

[54] **PITOT PUMP WITH CENTRIFUGAL
SEPARATOR**

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[22] Filed: **Jan. 8, 1973**

[21] Appl. No.: **321,709**

[52] U.S. Cl. **233/2, 233/17, 233/21,**
233/47 R, 233/3

[51] Int. Cl. **B04b 3/00**

[58] Field of Search **233/1 R, 17, 18, 21, 22,**
233/27, 28, 46, 47 R, 29, 2, 3

[56] **References Cited**
UNITED STATES PATENTS

2,847,158 8/1958 Thylefors 233/29

2,958,461 11/1960 Peltzer 233/47 R
3,125,516 3/1964 Kaldewey 233/47 R

Primary Examiner—George H. Krizmanich
Attorney, Agent, or Firm—Harris, Kern, Wallen &
Tinsley

[57] **ABSTRACT**

A pitot pump, i.e., a centrifugal pump comprising a rotating casing, means for delivering the fluid to be pumped to the interior of the casing, a pitot tube fixed within and extending radially of the rotating casing, and a discharge duct for the pitot tube coaxial with the rotating casing. A structure for removing heavier material from the fluid being pumped and including a plurality of peripheral nozzles in the rotating casing, an annular passage feeding the nozzles, and a plurality of strainer passages feeding the annular passage from the interior of the rotating casing.

10 Claims, 4 Drawing Figures

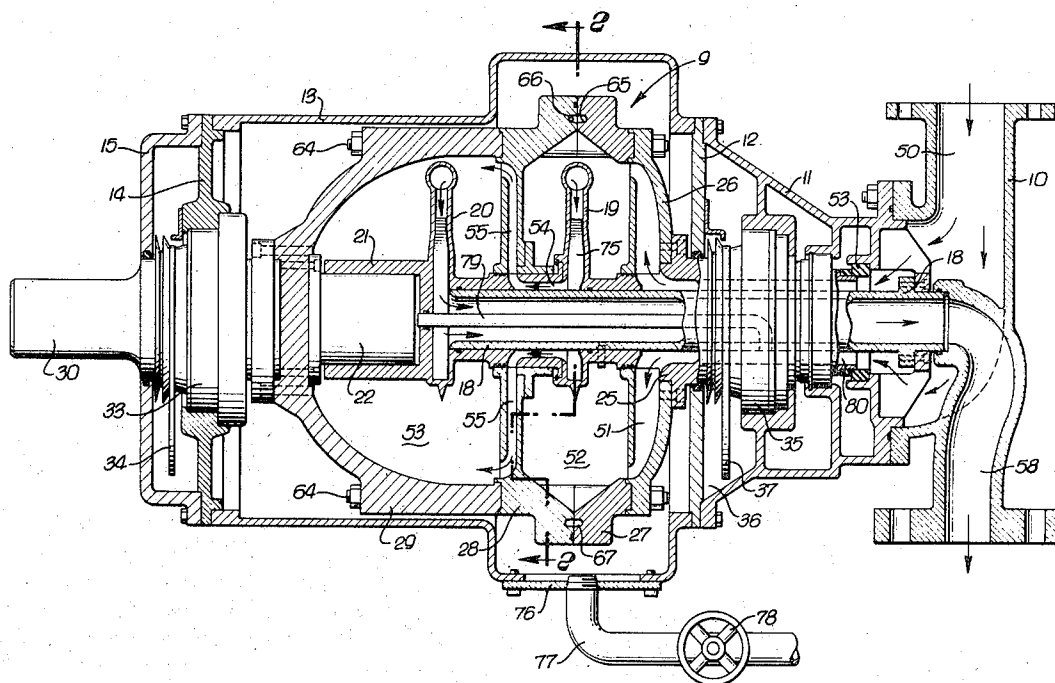


FIG. 1.

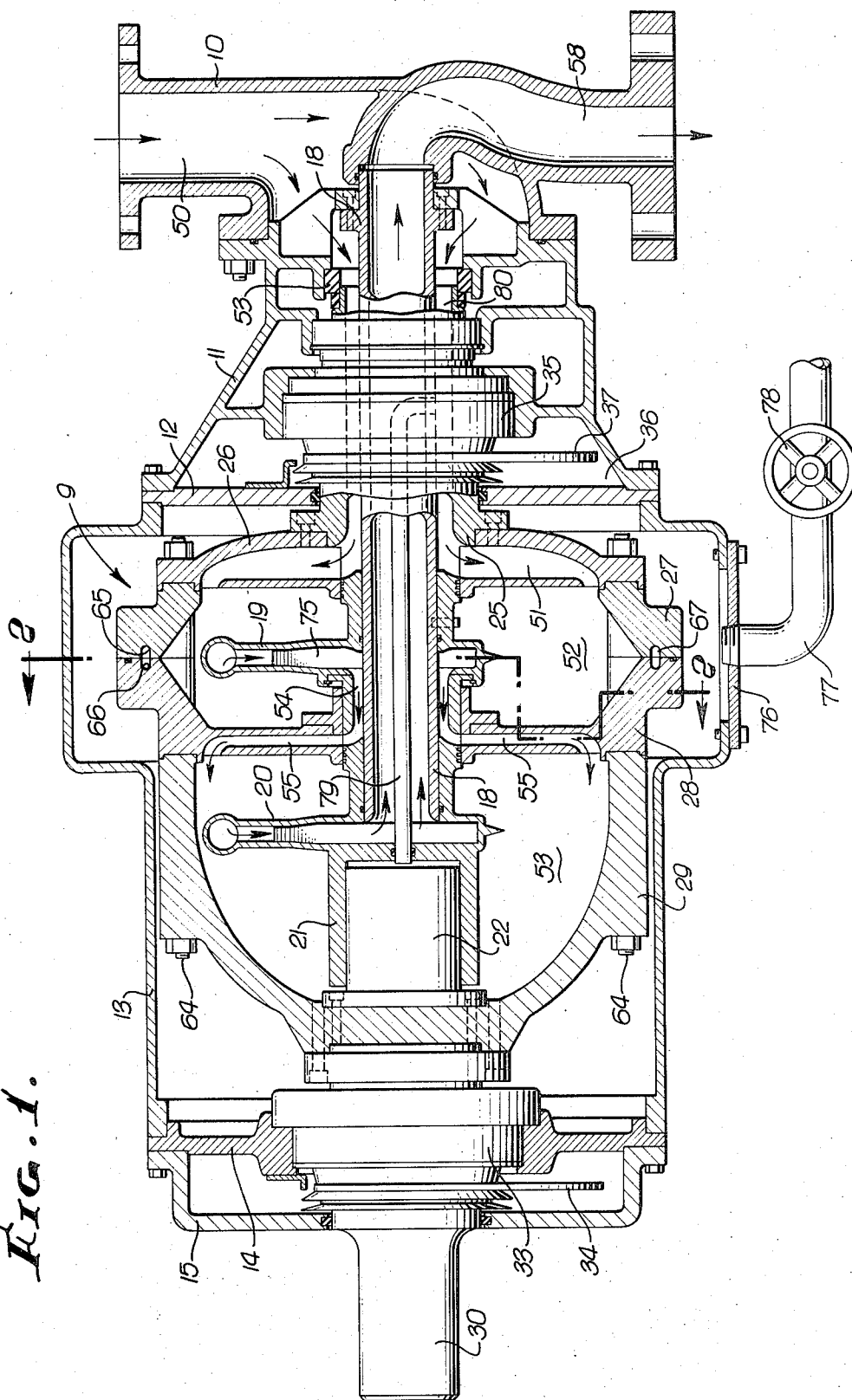


FIG. 2.

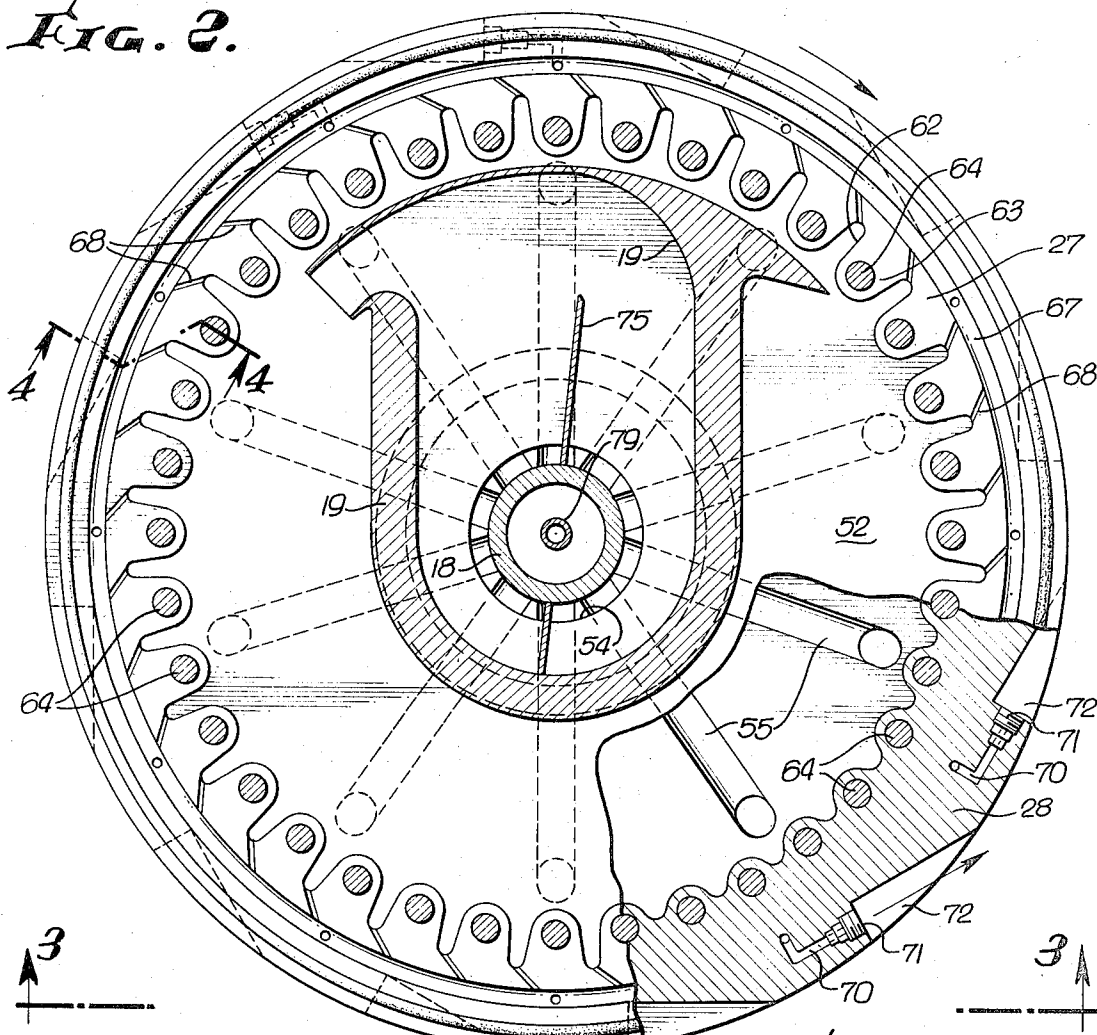


FIG. 3.

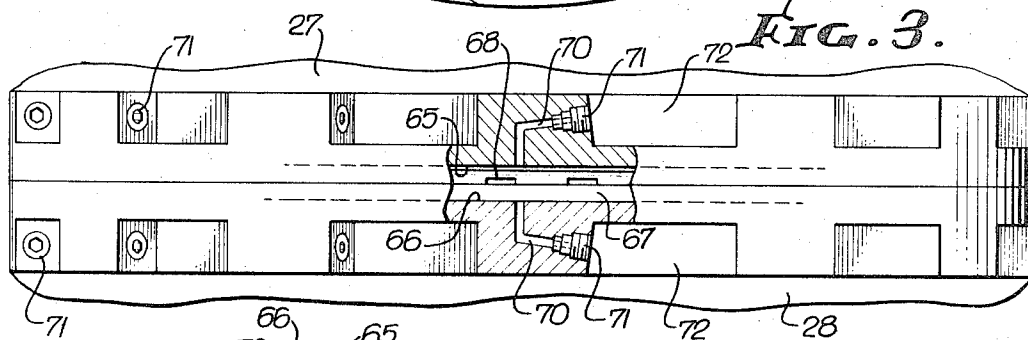
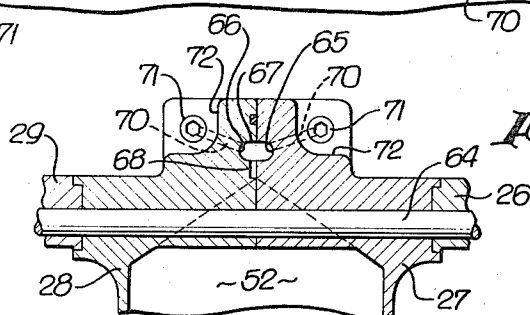


FIG. 4.



PITOT PUMP WITH CENTRIFUGAL SEPARATOR

BACKGROUND OF THE INVENTION

The present invention relates in general to centrifugal pumps and more particularly, to a centrifugal pump of the pitot type. A typical pitot pump comprises a rotating casing, means for delivering the fluid to be pumped to the rotating casing, a pitot tube fixed within the casing for picking up fluid adjacent the periphery of the casing with a ram effect and a discharge duct for receiving fluid from the pitot tube, with the discharge duct coaxial with the rotating casing. A typical pitot pump is shown in copending application serial no. 280,677, filed Aug. 14, 1972, now U.S. Pat. No. 3,776,658, issued Dec. 4, 1973, and assigned to the same assignee as the present application.

SUMMARY OF THE INVENTION

Pitot pumps are used for a variety of purposes, including the provision of a fluid at elevated pressure for driving a hydraulic pump or motor. Foreign material in the power fluid for hydraulic pumps and motors adversely affects the life of the unit, sometimes causing serious damage to seals, orifices and the like. Typical foreign materials include minerals in water, silt or sand in water and oil, and water in oil. It is highly desirable to separate the solid particles from the liquid and also to separate heavier liquids such as water from lighter liquids such as oil. The present invention is directed to a new and improved pitot pump incorporating means for separating heavier material from the liquid being pumped and it is an object of the present invention to provide such a new and improved pitot pump.

The pump of the present invention incorporates a number of orifices at the periphery of the rotary casing, with the heavier material being separated from the lighter liquid as the casing rotates, with the heavier material being discharged through the orifices. The orifices preferably are constructed as nozzles directed substantially tangential to the rotary casing and discharging opposite the direction of rotation to minimize power loss in the operation of the pump. Preferably, a strainer or filter structure is incorporated in the casing upstream of the orifices to block larger particles from the orifices. An annular passage may be provided in the casing acting in a nature of a manifold for feeding the orifices, with a plurality of strainer passages providing communication between the interior of the casing and the annular passage, with the strainer passages providing the filtering or straining function. The relative sizes of the orifice openings and the strainer openings may be selected so that the pressure drop at the filtering openings is small compared to that at the orifice openings to provide a relatively high velocity at the orifice outlet. It is a further object of the invention to provide a pitot pump with the peripheral orifices and with the strainers and interconnecting annular passage.

Other objects, advantages, features and results will more fully appear in the course of the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view of a pitot pump incorporating the presently preferred embodiment of the invention;

FIG. 2 is an enlarged sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is a view taken along the line 3—3 of FIG. 2;

FIG. 4 is a partial sectional view taken along the line 4—4 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The pitot pump has a rotating casing 9 carried in a fixed support structure, with the support structure including an inlet-outlet casting 10 bolted to a housing 11 which in turn is bolted to a baffle plate 12 and a shell 13. Another baffle plate 14 and an end bell 15 are bolted to the shell 13. A central duct 18 is carried at the right end in the housing 11 and is bolted thereto. A first pitot tube 19 and a second pitot tube 20 are carried on the duct 18, with the second pitot tube 20 having an end sleeve 21 riding on a shaft 22 of the casing 9.

The casing 9 includes a sleeve 25 disposed about the duct 18 and bolted to an end bell 26. A first casing section 27, a second casing section 28 and an end bell 29 are bolted to the end bell 26, with the shaft 22 bolted to the end bell 29. A drive shaft 30 is bolted to the outer side of the end bell 29.

The shaft 30 is carried in the plate 14 in a bearing 33. An oil supply for the bearing 33 is carried in the end bell 15, with a slinger 34 aiding oil distribution. The bearing 33 includes a seal for blocking fluid flow between the end bell 15 and the interior of the shell 13. The sleeve 25 of the casing 9 is supported in another bearing 35 carried in the housing 11, with an oil supply for the bearing in the compartment 36 with an oil slinger 37 positioned about the bearing. The plate 12 blocks fluid flow between the oil compartment 36 and the interior of the shell 13.

The fluid to be pumped enters at the casting 10 through inlet passage 50 and flows through the sleeve 25 and through radial passages 51 of the end bell 26 into chamber 52. A rotating seal 53 blocks fluid flow between the inlet passage 50 and the bearing 35.

The casing is driven in rotation clockwise as seen in FIG. 2, via the drive shaft 30, with the pitot tube 19 picking up fluid adjacent the outer periphery of the chamber 52 with a ram effect and delivering fluid to a second chamber 53 via an annular passage 54 and radial distribution passages 55 in the casing section 28. The pitot tube 20 operates the same way as the pitot tube 19, delivering fluid to the interior of the duct 18 to the outlet passage 58. The pitot pump described thus far may be conventional in construction and may have one stage or more than two stages as well as the two stage configuration illustrated.

The chamber 52 formed by the casing sections 27, 28 is shown in greater detail in FIGS. 2-4. A plurality of v-shaped zones 62 are provided in the outer periphery of the chamber between shoulders 63 which receive the bolts 64 holding the casing components together. Annular grooves 65, 66 in the mating faces of the casing sections 27, 28 form an annular passage 67 in the casing. A generally radial and preferably oblique passage 68 provides communication between each of the v-shaped zones 62 and the annular passage 67. The passages 68 preferably are rectangular and typically may comprise a rectangular groove formed in the face of one of the casing sections, as best seen in FIG. 3.

Outlet passages are provided from the annular passage 67 to the exterior of the casing and preferably take the form of a passage 70 terminating in a nozzle 71 having a sharp edged orifice. The nozzles may be manufactured separately and inserted into threaded openings in the casing sections. The nozzles preferably are disposed substantially tangential to the periphery of the casing, with portions of the casings cut away at 72 for clearance purposes.

Some other structural components include a vane 75 within the pitot tube 19, functioning as described in my aforementioned copending application (FIG. 2). A plate 76 serves as a removable cover for an access opening in the shell 13, with a drain line 77 and control valve 78 connected at the plate 76 (FIG. 1). A tube 79 provides pressure equalization between passage 80 within sleeve 25 about duct 18, and the space between the shaft 22 and the sleeve 21.

In operation, the major portion of the fluid within the chamber 52 of the rotating casing is picked up by the pitot tube 19. Heavier liquid and solid particles move to the periphery, into the zones 62 and through the slots 68 into the annular passage 67. These heavier materials are discharged through the passages 70 and nozzles 71 and collect within the shell 13. The zones 62 and slots 68 function as strainers or filters, i.e., a strainer means, for blocking large particles from the nozzle orifices. While the incoming fluid normally will be well screened, wellscreened, these strainers are desirable and serve to prevent an occasional larger particle from entering and damaging or blocking an orifice. A typical nozzle orifice may have a diameter in the order of .020 inches. A typical slot may be in the order of .005 by .100 inches thereby serving as a strainer while having a cross-section area somewhat larger than that of the nozzle, a desirable condition.

The size of the orifices in the nozzle is made small so as to prevent any substantial pressure drop in the chamber during operation. Also, the total cross-sectional area of the slots 68 is made larger than the total cross-sectional area of the nozzle orifices, at least by a factor of two to one and preferably by a factor of three to one. This size ratio is controlled by the size of the individual passages and by the number of trainer slots and nozzle orifices. With this size relationship, the pressure drop through the strainer section is small compared to the pressure drop through the nozzles, being in the order one to nine for the area ratio of three to one. With this configuration, the efficiency of the pump is not greatly affected by the heavy material removal operation. The major portion of the velocity head which would be lost through the material separation operation is regained by the jet effect of the fluid exhausting through the nozzle orifices.

With the construction of the invention, the heavier materials are separated from the fluid being pumped prior to its being picked up by the pitot tube. This separated material is collected in the shell 13 and withdrawn through the drain line 77. Large particles retained by the strainer section will be accumulated within the casing or broken up or abraded by fluid action until of a size to pass the strainer slots.

The passages 68 in the preferred oblique direction as seen in FIG. 2, impart a tangential velocity to the fluid in the annular passage 67 which prevents bridging or buildup of sediment in the passage 67.

I claim:

1. In a pitot pump adapted to pump a liquid containing undesirable heavier material, the combination of: a generally cylindrical rotary casing rotatable about its central axis, including an annular pump chamber having an annular outer wall;

means for delivering such a liquid to be pumped to said pump chamber;

means for rotating said casing and chamber in one direction to impart a velocity to said liquid in said direction and cause heavier material therein to tend to stratify adjacent said annular outer wall;

a stationary pitot tube in said chamber and extending radially therein, said pitot tube having adjacent its outer end an inlet opening radially inwardly of said annular wall facing in a direction opposite to said one direction of rotation of said rotary casing; and

a discharge duct coaxial with said rotary casing and communicating with the inner end of said pitot tube;

said annular outer wall including orifice means there-through, having a cross-sectional area great enough to permit the passage of particles contained in the liquid in said chamber to a point outside said casing but having a total effective cross-sectional area sufficiently smaller than that of said inlet opening to prevent a substantial pressure drop in the outer portion of said chamber during rotation of said casing.

2. A device as defined in claim 1, in which the outer portion of the pump chamber is generally v-shaped and the apex thereof communicates with said orifice means.

3. A device as defined in claim 1, in which said outer wall of said casing includes an annular passage between said pump chamber and said orifice means and coaxial with said casing and in which said outer wall of said casing includes strainer means between said annular passage and pump chamber and having passage means providing flow between said annular passage and said orifice means.

4. A device as defined in claim 3, including a plurality of said orifice means circumferentially spaced from each other around said casing.

5. A device as defined in claim 3, wherein the relative sizes of said strainer means passage means and said orifice means is such that during rotation of said casing the pressure drop across said strainer means is substantially less than the pressure drop across said orifice means.

6. A device as defined in claim 1, including a closed, stationary shell surrounding said rotary casing, with which said orifice means communicates, said shell collecting material discharged from said orifice means upon rotation of said casing.

7. A device as defined in claim 1 wherein said orifice means includes a plurality of discharge nozzles directed generally tangential to said casing in a direction opposite to the rotation of said casing.

8. A device as defined in claim 7 wherein said outer wall of said casing includes an annular passage coaxial with said casing and a plurality of strainer passages, providing fluid flow paths from said chamber through said strainer passages and said annular passage to said discharge nozzles.

9. A device as defined in claim 8 wherein each of said strainer passages comprises a relatively large upstream

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collection zone and a relatively small downstream zone, with the total cross-section area of said downstream zone is greater than the total cross-section area of said orifice means discharge nozzles by at least a factor of two.

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10. A device as defined in claim 8 wherein each of said strainer passages includes an outlet opening obliquely into said annular passage in a direction opposite to rotation of said casing.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,817,446 Dated June 18, 1974

Inventor(s) John W. Erickson and Vitolis Budrys

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

[75] after "Huntington", insert --Beach--
(page 1, line 4; also declaration)

[73] "Kabe" should be --Kobe-- (assignment)

Column 3, line 29, after "be", insert --fairly--
(page 7, line 10)

Column 3, line 29, after "screened", delete "wellscreened"
(page 7, line 10)

Column 3, line 44, "trainer" should be --strainer--
(page 7, line 25)

Signed and sealed this 15th day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents