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FLOW REGULATING TURBULENCE ARRESTOR FOR CENTRIFUGAL PUMPS

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Filed Mar. 11, 1965, Ser. No. 438,846
8 Claims. (Cl. 239—23)

This invention relates to fluid flow devices, and more particularly to apparatus for regulating fluid flow and for arresting turbulence produced in the fluid by said regulation, especially in conjunction with centrifugal pumps.

Low-cost decorative fountain systems are now commercially available for use by persons and firms other than large institutions, governmental units and the like. One such system is adapted for use in an existing fishpond, garden pool or the like and includes a fountain head or discharge nozzle and a centrifugal pump adapted to be disposed in the pool and to be driven by a submersible electric motor. The fountain head discharges water as discrete drops rather than as a stream of water. Proper operation of the fountain head to produce a uniform discharge pattern requires that the water supplied to the head from the pump flow essentially straight to the head, otherwise the pattern of water drops discharged from the head varies and the water drops are of non-uniform size. For aesthetic reasons, especially where the fountain is lighted, it is desired that the water discharge pattern be steady and that the drops be uniform in size.

In order to reduce the costs of fountain systems such as the system referred to above, it is desired that such systems be mass produced. The systems, however, are used in pools of various sizes. Therefore, the systems must include some means for regulating the pump discharge flowrate so that a standardized system can be used in different sized pools. The valving of the pump discharge to alter the flowrate of the discharge produces turbulence in the water supplied to the fountain head with the result that the fountain pattern fluctuates and the drops discharged from the head are not of uniform size.

This invention provides simple, economic and effective apparatus for regulating the discharge flowrate from a centrifugal pump and for arresting or suppressing turbulence in the regulated liquid. The apparatus provided by the invention is useful in a fountain system of the type referred to above, but it will be apparent to workers skilled in the art that the invention has utility in other applications.

Generally speaking, the invention is provided in combination with a centrifugal pump having an impeller chamber. The chamber has an outlet therefrom which has a selected cross-sectional area. The apparatus provided by this invention includes a duct having a cross-sectional area substantially equal to the area of the impeller chamber outlet and which extends from the impeller chamber outlet a selected distance around the impeller chamber to a pump discharge outlet. The apparatus also includes a valve in the duct substantially closer to the impeller chamber outlet than to the pump discharge outlet.

The above mentioned and other features of the invention are more fully set forth in the following detailed description of the invention presented in conjunction with the accompanying drawing, wherein:

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FIG. 1 is a side elevation view of a fountain system, incorporating apparatus according to this invention;

FIG. 2 is a side elevation view, taken along line 2—2 of FIG. 1, of the housing of a centrifugal pump and illustrating apparatus according to this invention; and

FIG. 3 is a cross-section view taken along line 3—3 of FIG. 2.

FIGURE 1 shows a compact fountain system 10 which includes a centrifugal pump 11, a fountain head or discharge nozzle 12, and a duct 13 connecting the fountain head to the pump. The pump includes a submersible electric motor 14 having a rotary output shaft 15 (see FIG. 2) and a pump housing 16 connected to the end of the motor from which the shaft extends. A motor support plate 17 is connected to the other end of the motor and a multi-conductor electric cable 18 extends from the motor through the support plate to a source of electrical power. The pump is supported on the bottom 19 of a garden pool 20 or the like having a water surface 21 above the pump. The pump is supported by a fixed foot 22 depending from support plate 17 and by two adjustable feet assemblies 23 engaged in lateral lugs 24 extended from the pump housing. Feet assemblies 23 are adjusted so that the fountain head, the upper end of which is disposed above water surface 21, is vertically oriented.

Fountain head 12 is so constructed that water supplied to it is discharged from it as a multitude of discrete drops. Preferably the drops are of uniform size and define a fountain pattern which has a constant height. Fountain head 12 preferably is constructed in accord with one or more of the following patents, all assigned to the assignee of this invention: U.S. Patent No. 3,081,036, issued March 12, 1963, to John O. Hruby, Jr.; U.S. Patent No. 3,082,957, issued March 26, 1963, to Jason V. Semple; and U.S. Patent No. 3,110,443, issued November 12, 1963, to John O. Hruby, Jr. It is desired that the water supplied to the head through duct 13 be low in turbulence, especially in turbulence manifested by spiral motion of the water along the duct, in order that the plume of water discharged from the head have a constant height and in order that the water drops be uniform in size.

Pump housing 16, as shown in FIGS. 2 and 3, defines a generally circular impeller chamber 25 which opens axially to motor 14. The impeller chamber is formed centrally of and extended beyond a circular recess 26 which has a diameter mating with the outer diameter of motor 14. The motor is engaged in recess 26 and is abutted against an end 27 of recess 26. The impeller chamber has an inlet 28 formed through the housing axially of the impeller chamber. A pipe nipple 29 or similar duct connects the impeller chamber inlet to the outlet of a pump intake filter 30 which is supported in pool 20 by the nipple. A vane-type pump impeller 31 is connected to motor shaft 15 in the impeller chamber. The impeller chamber has an outlet 32 of selected cross-sectional area. The impeller chamber outlet is communicated with a pump discharge outlet 33 which, in the pump shown in the drawing, includes a chamber 34 in housing 16 which communicates with the pump end of duct 13, the duct being secured to the pump housing.

In accord with this invention, impeller chamber outlet 32 is disposed, in the pump housing adjacent discharge outlet 34. A duct 35 extends around the impeller chamber from the chamber outlet to the discharge outlet. Pref-

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erably both the chamber outlet and the duct have similar rectangular cross-sectional configurations and equal cross-sectional areas. The duct is defined in the housing and is separated by a wall 36 which extends from the end of the impeller chamber to which inlet 28 opens to a surface coplanar with surface 27 of recess 26. The duct extends around the impeller chamber through an arc of approximately 315°. The pump discharge outlet extends tangentially of this arc, as shown in FIG. 2. The duct has opposite side surfaces 37 and 38, the former being defined by wall 36, and a surface 39 coplanar with the end of the impeller chamber. The fourth surface of the duct is defined by the end of motor 14.

A movable partition or valve member 40 is disposed in the pump housing for movement across duct 35 radially toward and away from the impeller chamber. The valve member extends from duct surface 38 to the exterior of the housing and has a lateral extent equal to the height of wall 36. As shown in the drawing, the valve member is a cylindrical member having a diameter equal to the distance from duct surface 39 to recess surface 27. The valve member is engaged in the housing by threads 41 for movement in response to rotation of the valve member toward and away from wall 36 to constrict the duct and thereby regulate the flowrate of the pump discharge through the duct. The outer end of the valve member is fitted with a handle 42 so that it may be rotated easily. The valve member is disposed in the housing closely adjacent the impeller chamber outlet, i.e., considerably closer to the impeller outlet than to the pump discharge outlet.

Assuming that the valve member is in the position shown in FIG. 2 so that the duct is partially restricted, water passing the valve member will show some turbulence because of the action of the impeller thereon and because of the path the water has followed to reach the valve member. Additional turbulence will be added to the water as it flows past the valve member. This turbulence, however, is suppressed to acceptable levels by the time the water reaches the fountain head by the configuration and extent of duct 35 between the valve member and the pump discharge outlet. Moreover, the amount of turbulence added to the water as it passes the valve member is a minimum because of the configuration of the valve member and its relation to the duct. The result is that the fountain head operates as desired and produces a plume of water which has a constant height and is composed of water drops of uniform size. The configuration described above provides a water flow path of maximum length from the impeller chamber outlet to the pump outlet while maintaining a compact device.

The construction of the flow regulating valve is simple and inexpensive to produce. Its use enables the mass production of a fountain system which is easily adjusted for best results in the garden pool or the like of a purchaser of the system.

The invention has been described above in conjunction with specific structure merely for the purpose of explaining the invention in the context of a preferred application of the invention. Various modifications and changes within the scope of the invention will become apparent to workers skilled in the art of fluid flow regulation from the foregoing detailed description. All such modifications and changes that fall within the scope of the following claims are intended to be included therein.

What is claimed is:

1. In a centrifugal pump having an impeller chamber, an inlet to the chamber, and an outlet of selected cross-sectional area from the chamber, apparatus for regulating the pump discharge flowrate and for arresting turbulence in the pump discharge comprising a substantially smooth-walled duct having a cross-sectional area at any point therealong substantially equal at least to the area of the impeller chamber outlet, the duct extending from the impeller chamber outlet a selected distance around the impeller chamber to a pump discharge outlet, and an in-

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finately adjustable valve locally in the duct substantially closer to the impeller chamber outlet than to the pump discharge outlet.

2. In a centrifugal pump having a housing defining a substantially circular impeller chamber, an inlet to the chamber, and an outlet of selected cross-sectional area from the chamber, the improvement comprising a duct in the housing extending from the impeller chamber outlet a selected distance around the impeller chamber to a pump discharge outlet, the duct having a rectangular cross-sectional configuration and substantially equal cross-sectional areas at any point therealong substantially equal to said selected area, a valve partition disposed in the duct substantially closer to the impeller chamber outlet than to the pump discharge outlet, the partition extending between two opposite sides of the duct, and means for moving the partition toward and away from one of the other two opposite sides of the duct through the other one of said other two sides.

3. Apparatus according to claim 2 wherein one side of the duct along at least a portion of the length thereof adjacent the impeller chamber outlet is formed by a wall defined by the housing between the duct and the impeller chamber.

4. Apparatus according to claim 3 wherein the valve partition is disposed in the housing opposite the duct from the impeller chamber and is movable toward and away from the wall.

5. Apparatus according to claim 4 wherein the valve partition is defined by a cylindrical member having a diameter equal to the distance between the two sides of the duct which are normal to said wall, the cylindrical member being threadably engaged in the housing and extending to an end externally of the housing.

6. In combination with a fountain discharge nozzle disposed above the surface of a pool of water and constructed to discharge water supplied thereto as discrete droplets and a centrifugal pump disposed in the pool and having a discharge outlet disposed vertically below the nozzle to which the nozzle is connected, a pump housing defining a circular chamber and an outlet of selected cross-sectional area from the impeller chamber, a duct in the housing of rectangular cross-sectional configuration and of cross-sectional area equal to the selected area extending around the impeller chamber from the impeller chamber outlet to the pump discharge outlet, and a duct partition member mounted in the housing adjacent the impeller chamber outlet for movement transversely of the duct for altering the fluid flow area of the duct to regulate the rate of water flow to the pump discharge outlet.

7. In combination with a fountain discharge nozzle disposed above the surface of a pool of water and constructed to discharge water supplied thereto as discrete droplets and a centrifugal pump disposed in the pool below the nozzle and having a discharge outlet to which the nozzle is connected, a pump housing defining a circular impeller chamber and an outlet of selected cross-sectional area from the impeller chamber, the impeller chamber outlet being located adjacent said discharge outlet, a duct in the housing of rectangular cross-sectional configuration and of cross-sectional area equal to the selected area extending around the impeller chamber from the impeller chamber outlet to the pump discharge outlet, the duct and the impeller chamber being separated for at least a portion of the length of the duct adjacent the impeller chamber outlet by a wall defined by the housing, and a duct partition member mounted in the housing adjacent the impeller chamber outlet for movement transversely of the duct toward and away from the wall for altering the fluid flow area of the duct to regulate the rate of water flow to the pump discharge outlet.

8. Apparatus according to claim 7 wherein the partition member comprises a cylindrical member disposed in the housing across the duct from the wall, the cylindrical member having an inner end of diameter equal to

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the distance between the two sides of the duct which are normal to the wall, the cylindrical member being threadably engaged in the housing and extending to an outer end exteriorly of the housing.

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