

## [54] AERATOR APPARATUS

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[51] Int. Cl. .... **B01f 3/04**

[58] Field of Search .... **261/91, 120**

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## [57]

## ABSTRACT

An aerator apparatus utilizing a top-mounted motor which provides a substantially streamlined flow of liquids from its input to its output. A hollow central frame member or volute is provided with a discontinuity in the form of an outwardly extending circumferential shoulder portion located substantially at the flotation line whereby liquids pumped with the central frame member are separated from contact therewith and exposed to atmospheric pressure. A principal deflector means is so formed vis-a-vis the inner shell for the flotation means that a diverging throat area is provided. The fluids leave the aerator apparatus substantially horizontally over the top of the flotation means. The latter is provided with a contour which corresponds substantially with the trajectory of the liquids expelled thereover. An auxiliary deflector means returns a small amount of the expelled liquids in order to provide lubrication for the bearings of a propeller driven by the motor.

30 Claims, 4 Drawing Figures

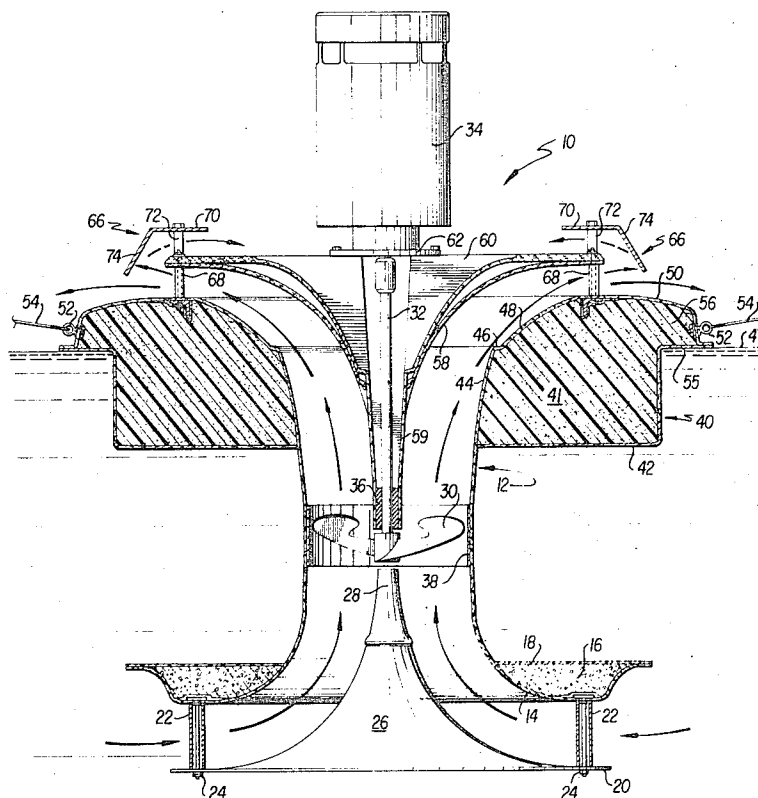


FIG. 1

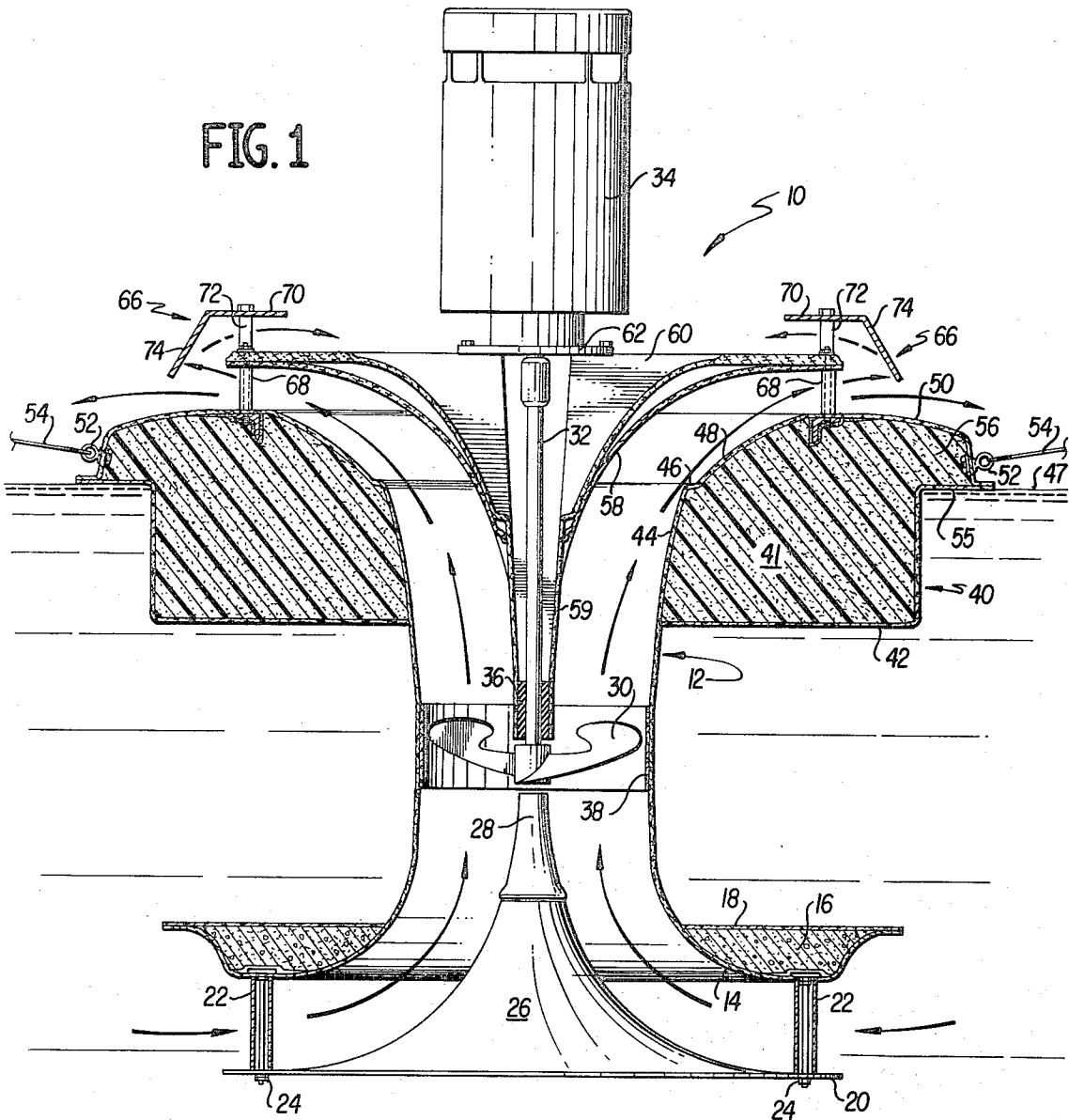


FIG. 2

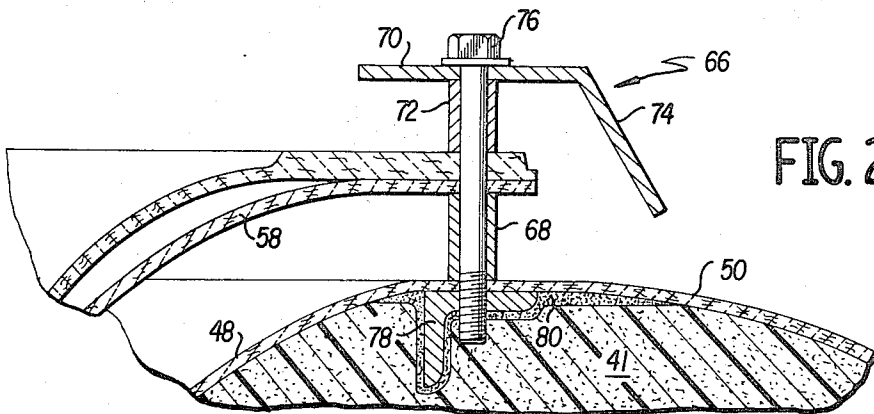


FIG. 3

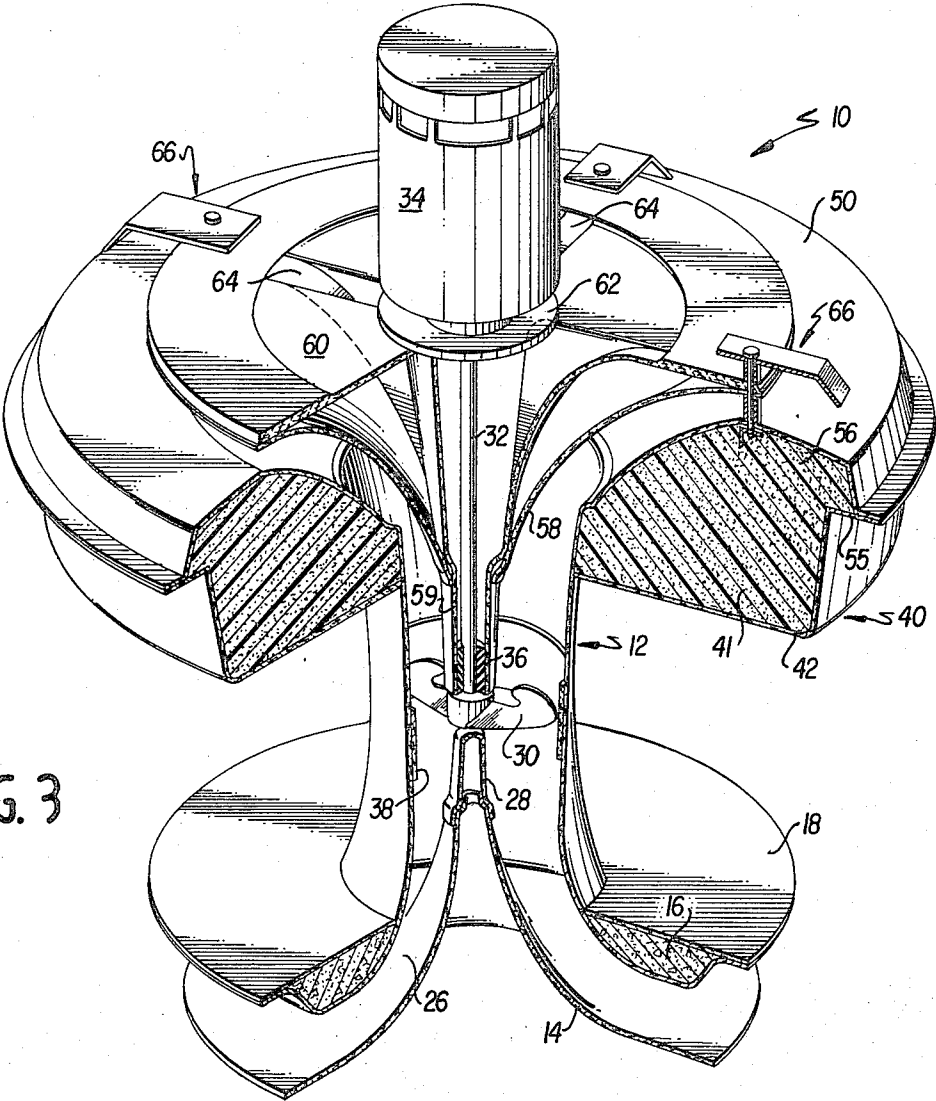
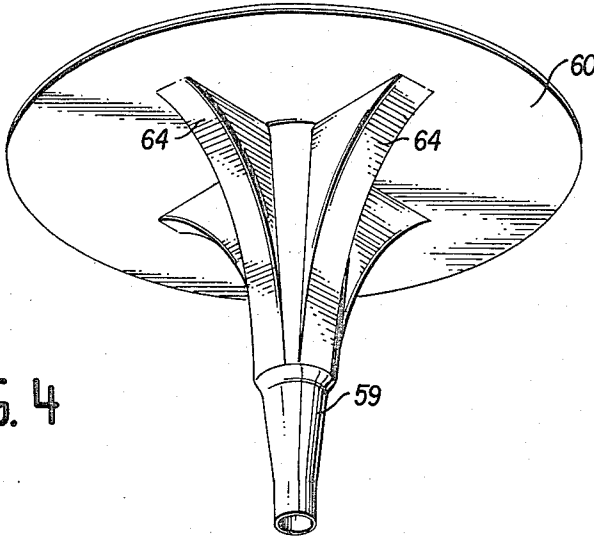


FIG. 4



## AERATOR APPARATUS

This invention relates to an aerator apparatus and, more particularly, to such an apparatus which provides a substantially streamlined flow of liquids from its input to its output.

Heretofore it has been known to mount motors for an aerator apparatus above the line of flotation for the unit and to employ anti-erosion disks whereby the bottom of a pond or the like in which the aerator apparatus is moored does not become unduly eroded. In using such disks, it is not unusual to experience a substantial amount of turbulent flow between the disk and a driven propeller by means of which the liquid in the pond is elevated and ejected from the aerator apparatus.

In accordance with the present invention, substantially streamlined flow is obtained by positioning a conical member atop the anti-erosion disk with the conical member extending to a point immediately below the propeller. In this manner a substantially streamlined toroidal flow is established from the inlet to the propeller. Moreover, the principal deflection means of the aerator apparatus continues this substantially streamlined toroidal flow to the exit of the aerator apparatus.

It has also been known to employ flotation means in the form of only partially submerged foamed plastic members which closely encircle the aerator apparatus and provide stability therefor. Ordinarily the water is received from beneath the flotation means and pumped by the propeller over the top of the flotation members.

In accordance with the present invention, a discontinuity in the form of an outwardly extending circumferential shoulder is provided in the hollow central frame member or volute whereby liquids being pumped within the central frame member are separated from contact with the wall of the central frame member and exposed to atmospheric pressure at approximately the flotation line. In other words, the pressure head is reduced and a greater volume of liquids may therefore be pumped by the aerator apparatus.

Also in other known devices it has been customary to expel the liquid both outwardly and upwardly in order to elevate the water within the central framemember and above the flotation line and thereby clear the top of the flotation means which extends out of the water. In the present invention the liquid is expelled much more nearly horizontally and the upper and outer portion of the flotation means is so formed so as to conform substantially to the anticipated trajectory of the expelled liquid.

The invention also embodies other features and improvements over previously known aerator devices. For example, deflector means are provided to intercept the upper portion of liquids being expelled from the aerator and return this small portion of water in order to lubricate the bearings for the propeller driven by the top mounted motor. It is preferred in accordance with the present invention to locate the propeller itself at least one diameter below the water level in order to minimize cavitation. Other features of the invention include the use of a diverging throat area and operation of the aerator apparatus under the torsional resonance of the unit but above the lateral resonance.

The inherent advantages and improvements of the present invention will become more readily apparent upon considering the following detailed description of

the invention and by reference to the drawings in which:

FIG. 1 is an elevational view taken in vertical cross-section and illustrating the aerator apparatus of the present invention;

FIG. 2 is a fragmentary elevational view, drawn to an enlarged scale, showing a portion of the aerator apparatus of FIG. 1 and taken in vertical cross-section;

FIG. 3 is a perspective view with certain parts removed between two intersecting vertical cross-section planes; and,

FIG. 4 is a perspective view showing the motor mounting plate and grooves for lubricating the bearings in the main deflector means.

Referring now to FIG. 1 of the drawings, there is illustrated an aerator apparatus indicated generally at 10. The aerator apparatus 10 is provided with a hollow central frame member or volute indicated generally at 12 having an outwardly flaring bottom portion 14. This outwardly flaring bottom portion 14 provides a trough in the form of a toroidal cavity within which any suitable ballast material is received, for example, cement 16. A cover plate 18 retains the toroidal-shaped ballast material 16 in place.

Suspended beneath the ballast material 16 and the outwardly flaring bottom portion 14 is an anti-erosion disk 20 which is suspended by means of a plurality of spacer members 22 and nut and bolt assemblies 24 from the bottom of the outwardly flaring bottom 14 of the central frame member 12. The anti-erosion disk 20 is provided with a cone-shaped member 26 the top of which carries a cap member 28 which terminates immediately below a propeller 30 contained within the hollow central frame member 12. The cone-shaped member 26 may be formed integrally with the anti-erosion disk 20 or be attached thereto as a separate member. Also, if desired, the cone-shaped member 26 and cap member 28 may be formed as a single member.

The purpose of the cone-shaped member 26 and cap member 28 thereon is to provide a substantially uniform flow of liquids from the inlet to the aerator apparatus formed between the outwardly flaring bottom 14 and anti-erosion disk 20. Thus a toroidal-shaped converging flow is established at the inlet to the aerator apparatus as is indicated by the arrows in FIG. 1.

The propeller 30 is suitably attached to a main drive shaft 32 for a top mounted motor 34 and is supported by suitable bearings 36 which will be described more fully hereinafter.

A stainless steel throat 38 in the form of a sleeve insert is provided in the region of propeller 30 within the hollow central frame member 12. The purpose of the stainless steel throat is to prevent undue wear on the hollow central frame member 12 which is preferably formed from Fiberglas. It is also possible to employ reinforcing means such as corrugated Fiberglas exterior to the stainless steel throat 38 and hollow central frame member 12 if desired.

The aerator apparatus is provided with sufficient buoyancy by flotation means indicated generally at 40 which consists in one form of the invention of a foamed plastic 41 received within a suitable container whose bottom and exterior outer wall is designated at 42. An interior wall 44 is provided by the hollow central frame member 12.

As a distinctive feature of the present invention the hollow central frame member 12 is provided with a dis-

continuity in the form of an outwardly extending circumferential shoulder portion 46 positioned vertically on the hollow central frame member 12 so as to be substantially at the line of flotation for the aerator apparatus 10. The hollow central frame member 12 is further provided with an outwardly flaring upper portion 48 and an upper surface 50 for the foamed plastic 41 with the portion 50 conforming substantially to the anticipated trajectory of the liquids being pumped by propeller 30. The purpose of the outwardly extending circumferential shoulder portion 46 is to effect a separation of liquids being pumped from the interior wall 44 of the central frame member 12 and thereby introduce atmospheric pressure at this point which is substantially at the line of flotation 47 for the aerator apparatus itself. This arrangement utilizes a lower head pressure than is customary and greater fluid volume whereby a greater input momentum is introduced into the pond or body of water.

The aerator apparatus 10 is provided with a number of eyelet or hook means 52 whereby suitable mooring cables 54 may be attached thereto in customary manner. It is thus possible to station the aerating apparatus on a given body of water or pond and maintain its position thereon.

The formed bottom 42 for the foamed plastic not only contains an upwardly extending wall portion but also an outwardly extending substantially horizontal portion 55 which thereby establishes a step 56 in the foamed plastic 41. The purpose of this construction is to establish a greater area of buoyant material immediately above the normal flotation line for the aerator apparatus whereby the depression of any portion of the aerator apparatus is counteracted by an increasingly larger buoyant restoring force. Any suitable cross sectional dimensioning for the principal flotation means 40 may be employed so as to effect this increasingly larger buoyant restoring force whenever the flotation means is depressed into the body of water below its normal flotation line.

As is shown in both FIGS. 1 and 3, the aerator apparatus 10 is provided with a principal deflector means 58 which cooperates with the portions 44 and 48 of the hollow central frame member 12 to provide a divergent throat. Principal deflector means 58 is provided with a stem portion 59 within which the bearings 36 for propeller 30 are contained. The principal deflector means 58 also is provided with an upper surface 60 on which a mounting plate 62 is provided by means of which the top mounted motors 34 are attached by suitable nut and bolt assemblies. The principal deflector means is further provided with a plurality of grooves 64 illustrated best in FIGS. 3 and 4 whereby a cooling liquid may be diverted and channeled to the bearings 36. This is effected by means of an auxiliary deflector means 66 which are spaced around the periphery of the principal deflector means of the aerator apparatus 10. The outer edge of the principal deflector means 58 is spaced above the flotation means 40 by means of a plurality of spacer members 68 the length of which may be changed so as to effect an adjustment of the exit area and the degree or extent of divergence from the propeller to the exit area. In this connection, the exit for the aerator apparatus 10 is defined by the juncture of interior wall 44 with circumferential shoulder 46 and the principal deflector means 58 being in the form of a frustum of a cone. At the same time, this variable spac-

ing adjusts the level above the floating level at which the liquid is discharged horizontally.

As seen best in FIG. 2, each auxiliary deflector means 66 comprises a deflector member 70 supported by a holder or spacer member 72 and a downturned leading end 74 which extend only partially into the liquids being ejected from the aerator apparatus thereby avoiding contact with any solids contained in the liquids and thereby diverts a portion of the liquid rearwardly as indicated by the dashed arrow toward its respective groove 64 whereby water may trickle downwardly and thereby provide water lubrication for bearings 36.

The shape of the deflector members 70 and downturned leading end 74 may take a number of configurations and still provide satisfactory lubrication for bearings 36. As is shown in detail in FIG. 2, a bolt 76 may be used to attach the deflector member 70 atop the holder or spacer member 72. The bolt is shown to extend into and to be threaded into a rolled angle bar ring 78 which functions as a float reinforcing member. It is preferred to utilize a Fiberglas coating 80 which extends completely over the underside of the rolled angle bar ring 78 and extends outwardly therebeyond so as to effect a force transfer which distributes the load from a steel rolled angle bar ring 78 to the Fiberglas material 80 and then to the foamed plastic material 41 in the flotation means 40. In this manner the load of the aerator apparatus itself is transmitted from the principal deflector means to the foamed plastic material over a relatively wide area.

The construction of the present invention is applicable to a complete line of aerator apparatus and may range, for example, from 2 h.p. to 100 h.p. By means of the present construction the input momentum of the liquids into the lake or pond is maximized by decreasing the head for the propelled liquids and increasing the velocity and volume thereof. The basic philosophy behind this is that lift results in wasted energy which may be employed in getting maximum quantities of liquid into the pond and thereby increase the aeration of the fluids. The hydraulic efficiency is maximized by effecting a streamlined flow from inlet to outlet of the aerator apparatus. By providing the discontinuity in the form of an outwardly extending circumferential shoulder portion 46 in the hollow central frame member or volute 12 atmospheric pressure is established at the water line within the hollow frame member and reflected to the propeller.

If desired, it is possible to utilize the same mold structure for the cone-shaped member 26 as is used for the main deflector member.

While it is preferred to employ an anti-erosion disk in the practice of this invention, it is also possible to operate without one. In this latter case, the outwardly flaring bottom portion 14 of the hollow central frame member 12 provides an inlet for liquids to the propeller 30.

It has been found to be desirable in actual practice to bond the surfaces of grooves 64 in FIG. 4 to the surface designated by numeral 58 of the principal deflector means. This feature contributes substantially to the structural rigidity of the principal deflector.

While presently preferred embodiments of the invention have been illustrated and described, it will be recognized that the invention may be otherwise variously

embodied and practised within the scope of the claims which follow.

What is claimed is:

1. In an aerator apparatus having a top mounted motor and a propeller submerged in a body of liquid and driven by said motor, the combination comprising:
  - a. a hollow central frame member having an interior wall portion surrounding and spaced from said propeller,
    1. said central frame member having an outwardly flaring bottom portion which partially defines an inlet for liquids to said propeller,
    2. said interior wall portion of said hollow frame member being provided with a pressure relief discontinuity in the form of an outwardly extending circumferential shoulder portion located in such a position on said wall portion that liquids being pumped within said central frame member are separated from contact with said interior wall portion and exposed to atmospheric pressure at said discontinuity,
  - b. an anti-erosion disk supported from said outwardly flaring bottom portion of said central frame member,
    1. said anti-erosion disk having a substantially cone-shaped member terminating immediately below said propeller,
    2. said cone-shaped member cooperating with said outwardly flaring bottom portion to define therewith a substantially streamlined inlet for liquids to said propeller,
  - c. a principal deflector means extending partially into an upper portion of said central frame member to define therewith an exit for liquid,
  - d. and flotation means attached exteriorly of said central frame member.
2. An aerator apparatus as defined in claim 1 wherein said flotation means is mounted exteriorly but immediately adjacent said central frame member and its cross-section is such as to provide a greater area of buoyant material immediately above its normal flotation line whereby the depression of any portion of the aerator apparatus into said body of fluids is counteracted by an increasingly larger buoyant restoring force.
3. An aerator apparatus as defined in claim 2 wherein said central frame member provides at least a partial enclosure for said flotation means.
4. An aerator apparatus as defined in claim 2 including means for providing variable spacing between the outermost edge of said principal deflector means and said enclosure for said flotation means and thereby varying the degree of divergence from said propeller to the exit of said aerator apparatus.
5. An aerator apparatus as defined in claim 2 wherein said flotation means comprises a foamed plastic material within an enclosure and includes means for supporting said enclosure from said main deflector means.
6. An aerator apparatus as defined in claim 5 including means to spread the load of said aerator apparatus itself from said principal deflector means to said foamed plastic material within said enclosure over a relatively wide area.
7. An aerator apparatus as defined in claim 1 wherein said principal deflector means extends into said central frame member to said propeller and thereby extending a substantially streamlined flow which is essentially to-

roidal in cross-section from the inlet to the outlet of said aerator apparatus.

8. An aerator apparatus as defined in claim 1 wherein said principal deflector means and said upper portion of said central frame area define a diverging throat area continuous in extent from said propeller to said exit.

9. An aerator apparatus as defined in claim 1 wherein said motor is mounted atop said principal deflector means and said principal deflector means carries a bearing support for a main shaft of said motor which drives said propeller.

10. An aerator apparatus as defined in claim 1 wherein liquids are projected substantially horizontally from the exit defined by said principal deflector means and said upper portion of said central frame member, and said flotation means has an upper surface over which said liquids pass with said upper surface of said flotation means being formed so as to conform to the anticipated trajectory of said liquids.

11. An aerator apparatus as defined in claim 1 wherein said propeller is normally positioned below the surface of the water a linear distance approximately equal to its diameter in order to minimize cavitation.

12. An aerator apparatus as defined in claim 1 wherein said central frame member is made from Fibreglas and is provided with a cylindrical inner sleeve of stainless steel in the region surrounding said propeller.

13. An aerator apparatus as defined in claim 1 including means for providing variable spacing between the outermost edge of said principal deflector means and said enclosures for said flotation means and thereby varying the degree of divergence from said propeller to the exit of said aerator apparatus.

14. In an aerator apparatus having a top mounted motor and a propeller submerged in a body of liquids and driven by said motor, the combination comprising:

- a. a hollow central frame member having an interior wall portion surrounding and spaced from said propeller,
  1. said central frame member having an outwardly flaring bottom portion which partially defines an inlet for liquids to said propeller,
- b. an anti-erosion disk supported from said outwardly flaring bottom portion of said central frame member,
  1. said anti-erosion disk having a substantially cone-shaped member terminating immediately below said propeller,
  2. said cone-shaped member cooperating with said outwardly flaring bottom portion to define therewith a substantially streamlined inlet for liquids to said propeller,
- c. a principal deflector means extending partially into an upper portion of said central frame member to define therewith an exit for liquids,
  1. said principal deflector means and said upper portion of said central frame member define a diverging throat area continuous in extent from said propeller to said exit,
  2. said motor being mounted atop said principal deflector means,
  3. said principal deflector means carrying a bearing support for a main shaft of said motor which drives said propeller,
- d. an auxiliary deflector means extending partially into said liquid at the exit of said aerator apparatus,

1. said principal deflector means having conduit means which extend downwardly toward said bearing support for said main shaft,
2. said auxiliary deflector means being so arranged so as to deflect some of said exit liquids into said conduit means of said principal deflector means to lubricate and cool said bearing support,
- e. and flotation means attached exteriorly of said central frame member.
15. An aerator apparatus as defined in claim 14 wherein said principal deflector means is substantially conical in cross-section and is provided with a plurality of grooves leading toward said bearing support whereby liquids deflected by said auxiliary deflector means are returned by gravity to said bearing support.
16. An aerator apparatus as defined in claim 15 wherein said auxiliary deflector means are mounted around the outer periphery of said principal deflector means.
17. In an aerator apparatus having a top-mounted motor and a propeller submerged in a body of liquids and driven by said motor, the combination comprising:
  - a. a hollow central frame member having an interior wall portion surrounding and spaced from said propeller,
    1. said central frame member having an outwardly flaring bottom portion which provides an inlet for liquids to said propeller,
  - b. a principal deflector means extending partially into an upper portion of said central frame member to define therewith an exit for liquids,
  - c. flotation means attached exteriorly of said central frame member,
  - d. and wherein said interior wall portion of said hollow frame member is provided with a pressure relief discontinuity in the form of an outwardly extending circumferential shoulder portion located in such a position on said wall portion that liquids being pumped within said central frame member are separated from contact with said interior wall portion and exposed to atmospheric pressure at said discontinuity.
18. An aerator apparatus as defined in claim 17 wherein said principal deflector means and said upper portion of said central frame area define a diverging throat area continuous in extent from said propeller to said exit.
19. An aerator apparatus as defined in claim 17 wherein said motor is mounted atop said principal deflector means and said principal deflector means carries a bearing support for a main shaft of said motor which drives said propeller.
20. An aerator apparatus as defined in claim 17 wherein liquids are projected substantially horizontally from the exit defined by said principal deflector means and said upper portion of said central frame member, and said flotation means has an upper surface over which said liquids pass with said upper surface of said flotation means being formed so as to conform to the

anticipated trajectory of said liquids.

21. An aerator apparatus as defined in claim 17 wherein said propeller is normally positioned below the surface of the water a linear distance approximately equal to its diameter in order to minimize cavitation.

22. An aerator apparatus as defined in claim 17 including means to spread the load of said aerator apparatus itself from said principal deflector means to said foamed plastic material within said enclosure over a relatively wide area.

23. An aerator apparatus as defined in claim 17 including means for providing variable spacing between the outermost edge of said principal deflector means and said enclosure for said flotation means and thereby varying the degree of divergence from said propeller to the exit of said aerator apparatus.

24. An aerator apparatus as defined in claim 17 wherein said central frame member is made from Fiberglas and is provided with a cylindrical inner sleeve of stainless steel in the region surrounding said propeller.

25. An aerator apparatus as defined in claim 17 including an auxiliary deflector means which extends partially into said liquids at the exit of said aerator apparatus, said principal deflector means having conduit means which extend downwardly toward said bearing support for said main shaft, said auxiliary deflector means being so arranged so as to deflect some of said liquids into said conduit means of said principal deflector means to lubricate and cool said bearing support.

26. An aerator apparatus as defined in claim 25 wherein said principal deflector means is substantially conical in cross section and wherein said conduit means consists of a plurality of grooves leading toward said bearing support whereby liquid deflected by said auxiliary deflector means are returned by gravity to said bearing support.

27. An aerator apparatus as defined in claim 26 wherein said auxiliary deflector means are mounted around the outer periphery of said principal deflector means.

28. An aerator apparatus as defined in claim 17 wherein said flotation means is mounted exteriorly but immediately adjacent said central frame member and its cross section is such as to provide a greater area of buoyant material immediately above its normal flotation line whereby the depression of any portion of the aerator apparatus into said body of fluids is counteracted by an increasingly larger buoyant restoring force.

29. An aerator apparatus as defined in claim 28 wherein said central frame member provides at least a partial enclosure for said flotation means.

30. An aerator apparatus as defined in claim 29 wherein said flotation means comprises a foamed plastic material within an enclosure and includes means for supporting said enclosure from said main deflector means.

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