US006739523B2

(12) **United States Patent**
Haverstraw et al.

(10) **Patent No.: US 6,739,523 B2**
(45) **Date of Patent: *May 25, 2004**

(54) **MULTI-FUNCTIONAL SHOWER HEAD**

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(73) Assignee: **Water Pik, Inc.**, Fort Collins, CO (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **10/253,387**

(22) Filed: **Sep. 23, 2002**

(65) **Prior Publication Data**

US 2003/0121993 A1 Jul. 3, 2003

Related U.S. Application Data

(63) Continuation of application No. 09/853,108, filed on May 9, 2001, now Pat. No. 6,454,186, which is a continuation of application No. 09/383,059, filed on Aug. 25, 1999, now Pat. No. 6,230,989.

(60) Provisional application No. 60/142,239, filed on Jul. 2, 1999, provisional application No. 60/105,490, filed on Oct. 23, 1998, and provisional application No. 60/097,990, filed on Aug. 26, 1998.

(51) **Int. Cl.**^{7} **A62C 31/00**; A62C 37/20

(52) **U.S. Cl.** **239/443**; 239/446; 239/562

(58) **Field of Search** 239/443, 446, 239/562, 444, 445, 447, 448, 449, 381; 137/872, 877, 881, 494, 887, 876; 251/126, 251

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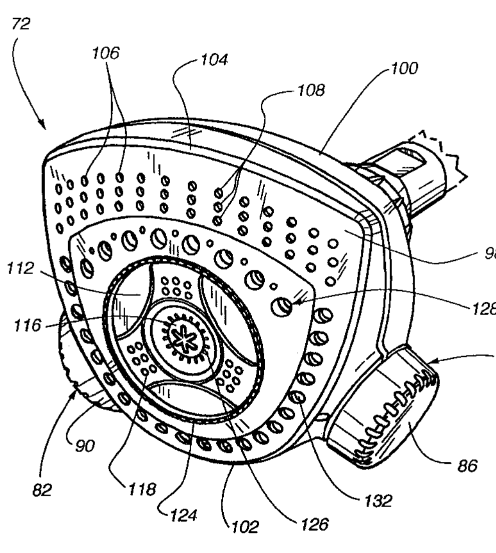
Primary Examiner—Davis Hwu
(74) *Attorney, Agent, or Firm*—Dorsey & Whitney LLP

(57) **ABSTRACT**

A shower head having a plurality of spray modes and unique controls to allow the selection of the desired mode. The shower head includes several unique features to allow the inclusion of several different spray modes, such as wide spray, medium spray, center spray, champagne spray, high speed pulsating spray, low speed pulsating spray, and mist. A waterfall mode can be implemented. The shower head includes a flow control valve that controls the pressure of the water flow, and acts to divert water to a mode selector or to a separate spray mode, such as the mist mode. The flow control valve diverts water between the mode selector and the separate spray mode. It also allows a combination of the modes controlled by the mode selector and the separate spray mode. The shower head also includes a mode selector. The mode selector transfers or routes fluids from the flow control valve to any number of individual or a combination of flow spray mode outlets.

22 Claims, 45 Drawing Sheets



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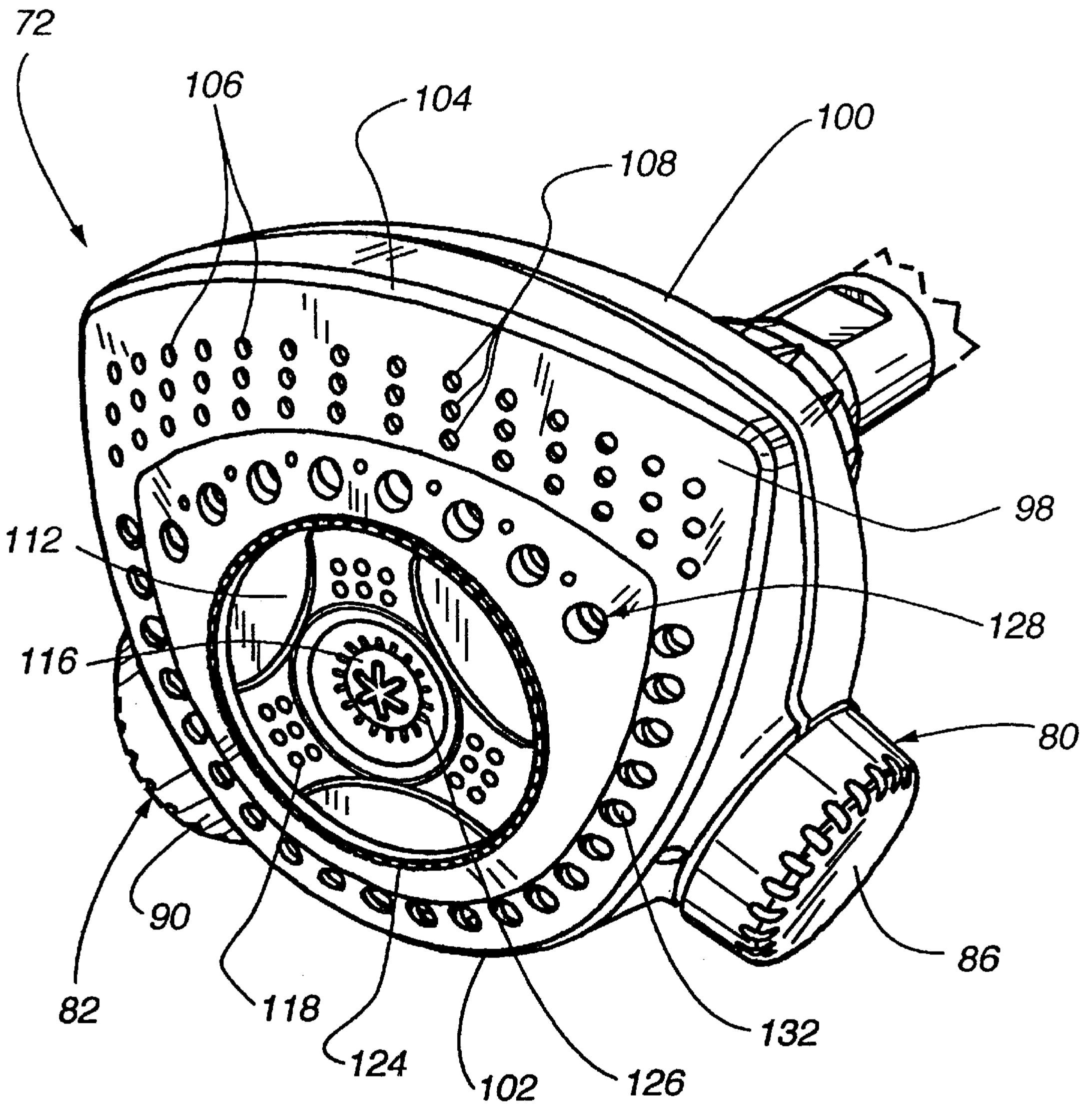

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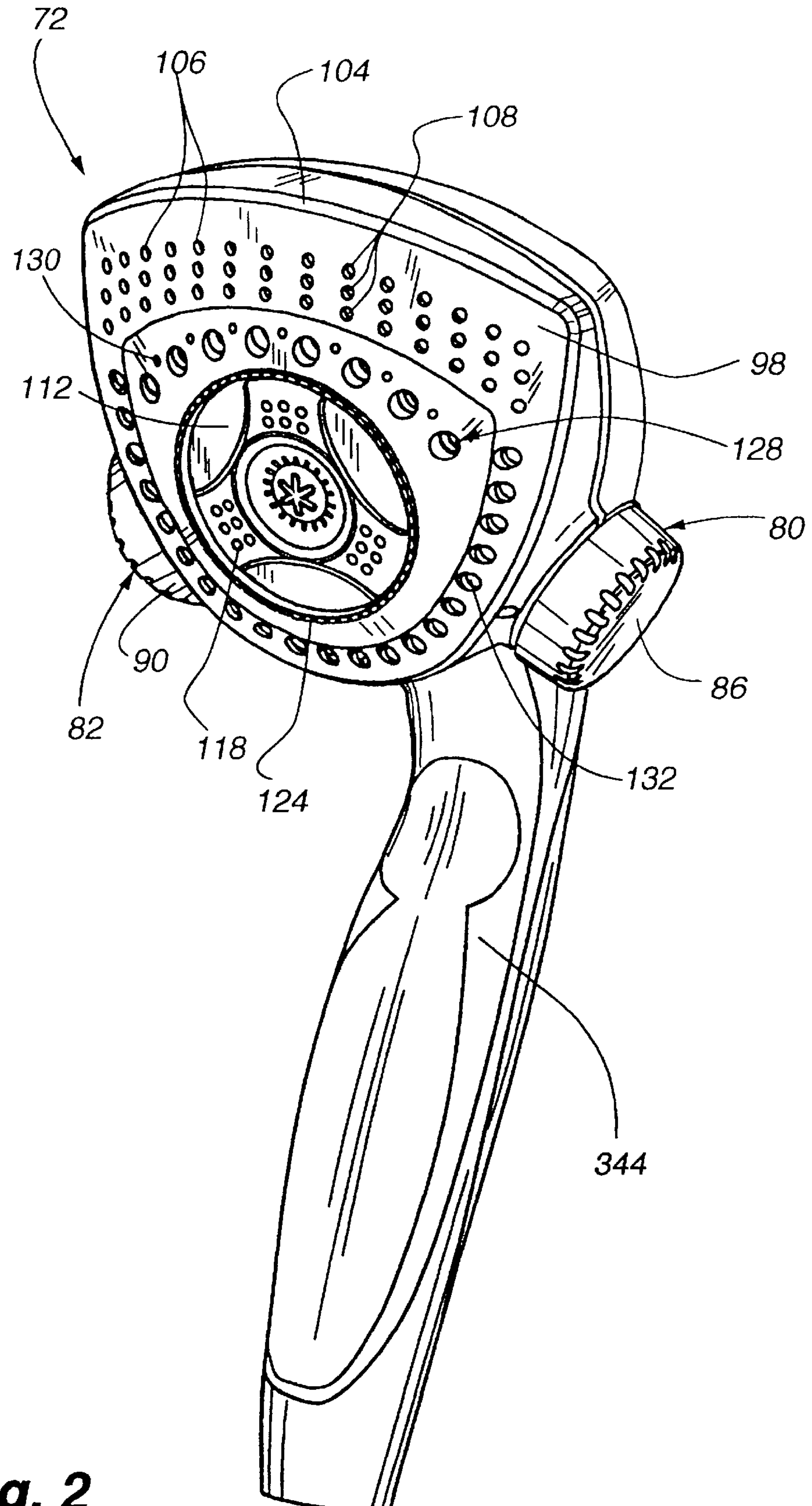

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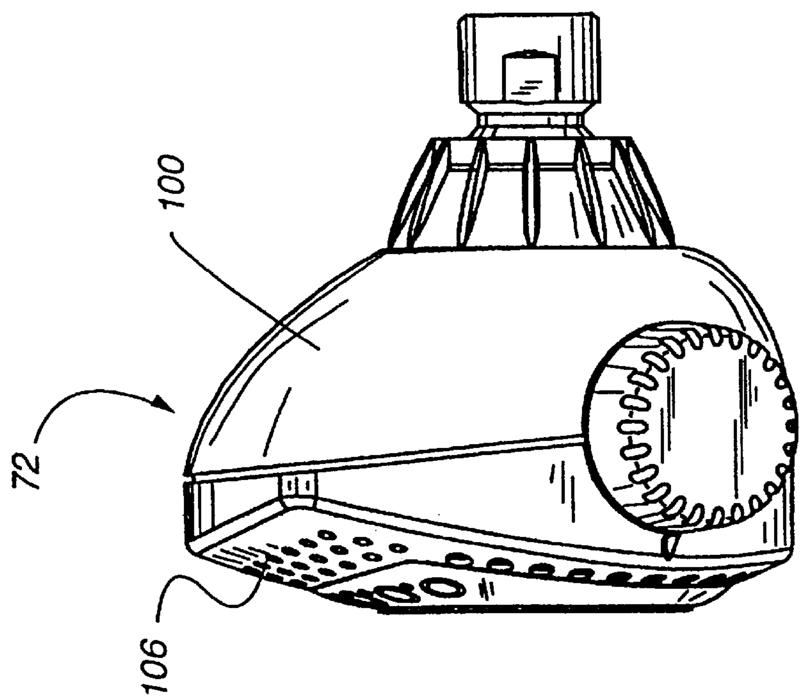
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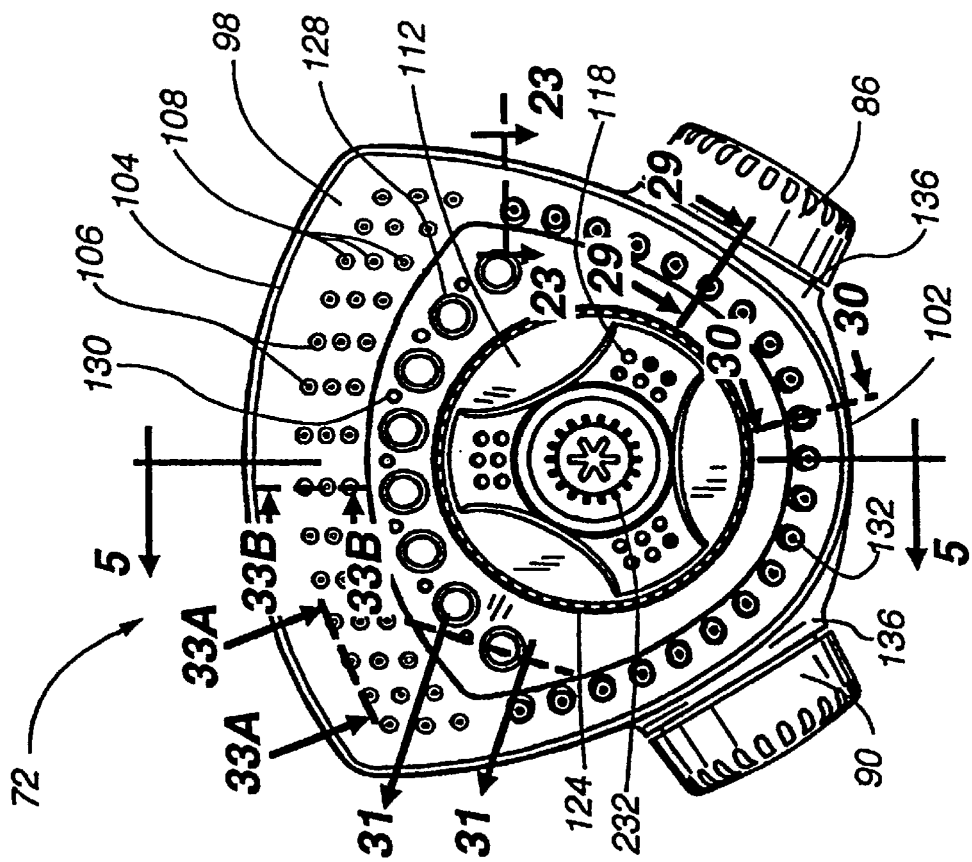
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Fig. 3

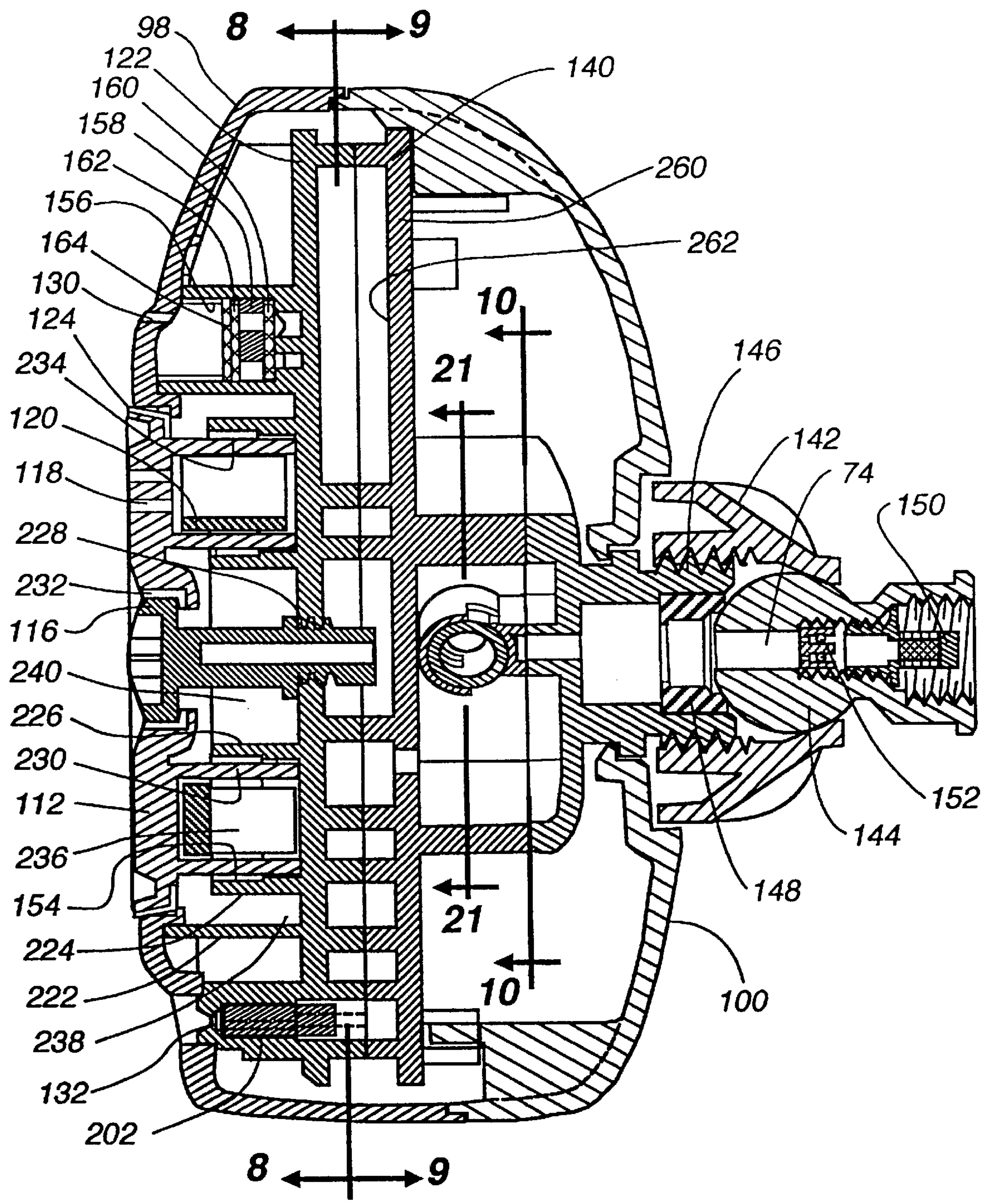

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Fig. 5

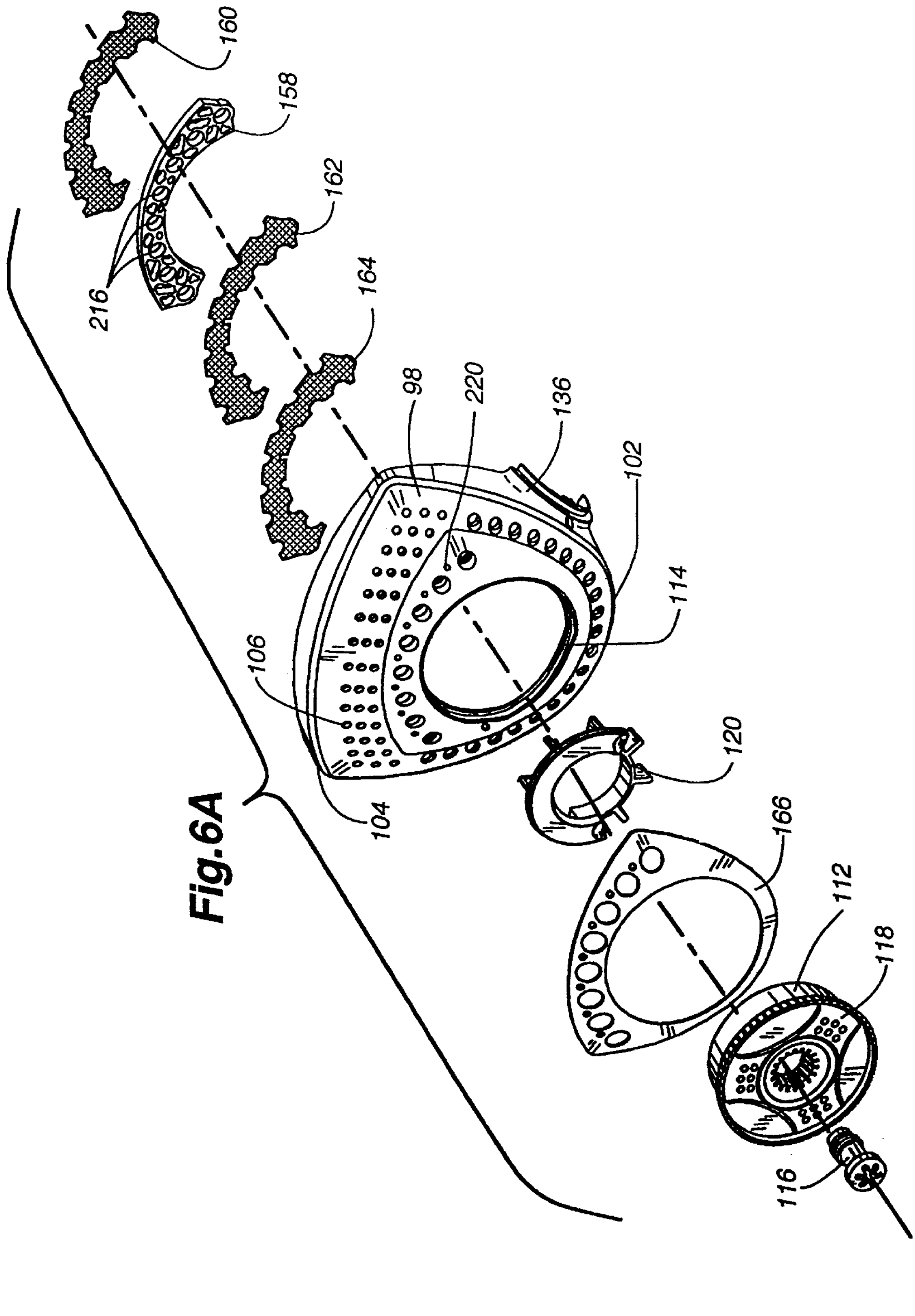
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Fig.6A

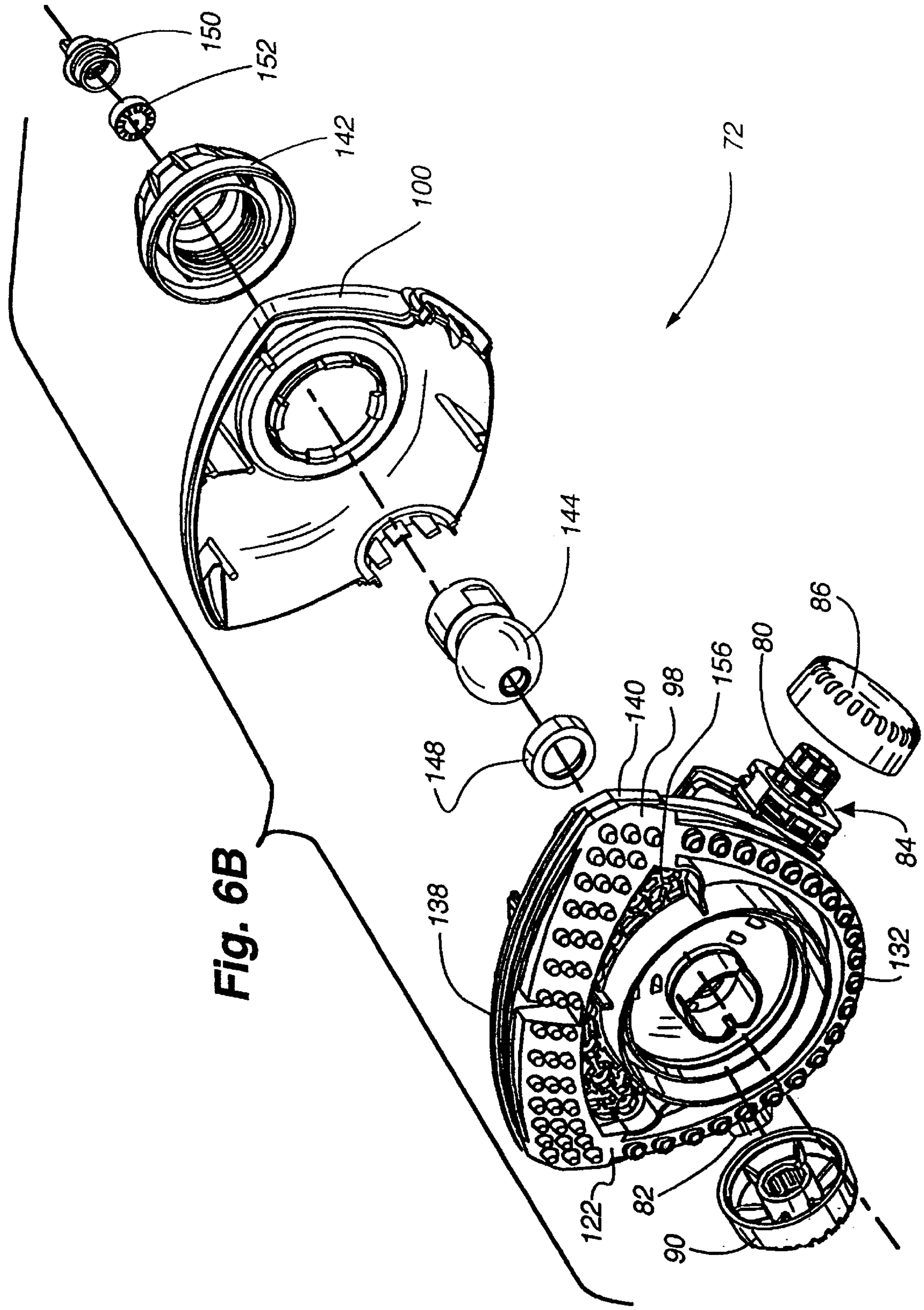

Fig. 6B

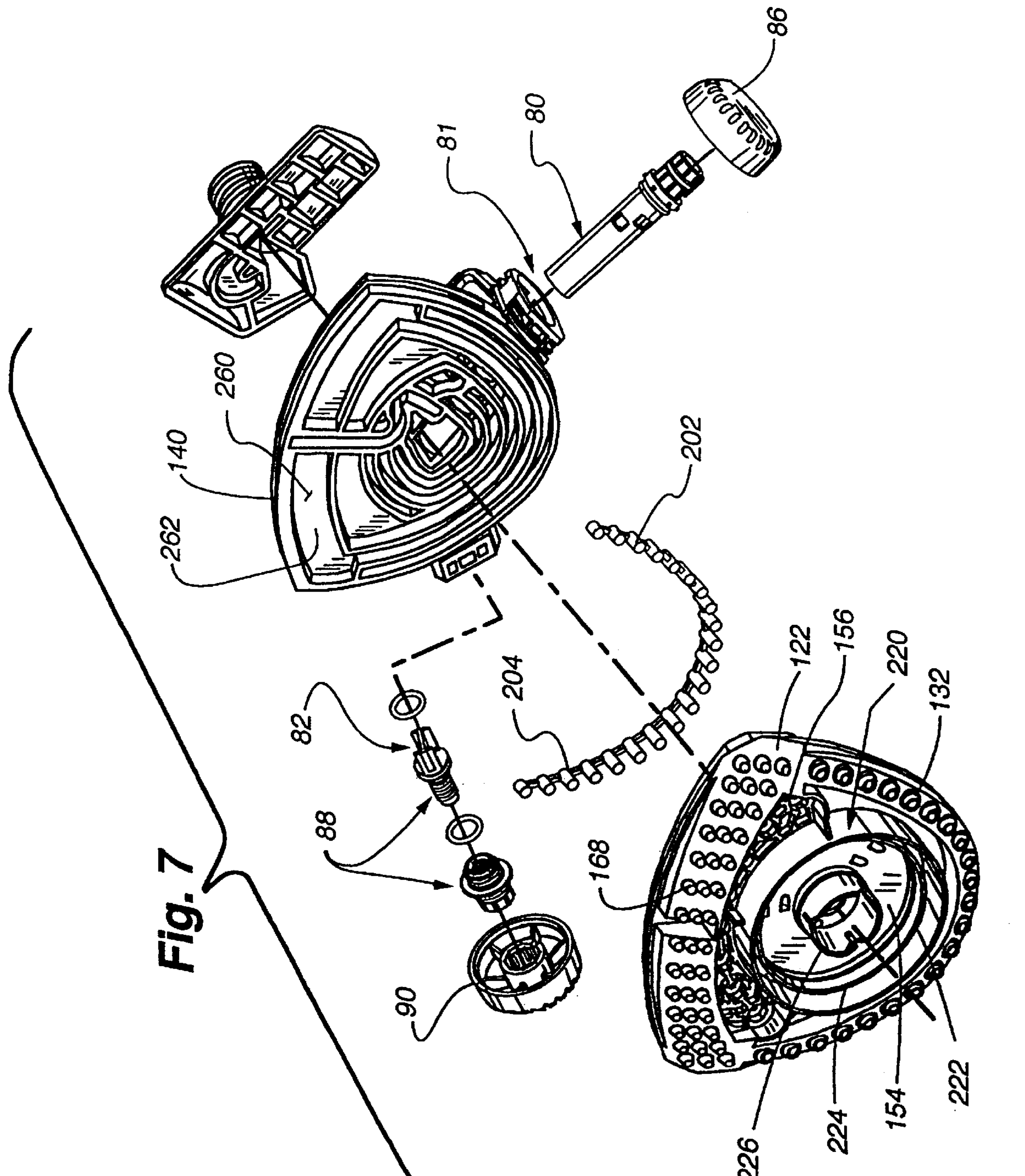
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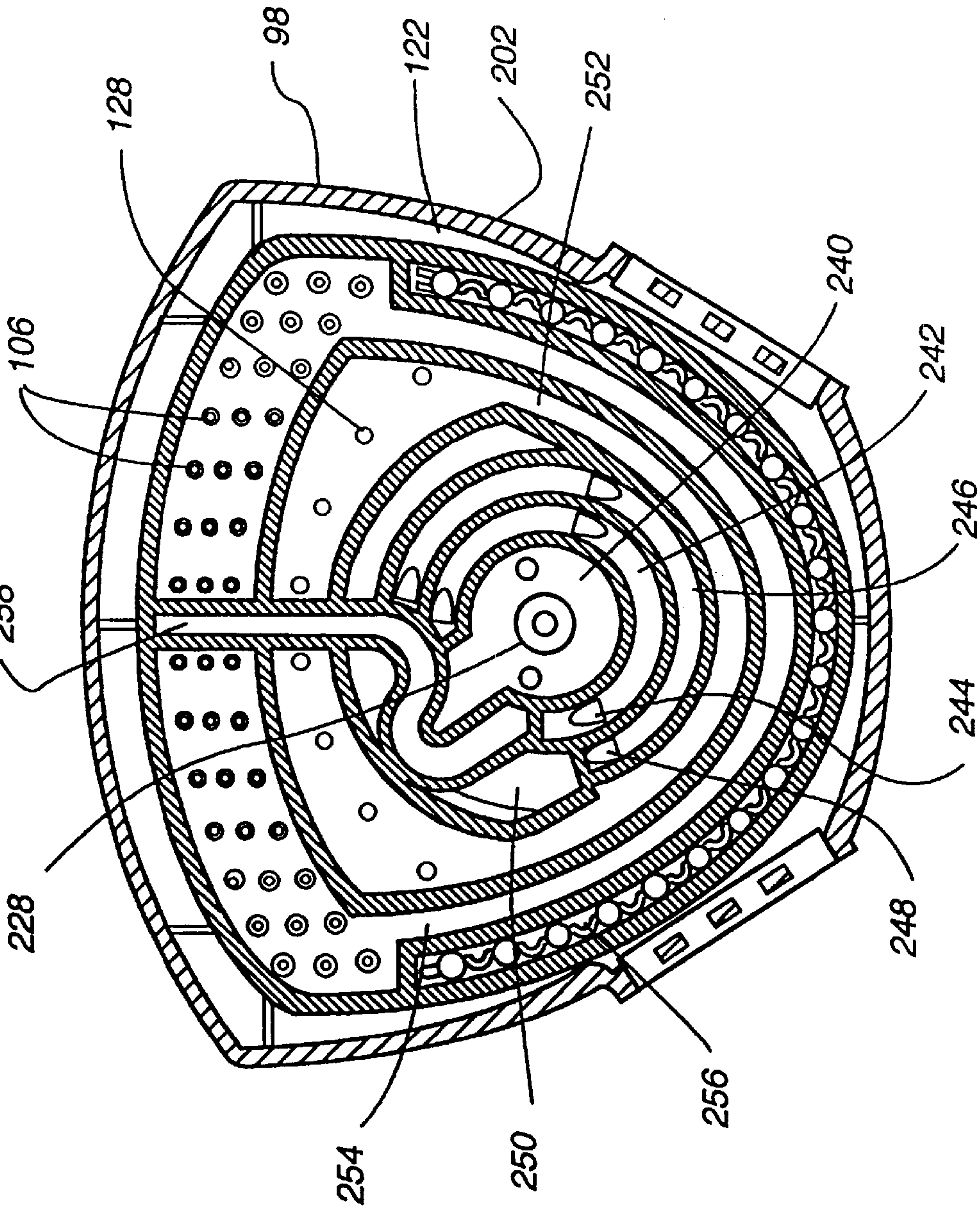
Fig. 7



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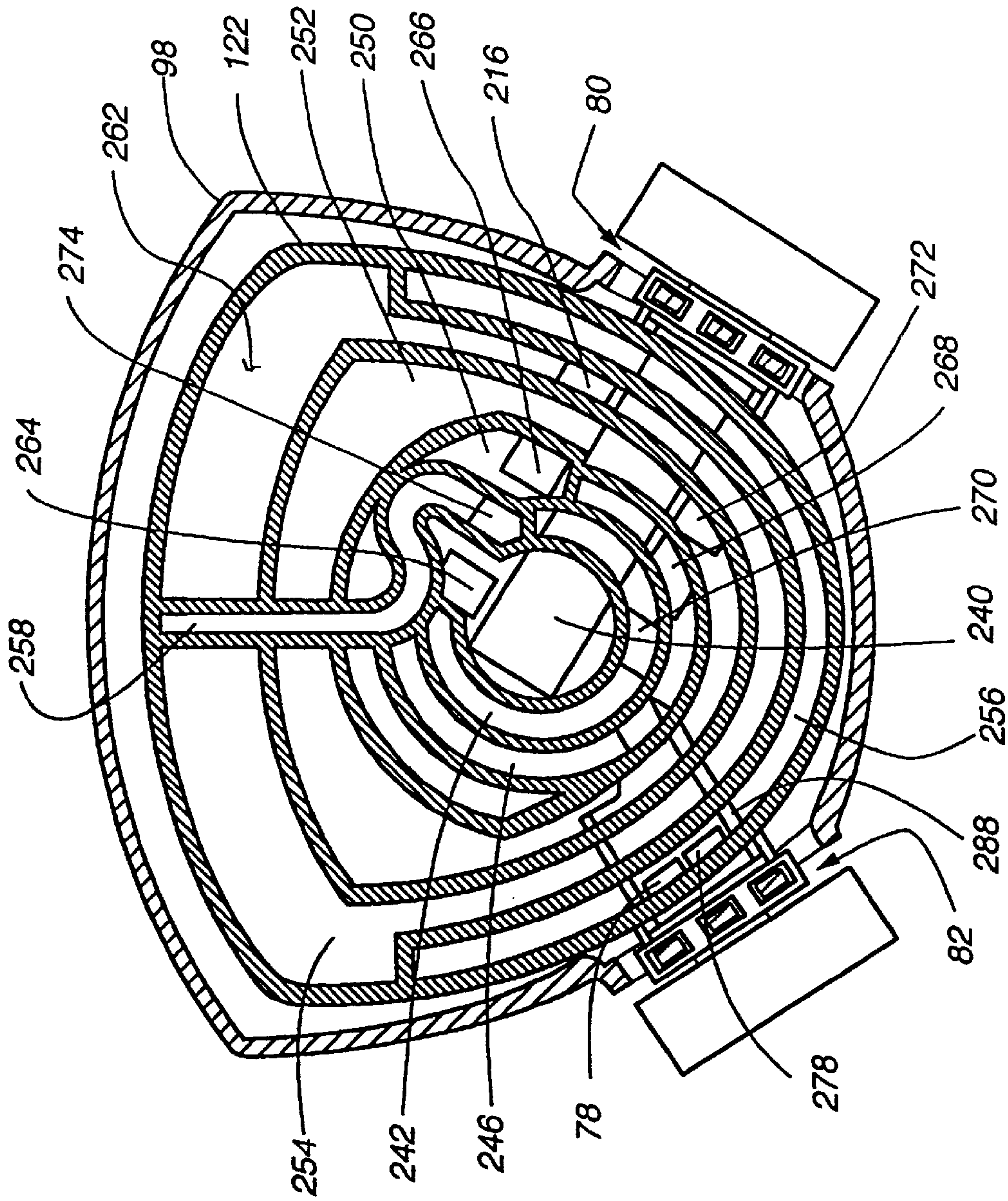
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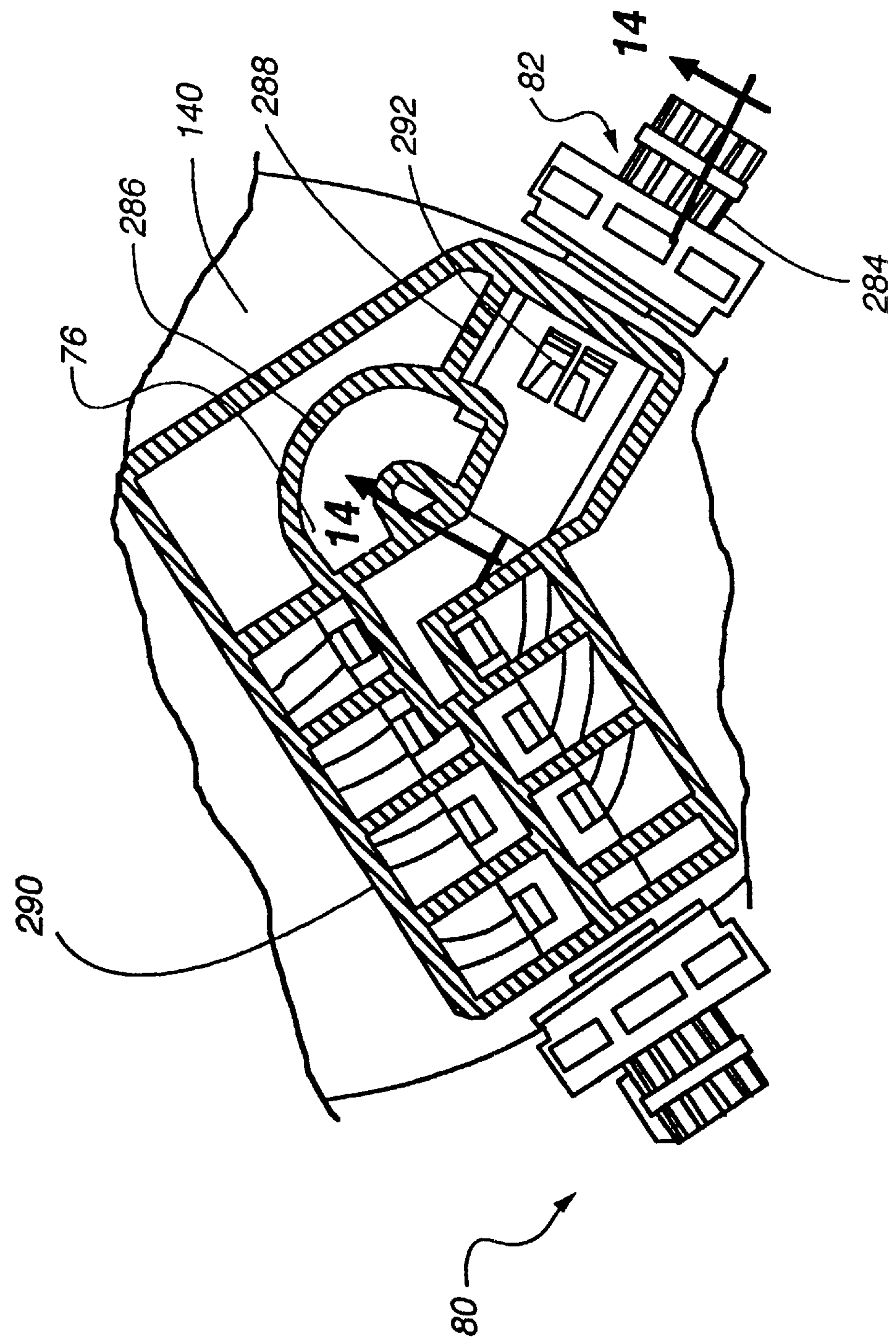
Fig. 9



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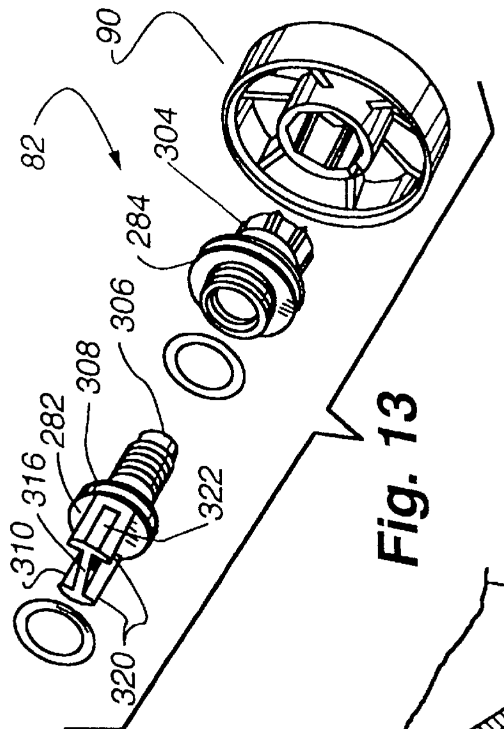

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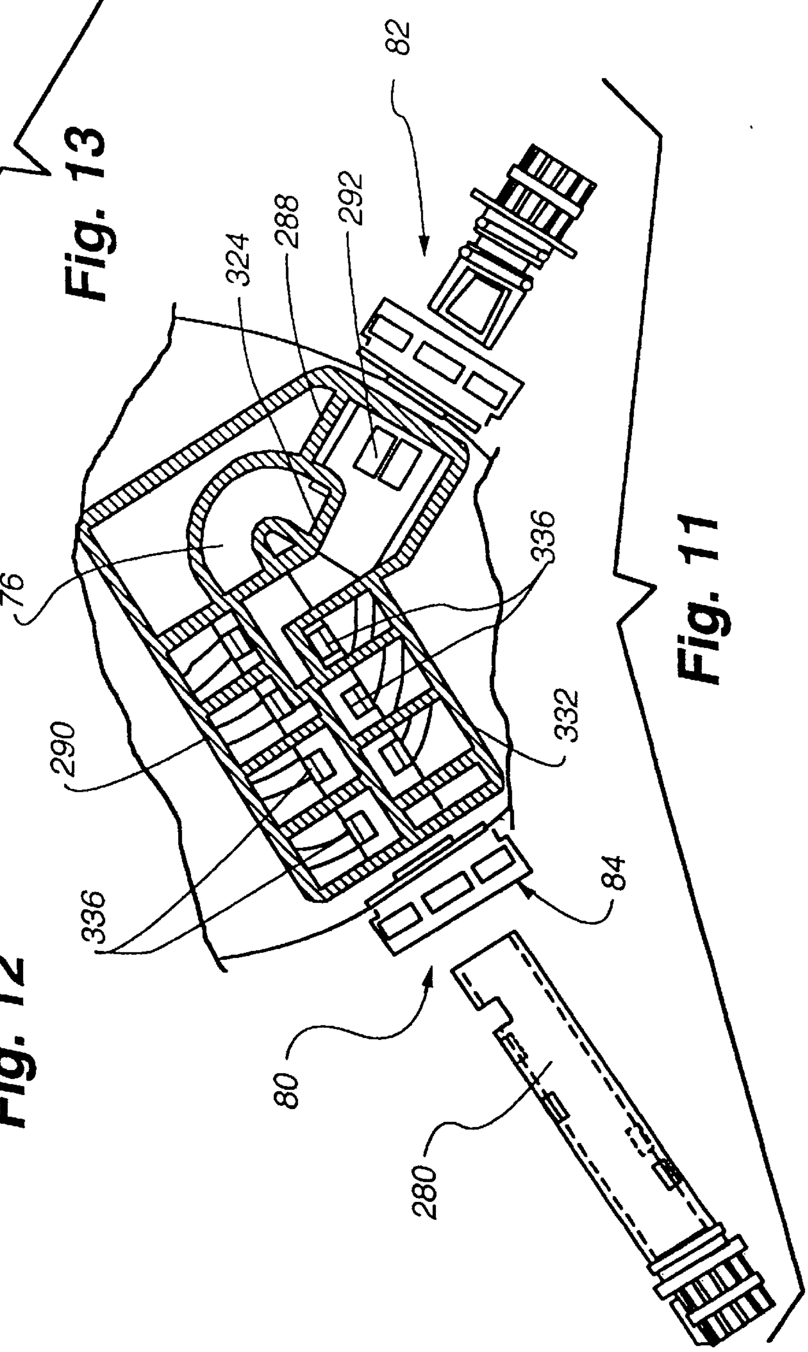

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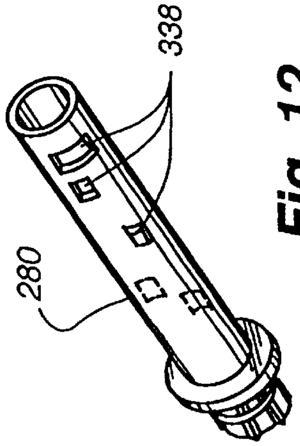

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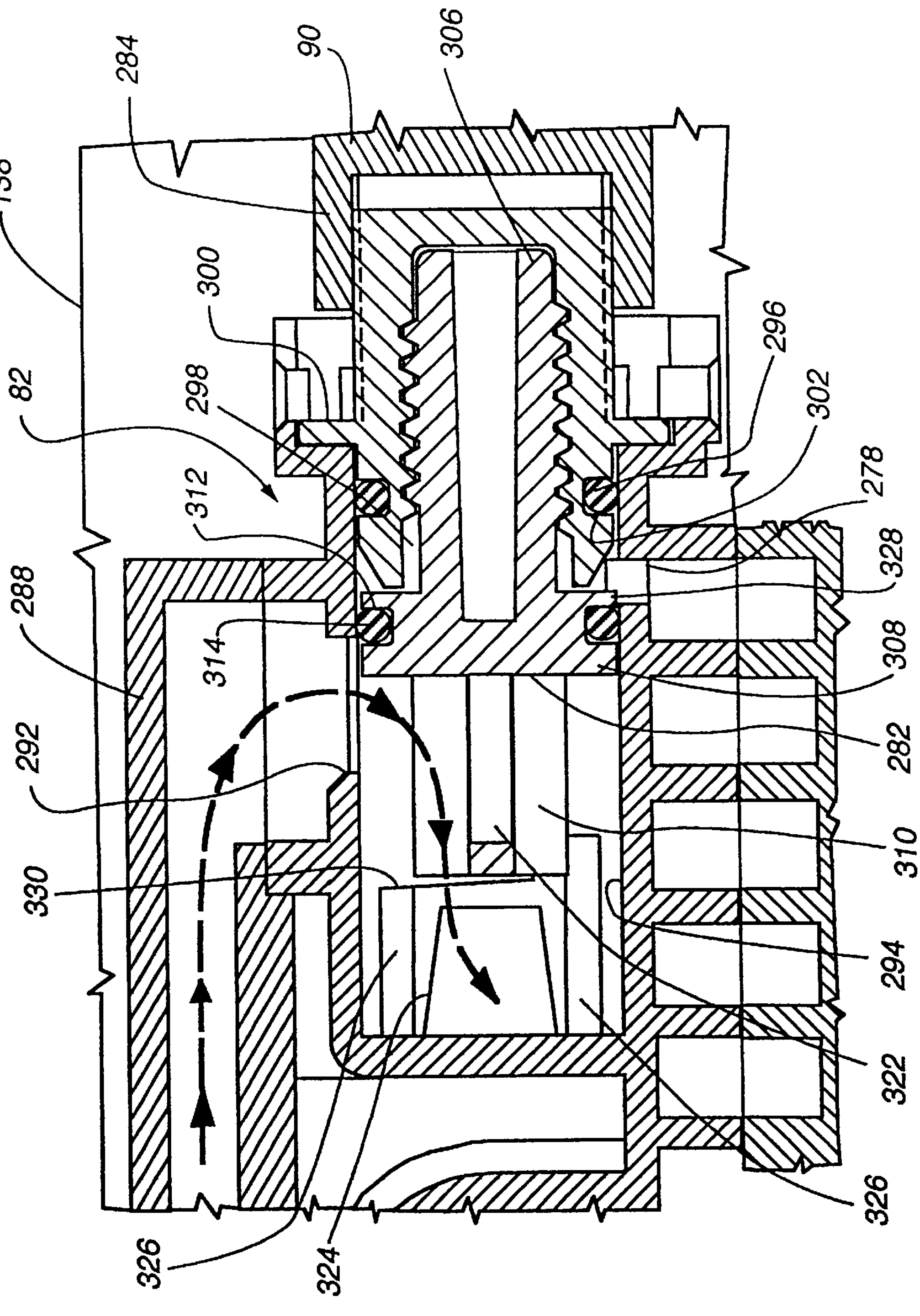
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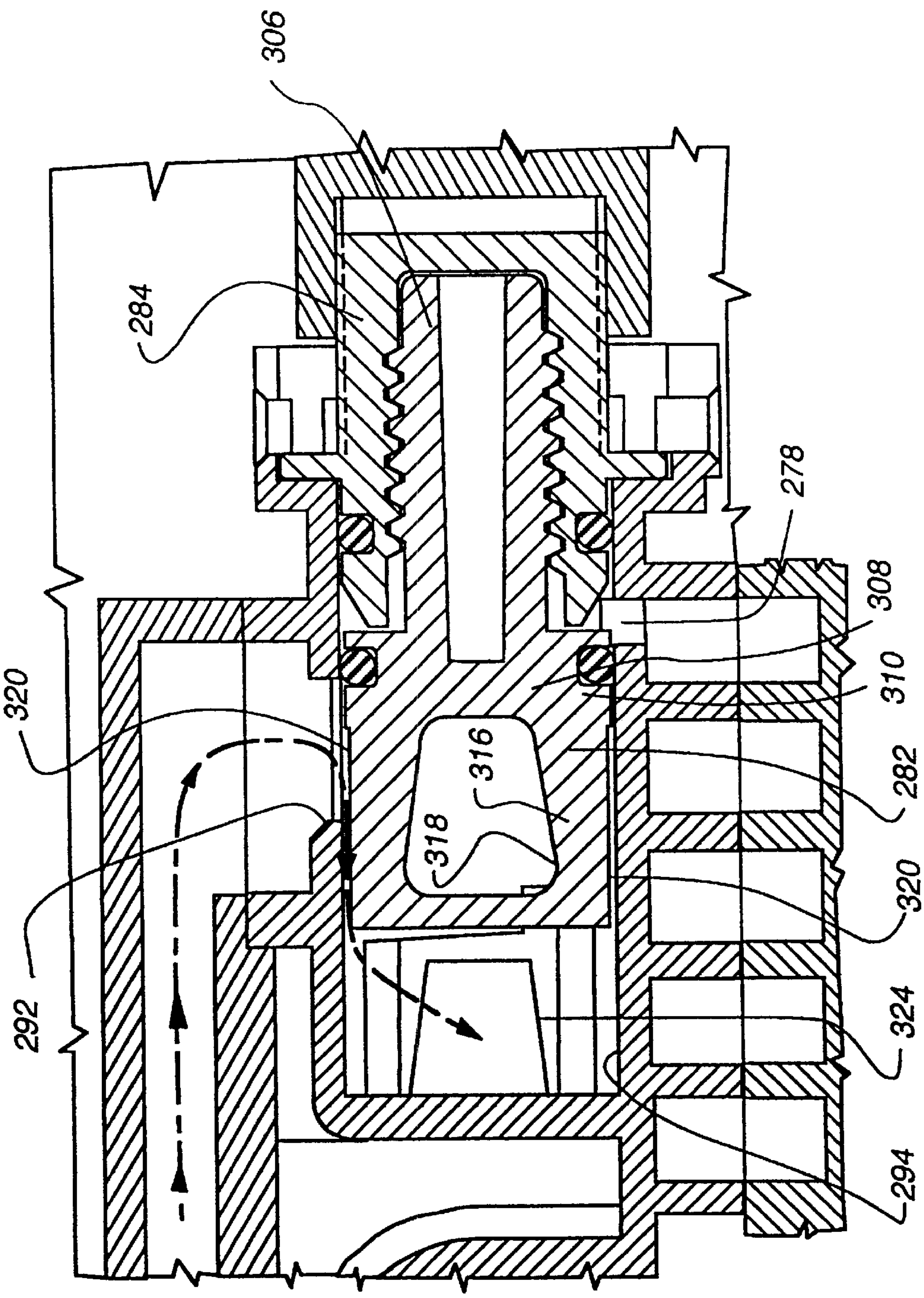
Fig. 14



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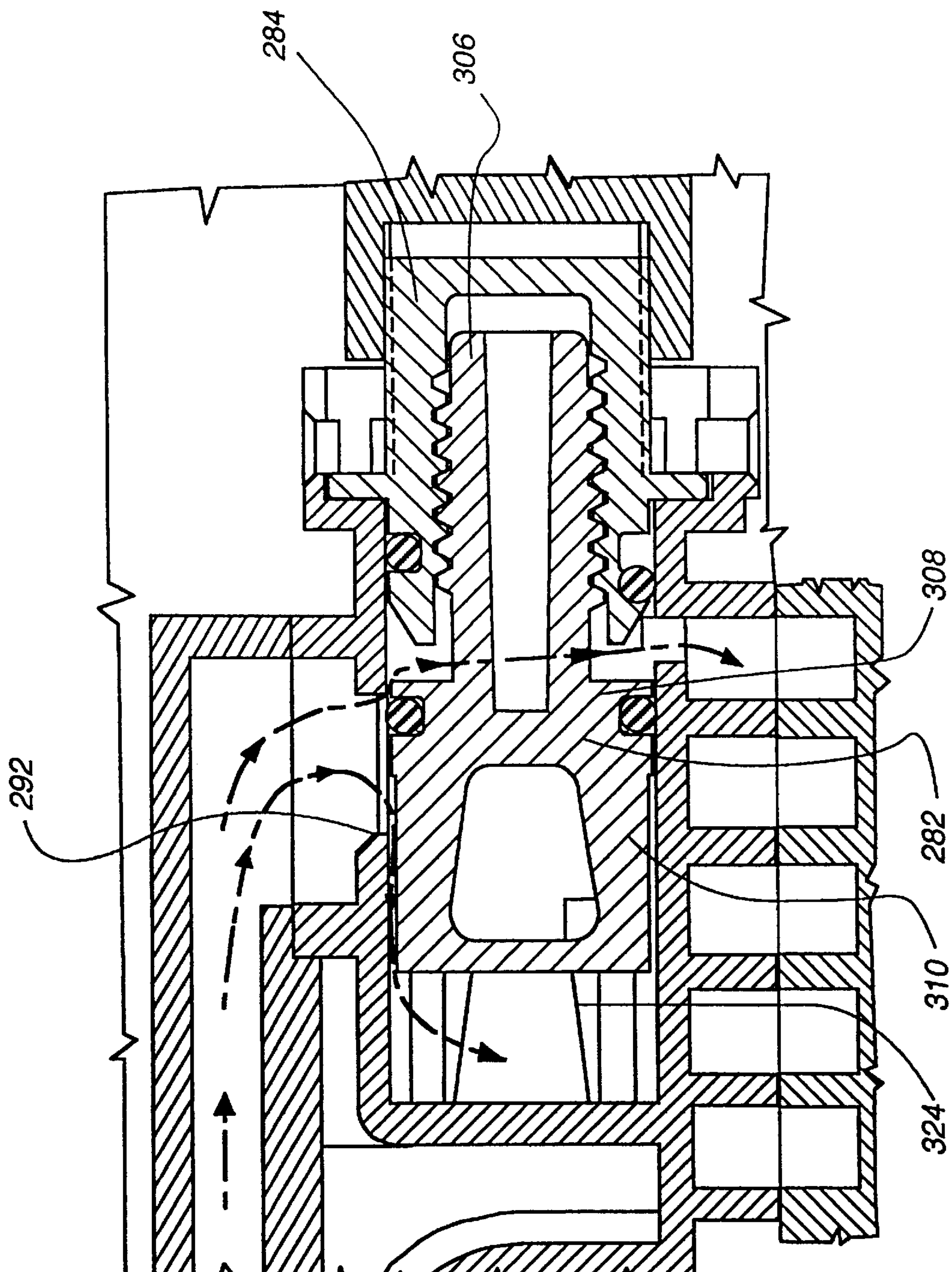

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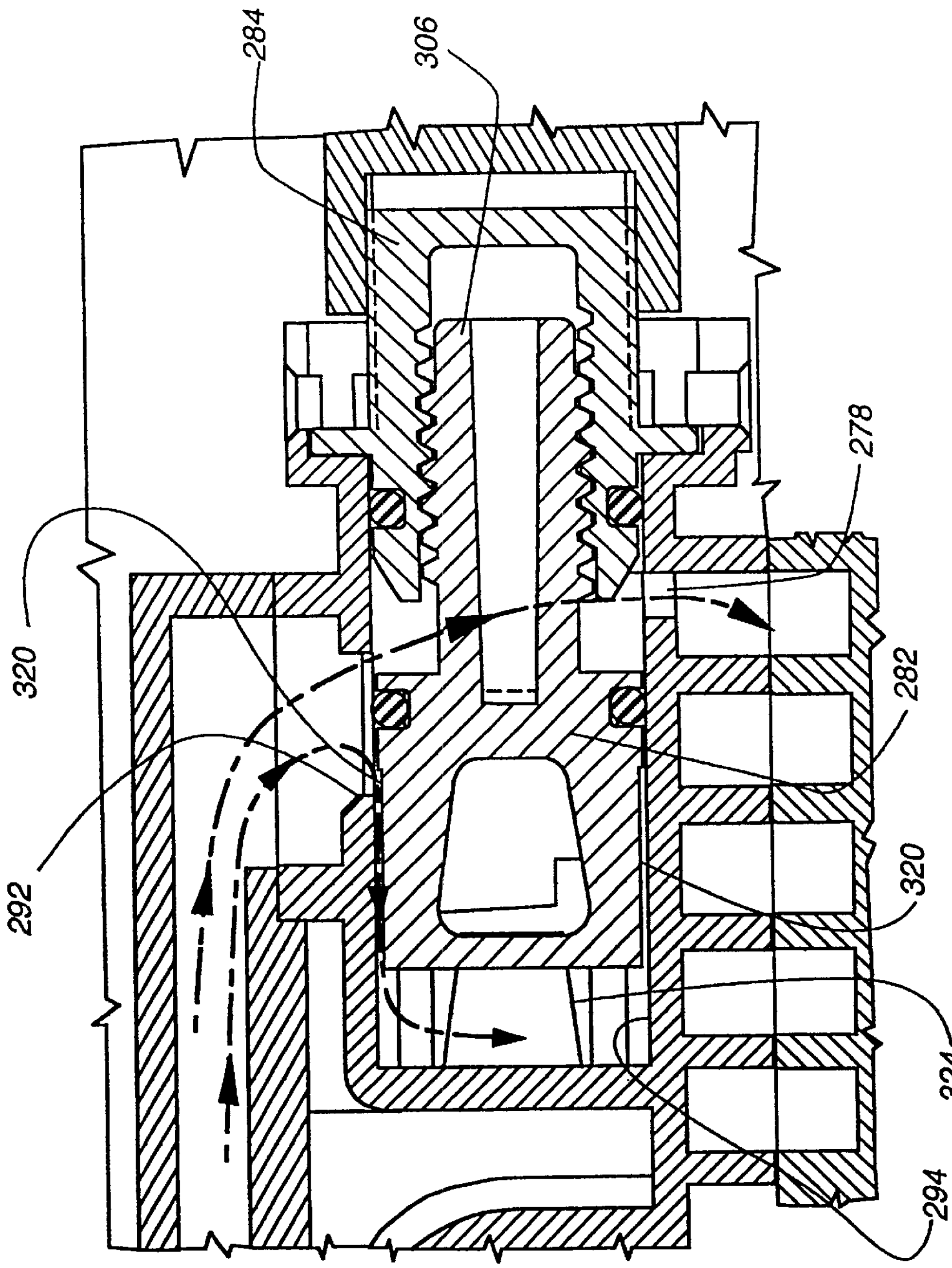

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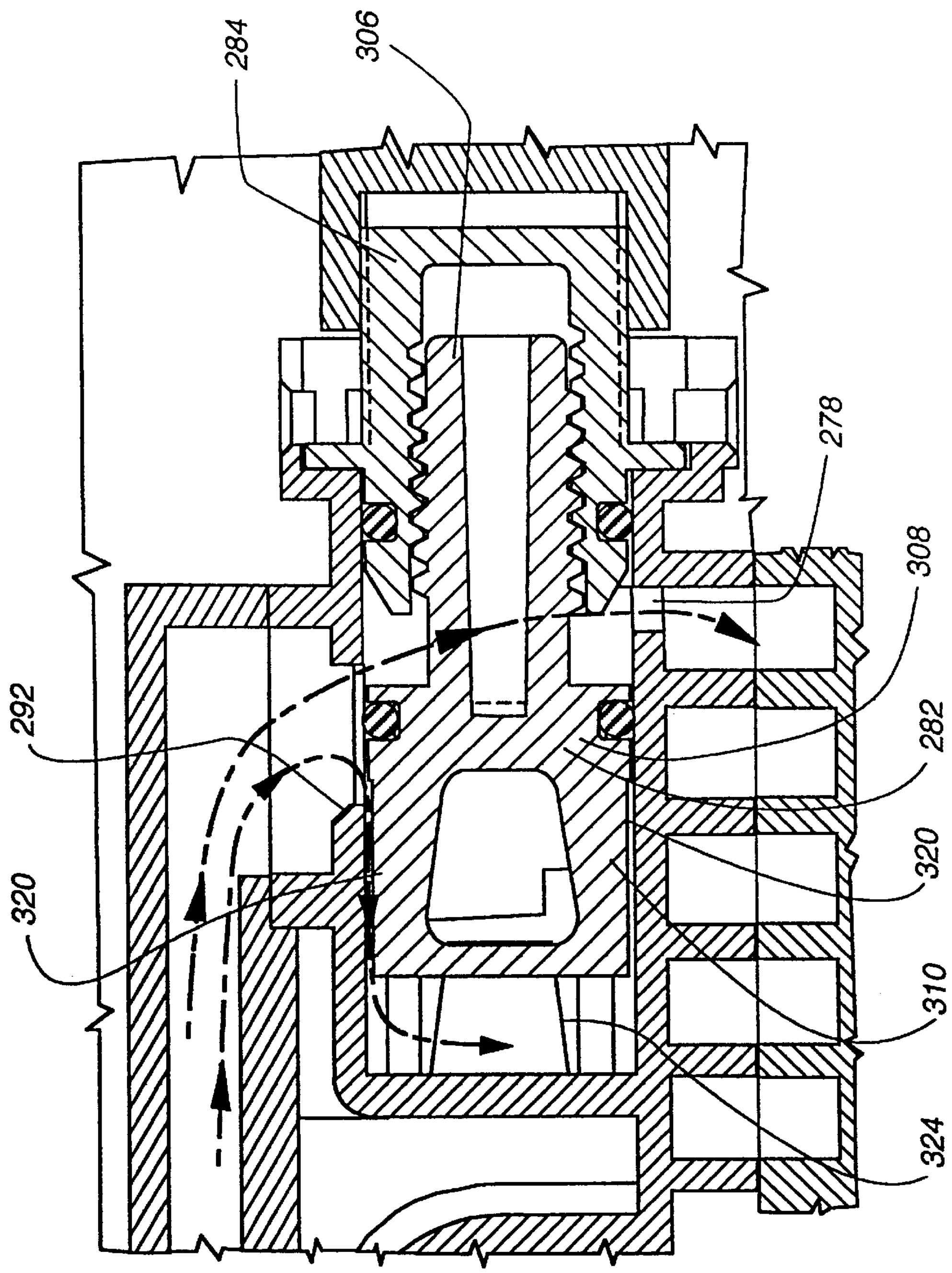

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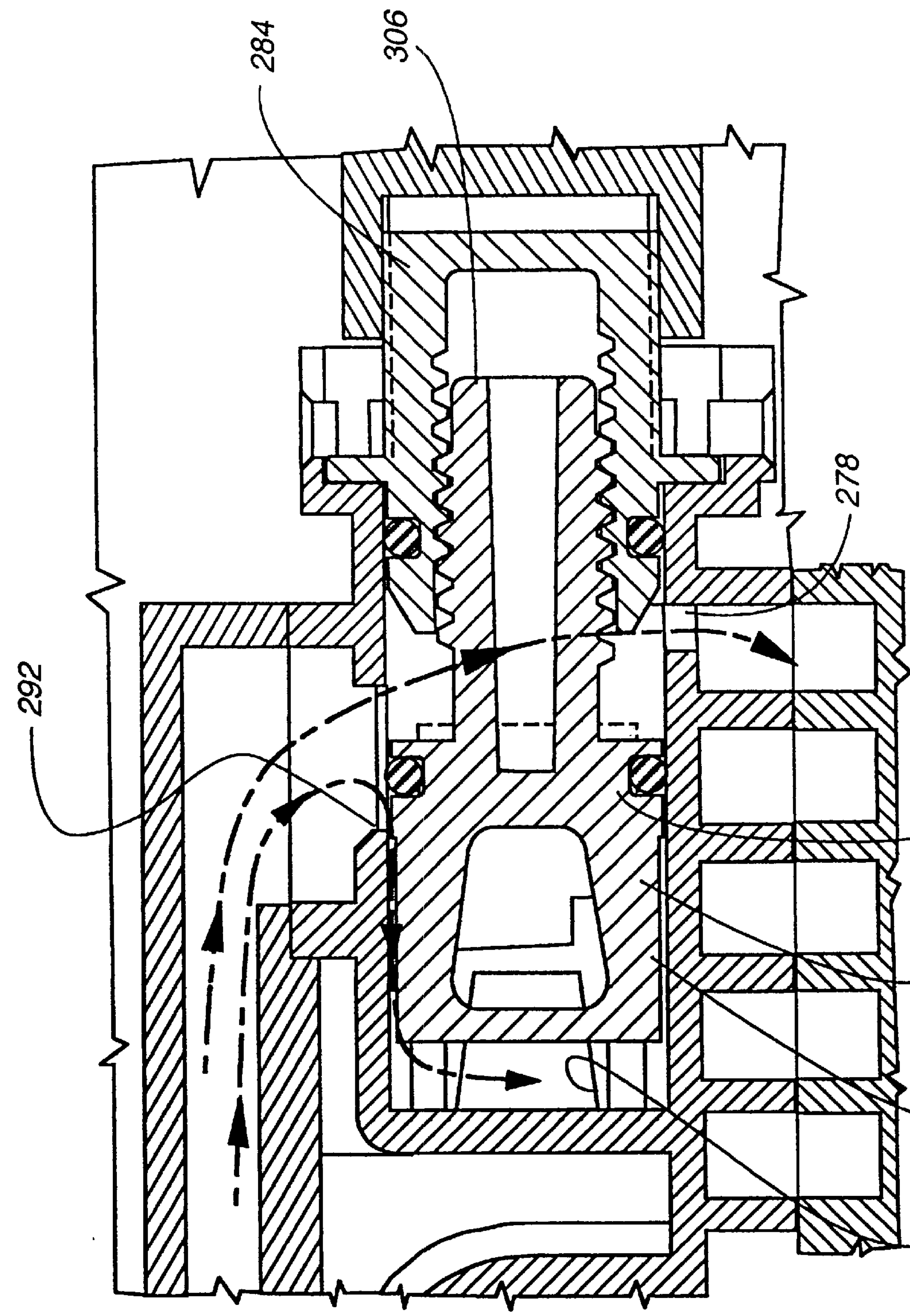

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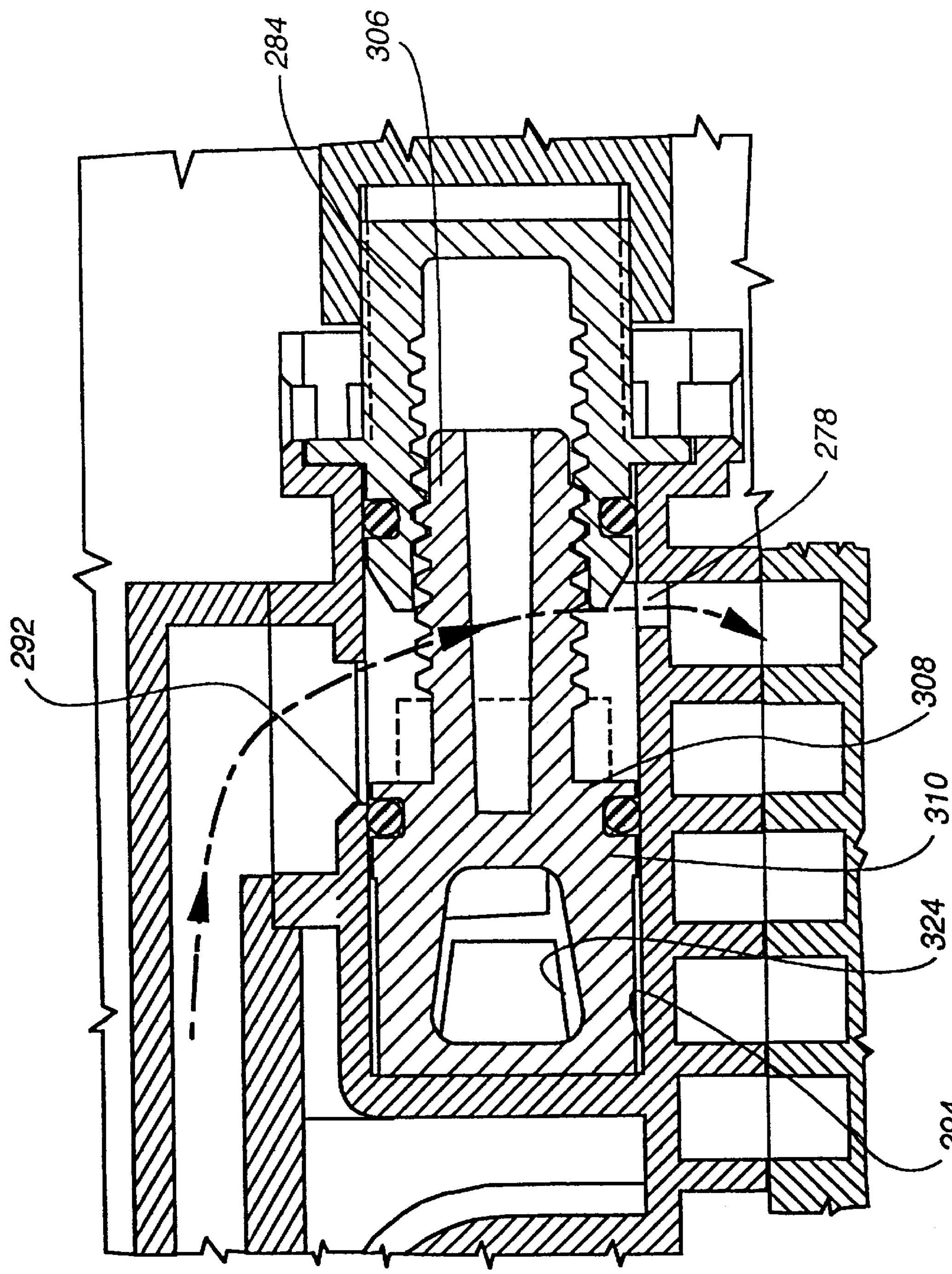

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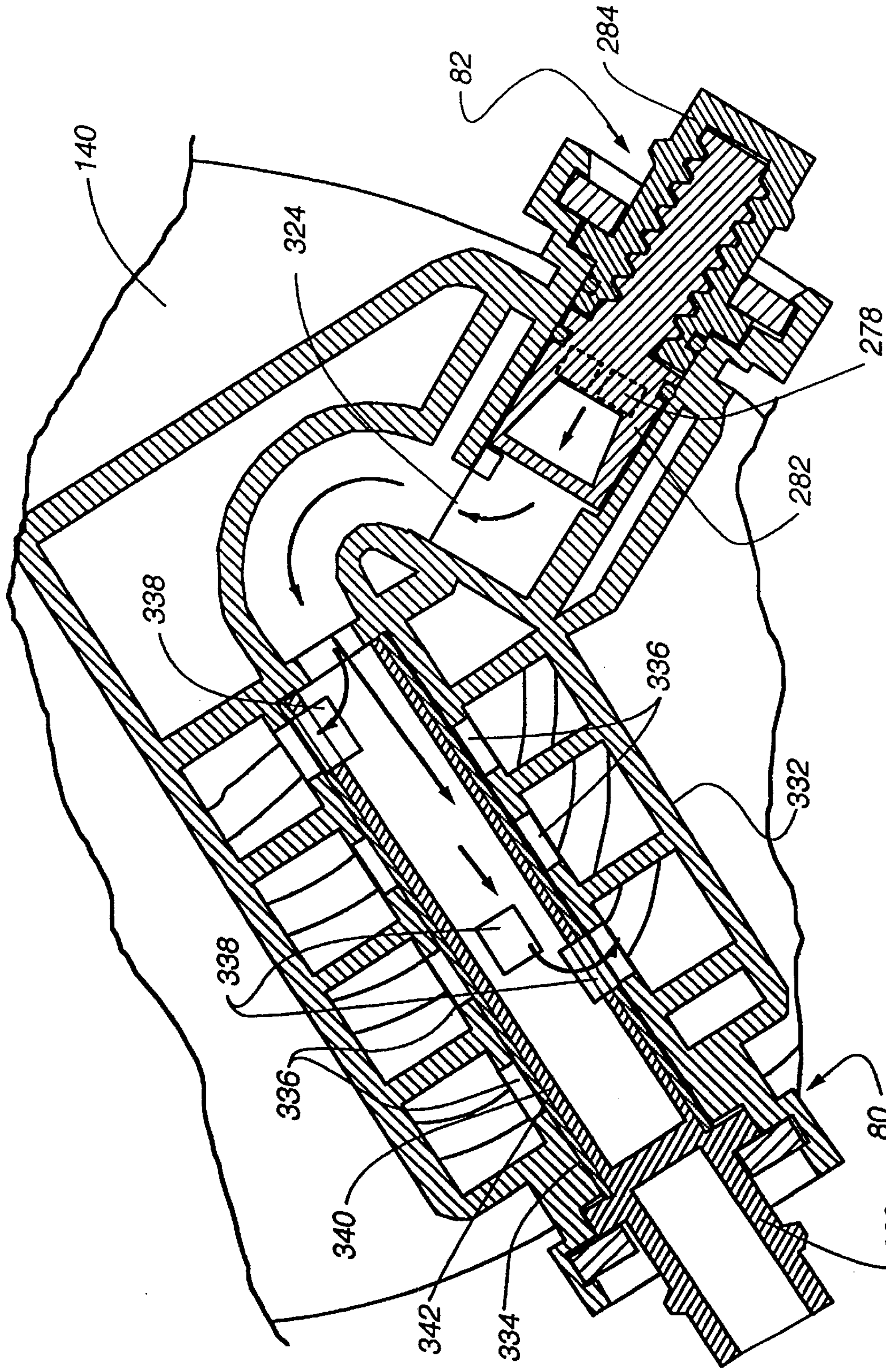

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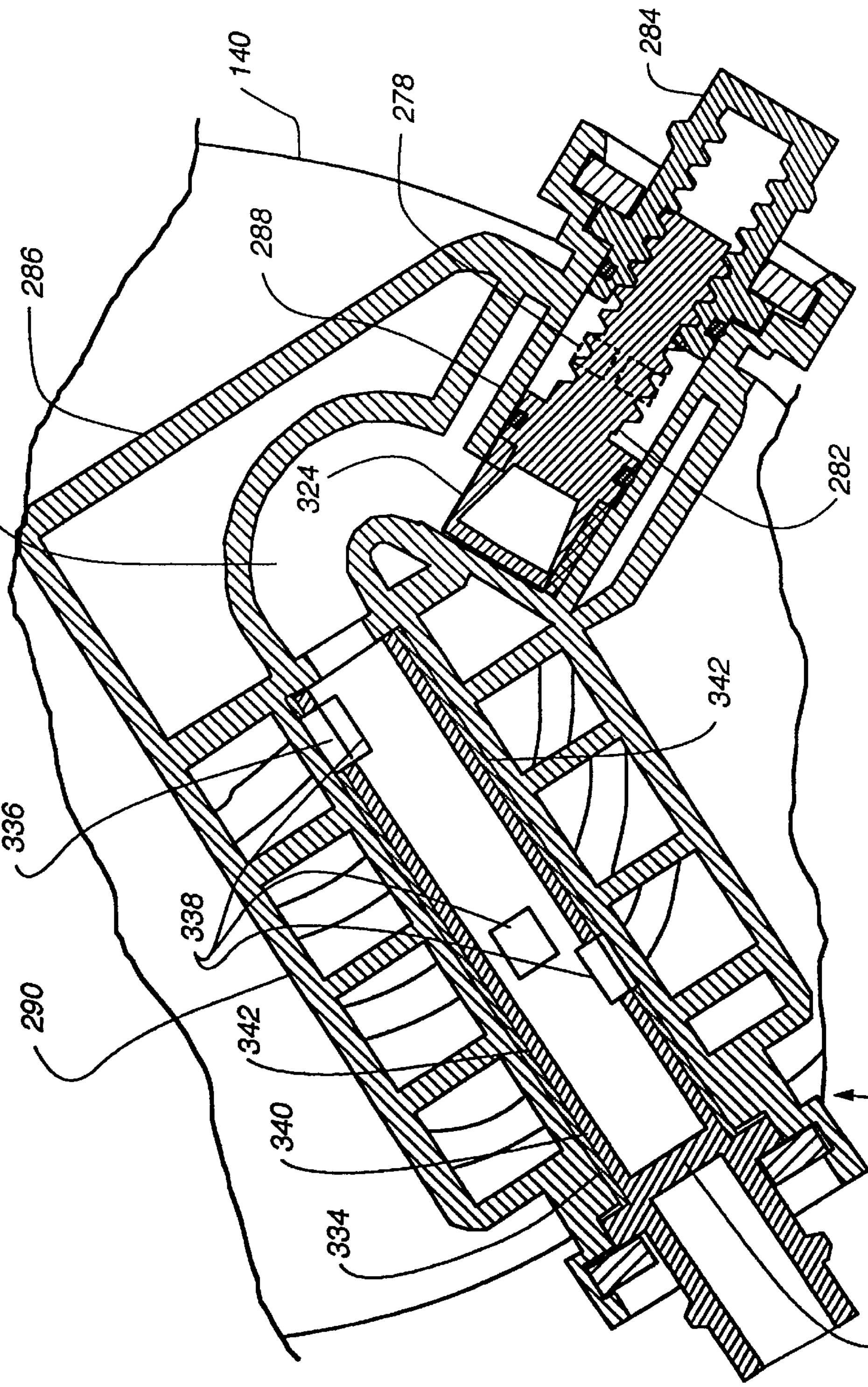

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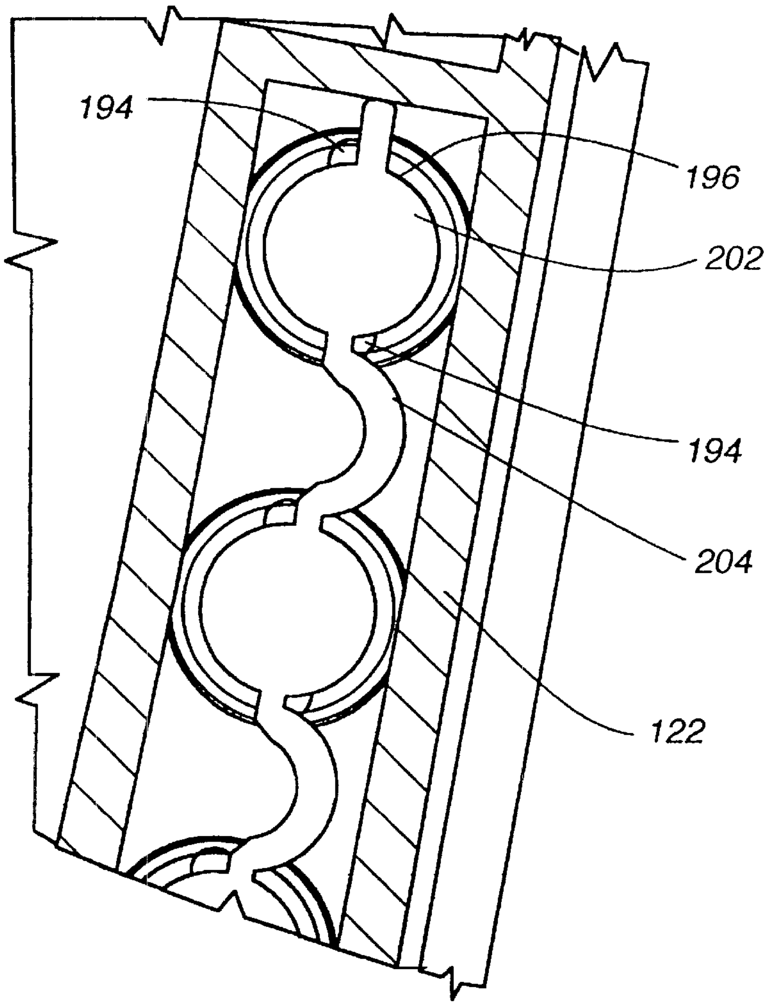
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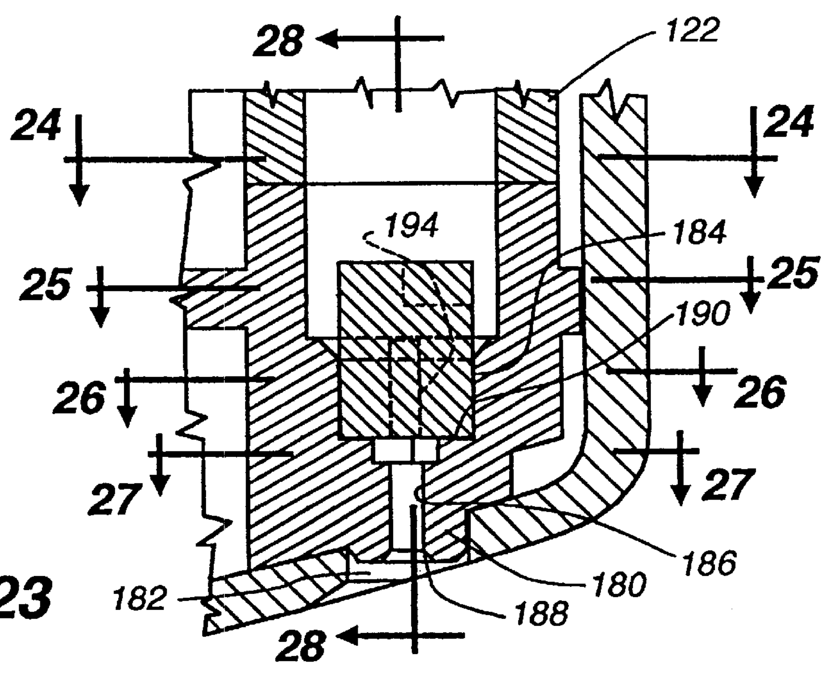
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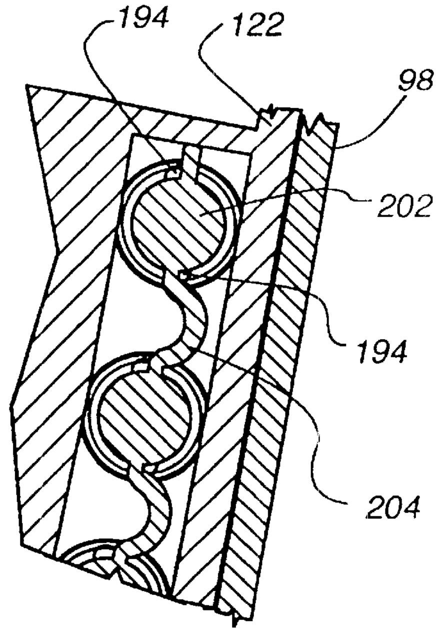
Fig. 23



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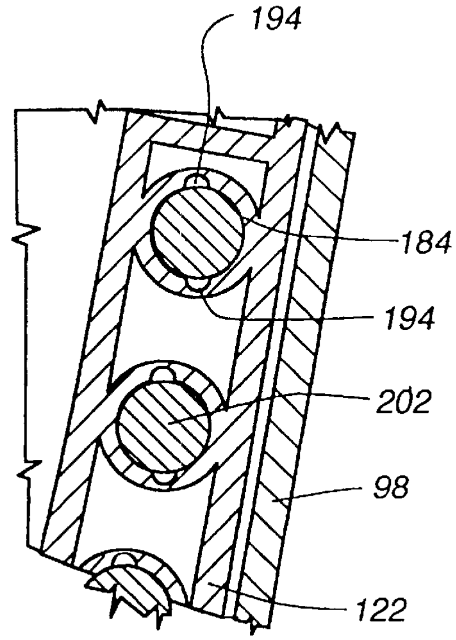

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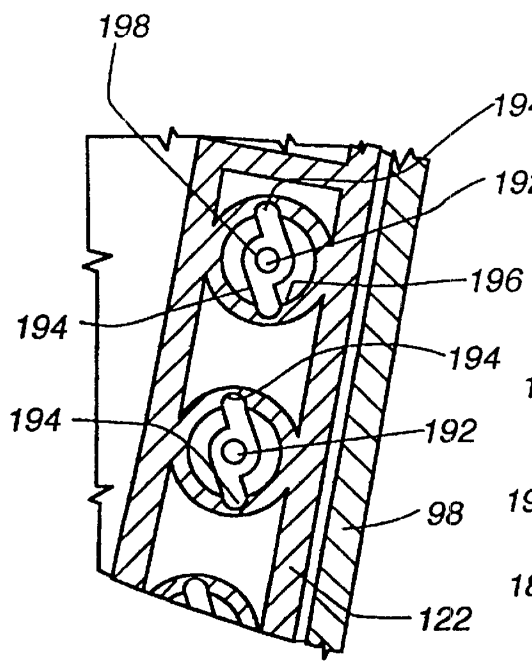

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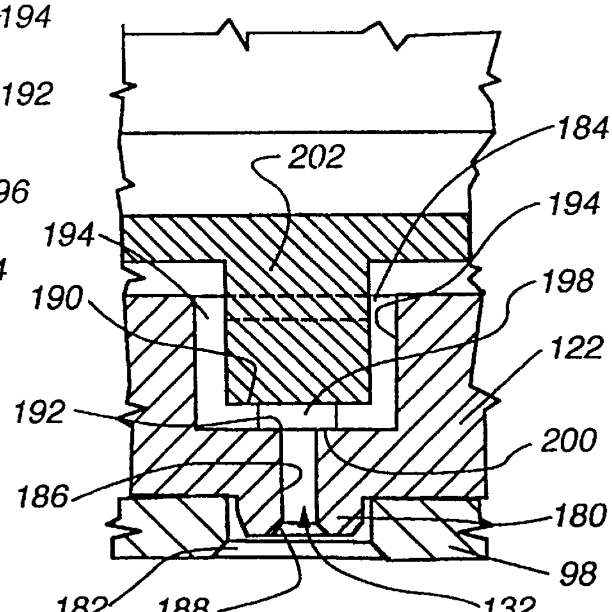

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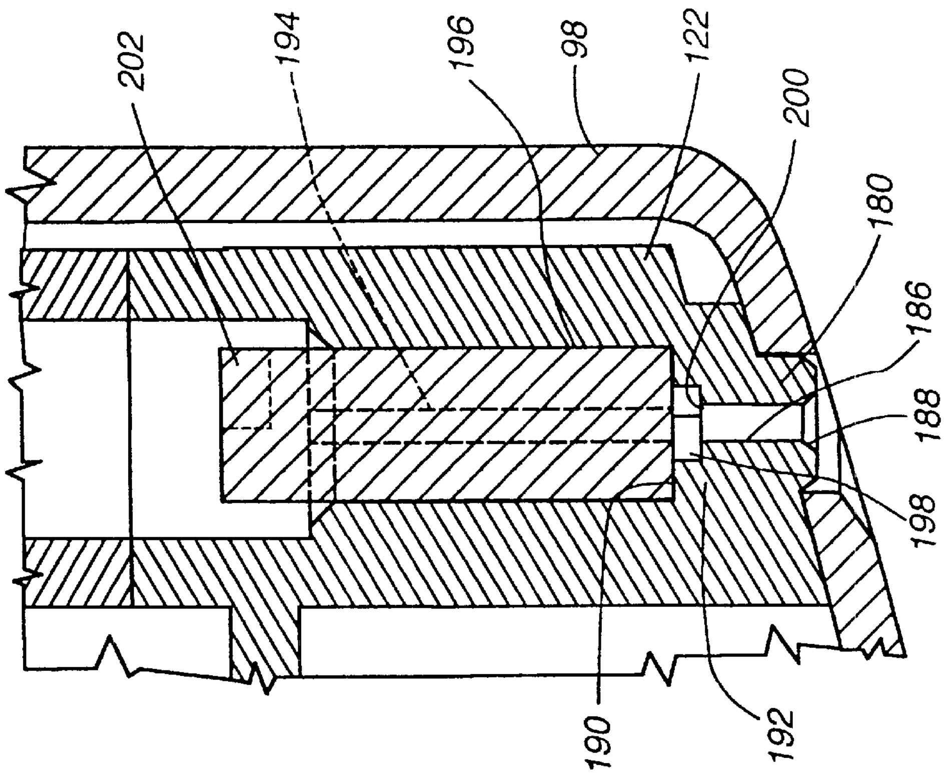
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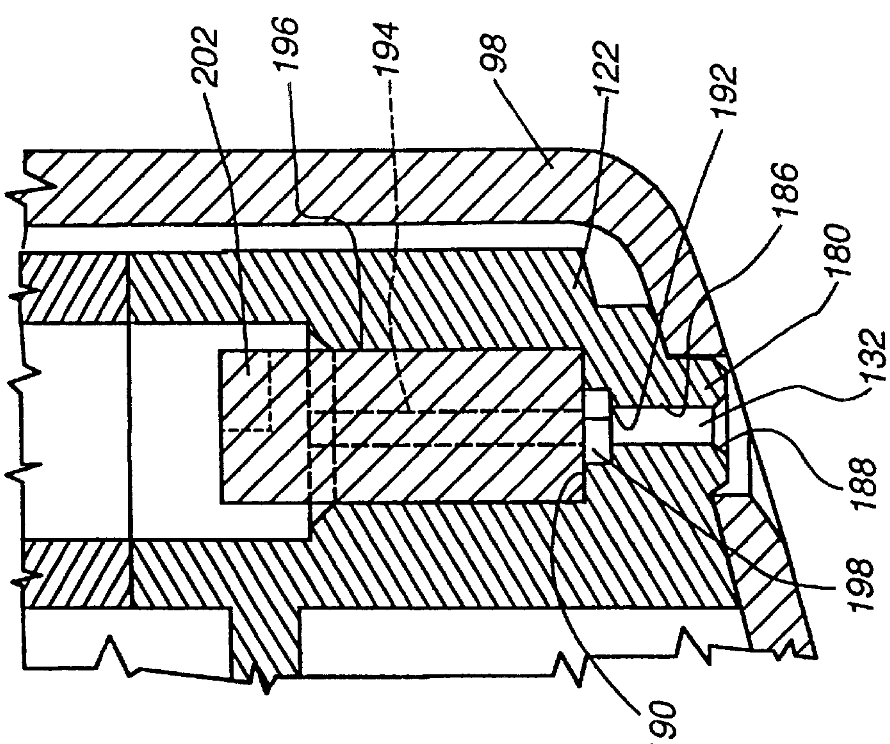
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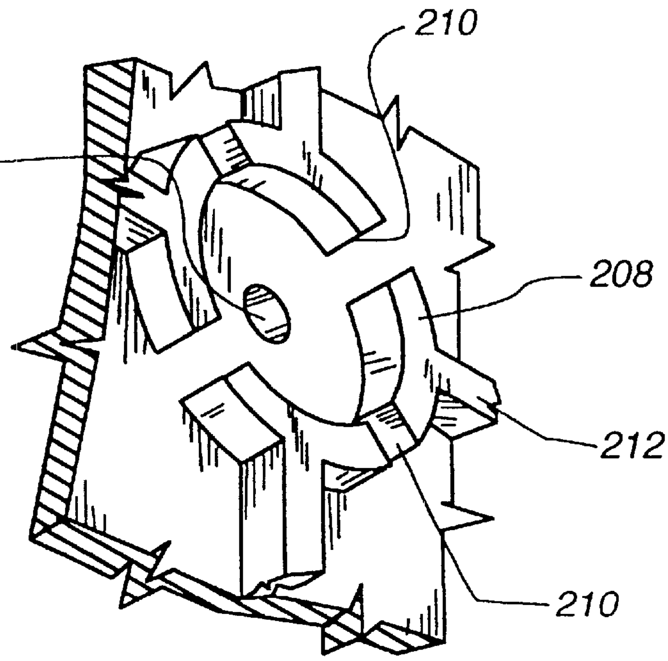
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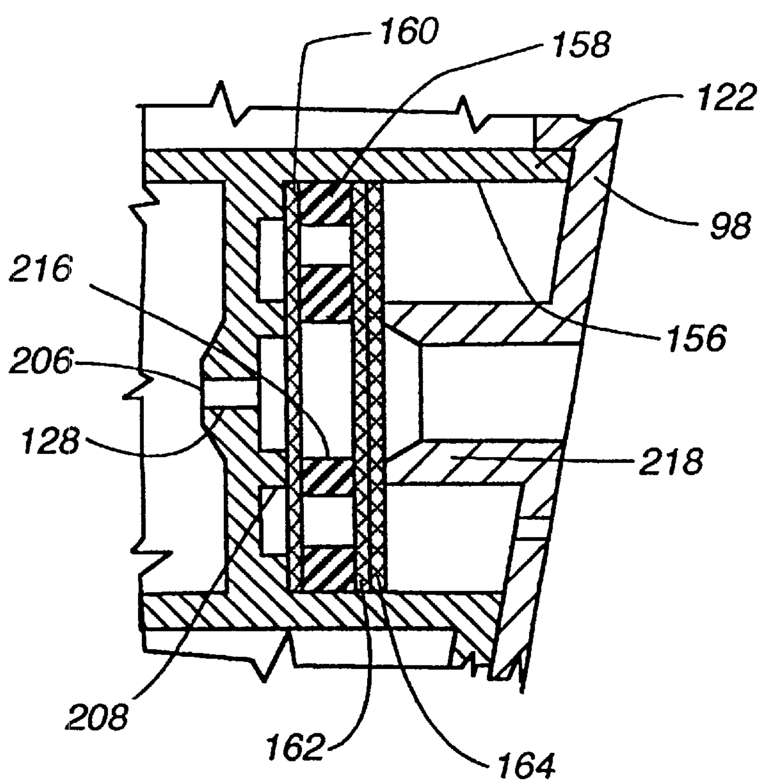
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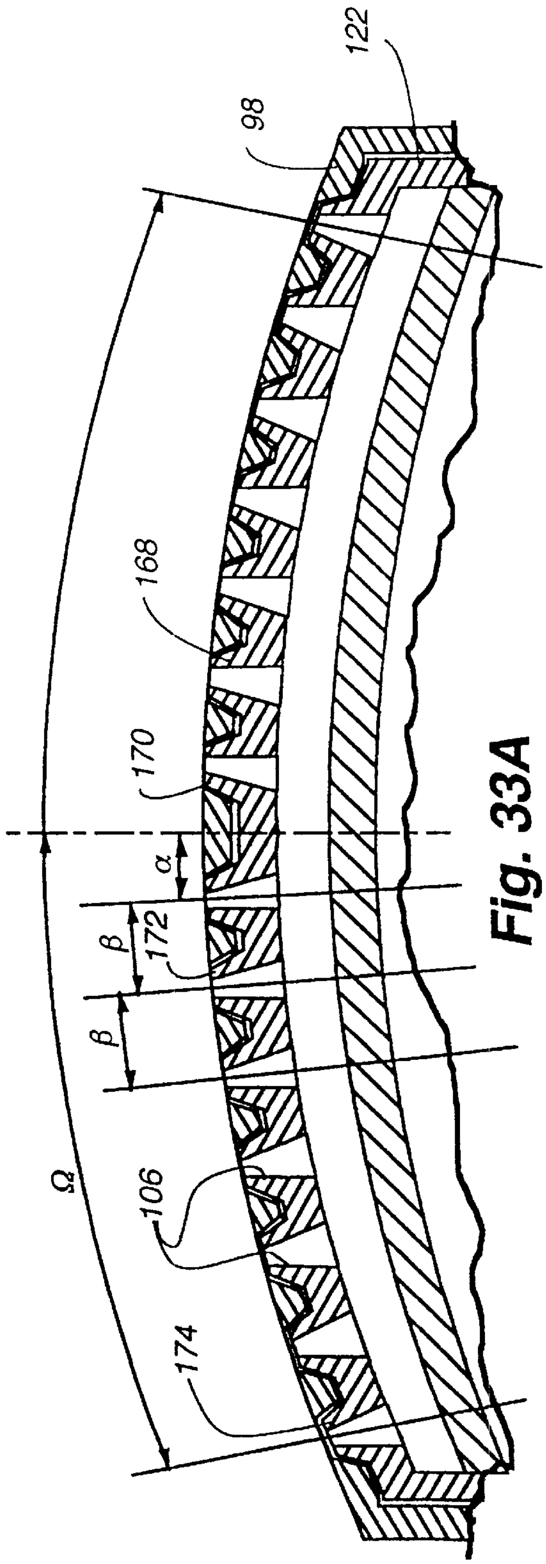

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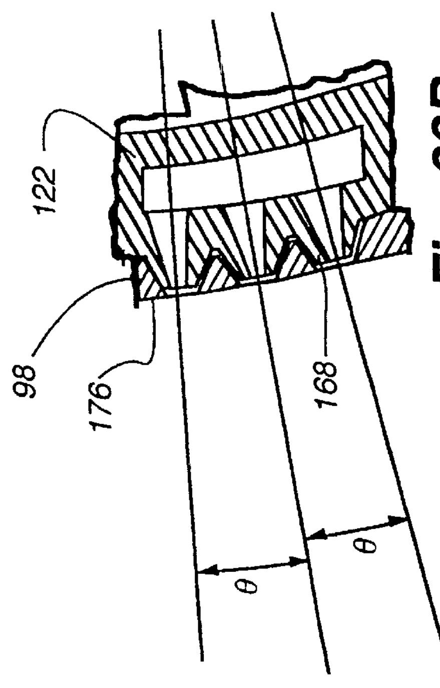

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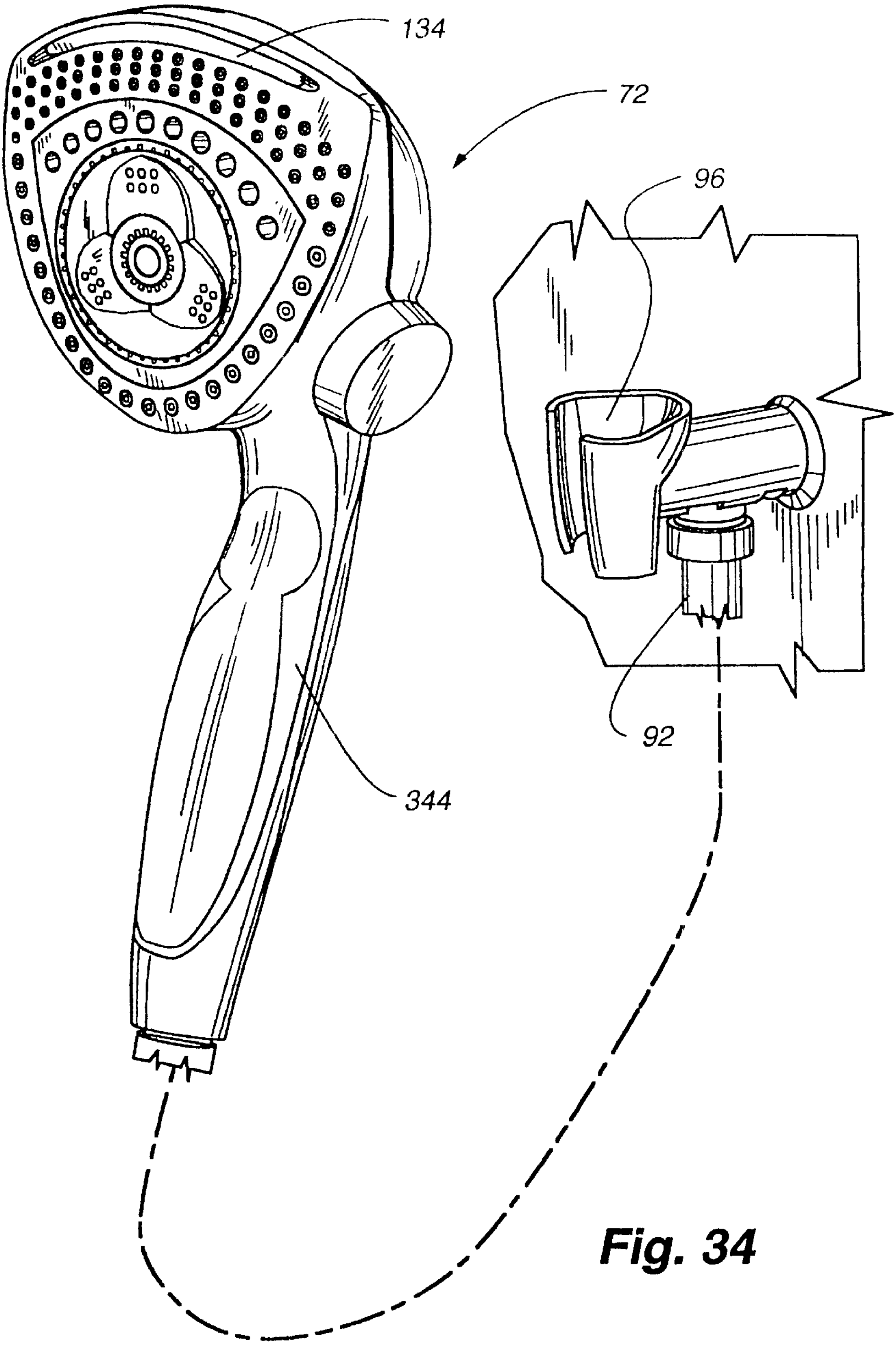

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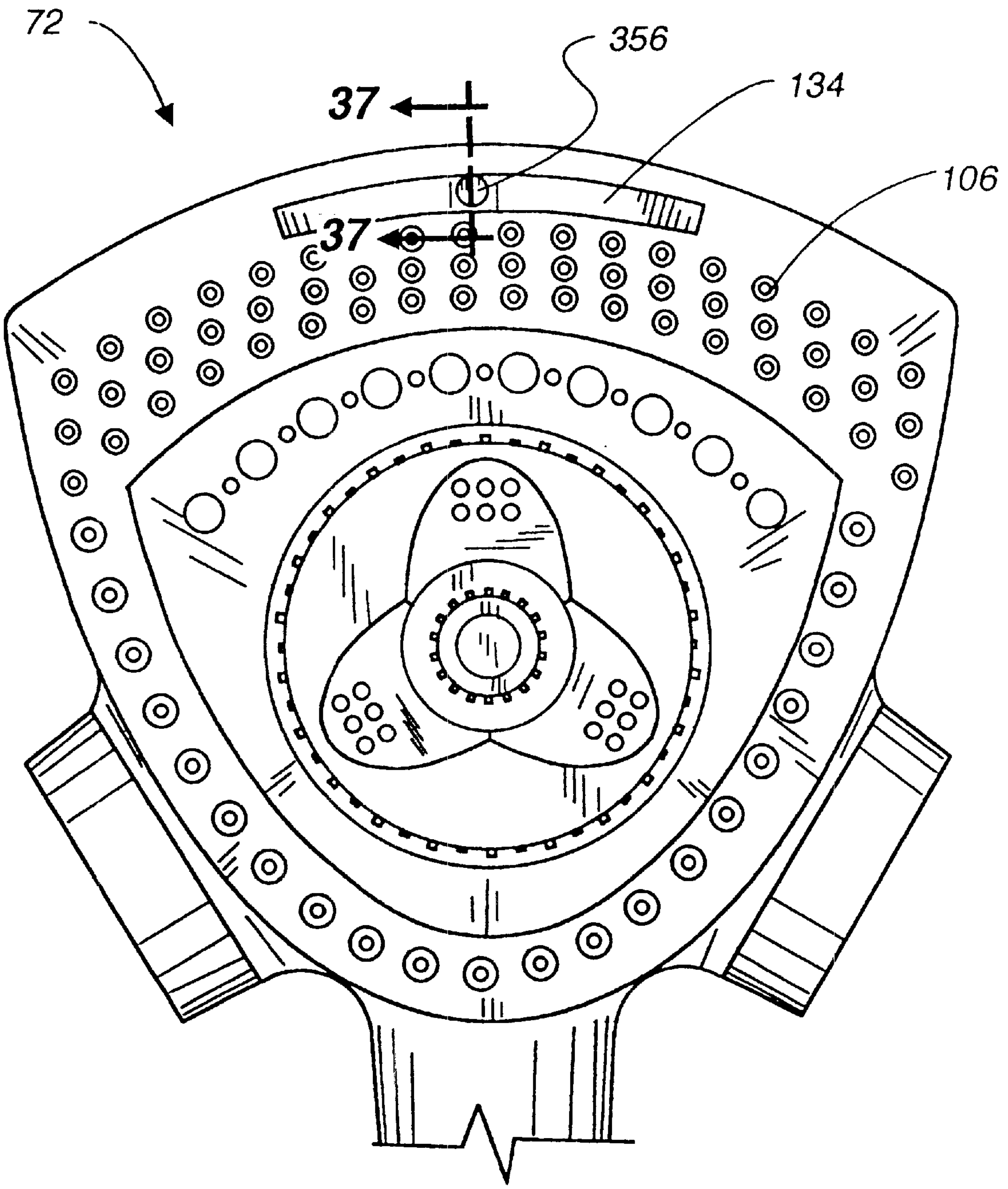

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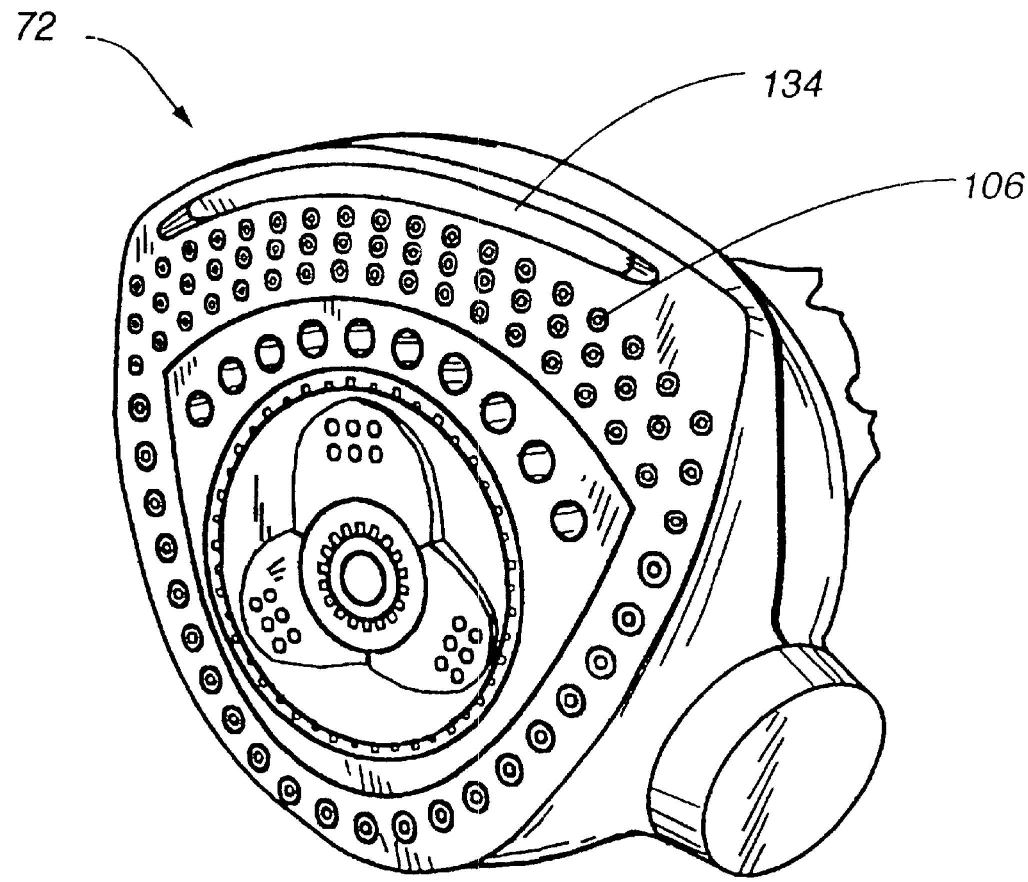

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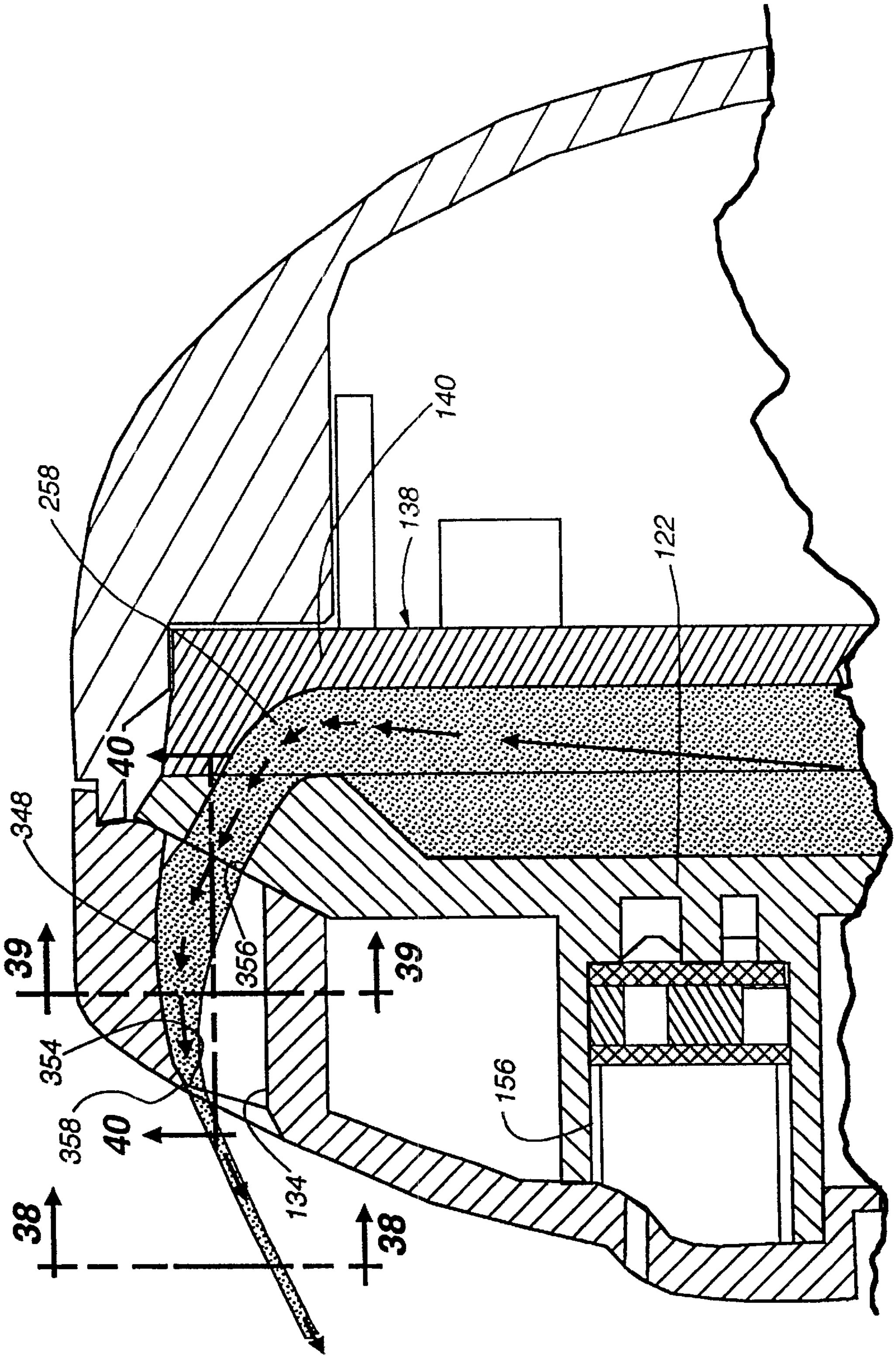

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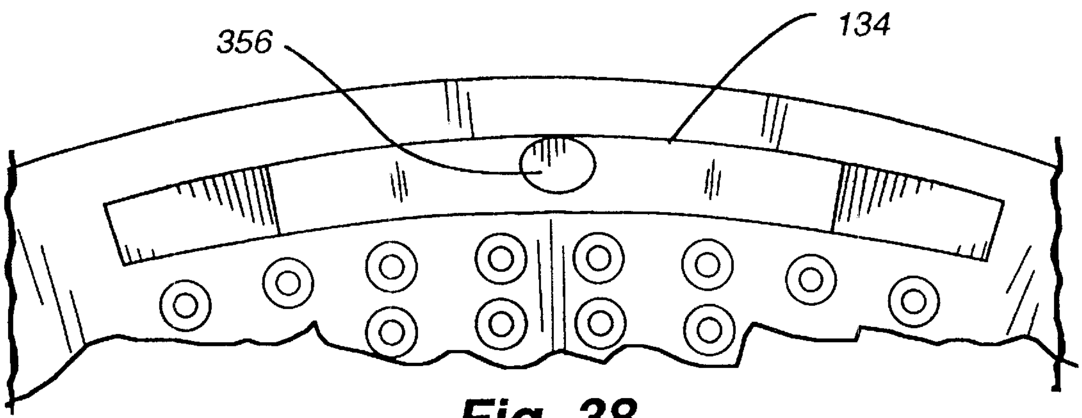

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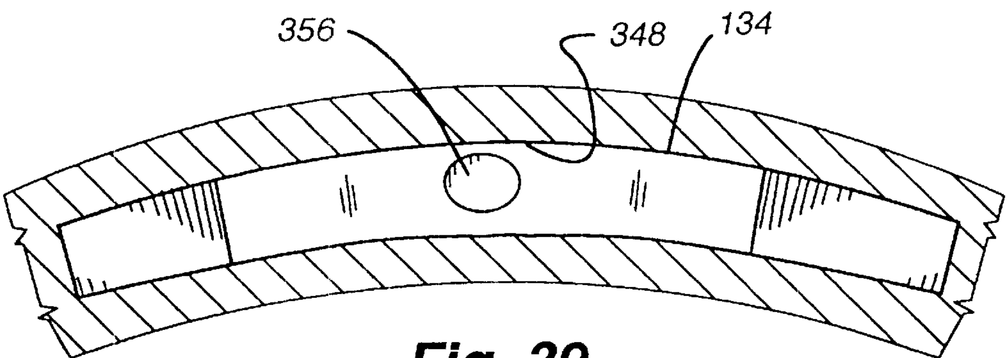

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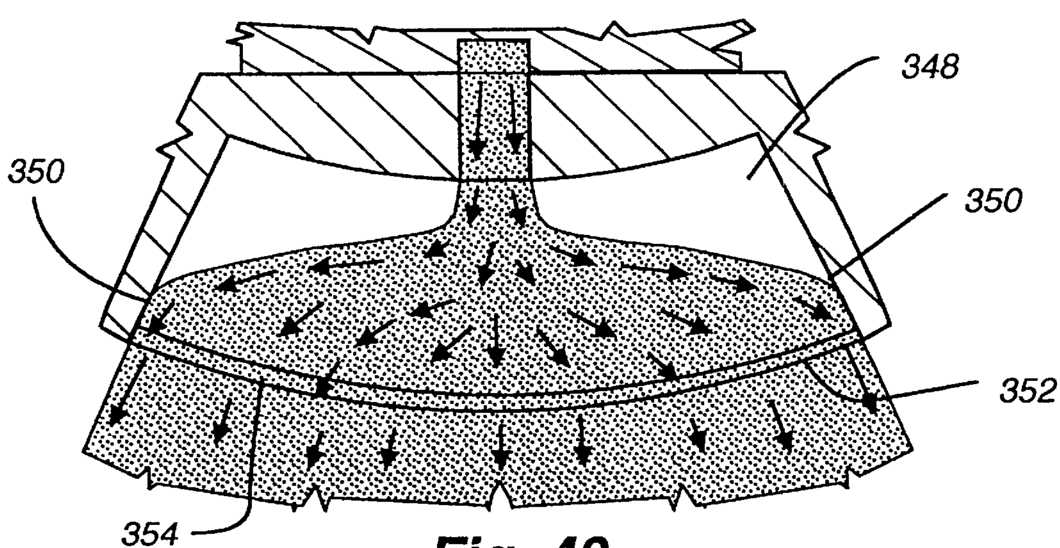

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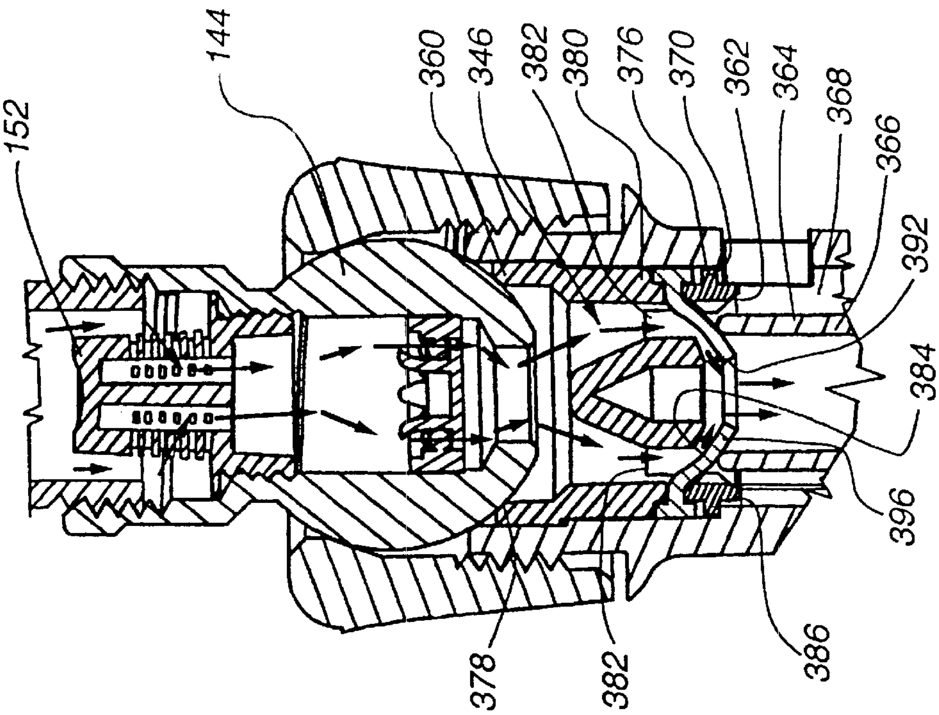
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Fig. 42

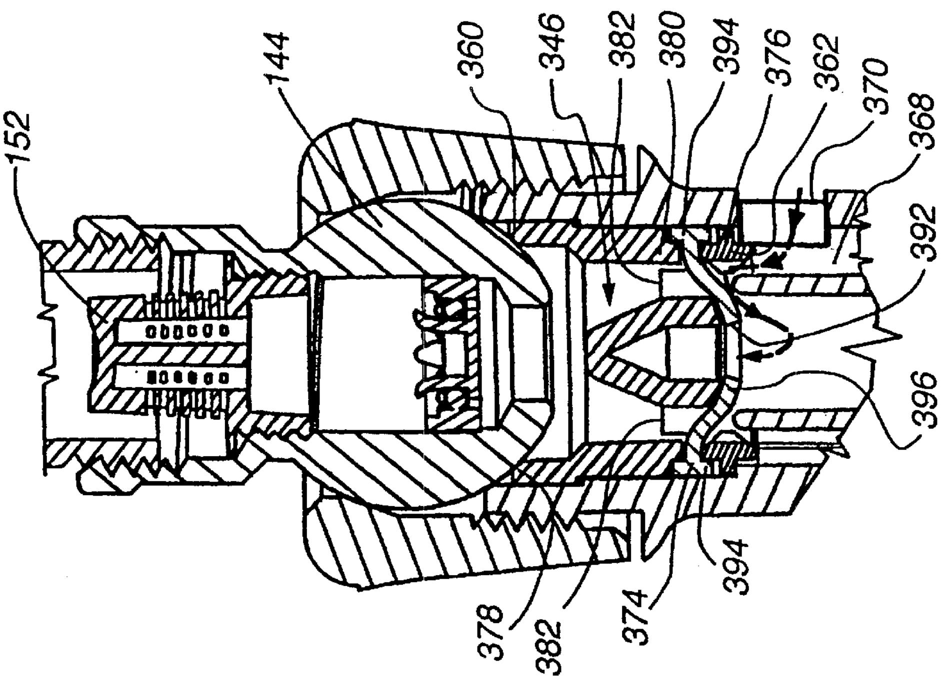
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Fig. 41

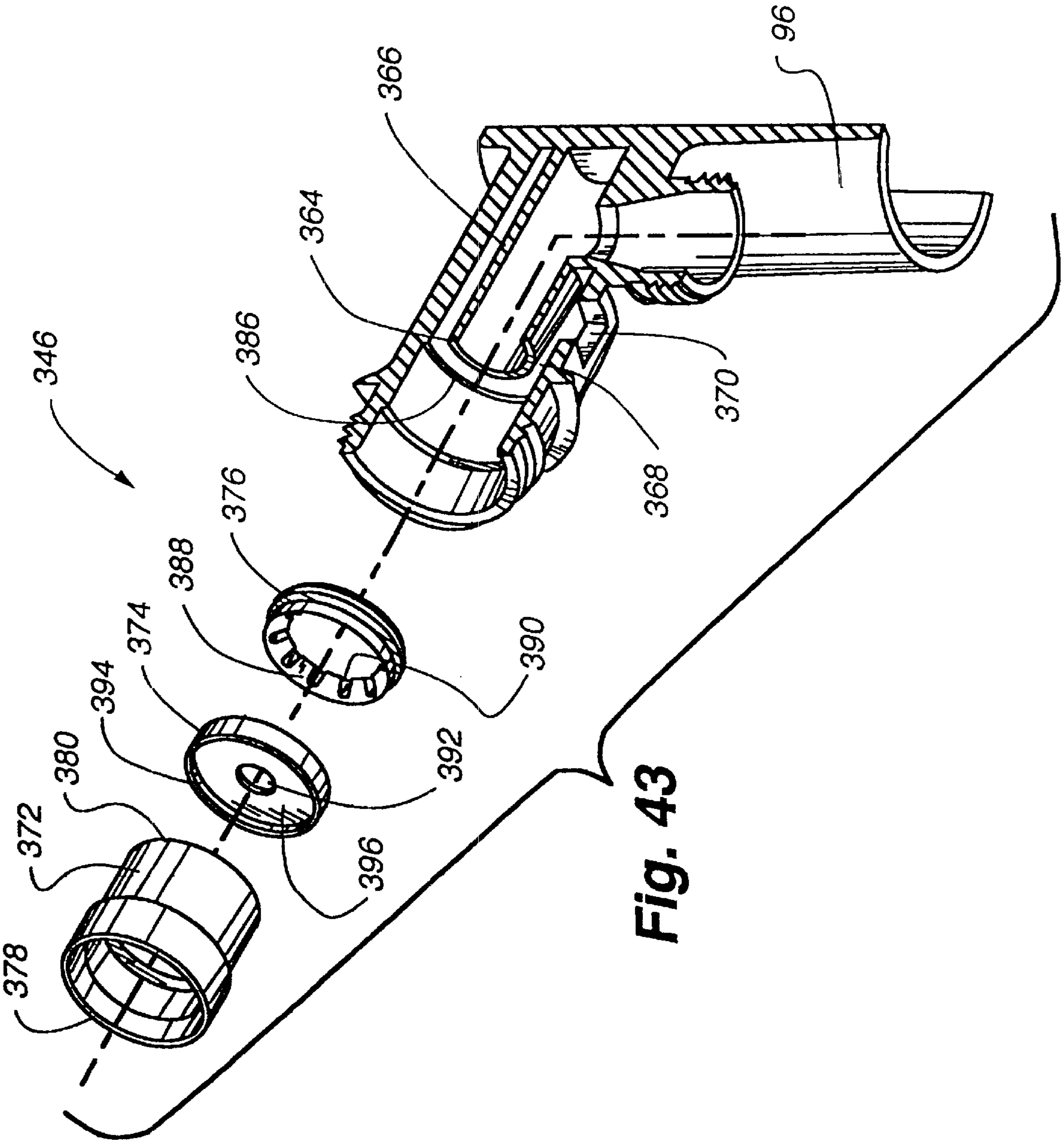
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Fig. 43

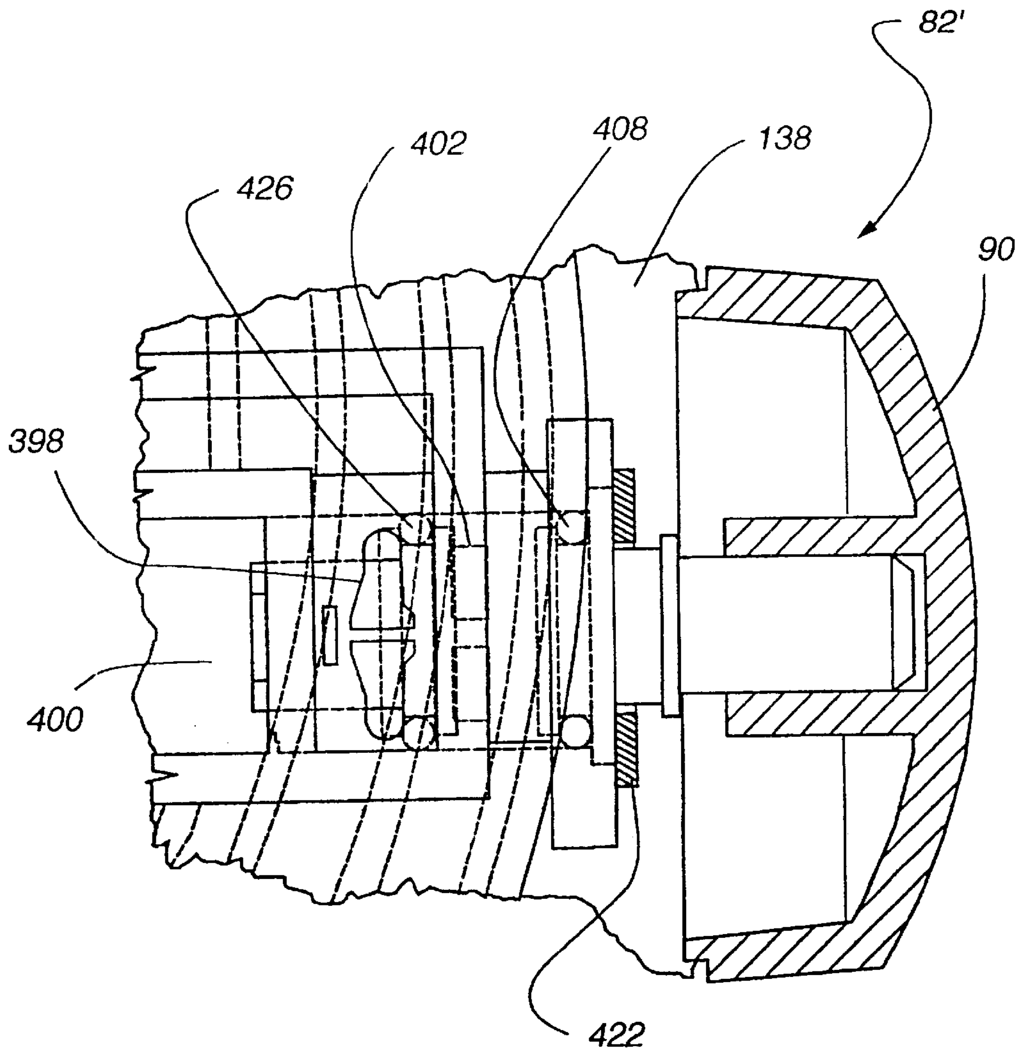
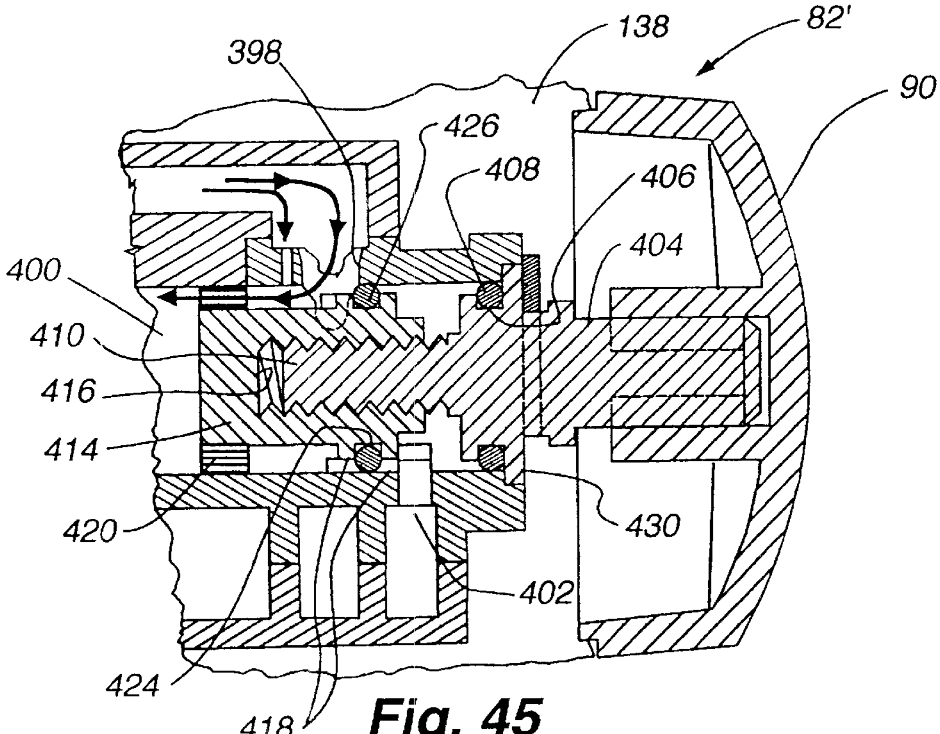
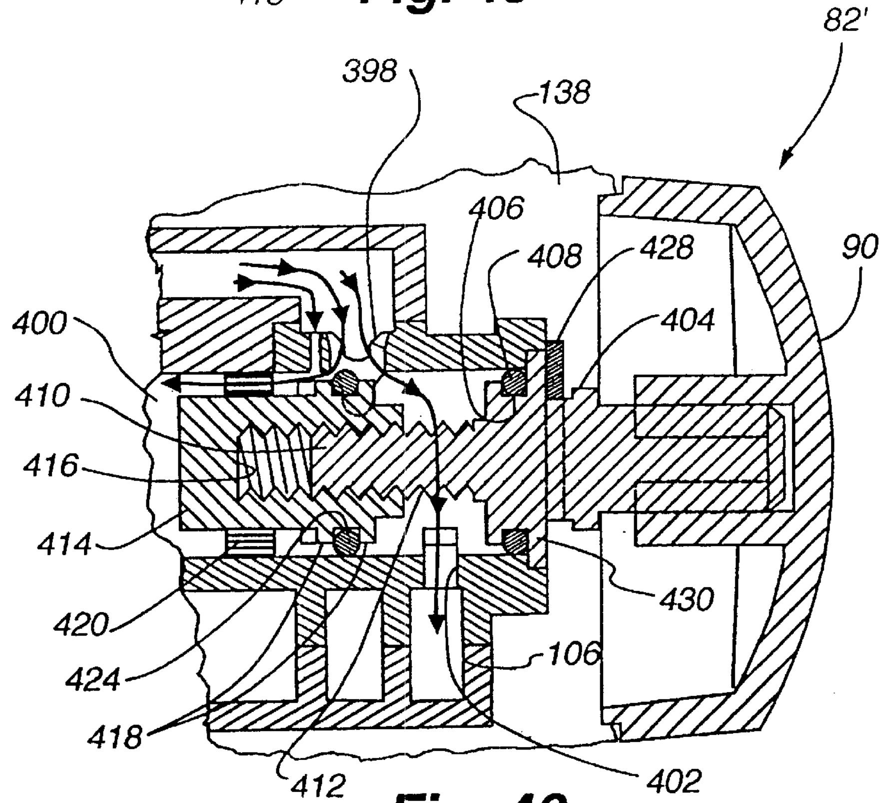


Fig. 44



82'
138
398
90
426
408
406
404
400
410
416
414
420
430
402
424
418

Fig. 45



82'
398
138
406
408
428
90
400
404
410
416
414
430
420
106
424
418
412
402

Fig. 46

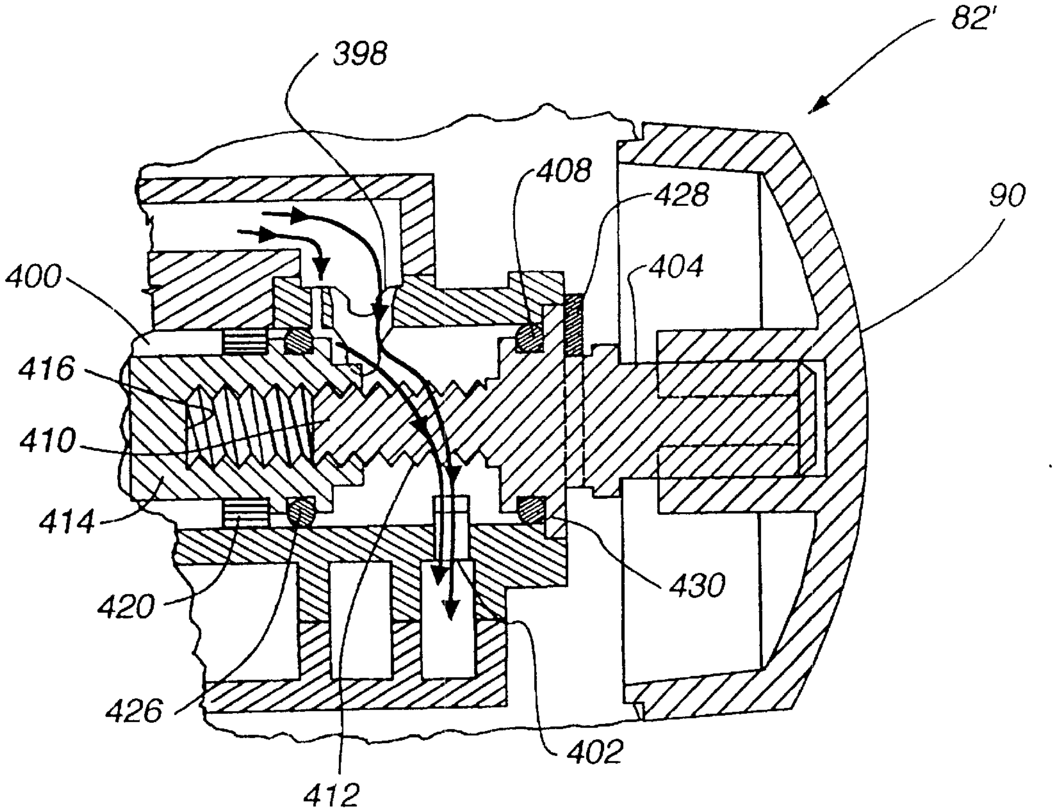

82'
398
408
428
90
404
400
416
410
414
420
426
412
402
430

Fig. 47

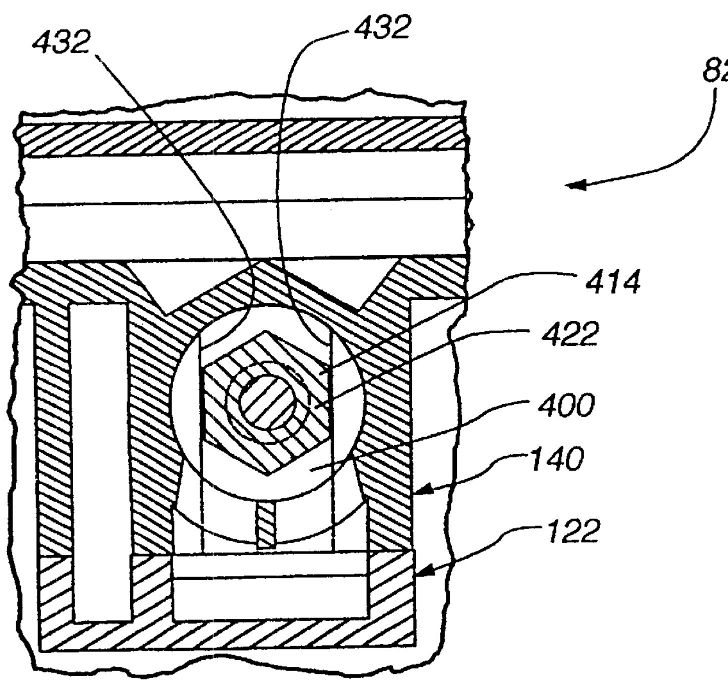

432
432
82'
414
422
400
140
122

Fig. 48

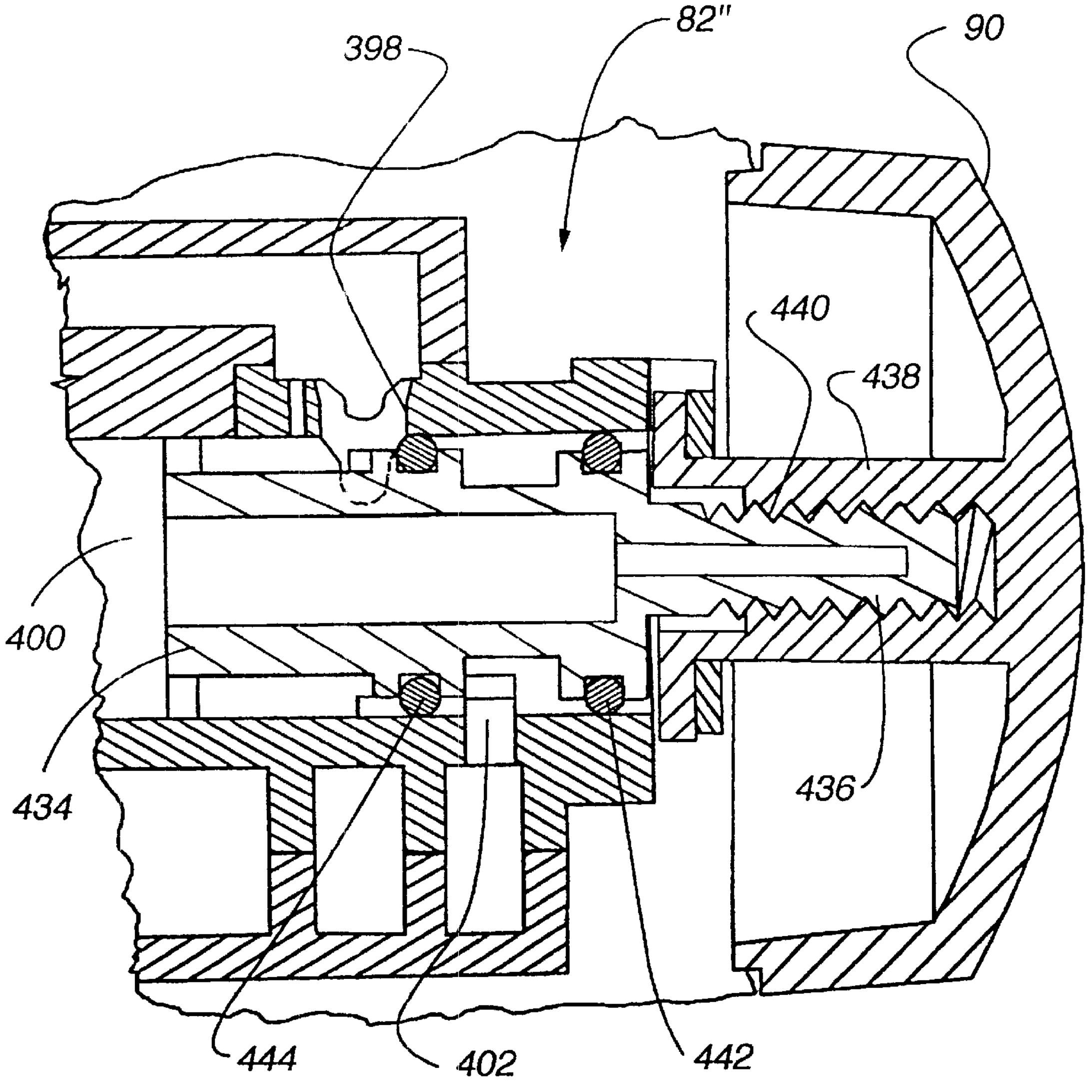


Fig. 49

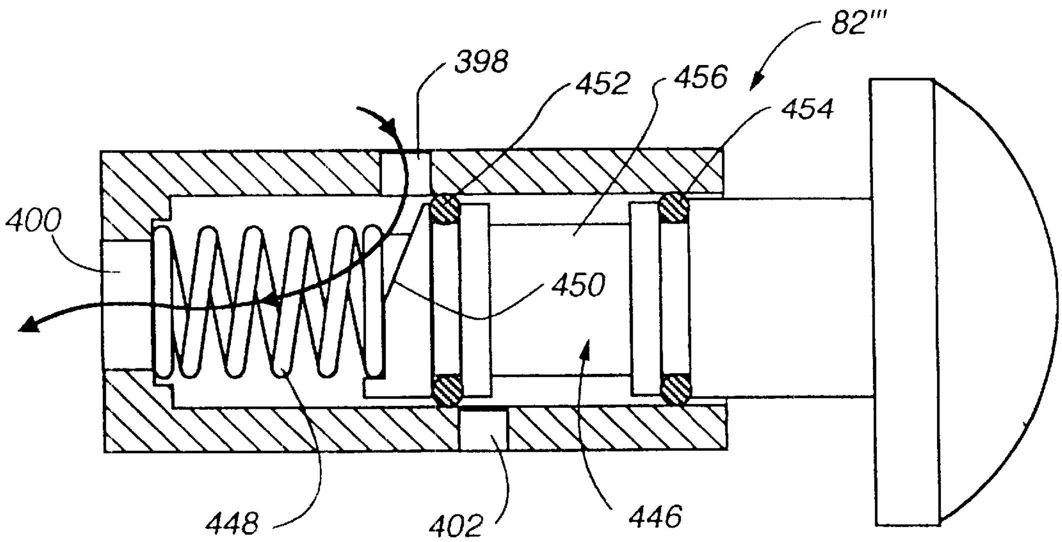

82'''
398
452
456
454
400
450
448
402
446

Fig. 50

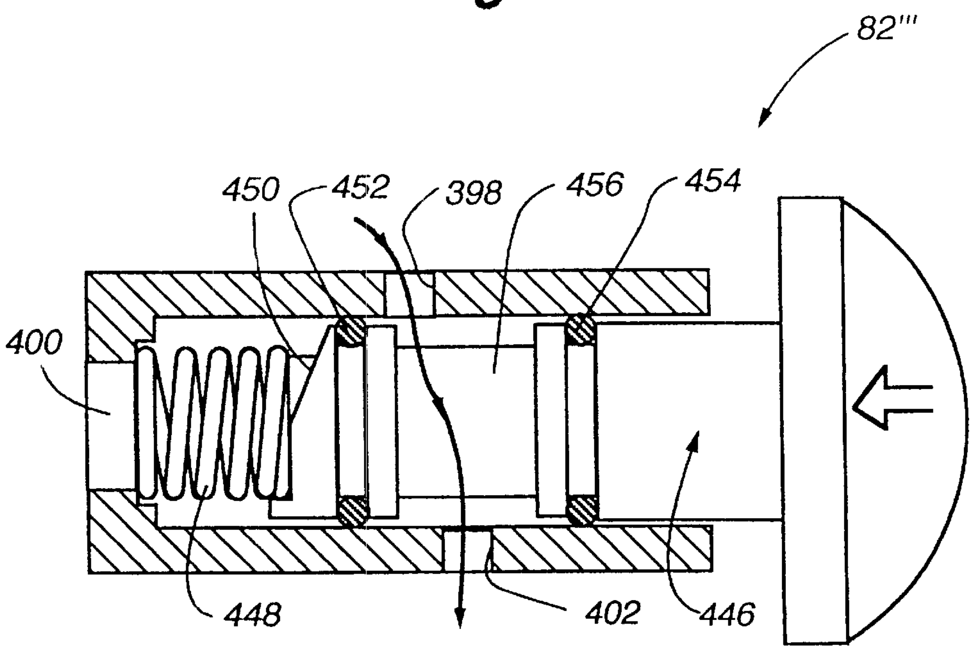

82'''
450
452
398
456
454
400
448
402
446

Fig. 51

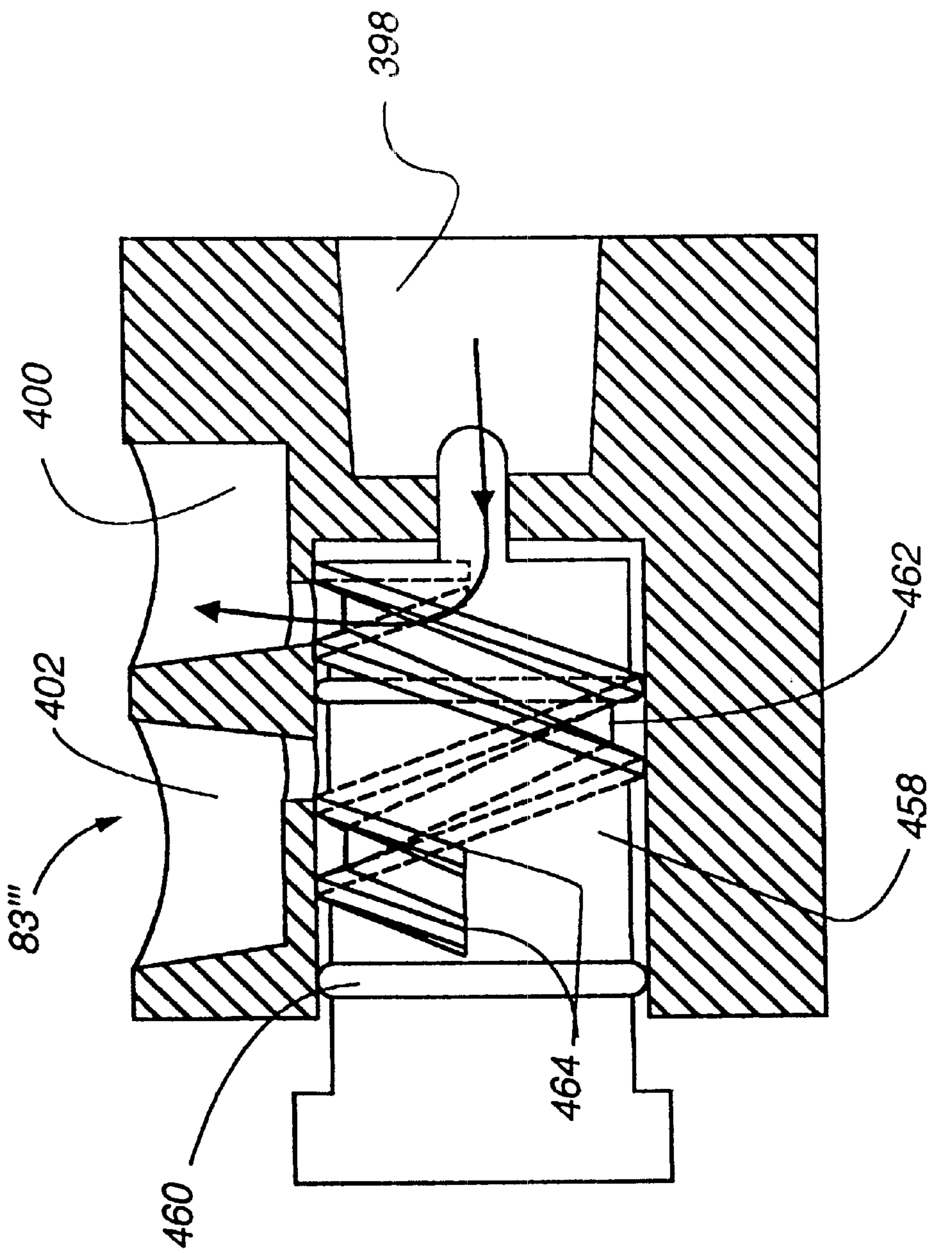


Fig. 52

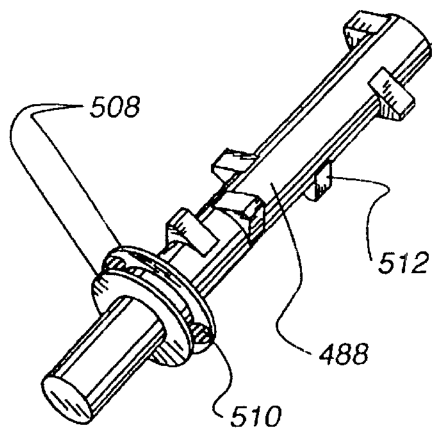


Fig. 53A

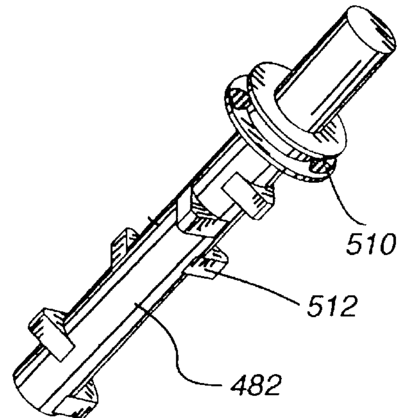


Fig. 53B

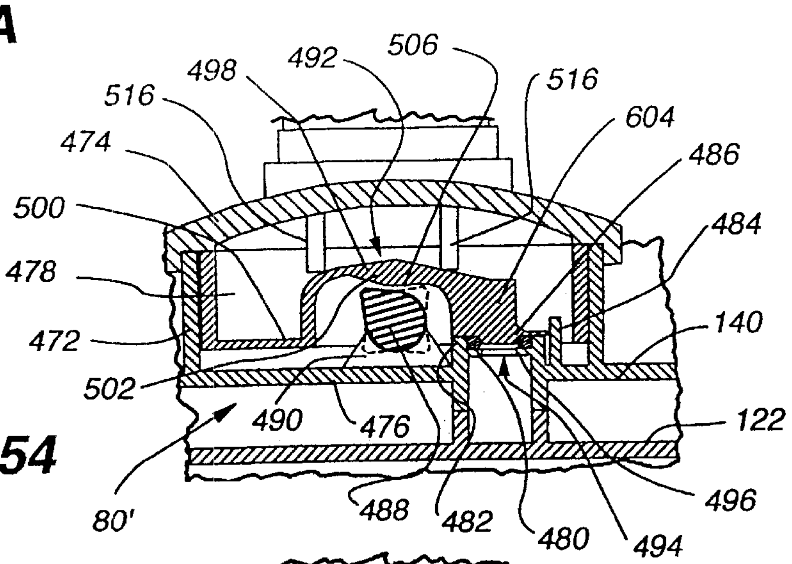


Fig. 54

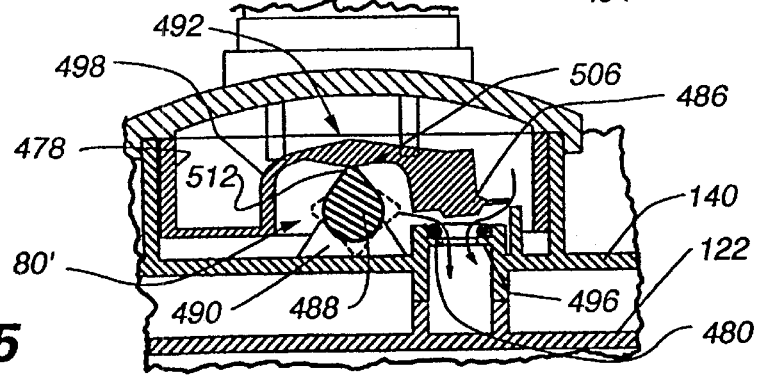


Fig. 55

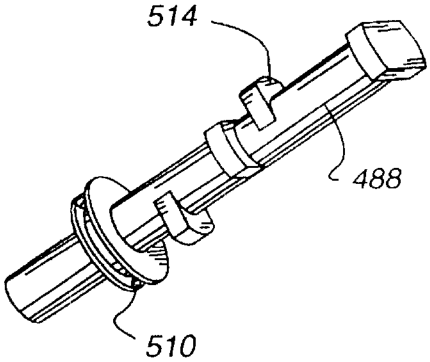


Fig. 56A

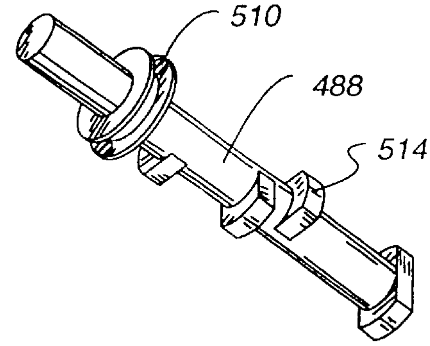


Fig. 56b

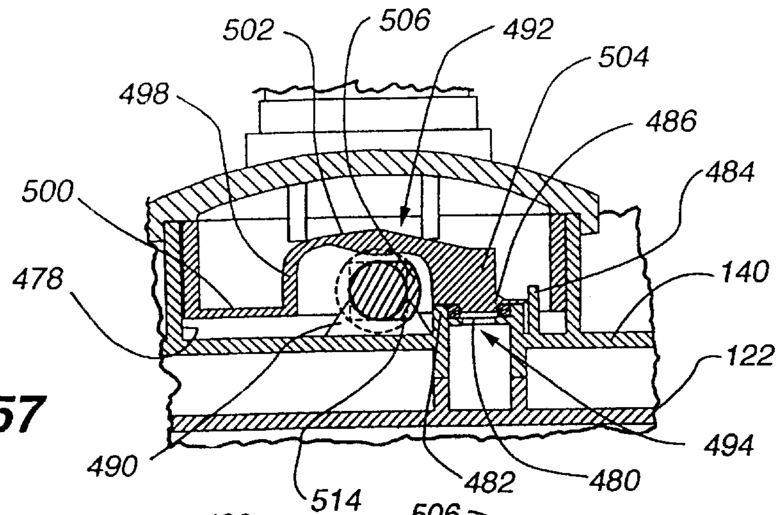


Fig. 57

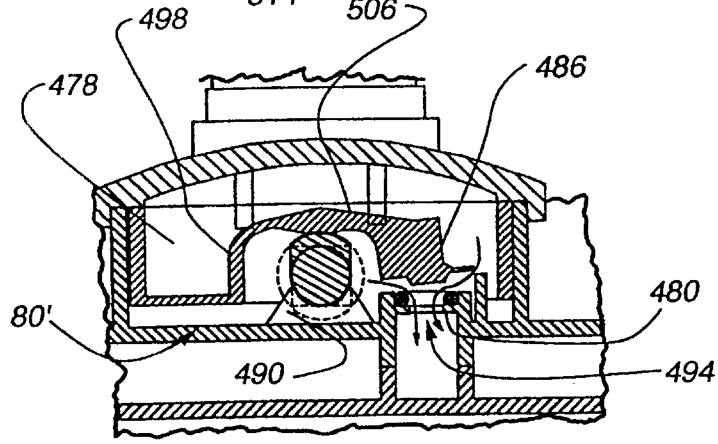


Fig. 58

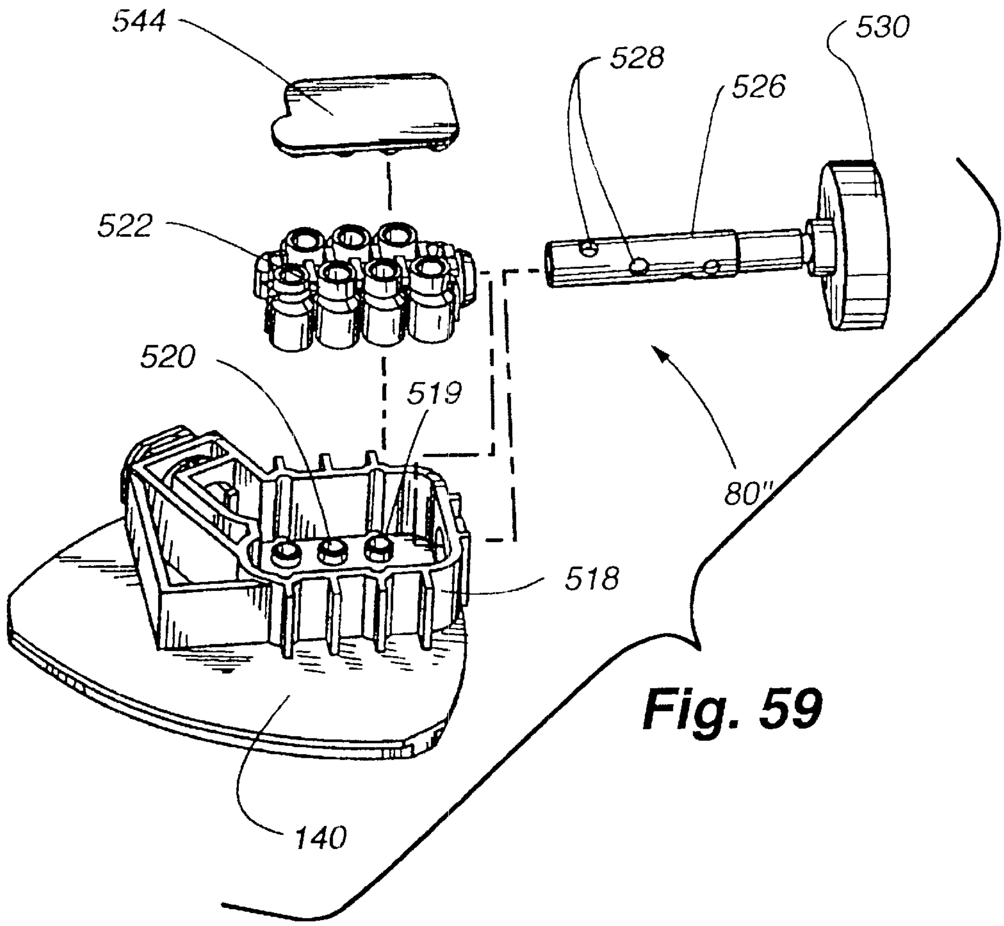


Fig. 59

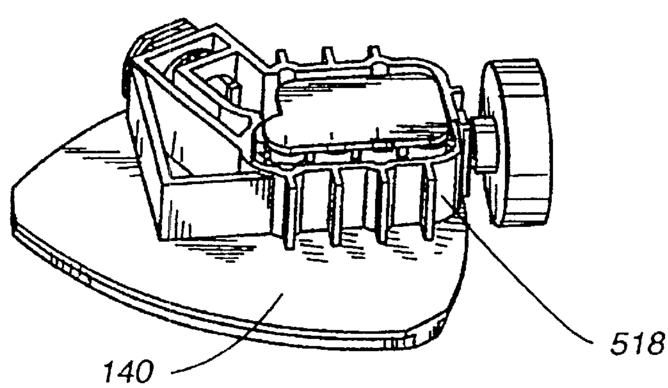


Fig. 60

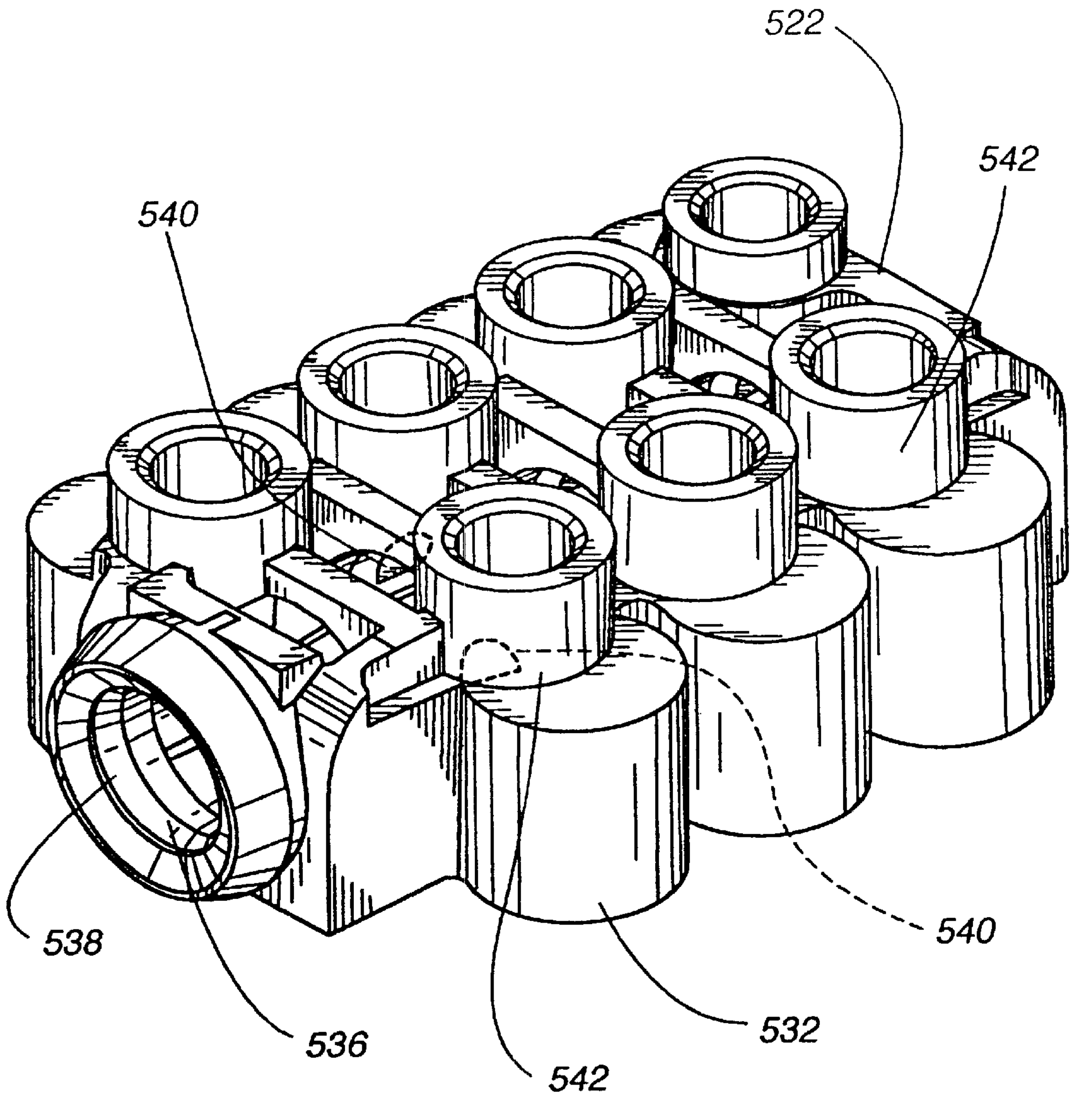


Fig. 61

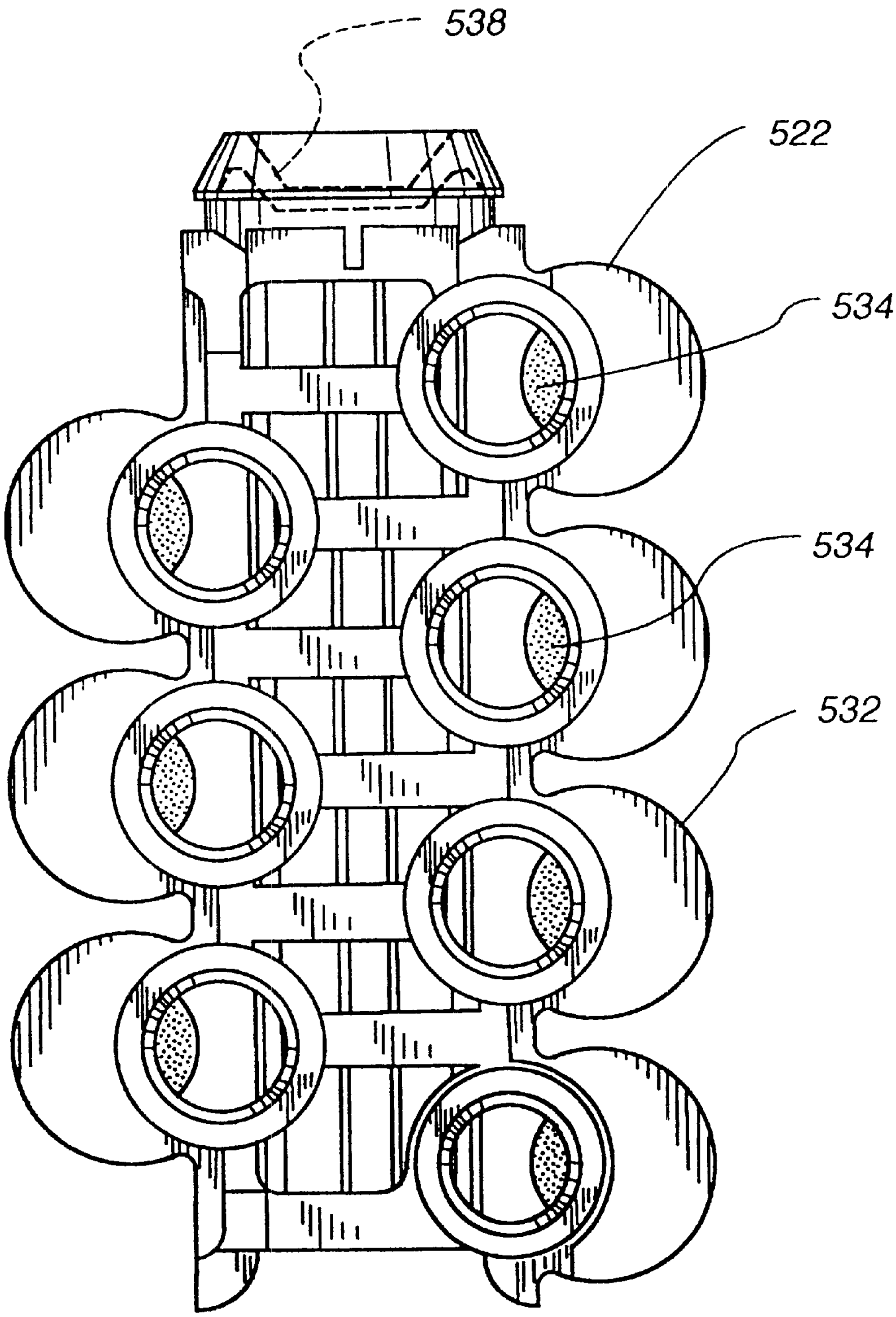


Fig. 62

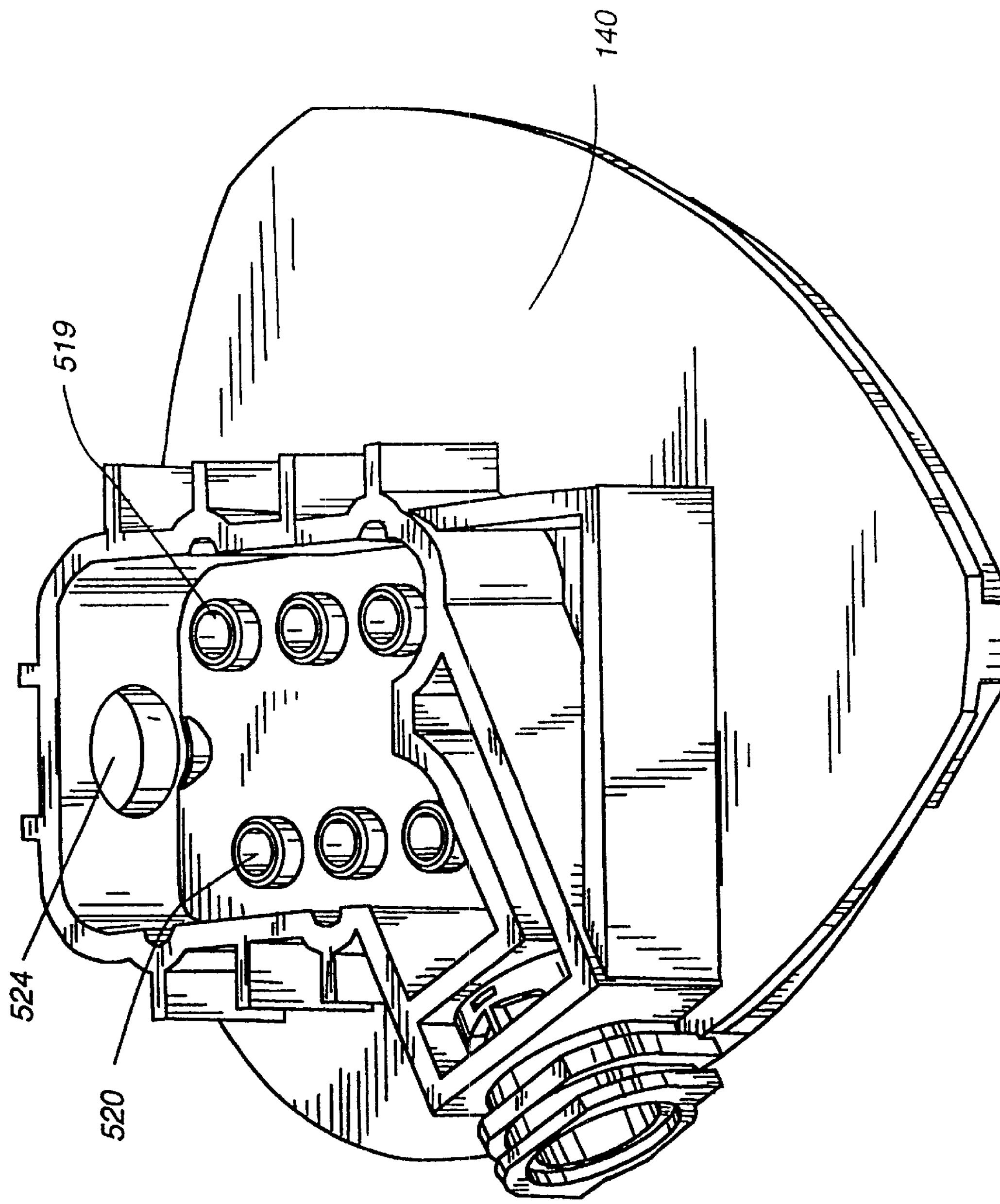


Fig. 63

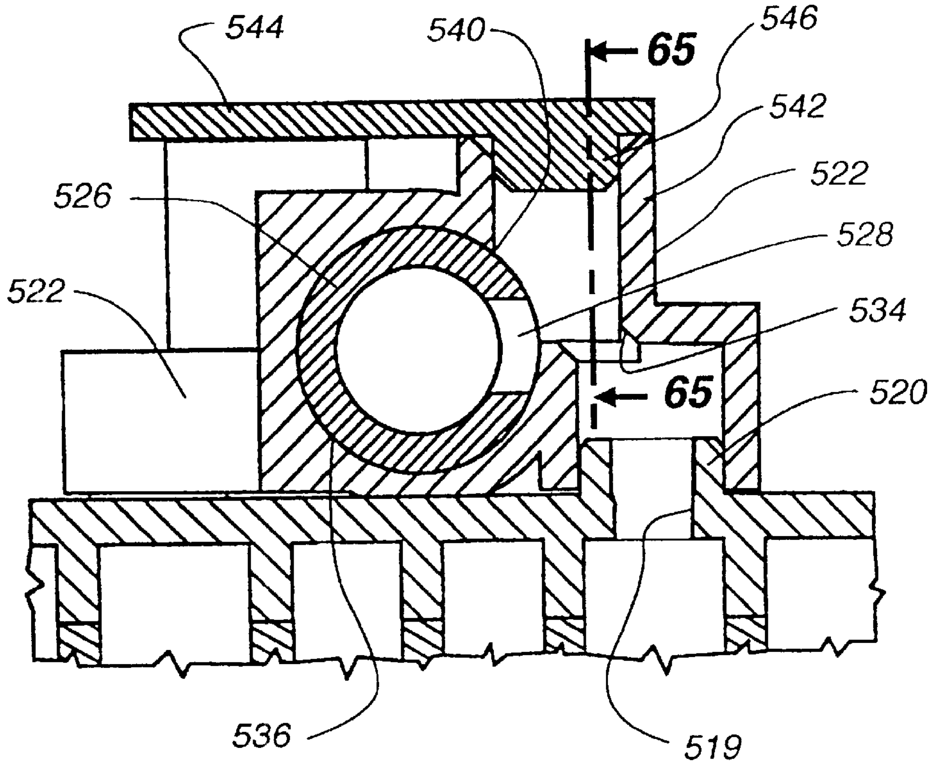

544
540
65
546
542
522
526
528
522
534
65
520
536
519

Fig. 64

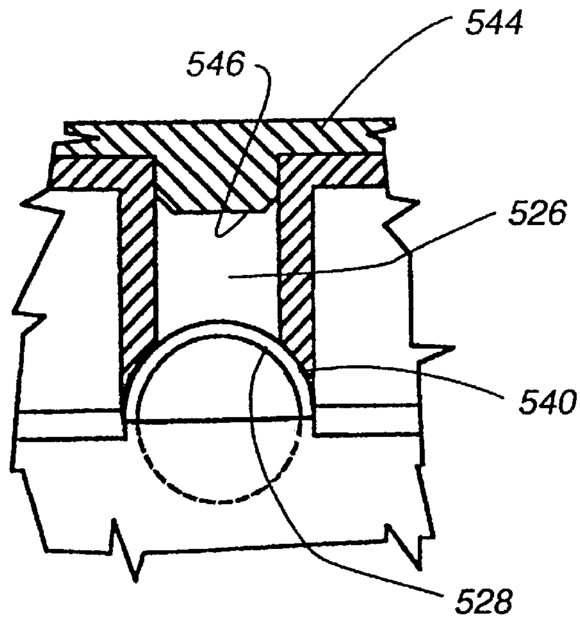

544
546
526
540
528

Fig. 65

MULTI-FUNCTIONAL SHOWER HEAD

RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 09/853,108 filed May 9, 2001 U.S. Pat. No. 6,454,186, which is a continuation of U.S. patent application Ser. No. 09/383,059, filed on Aug. 25, 1999, now U.S. Pat. No. 6,230,989, which patent claims the benefit of Provisional Application No. 60/142,239, filed Jul. 2, 1999, No. 60/105,490, filed Oct. 23, 1998, and No. 60/097,990, filed Aug. 26, 1998, from which priority is claimed and the disclosure of each is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

This invention relates to shower heads, and more particularly relates to new and improved multi-functional shower heads having several different spray modes and a flow control and mode selector valve allowing full exercise of the available options.

BACKGROUND OF THE INVENTION

Multi-function shower heads have a plurality of spray modes, including various standard sprays and pulsed sprays. Multi-function shower heads may also have flow control valves to allow the user to adjust the flow pressure to a desired level. Many flow control valves are ball valves, and simply restrict the area through which the water flows in order to control the pressure by rotation of the ball in the flow path.

Typically, the spray mode is selected using a control ring positioned around the circumference of the shower head, and moveable with respect to the shower head. The ring is rotated around the shower head to select the desired spray mode. Adjusting the control ring structure often requires the user to grab the control ring across the face of the shower head, thereby interfering with the flow from the shower head. Using the control ring also can cause the orientation of the spray head to be adjusted inadvertently.

Missing in the art is a multi-functional shower head having desired spray modes and convenient controls to select between the spray modes, as well as allow the user to control the flow rate.

SUMMARY OF THE INVENTION

The instant invention was developed with the shortcomings of the prior art in mind, and pertains to a shower head having a plurality of spray modes and unique controls to allow the selection of the desired mode. The shower head includes several unique features to allow the inclusion of several different spray modes, such as wide spray, medium spray, center spray, champagne spray, high speed pulsating spray, low speed pulsating spray, and mist. A waterfall mode can be implemented.

The shower head includes a flow control valve that controls the pressure of the water flow, and acts to divert water to a mode selector or to a separate spray mode, such as the mist mode. The flow control valve diverts water between the mode selector and the separate spray mode. It also allows a combination of the modes controlled by the mode selector and the separate spray mode.

The shower head also includes a mode selector. The mode selector transfers or routes fluids from the flow control valve to any number of individual or a combination of flow spray mode outlets.

In addition, the instant invention includes a shower head that is substantially triangular in shape that allows the control knobs for the flow control valve and the mode selector to be positioned on the lower side surfaces. This eliminates any interference with the spray when the controls are being actuated. Further, the instant invention includes a unique mist-spray aperture structure, and a vacuum breaker structure that can be built into the bracket of a hand-held shower.

In greater detail, the instant invention addresses a multi-functional shower head including a housing having an inlet flow path, a chamber, a first outlet flow path, a mode selector, a plurality of mode channels, and a plurality of outlet mode apertures. The inlet flow path and the first outlet flow path are each in fluid communication with the chamber, the first outlet flow path also being in fluid communications with the mode selector, and the plurality of mode channels each being in fluid communications with the mode selector and the outlet mode apertures. A flow control valve is positioned in the chamber and actuable to control the pressure of the water flow therethrough to the first outlet mode path, and the mode selector is actuable to select at least one of the mode channels. A first turn knob on the housing is operably connected to the flow control valve to allow selective manipulation of the flow control valve. A second turn knob on the housing is operably connected to the mode selector to allow selective manipulation of the mode selector.

In more detail, the above shower head has a substantially triangular front face, having opposing lower sides, and the first turn knob is on one lower side and the second turn knob is on the other of the lower sides.

A further embodiment of the present invention includes a housing having an inlet flow path, a chamber, a first outlet flow path, a second outlet flow path, a mode selector, a plurality of mode channels, and a plurality of outlet spray mode apertures. The inlet flow path, the first outlet flow path, and the second outlet flow path are each in fluid communication with the chamber. The first outlet flow path is in fluid communications with the mode selector, and the plurality of mode channels are each in fluid communications with the mode selector and the outlet mode apertures. The second outlet flow path is in fluid communication with a unique spray mode aperture. A flow control valve is positioned in the chamber and actuable to control the pressure of the water flow therethrough to the first outlet mode path, and includes a diverter portion for diverting water flow to either the first outlet flow path or the second outlet flow path, or a combination of both the first and second outlet flow paths. The mode selector is actuable to select at least one of the mode channels.

In more detail, the instant invention pertains to a shower head for directing the flow of water, the shower head including a housing having an inlet flow path, a chamber having an inlet port and an outlet port, and an outlet flow path. The inlet flow path is in fluid communication with the inlet port, and the outlet flow path is in fluid communication with the outlet port. The water flows from the inlet flow path, through the chamber, and out the outlet flow path. A flow control valve having a shuttle portion and a knob portion is positioned in the housing, the shuttle portion positioned in the chamber and the knob portion extending from the chamber. The shuttle portion and the knob portion are operably connected such that selective actuation of the knob portion moves the shuttle portion in the chamber. The shuttle portion also defines a restrictor. Upon actuation of the knob portion, the shuttle portion moves in the chamber and causes the restrictor to at least partially cover the inlet port to restrict the flow of water into the outlet flow path.

The instant invention also addresses a shower head having a plurality of spray modes for exiting water, the shower head including a housing having a flow path for incoming water, a mode selector, and a plurality of outlet flow paths, each of the outlet flow paths leading to a particular spray mode. The flow path for incoming water is in fluid communication with the mode selector, and the plurality of outlet flow paths are in fluid communications with the mode selector. The mode selector includes a spool valve having a hollow inner core and defining a plurality of outlet apertures, a manifold defining a tubular recess, having a side wall, for rotatably receiving the spool valve, and a plurality of mode apertures formed in the side wall of the recess. Each of the apertures are in fluid communication with at least one of the outlet flow paths and spray modes. The spool valve rotates in the manifold to align at least one outlet aperture with one of the mode apertures to allow water flow from the mode selector through the spool to the outlet flow path associated with the aligned outlet and mode apertures.

A different aspect of the invention is shown by a shower head having a plurality of spray modes for exiting water, the shower head including a housing having a flow path for incoming water, a mode selector, and a plurality of outlet flow paths, each of the outlet flow paths leading to a particular spray mode. The flow path for incoming water is in fluid communication with the mode selector, and the plurality of outlet flow paths are in fluid communication with the mode selector. The mode selector includes a reservoir defining a plurality of mode apertures, each of the apertures in fluid communication with at least one of the outlet flow paths and spray modes, and a valve assembly. The valve assembly defines at least one valve arm, the at least one valve arm having a valve seal and being movable between a first position in sealing engagement with the respective mode aperture and a second position disengaged from the respective mode aperture. The valve arm normally biases the valve seal in engagement with the respective mode aperture. A cam shaft is rotatably mounted in the reservoir and defines at least one cam protrusion aligned along the cam shaft to engage the at least one valve arm, wherein the rotation of the cam shaft causes the at least one cam protrusion to engage the at least one valve arm and move the at least one valve arm from the first position to the second position to allow fluid flow through the outlet aperture.

The flow control valves and the mode selector structures make the control of the features included in the instant invention easy and accurate.

With respect to the mist nozzle structure of the present invention, the mist nozzle includes a first incoming portion, a middle portion, and an outlet portion. The first portion has an end wall forming an aperture therethrough. The middle portion extends from the end wall of the first portion to an outwardly-diverging conical rim forming the outlet portion. Opposing grooves are formed in the side wall of the first portion and extend along the first portion, the opposing grooves continue to extend along the end wall and terminate in a circumferential recess, having a base, formed in the end wall about the aperture. A plug is positioned in the incoming portion and engages the end wall to force water through the opposing grooves and into converging streams at the recess, the converging streams impacting to form mist, and flowing through the middle portion and out from the outlet portion.

Regarding the vacuum breaker portion of the present invention, it is positioned in the bracket of a hand-held shower and activated by water pressure. The bracket has an outer housing, a pivot ball in the housing for attachment to a shower pipe, a stand-tube having a rim in the housing spaced from the pivot ball, and a space formed between the housing and the stand tube. The vacuum breaker includes a pivot ball support defining a bore therethrough, a first end for engaging the pivot ball, and a second end having an outwardly conical shape, and at least one aperture formed in the second end in the conical shape. A support ring is positioned in the housing adjacent the stand-tube, the support ring defining a central aperture. A flexible washer is included having a circular shape and defining a central aperture and a circumferential rim, with a web extending between the central aperture and the rim. The flexible washer is positioned between the pivot ball support and the support ring with the central aperture in alignment with the central aperture of the support ring. The web of the washer is movable from a first position with no water pressure where the web engages the second end of the pivot ball support to sealingly cover the aperture formed therein, to a second position under water pressure where the web sealingly engages the rim of the stand tube and uncovers the aperture in the second end of the pivot ball support to allow water to flow through the aligned central apertures.

Other aspects, features and details of the present invention can be more completely understood by reference to the following detailed description of a preferred embodiment, in conjunction with the drawings, and from the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a perspective view of a wall-mount shower head in accordance with the present invention.

FIG. **2** shows a perspective view of a hand-held shower head in accordance with the present invention.

FIG. **3** shows a front view of the wall-mount shower head in accordance with the present invention.

FIG. **4** shows a side view of the wall-mount shower head in accordance with the present invention.

FIG. **5** is a section taken along line **5—5** of FIG. **3**.

FIGS. **6**A–B show an exploded view of the wall-mount shower head in accordance with the present invention.

FIG. **7** is an exploded view of the spray head unit utilized in both the wall-mount and hand-held shower heads of the present invention.

FIG. **8** is a section taken along line **8—8** of FIG. **5**.

FIG. **9** is a section taken along line **9—9** of FIG. **5**.

FIG. **10** is a section taken along line **10—10** of FIG. **5**.

FIG. **11** is similar to FIG. **10** and shows an exploded view of the flow control valve and the mode selector.

FIG. **12** is a perspective view of the spool valve portion of the mode selector.

FIG. **13** is an exploded view of the flow control valve, particularly the shuttle and knob portion.

FIG. **14** is a section taken along line **14—14** of FIG. **10**, and shows the flow control valve in its outermost position with the diverter diverting water to the mode selector with the flow restrictor in the horizontal position for maximum flow.

FIG. **15** is a representative section similar to FIG. **14**, and shows the flow control valve in its outermost position with the diverter diverting water to the mode selector with the flow restrictor in the vertical position for minimum flow.

FIG. **16** is a representative section similar to FIG. **15**, and shows the diverter in an intermediate position to divert water to both the mode selector and the mist apertures.

FIG. **17** is a representative section similar to FIG. **16**.

FIG. **18** is a representative section similar to FIG. **17**.

FIG. **19** is a representative section similar to FIG. **18**.

FIG. **20** is a representative section similar to FIG. **19**, with the diverter in its innermost position and diverting water to the mist apertures only.

FIG. **21** is a section taken along line **21—21** of FIG. **5**, and shows the first outlet flow path from the flow control valve to the mode selector, and the second outlet flow path to the mist mode apertures, with the diverter of the flow control valve in the outermost position to divert water only to the mode selector.

FIG. **22** is a section similar to FIG. **21**, and shows the flow control valve in the innermost position to divert flow only to the mist mode apertures.

FIG. **23** is a section taken along line **23—23** of FIG. **3**, and shows the mist aperture structure.

FIG. **24** is a section taken along line **24—24** of FIG. **23**.

FIG. **25** is a section taken along line **25—25** of FIG. **23**.

FIG. **26** is a section taken along line **26—26** of FIG. **23**.

FIG. **27** is a section taken along line **27—27** of FIG. **23**.

FIG. **28** is a section taken along line **28—28** of FIG. **23**.

FIG. **29** is a section taken along line **29—29** of FIG. **3**.

FIG. **30** is a section taken along line **30—30** of FIG. **3**.

FIG. **31** is a section taken along line **31—31** of FIG. **3**, and shows the mist aperture structure.

FIG. **32** is an enlarged partial view of the collar on the outside of the spacer insert in the mist structure.

FIG. **33**A is a section taken along line **33**A—**33**A of FIG. **3**.

FIG. **33**B is a section taken along line **33**B—**33**B of FIG. **3**.

FIG. **34** is a perspective view of the hand-held shower head and the associated bracket, which incorporates the vacuum breaker.

FIG. **35** is a front view of the hand-held shower head and shows the waterfall slot.

FIG. **36** is a perspective view of the wall-mount shower head and shows the waterfall slot.

FIG. **37** is a section taken along line **37—37** of FIG. **35**, and shows the flow path of the water to the waterfall slot.

FIG. **38** is a front view taken in line with line **38—38** of FIG. **37**.

FIG. **39** is a section taken along line **39—39** of FIG. **37**.

FIG. **40** is a section taken along line **40—40** of FIG. **37**.

FIG. **41** is a representative section of the vacuum breaker structure in the bracket for the hand-held shower head, showing the vacuum breaker with no water pressure.

FIG. **42** is a representative section of the vacuum breaker structure in the bracket for the hand-held shower head, showing the vacuum breaker with water pressure.

FIG. **43** is an exploded view of the vacuum breaker.

FIG. **44** is a representative top section view of an alternative embodiment of the flow control valve.

FIG. **45** is a representative side section view of the alternative embodiment shown in FIG. **44**, with the diverter in the outermost position.

FIG. **46** is a representative side section view of the alternative embodiment shown in FIG. **45**, with the diverter in an intermediate position.

FIG. **47** is a representative side section view of the alternative embodiment shown in FIG. **46**, with the diverter in the innermost position.

FIG. **48** is an representative section of the alternative embodiment shown in FIG. **46**, specifically of the keyed end of the shuttle inserted into the mode selector outlet port.

FIG. **49** is a representative section view of another alternative embodiment of the flow control valve.

FIG. **50** is a representative section view of another alternative embodiment of the flow control valve, with the plunger and diverter in the outermost position and diverting water to the mode selector.

FIG. **51** is a representative section view of the alternative embodiment shown in FIG. **50**, and specifically of the flow control valve, with the plunger and diverter in the innermost position and diverting water to the mist aperture outlet.

FIG. **52** is a representative section view of another alternative embodiment of the flow control valve, specifically showing a channel structure on the outer surface of the shuttle.

FIGS. **53**A and B are perspective views of a cam shaft used in an alternative embodiment to the mode selector, showing triangular protrusions.

FIG. **54** is a representative section of the alternative embodiment of the mode selector using the cam shaft of FIGS. **53**A and B, and showing, in part, the reservoir, valve arm, valve seal, and mode outlet in the sealed position.

FIG. **55** is similar to FIG. **54** except the unsealed position is shown.

FIGS. **56**A and B are perspective views of an alternative cam shaft.

FIG. **57** is a representative section and shows the cam shaft of FIGS. **60**A and B in use in the alternative embodiment of the mode selector, in the sealed position.

FIG. **58** is a representative section and shows the cam shaft of FIGS. **56**A and B in use in the alternative embodiment of the mode selector, in the unsealed position.

FIG. **59** shows an exploded view of another alternative embodiment of the mode selector.

FIG. **60** shows an assembled view of the alternative embodiment of the mode selector shown in FIG. **59**.

FIG. **61** is an enlarged perspective view of the manifold of the embodiment shown in FIGS. **59** and **60**.

FIG. **62** is an enlarged top view of the manifold of the embodiment shown in FIGS. **60** and **61**.

FIG. **63** is an enlarged perspective view of the reservoir of the alternative embodiment for the mode selector shown in FIGS. **59** and **60**.

FIG. **64** is a representative section of the alternative embodiment of the mode selector shown in FIGS. **59** and **60**, and shows the spool aperture in alignment with the mode aperture to allow water to flow to selected spray mode.

FIG. **65** is a view taken from line **65—65** of FIG. **64**, and shows the alignment of the mode aperture and the spool aperture.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. **1**, a wall mount shower head **72** incorporating the features of the present invention is shown. The shower head includes a variety of spray modes, including at least normal spray, pulsating spray, champagne spray, mist spray, and combinations thereof. In general, the shower head defines an incoming flow path **74** and two outgoing flow paths **76**, **78**. One outgoing flow path **76** is split into several spray modes by a mode selector **80**. The other outgoing flow path **78** is to a mode not able to be selected by mode selector **80**, in this case the mist mode. A flow control valve **82** is used to divert water from the incoming flow path **74** to either, or both, of the outgoing flow paths **76**, **78**. The flow control valve **82** also allows the user to adjust the water pressure of the selected spray mode. A mode selector **80** is used to select the various spray modes, other than mist, and a flow controller **82** is used to convert to the mist mode, and for adjusting the pressure of the water passing through the selected spray modes. Much, if not all, of the shower head of the present invention can be made of plastic or other similar material suitable for the construction of shower heads.

The mode selector **80** includes a first valve assembly **84** (see FIG. **11**) for diverting flow to the desired spray modes, which is actuated by a first adjustment knob **86** extending from the bottom, right-hand side of the shower head **72**. The mode selector adjustment knob **86** allows the user to select the desired spray mode without having to grab the entire perimeter of the shower head **72** and possibly accidentally adjust the direction the shower head is pointing. In addition, the user's hand is less likely to interfere with the spray while adjusting the spray mode. The flow controller **82** includes a second valve **88** assembly for controlling the flow rate to the mode selector **80** and for converting into and out of mist spray mode, and is actuated by a second adjustment knob **90** extending from the bottom left-hand side of the shower head.

The shower head **72** is described herein as a wall-mount shower head. The inventive shower head can also be incorporated into a hand-held shower head, as shown in FIG. **2**. The hand-held shower head functions identically to the wall-mount shower head, except it requires a hose **92** to connect the shower head **72** to the shower pipe and a cradle **96** to support the shower head **72** when not being used in hand-held mode.

The shower head **72**, as shown in FIGS. **1**, **3** and **4** has a triangular front shaped portion **98** transitioning into a generally conical rear portion **100** for attachment to the shower pipe (not shown). The generally triangular front portion **98** is formed by a U-shaped bottom edge **102** and an arcuate (concave downwardly) top edge **104**. This generally triangular front portion **98** allows a deviation from the traditional circular shower head designs, and more importantly allows for unique and beneficial spray modes.

The mode selector adjustment knob **86** extends from the lower right-hand side of the front portion **98** of the shower head **72**, and the flow controller adjustment knob **90** extends from the lower left-hand side of the front portion **98** of the shower head **72**. The internal flow paths **76**, **78** have been designed for this configuration, while it is contemplated that the knobs **86**, **90** could be reversed if the appropriate changes to the flow paths are also made.

Referring to FIGS. **1**, **3** and **4**, the shower head **72** of the present invention includes several spray modes, such as normal spray, mist, champagne, pulsed, and waterfall. The arched rectangular band of apertures along the top edge of the faceplate **104** form the normal spray apertures **106**. The arched band is downwardly concave. The arched rectangular pattern emits a spray at virtually all flow levels that provides a more wide coverage pattern than the standard circular spray. The normal spray apertures **106** are preferably formed by a series of columns **108** each having three apertures. The columns **108** are each vertically offset from one another to form the arched array of spray apertures **106**. Each of the external spray apertures have internal bore directions formed so as to direct the spray generally away from spray path of the inwardly-adjacent nozzle spray paths. See FIGS. **33**A and B. This causes the spray to widen as it emerges from the shower head **72**, and remain substantially in separate streams. The wide, arcuate-rectangular spray path covers a wider area on a user's body than a circular spray pattern.

Pulsating spray emerges from the apertures formed in the orifice cup **112**, which is positioned in the central portion **114** of the front portion **98** and removably held in position there by a center retainer **116**. The pulsating flow apertures **118** are formed in three circumferentially spaced groups of apertures **118**. A turbine **120** is positioned inside of the orifice cup to create the pulsating flow. See FIG. **5**. The turbine **120** held between the orifice cup **112** and the front channel plate **122**, upon which the orifice cup **112** is positioned and secured to. This is described in more detail below. The turbine **120** structure itself is known and available in the art.

An outer circle of apertures **124** around the edge of the orifice cup **112** forms a circular-shaped medium normal spray. An inner circle of apertures **126** formed in the orifice cup **112** provides a small, dense, circular water spray formation.

The champagne apertures **128** are positioned just below the arched rectangular band of normal spray apertures **108**. The arched champagne apertures **128** form a pattern that is downwardly concave. The champagne apertures **128** are formed in a curved line which is slightly more arcuate than the arched band of regular spray apertures **106**. The curvilinear orientation of the apertures is important for the champagne spray mode in order to obtain the desired effect. Champagne flow is a highly aerated, relatively large stream of water that has a soft, bubbly feel to the user. The apertures are positioned in an arcuate orientation to each form an individual (separate) rope or stream of water flowing from each of the apertures preferably to the floor of the shower.

Air inlet apertures **130** are formed between the champagne apertures to allow air to be entrained in the champagne flow as it emerges from the shower head. This structure is described in more detail below with respect to FIGS. **5**, **31** and **32**.

The mist apertures **132** are formed along the perimeter of the lower side of the face plate **122** in a U-shape that is concave upwardly. This U-shaped aperture pattern helps keep the mist from flowing directly at the user's face when the mist mode is actuated (with the shower head positioned generally in front of the user's face). The water flow from the mist apertures **132** is conditioned into fine water droplets to simulate a steam effect. The structure of the mist apertures **132** is described in more detail below with respect to FIGS. **23–30**.

A waterfall slot **134** can be positioned above the normal spray band See FIG. **35**. The slot **134** for waterfall flow is also curvilinear and oriented to be downwardly concave. The waterfall slot creates a sheet of water as the water emerges from the shower head **72**. The structure of the waterfall slot is described in more detail below with respect to FIGS. **35–40**.

The front portion, or face plate **122**, has a raised or beveled central portion that has a top edge and bottom edge shaped similarly to the top and bottom edges of the face plate. The champagne apertures **128** are positioned along the top edge of the raised portion. Two partial shroud collars **136** for adjustment knobs **86**, **90** are formed along the bottom edge, each on opposite sides from one another, of the shower head.

FIGS. **6**A and **6**B show an exploded view of the wall-mount shower head of the present invention. The shower head includes a spray head unit **138** incorporating the flow control valve **82** and the spray mode selector **80**. The spray head unit includes a front channel plate **122** and a rear channel plate **140** attached together by a hot-melt process. The flow control valve **82** and the spray mode selector **80** are positioned in the rear channel plate **140**. Both the flow control valve **90** and spray mode selector **86** are user-actuated by knobs extending from the spray head unit.

A rear housing cover **100** fits over the rear side of the spray head unit, which in turn has a base cone **142** that houses the pivot ball **144** and related parts for attachment to the shower pipe. The base cone **142** threadedly attaches to the externally threaded collar **146** extending from the rear of the rear channel plate **140**. The base cone **142** has a generally frustoconical shape, with a threaded central bore and indentations spaced circumferentially around its body. The base cone holds the pivot ball in place, which inserts into the collar on the rear of the rear channel plate. One end of the pivot ball attaches to the shower pipe extending from the wall, which is the source of water for the shower head. The pivot ball is sealingly (by a seal washer **148**) and pivotably received in the collar **146** to allow pivotable orientation of the shower head on the shower pipe. The screen filter **150** and flow regulator **152** are positioned in the pivot ball. The base cone **142** also holds the housing tightly against the rear periphery of the front housing cover to encompass the spray head unit.

The front channel plate **122** defines a circular recess **154** for receiving a turbine, as is known and available in the art. A spray cup **112** covers the recess and turbine, and is attached to the front channel plate by a retainer **116**. The front channel plate **122** also defines a curved recess **156** formed around the champagne apertures **128**. A champagne insert **158** is positioned in the recess **156** on top of the first sized screen **160**. Two screens **162**, **164** are positioned over the champagne insert **158**. The screens **162**, **164** and champagne insert **158** help create an aerated champagne spray.

A front housing cover **98** (a triangular shaped front housing or faceplate) fits over the front channel plate **122** and around the spray cup **112**, and mates with the rear housing cover **100**. A cosmetic faceplate or nameplate **166** can be used to decorate the front cover, or other parts of the housing, as desired.

The spray head unit **138**, as shown in FIG. **7**, defines nozzles or apertures on the front side and houses the mode selector **80** and flow control valve **82** on the back side. The spray head unit **138**, by the attachment of the front and rear channel plates **122**, **140**, respectively, creates a housing having the inlet flow path and the outlet flow paths, and contains the flow controller and mode selector. Water outlet flow paths to the spray modes are also defined therein to direct the water from the mode selector to the proper apertures for the desired spray modes. Each water outlet flow path is in fluid communication with the mode selector **80**, such that when the mode selector is positioned as desired by the user, water flows from the mode selector, through the appropriate flow path and to the output apertures of the desired spray mode. The front and rear channel plates **122**, **140** respectively each define channels such that when attached together form continuous channels that are separate from other channels.

The front channel plate **122** has substantially the same triangular outer profile as the front housing cover **98** The front channel plate forms apertures that mate from behind with the apertures defined in the front housing cover. Each of the normal spray apertures **106** formed in the front channel plate **122** is a protruding nozzle **168**, which increases the velocity of the water flowing therethrough. The front of the nozzle extends through the corresponding aperture in the front housing cover and is flush with the front of the faceplate **98**. Each nozzle **168** in each column is offset from a line normal to the centerline of the front channel plate **122**.

Referring to FIG. **33**A, the first column **170** on each side of the centerline is offset an angle alpha, preferably 0.75 degrees outwardly. The second column **172** on each side is offset from the first row by an angle beta, preferably 1.5 degrees outwardly, and so on, with the seventh column **174** on each side being offset outwardly by an angle omega, preferably 9.75 degrees. The total angular coverage is thus 19.5 degrees. This is to allow for adequate spray separation and manufacturing ease (to satisfy mold processing limitations). Other degrees of divergence can be used between columns of nozzles, such as 3 degrees. The nozzles **168** also diverge in the vertical direction, with the middle row being normal to the front of the front channel plate **122**. See FIG. **33**B. The top nozzle **176** is diverted by angle theta, preferably 3 degrees upwardly, and the bottom nozzle **178** is diverted by angle theta also. The outlet port of each nozzle is the same size, preferably 0.050 inches. Due to the vertical and lateral curvature of the front channel plate **122** and the offset of the nozzles, each incoming port of the nozzle **168** is generally an asymmetrical ellipse and has a differing size. The nozzle geometry is a cone which is symmetrical about the axis which defines each individual water stream path.

Each of the mist apertures **132** formed in the front channel plate **122** is a protruding nozzle **180**. See FIGS. **7**, **23** and **28**–**30**. The mist aperture nozzles **180** in the front channel plate **122** plug into apertures **182** formed in the faceplate. Each mist nozzle **180** has an incoming portion **184**, a middle portion **186** and an outlet portion **188**. See FIG. **28**. The incoming portion **184** on the rear side of the front channel plate **122** for each mist aperture **132** is a cylindrical collar. The incoming portion **184** includes an end wall **190** forming an aperture **192** therethrough, which begins the middle portion **186**. The outlet portion **188** is an outwardly-diverging conical rim extending from the middle portion **186**.

Each incoming portion **184** has opposed grooves **194** formed longitudinally and linearly along the side wall **196**. Each groove **194** continues along the end wall **190** and engages the aperture **192** of the second portion **186** tangentially, and connects circumferentially with the opposing groove **194** to form a circumferential recess **198** around the outlet portion **188**. Each groove **194** along the side walls **196** and end wall **190** is preferably approximately 0.030 inches wide and 0.030 inches deep. The diameter of the circumferential area **198** formed by the intersecting grooves around the middle portion aperture **192** is approximately 0.090 inches. The middle portion aperture **192** is substantially cylindrical, and has a diameter in the range of 0.025 to 0.060 inches, and is preferably 0.040 inches. The length of the second portion, which is a cylinder, measured from the base of the circumferential recess **200** formed in the end wall **190** to the beginning of the third portion **188** is preferably about 0.065 inches. This length affects the coarseness of the mist spray. The third portion **188** is a conical portion, and helps disperse the mist evenly as it emerges from the mist apertures **182**. The angle of the conical third portion is preferably about 90 degrees or larger to avoid interfering with the spray pattern.

A plug **202** is inserted into each first portion **184** to leave only the grooves **194** open. See FIGS. **23**, **24**, **25**, **26**, **29** and

30. The water is split by the grooves 194 into two strands of high-velocity water. The grooves 194 direct the water to the second portion aperture 192 and almost directly at each other in a swirling manner about the circumferential recess 198 area to create the tiny droplets required for creating a steam effect. The mist is created when the water streams impact one another and flow through the second portion 186. The plugs 202 are polypropylene, and preferably cylindrical to fit into each first portion 184 of the mist apertures 132. A span 204 is formed between each of the plugs 202 to connect them together in a gang. The gang of plugs 202 can be inserted into the mist apertures 132 easily during manufacturing, thus eliminating the inconvenience-of inserting individual plugs 202. The size of the plugs 202 decrease from the center of the gang to the end of the gang because the mist nozzles at the lower portion of the U-shape are longer than those at the upper end of the U-shape. This change in length is due to the curvature of the front channel plate 122 of the shower head 72. FIG. 29 shows a shorter plug 202 at the upper end of the U-shape, and FIG. 30 shows a longer plug 202 at the lower portion of the U-shape.

The champagne apertures 128 are shown in detail in FIGS. 31 and 32, and are positioned in the curved recess 156 formed in the front of the front channel plate 122. The champagne apertures 128 formed in the front channel plate 122 have an inlet port 206 formed by a sloped cylindrical boss. The cylindrical boss allows the length to diameter ratio of the champagne aperture 128 in the front channel plate 122 to be approximately 3:1, which creates the desired fluid velocity under line pressure. A collar 208 surrounds the aperture 128 on the outer surface of the channel plate 122. Each collar 208 has two or preferably four radially spaced notches 210 formed therein to allow air to be incorporated into the water stream, as is described later. The collars 208 are interconnected by support braces 212. The support braces 212 and collars 208 are the same height, and support an aeration screen 160 that extends over the entirety of the curved formed in the front of the front channel plate 122.

A champagne insert 158 is positioned in the recess 156 on top of one aeration screen 160. The thickness of the insert element 158 is between 0.070 inches and 0.170 inches, and is preferably 0.120 inches, to space the screens 162, 164 apart a desired distance. The insert 158 defines apertures 216 that are positioned coextensive to and in alignment with the champagne apertures 128. Two aeration screens 162, 164 are positioned on the insert 158 and abut the collar 218 formed on the back of the front cover housing which surrounds the champagne aperture formed in the front cover housing. The champagne apertures 128 formed in the front housing coextend to and are in alignment with the champagne apertures formed in the front channel plate 122. Small air holes 130 are formed in the front cover housing over the champagne recess 156, preferably between the champagne apertures 128 in the housing cover, to allow air to be entrained in the water flowing through the screens 160, 162, 164. See FIGS. 3 and 5.

The combination of the screens, spacer insert and the notch 210 formed in the collar 208 create the aerated flow required for the desired champagne effect. The water is accelerated through the incoming champagne apertures 128 in the front channel plate 122 and passes to impact the screen 160 to break up the flow. The impact of the water on the screen 160 creates a vacuum, which draws air through the notch 210 and air inlet holes 130 into the water stream. The second screens 162, 164 further break up the flow and further aerate the water exiting the champagne apertures in the faceplate to have the desired aerated quality and form separate aerated ropes.

The center 220 of the front channel plate 122 defines three concentric annular flange rings 222, 224, 226. See FIGS. 5 and 7. A threaded bore 228 is formed in the front channel plate 122 inside the innermost annular flange ring 226 for locating the threaded end of the center retainer 116, which secures the orifice cup 112, through the front housing cover 98, to the front channel plate 122. The inner annular flange wall 230 of the orifice cup 112 sealingly mates with the innermost annular flange ring 226 of the front channel plate 122 to direct water to the center ring of spray apertures 232. The turbine 120 is positioned between the inner and outer flange walls 234 of the orifice cup 112 The outer annular flange wall 234 of the orifice cup 112 sealingly seats against the outermost annular flange ring 222 to form a turbine chamber 236 and to direct water through the turbine 120 to the corresponding pulsating water apertures 118. A chamber 238 is formed between the annular flange rings 222, 224 to allow water to pass to the mid-level spray.

The orifice cup 112, shown in FIGS. 5 and 6A, show the pulsating flow apertures 118, the central ring apertures 232, and medium flow slots 124 around the outer circumference. The central ring apertures 232 are actually slots formed along a side wall of a central aperture defined in the center of the orifice cup 112. The retainer 116 seals against the open side of the slots to form a channel to direct the water flow around the retainer and through the central ring apertures (slots). The annular flange walls 230, 234 mentioned above are also shown extending from the back side of the orifice cup 112. The medium flow through the slots in the outer circumference of the orifice cup can operate in combination with the flow through the inner ring as determined by the actuation of the mode selector 80.

The front channel plate 122 seats closely behind and adjacent to the rear of the face plate 98, with the various apertures mating with the corresponding apertures in the face plate, as described above.

As seen in FIG. 8, the rear side of the front channel plate forms a plurality of channels, compartments or chambers to direct water from the mode selector 80 to the appropriate spray mode apertures as selected by the user. A first chamber 240 is circular in shape and is the small spray chamber 240. This spray exits around the retainer 116, as described above.

A second chamber 242 concentrically surrounds a majority of the first chamber 240 and is the inner turbine chamber 242. Three apertures 244 are formed in the chamber, each aperture having a flat end and a curved end. Each aperture is angled through the channel plate in order to impact the turbine blade at a substantially right angle. These apertures are positioned relatively close to the center of the turbine and result in the fast pulsating flow.

A third chamber 246 concentrically surrounds a majority of the second chamber 242 and is the outer turbine chamber 246. Three apertures 248 similar to those described above are positioned to strike the turbine blades near their ends to cause the turbine to spin slower, to form the slow pulsating flow.

A fourth chamber 250 directs water to the medium spray apertures 124.

A fifth compartment 252 is generally U-shaped and partially surrounds the third 246 and fourth chambers 250, and directs water flow through the champagne apertures 128. A sixth 254 is generally U-shaped and surrounds the fifth compartment 250, and directs water flow through the broad band normal spray apertures 106. A seventh compartment 256 is also generally U-shaped and surrounds the sixth compartment 254, and directs water flow through the mist apertures **132**. An eighth channel **258** extends upwardly to direct flow through the waterfall slot **134**, if one is included. The channels and compartments are formed by walls or ridges extending rearwardly from the front channel plate **122**.

The rear channel plate **140**, as shown in FIGS. **7** and **9**, has a main wall **260** defining a front side **262** forming channels and compartments matching the channels and compartments formed on the rear surface of the front channel plate **122**. The front channel plate **122** and the rear channel plate **140** are sealingly engaged to direct water flow from the mode selector **80** to the appropriate spray mode aperture. Apertures are formed through the main wall **260** in the rear channel plate **140** into select channels and compartments on the front side **262** of the rear channel plate **140**, to allow water from the mode selector **80** to pass through. The apertures are labeled on FIG. **9**, and are for the center spray **264**, the medium spray **266**, the fast and slow turbine pulsed spray **268**, **270** respectively, champagne spray **272**, waterfall **274**, normal band spray **276** and mist spray (from the flow control valve) **278**

The curved channels and uniquely shaped chambers in the spray head unit are made possible by the use of hot-plate welding the front and rear channel plates together. Hot plate welding allows the joining of two surfaces together. The hot plate welding process provides for hermetic seals, long weld lengths, and desired bond strength required for a structure such as the shower head of the present invention. Seals formed by this process are reliably hermetic because the plastic is actually melted and joined together. The weld surface can be as long as is practical, such as for the channels in the spray head unit.

This manufacturing technique allows the shower head to deviate from the traditional circular heads of the past, and provide additional space and channel paths to allow for uniquely shaped spray patterns, such as the U-shaped mist, arcuate champagne, or wide-band normal spray.

The operation of the shower head of the instant invention is controlled by the flow control valve **82** and the mode selector **80**, both built into the back of the rear channel plate **140**. See FIG. **10**. The instant invention incorporates two turn-knobs **86**, **90**, one for each of the flow control valve **82** and mode selector **80**, which activate the functions of the shower head in a manner more convenient than the typical control ring found on conventional shower heads. One turn-knob **86** actuates the mode actuator **80**, which allows the user to select any non-mist spray mode. The other turn-knob **90** actuates the flow control valve **82** to allow the user to control the flow rate to the selected mode, activate the mist mode to mix with any existing mode, and transition entirely to the mist mode (and return from mist to the desired non-mist mode).

The turn-knobs **86**, **90** are located on the lower sides of the shower head for convenient use. This position minimizes interference of the spray while changing modes compared to a control ring positioned around the circumference of the shower head.

FIG. **11** shows a partial exploded view of a shower head **72** utilizing the flow control valve **82** and mode selector **80** of the present invention FIG. **12** shows the spool valve **280** used in the mode selector **80**, and FIG. **13** shows the shuttle **282** and knob portion **284** used in the flow control valve **82**. Referring to FIG. **10**, the flow control valve **82** and the mode selector **80** are contained in an L-shaped housing **286** on the rear face of the rear channel plate **140**. The L-shaped housing **286** is divided into two portions, the first portion **288** being for the flow control valve **82**, and the second portion **290** being for the mode selector **80**. There is a fluid passageway **76** defined between the first and second portions of the housing, with the passage of water therethrough controlled by the flow control valve **82**. The first portion **288** also defines an aperture **278**, for allowing flow to the chamber in the spray head unit that leads to the mist apertures. The flow control valve **82** controls the flow of water into the first portion **288**, and diverts it to the mist apertures, to the mode selector in the second portion, or to a combination of both.

If the water is directed to the mist apertures, the mist spray mode is activated. If the water is directed to the mode selector, then the setting of the mode selector determines the spray mode activated. The water can also be directed to a combination of both the mist mode and the selected spray mode. Basically, water flows through the flow path in the shower head, into the inlet apertures **292** of the first portion of the L-shaped housing to first flow past the flow control valve, then either to the mode selector for dispensing through certain output modes, or through the mist output mode, or both, depending on the position of the flow control valve.

The mode selector (mode actuator) changes the flow to various individual or combinations of output modes, such as normal spray, pulsed, combination of normal and pulsed, champagne-style flow and others. The mode selector is described in greater detail below.

The flow control valve **82** is a combination shuttle valve **282** and knob **284**, as shown in FIGS. **14–22**. The flow control valve **82** can be operated with one hand, and can be actuated without inadvertently causing the shower head orientation to be altered or interfering with the spray.

The shuttle valve **282**, as shown in FIG. **14**, is positioned in a recess or chamber **294**. The end of the recess is open, but is sealed off when the shuttle valve is inserted therein to keep water from leaking out of the recess. An outer O-ring **296** positioned around the knob **284** seals the chamber **294**.

The knob portion **284** has a generally cylindrical body defining a central axial threaded recess **298**. An annular flange **300** extends from the outer wall of the knob portion for engagement with the spray head unit **138**. An annular groove **302** is formed in the outer surface of the knob portion **284** for receiving the outer O-ring **296**. A series of radially spaced, longitudinally extending keys **304** are also formed on the outside wall of the knob portion for receiving the knob cover **90** in a torque-transmitting relationship. The knob cover **90** has corresponding grooves for receiving the keys **304**. The knob cover aesthetically covers the knob and, when turned, also turns the knob. The threaded end of the shuttle **282** is threadedly received in the threaded central recess **306** of the knob portion.

The shuttle **282** includes a threaded portion at one end **306**, a middle diverting portion **308**, and a flow restrictor portion **310** at the end opposite the threaded portion. The shuttle valve **282** is preferably made of a plastic, or other rigid material suitable for use as described herein The threaded end has approximately 7 flights of continuous threading. The knob portion receives the threaded end of the shuttle. The knob portion is rotationally fixed to the housing **286**, so that when it is turned the shuttle threads are engaged and the shuttle moves along the length of the recess. This is the threaded means for moving the shuttle in the chamber.

The threaded post of the shuttle can have a slot formed along its length There can be one slot formed in the post, or more than one slot, such as diametrically-opposed slots. The slots allow the post to collapse and "slip" on the threads in the knob portion when the shuttle has been moved all the way to one end or the other of the chamber and cannot move any further. At these locations, if the knob is turned the post collapses at the slots and lets the threads slip so as to not damage the threads in the cavity or on the post.

The diverting portion **308** is defined by an annular groove **312** receiving an O-ring **314** therein, and creates a diverting means. The diverting portion moves towards and away from the outer O-ring **296** depending on the direction the knob portion is rotated.

The flow restrictor portion **310** has an I-shaped cross section (see FIG. **13**), and extends across the diameter of the shuttle valve **282** in one direction. The intermediate flat portion **316** of the flow restrictor defines an aperture **318**. The opposing edges **320** of the flow restrictor form lateral flanges, forming the I-shaped cross section. The lateral flanges **320** are spaced from the wall of the chamber **294** to allow water to flow past when the flanges are adjacent the inlet apertures **292**. Each top and bottom edge of the shuttle valve can also form a groove **322** extending along its length to facilitate the flow of water therealong.

The recess or chamber defines an inlet aperture **292** for water, and a first outlet aperture **324** for directing water to the mode selector **80**, and a second outlet aperture **278** for directing water to the mist spray mode structure (or any other spray mode structure separated from the spray modes fed by the mode selector) See FIG. **14**. As the knob portion is turned, the shuttle is moved axially into or out of (along) the recess in the shower head by the interaction of the threads on the knob portion and the threads on the shuttle. The O-ring **296** on the knob portion seals against a side wall of the shower head in a substantially water-tight manner. As the shuttle **282** is moved from the outer extreme position (FIG. **14**) to the inner extreme position (FIG. **20**), the diverting section **308** on the shuttle **282** translates along a portion of the length of the chamber to move from separating the water outlet apertures **278**, **324** to exposing different amounts of each one for a mixture of flow through modes controlled by the mode selector **80**, and the separate spray mode, in this case the mist spray mode. The knob portion **284**, in the embodiment described herein, must be turned approximately 5 and one-half turns to move from diverting flow to the mode selector only to diverting flow to the mist mode only. In between there is a combination of flow to the mode selector and to the mist mode, with the majority of flow changing from the mode selector to the mist mode gradually, as described below.

The chamber also defines top and bottom key structures **326** to keep the shuttle valve **282** from rotating as it translates along the chamber **294**. The key structures **326** only restrict the shuttle valve **282** from rotating after one-quarter turn, if starting with the shuttle valve all the way out (FIG. **14**). From one-quarter turn to the five and one-half turns the shuttle valve only translates along the chamber **294** in the shower head **72** because it is kept from rotating by the key structure **326**. From zero to one-quarter turn, the shuttle valve rotates in the chamber to move the flow restrictor from the horizontally-extending position in FIG. **14**, which allows maximum flow to the mode selector, to a vertically-extending position in FIG. **15**, which allows minimum flow to the mode selector. The shuttle stays in the vertically-extending position, held in place by the key structures, for the rest of the translation along the chamber.

Referring to FIG. **14**, the shuttle valve **282** is shown in its outermost position, at the zero turn position. See also FIG. **21**. The flow restrictor **310** is horizontally-extending, thereby allowing a maximum flow to the mode selector **80**. Since the aperture to the mode selector is at one end of the chamber, and the aperture to the mist mode is at the other end of the chamber, the sealing section of the shuttle, at zero turns, seals against the side wall of the chamber to keep any water from flowing to the mist mode aperture. From here the knob can only be turned in one direction, chosen by the thread orientation of the knob and shuttle valve. The one direction the knob can be turned must actuate the shuttle valve to move it into the chamber, not further out of the chamber. The shuttle valve cannot translate out of the chamber any further due to engagement between the end of knob with the flange **328** forming the seat for receiving the inner O-ring on the shuttle. The shuttle valve **282** cannot translate any further into the chamber without first rotating the flow restrictor to the vertical orientation (see FIG. **15**), because of the interference of the flow restrictor with opposing sloped curved side walls **330** formed in the chamber. The sloped side walls **330** encourage the flow restrictor to rotate to the vertically-oriented position.

Between zero turns and one-quarter turn, the flow to the mode selector goes from maximum to minimum, since as the flow restrictor rotates from horizontal to vertical, it cuts off the area of the-inlet apertures through which water can flow, thus restricting flow. The flow from the water inlet is what is blocked off, although the flow restrictor could be designed to block-off flow at the aperture leading to the mode selector. This is how the flow pressure regulation to the spray modes controlled by the mode selector is performed. This allows the user to use a non-mist mode (in this example) and have high flow (horizontally-extending restrictor, FIG. **14**), low flow (vertically-extending restrictor, FIG. **15**), or substantially anywhere in between as desired.

Turning the valve one-quarter of a turn rotates the shuttle valve **282** by being urged to rotate from the horizontal position to the vertical position by the engagement of the opposing edges **320** with the opposing sloped side wall surfaces **330** in the chamber. See FIG. **15**. At this point the top and bottom edges **320** of the flow restrictor are engaged by the key structure **326** at the top and bottom of the chamber, respectively. This orientation of flow restrictor allows minimum flow to the mode selector **80**. From this point to the innermost position the shuttle valve can only translate along the chamber.

FIG. **16** shows the flow control valve **82** after one full turn. The shuttle **282** translates inwardly enough to cause the diverter section **308** to slightly move over the inlet aperture **292** to form a gap allowing some flow to the mist aperture **278**. The diverter section **308** begins to pass over the water inlet aperture **292**, which creates the gap. At this position there is still flow to the mode selector **80**, so two output spray modes are actuated at once. A space is formed between the end of the knob **284** and the flange **328** on the shuttle **282** that holds the O-ring **314**, which increases as the shuttle translates inwardly, thus increasing the size of the flow path for water flowing to the mist mode aperture. At this point, however, the water flow to the mist mode aperture is mainly constricted by the size of the gap formed by the diverting section moving over the water inlet aperture **292**.

FIG. **17** shows the shuttle **282** position after two turns, where the shuttle has translated further inwardly, thus increasing the gap size in the inlet aperture, and allowing more flow to the mist mode aperture while not increasing, and slightly decreasing, the flow to the mode selector.

FIG. **18** shows the shuttle **282** position after three turns, where the shuttle has translated further inwardly, thus further increasing the gap size in the inlet aperture **292**, and allowing more flow to the mist mode aperture **278** while not increasing, and slightly further decreasing, the flow to the mode selector **80**.

FIG. **19** shows the shuttle position after four turns, where the shuttle has translated further inwardly, thus further increasing the gap size in the inlet aperture **292**, and allowing more flow to the mist mode aperture **278** while not increasing, and slightly further decreasing, the flow to the mode selector **80**.

FIG. **20** shows the shuttle position after five turns, where the shuttle **282** has translated further inwardly to a point where the diverting section **308** of the shuttle has passed over the entire inlet aperture **202** and again contacts the side wall and blocks all flow to the outlet aperture **324** to the mode selector, and directs all flow to the mist mode aperture **278**. The gap size in the inlet aperture **292** has been increased to a maximum dimension to allow the maximum amount of flow to the mist mode aperture **278** and shutting off the flow to the mode selector. See also FIG. **22**, showing the shuttle valve **282** moved inwardly and entirely blocking the water from flowing to the aperture **324** leading to the mode actuator **80**.

In returning from 100% mist spray to 100% spray through the mode controlled by the mode selector, the user turns the knob approximately five times in the opposite direction to translate the shuttle in the opposite direction in the chamber. The shuttle **292** moves back to the outermost position, changing the flow gradually in reverse order through the stages described above. This gradual change allows the user to finely tune the amount of mist (or separated spray mode), the amount of mixed spray modes, and the flow rate to the desired levels.

The first quarter turn of the flow diverter from the outermost position moves the flow diverter from the horizontal position to the vertical position in the chamber. This is a result of the opposing edges of the flow diverter engaging the opposing sloped side wall surfaces **330**. Each opposing edge of the flow diverter engages one of the sloped surfaces. Each of the sloped surfaces **330** slopes away from the opposing respective edge in the direction the opposing edge moves when the shuttle **292** is rotated. For example, referring to FIG. **21**, the sloped surface engaging the right hand edge of the diverter slopes up and away from the opposing edge of the diverter along the well of the chamber, and the curved surface engaging the left hand of the diverter slopes down and away from the left edge of the diverter along the side wall of the chamber. When the shuttle is moved along the chamber, the edges **320** of the diverter engage the respective curved surface **330** and are urged to rotate from the horizontal to the vertical position. The key engages the sides of the edges **320** to keep the diverter from rotating.

This flow control valve has at least two unique features different from the existing technology. First, the moving member is a spool valve that routes fluids from an inlet port to any number of individual or any combination of fluid outlet ports. Second, the moving member has a soft sealing member bonded to the inner, rigid spool. This allows for a valve device that routs fluid to any number of exit ports that has only two parts. This structure allows adjustment of the mode selector without interfering with the flow of water from the shower head while actuating the mode selector.

The water flowing from the flow control valve **82** through the mode selector aperture is channeled to the mode selector **80**. See FIG. **21**. The mode selector **80** is actuated by the user to select the desired spray mode, such as normal, pulsed, champagne, small, or medium sprays, a combination of those, or others designed into the shower head **72**. The mode selector **80** is a manifold **332** in combination with a valve assembly (spool valve) **280**. See FIGS. **11** and **12**. The manifold **332** has a tubular recess **334** formed therein for receiving the cylindrical spool valve **280**. Several mode apertures **336** are formed in the walls of the tubular recess **334**. The apertures **336** each lead to a channel or chamber in the front of the spray head unit **138** to actuate different spray modes. FIG. **9** shows the apertures opening into the chambers in the spray head. More than one spray mode can be actuated at a time. See FIGS. **21** and **22**.

The spool valve **280** defines a plurality of outlet apertures **338** in its outer wall, the outlet apertures **338** each aligning at least with one mode aperture **336**. The outlet apertures **338** can be formed on the spool valve **280** so as to have only one mode aperture **336** aligned with one outlet aperture **338** at a time. The outlet apertures **338** can also be formed on the spool valve **280** so as to have more than one mode and outlet apertures aligned at a time for combination sprays modes.

The spool valve **280** has a hollow tube inner core **340** constructed of a rigid material. This tube **340** is sealed on one end. In a secondary operation a compliant elastomeric material is molded to the core tube **340** and forms an outer surface thereon **342**. The core and elastomeric material bond to each other creating a spool valve assembly with a soft compliant sealing surface **342**. The outlet apertures **338** are formed through the walls **340**, **342** of the spool valve. The cylindrical spool valve assembly **280** is located in the tubular recess **334** of the manifold **332**.

During normal use, the fluid is channeled to the inside of the spool valve **280** assembly through the flow control valve **82** as described above. The valve assembly **280** is rotated such that the openings along the length of the spool valve assembly **338** align with mode apertures **336** (openings within the housing) and allow fluid flow out of those openings. The compliant material on the spool valve seals against the wall of the tubular recess **334** in the manifold **332** so that water only flows into the mode aperture **336** aligned with an outlet aperture **338** in the spool valve **280**.

The water initially flows from the flow control valve **82** to the mode selector **80**. The water is then channeled into the inside of the spool valve through the open end. The water then flows through the spool valve **280** to the outlet aperture **338** aligned with a mode aperture **336**, and flows out of the outlet aperture **338**, through the mode aperture **336**, and on to the outlet spray mode as selected by the user.

An end of the spool valve **280** opposite the open end extends from the shower head housing, or is accessible to the user by an extension or knob, and can be rotated by the user to align the desired outlet apertures in the spool **338** with the corresponding mode apertures to actuate the desired spray modes.

The knob **90** for the flow control extends from one lower side of the shower head, and the knob **86** for the mode selector extends from the other lower side of the shower head for easy access by the users with a minimized occurrence of re-orientation of the shower head due to actuation of either one of the knobs.

The shower head **72** can be embodied in a hand-held shower device also FIGS. **2** and **34** show the hand held embodiment. The working structure of the shower head in this embodiment is substantially the same as that described above, with the following changes. The base cone and rear housing are not used, and instead the handle housing **344**, the wall mount **96**, and the vacuum breaker assembly **346** (shown in FIGS. **41**, **42** and **43**) are used.

In the hand-held embodiment, a wall bracket is available to mount to the shower pipe and support the hand-held shower head in a cradle shaped to conform to the downwardly extending handle portion. A water hose **92** extends from the bracket to the handle.

The waterfall mode can be implemented in either the wall-mount or the hand-held embodiments. The water fall mode is shown incorporated in FIGS. **35**, **36**, **37**, **38**, **39** and **40**. FIG. **35** shows the waterfall mode in the hand-held embodiment, with the waterfall slot **134** positioned above the wide-band of normal spray apertures **106**. The waterfall slot **134** is arcuate, and can extend about ⅓ to about ⅔ the width of the shower head **72**, depending on the desired spray effect. FIG. **36** shows the waterfall slot **134** incorporated into the wall-mount embodiment. The waterfall effect is created by directing a stream of laminar water onto a plate **348** having outwardly-diverging side walls **350** terminating in a wide end **352** with a sharp, clean edge **354**. See FIG. **40**. The stream should impact the plate **348** between 0 degrees and 90 degrees in a direction pointed toward the wide end **352** of the plate **348**.

In the instant embodiment, the plate **348** faces downwardly and the stream is directed upwardly at the spread plate **348**. FIG. **37** shows the eighth chamber **258** extending upwardly along the inside of the spray head unit **138**. The eighth chamber **258** is a pre-conditioning chamber to allow the water to become smooth so the resulting waterfall effect is a clear, not foamy, water spread. Preferably, the eighth chamber **258** has a straight, or smoothly-curving, path of approximately 8 inches in length to condition the water from a turbulent state to a non-turbulent state. The water stream exits a nozzle **356**, also designed to minimize turbulence, that is directed at the spread plate **348**.

Once the water hits the spread plate **348**, the water spreads out and engages the diverging side walls **350**. The water pools at the walls **350** and is thus thicker at each side wall than in the middle of the plate **348**. The water spreads across the plate, being thicker at the side walls **350**, and passes the edge **354** of the spread plate **348**. The thicker portions near the side walls **350** are diverging as they leave the plate and the web of water between them continues to spread in a smooth fashion, forming a sheet of water. The sheet of water extends out to approximately 18 inches from the shower head. After about 18 inches, the waterfall flow dissipates into a non-cohesive sheet.

The spread plate **348** should be flat or smoothly curved with no protrusions in order to create a continuous sheet of water. The edge **354** of the spread plate **348** must be a clean edge with no bumps or abrasions. Any bumps or abrasions will ruin the continuous, clear nature of the sheet of water The edge **354** can have a ramp surface **358**, if desired, to further conform the water sheet into a waterfall form. The spread plate **348** can be positioned to face upwardly, with the stream directed downwardly at it. In the instant embodiment the downwardly-facing spread plate **348** fit more efficiently into the design of the/shower head **72**. The term "turbulence" used above is to characterize a swirled, non-continuous flow, which may coincide with the technical meaning of the term. The term "laminar" used above is to characterize a continuous, clear flow, which may coincide with the technical meaning of the term. It is also contemplated that a turbulent spray could be directed at the spread plate, which would result in a water fall spray having a foamy, non-continuous characteristic.

A vacuum breaker **346** is used in the hand-held embodiment to prevent siphoning of possibly contaminated water from the shower hose **92** into the house water supply system. The vacuum breaker **346** of the present invention is shown in FIGS. **41**, **42** and **43**. The vacuum breaker **346** is built into the bracket **96** for holding the hand-held shower head. The bracket **96** attaches at one end to the shower pipe, and has a water flow path that leads to the shower hose **92** attached at the other end of the bracket. The water flow path is formed through the pivot ball **144** (and the flow restrictor **152** inside of the pivot ball) pivotally retained in the bracket. The vacuum breaker **346** is inside the bracket **96**, and engages the pivot ball **144** at one end **360**. The other end **362** of the vacuum breaker **346** is in selective engagement with the end **364** of a stand-tube **366**. The stand-tube **366** directs the water to the shower hose **92**. A space **368** is formed around the stand-tube **366** inside the bracket housing **96**, and an aperture **370** is formed in the bracket housing into the space.

The vacuum breaker **346**, as shown in FIGS. **41–43**, includes three members, a pivot ball support **372**, a flexible, resilient washer **374**, and a support ring **376**. The pivot ball support **372** is generally cylindrical in shape and has a rim **378** at its first end that engages the pivot ball **144**. The second end **380** defines an outwardly conical section with at least one aperture **382** formed therein, and preferably three formed at equal distance from one another. The aperture **382** or apertures are formed in the side walls **384**, not at the tip of the conical section. The very tip of the conical section reverses back into the pivot ball support **372**, and acts to circumferentially divert the in-flowing water to the apertures **382** formed in the side walls of the conical section **384** (See FIG. **42**.)

The bracket housing **92** forms a circumferential seat **386** for receiving the support ring **376**. The seat **386** is positioned just upstream of the end of the stand-tube **366**, and the support ring **376** rests on the upstream side of the seat **386**. The support ring **376** is circular in shape and defines a central aperture surrounded by an inwardly angled annular engagement surface **388** with radially-spaced notches **390** formed therein. The washer **374** is flexible, and is disc-shaped with a center aperture **392**. The outer edge **394** of the washer **374** forms a continuous rim extending in both directions from the washer.

As shown in FIG. **41**, the flexible washer **374** rests on the support ring **376**, against which the pivot ball support **372** in turn rests. The rim **394** on the flexible washer is captured by the downstream rim **380** of the pivot ball support and the upstream rim of the support ring **376**. This engagement creates a seal to keep water or air from passing the flexible washer other than through its central aperture **392**. The central portion or web **396** of the flexible washer **374** engages the conical end surface of the pivot ball support **372** and covers the apertures **382** formed therein when there is no incoming water pressure, or when there is a vacuum being drawn from the shower pipe. This is a first or sealed position.

FIG. **42** shows the vacuum breaker **346** when there is incoming water pressure. This is a second or unsealed position. The water pushes the central portion **396** of the flexible washer **374** away from the conical end of the pivot ball support **372**, which uncovers the apertures formed therein. The web extends downstream to engage the rim **364** of the stand-tube to form a seal therewith. Water thus flows through the pivot ball support **372**, through the apertures formed in its conical end **382**, through the central aperture of the flexible washer **392**, and into the stand-tube **366**. No water flows outside the stand-tube **366** and out of the aperture formed in the housing. This flow is depicted by the arrows of FIG. **42**.

The vacuum breaker **346** works to inhibit the siphoning of water from the shower hose and back into the house water supply when there is no incoming water flow. At certain times a vacuum is formed in the shower pipe, which could normally siphon the water out of the shower tube (between the bracket and the shower head). However, the flexible washer **374** acts to plug the holes in the pivot ball support **372** (see FIG. **41**), and keep any water from flowing back into the shower pipe. If there is a leak in the vacuum breaker **346**, air is drawn through the aperture in the housing near the stand-tube **366**, backwards through the leak in the vacuum breaker **346** and into the shower pipe. The arrows in FIG. **41** show this flow. Typically, when the vacuum breaker **346** is properly working, the air vent **370** is not utilized. The air vent aperture **370** is a back-up, and keeps water from accidentally being siphoned if the vacuum breaker fails.

The instant vacuum breaker structure is integral with the bracket, small in size, and easily manufactured and assembled. The diameter of each of the three components are smaller than the diameter of the pivot ball, allowing the vacuum breaker to be easily built into the bracket. It combines the required siphon barrier and the back-up air-vent system into only a small portion of the bracket structure.

While the preferred embodiment of the flow control valve is set forth above, several alternative embodiments are capable of providing similar function and benefits. Each of these valves are located in the shower head at the same location as the previously-described flow control valve, and each diverts incoming water either to the mode selector, the mist (or separated) spray mode, or a combination of both, and adjusts the flow pressure to the mode selector.

FIGS. **44–48** represent a second embodiment of the flow control valve **82'**. The valve **82'** is positioned in the sleeve or chamber. Water flows into the chamber in which the valve is located through an inlet aperture **398**. The inlet aperture **398** can be a single aperture or a plurality of apertures. The inlet apertures **398** can have particular shapes to affect flow pressure, as described below. An outlet aperture **400** is formed in the end of the chamber to allow water to flow to the mode selector **80**, and an outlet aperture **402** is formed in the side wall of the chamber to allow water to flow to the channel leading to the mist spray apertures. Once in the chamber, the valve **82'** acts to direct the water into the mode selector **80**, the mist mode, or both, through the respective apertures. The valve also controls the water pressure flowing into the mode selector.

The first half of the valve **82'** has a first knob portion **404** for receiving a turn-knob. The first knob portion **404** is shaped as a key to receive the turn-knob **90** in a torque transferring manner. A pair of radially extending flanges are formed on the shaft of the first knob portion **404** and form a seat **406** for an O-ring seal **408**. The outer flange extends outwardly further than the inner flange to act as a stop and to rotatably retain the knob portion **404** in the spray head unit **138**. It also keeps the first half from being inserted too far into the chamber. The O-ring seal **408** keeps water from exiting the shower head around the knob portion **404**. The internal end **410** of the knob portion **404** is cylindrical in shape and defines external threads **412**.

The second half of the valve is a shuttle **414**, and includes an internally threaded cavity **416**, a pair of radially extending flanges **418**, a stop structure **420**, and a hexagonally shaped keyed end **422**. See FIG. **48**. The flanges **418** form a seat **424** for an O-ring **426** which seals with the inside wall of the chamber, as described below. The shuttle **414** is received on the knob portion **404** inserting the threaded end **410** of the knob portion **404** into the threaded cavity **416**.

The valve **82'** is positioned in the chamber and the knob portion **404** is secured to the outer wall of the spray head unit **138**. The knob end **404** is secured using a snap-ring **428** or the like in conjunction with the outer flange **430** to rotatably retain the knob end. The first half is rotatable in the chamber. The keyed end **422** of the shuttle **414** is positioned in the mode selector outlet aperture **400**, which is shaped to prohibit the rotation of the keyed end **422**, but to allow the axial translation of the keyed end **422** therein. The mode selector outlet aperture **400**, for instance, can have opposing walls **432** engaging one or more of the walls of the keyed end of the second half of the valve (See FIG. **48**). The walls **432** keep the shuttle **414** from turning, but allow the shuttle to slide (translate) axially along the chamber.

The shuttle **414** is caused to slide or translate along the chamber when the knob portion **404** is rotated. The threaded engagement **410** of the knob portion **404** and the shuttle **414** result in the shuttle moving relative to the fixed knob portion when the knob portion is rotated. Generally, the shuttle **414** acts as a diverter and translates from an initial position, through an intermediate position, to a final position. This range of translation takes approximately three compete turns of the knob portion **404**. The amount of turning needed to move the shuttle through the entire range depends on the threading design of the post of the knob portion (which the threaded cavity of the shuttle matches). More or less than three turns can be obtained by changing the thread pitch. With a right-hand thread, the clockwise rotation of the knob portion **404** causes the shuttle **414** to move towards the knob portion **404**. A counter-clockwise rotation of the knob portion **404** causes the shuttle to move away from the knob portion. The opposite relative movements would occur with a left-hand thread. With respect to the description of the this valve **82'**, a right-hand thread convention is used.

The initial position of the diverter is shown in FIGS. **44** and **45**. The shuttle O-ring seal **426** (which is the diverter) is positioned outwardly of the two generally triangular and the rectangular inlet apertures **398** formed in the top of the chamber (together forming the inlet aperture). The shuttle O-ring seal **426** is positioned inwardly of the mist inlet aperture **402**. In this position, that water flows through the inlet aperture **398** and through the chamber, the mode selector aperture **400**, and on into the mode selector **80**. In this position, the flow into the mode selector for passage to any mode except mist mode is at a maximum level.

Upon turning the knob portion **404** in a counter-clockwise direction, the shuttle **414** is moved away from the knob portion **404**, thus moving the diverter **426** over the inlet aperture **398** to restrict flow to the mode selector **80**, and thus reduce the flow rate (and water pressure). This allows the water pressure to be adjusted by the user for whatever mode the user has chosen. As the knob portion **404** is turned further in a counter-clockwise direction, the diverter **426** moves further away from the knob portion **404**. This moves the diverter **426** further across the inlet aperture **398** to split the incoming water flow to both the mist apertures **402** and to the mode selector **80**. See FIG. **46**. At this point, water is flowing to both the mode selector and the mist mode outlet. As the knob portion **404** is continued to be turned in the counter-clockwise direction, the diverter **426** moves to a position where most of the water is diverted to the mist mode outlet **402**. At this point most water is flowing to the mist mode outlet aperture **402** and only a small amount of water is flowing to the mode selector **80**.

FIG. **47** shows the shuttle **414** in its innermost position, with the diverter **426** positioned inwardly of the inlet aperture **398** so all water flows to the mist mode aperture **402** and no water flows to the mode selector **80**.

In transitioning from mist mode back to another mode set by the mode selector **80**, the knob portion **404** is turned clockwise, and the above process is performed in reverse. The flow to the non-mist mode begins gradually and mixes with the mist mode, and strengthens until the mist mode is no longer actuated. The user can thus feel the non-mist mode before the mist mode is entirely turned off.

FIG. **49** shows a third embodiment of the flow control valve **82**". The valve **82**" is positioned in the chamber, and the chamber has the same inlet **398**, outlet **400** and mist **402** apertures. This third embodiment of the flow control valve **82**" is similar to the second embodiment, with the main difference being that the shuttle **434** defines the threaded post **436** and the knob portion **438** defines the threaded cavity **440**. Also, the outer seal **442** that keeps water from flowing past the knob portion **438** is formed on the shuttle **434**, and moves with the movement of the shuttle **434**. It does not, however, pass over the mist mode outlet aperture **402** at any point. It maintains a seal with the chamber to keep water from flowing past the knob portion **438**. An O-ring seal **444** is formed around the shuttle **434** to act as a diverter, similar to that described above. The actuation of the diverter is identical, with the same shuttle movement and resulting water flow control characteristics, as the embodiment described above.

The fourth embodiment, shown in FIGS. **50** and **51**, of the flow control valve **82**''' is positioned in the chamber as described above, and includes the same inlet **398**, outlet **400** and mist **402** apertures. This embodiment of the flow control valve **82**''' incorporates a pressure-locking feature which makes it difficult for the user to switch out of the mist mode, once selected, while the water is flowing. The pressure-locking flow control valve is a plunger **446**, or shuttle, slidably positioned in the chamber. The plunger **446** has a first, outer position (FIG. **50**) and second, inner position (FIG. **51**) The plunger **446** is biased into the outer position by a spring **448**. A sloped surface **450** at the end of the plunger forms a flow restriction **450**. A first O-ring **452** is positioned adjacent to and outwardly from the flow restrictor **450**, and forms a seal with the wall of the chamber. This first O-ring **452** acts as a diverter, as described below. A second O-ring **454** is positioned near the outer end of the plunger **446**, and forms a seal with the wall of the chamber. This second O-ring **454** keeps water from flowing past the plunger **446** and out of the spray head unit **138**

In the outer position, as shown on the top of FIG. **50**, the water flows in the inlet aperture **398** and out of the mode selector outlet **400**. The first O-ring **452** (the diverter) is to the right of the inlet aperture **398**, thus diverting water through mode selector outlet **400** into the mode selector **80** to be diverted to all the spray modes except the mist mode. The plunger **446** is rotatable in the chamber, and can be turned when in the outer position to control the flow through the inlet **398**. The flow restrictor **450** is a circumferential ramp that reduces the effective inlet area of inlet aperture **398**, thus cutting off the inlet flow, and thus reducing the flow to the mode selector outlet **400**. No water flows through mist mode aperture outlet **402** when the plunger **446** is in the outer position.

When the plunger **446** is in the inner position, as shown in FIG. **51**, the diverter **452** is to the left of the inlet aperture **398**, and diverts the water past the intermediate portion of the plunger **456** to the mist mode aperture outlet **402**. No water flows to mode selector outlet **400**, and the flow restrictor is thus inactive. The pressure on the plunger **446** developed by the flowing water overcomes the spring force, and keeps the plunger in the inner position until the water pressure is reduced sufficiently to allow the spring force to overcome the water pressure and move the plunger **446** to the outer position.

Another embodiment of the present invention, and particularly the flow control valve **82**"", is shown in FIG. **52**. The structure is a cylindrical body, or shuttle **458**, rotatably received in the chamber, as described above. A portion of the shuttle **458** extends from the chamber for manipulation by the user. The chamber has an inlet aperture **398**, and a mist mode aperture outlet **402** and a mode selector outlet **400**. A seal **460** is formed around the outer end of the shuttle to seal with the wall of the chamber to keep water from flowing past the shuttle and out of the spray head unit **138**.

The shuttle **458** has at least one helical channel **462** formed on its outside surface to channel water from the inlet aperture **398** to either of the two outlets **400**, **402**. FIG. **52** shows a shuttle **458** having a single helical channel on the outer surface of the shuttle. There are ridges **464** on either side of the channel that form a seal against the cavity walls. In FIG. **52**, the channel **462** is aligned with the inlet aperture **398**, and directs flow to the mode selector outlet **400**. When the knob is turned, the channel moves out of alignment with the outlet **400** and thereby restricts the flow into the outlet **400**. This controls the water pressure. As the knob is turned further, the channel aligns itself with the outlet **402** and out of alignment with the outlet **400** to divert water to the mist mode outlet **402** and not to the outlet **400**. In between, water is diverted to both outlets **400** and **402**. The shuttle having the channel formed in its outer surface is contemplated for use with more than two exit apertures.

In each of the above flow control valve embodiments, the flow control valves **82**, **82**', **82**", **82**''' include diverters, such as channels and O-rings, and are the means for diverting the water flow from one outlet flow path to the other outlet flow path, or for mixing the water flow between the two outlet flow paths.

The shape of the inlet aperture or apertures to the chamber containing the flow control valve is very important. The movement of the diverter past the inlet aperture or apertures affects the water flow into the chamber. The shape of the inlet aperture can change that affect as a result of its shape. If the inlet aperture is square, the effect would be analogous to a step function in that once the diverter passed the front edge of the aperture, the flow would be significant. If the inlet aperture was a diverging hole, such as a triangle starting narrow and widening, the flow would increase more gradually. In the preferred embodiment of the instant case, the flow rate is controlled mainly by the shuttle portion of the flow control valve, and the inlet apertures are made as large as possible. However, for instance, in the second embodiment of the flow control valve, the inlet aperture is actually a group of apertures: two symmetric, triangularly-shaped inlet apertures and a third smaller rectangularly-shaped inlet aperture (such as in apertures **398** in FIG. **44**). This aperture combination has been found to provide somewhat desirable flow characteristics. The apertures could take on any of a variety of shapes, such as oval, circular, rectangular, square, or some non-geometric shape, to condition the inlet flow pressure as desired.

While the preferred embodiment of the mode selector **80** is set forth above, other alternative embodiments are capable of providing similar function and benefits. Each of these mode selectors are located in the shower head at the same location as the previously-described mode selector, and each allows the user to select the desired spray mode.

The second embodiment of the mode selector **80'** or actuator is positioned in a reservoir having side walls **472**, a lid **474**, and a base **476**. See FIGS. **54** and **55**. The base **476** defines two rows of outlet apertures, with each aperture leading to a different channel or chamber for its respective spray mode. Water is diverted into the reservoir **478** from the flow control valve **82** as described above. Each outlet aperture **480** has a collar **482** (raised sealing surface) formed around it, and a shield **484** formed partially circumferentially around it. The shields **484** are to help align the sealing members **486** over the apertures, but are not required.

The wall at one end of the diverter reservoir **478** defines a circular aperture to receive the cam shaft **488**, which is described in more detail below Two cam shaft support bearings **490** are also formed to extend rearwardly from the bottom **476** of the reservoir to rotationally support the cam shaft **488**.

The mode selector **80'** is formed inside the diverter reservoir **478**, and allows the user to select the desired spray mode. A valve sealing surface **494** surrounds the aperture **480** and includes the collar and an O-ring **496** positioned inside of the collar and outside of the aperture **480**. The mode selector **80'** includes the cam shaft **488** and the valve assembly **492**, as shown in FIGS. **53–55A**. Each valve sealing surface is positioned around an outlet aperture, the outlet apertures preferably aligned in one row of four and one row of three inside the reservoir **478**. The rows of valve sealing surfaces **494** are substantially parallel to one another. There is one valve seal for selectively engaging and sealing with each valve sealing surface.

Each valve sealing member **486** is attached to a valve actuating arm **498** fixed at one end to the wall of the reservoir or the lid **474** of the reservoir **478** (as shown). The valve seal **486** is attached at the distal end of the valve actuating arm **498**, and is positioned over the respective outlet aperture **480** and which will seal sealingly surface **494**. The valve arm **498** fundamentally acts as a cantilever beam. Each valve arm has a first **500**, second **502** and third **504** section. The first section **500** is relatively flat and extends at right angles from the wall of the reservoir **478**. The second section **502** curves upwardly (see FIGS. **54** and **55**) from the first section **500** and then extends over to the opposite side of the reservoir **478**. The second section **502** defines cam surfaces **506** for engagement with the lobes on the cam shaft **488**, as described in more detail below. The valve arm **498** acts as a spring to sealingly bias the valve seal against the valve sealing surface **494** (the raised sealing surface) in the diverter reservoir. The third section **504** defines the valve seal **486**, which is spaced downwardly from the second section so as to be positioned over and in engagement with the raised sealing surface **494**.

The valve seal **486** is circular, and has a protruded central portion to fit into the respective outlet aperture to center the seal over the aperture and improve the sealing qualities.

The cam shaft **488**, as shown in FIGS. **53**A and B extends into the diverter reservoir **478** in selective engagement with the valve assembly as part of the mode selector **80'**. The cam shaft **488** is rotationally supported on two bearing posts **490**. The cam shaft sealingly passes through the aperture in the reservoir wall. An O-ring **510** is positioned between two radially-extending flanges **508** at one end of the cam shaft **488**, the O-ring **510** helping maintain a seal to keep water from escaping the reservoir. The end of the cam shaft **488** that extends out of the diverter reservoir **478** receives a knob to allow the user to easily and accurately actuate the cam shaft. The end of the cam shaft **488** inside the reservoir **478** defines lobes that extend substantially radially outwardly from the cam shaft. Two different shapes of lobes are disclosed. Generally triangular lobes **512** with flat tops are shown in FIGS. **53**A and B. Generally rectangular lobes **514** having slightly arcuate tops are shown in FIGS. **56**A and B. The triangularly shaped lobes allow more lobes to be placed on the cam shaft to actuate more valves if desired.

The lobes on the cam shaft are positioned so as to engage the valve arms to lift the valve seals **486** out of engagement with the valve sealing surface **494** of the desired spray mode. More than one outlet port can be uncovered at a time, depending on the placement of the lobes on the shaft.

The rotation of the cam shaft **488** acts to lift the valve seal **486**, which allows water into the appropriate channel to flow to the desired spray mode apertures. Specifically, the lobe on the cam shaft engages the second section **502** of the valve actuation arm and lifts the seal **486** off the outlet aperture **480** and corresponding valve sealing surface **494** The valve arm **498** is resiliently biased against the lobe on the cam shaft, such that when the valve arm is disengaged from the cam shaft lobe, the valve arm biases the valve seal **494** against and into the valve outlet port **480** and valve sealing surface **494**. The bias force on the arm is derived from its cantilever-style attachment to the lid **474** of the reservoir, as shown in FIG. **54**. Water pressure on the back side of the valve seal **494** also helps maintain the water tight seal of the valve seal when engaged with the valve outlet port **480**.

In more detail, as shown in FIGS. **54** and **55**, the lobe on the cam rotates with the cam to engage a first cam surface **506** on the second portion **502** of the valve actuation arm **498**. The cam shaft **488** is being rotated clockwise in FIGS. **54** and **55**. As the cam shaft is rotated, the lobe **512** further engages the first sloped surface **506** and pushes the arm **498** up to lift the seal **486** from the aperture. When the top of the lobe (flat) engages the second engagement surface (also flat), the two surfaces align and engage firmly together, as is shown in FIG. **55**. The downward force of the biased valve arm **498** is then directed through the axial center of the cam shaft **488** and does not create an appreciable rotational force on the cam shaft **488**. In this position, the cam shaft resists rotation, and acts as a register that the cam is in the proper position to open and unseat the seal **486** (FIG. **55**). When the seal **486** is unseated, water can flow therethrough to the appropriate spray mode as desired. Different valve arms are engaged by the different lobes to select the desired spray mode. When the aperture is to be closed, the cam is rotated either direction, and the lobe moves from the engagement with the second cam surface to engagement with the third or first cam surface and allows the seal to seat on the raised seal surface **494**. Once the cam is rotated a little, the force of the valve arm acts to assist in turning the cam shaft. The cam shaft **488** can be turned to cause a lobe to engage the valve arm of another seal to open a different aperture. The order in which the apertures are uncovered depends on the positioning of the lobes on the cam shaft, which can be in any order. Two or more valves can be opened at the same time or closed at the same time, or alternatively, if desired.

A diverter reservoir lid **474**, as shown in FIGS. **54** and **55**, mounts to the top of the reservoir **478** diverter to form a chamber, in which is positioned the mode actuator **80'** (valve assembly and cam shaft). Two rows of eight prongs **516** each extend from the front side of the reservoir lid and extend downwardly adjacent to the valve arms to keep the valve arms in alignment as they move up and down.

FIGS. **57** and **58** show the actuation of the valve arm **498**, similar to that shown by FIGS. **54** and **55**, by a cam shaft **488** with the substantially rectangular lobes **514**.

This embodiment of the mode selector structure allows a variety of modes to be selected, depending on the lobe structure on the cam shaft. Modes can be permanently de-activated by removing the corresponding lobe from the cam shaft, or multiple modes can be activated simultaneously by the proper positioning of the lobes. A variety of cam options can be used with a mode actuator to provide the user with the desired number of modes. A four-mode shower would have three lobes if mist mode was one of the modes (the mist mode does not depend on the mode actuator). A seven-mode shower would have six lobes if the mist mode was one of the modes. This provides an easy way to modify the level of modes available to the user without having to redesign the entire product.

FIGS. **59–65** show a third embodiment of the mode selector **80**". FIGS. **59**, **60** and **63** show the back plate **140** of the spray head unit **138** with the engine housing **518**, or reservoir, attached thereto. Apertures are shown formed through the plate **140** to the channels on the front face thereof, each of which lead to a different spray mode, as described earlier. Each of the apertures **519** has a collar **520** The collars **520** are approximately 0.030 to 0.050 inches in height. The collars **520** have a beveled top edge, and assist in sealing against the manifold **522**, as described in greater detail below.

Referring to FIG. **59**, an aperture **524** is formed through the end wall of the reservoir to receive the spool valve assembly **526**. At one end of the reservoir extends the housing for the flow control valve **82** described earlier The structure of that housing is substantially the same as described above.

FIG. **59** also shows the spool valve **526**. The spool valve includes a hollow cylinder and a knob **530**. The hollow cylinder is positioned in the reservoir and the knob **530** is positioned outside the reservoir for actuation by the user. The hollow cylinder **526** is closed at the end attached to the knob, and is open at the free end. The hollow cylinder has a channel formed at the end attached to the handle to receive a U-shaped clip that keeps the spool valve **526** from being extracted from the reservoir once inserted therein with the clip in place.

The hollow cylinder **526** defines a plurality of apertures **528** at different locations along its walls. The hollow cylinder **526** is made of a preferably rigid material such as plastic.

FIGS. **59–62** show the valve seat (or manifold) **522**. The manifold **522** fits into the engine housing **518**, with the hollow cylinder **526** received in the manifold **522**. The manifold **522** is made of a flexible material, such as Santoprene™ or other type of plastic or rubber that can withstand the high temperatures of shower water and still maintain its shape. The manifold **522** has a main body made up of several vertically-oriented cylindrical lobes **532**.

Each lobe **532** is a pair of vertically-stacked, offset cylinders. The overlapping region between the upper and lower cylinders forms an opening **534** for water to flow through. See the oval-shaped shaded areas in FIG. **66**. There is one lobe **532** for each aperture formed in the base wall of the engine housing **518**. Each bottom cylinder of each lobe fits in sealing engagement around the collar **520** formed around the corresponding aperture **519** in the floor of the engine housing **518**.

The manifold **522** defines a longitudinally-extending axial cylindrical chamber **536** for receiving the cylindrical portion of the spool **526**. The curved walls of the chamber **536** match the curved cylindrical wall of the spool valve **526** in a tight fit. An aperture is formed at one end of the manifold to be positioned in alignment with the aperture formed in the wall of the engine housing **518**. The spool valve **526** inserts through both apertures and in to the manifold **522**. The aperture in the manifold **522** defines an end seal that extends radially inwardly and is curved toward the inside of the manifold **522**. The seal **538** helps center the spool valve **526** relative to the manifold **522**, not the engine housing **518**, for the alignment of the outlet apertures **528** in the spool valve **526** to the internal water inlet apertures **540** formed in the manifold, as described below.

The chamber **536** in the manifold **522** defines water inlet apertures **540** in each top cylinder **542** of each lobe. See FIG. **61**. The inlet apertures **540** are preferably half-circle shaped, and are each positioned to align with a water outlet aperture **528** formed on the cylindrical portion of the spool valve **526**. An example of this alignment is shown in FIGS. **64** and **65**. More than one outlet aperture **528** can mate with an inlet aperture **540** at a time to effect actuation of more than one mode at a time, as desired by the manufacturer. The outside wall of the reservoir helps position the lobes with respect to one another, and portions of the outside wall span the open top of the cylindrical chamber between lobes for reinforcement.

FIGS. **59** and **64** show a manifold lid **544** that includes plugs **546** for each open-ended lobe **522**. The water in each lobe thus flows only to the aperture **519** formed in the floor of the engine housing **518** and on to the corresponding spray mode.

In operation, the water flows into the reservoir **518**, and surrounds the manifold **522**. The water flows into the open end of the spool **526**. The water flows from inside the spool **526**, through the outlet apertures **528** in the spool, into the associated inlet aperture **540** in the lobe aligned with the outlet aperture in the spool, through the overlap-aperture **534** between the top and bottom portion of the lobe, and through the aligned aperture **519** formed in the floor of the engine housing **518** to the channel for the desired spray mode. If more than one pair of apertures is aligned, then the water flows from the spool into the lobe having aligned apertures. The spool seals over the lobe inlet apertures **540** not aligned with apertures on the spool so that water does not flow from inside the spool to those lobes. The water pressure on the outside of the manifold **522** helps seal the manifold against the apertures **526** on the spool and on the floor of the engine housing.

The apertures **528** in the spool **526** are preferably positioned so that one mode is always at least partially selected. In other words, the water flow is not "dead-headed" in the engine housing. Water does not leak out from the engine housing around the handle because of a seal formed between the handle and the engine housing aperture through which the spool is positioned. As the spool is rotated, different modes are selected by the alignment of spool apertures **528** and lobe apertures **540**.

A presently preferred embodiment of the present invention and many of its improvements have been described with a degree of particularity. It should be understood that this description has been made by way of example, and that the invention is defined by the scope of the following claims.

What is claimed is:

1. A shower head for directing the flow of water, said shower head comprising:

a housing having an inlet flow path, a chamber having an inlet port and an outlet port, and an outlet flow path; wherein said inlet flow path is in fluid communication with said inlet port;

said outlet flow path is in fluid communication with said outlet port, and water flows from said inlet flow path, through said chamber, and out said outlet flow path; and

a flow control valve having a shuttle portion and a knob portion, said shuttle portion positioned in said chamber and said knob portion extending from said chamber, said shuttle portion and said knob portion operably connected such that selective actuation of said knob portion moves said shuttle portion axially in said chamber; wherein,

said shuttle portion further defines a restrictor; and

upon actuation of said knob portion, said shuttle portion moves in said chamber and causes said restrictor to at least partially cover said inlet port to restrict the flow of water into the outlet flow path.

2. The shower head of claim **1**, wherein the shuttle valve rotates in the chamber to cause the restrictor to cover the inlet port.

3. The shower head of claim **1**, wherein

the chamber defines a groove and

the shuttle portion defines a key corresponding to the groove,

wherein when the shuttle portion moves in the chamber, the key interfaces with the groove and restricts the shuttle portion from radial movement.

4. The shower head of claim **1**, wherein the restrictor at least partially covers the outlet port to restrict the flow of water into the outlet flow path.

5. The shower head of claim **1**, wherein the flow restrictor is a circumferential ramp formed on the shuttle.

6. The shower head as defined in claim **1**, wherein the inlet port is a plurality of ports.

7. A shower head for directing the flow of water to a plurality of spray modes, the shower head comprising:

a housing enveloping

an inlet flow path;

an outlet flow path;

a flow control valve;

a mode selector; and

a plurality of outlet mode apertures;

a first turn knob on the housing operably connected to the flow control valve to allow selective manipulation of the flow control valve; and

a second turn knob on the housing operably connected to the mode selector to allow selective manipulation of the mode selector; wherein

the housing has a substantially triangular front face and opposing first and second lower sides defining an acute angle between the first and second lower sides, and

the first turn knob is positioned on the first lower side and the second turn knob is positioned on the second lower side.

8. A shower head for directing the flow of water to a plurality of spray modes, the shower head comprising:

a housing enveloping

an inlet flow path;

a chamber;

a flow control valve;

a first outlet flow path;

a second outlet flow path;

a mode selector;

a plurality of mode channels;

a unique spray mode aperture; and

a plurality of outlet spray mode apertures; wherein

the inlet flow path, the first outlet flow path, and the second outlet flow path are each in fluid communication with the chamber;

the first outlet flow path is in fluid communication with the plurality of mode channels via the mode selector;

the plurality of mode channels are in fluid communication with and the plurality of outlet spray mode apertures via the mode selector;

the second outlet flow path is in fluid communication with the unique spray mode aperture;

the flow control valve is positioned in the chamber and actuable to control the pressure of the water flow therethrough to the first outlet mode path;

the flow control valve further includes a diverter portion for diverting water flow to either the first outlet flow path or the second outlet flow path, or a combination of both the first and second outlet flow paths; and

the mode selector is actuable to select at least one of the plurality of mode channels.

9. The shower head of claim **8**, wherein the unique spray mode aperture provides a mist spray mode.

10. The shower head of claim **9**, wherein the diverter portion of the flow control valve gradually transitions the flow of water from the first outlet flow path to the second outlet flow path and likewise from the second outlet flow path to the first outlet flow path thereby gradually exposing a user to water temperature differences between water exiting the mist spray mode and water exiting any one of the plurality of outlet spray mode apertures and allowing the user adequate time to adjust the water temperature accordingly.

11. The shower head of claim **8** further comprising:

a first turn knob on the housing operably connected to the flow control valve to allow selective manipulation of the flow control valve; and

a second turn knob on the housing operably connected to the mode selector to allow selective manipulation of the mode selector; wherein

the housing has a substantially triangular front face and has opposing first and second lower sides defining an acute angle between the first and second lower sides, and

the first turn knob is positioned on the first lower side and the second turn knob is positioned on the second lower side.

12. The shower head of claim **8** wherein the flow control valve comprises:

a shuttle portion at least partially defining a restrictor; and

a knob portion, wherein

the shuttle portion is positioned in the chamber and the knob portion extends from the chamber;

the shuttle portion and the knob portion are operably connected such that selective actuation of the knob portion moves the shuttle portion axially in the chamber; and

upon actuation of the knob portion, the shuttle portion moves in the chamber and causes the restrictor to at least partially impede fluid communication between the inlet flow path and the chamber to restrict the flow of water into the outlet flow path.

13. The shower head as defined in claim **12**, wherein the shuttle portion rotates in the chamber to cause the restrictor to at least partially impede fluid communication between the inlet flow path and the chamber.

14. The shower head of claim **12**, wherein the shuttle portion rotates in the chamber to cause the restrictor to at least partially impede fluid communication between the first outlet flow path and the chamber to restrict the flow of water into the first outlet flow path.

15. The shower head of claim **12** wherein

the shuttle portion defines a diverter portion;

the shuttle portion is movable to a first position with respect to the inlet flow path whereby the diverter portion diverts water flow to the first outlet flow path; and

the shuttle portion is movable to a second position with respect to the inlet flow path whereby the diverter portion diverts water flow to the second outlet flow path.

16. The shower head of claim **15**, wherein the shuttle portion rotates in the chamber to move the diverter portion.

17. The shower head of claim **15**, wherein the shuttle portion translates in the chamber to move the diverter portion.

18. The shower head of claim **15** wherein the diverter portion is an O-ring engaged with the chamber to create seal therebetween.

19. The shower head of claim **15**, wherein the diverter portion is a channel formed in the shuttle portion.

20. The shower head of claim **12**, wherein the inlet port is a plurality of ports.

21. The shower head of claim **8**, wherein

the flow control valve is positioned in the chamber and is axially movable between a first position and a second position;

the first position allows flow from the inlet flow path through the chamber to a first outlet port;

the second position allows flow from the inlet flow path through the chamber to a second outlet port;

the flow control valve is biased by a bias means to the second position; and

when the flow control valve is in the first position, the water flow in the chamber creates sufficient pressure on the valve to overcome the bias force and maintain the valve in the second position.

22. A shower head for directing the flow of water, the shower head comprising:

a housing;

a manifold encompassed within the housing;

an inlet flow port;

an outlet flow port;

a chamber defined by the manifold, wherein the chamber is in fluid communication with both the inlet flow port and the outlet flow port;

a retainer that passes through the chamber and connects the manifold with the housing;

a cup that interfaces with the chamber and the housing; wherein

the retainer interfaces with the cup and passes through an aperture therein to connect the manifold with the housing;

the retainer and the cup together define the outlet flow port; and

the retainer defines a portion of the outlet flow port.

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