United States Patent

[11] 3,612,168

[72] Inventor **Maurice L. Peterson**
Kerkhoven, Minn. 56252

[21] Appl. No. **840,658**
[22] Filed **July 10, 1969**
[45] Patented **Oct. 12, 1971**

[54] **ROTATABLE HEAT TRANSFER MEANS**
11 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **165/86,** 165/92, 165/109, 219/372, 416/95
[51] **Int. Cl.** **F28d 11/00,** F28f 5/00
[50] **Field of Search** 165/86, 88, 92, 108, 109; 219/372; 416/95, 96; 415/177, 178

[56] **References Cited**

UNITED STATES PATENTS

1,417,037	3/1922	Cushman	165/86
1,454,315	5/1923	Cushman	165/86
1,897,607	2/1933	Cornell	165/92
2,380,346	7/1945	Thomlinson	219/372
3,253,649	5/1966	Laing	165/86

FOREIGN PATENTS

144,425	10/1903	Germany	165/86
285,183	6/1915	Germany	165/86
722,058	1/1955	Great Britain	165/86

Primary Examiner—A. Bartis
Attorney—Burd, Braddock & Bartz

ABSTRACT: A rotatable heat transfer fan has a plurality of radially extending blades secured to a rotatable hub having fluid inlet and outlet passages. A plurality of radially extending heat exchange tubes are spaced from opposite faces of the blades by a plurality of radially spaced fins secured to the blades and the tubes. The inner ends of the tubes are connected to the inlet and outlet passages in the hub whereby a heat exchange fluid may be circulated through the tubes. The outer ends of each tube is fluidly connected to a tubular ring secured to the outer peripheral portions of the blades. The tubular ring defines a circumferentially extending annular fluid passage which equalizes the fluid pressure on all of the tubes. A pump is operable to force fluid through the tubes. In an alternative nonillustrated embodiment, the heat exchange tubes can be replaced electric heating elements.

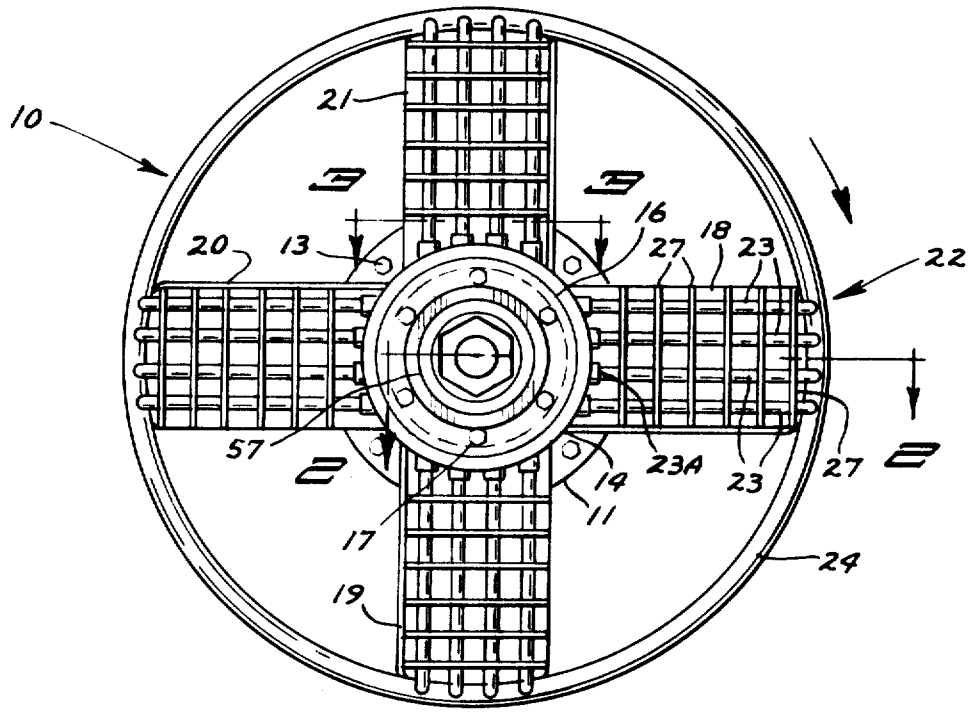
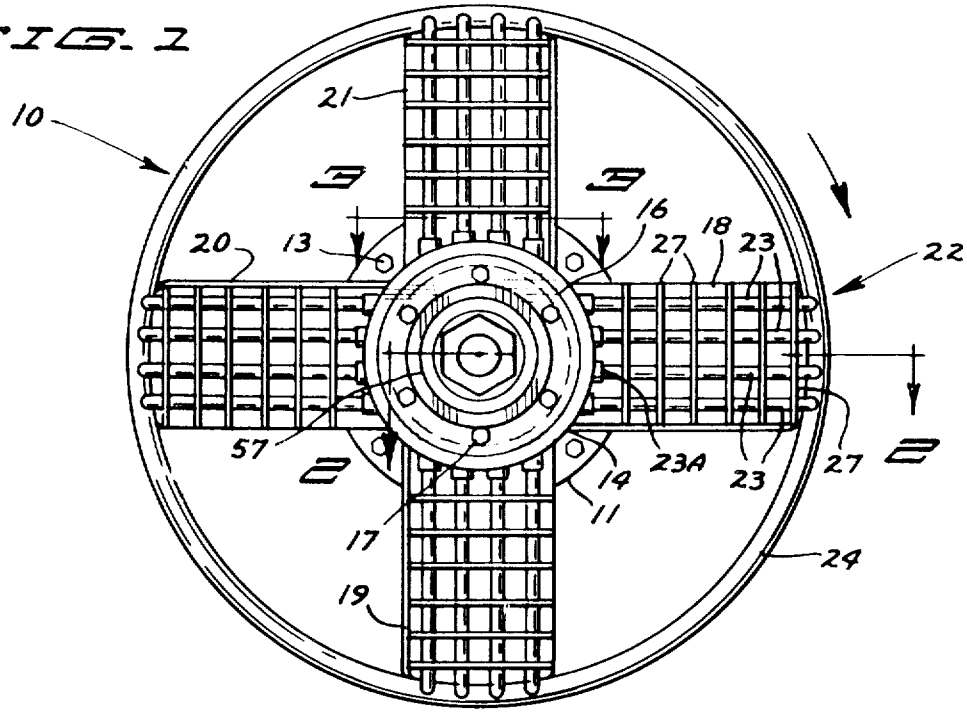


FIG. 1



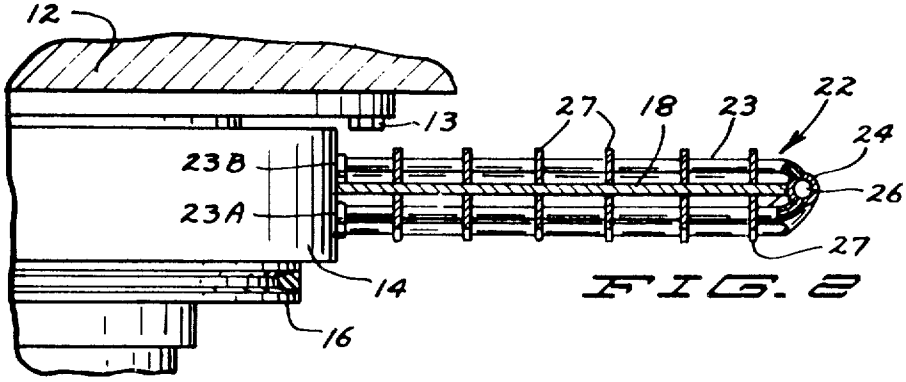


FIG. 2

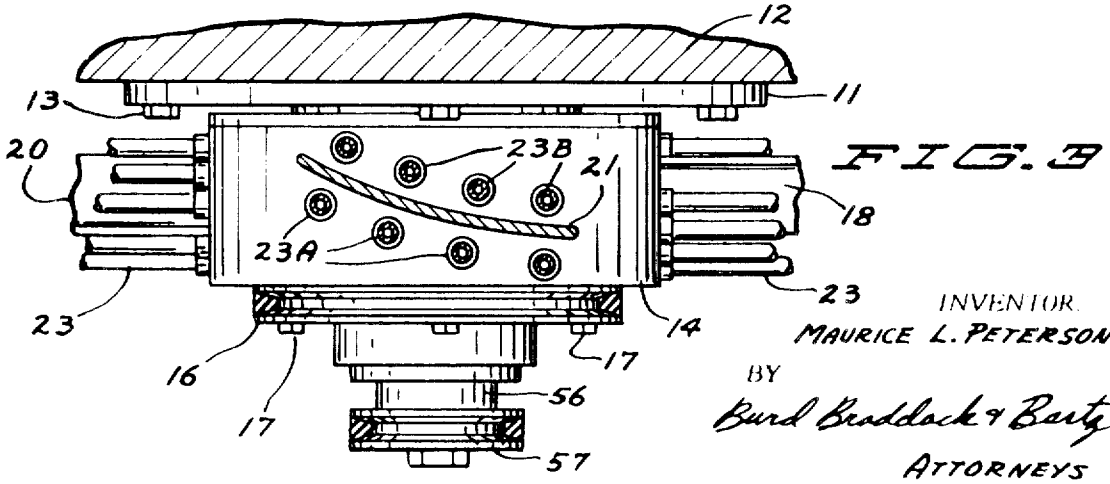
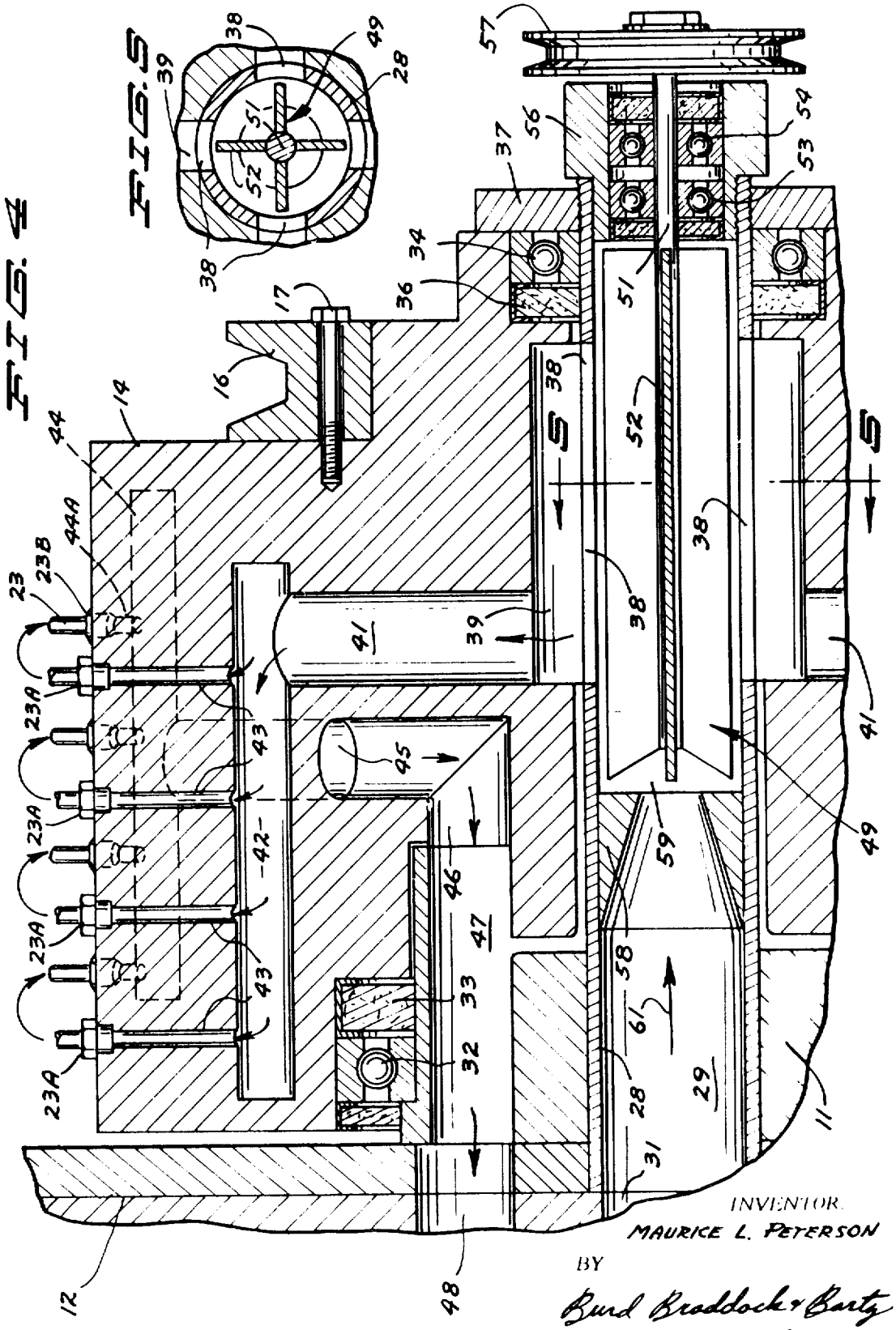


FIG. 3

INVENTOR.
MAURICE L. PETERSON
BY
Burd Braddock & Bartz
ATTORNEYS

FIG. 4


FIG. 5
38
49
28
39
51
52
38
57
54
56
37
53
34
36
17
16
14
44
44A
23
23B
23A
43
45
42
46
47
33
32
58
61
28
29
31
11
12
48
59
41
39
38
52
S
INVENTOR
MAURICE L. PETERSON
BY
Bard Braddock & Barty
ATTORNEYS

ROTATABLE HEAT TRANSFER MEANS

BACKGROUND OF INVENTION

The rotary devices, as agitators and turbine blades, are provided with passages forming part of cooling or heating systems to control the temperature of these parts during the operation of the machines. Examples of these structures are shown in U.S. Pats. No. 1,667,944, No. 2,778,601, and No. 2,883,151.

SUMMARY OF INVENTION

The invention relates to a moving apparatus for transferring heat from a heat transfer means to a fluid surrounding the apparatus. The apparatus has a stationary member rotatably carrying a movable member. Secured to portions of the movable member are outwardly directed structures carrying the heat transfer means. The heat transfer means may be a plurality of tubes secured to the movable member in fluid communication with inlet and outlet passages. In one form of the invention, the heat-conducting members may be electrically heated elements surrounding and insulatively secured to the outwardly directed structure, as a fan blade mounted on the rotatable member. On rotation of the movable member, the surrounding fluid, as air, is moved past the apparatus so that a continuous stream of fluid engages the heat transfer means whereby heat is transferred to the surrounding fluid. In another form of the invention, the stationary and movable members are provided with passage means for carrying a fluid, as water. A pump, having a rotatable member located in the passage, is operable to move the fluid through tubes surrounding the fan blades mounted on the rotatable member.

IN THE DRAWINGS:

FIG. 1 is a front elevational view of the rotary heat transfer apparatus of the invention;

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

FIG. 3 is an enlarged sectional view taken along the line 3—3 of FIG. 1;

FIG. 4 is a fragmentary longitudinal sectional view of the heat transfer apparatus; and

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 4.

Referring to the drawings, there is shown in FIG. 1 a heat transfer apparatus of the invention, indicated generally at 10, operable to transfer heat energy to a surrounding fluid medium, as air. Apparatus 10 comprises a stationary member 11 attached to a support 12, shown in FIGS. 2 and 3, with a plurality of bolts 13. The support 12 may be an internal combustion engine block having passages for cooling fluid, as water. The apparatus is usable in any environment to transfer heat to a surrounding fluid medium.

A movable member, or hub 14, is rotatably mounted on the stationary member 11 adjacent the support 12. A pulley ring 16, having an outwardly open groove for a V-belt or other power transmitting means, is secured to the front face of the hub with a plurality of bolts 17. A plurality of identical fan blades 18, 19, 20 and 21 are secured to and extend radially from the circumferential face or side of the hub 14. As shown in FIG. 3, each blade has a slight rearwardly directed curvature whereby upon rotation of the hub the blades move the surrounding fluid past the heat transfer apparatus 10.

Associated with each blade are a plurality of heat conductors, indicated generally at 22, operable to transfer heat energy to the surrounding fluid medium. The conductors 22 comprise a plurality of side-by-side radial tubes 23 having inlet ends 23A coupled to the hub 14. In a similar manner, on the opposite side of the blade, outlet means 23B of the tubes 23 are attached to the hub 14.

A circular tubular ring 24 concentrically surrounding the hub 14 is secured to peripheral portions of the blades 18, 19, 20, and 21. The ring 24, as shown in FIG. 2, has an annular passage 26. Outer portions of each tube 23 are secured to the ring 24. The passage of each tube 23 is open to the circumferential passage 26 so that all of the fluid moving through the tubes 23 must flow through the passage 26. The circumferential ring 24 functions to balance the rotary member and equalize the fluid pressure on all of the tubes.

The tubes 23 are spaced from the opposite faces of the blades by a plurality of laterally projected radially spaced fins 27. The fins 27 extend in a generally tangential direction and are secured at their inner ends to the opposite faces of the blades. The fins 27 increase the efficiency of heat transfer from the heat conductors 22. The generally tangential fins 27 cause slight turbulence of the air as it moves past the tubes 23. This type of air flow increases the rate of heat transfer. The fins 27 may be corrugated, louvered or interrupted in construction and preferably made of heat conductive material, as copper, aluminum, or the like. Tubes 23 can be secured directly to the blades or formed in the blades.

As shown in FIG. 4, the stationary member 11 has a forwardly directed tubular member 28 having an axial inlet passage 29. The passage 29 is in alignment with a discharge port 31 in the support 12. Mounted on stationary member 11 is a rear bearing 32 and seal 33 for carrying the inner end of hub 14. The outer end of hub 14 is carried on a similar bearing 34 located adjacent a seal 36. A nut 37, threaded on the outer end of tubular member 28, holds the hub 44 in assembled relation on the stationary member 11.

An upper portion of the tubular member 28 has several elongated openings 38 in alignment with an inlet annular chamber 39 on the inside of hub 14. Extended radially outwardly from chamber 39 is a passage 41 leading to an axial inlet header 42. A plurality of radially directed feeder bores 43 connect the header 42 to the inlet portions 23A of the tubes 23. Spaced from the header 42 is a return header 44 connected with bores 44A in fluid relation with the return or exit portions 23B of the tubes 23. A passage 45 extends inwardly from the header 44 to an annular chamber 46 leading to an axial exit passage 47 in the stationary member 11. The passage 45 is open to an annular exit chamber 46 in communication with the exit passage 47 in the stationary member 11. Passage 47 is in alignment with an inlet port 48 in the support 12. Both the annular chamber 46 and the exit passage 47 are located radially outwardly from the inlet passage 29 and the inlet chamber 39 so that the centrifugal force acting on the fluid in the system will cause the fluid to flow from the inlet chamber 39 into the inlet header 42 through the tubes 23 and back into the outlet header 44 and outlet chamber 46 into the exit passage 47. Each of the conductors 22 associated with a blade is connected to separate inlet and exit headers coupled to the annular chambers 39 and 46.

An increase in the flow of the fluid through the system is accomplished with the use of a pump, indicated generally at 49. The pump 49 has a rotor comprising an elongated axial shaft 51 carrying a plurality of circumferentially spaced blades or vanes 52. The shaft 51 is rotatably mounted on a pair of spaced bearings 53 and 54 carried in a removable threaded plug 56. The plug 56 is removably attached to the forward end of the stationary tube 28. Secured to the outer end of shaft 51 is a pulley 57 having an outwardly directed V-groove for accommodating a V-belt, or other power transmitting means, used to transmit power to the pump. The vanes 52 are located within the passage 29 immediately adjacent the opening 38 so that on rotation of the vanes fluid will be forced through the opening 38 into the annular inlet chamber 39.

Located adjacent the inlet side of the pump 49 in the passage 29 is a restrictor plug 58 having a centrally located throat 59 immediately adjacent the inlet ends of the vanes 52. The fluid flowing in the axial direction of the arrow 61 moves through the throat 59 and fills the pump with a rapidly moving fluid. The pump 49 can be operated at varying speeds to control the flow of fluid through the system. In addition, the pump can be operated independently of the rotation of the hub 14 so that the fluid can be moved through the system at times when the hub is not rotated.

The fluid in the system can be a liquid or gas which carries heat energy. The heat energy is dissipated through the plurality of tubes **23** located adjacent the surfaces of the blades **18** to **21**. This heat energy is transferred to the surrounding fluid medium which may be air, water, or like fluids.

The blades **18** to **21** can be increased or decreased in number and attached in numerous ways to the hub **14**. Preferably, the blades are secured by welds to the hub. In addition, the blades may be integral with the hub. The tubes **23** may be located only on the leading side of the blade where they engage a majority of the air moved by the blade. The tubes may be circumferentially coiled around each blade. Each tube can be split into several branch tubes to that the number of tubes increase along the radial length of the fan blade. In addition, the blades may be mounted in a plurality of longitudinally spaced rows along the the hub to increase the heat transfer capacity of the apparatus.

The heat conductors **22** can be an electrical heating element, as electric heating wires or bands, insulatively mounted on the blades. The stationary member **11** and rotatable member **14** can be provided with suitable brushes and slip rings to complete the electric circuit to transfer electric power to the heating wires. The stationary member can be an electric motor carrying the rotatable member and its blades.

While there have been shown and described preferred embodiments of the invention, it is to be understood that various changes, additions, and substitutions of materials, sizes and shapes may be made by those skilled in the art without departing from the spirit of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An apparatus for transferring heat from a first fluid to a second fluid surrounding the apparatus comprising: a stationary member, a movable member rotatably mounted on the stationary member, a plurality of circumferentially spaced and outwardly directed blades mounted on the movable member operable to move the second fluid past the apparatus, tube means comprising a plurality of tubes radially positioned around each blade, each tube having a passage for carrying the first fluid, said tube means having inlet and outlet portions secured to the movable member, inlet passage means in the stationary member and movable member connected to the inlet portions of the tube means, outlet passage means in the stationary member and movable member connected to the outlet portions of the tube means whereby the first fluid can flow through the inlet passage means into the tube means and back through the outlet passage means to transfer heat from the first fluid to the second fluid, a plurality of laterally directed fins located in heat conductive contact with tubes and blades, and a tubular ring secured to the outermost portions of the tubes, said ring having an annular passage in fluid communication with the passages of said tubes.

2. The apparatus of claim **1** wherein: pump means for moving the first fluid through the tube means, said pump means having means removably mounted on the stationary member whereby the pump means can be removed from the stationary member.

3. The apparatus of claim **2** including: said pump means having a drivable rotor extended axially into the inlet passage means of the stationary member.

4. The apparatus of claim **2** including: said stationary member being a tubular member rotatably carrying the movable member.

5. The apparatus of claim **1** including: a pump means in the inlet passage for moving the first fluid through the tube means.

6. The apparatus of claim **5** wherein: the pump means has a rotor located in the inlet passage of the stationary member and means rotatably mounting the rotor on the stationary member.

7. The apparatus of claim **5** including: means to operate the pump means at a different speed than the movable member.

8. The apparatus of claim **1** wherein: said tubular ring is secured to the outer ends of the blades.

9. An apparatus for transferring heat from a first fluid to a second fluid surrounding the apparatus comprising: a stationary member, a movable member rotatably mounted on the stationary member, a plurality of circumferentially spaced and outwardly directed blades mounted on the movable member operable to move the second fluid past the apparatus, tube means positioned adjacent the blades, said tube means having inlet and outlet portions secured to the movable member and passages having outer sections, inlet passage means in the stationary member and movable member connected to the inlet portions of the tube means, outlet passage means in the stationary member and movable member connected to the outlet portions of the tube means whereby the first fluid can flow through the inlet passage means into the tube means and back through the outlet passage means to transfer heat from the first fluid to the second fluid, and tubular ring means secured to the outermost portions of the tube means, said tubular ring means having an annular passage in fluid communication with the passages of said tubes.

10. The apparatus of claim **9** including: pump means in the inlet passage for moving the first fluid through the tube means.

11. The apparatus of claim **9** wherein: said tubular ring means is secured to the outer ends of the blades.