United States Patent [19]

Martin et al.

[11] **3,904,323**

[45] **Sept. 9, 1975**

[54] **WATER TURBINES AND/OR PUMPING APPARATUS INCORPORATING SAID TURBINES**

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[30] **Foreign Application Priority Data**

Sept. 29, 1972 New Zealand 168,546

[52] **U.S. Cl.** **417/334**; 417/405; 415/4; 415/7

[51] **Int. Cl.²** **F04B 17/00**; F03D 7/00

[58] **Field of Search** ..... 415/2, 3, 4, 199 R, 208, 415/7; 417/334, 35, 200, 337, 405; 416/207

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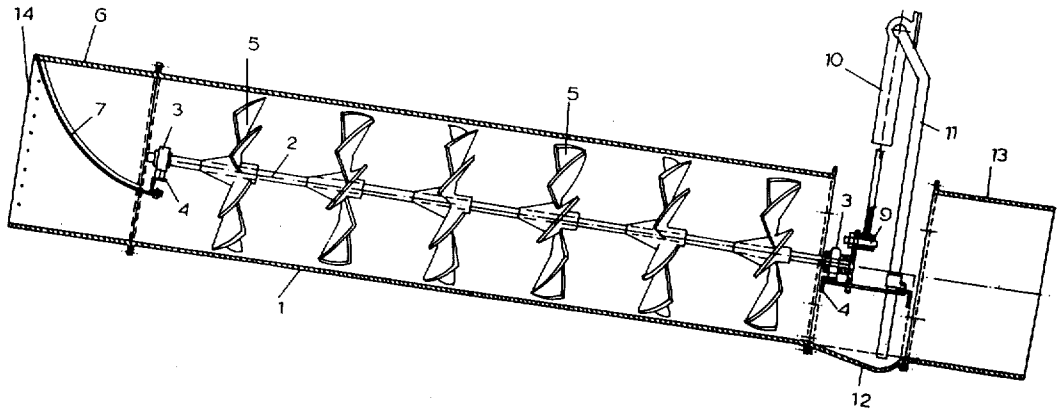
Primary Examiner—Henry F. Raduazo
Attorney, Agent, or Firm—Holman & Stern

[57] **ABSTRACT**

A water turbine primarily designed for operating a pump has a plurality of multi-bladed propellers mounted on a shaft with a sufficient spacing between the propeller wheels to allow the flow of water to re-establish after each propeller wheel. The shaft and propeller wheels rotate within a casing which has a control flow of water passing there-through so that half or less of the propeller wheel is submerged in the flow of water.

6 Claims, 7 Drawing Figures



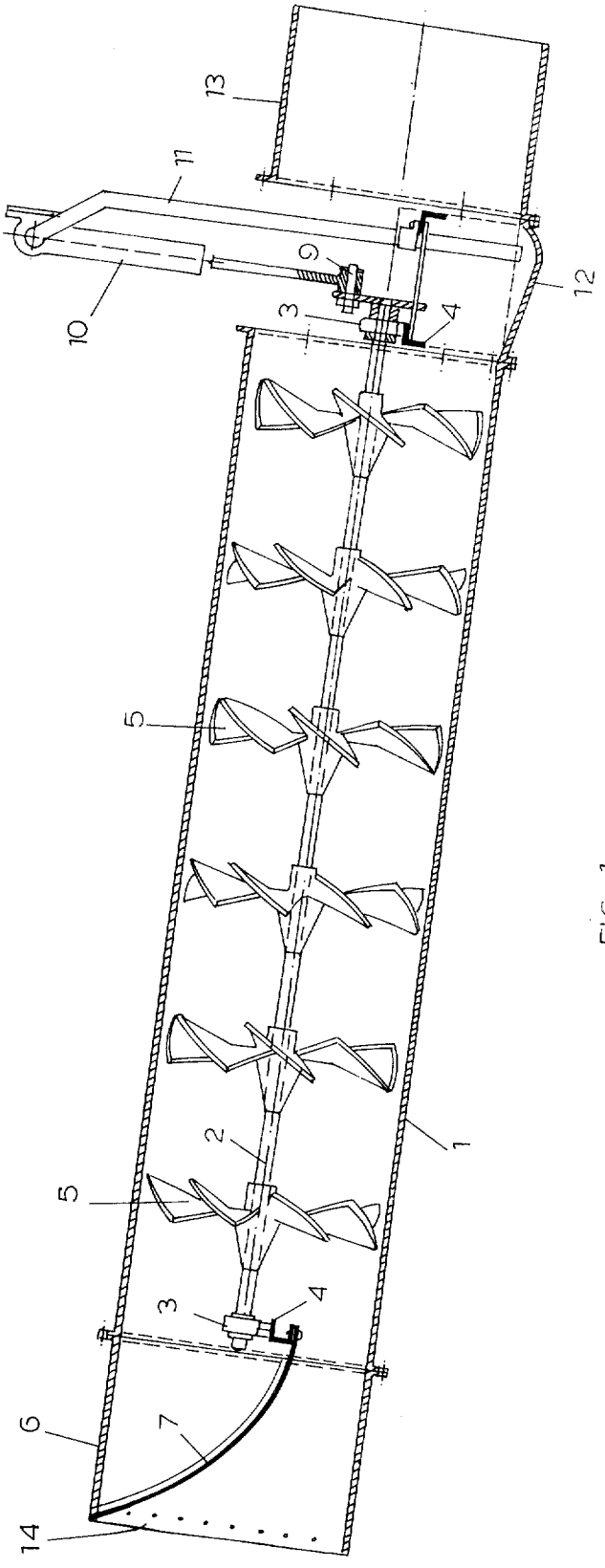


FIG. 1

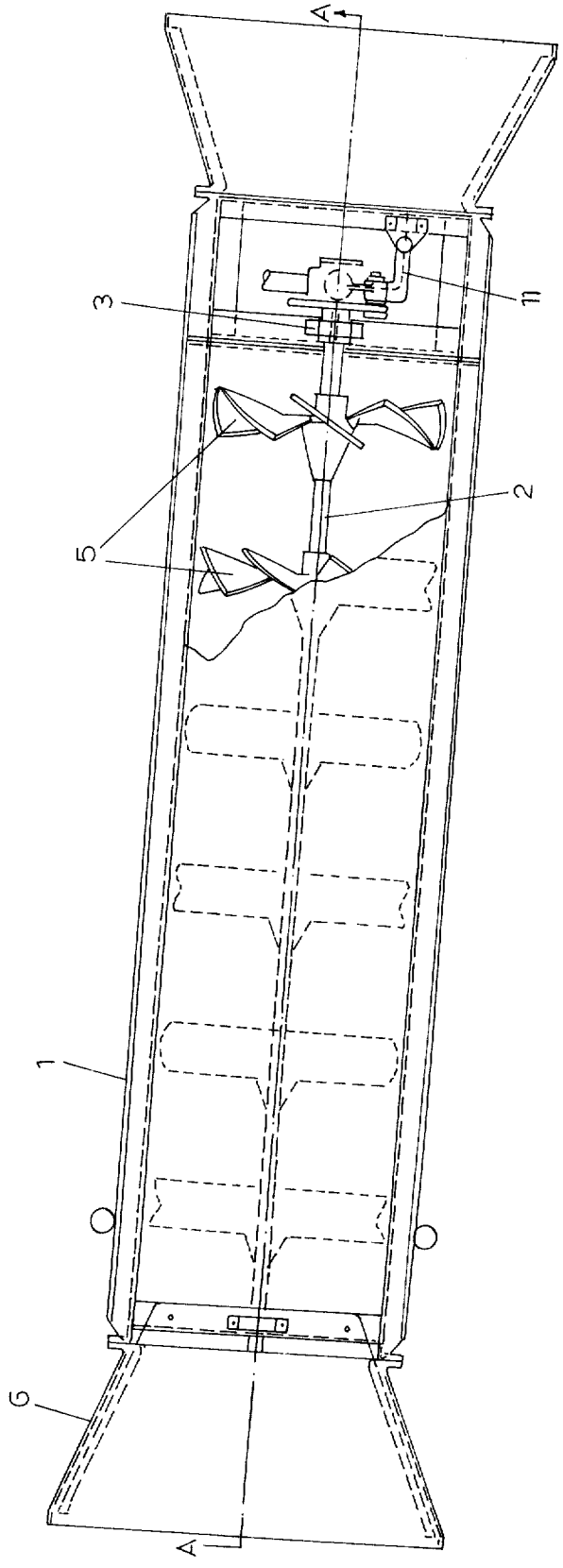


FIG 2

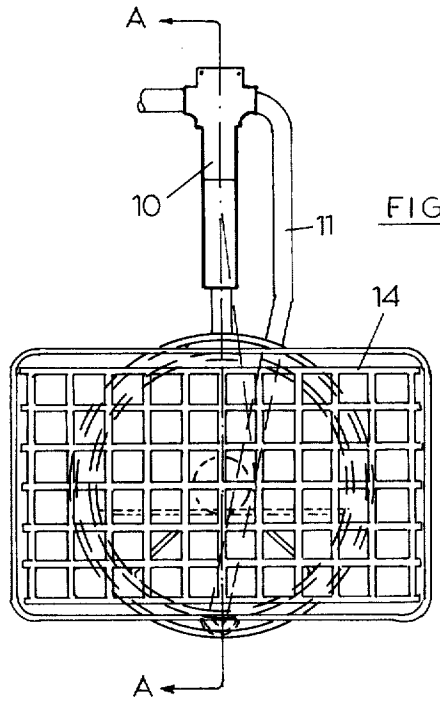


FIG 3

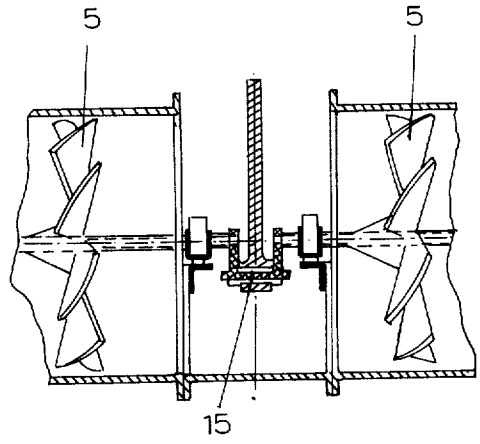


FIG. 4

FIG. 5

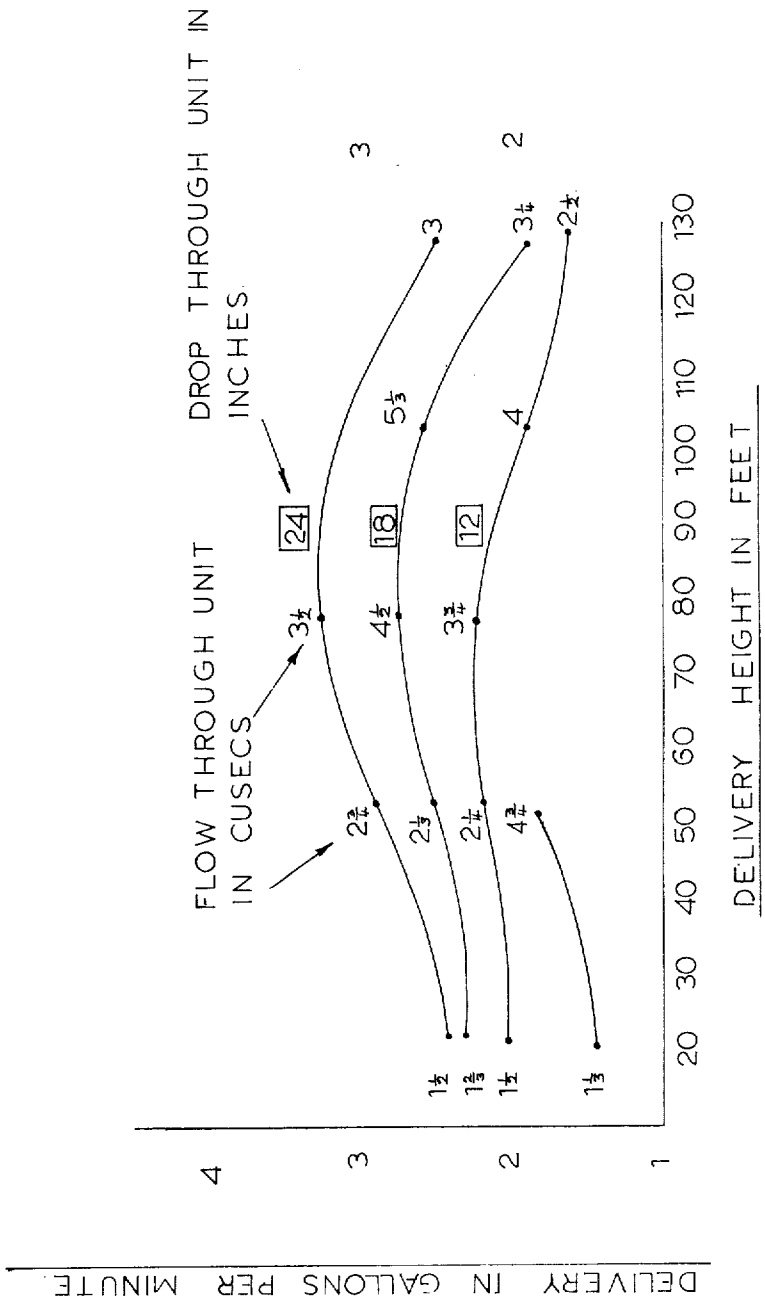

DELIVERY IN GALLONS PER MINUTE
1
2
3
4
DELIVERY HEIGHT IN FEET
20 30 40 50 60 70 80 90 100 110 120 130
FLOW THROUGH UNIT IN CUSECS
DROP THROUGH UNIT IN INCHES
24
18
12
3½
4½
3¾
4
5⅓
3
3¼
2¾
2½
2⅓
2¼
4⅔
1½
1⅔
1¼
1⅓

FIG. 6

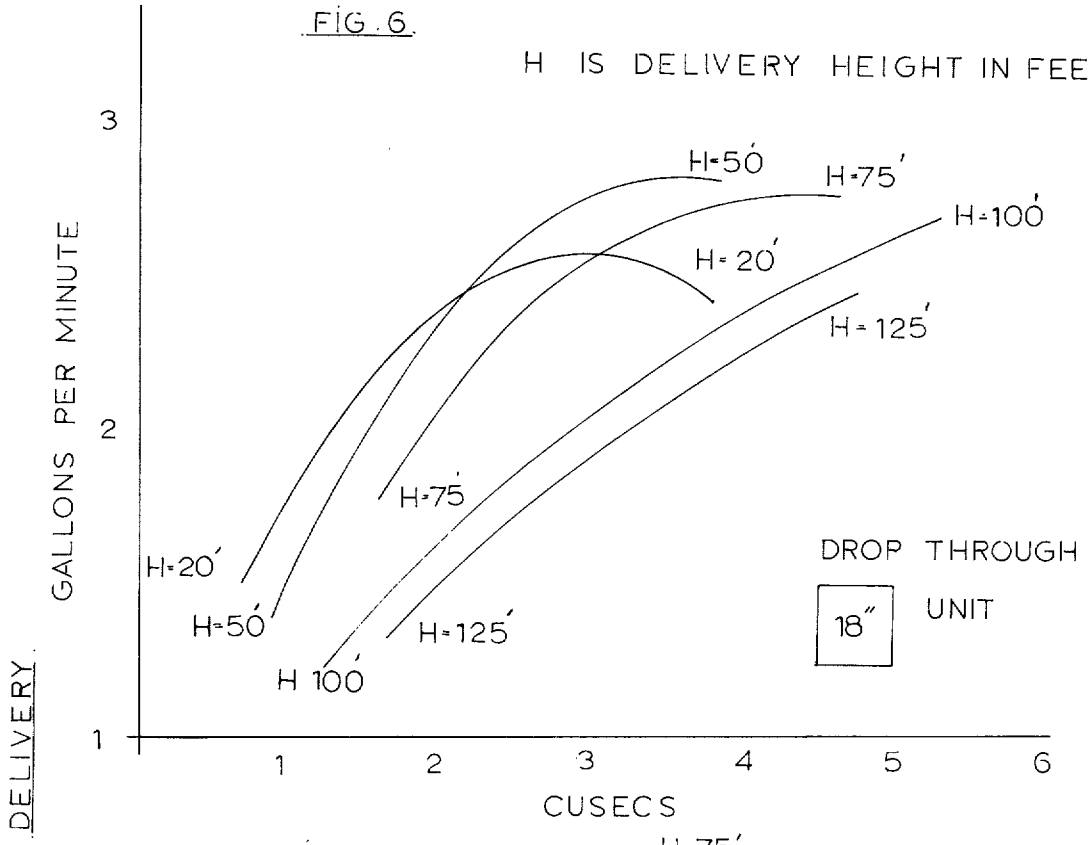
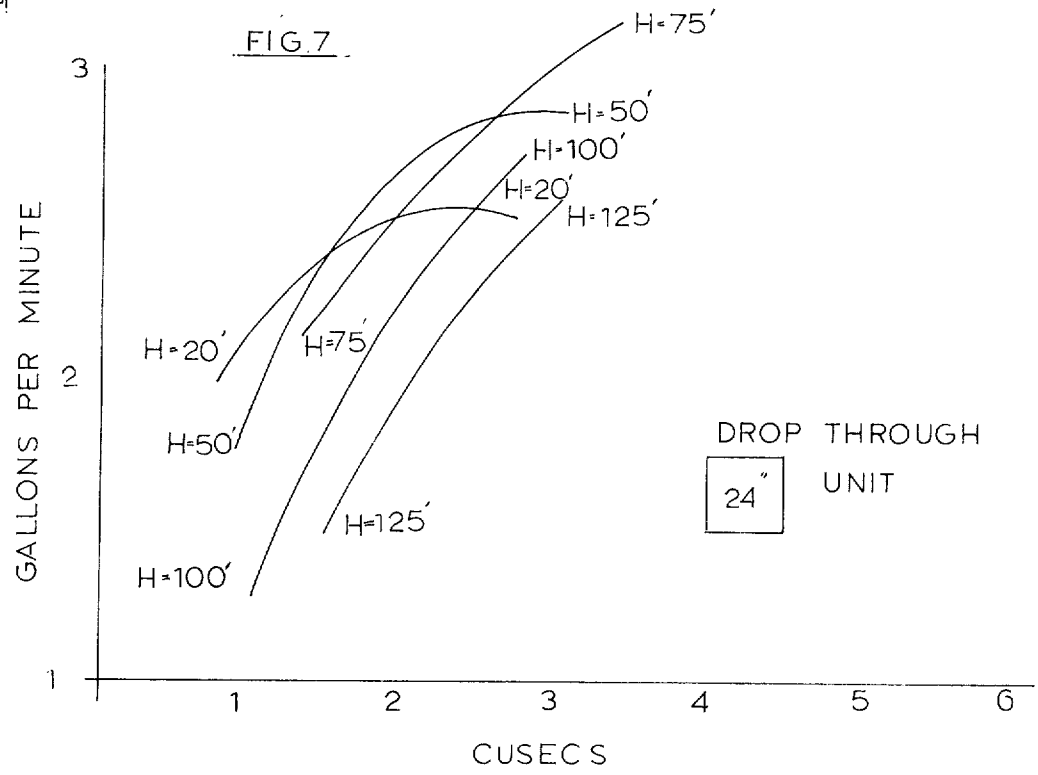

H IS DELIVERY HEIGHT IN FEET
DELIVERY
GALLONS PER MINUTE
CUSECS
H=50'
H=75'
H=100'
H=20'
H=125'
H=75'
H=20'
H=50'
H=125'
H 100'
DROP THROUGH
18"
UNIT

FIG. 7


GALLONS PER MINUTE
CUSECS
H=75'
H=50'
H=100'
H=20'
H=125'
H=20'
H=75'
H=50'
H=125'
H=100'
DROP THROUGH
24"
UNIT

WATER TURBINES AND/OR PUMPING APPARATUS INCORPORATING SAID TURBINES

This invention relates to water turbines and/or pumping apparatus incorporating said turbine.

In many instances there is a need for a source of power which may be used to raise water from a stream or river in circumstances where a pump driven by an internal combustion engine or an electric motor is not satisfactory because of the problems associated with supplying the necessary power or maintaining the motor in an operative condition.

Water rams are designed to operate upon the power provided by a head of water but there are many instances where a sufficient head of water is not readily available and this may create difficulties for installation and/or seriously limit the amount of water which can be pumped.

It is an object of the present invention to provide a water turbine and/or pumping apparatus incorporating the turbine which may be installed with a minimum of difficulty and which will operate cheaply and efficiently to supply a source of power from the flow of water.

Accordingly in one aspect the invention consists in a water turbine comprising a casing through which water may pass, a longitudinal shaft rotatably mounted within said casing, a plurality of multi-bladed propellers mounted on said shaft and flow control means to control the amount of water passing through said casing, and past said multi-bladed propellers so that in use part only of the multi-bladed propeller is in the water flow.

In a further aspect the invention consists in a water pumping apparatus comprising a longitudinal casing having a water inlet at one end and an outlet at the opposite end, a longitudinal shaft rotatably mounted within said casing, a plurality of multi-bladed propellers fixed at intervals along said shaft, a restricted intake to limit the flow of water through said casing so that half or less of the multi-bladed propellers will be immersed in the flow of water, a crank in said shaft, a reciprocating pump operatively connected to said crank, an inlet to said reciprocating pump immersed in the flow of water passing through the casing and an outlet from said pump connectable to a discharge pipe.

One preferred form of the invention and modifications thereof will now be described with reference to the accompanying drawings in which:

FIG. 1 is a sectional elevation through one preferred embodiment of the present invention,

FIG. 2 is a plan view of FIG. 1 with part of the upper casing broken away to show the multi-bladed propellers,

FIG. 3 is an end view of FIG. 1,

FIG. 4 is an alternate arrangement of the power take-off,

FIG. 5 is a comparative performance graph for the present invention with the unit positioned at varying angles,

FIG. 6 is a more detailed performance graph with a drop through the unit of 18 inches,

FIG. 7 is a more detailed performance graph of the unit with a drop through the unit of 24 inches.

The unit according to the present invention has a casing 1 which is preferably a clylindrical casing made up in two sections. The lower section is a semi-cylindrical part defining the water channel and the upper section functions as a guard.

A longitudinal shaft 2 is mounted within the casing and is supported in bearings 3 fixed on structural members 4 extending across the casing. This shaft is preferably located centrally in the casing although it could be displaced below the centre with a minimum clearance at the bottom and an increasing clearance up the sides of the casing.

Fixed at intervals along the shaft 2 are a series of multi-bladed propellers 5. The multi-bladed propellers are spaced apart suficiently to allow the water flow to reestablish before it contacts the next multi-bladed propeller. We have found a distance of approximately 12 inches (304.8 mm) provides satisfactory results, but this dimension may be varied. The efficiency of the unit will tend to drop if the multi-bladed propellers are closer together. However, advantages will still be gained with the propeller blades significantly closer for example, down to 6 inches apart (152.4 mm). The spacing may be increased beyond the optimum without increasing the efficiency but of course, this will result in an increased cost of the completed unit which should be avoided.

An inlet funnel 6 directs the flow of water into the main part of the casing and has included therein a baffle or guide 7 which in conjunction with the remainder of the inlet casing defines a nozzle 8 restricting the flow of water through the main part of the casing which does not extend above the shaft 2.

The inlet 6 is preferably guarded by a screen 14 to minimize the possibility of material entering the turbine and fouling blades.

A crank pin 9 mounted on a crank plate is provided at the end of the shaft 2 and a reciprocal pump 10 is operatively connected to the crank pin.

The crank plate supporting the crank pin 9 has apertures at varying distances from the centre of the shaft to allow adjustment of pump displacement dependent upon the pumping head and rate of flow.

The inlet 11 for the pump is arranged to draw the water supply from a small well 12 provided in the casing.

The casing is completed by a slightly flared discharge end 13.

Each multi-bladed propeller has eight blades with each blade set at 30° at the perimeter and reducing to 0° at the centre cone, but again the angle of the blades may be varied for example from 15° to 45°.

An alternative location of the crank to drive the pump is illustrated in FIG. 4. In this case the crank 15 is located at the mid-point of the shaft that is, with an equal number of multi-bladed propellers on each side thereof. The crank is preferably arranged with an adjustable throw whereby the stroke of the pump can be varied as was described above. Also, more than one crank could be incorporated. As will be seen from the drawings in the preferred embodiment six multi-bladed propellers are provided in the unit.

It will be appreciated that the size of the unit can be varied but performance data is given herein based upon a unit with a 21 inch diameter casing and six 20 inch diameter multi-blade propellers. The main body of the casing has an effective length of 8 feet 3 inches (2,514.6 mm).

The testing took place on a site with a weir and horizontal concrete flow channel delivering the water into the unit which was adjustable so that the drop through the unit was varied in 6 inch stages from 6 inches to 24

inches. The performance achieved is shown in FIG. 5 with more detailed analyses for the drops of 18 and 24 inches given in FIGS. 6 and 7.

As will be seen from the information supplied, the unit is capable of delivering a substantial flow of water to a considerable height.

The unit may be installed in any of a number of locations for example as with the test rig in a discharge channel from a weir, or any water course without the erection of a weir provided a sufficient fall was achieved.

The novelty claimed in the present invention resides in a control of the flow of water so that the multi-blade propellers are only partially submerged. The series of propellers are capable of effectively extracting power from the shallow super-critical flow which re-establishes after each propeller and so justifies the series of propellers.

The power possible by allowing the unit to operate in a fully submerged condition is significantly less than that which can be achieved with the flow control in accordance with the present invention.

Tests completed indicate that the unit makes most efficient use of the water with a minimum flow through the casing past the multi-bladed propellers. While the efficient use of the water decreases as the depth increases this is not critical until the water extends beyond the shaft on which the multi-bladed propellers rotate. As the mid-point is passed the efficiency drops away rapidly to the least efficient condition which is when the casing is full of water.

What we claim is:

1. A water turbine comprising a generally, horizontally disposed casing through which water may pass, a longitudinal shaft rotatably mounted within said casing, a plurality of multi-bladed propellers mounted on said shaft at intervals along said shaft with the spacing sufficient to allow the flow of water to re-establish after passing each propeller, and flow control means to control the amount of water passing into said casing and past said multi-bladed propellers so that in use only part of the multi-bladed propeller is in the water flow, the flow control means comprising an upstream guide member in the casing defining a nozzle that directs the flow of water toward the propellors below the longitudinal shaft so that half or less of the propeller blades are successively submerged in the limited flow of water through the casing.

2. A water turbine as claimed in claim 1 wherein the spacing between each said propeller is approximately one foot.

3. A water turbine as claimed in claim 1 having a crank means attached to the shaft to act as a power take-off means.

4. A water turbine as claimed in claim 1 wherein the multi-bladed propeller has eight blades with the angular pitch of the blades being between 15° and 45°.

5. A water turbine as claimed in claim 4 wherein the angular pitch of the blades is 30°.

6. A water pumping apparatus comprising a generally, horizontally disposed longitudinal casing having a water inlet at one end and an outlet at the opposite end, a longitudinal shaft rotatably mounted within said casing, a plurality of multi-bladed propellers fixed at intervals along said shaft, flow control means comprising a guide member in said casing at said inlet defining a nozzle limiting the flow of water through said casing toward the propellers to half or less of the radial length of multi-bladed propellers from the longitudinal shaft so that the blades are immersed in the maximum free-flow of water, a crank in said shaft, a reciprocating pump operatively connected to said crank, an inlet to said reciprocating pump immersed in the flow of water passing through the casing and an outlet from said pump connectable to a discharge pipe.

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