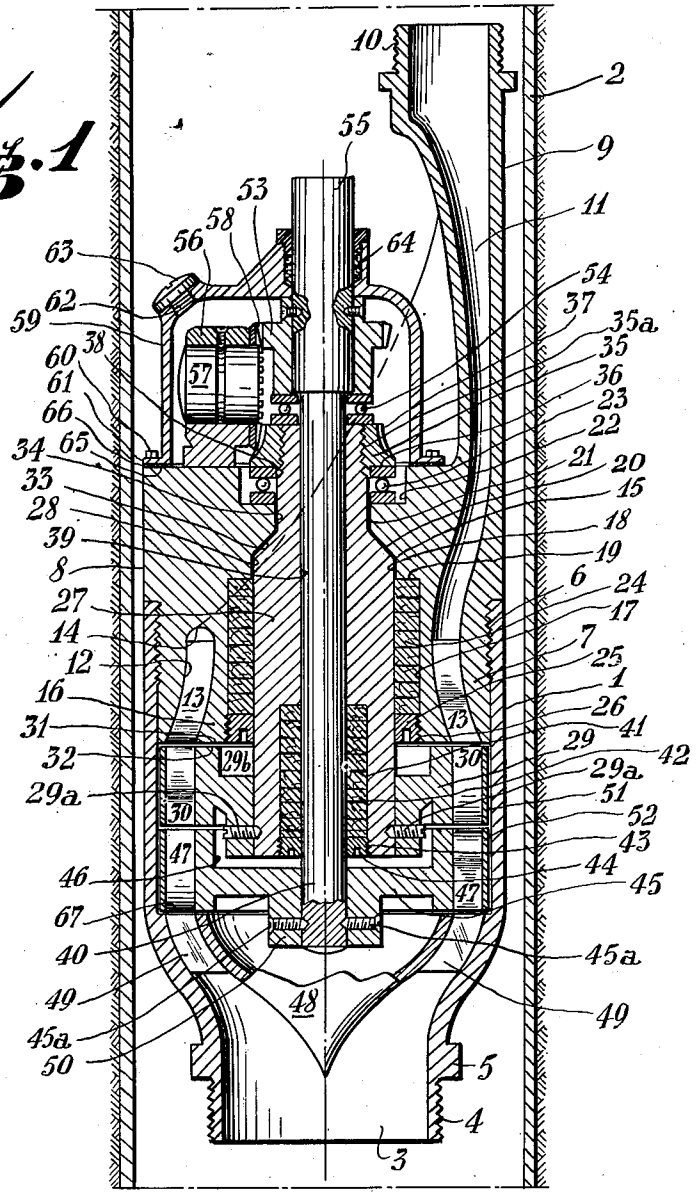
Dec. 9, 1952 G. F. BAEZ 2,620,735

ROTARY TURBINE PUMP

Filed Jan. 18, 1951 2 SHEETS—SHEET 1

Fig. 1



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Fig. 2

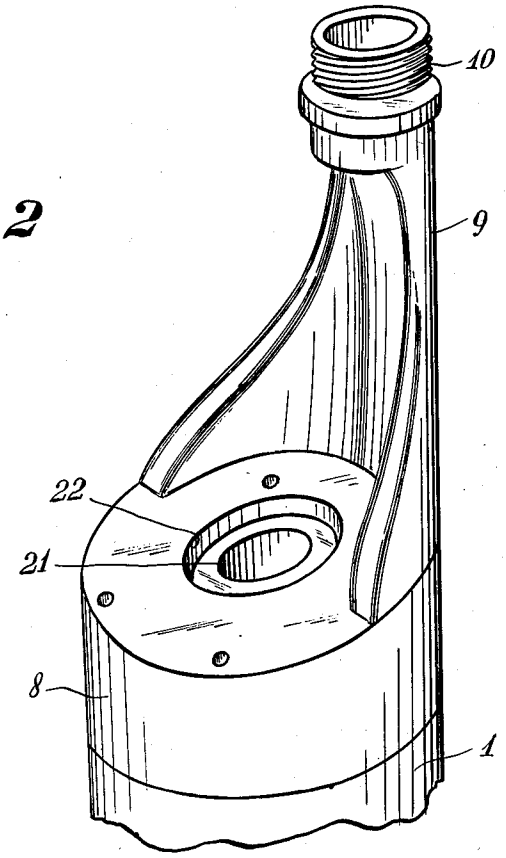
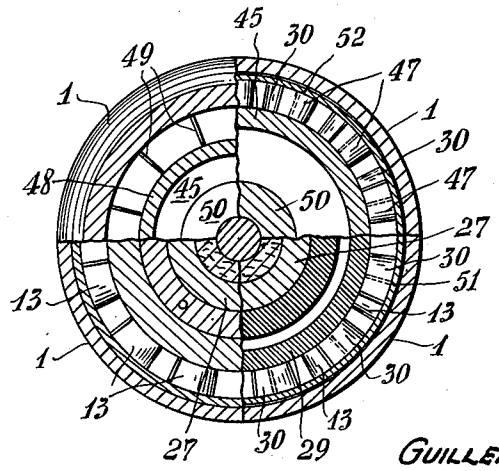


Fig. 3



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ROTARY TURBINE PUMP

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2 Claims. (Cl. 103—94)

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The present invention relates to pumps and more particularly to rotary turbine pumps and has for its object to provide an improved rotary turbine pump which, while of comparatively simple construction, offers a number of advantages over known pump constructions.

Another object of the invention is to provide a pumping apparatus having a greater lifting power than a centrifugal pump of similar dimensions.

A further object of the invention is to provide a pump having a greater capacity than the conventional gear pumps of similar dimensions.

With these and various other objects in view the invention consists of certain novel features of construction and operation and will be more fully described and particularly pointed out in the following description and drawings.

In the drawings, wherein like reference characters are used to designate like parts,

Fig. 1 is a longitudinal section of the rotary turbine pump according to the invention.

Fig. 2 is a fragmentary perspective view of the novel pump, and

Fig. 3 is a part sectional end view looking axially towards the inlet end.

Referring now to Figures 1 and 2, the pump comprises a casing 1, the maximum diameter of which is such that it may be lowered into a well casing 2. Casing 1 is formed at the lower end thereof with a constricted inlet 3, which may be externally screw threaded as indicated at 4, and provided with a polygonal nutlike portion 5 to enable an accessory such as a filter unit to be conveniently screw connected thereto. The end of the casing remote from the inlet 3, is internally screw threaded as at 6 to receive an externally threaded spigot 7 of a head member 8. Said head member 8 has projecting from the end thereof remote from the spigot 7 a discharge extension indicated by the general reference 9, the free end of which is externally threaded as at 10 for connection to a delivery pipe not shown. The outlet extension is hollow to provide a passage 11, which in the neighbourhood of the free end of said extension is substantially circular in cross section and of diameter substantially equal to the bore of such delivery pipe. From said free end towards the head member 8, said passage becomes constricted in one direction and gradually widened in an arcuate direction so as to have a gradually increasing, roughly kidney shape section and to meet over a considerable arc of a circle an annular, lengthwise arcuate chamber 12, formed in the end of said spigot and extending inwardly thereof in a generally axial direction. Fixedly secured inside chamber 12 is a set of

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radial, circumferentially spaced and axially inclined stator blades 13 arranged at a certain distance from the top of said chamber so as to leave an annular space 14 therebetween. Head member 8 including spigot 7 has a centrally disposed, substantially axial, stepped bore, indicated generally by reference character 15, which bore extends through said head member on the inside of the annular chamber 12, from which it is separated by an annular wall portion 16. Starting from the free end of the spigot 7, said stepped bore 15 comprises a relatively wide cylindrical portion 17, extending axially towards the body of the head member where said relatively wide portion 17 meets a cylindrical portion 18 of smaller diameter and coaxial with said relatively wide portion thereby forming an internal annular step 19. The narrower bore portion 18 at its end remote from the wider portion meets a frusto-conical bore portion 20 whereby it is connected to a still narrower relatively short cylindrical bore portion 21, between which and the end of the head member 8 remote from the spigot 7 one or more stepped portions are formed as at 22 of a diameter adapted to receive a suitable thrust bearing, for instance, a ball thrust bearing 23. In the relatively wide bore portion 17, a packing member 24 is housed, which packing member is adapted to be compressed axially as by an annular externally threaded pressure ring 25, screwed into the mouth of said relatively wide bore portion 17, which mouth is to this end screw threaded as indicated at 26. Packing member 24 is cylindrical and its bore is of substantially the same diameter as the narrow cylindrical bore portion 18.

It will be observed that any compression exerted axially of the packing member 24, by the screw ring 25, is taken up by said annular step or shoulder 19 and that with the packing member 24 and the screw ring 25 inserted into the relatively wide bore portion 17 there is defined within the head member 8 a substantially cylindrical coaxial space which extends from the free end of the spigot 7 axially of the head member to meet the frusto-conical portion 20 of the stepped bore 15, said space being adapted to receive a shank 27 of a main rotor 28 including a head 29 having a plurality of rotor blades 30 extending outwardly from its circumference, said head being secured to said shank as by grub screws 29a. Said shank extends from one side of said head 29 and is substantially cylindrical over an axial distance sufficiently longer than the depth of the aforesaid cylindrical space to provide for sufficient clearance between the end face 31 of said spigot and the rear annular face

32 of said head 29 formed between the periphery of the head and an annular recess 29b provided in the end of said head adjacent the spigot. Beyond the cylindrical portion aforesaid the shank 27 is reduced in diameter by means of a frusto-conical reduction 33 adapted to engage the frusto-conical bore portion 20 and to provide a cylindrical bearing portion 34, the extreme end of which is adapted to have mounted thereon and secured thereto as by grub screws 35a, a bevel gear 35. The arrangement is such that the annular face 36 formed between the toothed portion 37 of said bevel gear 35 and that the neck 38 thereof will normally seat on the thrust bearing 23. The shank 27 of main rotor member 28 is centrally and axially bored as at 39 to receive a driving shaft 40.

Conveniently, a portion of said bore 39 extending from the free end of the shank 27 inwardly for a suitable distance is enlarged to provide a packing chamber 41 adapted to receive a cylindrical packing member 42 which, like the packing member 24 may be retained in the packing chamber by a retaining ring 43 screwed into the mouth of said packing chamber 41. Said driving shaft 40 is adapted to project beyond the outer surface 44 of the retaining ring 43 and has secured thereto as by grub screws 45a a secondary rotor member 45 generally similar to the head 29 of main rotor 28 and including an outwardly extending set of rotor blades 47, which are inclined with respect to the axis of the rotor but in a sense opposite to the inclination of the blades 30 of head 29. For convenience of assembly the face of rotor 45 adjacent head 29 may be recessed as indicated at 46. Immediately below said secondary rotor member 45, is a set of stator blades 49 fixedly secured to the inside of the wall of said casing 1. Said stator blades 49 extend radially inwards of the casing 1 and support a substantially streamline portion 48 which is hollow and open at the larger end thereof adjacent said secondary rotor member to allow the hub 50 of said rotor 45 and the end of shaft 40 to project thereinto. Said streamline portion acts to direct the incoming liquid towards the stator blades 49 in a funnel-like stream. It will be observed that in the vicinity of the afore-mentioned sets of rotor blades the casing 1 is slightly recessed so as to provide a clearance for the blades 47, of the secondary rotor 45, and the blades 30, of the main rotor 28, since these blades not only have to be of the full radial width of the stator blades 13 but are also enclosed by a circumferential guard ring 51, 52, for the rotor 28 and the secondary rotor 45, respectively.

The end of the shaft 40 remote from the secondary rotor member 45 extends well beyond the shank 27 to receive an inverted conical gear 53 between the inner end of which and the opposed end of the shank 27, a thrust-bearing, such as the ball bearing 54 is provided.

Said inverted conical gear 53 is fast on the shaft 40 and said shaft extends beyond said inverted conical gear 53 to provide an end 55 adapted to be coupled to a motor shaft which may extend axially of the pump from a suitable source of power (not shown). On the free end of the head member 8 I provide a bearing support 56 adapted to receive an auxiliary shaft 57 extending radially with respect to the shaft 40 and having an inner end on which a conical gear 58 is fixed, which gear meshes simultaneously with gears 35 and 53 so as to drive the gear 35 oppositely with respect to the gear 53 and hence with respect to the rotation of the shaft 40. Since, as has already been explained the conical gear 53 is fast on the shank 27 of the main rotor 28 whereas the secondary rotor 45 is fast on the shaft 40 it will be understood that when the shaft 40 is caused to rotate in one direction the main rotor 28 will rotate in the opposite direction and therefore also in the opposite direction with respect to the secondary rotor 45.

The end of shaft 57 remote from gear 58 may terminate at the outer face of the bearing support 56 or the shaft 57 may be extended outwardly to be coupled to a driving means not shown which would then replace the driving means connected to the end 55 of shaft 40. The purpose of this alternative arrangement for driving the pump will be explained hereinbelow.

To protect the gears 35, 53, and 58 and also to provide a grease chamber for lubricating said gears and the other rotating said parts of the pump, I provide a cap member 59 suitably secured as by screws 60 passing through flange 61 of said cap member. At a suitable point in the cap member I provide a filler hole 62 normally closed as by a screw plug 63. The cap member may also be conveniently provided with a gland or stuffing box 64 for the end 55 of the shaft 40 whilst between the flange 61 of the cap member 59 and the seat 65 there may be inserted a packing 66.

For the purposes of describing the operation of the pump according to this invention it will be assumed that the shaft 40 is connected as shown in Figure 1 to a coaxial driving shaft 53, since any minor changes in the wording of the description which a lateral drive might necessitate will readily be understandable by those skilled in the art.

If the pump is installed as is shown in Figure 1 and power is transmitted thereto through the shaft 53, the shaft 40 which is directly coupled to the driving shaft 53 and which has fast on it the secondary rotor 45, will be positively and directly rotated to drive said secondary rotor 45 in a given sense, say clockwise when viewed as shown in Fig. 3.

The blades 47 of the secondary rotor 45 are, as already stated, inclined with respect to the axis of the secondary rotor and they are so inclined that their lower edges 65, that is to say the edges adjacent the stator blades 49, are the leading edges. Hence rotation of said auxiliary rotor 45 will create a suction lengthwise of the pump and towards the output end thereof whereby liquid is drawn in through the inlet 3 (if desired after passing through a filter or other auxiliary device not shown) into the casing 1, where the streamline portion 48, as previously indicated, spreads and directs the liquid into a funnel shaped mass which is subdivided into a plurality of streams flowing past stator blades 47. Said streams are caught up by the blades 47 of secondary rotor 45 and owing to the shape of said blades the water is given an additional axial impulse as well as being subjected to the centrifugal forces produced by said rotor 47 as is usual in turbine constructions. The streams of water thrown up by the individual rotor blades 47, are cast against the blades 30 of the main rotor 29 which is rotating in a contrary direction, that is to say, anti-clockwise in Figure 3.

The effect of the impact of the streams of water against the rotor blades 30 and of the change in direction of rotation is to add a still further impulse in a generally axial direction to the streams, which on issuing from the ends

of the blades 39, remote from the secondary rotor are caused to impinge against the upper stator blades 13 which are fixed but are shaped and inclined in general similarly to the shape and inclination of the blades 47 of the secondary rotor 45, but in addition are inclined inwardly and upwardly following the longitudinally arcuate shape of the chamber 12. Said upper stator blades 13 direct the streams of water first into the annular space 24 and thence into the passage 11 of the discharge extension 9.

It will therefore be understood that in passing through the pump the water is first spread out as it were and guided towards the sides of the pump and is then subjected to two active stages of turbine effect whereby a high degree of lift as well as a high velocity flow in the axial direction and consequently a very considerable capacity are obtained by means of a relatively simple combination of mechanical parts.

It might be though that the omission of a stator between the two rotors in order to change the direction of flow in the manner usual in turbines, and the further fact that the two rotors rotate in opposite directions, would not give the result claimed. However contrary to such expectations experiment has shown that the advantageous results indicated herein above are in fact that the novel pump of the present invention does have a greater lifting power than known centrifugal pumps of similar dimensions and a greater capacity than conventional gear pumps of similar dimensions. In the course of the investigations leading to the present invention experiments were made with turbine type structures comprising a series of pairs of alternating rotors and stators and when the present structure was tested against such other structure it was found that the present structure gives results comparable to a rotor stator series structure having twice as many pairs of elements as there are rotors in the pump of the present invention. The reason for this remarkable difference in results is not entirely clear but it is supposed that the combination of the shape of the rotor blades and the contrary rotations thereof is responsible for the increased overall effectiveness of the pump.

I claim:

1. A rotary turbine pump comprising a casing having an inlet at one end and a hollow outlet extension at the opposite end, a streamline portion centrally located inside said casing adjacent said inlet end, a plurality of first stator blades extending radially between said casing and said streamline portion, a centrally disposed shaft extending lengthwise into said casing from said other end, bearing means secured to said casing and rotarily supporting said shaft, a secondary rotor fast on said shaft adjacent said streamline portion, said secondary rotor including radial and helical blades inclined in a first direction with respect to the axis of said shaft, said secondary rotor blades being substantially coextensive radially with said first stator blades, a first guard ring coaxial with said shaft surrounding said secondary rotor blades and secured thereto, a shank mounted for rotation on said shaft and including an inner end and an outer end extending beyond said other end of the casing, a main rotor fast on said shank adjacent said inner end and adjacent said secondary rotor, a plurality of main rotor blades radially and helically disposed about said main rotor and inclined in a second direction opposed to said first

direction with respect to the axis of said shaft, an annular chamber provided in said casing and having an open end adjacent said main rotor on the side thereof remote from said secondary rotor and an upper end communicating with said hollow outlet extension, a plurality of second stator blades radially and helically disposed in said chamber with respect to the axis of said shaft and inclined in said first direction and positive driving means operatively associated with said shaft and said shank for driving said shaft in one direction and said shank in the opposite direction.

2. A rotary turbine pump comprising a cylindrical casing having a constricted inlet at one end, a head member including a spigot at one end and a hollow outlet extension excentrically disposed at the other end, said spigot having a free end and extending into and being secured to the end of the casing remote from the inlet, said head member including the spigot being centrally and axially bored, an annular chamber formed in said spigot and extending axially thereof from said free end between said bore and said casing, a streamline portion centrally located adjacent said inlet and extending thereinto, said streamline portion being spaced from said casing, a plurality of first stator blades extending radially between said casing and said streamline portion and supporting said streamline portion, a plurality of second stator blades in said chamber disposed radially and helically therewithin, said second stator blades being inclined in a first direction with respect to the axis of the casing, a main rotor member including a shank and a plurality of main rotor blades arranged helically and radially about said rotor member, said shank being housed for rotation in said bore and said main rotor blades being radially coextensive with said second stator blades, and being inclined in a second direction opposed to said first direction, said main rotor blades being disposed in said casing with one end adjacent said second stator blades and being surrounded by a guard ring secured thereto, said shank being hollow to provide an inner bore, a shaft located for free rotation in said inner bore and having an outer end extending beyond said end member and an inner end, a secondary rotor mounted on said inner end and including a plurality of secondary rotor blades disposed axially and helically about said secondary rotor and inclined in said first direction, said secondary rotor being located between said first stator blades and said first rotor, a bearing support mounted on the end of the head member remote from the spigot, a stub shaft supported for rotation on said bearing support, a first bevel gear fast on said shank, a second bevel gear fast on said shaft on the side of said first bevel gear remote from said head member and a third bevel gear fast on said stub shaft and simultaneously meshing with said first and second bevel gear to cause said shaft and said shank to be rotated in opposite directions when power is applied to the pump.

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