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AERATING NOZZLE

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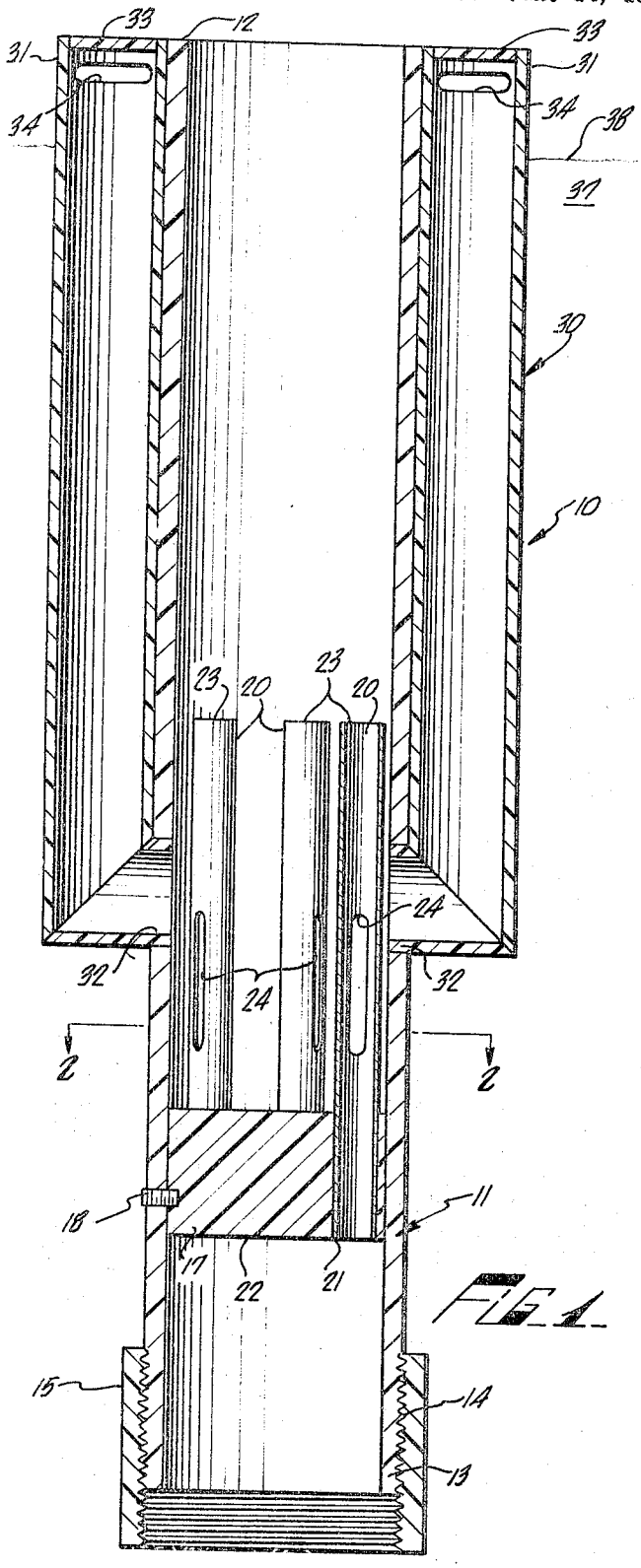


FIG. 1

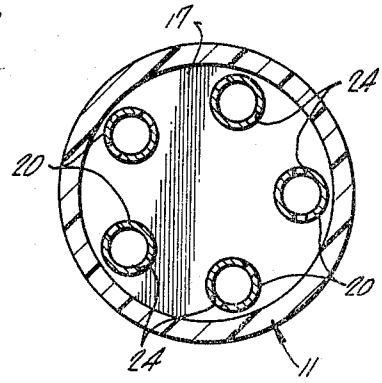
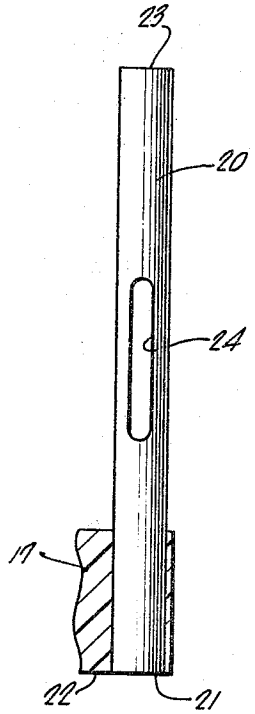


FIG. 2

FIG. 3



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3,330,486
AERATING NOZZLE

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This invention relates to liquid discharge devices and, more particularly, to an aerating liquid discharge nozzle having utility in ornamental fountains and the like.

In ornamental fountains it is often desired, especially where the fountain is operated in daylight, to provide a pillar or plume of water which is aerated so as to appear essentially white, and devices for producing such an aerated plume of water are known. These existing devices, however, are delicate in their operation since the discharge nozzle must be precisely positioned relative to the surface of the fountain pool. If the water level in the pool varies, the aerating function provided by the device is disrupted, and the plume of water ejected from the device is not aerated in a sufficient amount to provide the aesthetic effect desired. Moreover, these areating devices are complex mechanisms and require precise adjustment. Their aerating efficiency is closely dependent upon the pressure and flowrate of water passed through them.

This invention provides a simple, effective and economic aerating liquid discharge nozzle. The nozzle is characterized by the absence of moving parts and is insensitive to the level of water in a pool or the like in which the nozzle is disposed. The nozzle provides an extensive degree of aeration of water flowing through it, and yet the efficiency of the device is not dependent upon the pressure or flowrate of the water passing through the device.

Generally speaking, this invention provides an aerating liquid discharge nozzle comprising an elongated hollow body having an open upper end and a lower end. The lower end of the body is adapted for connection to a source of the liquid to be discharged. A plug closes the interior of the body within the length of the body at a location spaced from the upper end of the body. At least one liquid flow duct extends through the plug in spaced relation to the body. The duct extends within the body to an upper end disposed above the plug. A pair of elongate slots are formed through the duct between the plug and the upper end of the duct. Preferably the slots are located at substantially diametrically opposed locations of the duct. Air supply conduit means are connected to the body and extend exteriorly of the body. The conduit means has a lower end communicating with the interior of the body laterally adjacent at least a portion of the lengths of the slots. The air supply conduit means has an upper end adjacent the upper end of the body.

The above mentioned and other features of the invention are more fully explained in the following detailed description of the invention taken in conjunction with the accompanying drawing wherein:

FIG. 1 is a cross-sectional elevation view of an aerating liquid nozzle according to this invention;

FIG. 2 is a cross-sectional plan view taken along line 2—2 of FIG. 1; and

FIG. 3 is an enlarged elevation view of a fluid flow duct in the nozzle shown in FIG. 1.

An aerating liquid discharge nozzle **10** according to this invention includes an elongated hollow cylindrical body **11** having an open upper end **12** and a lower end **13**. The lower end is adapted for connection to a water supply pipe (not shown); to facilitate such a connection the lower end of the body is externally threaded as at **14** to receive an internally threaded union sleeve **15** which connects the body to the externally threaded water supply

pipe. Preferably the body and the union sleeve are fabricated of polyvinyl chloride pipe.

A cylindrical plug **17** is disposed in the body adjacent the lower end thereof for closing the interior of the body. The plug preferably is fabricated of polyvinyl chloride and is held in position in the body by a positioning screw **18** passed through the body into the plug.

A plurality, preferably five, of water flow ducts **20** extend through plug **17** from lower ends **21** coextensive with a bottom surface **22** of the plug to upper ends **23** disposed in the body a substantial distance above the upper surface of plug **17** but below the upper end of the body. Preferably the upper ends of ducts **20** are disposed closer to the plug than to the upper end of the body. The ducts are spaced from one another and from the interior walls of the body, but are disposed closer to the interior walls of the body than to each other as shown in FIG. 2. The ducts have substantially identical diameters substantially smaller than the diameter of body **11**. In a presently preferred embodiment of the invention, body **11** has a nominal diameter of four inches and the ducts have nominal diameters of five-eighths of an inch. A pair of elongate slots **24** are formed through the walls of each of ducts **20** at a location on the ducts above plug **17**, but closer to the plugs than to the upper ends of the ducts. Preferably the slots are located at substantially diametrically opposed locations on the ducts and open toward the adjacent ducts which preferably are disposed in a circular pattern in the plug as shown in FIG. 2. In the four inch nozzle referred to above, slots **24** have a width of approximately five-sixteenths of an inch and extend approximately two and one-half inches along the ducts.

A pair of air conduit tubes **30**, each preferably fabricated of polyvinyl chloride tubing having a diameter less than the diameter of body **11**, are secured to the exterior of the body at diametrically disposed locations of the body. Preferably the air conduit tubes are secured to the body by a solvent welding process. The tubes extend from upper ends **31** aligned with the upper end of body **11** to lower ends **32** which open to the interior of the body. As shown in FIG. 1, the lower ends of tubes **30** open to the interior of the body adjacent at least a portion of the elongate extents of duct slots **24**. The extreme upper ends of the air supply tubes are closed by plugs **33**, preferably fabricated of polyvinyl chloride sheet. A pair of air inlet openings **34** are formed through the air supply tubes just below plugs **33**.

Aerating nozzle **10** is adapted to be disposed in a fountain pool **37** having a surface **38**. The position of the nozzle relative to the surface of the pool is critical only to the extent that air inlet openings **34** should be placed a sufficient distance above surface **38** to assure that water does not splash into the air supply tubes. Otherwise the nozzle can be disposed at any desired position relative to the surface of the pool; a device in accord with this invention has been operated with the lower end of the body positioned above the pool surface. It is desirable for aesthetic reasons, however, that the bulk of the nozzle be disposed within the depth of the pool.

The operation of the nozzle is extremely simple. Water is supplied to the lower end of the body through a water supply duct connected thereto. This water passes upwardly through ducts **20**. As the water passes through the ducts, air supplied to the interior of the body through air supply tubes **30** is entrained in the water. The air passes through slots **24** to mix with the water passing through the ducts. The water is then discharged from ducts **20** and passes upwardly out of the upper end of the body. The height of the aerated water column or plume emitted from the upper end of the body is dependent upon the pressure of the water supplied to the nozzle.

The four inch nozzle, referred to above, has been operated at various pressures with the following results:

4 INCH AERATING NOZZLE

Pressure (p.s.i.)	Flow (g.p.m.)	Height of Discharged Column (ft.)
10	163	12
20	220	18
30	260	[1] 29 to 45
40	275	56
48	295	64

[1] Pulse.

The pulsation shown in the discharged water column when the water supplied to the nozzle is at 30 p.s.i. is an extremely beautiful effect. Heretofore, such pulsation could be provided only by varying the pressure of the water supplied to the nozzle (such variation normally being effected by cyclic operation of a control valve), or by a flutter valve or the like included within the nozzle. It is apparent, however, that this effect is provided in devices according to the present invention by the nozzle itself without reliance on any moving part.

Nozzles according to this invention have the characteristic that the water discharged from the nozzles emerges from body **11** as a hollow cylinder of aerated water. As the aerated water emerges from ducts **20**, the water, for a reason presently not fully understood, tends to follow along the interior surfaces of the body. Accordingly, the column of water emerging from the nozzle has a massive appearance which could be provided in previous devices only when such devices were operated at considerably higher flowrates than the present invention. Accordingly, it is apparent that the present invention enables economical use of water with the result that smaller capacity pumps than were required with prior art devices can be used in fountains incorporating nozzle **10**. Also, nozzle **10** provides a small pressure drop in the water flowing through it, thereby reducing the power needed to pump water through the nozzle to obtain a water column of the same height as produced by presently known fountain systems.

Nozzle **10** has been described above as being particularly adapted for use in an ornamental fountain. Because the nozzle provides extensive aeration of the water flowing through it, it is readily useful in many other applications. For example, the nozzle can be used as an aerating device in sewage treatment plants; this use of the nozzle is enhanced by the fact that the nozzle has no moving parts.

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. An aerating liquid discharge nozzle comprising an elongated hollow cylindrical body having an open upper end and a lower end adapted for connection to a source of the liquid to be discharged, a plug closing the interior of the body within the length of the body in spaced relation to the upper end of the body, a plurality of parallel liquid flow ducts of diameter substantially smaller than the interior diameter of the body extending through the plug in spaced relation to each other and to the body and extending within the body to an upper end disposed above the plug and below the upper end of the body, the ducts being arranged in a circular pattern in the plug, a pair of elongate slots formed through each duct between the plug and the upper end of the duct at substantially diametrically opposed locations of the duct, the ducts being positioned so that the slots in each duct open to the ducts adjacent thereto in said pattern, and a pair of air supply tubes connected to the body and extending along the exterior of the body on opposite sides thereof from upper ends aligned with the upper end of the body to lower ends communicating with the interior of the body at diametrically opposed locations thereof within at least a portion of the lengths of said slots, the upper ends of the tubes defining means communicating the interiors thereof with the atmosphere.

2. A nozzle according to claim **1** wherein the upper ends of the air supply tubes are closed, and the tubes adjacent their upper ends define apertures laterally therethrough.

3. An aerating liquid discharge nozzle consisting of an elongated hollow cylindrical body having an open upper end and a lower end adapted for connection to a source of the liquid to be discharged, a plug closing the interior of the body adjacent the lower end of the body, a plurality of liquid flow ducts of diameter substantially smaller than the interior diameter of the body extending through the plug in spaced relation to each other and to the body and extending within the body to upper ends disposed above the plug, the ducts being arranged substantially parallel to one another in a circular pattern in the plug, a pair of elongate slots formed through each duct between the plug and the upper end of the duct at substantially diametrically opposed locations of the duct, the ducts being positioned so that the slots in each duct open to the ducts adjacent thereto in said pattern, and a pair of air supply tubes connected to the body and extending along the exterior of the body on opposite sides thereof from communication with the interior of the body laterally adjacent the elongate extents of said slots to upper ends adjacent the upper end of the body, the upper ends of the air supply tubes opening to the atmosphere.

4. An aerating liquid discharge nozzle comprising an elongated hollow body having open upper and lower ends and means carried by the lower end of the body adapting the body for connection to a source of pressurized liquid to be discharged, a plug closing the interior of the body disposed within the length of the body at a location spaced from the upper end thereof, at least one liquid flow duct extending through the plug and from the plug within the body to an upper end disposed within the length of the body above the plug, the duct having opposite fully open ends, at least one slot being formed through each duct adjacent the plug, the slot being located wholly between the plug and the upper end of the duct and being elongated in the direction of the length of the duct, and air supply conduit means connected to the body and extending exteriorly of the body from communication with the interior of the body laterally adjacent at least a portion of the length of the slot to communication with the exterior of the body, the body and the duct being arranged so that liquid discharged from the upper end of the duct can engage only the body thereabove before being discharged from the nozzle.

5. A nozzle according to claim **4** wherein the body is cylindrical and has an inner diameter substantially greater than the diameter of the liquid flow duct.

6. A nozzle according to claim **4** wherein the duct extends within the body less than one-half the distance from the plug to the upper end of the body.

7. A nozzle according to claim **4** wherein the air supply conduit means comprises a hollow tube extending along the exterior of the body from an upper end aligned with the upper end of the body to a lower end communicating with the interior of the body.

8. A nozzle according to claim **4** wherein the plug is disposed closer to the lower end of the body than to the upper end of the body.

9. In an aerating fountain nozzle adapted to be substantially submerged in a fountain pool and including an elongate hollow body having open upper and lower

ends and means adapting the lower end of the body to a source of pressurized water so that the body is disposed in a substantially vertical attitude and is substantially submerged in the pool with the upper end of the body above the pool, the improvement comprising a plug closing the interior of the body adjacent the lower end thereof, at least one liquid flow duct extending through the plug and from the plug to an upper end disposed within the length of the body above the plug, the duct having opposite fully open ends, at least one slot being formed through the duct adjacent the plug, the slot being located wholly between the plug and the upper end of the duct, being elongated in the direction of the length of the duct, and having a length substantially less than the length of the duct between the upper end thereof and the plug, an air supply conduit disposed externally of the body and extending from communication with the interior of the body laterally adjacent at least a portion of the slot to an end open to the atmosphere adjacent the upper end of the body.

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