United States Patent [19]

Jacuzzi

[11] **3,905,358**

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[54] **HYDRO-AIR FITTING**

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[52] **U.S. Cl.** **128/66;** 4/180

[51] **Int. Cl.²** **A61H 9/00;** A47K 3/00

[58] **Field of Search** 128/66; 4/178, 180

[56] **References Cited**

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3,540,438	12/1968	Jacuzzi	128/66
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Primary Examiner—Lawrence W. Trapp

Attorney, Agent, or Firm—Hill Gross, Simpson, Van Santen, Steadman, Chiara & Simpson

[57] **ABSTRACT**

A hydrotherapy nozzle is swivelably mounted in a ball joint for universal adjustment and is also continuously adjustable axially. A air inlet tube has a port disposed in alignment with the axial center of the nozzle throat. A water inlet receives a supply of liquid from a pressurized source and directs a stream of water around the inlet tube and into the swivelably mounted nozzle to entrain a supply of air from the port to form an enhanced stream of treatment fluid. The axial spacing adjustment between the inlet port and the nozzle throat is selectively variable.

12 Claims, 4 Drawing Figures

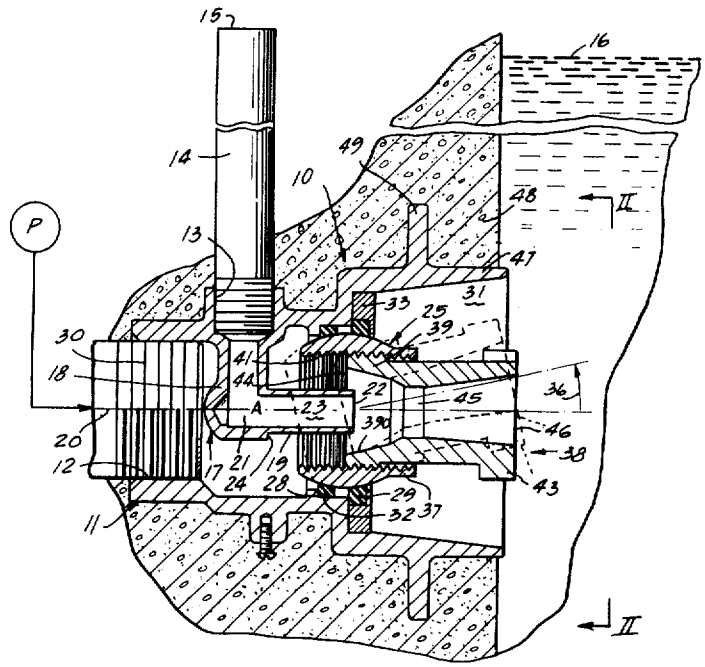
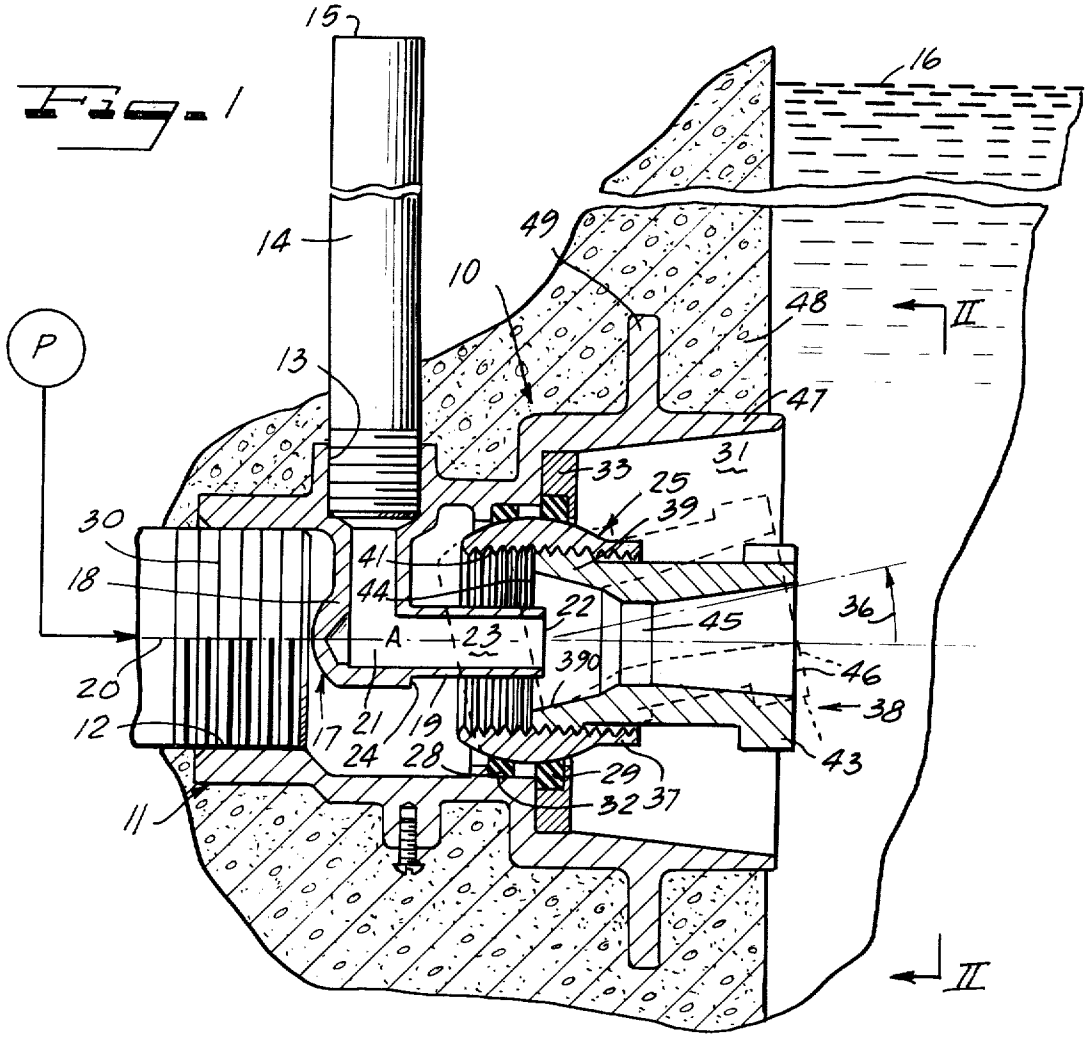


Fig. 1



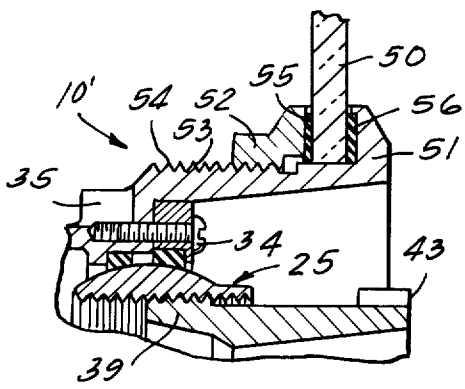


Fig. 3

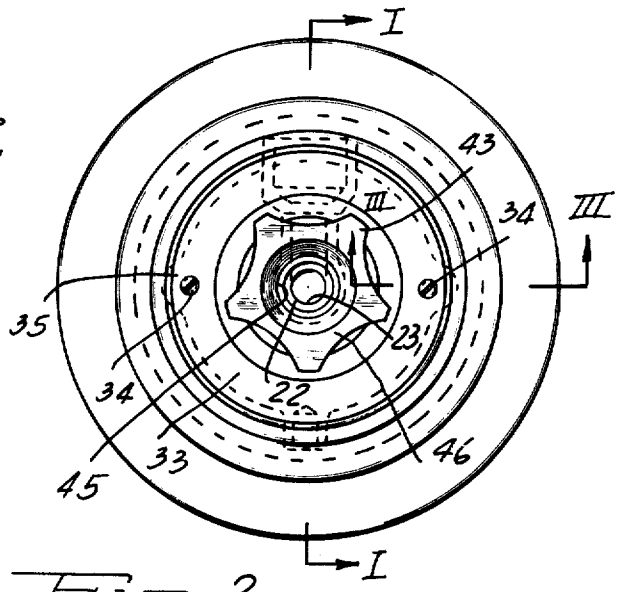


Fig. 2

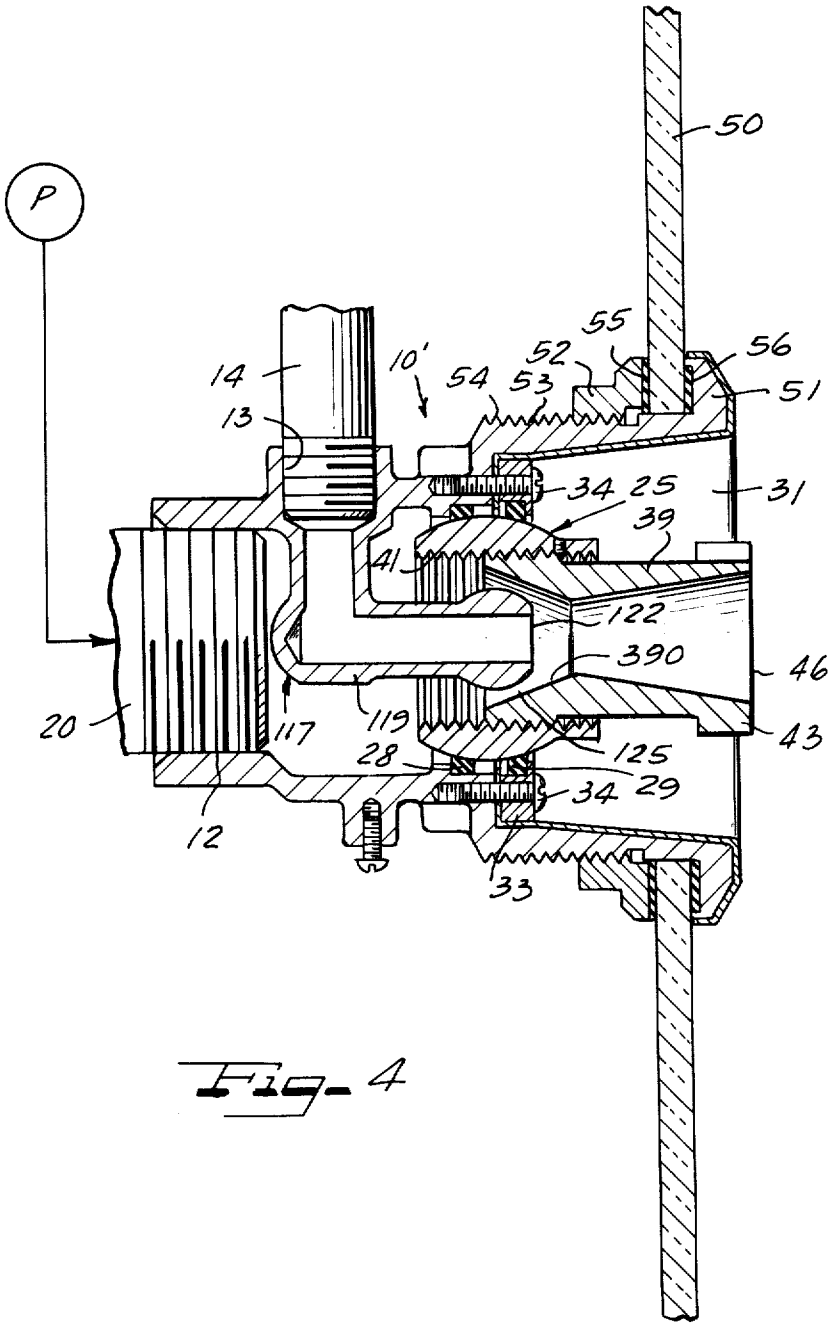

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Fig. 4

HYDRO-AIR FITTING

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to improvements in fittings used to combine air with pressurized water streams in swimming pools and baths, for aeration, hydrotherapy, hydromassage, and like purposes.

2. Description of the Prior Art

The prior art is exemplified by the U.S. Pat. No. 3,297,025 to Candido Jacuzzi, wherein a stream of water is introduced under pressure into the center of a nozzle submerged in a pool or bath of water. Air inlet zones about the periphery of the nozzle are connected to atmosphere and serve to draw air by venturi action into the stream of water. The air emerges from the nozzle as bubbles within the stream of water, to provide aeration to the body of water or a vigorous massage of the body of a bather. The prior art has also provided means to vary the direction of flow by use of a ball joint at the base of the nozzle, and simultaneously to vary the force or volume of the flow by reducing the size of the water inlet by moving the nozzle along its own axis and on helical threads against a seat provided.

SUMMARY OF THE INVENTION

In accordance with this invention, an air inlet port is placed in the axial center of a pressurized stream of water, such as that provided by a filter return inlet on a swimming pool or by a whirlpool bath device. Air is thereby entrained into the water flow, forming bubbles in the stream. Flow direction and water volume control capabilities are also provided. Reversal of the radial positions of the air and water inlets from the prior art produces surprising and unexpected improvement in performance in several respects, including reduction of noise produced by the fitting (by absorption of the air-water mixing sounds by the water flow surrounding the air inlet), achieving more uniformly small bubbles of air with better bubble distribution through the water stream, and improvement in air and water flow characteristics. The device disclosed is also simpler to manufacture than the prior art fittings, requiring less complex dies and molds.

Particular features and characteristics of one embodiment of the present invention include use of a cylindrical nozzle having on its interior an axially converging-diverging cross-section. Helical threads on the inlet end of the nozzle in screw engagement with corresponding threads in a ball joint cause the nozzle to move inward or outward from the ball joint with manual axial rotation of said nozzle. A ball segment supports the nozzle by screw threads as stated and is itself supported within seal rings attached to the body of the assembly in a manner allowing the ball segment to swivel within a cone about the center-line of the assembly but not to rotate about its own axis in response to rotation of the nozzle. At the end of said body opposite the nozzle outlet is a connection by which pressurized water may be introduced into the assembly. At the top side of the body upstream of the seal rings and ball joint is an air inlet connection. An air inlet port communicating with the air inlet connection projects therefrom into the interior of the body. The air inlet port comprises a cylindrical tube located longitudinally along the center-line of the assembly and a vertical portion fixing the tube to the inlet connection. The tube is closed at the upstream end, while the downstream end is open and is located at the center of the ball joint. When the nozzle is screwed into the ball segment the air inlet tube will close off the flow of water from the connection at the rear of the body, regardless of any swivel of the ball joint from the center-line of the assembly. If desired, the air induction tube is provided with a spherical segment on its periphery near the port end, thereby to seal off flow completely against the tapered throat of the nozzle and achieving selective cessation of flow in any direction the nozzle may be placed.

By this structure water flowing between the connection at the rear of the body through the nozzle entrains air at the center of the stream and mixes turbulently with it in passing through the nozzle, forming fine bubbles of even distribution throughout the stream. The nozzle may be swiveled in any direction within a cone about the center-line of the assembly without affecting the volume of flow, and the nozzle may be screwed into the assembly to reduce the volume flow of water or to shut it off entirely at any swiveled position.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view through the assembly from one side;

FIG. 2 is a view from the front of the assembly;

FIG. 3 is a partial view of an alternative mounting flange arrangement on the line of section 3—3; and

FIG. 4 is a view similar to FIG. 1 but showing the air induction tube with a spherical segment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, a hollow body is shown generally at **10** which may conveniently be formed or cast in one piece of any suitable material. It includes a rear portion **11** in which is formed a water connection sleeve **12** which communicates to a source of pressurized water which may include a water pump shown diagrammatically at P or swimming pool filter system. An air inlet sleeve or coupling **13** is shown atop the rear portion **11** of the body **10**, which communicates via a tube or pipe **14** to atmosphere, the end **15** of the tube being located higher than the level **16** of water in the pool or bath in which the assembly is employed. It will be appreciated, of course, that the tube could rise above **16** and then fall below **16** which would keep the pool from siphoning when the unit is not in operation.

In accordance with this invention, there is provided inwardly of the air inlet sleeve or coupling **13** an air inlet or air induction tube shown generally at **17** and formed as an integral part of the body **10**. The tube includes a vertical cylindrical portion **18** and a longitudinal or horizontal tube portion **19**. The tube portion **19** is cylindrical in cross-section and is disposed to be coaxial with the center-line **20** of the body. The vertical tube **18** and the horizontal tube **19** together with one another form an angled air inlet passage A, the point of juncture between the two tubes being indicated at **21**. The end of the horizontal tube **19** is open to form a port **22** to allow entrainment of the air within the port, at **23**, by water streaming past the tube. A step **24** may be formed about the periphery of the tube portion **19** and provides a spoiler to disrupt any even or laminar flow of water about the air inlet port **17** and ensure that said flow is turbulent as it passes the air inlet port **22**. The

end 22 of the air inlet tube 17 is located longitudinally near the spherical center of a ball segment 25.

The ball segment 25 has a spherical outer surface 26 and a cylindrical inner surface 27. Two seal rings 28 and 29 support the ball segment 25 and fix its longitudinal position within the body 10 and substantially prevent leakage of water from the rear of the body 30 to the front part 31 around the ball 25. The seal rings 28 and 29 may be of Teflon or other material which can serve both sealing and bearing functions. The rear seal 28 may be fitted into a shouldered cylindrical base 32 in the body 10 while the front seal 29 may be spaced from seal 28 and retained in its position by a retaining flange 33. That flange is shown secured to the body 10 by screws 34, 34 threaded into the body; bosses 35, 35 may be provided in the body to receive and reinforce the corresponding screws. Thus the ball 25 may be fixed longitudinally and rotatably in the body 10 but be free to swivel with respect thereto up to an angle 36 from the center-line 20 of the body in any direction. A stop ring 37 about the forward end of the ball limits further swiveling of the ball away from the center-line 20 by contacting the retaining flange 33 once the angle 36 is achieved in any direction.

A cylindrical nozzle 38 is received at its rearward end 39 in the interior 27 of the ball 25 by means of helical threads 40 and 41 on the exterior surface of the nozzle and in the interior of the ball, respectively, thereby permitting the nozzle 38 to be continuously axially adjustable along the length of its own axis. The forward end 42 of the nozzle has a notched knob 43 formed on the exterior surface thereof, which may be of any design suitable for grasping in one hand to facilitate manual axial rotation and pivoting of the nozzle through universal adjustment in the ball segment 25.

The nozzle 38 is open through its axial core for the passage of air and water and has a cylindrical cross-section which generally converges from the rear portion 44 to a minimum cross-section forming a nozzle throat at 45 and thereafter diverges in the downstream direction terminating in a mouth of the nozzle as at 46.

The throat or minimum cross-section 45 is sized to be of a diameter equal to or slightly larger than that of the cross-section of the port 22 of the horizontal tube portion 19 of the air inlet tube 17 and is located longitudinally in the nozzle 38 so that when the end 44 of the nozzle 38 is adjusted towards the rear of the ball segment 25, the horizontal tube 19 will progressively close the nozzle throat 45 to the flow of water from the rear 30 of the body.

The front interior part 31 of the body 10 is of sufficient diameter to allow free movement of the nozzle 38 and its knob 43 through the maximum swivel angle 36 at the full-flow position of the nozzle, i.e., where the nozzle is maximally extended from the ball segment 25. The front exterior 47 of the body 10 may as shown be formed with flanges for affixing the body in or to the wall of a bath or swimming pool. If the body is to be used with a concrete wall 48, a radial flange 49 may be formed about the front exterior 47 of the body to give purchase on the concrete poured around the body. A body 10' for use in a thin wall 50 may be formed with a flange 51 inwardly of the wall 50 and be forced into sealing engagement with said wall by means of a nut 52 threaded onto threads 53 on the exterior surface 54 of the front exterior 47 of the body 10, and snugged thereby against the wall 50. A sealing washer 55 and sealing gasket 56 may be used between the nut 52 and wall 50 and the wall 50 and flange 56, respectively, to make the connection water tight.

In operation, the assembly may be mounted in the wall of a hydrotherapy bathtub or a swimming pool below the surface of the water for the purpose of ejecting a stream of therapeutic water into the body of water. Water is driven in the form of a stream after first being pressurized by a pumping means and is directed along the axis of the assembly body in the general direction of the nozzle. Because the air tube is disposed on the axis of the nozzle assembly, the water moves at increased velocity past the edges of the radial port and into the throat of the nozzle. By the venturi action thus established, air is drawn through the air inlet tube and is admixed with the stream in copious quantities in the form of fine bubbles. The resultant stream of aerated water is then directed outwardly by the nozzle into the main body of water within the hydrotherapy tub or swimming pool.

The nozzle can be continuously adjusted in axial direction by merely rotating the nozzle in the threaded joint provided by the universal ball joint, thereby axially adjusting the nozzle toward and away from the port in the air inlet tube. There is thus provided a ready and convenient means of flow control.

Further, the nozzle can be universally adjusted by selectively pivotally adjusting the nozzle in the ball joint, thereby redirecting the stream of aerated water in various angular variations relative to the main axis of the nozzle assembly.

In the form of the invention shown in FIG. 4, like reference numerals have been applied to like parts for the sake of convenience and it will be understood that said parts and function corresponds with that already described.

The air induction tube of FIG. 4 is identified at 117 and is particularly characterized by a sphere or spherical segment 125 formed on the periphery of its inwardly extending leg 119 adjacent or near the port end 122 thereof. The sphere or segment 125 is sized to cooperatively engage and seal the adjoining surfaces of the tapered throat 390 of the nozzle 39 if cessation of flow is to be achieved in the sleeve 12 and the passage 123.

Thus, by selectively positioning the nozzle 39 axially, shut-off can be achieved in any angular direction the nozzle may be placed.

Although various modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. The method of aerating a hydrotherapeutic stream which includes the steps of:

1. at a first point in a hydraulic circuit pressurizing a supply of liquid to form a stream,
2. driving the stream at increased velocity along a fixed axis past a second point in the circuit,
3. spoiling the stream between the first and second points to render the flow of the stream turbulent,
4. admixing air into the center of the stream at said second point in the circuit by flowing the turbulent stream around the edges of a radial air port disposed in the stream at said axis.

5. successively constricting and expanding the flow stream downstream of said second point to mix the air into the water in the form of small bubbles to form an aerated therapeutic stream, and

6. selectively redirecting the aerated therapeutic stream in different directions of angular variation from said axis.

2. A hydrotherapeutic nozzle, comprising:

means forming an axial flow passage for directing a stream of liquid from a pressurized source along an axis,

a tubular air means forming a radially disposed air port at the center axis of said axial flow passage,

and a nozzle having a reduced diameter throat disposed between converging and diverging sections of said nozzle about said axis and spaced axially downstream from said air port,

whereby the liquid stream flowing past the edges of said air port will entrain air into the stream of liquid to form a stream of aerated therapeutic liquid.

3. A hydrotherapeutic nozzle as defined in claim 2 and further characterized by

a ball joint mounting said nozzle for universal movement around said axis,

whereby said nozzle can be selectively adjusted to vary the direction of the therapeutic stream in selected adjustments relative to said axis.

4. A hydrotherapeutic nozzle as defined in claim 2 and further characterized by

means mounting said nozzle in said ball joint forming continuous axial adjustment means between said nozzle and said ball joint to selectively vary the relative axial position of said tubular air means in said converging section and said air port relative to said reduced diameter throat and consituting a flow control means for selectively varying the amount of liquid flowing through said nozzle.

5. A hydrotherapy nozzle assembly adapted to be mounted in the opening of a wall of an enclosure, said assembly comprising:

a hollow housing having an open forward end with a periphery adapted to sealingly engage an opening in the enclosure wall and a closed rearward end with a water conduit extending thereinto,

an air inlet tube having a first leg extending into said water conduit and a second leg disposed on the center axis of said water conduit,

said second leg of said air inlet tube having a port formed at the end thereof and arranged in generally concentric relation relative to the axis of the passage extending through the water conduit,

a socket ball mounted for universal pivoting movement and having an axially extending bore formed therein,

a nozzle member extending into said bore of said socket ball,

said bore wall of said socket member and said external wall of

said nozzle member having continuously adjustable screw threads formed therebetween so that said nozzle may be rotatably adjusted in selected axial positions in said socket ball, said nozzle having formed therein convergent and divergent passage means with a reduced diameter throat therebetween,

said throat being relatively axially positioned with respect to said port when said nozzle is axially adjusted in said socket ball,

thereby to constitute a flow control means for adjusting the flow of fluid from said water conduit through said nozzle,

the flow of liquid from said conduit through said nozzle acting to entrain and admix air from the air inlet tube into the stream and forming an aerated stream of therapeutic liquid for direction outwardly from said nozzle,

said nozzle being pivotally adjusted in universal direction to vary the direction of flow of the therapeutic stream relative to the axis of the water conduit.

6. A hydrotherapy nozzle assembly as defined in claim 5 wherein said nozzle is particularly characterized by a notched knob construction on the front end thereof, thereby to facilitate manipulation

7. A hydrotherapeutic system comprising:

a body of water bounded by a wall on one or more sides thereof, one or more openings in said wall,

a hydrotherapy nozzle assembly in each of said openings and

sealingly engaged with said wall, one or more sources of pressurized water in communications with said openings and said hydrotherapy nozzle assemblies therein,

each of said hydrotherapy nozzle assemblies comprising,

means forming an axial flow passage for directing a stream of liquid from a pressurized source along an axis,

a tubular air means forming a radially disposed air port at the center axis of said axial flow passage,

and a nozzle having a reduced diameter throat on said axis and spaced axially from said air port,

whereby the liquid stream flowing past the edges of said air port will entrain air into the stream of liquid to form a stream of aerated therapeutic liquid.

8. A hydrotherapy system as defined in claim 7 and further characterized by

a ball joint mounting said nozzle for universal movement around said axis,

whereby said nozzle can be selectively adjusted to vary the direction of the therapeutic stream in selected adjustments relative to said axis.

9. A hydrotherapy system as defined in claim 7 and further characterized by means mounting said nozzle in said ball joint forming continuous axial adjustment means between said nozzle and said ball joint,

thereby to selectively vary the relative axial position of said nozzle relative to said air port and constituting a flow control means for selectively varying the amount of liquid flowing through said nozzle.

10. A hydrotherapeutic nozzle comprising:

means forming an axial flow passage for directing a stream of liquid from a pressurized source along an axis,

a tubular air means forming a radially disposed air port at the center axis of said axial flow passage,

and a nozzle having a reduced diameter throat between converging and diverging sections of said nozzle about said axis and spaced axially downstream from said air port.

whereby the liquid stream flowing past the edges of said air port will entrain air into the stream of liquid to form a stream of aerated therapeutic liquid, and

means including spherically shaped means on the peripheral surface of said tubular air means and selectively engagable with said reduced diameter throat of said nozzle to achieve shut-off.

11. A hydrotherapy nozzle assembly adapted to be mounted in the opening of a wall of an enclosure, said assembly comprising:

a hollow housing having an open forward end with a periphery adapted to sealingly engage an opening in the enclosure wall and a closed rearward end with a water conduit extending thereinto,

an air inlet tube having a first leg extending into said water conduit and a second leg disposed on the center axis of said water conduit,

said second leg of said inlet tube having a port formed at the end thereof and arranged in generally concentric relation relative to the axis of the passage extending through the water conduit,

a socket ball mounted for universal pivoting movement and having an axially extending bore formed therein,

a nozzle member extending into said bore of said socket ball,

said bore wall of said socket member and said external wall of said nozzle member having continuously adjustable screw threads formed therebetween so that said nozzle may be rotatably adjusted in selected axial positions in said socket ball, said nozzle having formed therein convergent and divergent passage means with a reduced diameter throat therebetween,

said throat being relatively axially positioned with respect to said port when said nozzle is axially adjusted in said socket ball,

thereby to constitute a flow control means for adjusting the flow of fluid from said water conduit through said nozzle,

the flow of liquid from said conduit through said nozzle acting to entrain and admix air from the air inlet tube into the stream and forming an aerated stream of therapeutic liquid for direction outwardly from said nozzle,

said nozzle being pivotally adjusted in universal direction to vary the direction of flow of the therapeutic stream relative to the axis of the water conduit,

said second leg of said air inlet tube being formed with spherically shaped means adjacent said port on the periphery thereof and being engageable selectively with said reduced diameter throat for achieving cut-off.

12. A hydrotherapeutic nozzle comprising:

means forming an axial flow passage for directing a stream of liquid along an axis;

a tubular air means forming a radially disposed air port at the center axis of said axial flow passage;

a nozzle having a reduced diameter throat on said axis,

whereby the liquid stream flowing past the edges of said port will entrain air into the stream of liquid for admixture with the stream to form a stream of aerated therapeutic liquid; and

means including spherically shaped means on the peripheral surface of said tubular air means and selectively engageable with said throat of said nozzle to shut off the flow past the edges of said port.

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