

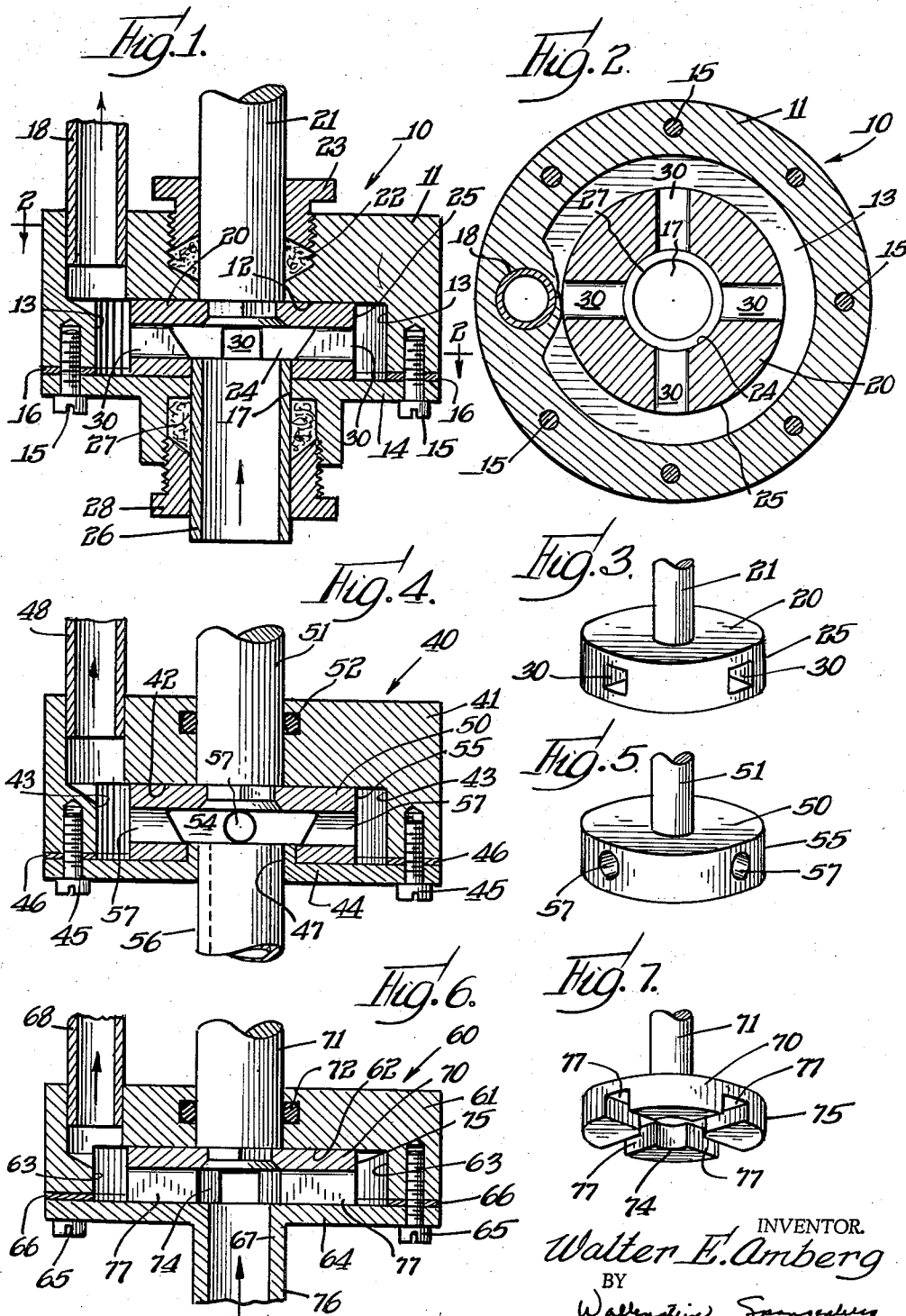
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CENTRIFUGAL LIQUID PUMP

3,107,625

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

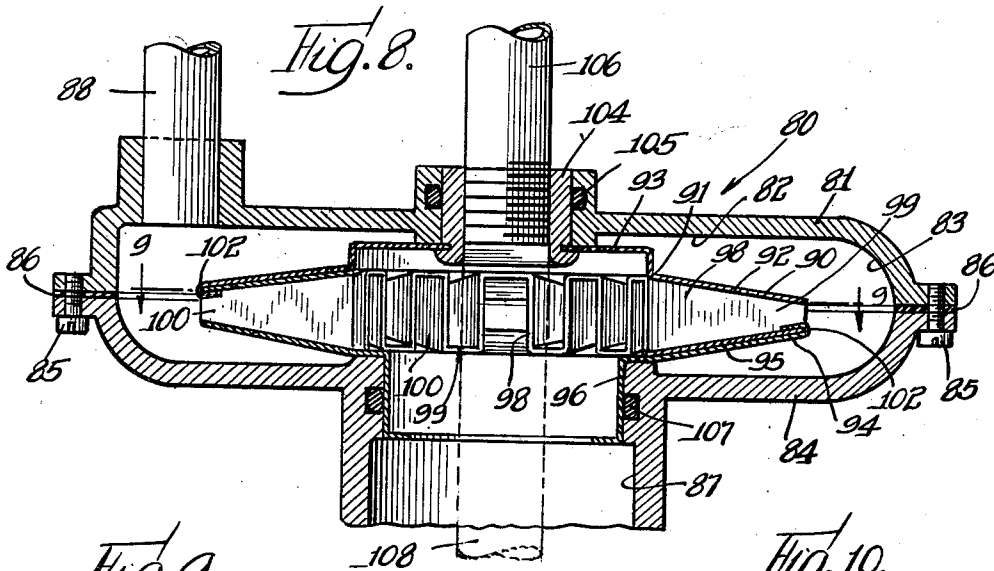


Fig. 9.

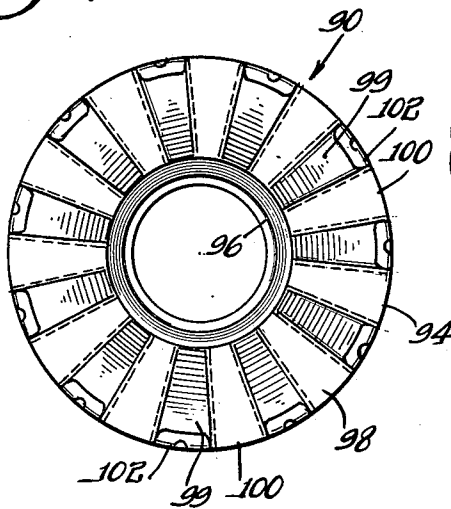


Fig. 10.

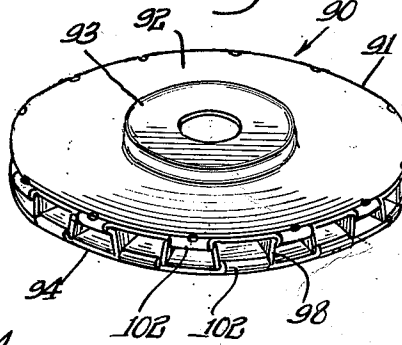


Fig. 12.

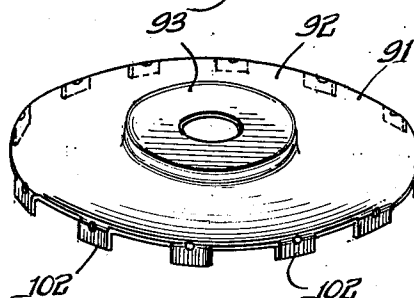
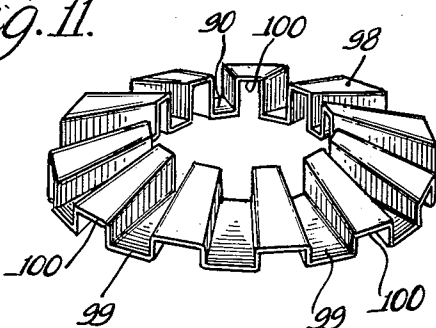


Fig. 11.



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CENTRIFUGAL LIQUID PUMP

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5 Claims. (Cl. 103-103)

The principal object of this invention is to provide a new and improved centrifugal liquid pump, which operates on a new and different principle from conventional vane type pumps, which produces outlet liquid pressures higher than those of conventional vane type pumps of comparable size, which is considerably more efficient than conventional vane type pumps, which can efficiently pump substantially all types of liquids, from extremely light and fluid to extremely heavy and viscous fluids, which is simple and rugged in construction and fool-proof in operation, and which is inexpensive to manufacture.

Conventional vane type liquid pumps are essentially flow pumps rather than pressure pumps, the vanes in the rotating impeller thereof being spirally arranged with the spacing between the vanes increasing appreciably from the inside to the outside and operating to impel the liquid from the inlet to the outlet, to circulate the liquid in the outlet and to discharge the circulating liquid from the outlet substantially at a tangent to its peripheral motion. Because of turbulence and the slippage of the flow of liquid in the impeller, appreciably large pressures cannot be built up by the conventional vane type liquid pumps, the pumping being provided essentially by imparting motion to the liquid as distinguished from imparting pressure forces thereto.

On the other hand, the centrifugal liquid pump of this invention pumps the liquid by essentially applying pressure forces thereto, motion and circulation and tangential take-off by the liquid being of no significance. As a result, the centrifugal liquid pump of this invention is essentially a pressure pump as distinguished from a flow pump, it producing considerably greater pressures than conventional vane type pumps, up to 30 percent higher pressures for comparably sized pumps, and it providing high pressure for liquid take-off at any desired position or angle.

Briefly, the centrifugal liquid pump of this invention comprises a new and improved centrifugal impeller which is rotatably mounted in the pumping chamber of a liquid pump having an inlet and an outlet which are separated by the rotating centrifugal impeller. The rotating centrifugal impeller includes a central cavity communicating with the pump inlet and an outer peripheral surface communicating with the pump outlet. It also includes a plurality of radial pockets extending radially between the central cavity and the outer peripheral surface for pocketing columns of liquid therein and forcing by centrifugal force such pocketed columns of liquid radially outwardly from the pump inlet to the pump outlet.

By reason of the radial pockets in the impeller, the columns of liquid pocketed therein are impelled radially outwardly with great force by the centrifugal force applied thereto to produce high pressures in the pump outlet, there being substantially no turbulence or slippage of the liquid in the radial pockets or voids therein, the pocketed columns of liquid being substantially solid liquid columns being acted upon by the centrifugal force. The centrifugal force acting upon the pocketed radial columns of liquid remains the same regardless of the rate of flow of the liquid through the pump, and this is so even where the liquid flow may be zero due to closing off the discharge from the pump. Since the pumping of liquid in accordance with this invention is accomplished by centrifugal force acting upon the radially

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disposed pocketed columns of liquid, as distinguished from moving, circulating and tangentially discharging the liquid as in conventional vane type pumps, the required torque for rotating the impeller is maintained at a minimum for maximum flow and outlet pressure of the pumped liquid, and there is no need for tangential discharge of the pumped liquid.

For maximum pumping efficiency, the input area of each of each of the pockets of the impeller is made at least as great as the output area thereof to insure a solid column of pocketed liquid in the radially arranged pockets, and each of the radial pockets is constructed to have a radial length at least as great as the diameter of a circular area equalling the output area thereof to insure the formation of a sufficiently long column of pocketed liquid to be acted upon by the centrifugal force.

The pump and its rotating impeller of this invention may take various forms for producing the aforementioned pumping characteristics of this invention, and several such various forms are disclosed herein by way of example.

Further objects of this invention reside in the details of construction of the centrifugal liquid pump and its impeller of this invention and in the cooperative relationships between the component parts thereof.

Other objects and advantages of this invention will become apparent to those skilled in the art upon reference to the accompanying specification, claims and drawings in which:

FIG. 1 is a vertical sectional view through one form of the centrifugal liquid pump of this invention.

FIG. 2 is a horizontal sectional view through the pump of FIG. 1, taken substantially along the line 2-2 of FIG. 1.

FIG. 3 is a perspective view of the impeller utilized in the pump of FIGS. 1 and 2.

FIG. 4 is a vertical sectional view through another form of the centrifugal liquid pump of this invention.

FIG. 5 is a perspective view of the impeller utilized in the pump of FIG. 4.

FIG. 6 is a vertical sectional view through still another form of the centrifugal liquid pump of this invention.

FIG. 7 is a perspective view of the impeller utilized in the pump of FIG. 6.

FIG. 8 is a vertical sectional view through a further form of the centrifugal liquid pump of this invention.

FIG. 9 is a horizontal plan view of the impeller used in the pump of FIG. 8 with the top disc of the impeller omitted.

FIG. 10 is a perspective view of the impeller utilized in the pump of FIG. 8.

FIG. 11 is a perspective view of the corrugated annular strip utilized for forming the pockets in the impeller of the pump of FIG. 8.

FIG. 12 is a perspective view of the top disc of the impeller of FIG. 8.

Referring now to FIGS. 1, 2 and 3, one form of the centrifugal liquid pump of this invention is generally designated at 10. It includes a suitable housing 11 having a central pump chamber 12 and an annular outlet 13. A cover 14 is provided for closing off the housing 11 and it is secured in place by suitable screws 15 and sealed by a gasket 16. The cover 14 is provided with a central pump inlet 17 which communicates with the pumping chamber 12 and the pump outlet 13 also communicates with the pumping chamber 12. A discharge conduit 18 communicates with the pump outlet 13 for discharging pumped fluid from the pump 10.

A centrifugal impeller 20 is rotatably mounted in the pumping chamber 12 and it is interposed between the pump inlet 17 and the pump outlet 13. A shaft 21 is suitably secured to the impeller 20 for rotating the same,

the shaft 21 being sealed by suitable packing 22 and a gland nut 23. The impeller 20 has a central cavity 24 which communicates with the central pump inlet 17 and it also has an outer peripheral surface 25 which communicates with the pump outlet 13. If desired, the impeller 20 may be provided with a downwardly extending sleeve or tube 26 for supplying liquid to be pumped into the central cavity 24, and the sleeve or tube 26 may be sealed by suitable packing 27 and a gland nut 28. The impeller 20 is provided with a plurality of radial pockets 30 which extend radially between the central cavity 24 and the outer peripheral surface 25. As here shown, the radial pockets 30 are substantially rectangular or square in cross-section and the input area of each of these pockets is at least as great as the output area thereof.

In the operation of the pump, the liquid to be pumped enters through the pump inlet 17 into the central cavity 24 in the impeller 20. The liquid from the central cavity 24 is then pocketed in the radial pockets 30 to form columns of liquid therein which are forced by centrifugal force radially outwardly into the pump outlet 13. Each of the pockets 30 has a radial length at least as great as the diameter of a circular area equalling the output area thereof to insure the formation of a sufficiently long column of pocketed liquid to be acted upon by the centrifugal force. By reason of these radial pockets 30 in the impeller 20, the columns of liquid pocketed therein are impelled radially outwardly with great force by the centrifugal force applied thereto to produce high pressure in the pump outlet, there being substantially no turbulence or slippage of the liquid in the radial pockets or voids therein, the pocketed columns of liquid being substantially solid liquid columns being acted upon by the centrifugal force. As a result, high liquid pressures are built up in the pump outlet 13 and the liquid may be discharged through the discharge conduit 18 at high pressure regardless of the angle or position of the discharge conduit 18 with respect to pump outlet 13.

Referring now to FIGURES 4 and 5, another form of the centrifugal liquid pump of this invention is generally designated at 40, it being very much like that illustrated in FIGS. 1 to 3. It includes a housing 41 having a central pumping chamber 42, a pump outlet 43 and a cover or closure 44 secured to the housing 41 by screws 45 and sealed by a gasket 46. The cover or closure 44 has a pump inlet 47, and a discharge conduit 48 in the housing communicates with the pump outlet 43. A centrifugal impeller 50 is rotatably mounted in the pump chamber 42 and it operates to separate the pump inlet 47 from the pump outlet 43. The impeller 50 is rotated by a shaft 51 which is suitably secured thereto and which is suitably sealed in the housing by a sealing ring 52 or the like. The impeller 50 has a central cavity 54 which communicates with the pump inlet 47 and an outer peripheral surface 55 which communicates with the pump outlet 43. If desired, the pump inlet 47 may be provided with an extension 56 for feeding liquid to be pumped into the central cavity 54 into the impeller 50. Here, also, the impeller 50 is provided with a plurality of radial pockets 57 which extend radially from the central cavity 54 to the outer peripheral surface 55 for pocketing columns of liquids therein and forcing by centrifugal force said pocketed columns of liquid radially outwardly there-through from the inlet 47 to the outlet 43. These pockets 57 also have a length at least as great as the diameter of the output area thereof and an input area at least as great as the output area. Here, the radial pockets are of circular cross-section as distinguished from the rectangular or square cross-section as in the impeller 20.

The pump 40 of FIGS. 4 and 5 functions and operates in the same manner as the pump 10 of FIGS. 1 to 3 and, therefore, a further description of the function and operation thereof is not considered necessary. In both instances the plurality of radial pockets pocket columns of liquid therein, and force by centrifugal force the

pocketed columns of liquid radially outwardly there-through from the inlet to the outlet.

Referring now to FIGS. 6 and 7, a further form of the centrifugal liquid pump of this invention is generally designated at 60, it being similar to the pumps 10 and 40 heretofore discussed. Here, the pump 60 includes a housing 61, having a central pumping chamber 62 and a pump outlet 63. A cover or closure 64 is secured to the housing 61 by screws 65 and is sealed there against by a gasket 66. The cover 64 is provided with a central pump inlet 67 and, if desired, the pump inlet may be provided with an extension 76 for conveying the fluid to the pump. A discharge conduit 68 communicates with the pump outlets 63 and, as expressed heretofore, its position and direction are not critical.

A rotary impeller 70 is rotatably mounted in the pumping chamber 62 and it may be driven by a shaft 71 suitably secured thereto and suitably sealed by a packing ring 72 or the like. The impeller 70 has a central cavity 74 which communicates with the pump inlet 67 and an outer peripheral surface 75 which communicates with the pump outlet 63. The lower surface of the impeller 70 is provided with a plurality of radial grooves 77 which extend radially from the central cavity 74 to the outer peripheral surface 75 of the impeller. The bottom surface of the impeller 70 is in substantial contact with the cover or closure 64, so that the radial grooves 77 in conjunction with the cover or closure 64 form a plurality of radial pockets, extending radially between the central cavity 74 and the other peripheral surface 75 of the impeller 70.

The centrifugal liquid pump 60 of FIGS. 6 and 7 operates in the same way as the pumps 10 and 40 heretofore discussed, the radial pockets 77 pocketing columns of liquid therein and forcing by centrifugal force the pocketed columns of liquid radially outwardly there-through from the inlet 67 to the outlet 63.

Referring now to FIGS. 8 through 12, still another and a preferred form of the centrifugal liquid pump of this invention is generally designated at 80. It includes a housing 81 having a central pumping chamber 82 and an outer pump outlet 83. A cover or closure 84 is suitably secured to the housing 81 by screws 85 and is sealed with respect thereto by a gasket 86. The cover or closure 84 is provided with a central pump inlet 87 and a discharge conduit 88 communicates with the pump outlet 83 for discharging the pumped liquid therefrom.

Rotatably mounted in the pumping chamber 82 is a centrifugal impeller 90, which includes an upper disc 91 having a conical wall portion 92 and an offset attaching portion 93. The impeller 90 also includes a lower disc 94 having a conical wall portion 95 and an extension portion 96. Arranged between the two conical wall portions 92 and 95 of the upper and lower discs 91 and 94 is a radially corrugated strip 98 which forms thin partitions between the upper and lower discs, which in turn form radial pockets extending radially from the central cavity of the impeller to the outer peripheral surface of the impeller, these radial pockets being designated at 99 and 100. The discs 91 and 94 may be formed from sheet metal by stamping or spinning procedures and the radially corrugated annular strip 98 may be formed from a strip of sheet metal by suitably stamping the strip in progressive dies or the like. Thus, the impeller 90 of the pump 80 may be readily and inexpensively formed by conventional stamping and spinning procedures. The peripheral edges of the discs 91 and 94 are provided with a plurality of spaced apart ears 102 which are bent over the corrugations of the radially corrugated annular strip 98 for securing together the discs 91 and 94 and the radially corrugated annular strip 98. In this way the impeller may be readily and easily fabricated. They also may be secured together by spot welding or the like. The pockets 99 and 100, so formed, have a radial length at least as great as the diameter of a circular area equalling

the output area thereof and the input area of each of the pockets is at least as great as the output area thereof. In this respect, it is noted that the pockets at the central cavity are narrow and deep, while the pockets at the outer peripheral surface of the impeller are wide and shallow, the input areas and the output areas of the pockets being substantially the same and the cross-sectional areas also being substantially the same all the way along the radial pockets. As a result, the radial pockets 99 and 100 pocket columns of liquid therein and force by centrifugal force the pocketed columns of liquid radially outwardly therethrough from the inlet to the outlet, and this being accomplished with substantially no turbulence or slippage of the liquid in the radial pockets or voids therein. Accordingly, the impeller 90 of the centrifugal pump 80 operates in substantially the same way as the impellers of the aforementioned pumps 10, 40 and 60.

The impeller 90 may be rotated in the pump chamber 82 by a shaft 106 suitably secured to a collar 104 which, in turn, is suitably staked to the offset portion 93 of the disc 91 of the impeller 90. The collar 104 may be sealed against leakage by a suitable sealing ring 105 carried by a boss on the housing 81. The downwardly extending extension 96 of the lower disc 94 may be sealed against leakage in the pump inlet 87 by a suitable sealing ring 107 located therein. If desired, the shaft 106 which rotates the impeller 90 may extend downwardly through the central cavity in the impeller 90 and through the pump inlet 87 for operating similar impellers in other pump chambers, this extension of the shaft 106 being indicated at 108.

While for purposes of illustration several forms of this invention have been disclosed, other forms thereof may become apparent to those skilled in the art upon reference to this disclosure and, therefore, this invention is to be limited only by the scope of the appended claims.

I claim as my invention:

1. In a centrifugal liquid pump having a pumping chamber, an inlet and an outlet, a rotating centrifugal impeller rotatably mounted in the pumping chamber and including a circular side wall, and a substantially radially corrugated annular strip of substantially uniform thickness secured to the circular side wall and forming a central cylindrical cavity communicating with the inlet, an outer cylindrical peripheral surface communicating with the outlet and of lesser axial depth than the axial depth of the central cavity, and a plurality of equally dimensioned substantially radial pockets on opposite sides of each corrugation of the corrugated annular strip and extending substantially radially between the central cylindrical cavity and the outer cylindrical peripheral surface for pocketing columns of liquid therein and forcing by centrifugal force said pocketed columns of liquid substantially radially outwardly therethrough from the inlet to the outlet, the total cylindrical input area of the pockets at the cylindrical central cavity end thereof being at least as great as the total cylindrical output area of the pockets at the cylindrical peripheral surface end thereof.

2. In a centrifugal liquid pump having a pumping chamber, an inlet and an outlet, a rotating centrifugal impeller rotatably mounted in the pumping chamber and including a circular side wall, and a substantially radially corrugated annular strip of substantially uniform thickness secured to the circular side wall and forming a central cylindrical cavity communicating with the inlet, an outer cylindrical peripheral surface communicating with the outlet and of lesser axial depth than the axial depth of the central cavity, and a plurality of equally dimensioned substantially radial pockets on opposite sides of each corrugation of the corrugated annular strip and extending substantially radially between the central cylindrical cavity and the outer cylindrical peripheral surface for pocketing columns of liquid therein and forcing by centrifugal force said pocketed columns of liquid substan-

tially radially outwardly therethrough from the inlet to the outlet, each of said substantially radially disposed pockets having an input area at the cylindrical central cavity end thereof at least as great as the output area at the cylindrical peripheral end thereof and having a length at least as great as the diameter of a circular area equalling the output area thereof.

3. In a centrifugal liquid pump having a pumping chamber, an inlet and an outlet, a rotating centrifugal impeller rotatably mounted in the pumping chamber and including a circular side wall, and an elongated substantially straight sided strip of substantially uniform thickness corrugated into a substantially radially corrugated annular member and secured to the circular side wall and forming a central cylindrical cavity communicating with the inlet, an outer cylindrical peripheral surface communicating with the outlet and of lesser axial depth than the axial depth of the central cavity, and a plurality of equally dimensioned substantially radial pockets on opposite sides of each corrugation of the corrugated annular member and extending substantially radially between the central cylindrical cavity and the outer cylindrical peripheral surface for pocketing columns of liquid therein and forcing by centrifugal force said pocketed columns of liquid substantially radially outwardly therethrough from the inlet to the outlet, the total cylindrical input area of the pockets at the cylindrical central cavity end thereof being at least as great as the total cylindrical output area of the pockets at the cylindrical peripheral surface end thereof.

4. In a centrifugal liquid pump having a pumping chamber, an inlet and an outlet, a rotating centrifugal impeller rotatably mounted in the pumping chamber and including a disc member having a conical side wall portion, and a substantially radially corrugated annular strip of substantially uniform thickness secured to the conical side wall portions of the disc and forming a central cylindrical cavity communicating with the inlet, an outer cylindrical peripheral surface communicating with the outlet and of lesser axial depth than the axial depth of the central cavity, and a plurality of equally dimensioned substantially radial pockets on opposite sides of each corrugation of the corrugated annular strip and extending substantially radially between the central cylindrical cavity and the outer cylindrical peripheral surface for pocketing columns of liquid therein and forcing by centrifugal force said pocketed columns of liquid substantially radially outwardly therethrough from the inlet to the outlet, the total cylindrical input area of the pockets at the cylindrical central cavity end thereof being at least as great as the total cylindrical output area of the pockets at the cylindrical peripheral surface end thereof.

5. In a centrifugal liquid pump having a pumping chamber, an inlet and an outlet, a rotating centrifugal impeller rotatably mounted in the pumping chamber and including a pair of spaced apart discs having conical enclosing side walls, and a substantially radially corrugated annular strip of substantially uniform thickness secured between the conical enclosing side walls of the pair of discs and forming a central cylindrical cavity communicating with the inlet, an outer cylindrical peripheral surface communicating with the outlet and of lesser axial depth than the axial depth of the central cavity, and a plurality of equally dimensioned substantially radial pockets on opposite sides of each corrugation of the corrugated annular strip and extending substantially radially between the central cylindrical cavity and the outer cylindrical peripheral surface for pocketing columns of liquid therein and forcing by centrifugal force said pocketed columns of liquid substantially radially outwardly therethrough from the inlet to the outlet, the total cylindrical input area of the pockets at the cylindrical central cavity end thereof being at least as great

as the total cylindrical output area of the pockets at
the cylindrical peripheral surface end thereof.

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