United States Patent [19]

Frempter

[11] **3,784,101**

[45] **Jan. 8, 1974**

[54] **LIQUID DISCHARGE NOZZLE HAVING CYLINDRICAL INTERNAL LIQUID FLOW DIRECTOR MEANS**

[75] Inventor: **Wayne W. Frempter,** Burbank, Calif.

[73] Assignee: **Rain Jet Corp.,** Burbank, Calif.

[22] Filed: **July 24, 1972**

[21] Appl. No.: **274,186**

[52] **U.S. Cl.** **239/17,** 239/553, 239/552

[51] **Int. Cl.** **B05b 17/08**

[58] **Field of Search** ..... 239/17, 22, 460, 239/552, 553, DIG. 19

[56] **References Cited**

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2,351,819	6/1944	Judell	239/460
3,706,415	12/1972	Hruby, Jr.	239/17
3,640,472	2/1972	Hruby, Jr.	239/17 X
2,675,068	4/1954	Gozzus et al.	239/552 X
3,062,456	11/1962	Thompson et al.	239/552 X

Primary Examiner—M. Henson Wood, Jr.
Assistant Examiner—John J. Love
Attorney—Robert L. Parker et al.

[57] **ABSTRACT**

A liquid discharge nozzle for discharging liquid generally upwardly therefrom has an elongate straight body which defines a duct which extends between liquid inlet and outlet openings at the lower and upper ends of the body. A plug having substantial length between its opposite ends is disposed across the duct adjacent the duct outlet opening. A plurality of liquid flow passages are defined through the plug at regular intervals around the plug at locations proximate to the periphery of the plug. An elongate cylindrical liquid flow director member extends from the plug lower end along the duct toward the lower open end of the body. The director member and the body cooperate to define an elongate annular liquid flow path between the passages and the liquid inlet opening. The annular flow path gas a width transversely has the body which is sufficiently great to prevent the upper end of the director member from restricting to any significant degree the liquid flow area of the passages formed through the plug. The director member has a length which is substantially greater than any dimension of the director member transversely of the duct.

2 Claims, 4 Drawing Figures

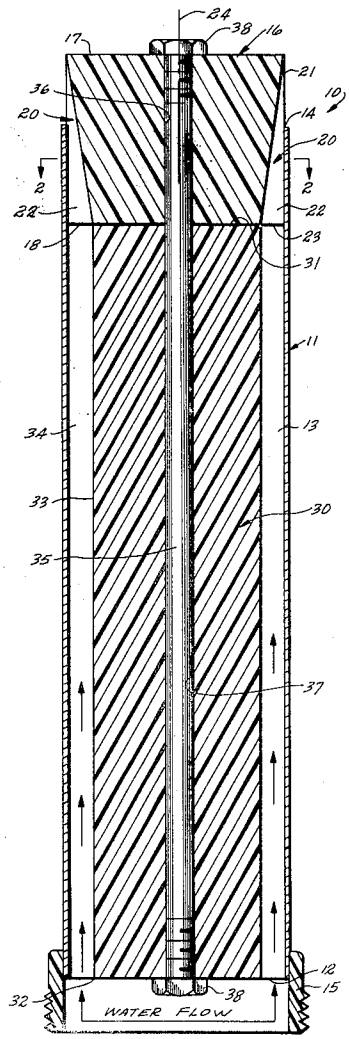


FIG_1

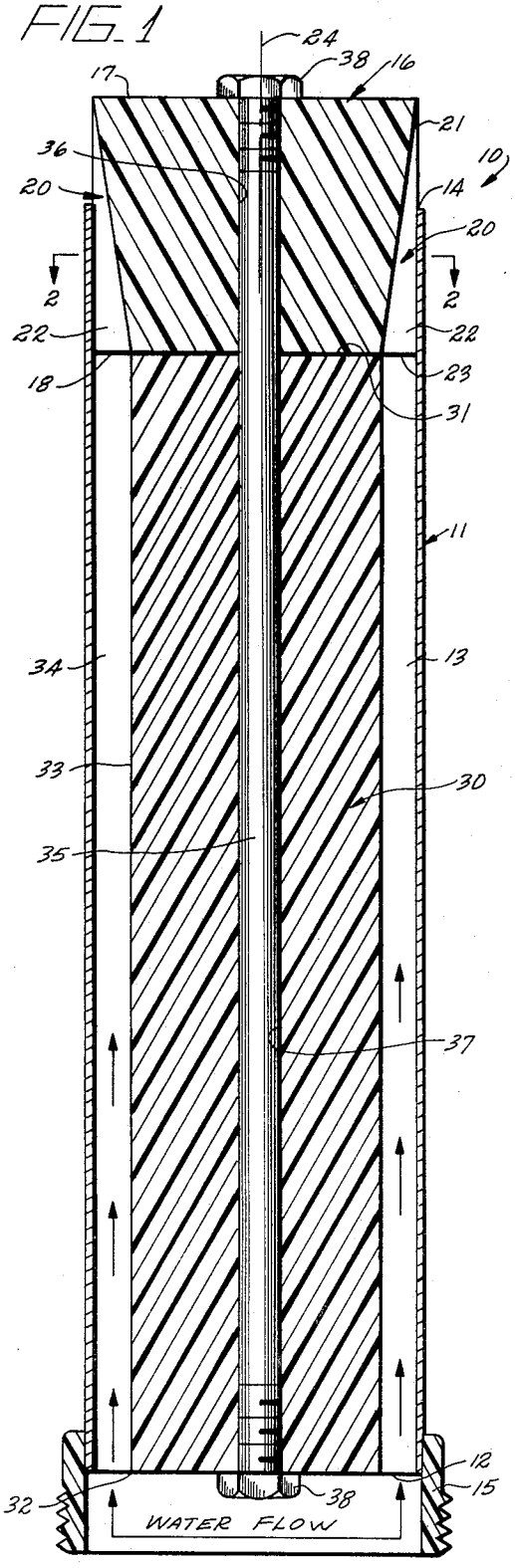

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WATER FLOW

FIG_3

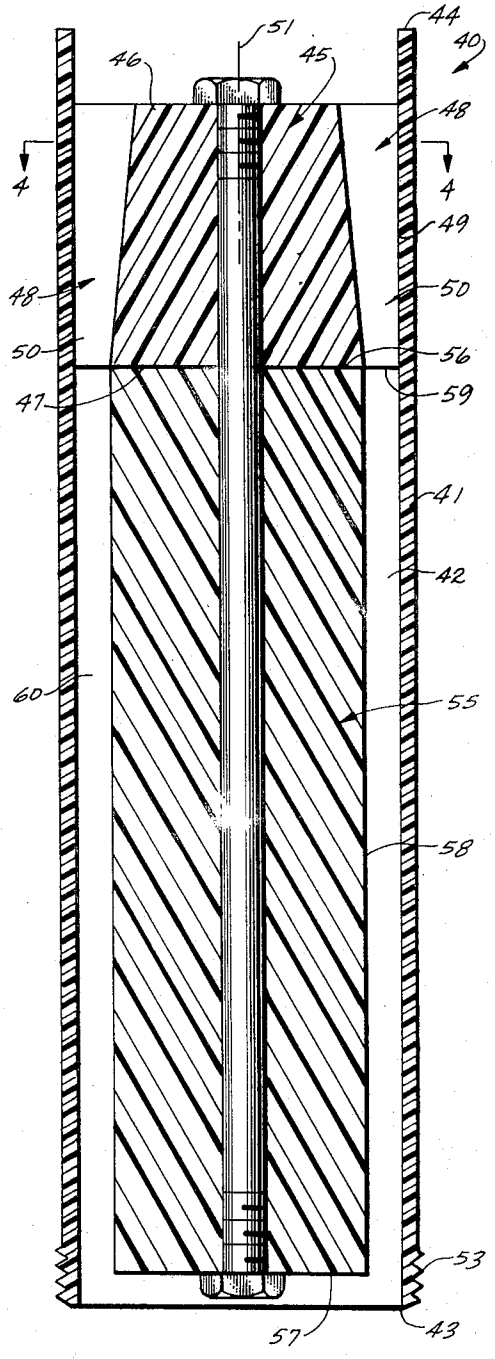

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FIG. 2

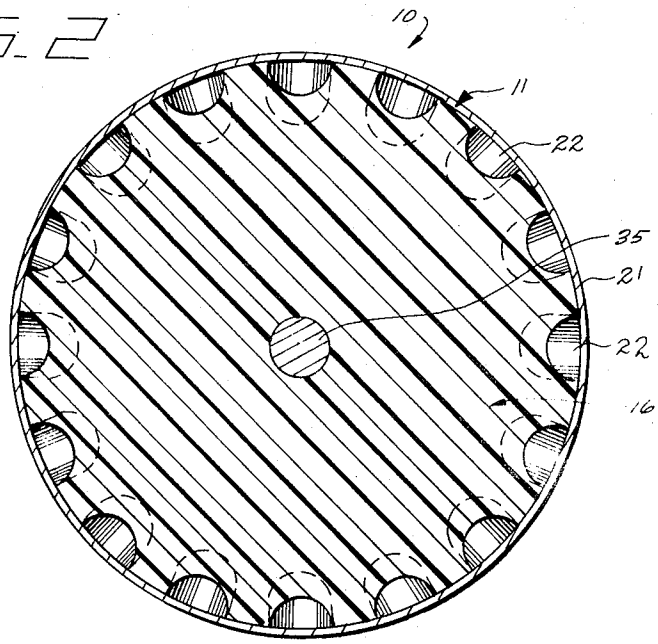
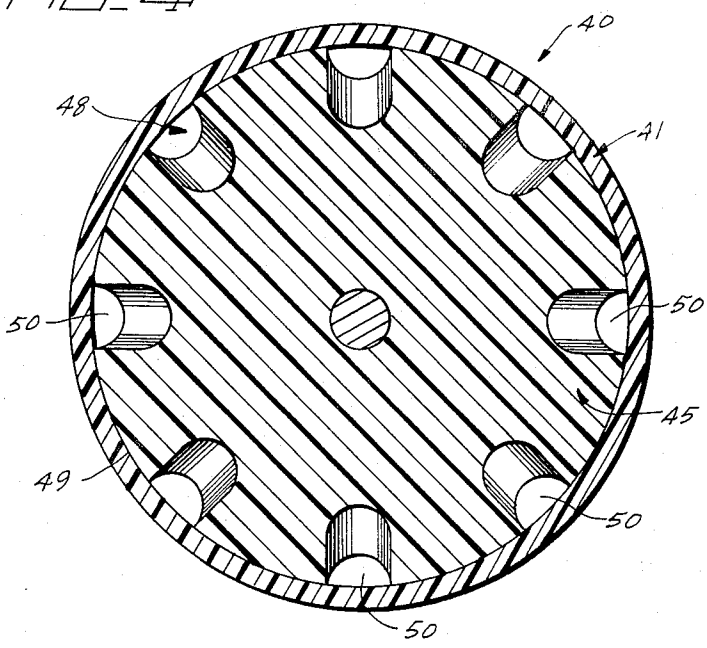


FIG. 4



LIQUID DISCHARGE NOZZLE HAVING CYLINDRICAL INTERNAL LIQUID FLOW DIRECTOR MEANS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to ornamental fountain nozzles capable of producing a desired aesthetic discharge characteristic over an extended range of liquid flow rates through the nozzle. Nozzles according to this invention are characterized by the absence of moving parts in the liquid stream.

2. Description of the Prior Art

U. S. Pat. No. 3,640,472, owned by the assignee of this invention, pertains to structure within an ornamental fountain nozzle, notably an aerating fountain nozzle, which is effective to minimize the extent to which mist and fine spray is manifested in the discharge from the nozzle, and also to impart an improved degree of predictability to the aesthetic characteristics of the fountain discharge over a range of water flow rates through the nozzle structure. While the invention described in this prior patent is effective upon aerating fountain nozzles for the purposes of eliminating mist or spray from the discharge pattern and does contribute beneficially to the predictability of the aesthetic characteristics of the discharge pattern over a range of flow rates, such structure is not readily and beneficially adaptable in any significant degree to non-aerating fountain nozzles such as that illustrated in FIG. 2 of commonly owned patent application Ser. No. 102,757 filed Dec. 30, 1970, now U.S. Pat. No. 3,690,554 for example.

SUMMARY OF THE INVENTION

This invention provides a simple, reliable and efficient liquid discharge nozzle particularly adapted for use as an ornamental fountain nozzle of either the aerating or non-aerating type. Nozzles according to this invention are characterized by being operable over a wide range of water flow rates to manifest a stable and predictable discharge pattern of desired aesthetic characteristics.

Generally speaking, this invention provides a liquid discharge nozzle for discharging liquid generally upwardly therefrom. The nozzle includes an elongate straight body which defines a duct therethrough between liquid inlet and outlet openings defined across open lower and upper ends of the body. A plug having substantial length between its opposite ends relative to the diameter of the duct is disposed across the duct adjacent the duct outlet opening. A plurality of liquid flow passages are defined through the plug at regular intervals around the plug at locations proximate the periphery of the plug and at substantially uniform distances from the periphery of the plug. An elongate liquid flow director member extends from the plug along the duct toward the liquid inlet opening and is of cylindrical configuration for at least a substantial portion of its length immediately adjacent the plug. The director member and the body cooperate to define an elongate annular liquid flow path terminating at the passages. The director member has smooth walls along its length and is dimensioned transversely of its length so that the width of the annular flow path is sufficiently great that the member does not significantly restrict the effective flow area of any of the passage defined through the plug. The director member has a length along the duct which is substantially greater than any dimension of the director member transversely of the duct.

DESCRIPTION OF THE DRAWING

The above mentioned and other features of the present invention are more fully set forth in the following detailed description of presently preferred embodiments of the invention, which description is presented with reference to the accompanying drawings in which

FIG. 1 is a cross-sectional elevation view of a non-aerating ornamental fountain nozzle according to this invention;

FIG. 2 is an enlarged cross-section view taken along line 2—2 in FIG. 1;

FIG. 3 is a cross-sectional elevation view of an aerating ornamental fountain nozzle according to this invention; and

FIG. 4 is an enlarged cross-section view taken along line 4—4 in FIG. 3.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

A non-aerating ornamental fountain nozzle **10**, shown in FIGS. **1** and **2**, includes an elongate straight tubular body **11** which has an open lower end **12** defining a liquid inlet opening to the nozzle and to a duct **13** which extends along the length of the body. The duct extends to an upper liquid outlet opening defined across an open upper end **14** of the body. Duct **13** is of uniform cross-sectional area along its entire length. The lower end of the nozzle defines means for securing the nozzle to a suitable source of pressurized water; in the case of nozzle **10**, this connection means is defined by an externally threaded collar **15** secured to the lower end of body **11**.

A cylindrical plug **16** has opposite upper and lower ends **17** and **18**, respectively. The spacing between the end surfaces of the plug along the length of the plug is a substantial distance relative to the diameter of the duct **13** and preferably is at least about equal to the diameter of the duct. Plug **16** is disposed across the duct adjacent the duct outlet opening. In the case of nozzle **10**, plug **16** is disposed so that approximately one half of its length is disposed outwardly from the upper end of the body.

A plurality of liquid flow passages **20** are defined through the plug at regular intervals around the plug at locations proximate to the peripheral surface **21** of the plug and at substantially uniform distances inwardly from the periphery of the plug. In the case of nozzle **10**, passages **20** are defined by a plurality of grooves **22** formed in the plug circumferential surface to have open lower ends **23** in the lower end surface **18** of the plug. The upper ends of the grooves open through the circumferential side walls of the plug, but it is within the scope of this invention that the grooves may open both through the circumferential surface and the top surface of the plug. The grooves are essentially straight and preferably are inclined upwardly and outwardly relative to the center axis **24** of the plug, which axis preferably is coaxial with the axis of body **11** and the duct formed through the body. Each groove **22** lies in a plane radially through the plug and including axis **24**. To assure that minimum mist is generated in the discrete unaerated water streams which emerge from the several grooves during operation of nozzle **10**, the upper end **14** of the nozzle body preferably is defined

in a plane perpendicular to the axis of the body and the edges of the body at its upper end are free of burrs. Also, it is preferred that the circumferential surface of the plug between adjacent ones of grooves **22,** as shown in FIG. **2,** be engaged in intimate surface-to-surface contact with the inner walls of body **11.** In this manner, grooves **22** provide the only water flow communication between the interior of nozzle **11** and the exterior of the nozzle, and thus the discharge pattern produced by operation of nozzle **10** consists only of several non-aerated crystal clear water streams which emerge from the upper end of grooves **20** to curve gracefully upwardly and outwardly from the nozzle and then downwardly into a fountain pool or the like in which nozzle **10** is located with at least its upper portion above the level of the water pool.

Because grooves **22** decrease in area proceeding upwardly along their length, the effective flow area of each groove is the cross-sectional area of the groove in a plane normal to axis **24** and coplanar with the upper end **14** of body **11.**

FIG. **1** illustrates that plug **16** is solid, but it will be apparent that plug **16** may be hollow so long as it defines the necessary water flow passages to communicate from duct **13** within body **11** to the exterior of the nozzle adjacent the upper end of the nozzle. In a preferred form of nozzle **10,** plug **16** is defined of a synthetic material such as polyvinyl chloride or the like.

An elongate, water flow director member **30** is disposed within body **11** in coaxial alignment with plug **16.** The director member has its upper end **31** intimately engaged with the lower surface **18** of plug **16.** Preferably the lower end **32** of the director member is disposed at or near the open lower end of body **11**; compare the illustrations FIGS. **1** and **3.** The director member has a smooth exterior surface **33**; in nozzle **10,** the director member is of cylindrical configuration along its entire length and has its exterior surface uniformly spaced along the length of the director member and around its circumference from the inner walls of body **11** thereby to define an elongate annular water flow path **34** extending from near the duct liquid inlet opening to the lower ends of passages **20.**

FIGS. **1** and **3** illustrate director members which are of cylindrical configuration along their entire length. It is a feature of this invention that the director member have a cylindrical configuration for a substantial portion of its length immediately adjacent the bottom surface of the nozzle plug. Thus, this invention contemplates the use of a director member which is cylindrical along the upper one-half or so of its length and which is conical over the remaining lower portion of its length. The elements which form a principal feature of the nozzles described in Pat. No. 3,640,472 are conically configured along their entire length.

The exact causes for the benefits realized by use of this invention are not fully understood. It is believed, however, that a principal cause of these benefits is the operation of the director member to markedly reduce turbulence in the water entering the plug passages so that the plug passages can act upon water flowing along the passage predictably in a manner desired and defined by the geometry of the passages.

The diameter of a director member according to this invention, such as director member **33,** at least at its upper end is defined such that the director member does not restrict the effective flow area of any of the adjacent passages defined through the plug immediately above the director member. Thus, in nozzle **10,** the outer surface of the director member at its upper end should not be any closer to the inner wall of body **11** than the distance (in a plane normal to axis **23**) between the body inner wall at body end **14** and the portion of any groove **22** most remote from the inner upper rim of the body tube. Further, if the upper end of the director member partially closes the open lower end of any of grooves **22,** such closure cannot be sufficiently great to generate turbulence in water flowing past the upper end of the director member into the lower portion of the groove. FIG. **1** illustrates a preferred situation in one nozzle according to this invention in which the diameter of the upper end of the director member is equal to the diameter of the circle defined on the bottom surface of plug **16** by the loci of the portions of the openings of passages **20** which lie closest to plug axis **24.** water supply

As is clear from FIG. **1,** director member **30** has a length along the length of duct **13** which is substantially greater than any dimension of the director member transversely of the duct. It has been found that the length of the director member should be at least two to three times greater than the diameter of the director member, and preferably the director member is as long as possible consistent with other factors such as the overall length of body **11,** the nature of the watersupply structure to which the nozzle is connected in use, and the height limitations imposed upon the design of the nozzle by the requirements of a customer, for example.

Plug **16** is preferably press-fitted into the upper end of body **11** and director member **30** preferably is suspended from the plug by an elongated tie-rod **35.** The tie-rod is disposed through coaxially aligned bores **36** and **37** formed in the plug and director member, respectively. The tie-rod has externally threaded ends for cooperation with nuts **38** to securely clamp the director member in the desired position against the bottom surface of plug **16.**

FIG. **1** illustrates that director member **30** is solid but for the presence of bore **37** coaxially of its length. It is within the scope of this invention, however, that the director member may be made hollow so long as it has an outer surface **33** bearing the above described relationship to the inner walls of body **11.** In any event, the effective water flow area of the annular flow path provided between the director member and the inner walls of body **11** along the length of the director member is greater, at all locations along the length of the annular flow path, than the aggregate water flow area through passages **20.** Also, the effective area of the liquid inlet opening to the nozzle is at least as great as the minimum cross-sectional area of the annular flow path.

FIGS. **3** and **4** illustrates an aerating water discharge nozzle **40,** which nozzle is also useful as an ornamental fountain nozzle. Nozzle **40** includes the same basic structural components as nozzle **10.** Thus, nozzle **40** includes an elongate straight tubular body **41** defining therethrough a duct **42** which has a liquid inlet opening defined at an open lower end **43** of the body and a liquid outlet opening defined across an open upper end **44** of the body. Also, nozzle **40** includes a plug **45** which has substantial length relative to the diameter of duct **42** between its opposite upper and lower end surfaces **46** and **47.** The plug is disposed across the duct adjacent the duct outlet opening; in the case of nozzle **40,**

plug **45** is disposed wholly within body **41** somewhat below the open upper end **44** of the body. A plurality of liquid flow passages **48** are defined through the plug and communicate between the opposite end surfaces of the plug. The passages are positioned at regular intervals around the plug at locations proximate the periphery of the plug and at substantially uniform distances inwardly from the peripheral surface **49** of the plug. Passages **48** are defined by a plurality of regularly spaced grooves **50** of substantially semi-circular cross section formed in the circumferencial surface of the plug. Grooves **50** increase regularly in cross-sectional area proceeding upwardly along their length. Preferably, the walls of each groove **50** make a relatively sharp corner with the upper surface of the plug, which preferably is disposed in a plane perpendicular to the center axis **51** of the plug. As shown best in FIG. **2,** it is preferred that the walls of the grooves intersect the inner walls of body **41** at a substantial angle and that the circumferencial surface **49** of the plug between adjacent grooves be engaged in intimate surface-to-surface contact with the inner walls of the body.

The lower end of body **41** is externally threaded as at **53** to adapt the nozzle for connection to a suitable mounting base or other structure providing a source of pressurized water to the nozzle during use.

An elongate cylindrical water flow director member **55** is disposed coaxially of plug **45** within body **41** and has its upper end **56** intimately engaged with the bottom surface **47** of the plug. The lower surface **57** of the director member is disposed at or near the open lower end of the nozzle body. The director member also has a circumferencial surface **58** which, about its circumference, is uniformly spaced from the inner walls of the nozzle body, thereby to define an elongate annular liquid flow path **60** extending within the nozzle body from near the nozzle liquid inlet opening to the open lower ends **59** of plug water flow passages **48.** As noted above, it is within this invention that the director member may be cylindro-conical rather than cylindrical as shown in FIG. **3.** The diameter of the director member at its upper end is defined to be equal to or less than the diameter of the circle defined on the bottom surface of the plug by the loci of those points along the rim of each passage opening **59** lying closest to the plug axis; if the diameter of the director member is less than the diameter of this circle, then the diameter of the director member is not substantially smaller because of the aforementioned consideration of turbulence generation. The diameter of the upper end of the director member is not greater than the diameter of this circle because in plug **45** the effective flow area of passages **48** is defined at the lower end of each passage. It is apparent, therefore, that the cross-sectional area of the annular water flow path defined between the director member and the inner walls of the body, at all locations along the length of the director member, is greater than the aggregate water flow area defined by the inlet openings **59** to passages **48** through plug **45.** Also, the water flow area afforded by the annular flow path is preferably less than, but possibly equal to, but not greater than, the effective water flow area provided by the water inlet opening to the nozzle at the open lower end of body **41.**

As in the case of nozzle **10,** director member **55** has a length which is at least two to three times greater than its diameter and preferably is as long as possible relative to its diameter as is permitted by the structure of the nozzle.

In cases where the nozzle is used with a fountain base of the type shown in FIG. **1,** for example, of commonly owned U.S. Pat. No. 3,705,686, the director member of a nozzle according to this invention may extend below the open lower end of the nozzle body and into the fountain base.

It has been found that the presence of the elongate cylindrical water flow director in nozzle **10,** a non-aerating ornamental fountain nozzle, eliminates certain effects of random flutter which are encountered in nozzles of the type in which the nozzle structure was comprised primarily of a body and a plug, such as plug **16.** These flutter effects were manifested in momentarily in the individual water streams generated by these prior nozzles when operated at constant water flow rate. Also, it has been found that when the elongate flow director member is present in nozzle **10,** the nozzle may be operated over a considerably greater range of water flow rates without appreciable change in the aesthetic characteristics of the nozzle water discharge pattern than is the case in equivalent nozzles which do not include the water flow director member. This same benefit, namely, that of operability over an extended range of water flow rates with constant or essentially constant aesthetic characteristics is also provided by the water flow director member when it is included in aerating ornamental fountain nozzles such as nozzle **40.** It has further been found that the presence of the flow director within the nozzle structure has very little affect upon the pressure required to operate the nozzle at a desired discharge rate. Moreover, it has been found that the presence of the director member within the nozzle structure allows the discharge pattern produced by a particular style of fountain nozzle to be run to a greater height than was heretofore possible before the desired aesthetic characteristic of the discharge pattern begins to degrade or break up. The benefit provided by the presence of a cylindrical or cylindro-conical director member as described above is substantially greater, in many cases, that the benefits which are realized when a fully conical flow modulating member, as described in U.S. Pat. No. 3,640,472, is used. The advantages of the above-described water flow director members over the fully conical member of U.S. Pat. No. 3,640,472 is particularly significant in nozzles having the plug configurations and features described as to nozzles **10** and **40.**

Workers skilled in the art to which the invention pertains will readily appreciate that alterations, changes and modifications in the structures described above may be made while still practicing the principles of and achieving the benefits of this invention. Such workers will appreciate that the foregoing description is presented by way of example, rather than as an exhaustive catalog of the structural forms which this invention may take. Accordingly, the preceding description should not be taken as defining the only forms which apparatus according to this invention may take, or as otherwise limiting the scope of this invention.

What is claimed is:

1. A liquid discharge nozzle for discharging liquid generally upwardly therefrom comprising

a. an elongate straight body defining a duct therethrough between a lower liquid inlet opening defined at an open lower end of the body and an

upper liquid outlet opening defined across an open upper end of the body;

b. a plug having substantial length between opposite ends thereof relative to the diameter of the duct disposed across the duct adjacent the duct outlet opening;

c. a plurality of liquid flow passages defined through the plug at regular intervals around the plug at locations proximate the periphery of the plug and at substantially uniform distances from the periphery of the plug, the passages communicating between the duct and the exterior of the nozzle; and

d. an elongate liquid flow director member extending from the plug along the duct toward the liquid inlet opening, the director member being of cylindrical configuration for at least a substantial portion of its length immediately adjacent the plug, the director member and the body cooperating to define an elongate annular liquid flow path extending from the passages toward the liquid inlet opening, the director member at its upper end having a diameter substantially identical to the diameter of an imaginary circle defined on the lower end of the plug by the loci side of those points on the bottom openings of the passage lying farthest from the periphery of the plug, the director member having a length along the duct which is substantially greater than any dimension of the director member transversely of the duct.

2. Apparatus according to claim 1 wherein the annular flow path along the length thereof has uniform cross-sectional area.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,784,101 Dated January 8, 1974

Inventor(s) Wayne W. Frempter

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Abstract, line 16, for "gas" read -- has --; for "has" read -- of --.

Column 3, line 35, after "illustrations" insert -- of --.

Column 4, line 19, at the end of the paragraph, delete "water supply".

Column 4, line 28, for "watersupply" read -- water supply --.

Column 4, line 56, for "illustrates" read -- illustrate --.

Column 5, line 49, for "consideration" read -- considerations--.

Column 8, line 7, delete "side".

Signed and sealed this 3rd day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents