MULTI-STAGE SUBMERSIBLE PUMP

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ABSTRACT
Embodyments of the disclosure provide a booster pump to pressurize fluid for use by a pool cleaner in a pool or spa. The booster pump includes a front housing having an inlet, a plurality of diffuser units positioned in the front housing, and a motor housing detachably coupled to the front housing and having an outlet. A submersible motor positioned in the motor housing is operatively coupled to the diffuser units. A space is defined between an outer surface of the motor and an interior surface of the motor housing. A self-contained fluid flow path is formed from the inlet, through the diffuser units, and through the space to the outlet. As the fluid passes over the motor, the motor can be cooled and acoustic output of the booster pump can be dampened. The booster pump can be constructed of plastic for applications in the pool and spa industry.
MULTI-STAGE SUBMERSIBLE PUMP
RELATED APPLICATIONS


BACKGROUND

[0002] Booster pumps are commonly used to drive pressure cleaners for swimming pool and spa applications. For such pressure-side pool cleaners to operate, the booster pump must increase the water pressure of the system to about 50 pounds per square inch (PSI) in order to have sufficient pressure at the cleaner to clean the pool. Typically, this pressure increase is achieved by using a single-stage centrifugal pump with a large diameter impeller.

[0003] A drawback of such systems is that to provide a pump capable of such increased pressures, the diameter of the impeller must be increased. Larger diameter impellers require additional power to drive them, leading to greater power consumption and reduced efficiency. Another drawback of such systems is that the motor for driving the pump as well as the pump itself are typically larger than desired. In general, smaller motor and pump assemblies are preferred because less power is required to operate them.

SUMMARY

[0004] In some embodiments, a booster pump to pressurize fluid for use by a pool cleaner in a pool or spa is provided. The booster pump includes a front housing and a motor housing. The front housing includes an inlet to receive fluid from the pool or spa. A plurality of diffuser units are positioned in the front housing. The motor housing detachably couples to the front housing and has an outlet to provide fluid to the pool cleaner. A submersible motor is positioned in the motor housing and is operatively coupled to the diffuser units. A space is defined between an outer surface of the motor and an interior surface of the motor housing. A self-contained fluid flow path is formed from the inlet, through the diffuser units, and through the space to the outlet.

[0005] Other aspects of the disclosure will become apparent by consideration of the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 illustrates a submersible booster pump according to one embodiment of the disclosure.

[0007] FIG. 2 illustrates the submersible booster pump of FIG. 1 with a front housing removed.

[0008] FIG. 3 illustrates the submersible booster pump of FIG. 2 with diffusers removed.

[0009] FIG. 4 illustrates the submersible booster pump of FIG. 3 with a central housing removed.

DETAILED DESCRIPTION

[0010] Before any embodiments of the disclosure are explained in detail, it is to be understood that the disclosure is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The disclosure is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of “including,” “comprising,” or “having” and variations thereof herein is meant to encompass the items listed thereunder and equivalents thereof as well as additional items. Unless specified or limited otherwise, the terms “mounted,” “connected,” “supported,” and “coupled” and variations thereof are used broadly and encompass both direct and indirect mountings, connections, supports, and couplings. Further, “connected” and “coupled” are not restricted to physical or mechanical connections or couplings.

[0011] FIGS. 1-4 illustrate a booster pump 10 according to one embodiment of the disclosure. The booster pump 10 includes a front housing 12, a center housing 14, and a rear housing 16 arranged along a longitudinal axis 18. The front housing 12 has an inlet port 20 for receiving fluid. The fluid received through the inlet port 20 is pressurized within the booster pump 10 and expelled as pressurized fluid through an outlet port 22 in the rear housing 16. The booster pump 10, which can have a generally cylindrical configuration, can be supported by a footing 24. In some embodiments, the footing 24 can be secured or otherwise mounted to a wall or a floor of a pool or spa so as to secure the booster pump 10 within the pool for use with a pool cleaner (not shown).

[0012] FIG. 2 illustrates the booster pump 10 with the front housing 12 removed. Inside the front housing 12 can be positioned one or more diffuser units 26 arranged in a stacked formation along the longitudinal axis 18. The diffuser units 26 each include an impeller (not shown). The diffuser units 26 including the impellers can be constructed of a variety of materials. For example, in some embodiments, the diffuser units 26 can be constructed of a metal or other wear-resistant material for applications in which the booster pump 10 is subject to sand or other debris. In some embodiments, the diffuser units 26 can be constructed of a plastic material for applications in which the booster pump 10 is subject to chlorinated water or other chemicals as are commonly found in the spa and pool industry.

[0013] In some embodiments, the booster pump 10 can include two diffuser units 26. Each diffuser unit 26 can form a “stage” of the booster pump 10 for pressurizing fluid. The booster pump 10 can have an increased number of diffuser units 26 or stages to provide the booster pump 10 with greater pressurizing capability. For example, the booster pump 10 can have one, two, three, four or more diffuser units 26. The front housing 12 shown in FIG. 1 can be increased in size to accommodate an increased number of diffuser units 26.

[0014] FIG. 3 illustrates the booster pump 10 with the diffuser units 26 removed. A submersible motor 30 is positioned within the center housing 14. The motor 30 includes a drive shaft 32 operably coupled to the diffuser units 26. The motor 30 can be an AC type motor or a DC type motor. The center housing 14 is larger than the motor 30 such that a space 34 exists between an outer surface 36 of the motor 30 and an inner surface 38 of the center housing 14. The space 34 is in fluid communication with the diffuser units 26 so that fluid pressurized by the diffuser units 26 flows from the front housing 12 into the center housing 14 within the space 34.

[0015] FIG. 4 illustrates the booster pump 10 with the center housing 14 removed. The center housing 14 can be in fluid communication with the rear housing 16 and the outlet port 22. Pressurized fluid flowing through the space 34 can be expelled through the outlet port 22. A self-contained fluid
flow path can be defined in the booster pump 10 from the inlet port 20, through the diffuser units 26, over the motor 30 within the space 34, and to the outlet port 22.

[0016] In operation, the booster pump 10 is submerged into a body of fluid, such as a pool or spa. The footing 24 can be mounted to a wall or floor of the pool or spa to secure the booster pump 10 in position. The motor 30 is operated to drive the diffuser units 26 so as to draw fluid into the booster pump 10 through the inlet port 20, pressurize the fluid, and expel pressurized fluid through the outlet port 22. The drive shaft 32 rotates the impellers of the diffuser units 26, which creates a fluid current. The fluid current draws fluid into the booster pump 10 through the inlet port 20, as indicated by arrow 40 (as shown in FIG. 1). As the fluid enters the front housing 12, it is acted upon by the diffuser units 26. The diffuser units 26 impart energy to the fluid, effectively changing motor torque at the drive shaft 32 to fluid velocity and finally into fluid flow at a higher pressure. The fluid flows from the diffuser units 26 to the center housing 14 within the space 34, passing over the submersible motor 30. As shown in FIG. 4, one or more vanes 42 can be positioned on the inner surface 38 of the center housing 14 to direct the fluid flow. The pressurized fluid passes through the space 34 into the rear housing 16 and is expelled through the outlet port 22 as indicated by arrow 44 (as shown in FIG. 1).

[0017] Because more diffuser units 26 can be selectively added to the booster pump 10 to provide increased pressurizing capabilities, the individual diffuser units 26 need not be sized so as to be capable of pressurizing fluid to the same degree. Thus, in one embodiment, the impellers of the diffuser units 26 are approximately 4 inches in diameter. Each additional diffuser unit 26 provides approximately a 175 percent to 200 percent increase in the pressurizing capability of the booster pump 10. However, because each diffuser unit 26 is relatively small in size, the power required to operate the motor 30 is minimally increased. In general, this is because the power required to overcome the inertia of a larger impeller is greater than the power required to overcome the hydraulic drag in the system. Therefore, by using multiple smaller diffuser units 26, a higher output pressure is achieved with less power consumption.

[0018] As the fluid passes over the motor 30, the fluid absorbs heat generated by the motor 30. The fluid continually flows over the motor 30 during operation of the booster pump 10, carrying heat generated by the motor 30 away from the motor 30 and acting as a cooling system for the motor 30. The heat carried away by the flowing fluid is dispersed into the remaining fluid in the pool or spa, which acts as a heat sink. In addition, as the fluid passes over the motor 30, the fluid absorbs and dampens motor vibration and noise.

[0019] In the embodiment illustrated in FIGS. 1-4, the front housing 12, the center housing 14, and the rear housing 16 are separate components and are coupled to one another. In other embodiments, however, the front housing 12, the center housing 14, and the rear housing 16 or a combination thereof can be formed as an integral unit. In one embodiment, the front housing 12 is coupled to a combination center/rear housing. This configuration allows different front housings 12 to be coupled to a single type of center/rear housing to assemble the booster pump 10 without reconfiguring the assembly process. For example, the same center housing 14 and rear housing 16 can be coupled to differently sized front housings 12 containing different numbers of diffuser units 26 to provide variously powered booster pumps 10 within a single assembly position.
14. The booster pump of claim 10, and further comprising a plurality of vanes on an interior of the booster pump housing for directing the fluid flow path over the motor.

15. A method for pressurizing fluid for use by a pool cleaner in a pool or spa, the method comprising:
- submerging a booster pump in the pool or spa, the booster pump having an inlet to receive fluid from the pool or spa, an outlet to provide fluid to the pool cleaner, and a selected number of diffuser units arranged along a common axis;
- engaging a motor to rotate the diffuser units, the rotation of the diffuser units generating a fluid current from the inlet to the outlet;
- drawing fluid from the pool or spa into the inlet with the fluid current;
- passing the fluid through the diffuser units to pressurize the fluid;
- passing the pressurized fluid over the motor; and
- expelling the pressurized fluid out of the booster pump through the outlet.

16. The method of claim 15, and further comprising cooling the motor by passing the pressurized fluid over the motor.

17. The method of claim 15, and further comprising dampening acoustic output of the booster pump by passing the pressurized fluid over the motor.

18. The method of claim 15, and further comprising selecting a greater number of diffusers to increase pressurization of the fluid.

19. The method of claim 15, and further comprising securing the booster pump to a wall of the pool or spa.

20. The method of claim 15, and further comprising directing the flow of the fluid with a plurality of vanes as it passes over the motor.