Sept. 22, 1953 T. HUDYMA ET AL 2,652,688

VERTICAL AXIS, PUMP AND TURBINE HYDRAULIC COUPLING

Filed June 15, 1950

FIG. 1

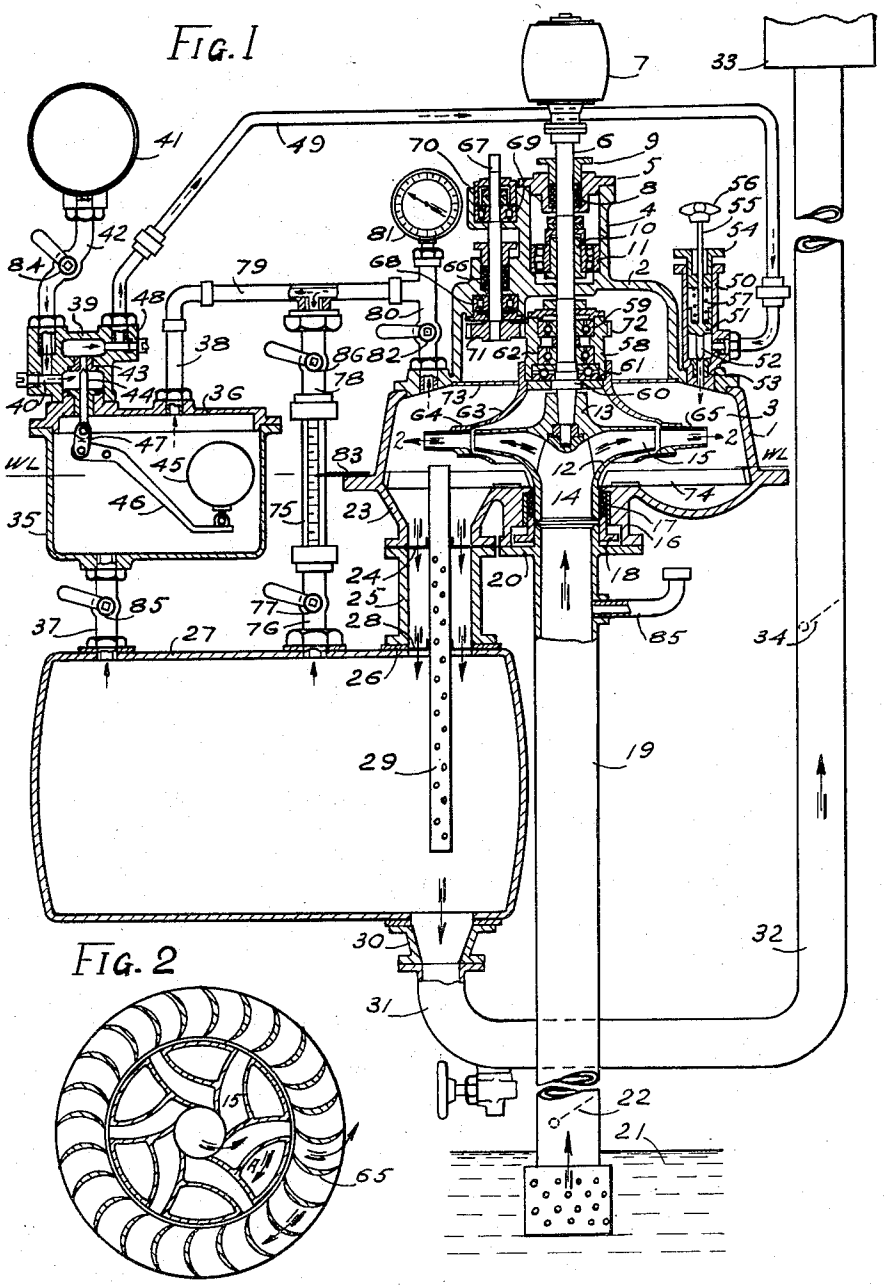


FIG. 2

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Patented Sept. 22, 1953

2,652,688

UNITED STATES PATENT OFFICE

2,652,688

VERTICAL AXIS, PUMP AND TURBINE HYDRAULIC COUPLING

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Application June 15, 1950, Serial No. 168,331

8 Claims. (Cl. 60—54)

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This invention relates to a rotary pump and turbine fluid coupling.

One object of the invention is to provide a device of this character wherein liquid used in the coupling will be maintained at a constant height relative to the turbine.

Another object of the invention is to provide a device of this character wherein a constant gas pressure will be exerted on top of the liquid used in the coupling.

A further object of the invention is to provide a device of the foregoing character having a turbine and pump so arranged that the fluid from the pump will have both the centrifugal force and the tangent force of inertia of movement utilized for separate purposes.

A still further object of the invention is to provide a novel arrangement of a coupling for the purpose described and wherein the coupling will have concentric rotary elements enabling the liquid from the turbine to be utilized in liquid form and further enabling the action of the turbine as a driving means for one or more driven mechanisms.

A still further object of the invention is to provide a novel housing and turbine arrangement wherein liquid from the turbine may be used as a house supply or the like.

Yet another object of the invention is to provide, in a device of this character, controlling means for the liquid and the gas used, the controlling means being arranged to maintain a constant liquid level for the liquid used by the turbine, therefore keeping a constant gas pressure on the top of such liquid.

Furthermore, it is an object of the invention to provide means, for such a device, whereby any gas lost in the operation of the device will be automatically replaced.

With the above and other objects in view, as will be hereinafter apparent, the invention consists in general of certain novel details of construction and combinations of parts hereinafter fully described, illustrated in the accompanying drawing, and particularly claimed.

In the accompanying drawing, like characters of reference indicate like parts in the several views and:

Fig. 1 is a vertical section through the pump and turbine, the housing and associated parts of the apparatus, and

Fig. 2 is a detail sectional view taken on line 2—2 of Fig. 1.

In the construction of this invention there is provided a lower housing 1 which may be termed the coupling housing proper. This lower housing is open at the top, and seated on the rim of the opening there is provided an upper housing 2 which serves to close the opening at the top of the lower housing and, as will be presently described, forms a gas chamber 3 which is open downwardly to the housing 1. The housing 2 has a tubular upper extension 4 on which rests the cap 5 forming the body of a packing gland. Through this packing gland extends a shaft 6 constituting the drive shaft of the coupling and driven by any suitable motor such as is shown at 7 in Fig. 1. Surrounding the shaft 6 in the extension 4 is suitable packing 8 held in properly compressed condition by an adjustable member 9. Within the extension 4 is arranged a second packing gland 10 surrounding the shaft, and between the gland 10 and the wall of the extension there is provided an antifriction bearing 11. The shaft 6 projects downwardly into the lower housing and this shaft has fixed thereon a rotor indicated in general by the numeral 12 and which is the inner rotor or radial flow centrifugal pump that drives a radial flow turbine.

The radial flow centrifugal pump is of general inverted frusto-conoidal form and has projecting upwardly from its base a boss 13 wherein the shaft 6 fits. At the lower end of the pump there is provided a centrally disposed chamber 14 from which extend a series of liquid passages or nozzles 15. These passages extend from the chamber 14 in both vertically curved and laterally curved directions. These curvatures are shown in Figure 2 and it is to be noted that the pump rotor rotates in the direction of the arrow A in Fig. 2. Extending downwardly from the center at the bottom of the lower housing 1 is a tubular boss 16, and the lower end of the pump fits in the boss 16. Between the inner surface of the boss and the outer surface of the pump there is provided packing 17 which is adjustably compressed by the gland 18. The rotor is thus sealed so that no liquid loss can take place around the lower end of said pump as it passes downwardly in the bottom of the housing 1. Extending downwardly in alinement with the chamber 14 is a supply pipe 19 provided with a flange 20 whereby the upper end of this pipe is secured to the boss 16. Pipe 19 communicates, at its lower end, with a suitable supply tank 21 and an upwardly opening check valve 22 is provided to prevent downward movement of the liquid through the pipe 19. Disposed laterally of the boss 16, the lower housing 1 is provided with a second downwardly extending boss 23 across the bottom of which a spider 24 extends. A nipple 25 is secured to the bottom of

the boss 23 by means of suitable bolts (not shown) passing through the spider 24. The lower end of this nipple is likewise spanned by a spider 28. Similarly bolted to the lower end of the nipple and lower spider is the neck 26 of the draw-off tank 27. These spiders 24 and 28 support the gas vent pipe 29 perforated at its lower end. Extending from the lower end of the tank 27 is a nozzle 30 and a pipe 31 for the used liquid of the device and this pipe may be arranged to extend upwardly as at 32 in order to supply liquid to an elevated tank 33 for use for any desired purpose. In the upwardly extending pipe 33 is an upwardly opening check valve 34 so that liquid from the tank 33 cannot flow downwardly in the pipe 32.

At one side of the housing 1 is located a casing 35 whereon is a cover 36. A pipe 37 connects the bottom of the casing 35 with the top of the tank 27. A pipe 38 connects the cover 36 with the housing 1 above the rotary centrifugal pump. Screwed on the cover 36 is a valve casing 39. At one side of this valve casing is an inlet opening 40. At 41 is a gas tank for the provision of gas under pressure and a pipe 42 connects this gas tank with the inlet opening 40. Within the valve casing is a valve seat 43 and a needle valve 44 extends upwardly from the casing 35 through the cover 36 and seats on the valve seat 43. Within the casing 38 is a float 45 which is connected to one arm of a lever 46 pivoted in the casing 35. A link 47 connects the remaining arm of the lever with the needle valve 44. Opening outwardly from the valve casing is a boss 48 having a pipe 49 leading therefrom. The pipe 49 opens into the lower part of a second valve casing 50 which is mounted on the upper housing 2 and opens downwardly to provide gas in the upper part of the lower housing 1. In the valve casing 50 is a plunger 51 which carries a needle valve 52 adapted to seat in a valve seat 53. The upper end of the valve casing 50 is provided with a closure 54 through which passes a rod 55 having a handle 56 on its upper end. A spring 57 surrounds the rod 55 between the closure 54 and the plunger 51 and urges the plunger downward so that the needle valve 52 will engage on its seat.

Within the upper part of the housing 2 the shaft 6 is surrounded by a sleeve 58 at the upper end of which, between the shaft and sleeve, is arranged an anti-friction bearing 59. On the shaft 6 is a collar 60 on which rests a thrust bearing 61 holding the sleeve in proper position. Also a lateral bearing 62 spaces the lower part of the sleeve 58 from the shaft 6. Fixed to and surrounding the lower part of the sleeve 58 is a rotatable support 63 which spreads out above the before-mentioned rotor or centrifugal pump 12 and carries on its periphery a ring 64. This ring 64 surrounds the ejection ports of the pump 12 and on its inner surface supports a circumferentially spaced series of lunate vanes 65 as shown in Fig. 2 and so arranged that their concave sides receive the fluid issuing from the ejection nozzles 15 and constitute a radial flow turbine.

Alongside of the member 4 the housing 2 is provided with a packing box 66 through which extends a power take-off shaft 67. The shaft 67 is intended for connection to any desired mechanism. Below the packing box 66, the housing 2 is provided with a bearing 68 through which the shaft 67 passes. Also, the shaft 67 extends through a bearing 69 supported in an extension 70 of the extension 4. On the lower end of the shaft 67, where it projects into the housing 2, there is provided a gear 71 wherewith meshes a gear 72 formed on the upper part of the sleeve 58. Between the housing 2 and the housing 1 is arranged a partition 73 for the confinement of gas under pressure. Fixed to the circumferential wall of the housing 1 are baffle blades 74 ending close to the radial flow centrifugal pump 12.

At one side of the housing 1 there is positioned a sight water gage 75 which is connected with the tank 27 by means of a pipe 76 provided with a shut-off valve 77. From the upper end of the sight gage 75 extends a pipe 78 which connects to a T-fitting 79 one branch of which extends to the left to the pipe 38, while the other branch extends by way of T-fitting 80 to chamber 2 and manometer 84. A cut-off valve 82 controls passage through the lower branch of the T-fitting 80. A pointer 83 is carried by the housing 1 and projects in front of the sight gage 75.

In the operation of the invention, when the motor 7 drives the shaft 6, the radial flow centrifugal pump is rapidly revolved. Due to centrifugal action liquid is drawn up through the supply pipe 19 into the central chamber 14 of the pump and from there is ejected through the passages 15. The ejected liquid impinges against the vanes or buckets 65 of the turbine and causes rotation of the sleeve ring 64, support 63 and sleeve 58. This, through the gears 72 and 71, causes rotation of the power take-off shaft 67. The float 45 is so arranged that liquid in the tank 35 will be at a level substantially even with the pointer 83. Because of the connection 37 between the tank 35 and the tank 27, together with the nipple 31, a water-level along the line WL will obtain in housing 1. It will be noted from the Fig. 1 showing, that this water level is below the line of the buckets or vanes. In the pipe 42, the valve 84 is now open. At the same time the valves 77 and 86 are open. With the opening of the valves 82 and 85 and the manually opened needle valve 52 likewise in open position, the needle valve 44 will tend to open as the float 45 rises. With the valve 44 open, under these conditions gas under pressure will be admitted through the pipe 49 to the upper part of the housing 1. When the desired reading is had on the manometer 81, under these conditions, the valve 52 is allowed to close. The closing will occur when reading of the sight gage 75 is that desired by the operator, this being at such time as the tank or other disposal means at 33 is provided with water from the turbine. With the valve 52 closed, gas under desired pressure, as indicated by the manometer 81, will have been accumulated above the water level. Thus a balance will exist between liquid in the tank 35 and liquid in the housing 1. If any gas is absorbed by the liquid or if there is any escape of gas from the housing 1, the float will rise to open the needle valve 44 and this rising of the water level will be clearly indicated on the sight gage 75. The operator may then open the needle valve 52 as before, whereupon the proper pressure will be restored in the housing 1 and the proper reading will show on the manometer. It is to be observed that the baffles 74 prevent swirling of the liquid in the housing 1 so that its flow into the tank 27 is along a smooth path.

In order to provide for filling the pipe 19 to a point closely below the chamber 14, and thus to avoid loss of lift by the creation of a partial vacuum in said chamber, there is provided a capped filling nozzle 85.

While there is herein shown and described the preferred embodiment of the invention, it is

nevertheless to be understood that minor changes may be made therein without departing from the spirit and scope of the invention as claimed.

What is claimed as new, is:

1. In a device of the kind described, a lower housing, an upper housing superimposed on the lower housing, said housings being circular in plan and surrounding a vertical axis, a motor driven drive shaft extending through the top of the upper housing and terminating in the lower housing, a radial flow centrifugal pump fixed on the lower end of the drive shaft and discharging in a horizontal plane, said pump having a central downwardly extending intake and a supply pipe therefor extending through the bottom of the lower housing, a turbine rotatably mounted on said drive shaft and having a circular series of blades in the plane of discharge of the pump, means maintaining a constant level of liquid below said horizontal plane in the lower part of the lower housing, and other means maintaining a constant high gas pressure in the upper part of the lower housing.

2. In a device of the kind described, a lower housing, an upper housing superimposed on the lower housing, said housings being circular in plan and surrounding a vertical axis, a motor driven drive shaft extending through the top of the upper housing and terminating in the lower housing, a radial flow centrifugal pump fixed on the lower end of the drive shaft and discharging in a horizontal plane, said pump having a central downwardly extending intake and a supply pipe therefor extending through the bottom of the lower housing, a turbine rotatably mounted on said drive shaft and having a circular series of blades in the plane of discharge of the pump, a delivery pipe leading downwardly from the bottom of the lower housing, an overflow pipe leading downwardly in the delivery pipe and terminating at its upper end in spaced relation below the turbine, and means maintaining constant high gas pressure in the upper part of the lower housing.

3. In a device of the kind described, a lower housing, an upper housing superimposed on the lower housing, said housings being circular in plan and surrounding a vertical axis, a motor driven drive shaft extending through the top of the upper housing and terminating in the lower housing, a radial flow centrifugal pump fixed on the lower end of the drive shaft and discharging in a horizontal plane, said pump having a central downwardly extending intake and a supply pipe therefor extending through the bottom of the lower housing, a turbine rotatably mounted on said drive shaft and having a circular series of blades in the plane of discharge of the pump, means maintaining a constant level of liquid below said horizontal plane in the lower part of the lower housing, a high pressure gas supply, a valve controlling the flow of gas from the gas supply, a pipe connection leading from said valve, a pressure regulating valve connected to said pipe connection and opening into the lower housing, and liquid level operating means controlling the first valve.

4. In a device of the kind described, a lower housing, an upper housing superimposed on the lower housing, said housing being circular in plan and surrounding a vertical axis, a motor driven drive shaft extending through the top of the upper housing and terminating in the lower housing, a radial flow centrifugal pump fixed on the lower end of the drive shaft and discharging in a horizontal plane, said pump having a central downwardly extending intake and a supply pipe therefor extending through the bottom of the lower housing, a turbine rotatably mounted on said drive shaft and having a circular series of blades in the plane of discharge of the pump, means maintaining a constant level of liquid below said horizontal plane in the lower part of the lower housing, a high pressure gas supply, a valve controlling the flow of gas from the gas supply, a pipe connection leading from said valve, a pressure regulating valve connected to said pipe connection and opening into the lower housing, a liquid controlling tank spaced laterally from the lower housing and projecting above and below the horizontal level of the liquid in said housing, and a float in said tank having operative connection with the first mentioned valve.

5. In a device of the kind described, a lower housing, an upper housing superimposed on the lower housing, said housings being circular in plan and surrounding a vertical axis, a motor driven drive shaft extending through the top of the upper housing and terminating in the lower housing, a radial flow centrifugal pump fixed on the lower end of the drive shaft and discharging in a horizontal plane, said pump having a central downwardly extending intake and a supply pipe therefor extending through the bottom of the lower housing, a turbine rotatably mounted on said drive shaft and having a circular series of blades in the plane of discharge of the pump, means maintaining a constant level of liquid below said horizontal plane in the lower part of the lower housing, a high pressure gas supply, a valve controlling the flow of gas from the gas supply, a pipe connection leading from said valve, a pressure regulating valve connected to said pipe connection and opening into the lower housing, a liquid controlling tank spaced laterally from the lower housing, and projecting above and below the horizontal level of the liquid in said housing, a float in said tank having operative connection with the first mentioned valve, and a valve controlled gas conducting pipe leading from the space within the lower housing through the top of said tank.

6. In a device of the kind described, a lower housing, an upper housing superimposed on the lower housing, said housings being circular in plan and surrounding a vertical axis, a motor driven drive shaft extending through the top of the upper housing and terminating in the lower housing, a radial flow centrifugal pump fixed on the lower end of the drive shaft and discharging in a horizontal plane, said pump having a central downwardly extending intake and a supply pipe therefor extending through the bottom of the lower housing, a turbine rotatably mounted on said drive shaft and having a circular series of blades in the plane of discharge of the pump, a delivery pipe leading downwardly from the bottom of the lower housing, an overflow pipe leading downwardly in the delivery pipe and terminating at its upper end in spaced relation below the turbine, a high pressure gas supply, a valve controlling the flow of gas from the gas supply, a pipe connection leading from said valve, a pressure regulating valve connected to said pipe connection and opening into the lower housing, and liquid level operating means controlling the first valve.

7. In a device of the kind described, a lower housing, an upper housing superimposed on the lower housing, said housings being circular in

plan and surrounding a vertical axis, a motor driven shaft extending through the top of the upper housing and terminating in the lower housing, a radial flow centrifugal pump fixed on the lower end of the drive shaft and discharging in a horizontal plane, said pump having a central downwardly extending intake and a supply pipe therefore extending through the bottom of the lower housing, a turbine rotatably mounted on said drive shaft and having a circular series of blades in the plane of discharge of the pump, a delivery pipe leading downwardly from the bottom of the lower housing, an overflow pipe leading downwardly in the delivery pipe and terminating at its upper end in spaced relation below the turbine, a high pressure gas supply, a valve controlling the flow of gas from the gas supply, a pipe connection leading from said valve, a pressure regulating valve connected to said pipe connection and opening into the lower housing, a liquid controlling tank spaced laterally from the lower housing and projecting above and below the horizontal level of the liquid in said housing, and a float in said tank having operative connection with the first mentioned valve.

8. In a device of the kind described, a lower housing, an upper housing superimposed on the lower housing, said housings being circular in plan and surrounding a vertical axis, a motor driven drive shaft extending through the top of the upper housing and terminating in the lower housing, a radial flow centrifugal pump fixed on the lower end of the drive shaft and discharging in a horizontal plane, said pump having a central downwardly extending intake and a supply pipe therefor extending through the bottom of the lower housing, a turbine rotatably mounted on said drive shaft and having a circular series of blades in the plane of discharge of the pump, a delivery pipe leading downwardly from the bottom of the lower housing, an overflow pipe leading downwardly in the delivery pipe and terminating at its upper end in spaced relation below the turbine, a high pressure gas supply, a valve controlling the flow of gas from the gas supply, a pipe connection leading from said valve, a pressure regulating valve connected to said pipe connection and opening into the lower housing, a liquid controlling tank spaced laterally from the lower housing and projecting above and below the horizontal level of the liquid in said housing, a float in said tank having operative connection with the first mentioned valve, and a valve controlled gas conducting pipe leading from the space within the lower housing through the top of said tank.

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