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(54) **ADJUSTABLE NOZZLE AND METHOD OF OPERATION**

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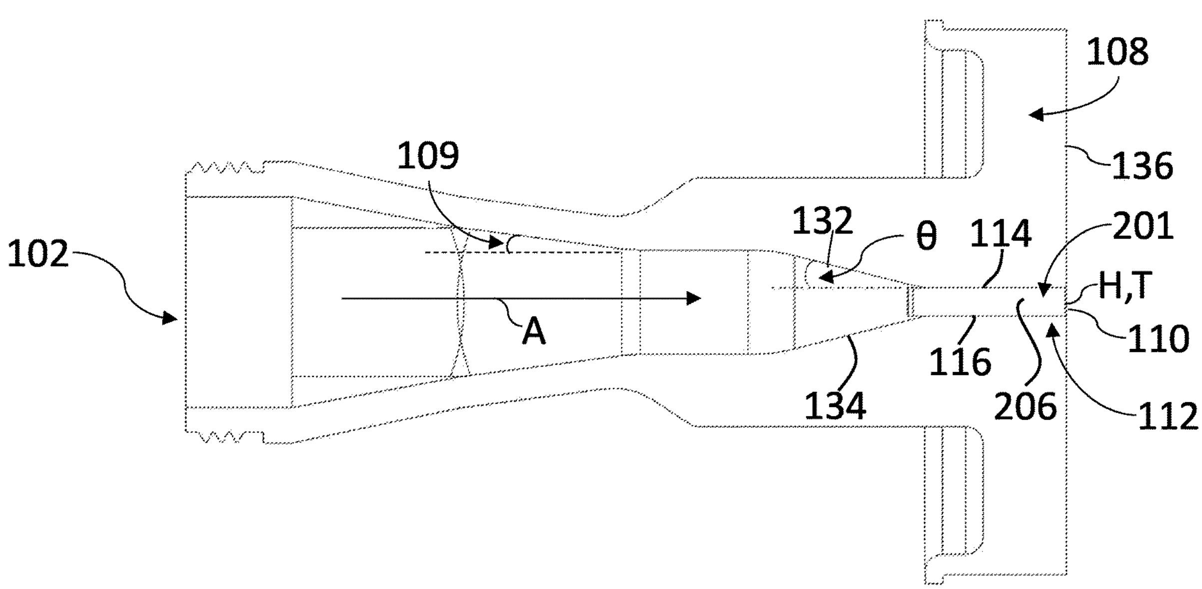
(52) **U.S. Cl.**

CPC ***A62C 31/03*** (2013.01); ***B05B 1/06*** (2013.01); ***B05B 1/12*** (2013.01); ***B05B 1/26*** (2013.01)

(57) **ABSTRACT**

An adjustable nozzle having a nozzle body having an inlet section with an inlet opening, an outlet section with an outlet opening, and a fluid flow path extending from the inlet opening to the outlet opening; a spray restrictor segment located in the outlet section; and an actuator that displaces the spray restrictor segment toward and away from a center of the fluid flow path, thereby varying a pattern of fluid flowing from the fluid flow path through the outlet opening.



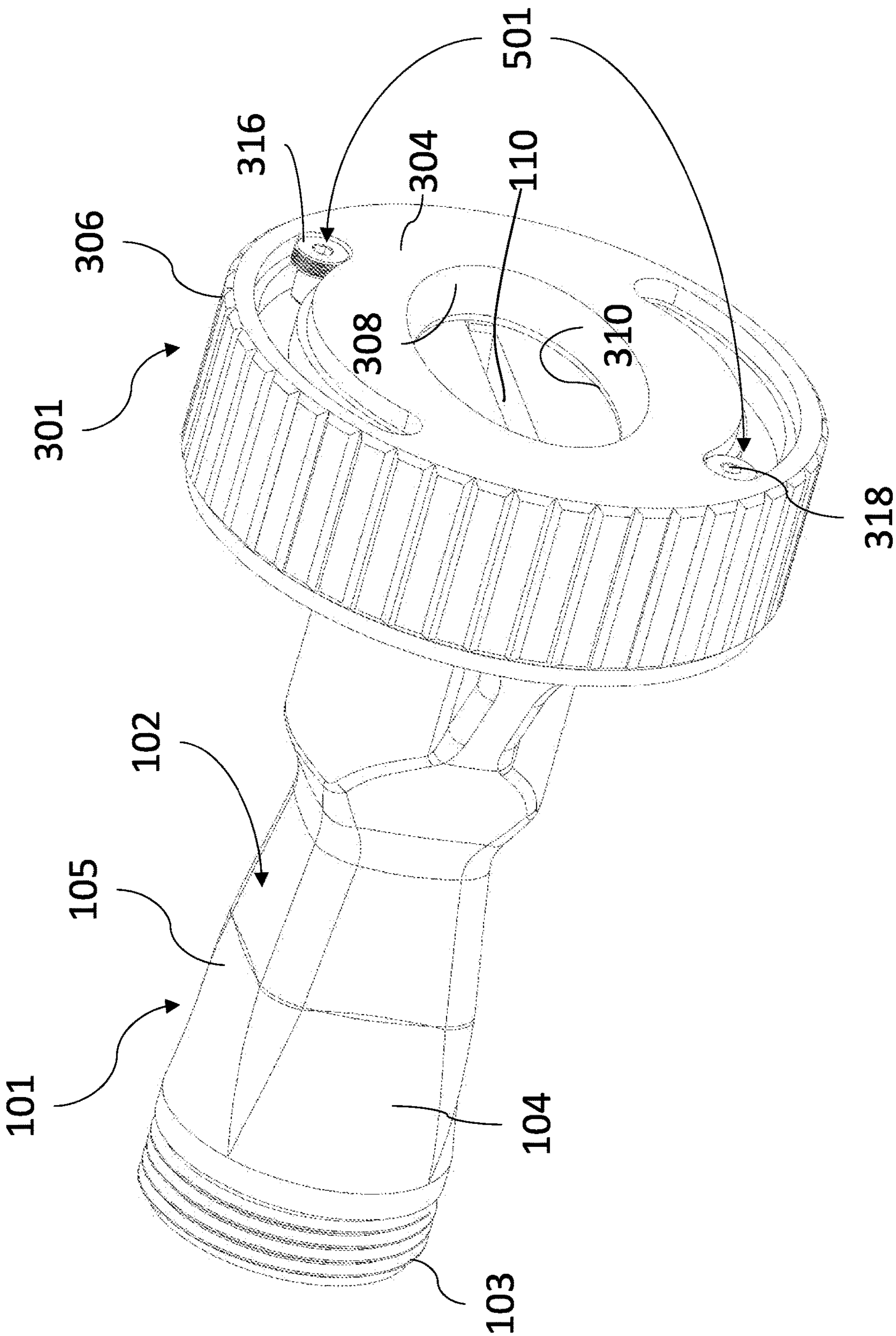


Fig. 1

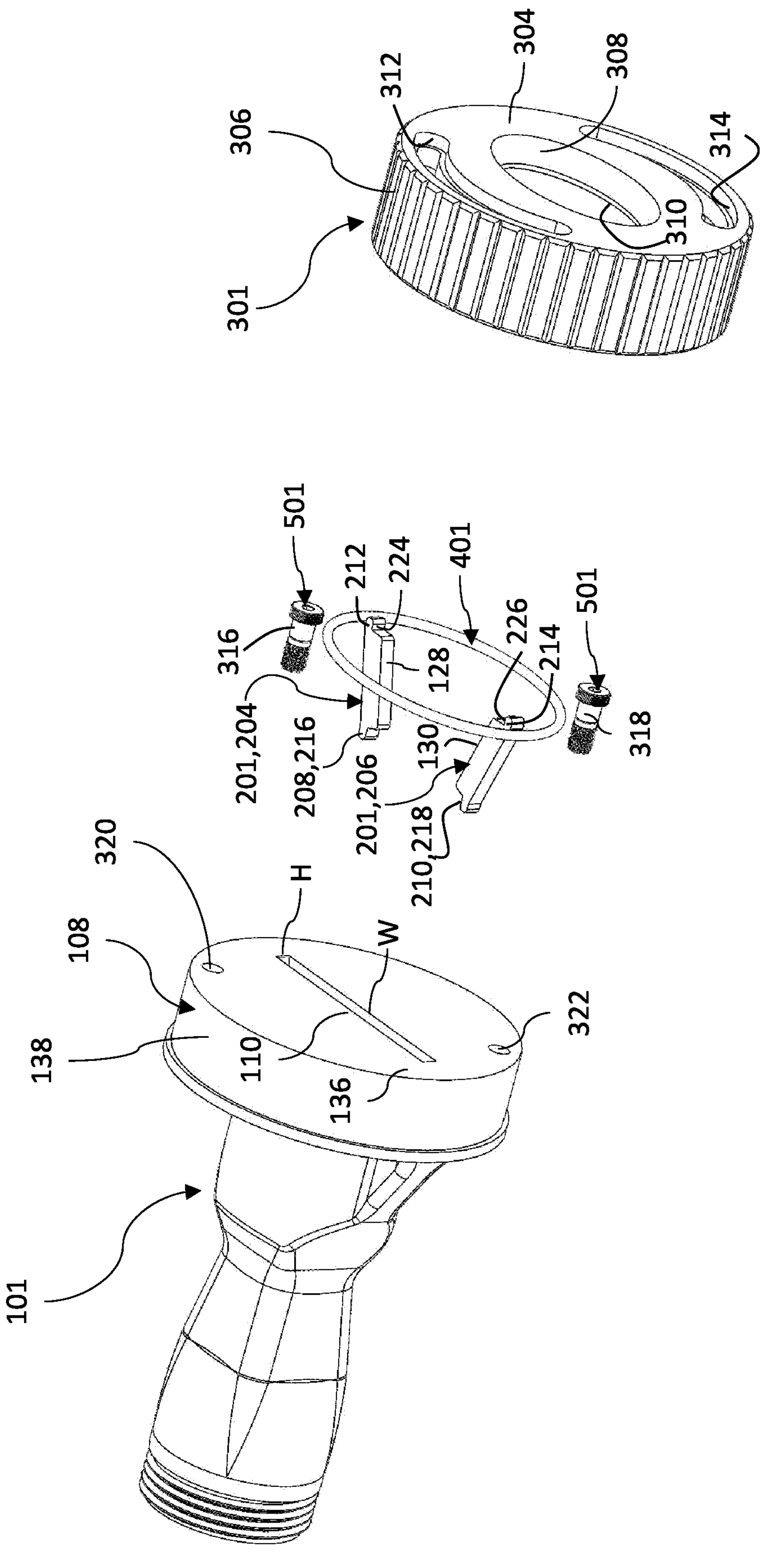

301
306
312
304
308
314
310
501
212
224
401
316
226
214
128
501
201,204
208,216
130
318
201,206
210,218
320
H
W
108
138
110
136
322
101

Fig. 2

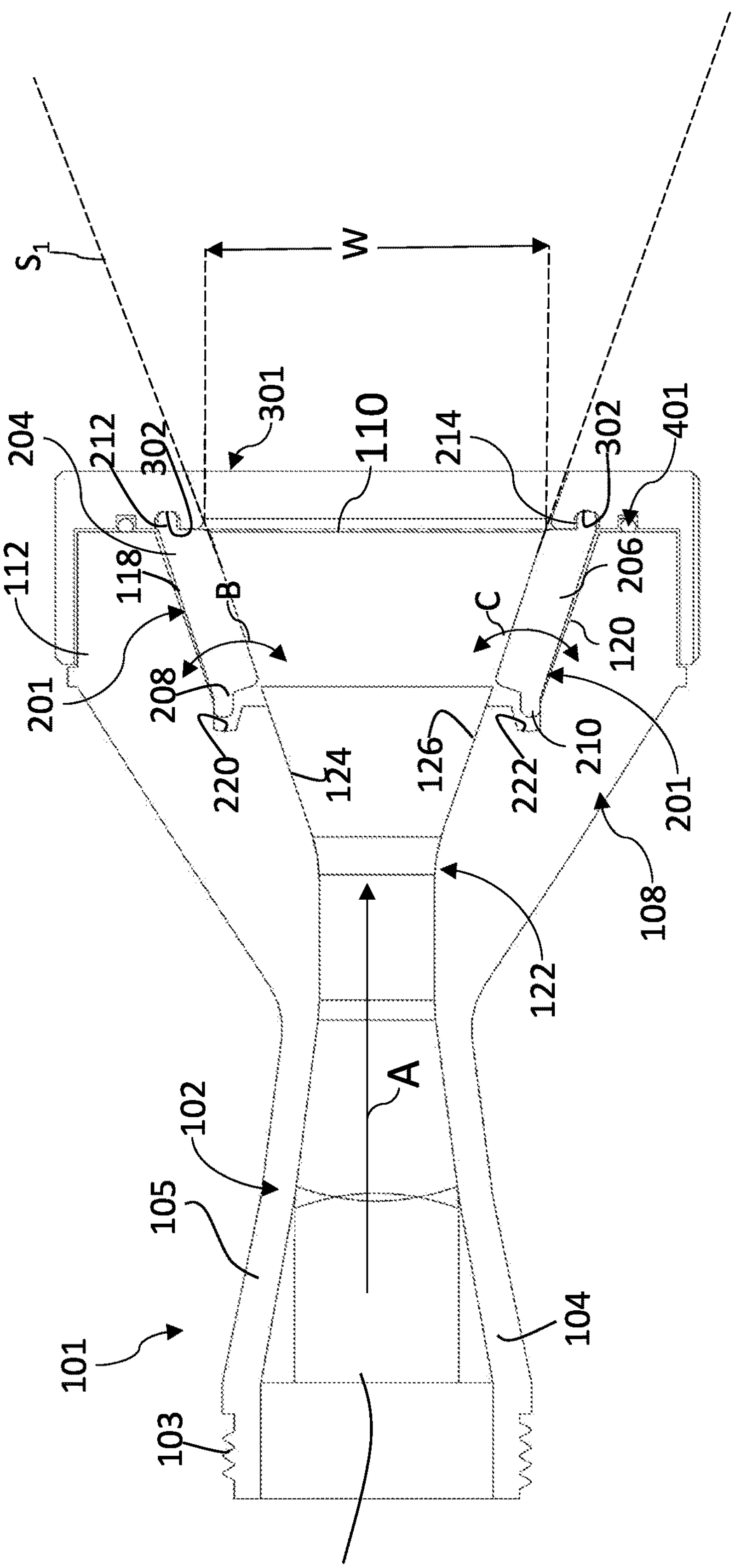
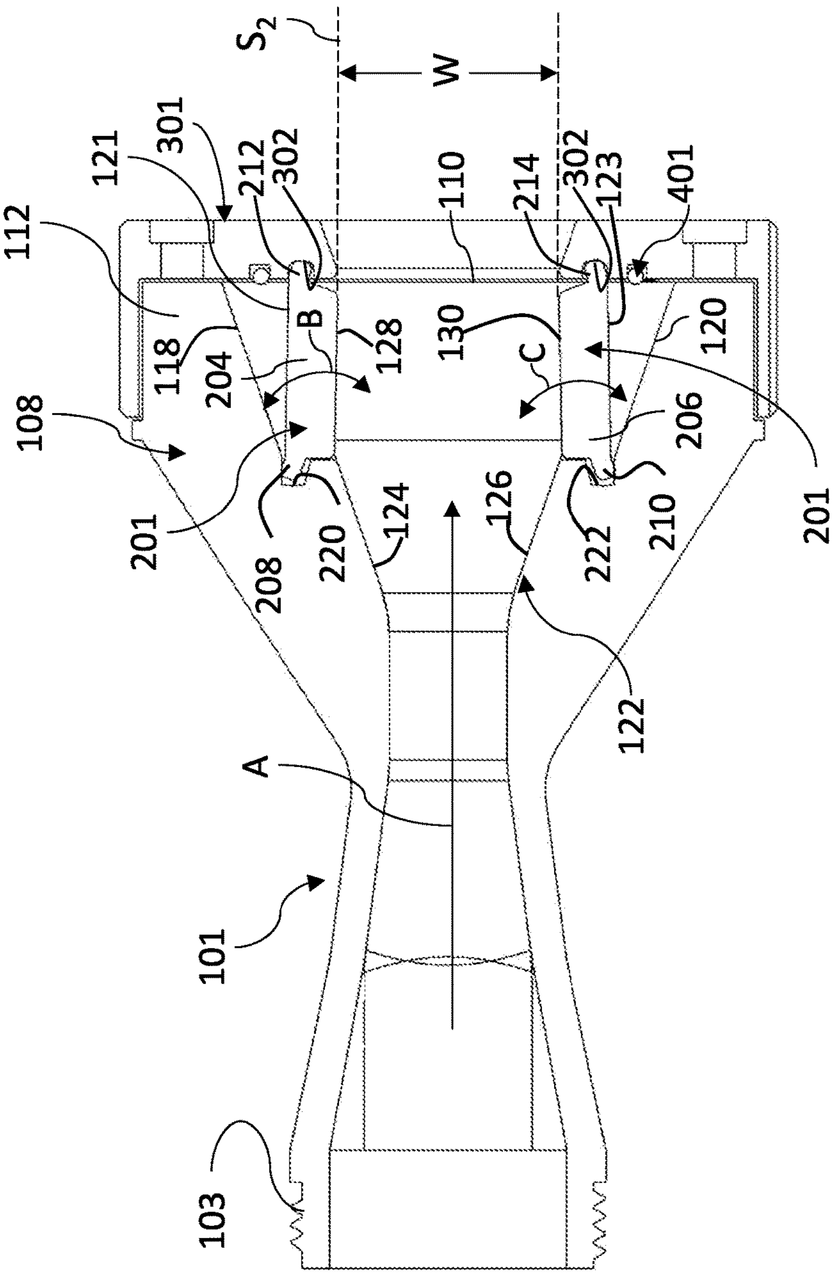

S1
W
301
110
214
302
401
204
212
302
112
118
B
206
C
120
201
208
220
124
126
222
210
201
122
108
A
102
105
101
103
104
106

Fig. 3



S_2
W
301
121
212
302
110
214
302
123
401
112
118
B
128
130
C
120
204
108
206
201
201
208
220
124
126
222
210
122
A
101
103

Fig. 4

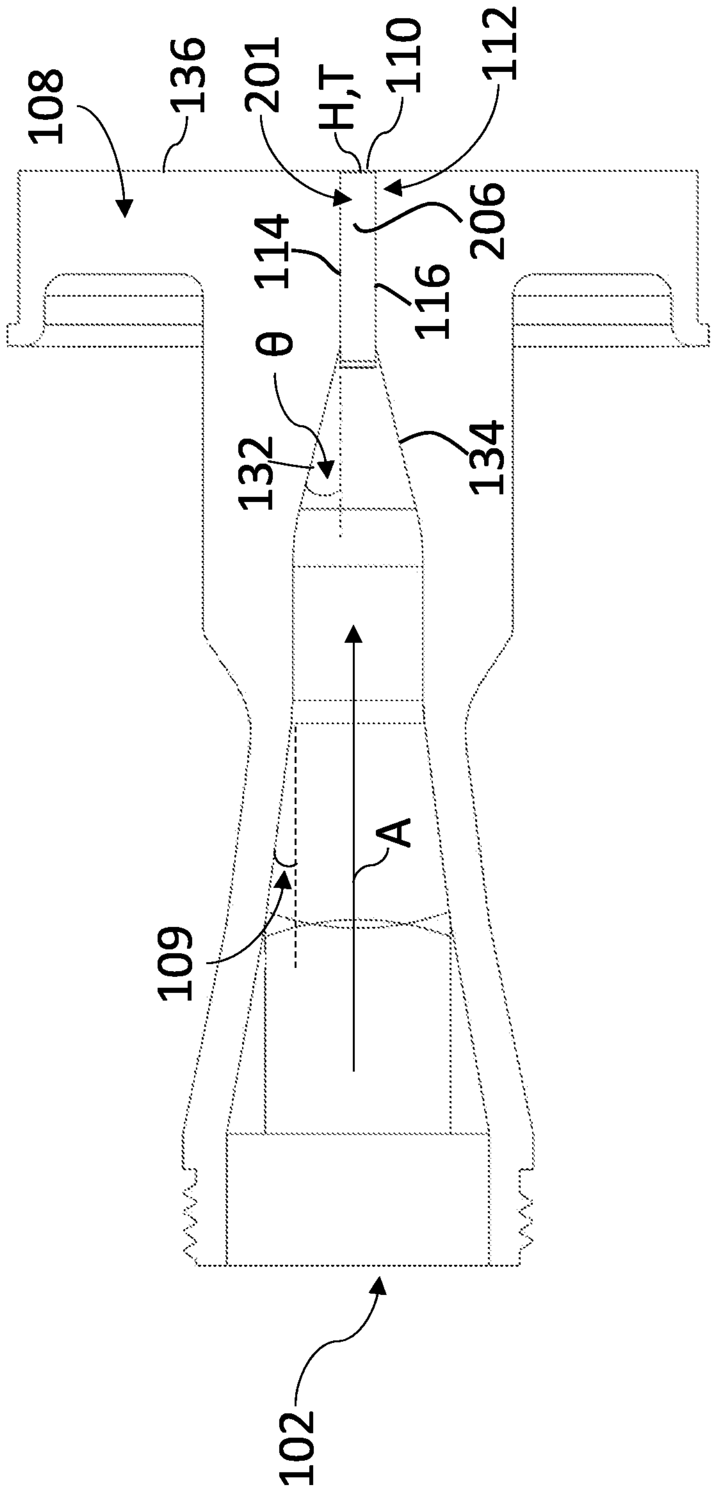


Fig. 5

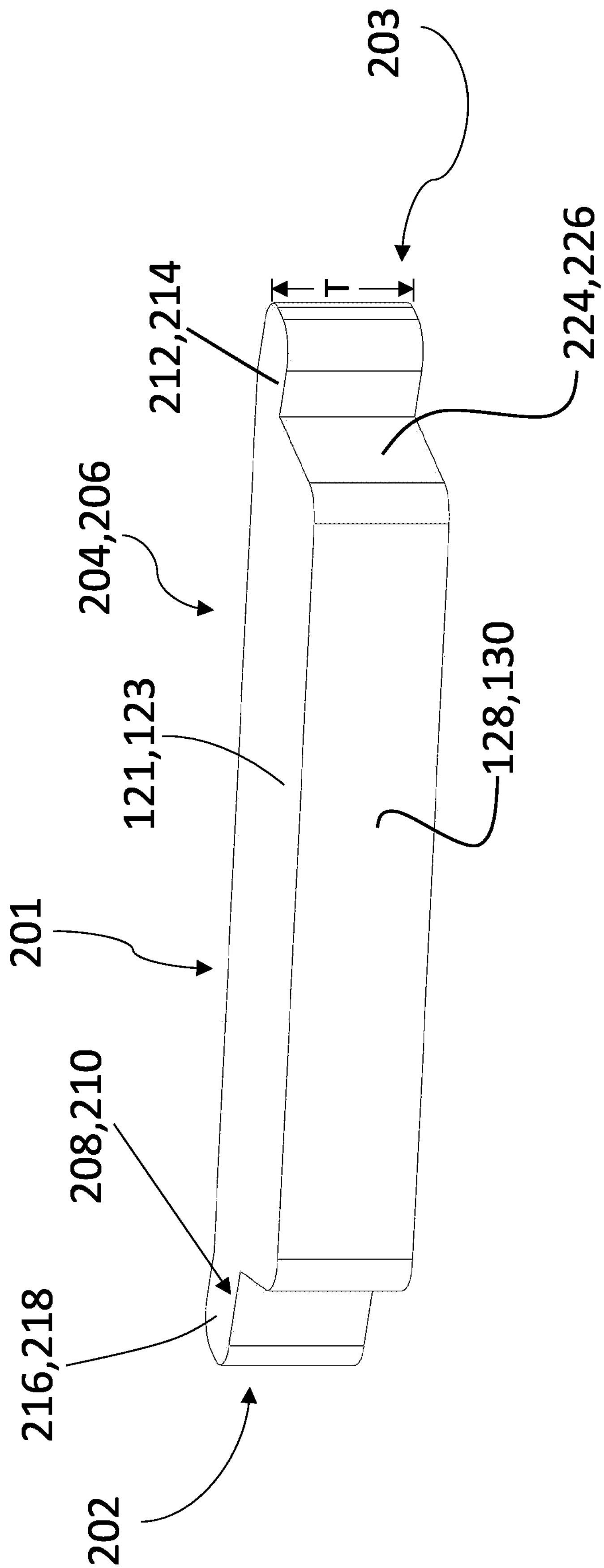

203
T
212,214
224,226
204,206
121,123
128,130
201
208,210
216,218
202

Fig. 6

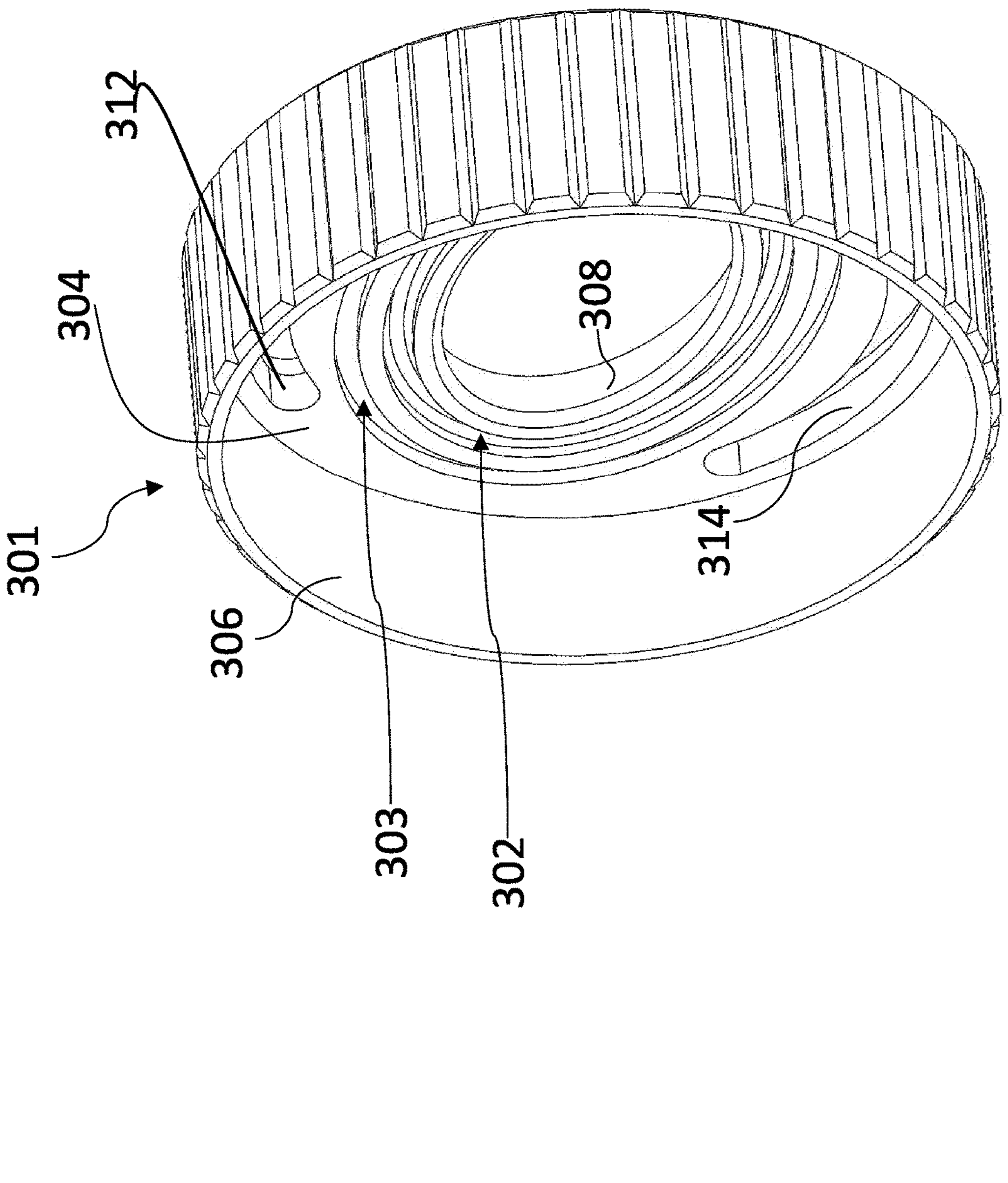


Fig. 7

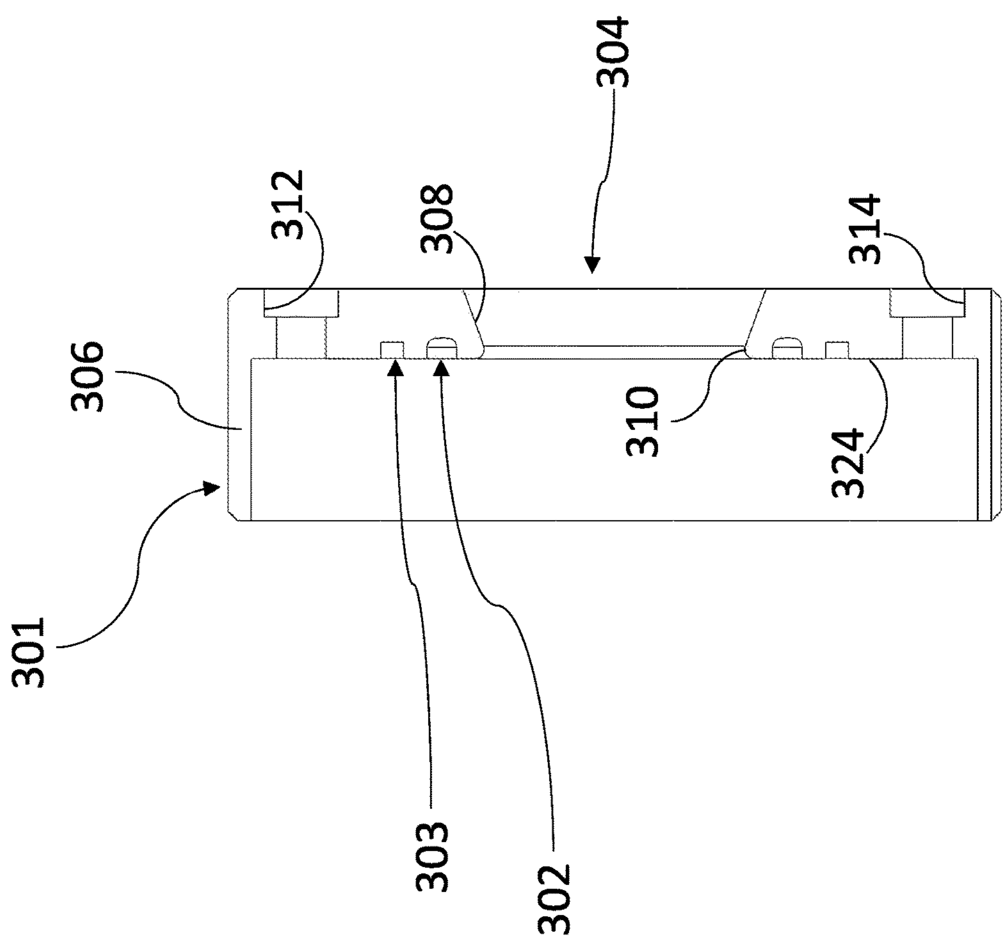


Fig. 8

ADJUSTABLE NOZZLE AND METHOD OF OPERATION

GOVERNMENT LICENSE RIGHTS

[0001] This invention was made with government support under Contract No. 2127461 awarded by The National Science Foundation. The government has certain rights in the invention.

TECHNICAL FIELD

[0002] This disclosure relates to nozzles for spraying fluid under pressure and more particularly to adjustable nozzles that shape the stream of fluid exiting the nozzle.

BACKGROUND

[0003] Nozzles are used to receive a fluid under pressure and control the shape and other characteristics of the stream of the fluid as it exits the nozzle. Such nozzles typically have an inlet opening, an exit opening that may take the form of a single orifice or multiple orifices, and a fluid flow path extending between the inlet opening and the exit opening. The inlet opening may include a fitting for connecting the nozzle to a tank, flexible hose, or pipe. Nozzles frequently are designed to increase the velocity of the fluid entering the nozzle. This is achieved by providing a fluid flow path that decreases in cross-sectional area from the inlet opening to the exit opening and/or includes an orifice in the fluid flow path of reduced cross-sectional area. Providing such a constriction to fluid flow under constant pressure and constant volume flow rate results in the increase in fluid flow velocity. Typically, the outlet orifice itself of the nozzle is reduced in cross-sectional area relative to the fluid flow path and provides the velocity increase.

[0004] A desirable feature of nozzles is the ability to vary the velocity of the fluid exiting the nozzle. In some designs, fluid flow velocity and fluid flow rate are varied by providing a plunger in the fluid flow path that is displaceable toward and away from a constricting orifice, which may be the nozzle exit opening. By advancing the plunger toward the constricting orifice, the cross-sectional area of the flow path between the outer periphery of the plunger and the inner periphery of the orifice is varied. This adjusts the velocity of the fluid exiting the nozzle, which increases the distance the stream travels from the nozzle. Other components, such as valves, may be employed to vary the velocity of fluid exiting the nozzle.

[0005] Nozzles with a flow path defined by smooth continuous nozzle walls and an absence of internal obstructions provide laminar fluid flow. Laminar fluid flow is desirable because it optimizes fluid flow through the nozzle and provides a uniform spray from the exit opening. A disadvantage with such adjustable designs is that the addition of a plunger, valve, or other flow regulating component in the fluid flow path of the nozzle presents an obstruction to the flow of fluid through the nozzle that causes turbulent fluid flow. Turbulence in fluid flow through nozzles is undesirable in applications in which a spray from the exit opening that is uniform across the width of the exit opening is desired.

[0006] Accordingly, there is a need for a nozzle that adjusts the effective cross-sectional area of the exit opening to vary the shape of the fluid stream from the exit opening but that does not present inclusions or obstructions in the fluid flow path through the nozzle. There is also a need for an adjustable nozzle that can provide a flat stream or fluid from its exit opening that can be varied in width easily.

SUMMARY

[0007] The present disclosure describes an adjustable nozzle and the method of its operation that optimizes fluid flow through the nozzle and consequently the throw distance and coverage of the fluid stream, and at the same time can be actuated easily by a user to adjust a width of the stream. The disclosed nozzle provides adjustability of the width of the fluid stream without requiring the presence of plungers, valves, or other components in the fluid flow stream. The fluid flow pathway of the nozzle is smooth and free of obstructions, which promotes laminar fluid flow resulting in a fluid flow stream that is uniform along its width and along its length.

[0008] In one embodiment, an adjustable nozzle includes a nozzle body having an inlet section with an inlet opening, an outlet section with an outlet opening, and a fluid flow path extending from the inlet opening to the outlet opening. A spray restrictor segment is located in the outlet section. An actuator displaces the spray restrictor segment toward and away from a center of the fluid flow path, thereby varying a pattern of fluid flowing from the fluid flow path through the outlet opening.

[0009] In another embodiment, an adjustable nozzle includes a nozzle body having an inlet section with an inlet opening and an outlet section with an outlet opening, the outlet section having a terminal segment with opposed planar, parallel top and bottom walls and first and second opposed planar side walls contiguous with the top and bottom walls. The top and bottom walls are greater in length than the first and second side walls such that the outlet opening is oblong. A fluid flow path extends from the inlet opening to the outlet opening such that fluid exits the outlet opening in a rectangular stream. First and second opposed spray adjustment arms are attached to the outlet section and are extendable into the fluid flow path. The spray adjustment arms each have a planar body terminating in an upstream cam tab, a downstream cam tab, and a rectilinear edge facing a center of the fluid flow path. The upstream cam tabs are received for pivotal movement of the first and second spray adjustment arms in first and second sockets formed in the first and second side walls, respectively.

[0010] An actuator ring is rotatably mounted on an end of the nozzle body, the actuator ring having an elliptical groove concentric with a center of the fluid flow path that receives the downstream cam tabs attached to the spray adjustment arms. Rotation of the actuator ring relative to the end of the nozzle body pivots the spray adjustment arms toward and away from the center of the fluid flow path, thereby varying a width of the rectangular stream of fluid from the outlet opening.

[0011] In yet another embodiment, a method of varying a width of an oblong stream of fluid exiting an oblong outlet opening in an outlet section of a nozzle body includes actuating an actuator in the outlet section to displace a spray restrictor segment toward and away from a center of the fluid flow path to vary an effective width of the oblong outlet opening, thereby varying the width of the rectangular stream of fluid exiting the outlet opening.

[0012] Other objects and advantages of the disclosed adjustable nozzle and method of operation will be apparent from the following description, the accompanying drawings, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. **1** is a perspective view of an exemplary embodiment of the disclosed adjustable nozzle;

[0014] FIG. **2** is an exploded perspective view of the adjustable nozzle of FIG. **1**;

[0015] FIG. **3** is a top plan view in section of the adjustable nozzle of FIG. **1**, showing the spray adjustment arms pivoted by the actuator for maximum fluid spray width;

[0016] FIG. **4** is a top plan view in section of the adjustable nozzle of FIG. **1**, showing the spray adjustment arms pivoted by the actuator for minimum fluid spray width;

[0017] FIG. **5** is a side elevation in section of the adjustable nozzle of FIG. **1**;

[0018] FIG. **6** is a perspective view of a representative spray adjustment arm;

[0019] FIG. **7** is a perspective view of an embodiment of an actuator of the adjustable nozzle of FIG. **1** in the form of an actuator ring; and

[0020] FIG. **8** is a side elevation in section of the actuator ring of FIG. **7**.

DETAILED DESCRIPTION

[0021] As shown in FIGS. **1**, **2**, and **3**, an exemplary embodiment of the disclosed adjustable nozzle, generally designated **101**, includes a nozzle body **102** having an inlet section **104** with an inlet opening **106**, an outlet section **108** with an outlet opening **110**, and a fluid flow path A extending from the inlet opening to the outlet opening. In embodiments, the inlet section **104** includes a connector **103**, which may take the form of a threaded fitting, for connecting the nozzle **101** to a flexible hose (not shown) or other source of fluid, such as water, to be sprayed from the outlet opening **110**. In other embodiments, the connector **103** may take the form of a valve or a quick disconnect.

[0022] The nozzle **101** also includes a spray restrictor segment **201** is located in the outlet section **108**. The nozzle **101** also includes an actuator that in embodiments takes the form of an actuator ring **301** that displaces the spray restrictor segment **201** toward and away from a center of the fluid flow path A, thereby varying a pattern of fluid flowing from the fluid flow path through the outlet opening **110**. In other embodiments, the actuator may take the form of a lever. In embodiments, the nozzle **101** is made of a rugged, corrosion-resistant material, such as bronze, brass, aluminum, and stainless steel. The type and thickness of material is determined by the type of fluid sprayed and the fluid pressures encountered by the nozzle. In a particular embodiment, the nozzle **101** is sized to be used in firefighting applications.

[0023] In an embodiment, the nozzle body **102** includes a transition segment **105** that defines a segment of the fluid flow path A that transitions in the shape of the inner periphery from a round cross section, adjacent the connector **103**, gradually and continuously to an inner periphery forming a square or rectangular cross section. In some embodiments, the cross sectional area of the transition segment gradually and continuously decreases in the direction of the fluid flow path A as the walls defining the fluid flow path converge toward the center of the flow path.

[0024] As best shown in FIG. **2**, in an embodiment, the outlet opening **110** of the adjustable nozzle **101** is oblong in shape, having a width W and a height H. The actuator ring **301** displaces the spray restrictor segment **201** toward and away from the center of the fluid flow path A (see FIG. **3**) to vary the effective width of the outlet opening **110** and thereby control the width of the pattern of fluid spray S_1, S_2 from the outlet opening. In an embodiment, the spray restrictor segment **201** has a thickness T (see FIGS. **5** and **6**) that equals, or approximately equals, the height H of the outlet opening.

[0025] A shown in FIGS. **2**, **3**, and **4**, in an embodiment the spray restrictor segment **201** includes at least a first spray adjustment arm **204** that is displaced by the actuator **301** toward (see FIG. **4**) and away from (see FIG. **3**) the center of the fluid flow path A in the direction of double-headed curved arrow B to vary the effective width W of the outlet opening **110**. In an embodiment, the spray restrictor segment **201** includes a second spray adjustment arm **206** that is opposed to the first spray adjustment arm **204**. In an embodiment, the first and second spray adjustment arms **204**, **206** are displaced by the actuator **301** toward and away from the center of the fluid flow path A to vary the width W of the outlet opening **110**. In a particular embodiment, the actuator **301** displaces the second spray adjustment arm **206** in the direction of double-heated curved arrow C. In an embodiment, the first and second spray adjustment arms **204**, **206** are pivotally attached at upstream ends **208**, **210**, respectively, thereof to the outlet section **108**.

[0026] As shown in FIGS. **4** and **5**, in an embodiment, the outlet section **108** includes a terminal segment **112** having opposed planar, parallel top and bottom walls **114**, **116**, respectively, and first and second opposed planar side walls **118**, **120**, respectively. In an embodiment, the first and second opposed planar side walls **118**, **120** are contiguous with the opposed top and bottom walls **114**, **116**, respectively, and in a particular embodiment, the first and second opposed planar side walls diverge from each other in a downstream direction. In an embodiment, the first and second spray adjustment arms **204**, **206** are mounted in the terminal segment **112** to pivot toward and away from the first and second side walls **118**, **120** along arcuate paths designated by arrows B and C, respectively, when displaced by the actuator ring **301**.

[0027] In an embodiment, the actuator ring **301** is connected to the first and second spray adjustment arms **204**, **206** to pivot the first and second spray adjustment arms relative to the terminal segment **112** to selectively vary the effective width W of the outlet opening **110**. In embodiments, the effective width W of the outlet opening **110** is continuously adjustable by the actuator **301** between the configuration shown in FIG. **3**, which is a maximum width outlet opening that provides a fluid stream flowing from the outlet opening having a maximum width, to the configuration shown in FIG. **4**, which is a minimum width outlet opening that provides a fluid stream flowing from the outlet opening having a minimum width.

[0028] In an embodiment, the first and second spray adjustment arms **204**, **206** are pivotally mounted at the upstream ends thereof to the first and second side walls **118**, **120**, respectively. And in an embodiment, the first and second spray adjustment arms **204**, **206** are pivotally mounted at downstream ends **212**, **214** thereof, respectively, to the actuator ring **301**. In an embodiment, the actuator ring

301 is rotatably mounted on the nozzle body **102** such that rotation of the actuator ring relative to the nozzle body pivots the first and second spray adjustment arms **204**, **206** toward and away from the first and second side walls **118**, **120**, respectively.

[0029] As shown in FIGS. **3**, **4**, and **7**, in an embodiment, the first and second spray adjustment arms **204**, **206** engage an eccentric groove **302** formed in the rear or upstream surface of the face **304** of the actuator ring **301** (see also FIGS. **1** and **2**). Rotation of the actuator ring **301** relative to the outlet section **108** causes the eccentric groove **302** to move or rotate relative to the first and second spray adjustment arms **204**, **206**, about a center of the fluid flow path A, thereby pivoting the first and second spray adjustment arms toward and away from the first and second side walls **118**, **120**, respectively. In an exemplary embodiment, the spray adjustment arms **204**, **206** include mating surfaces **121**, **123**, respectively, that fit flush with the first and second side walls **118**, **120**, respectively. In a particular embodiment, the surfaces of the first and second side walls **118**, **120** and mating surfaces **121**, **123** are flat and rectilinear.

[0030] In an embodiment, the first and second spray adjustment arms **204**, **206** include first and second downstream cam tabs **212**, **214**, respectively (see also FIGS. **2** and **6**), shaped to fit within the eccentric groove **302**. In an embodiment, the upstream ends **208**, **210** of the first and second spray adjustment arms **204**, **206** include first and second upstream cam tabs **216**, **218**, respectively. The first and second side walls **118**, **120** include first and second rounded sockets **220**, **222**, respectively, shaped to receive the first and second upstream cam tabs **216**, **218**, respectively, for pivotal movement of the first and second spray adjustment arms **204**, **206**, relative to the first and second side walls, respectively.

[0031] As shown in FIGS. **3**, **4**, and **5**, in an embodiment, the outlet section **108** includes a divergent section **122** upstream of the spray restrictor segment **201**. The divergent section **122** includes first and second opposed planar diverging side walls **124**, **126**, respectively. The first and second spray adjustment arms **204**, **206** include first and second planar interior walls **128**, **130** (see also FIG. **2**) facing the center of the fluid flow path A, respectively. The first and second interior walls **128**, **130** are adjacent the first and second diverging side walls **124**, **126**. The first and second interior walls **128**, **130** cooperate with the diverging side walls **124**, **126** and the interior walls of the inlet section **104** to provide a fluid flow path A that is defined by smooth, continuous walls without obstructions protruding into the fluid flow path that extends from the inlet opening **106** to the outlet opening **110**. This design minimizes turbulence of the fluid within the fluid flow path A to provide a pattern of spray S_1, S_2 from the outlet opening **110** having a more uniform height H across its width W.

[0032] As shown in FIG. **5**, an embodiment, the divergent section **122** includes opposed planar top and bottom walls **132**, **134**, respectively. The planar top and bottom walls **132**, **134** are contiguous with the first and second planar diverging side walls **124**, **126**, respectively and therefore are themselves diverging in a downstream width dimension. In an embodiment, the planar top and bottom walls **132**, **134** terminate adjacent the first and second spray adjustment arms **204**, **206** at an upstream end of the terminal segment **112**. In an embodiment, the planar top and bottom walls **132**, **134** converge toward each other in a downstream fluid flow direction, making an angle θ with the planes of the parallel top and bottom walls **114**, **116** of the terminal segment **112**.

[0033] In an exemplary embodiment, the disclosed adjustable nozzle **101** includes a nozzle body **102** having an inlet section **104** with an inlet opening **106** and an outlet section **108** with an outlet opening **110**. The outlet section **108** includes a terminal segment **112** having opposed planar, parallel top and bottom walls **114**, **116** and first and second opposed planar side walls **118**, **120** contiguous with the top and bottom walls. The top and bottom walls **114**, **116** are greater in width than the first and second side walls **118**, **120** such that the outlet opening **110** is oblong. A fluid flow path A extends from the inlet opening **106** to the outlet opening **110** such that fluid exits the outlet opening in a rectangular stream S_1, S_2.

[0034] First and second opposed spray adjustment arms **204**, **206** are attached to the outlet section **108** and are extendable into the fluid flow path A. The spray adjustment arms **204**, **206** each have a planar body terminating in an upstream cam tab **216**, **218** and a downstream cam tab **212**, **214** and having planar interior walls **128**, **130** forming a rectilinear surface facing a center of the fluid flow path A. The upstream cam tabs **216**, **218** are received for pivotal movement of the first and second spray adjustment arms **204**, **206** in the first and second sockets **220**, **222** formed in the first and second side walls **118**, **120**, respectively.

[0035] An actuator ring **301** is rotatably mounted on an end of the nozzle body **102**. The actuator ring **301** has an elliptical groove **302** concentric with a center of the fluid flow path A. The elliptical groove **302** receives the downstream cam tabs **212**, **214** of the spray adjustment arms **204**, **206** such that rotation of the actuator ring relative to the outlet section **108** end of the nozzle body **102** pivots the spray adjustment arms toward and away from the center of the fluid flow path A, thereby varying a width of the rectangular stream of fluid from the outlet opening.

[0036] The actuator ring **301** may take many forms. In embodiments shown in FIGS. **1**, **2**, and **8**, the actuator ring **301** includes a knurled annular side wall **306** contiguous with the face **304** to form a cup shape. the face includes an elliptical opening **308** sized to provide clearance for the outlet opening **110**. The inner periphery **310** of the elliptical opening is shaped to align with downstream faces **224**, **226** of the spray adjustment arms **204**, **206** (see also FIG. **6**). In an embodiment, the face **304** includes opposing arcuate countersunk slots **312**, **314** extending therethrough that receive threaded retention studs **316**, **318** that thread into holes **320**, **322** formed in the flat, circular downstream face **136**, which is sized to seat the flat, upstream side **324** of the face **304** of the actuator **301**, together forming a retention system **501**. In an embodiment, the spray retention arms **204**, **206** are shaped such that the downstream cam tabs **212**, **214** protrude through the outlet opening **110** from the downstream face **136** and into the elliptical groove **302** of the actuator ring **301**, as shown in FIGS. **3** and **4**.

[0037] In an embodiment, the upstream side **324** includes an elliptical groove **303** that receives a resilient elliptical gasket **401** to seal the actuator **301** against the downstream face **136** and provide resistance to relative rotational movement between the nozzle body **102** and the actuator ring **301**. The elliptical groove **303** that receives gasket **401** and the elliptical groove **302** that receives the downstream cam tabs **212**, **214** are concentric on the upstream side **324** of the face **304** of the actuator ring **301**. In an embodiment, the retention studs **316**, **318** hold the actuator ring **301** against the outlet section **108** so that the radially inner surface of the side wall **306** overlies and is concentric with the annular side wall **138** of the outlet section **108** but allows rotation of the actuator relative to the outlet section. In an embodiment, the slots **312**, **314** define limits of rotation of the actuator **301** relative to the outlet section **108** and are selected with the elliptical groove **302** to coincide with maximum and minimum pivoting movement of the spray adjustment arms **204**, **206** to vary the width W of the outlet opening **110**.

[0038] In an embodiment, the shape (eccentricity) of the elliptical groove **302** is selected and is formed on the upstream side **324** of the face **304** of the actuator ring **301** such that when the major axis of the elliptical groove **302** is parallel to the width W of the outlet opening **110**, the spray adjustment arms **204**, **206** are pivoted to a maximum divergence angle, as shown in FIG. **3**, resulting in a spray S_1 of maximum width. When the actuator ring **301** is rotated so that the major axis of the elliptical groove **302** is perpendicular to the width W of the of the nozzle outlet opening **110**, in which it is parallel to the height H of the outlet opening, the spray adjustment arms **204**, **206** are pivoted to a minimum divergence angle, as shown in FIG. **4**, resulting in a spray S_2 of minimum width. Because the height H is not affected by the rotation of the actuator ring **301** and the resultant pivoting of the spray adjustment arms **204**, **206**, the height does not change between maximum spray S_1 and minimum spray S_2.

[0039] In an embodiment, a method of varying a width of an oblong stream S_1, S_2 of fluid exiting an oblong outlet opening **110** in the outlet section **108** of the nozzle body **102** includes actuating an actuator in the form of an actuator ring **301** in the outlet section to displace the spray restrictor segment **201** toward and away from the center of the fluid flow path A to vary an effective width W of the oblong outlet opening **110**, thereby varying the width of the rectangular stream S_1, S_2 of fluid exiting the oblong outlet opening.

[0040] In an embodiment, actuating the actuator ring **301** to displace the spray restrictor segment **201** includes pivoting first and second opposed spray adjustment arms **204**, **206** attached to the outlet section **108** and extending into the fluid flow path A toward and away from the center of the fluid flow path, thereby varying the effective width W of the oblong outlet opening **110** to vary the width of the oblong stream S_1, S_2 of fluid from the outlet opening. In an embodiment, actuating the actuator ring **301** to displace the spray restrictor segment **201** includes rotating an actuator ring **301** rotatably attached to the nozzle body **102** to pivot the first and second opposed spray adjustment arms **204**, **206** toward and away from the center of the fluid flow path A.

[0041] The disclosed embodiments of the adjustable nozzle **101** provide a robust nozzle system that is easily adjustable by a user simply by grasping the actuator ring **301** and rotating it relative to the nozzle body **102** to vary the effective width W of the outlet opening **110** and thereby vary the width of the stream S_1, S_2 from the outlet opening. The smooth walls of the interior of the nozzle body **102**, combined with the rectangular outlet opening **110** provide a flat stream S_1, S_2 that is uniform across its width and provides a maximum throw for a given fluid pressure.

[0042] While the forms of apparatus and methods disclosed herein constitute preferred embodiments of the adjustable nozzle, it is to be understood that the invention is not limited to these precise forms of apparatus and methods, and that changes may be made therein without departing from the scope of the invention.

What is claimed is:

1. An adjustable nozzle, comprising:
- a nozzle body having an inlet section with an inlet opening, an outlet section with an outlet opening, and a fluid flow path extending from the inlet opening to the outlet opening;
- a spray restrictor segment located in the outlet section; and
- an actuator that displaces the spray restrictor segment toward and away from a center of the fluid flow path, thereby varying a pattern of fluid flowing from the fluid flow path through the outlet opening.

2. The adjustable nozzle of claim **1**, wherein the outlet opening is oblong in shape having a width and a height; and the actuator displaces the spray restrictor segment toward and away from the center of the fluid flow path to vary the width of the outlet opening.

3. The adjustable nozzle of claim **2**, wherein the spray restrictor segment has a thickness that equals the height of the outlet opening.

4. The adjustable nozzle of claim **3**, wherein the spray restrictor segment includes at least a first spray adjustment arm that is displaced by the actuator toward and away from the center of the fluid flow path to vary the width of the outlet opening.

5. The adjustable nozzle of claim **4**, wherein the spray restrictor segment includes a second spray adjustment arm that is opposed to the first spray adjustment arm; and the first and second spray adjustment arms are displaced by the actuator toward and away from the center of the fluid flow path to vary the width of the outlet opening.

6. The adjustable nozzle of claim **5**, wherein the first and second spray adjustment arms are pivotally attached at upstream ends thereof to the outlet section.

7. The adjustable nozzle of claim **6**, wherein the outlet section includes a terminal segment having opposed planar, parallel top and bottom walls and first and second opposed planar side walls contiguous with the top and bottom walls; and wherein the first and second spray adjustment arms are mounted in the terminal segment to pivot toward and away from the first and second side walls, respectively, when displaced by the actuator.

8. The adjustable nozzle of claim **7**, wherein the actuator is connected to the first and second spray adjustment arms to pivot the first and second spray adjustment arms relative to the terminal segment to selectively vary an effective width of the outlet opening.

9. The adjustable nozzle of claim **8**, wherein the first and second spray adjustment arms are pivotally mounted at the upstream ends thereof to the first and second side walls, respectively.

10. The adjustable nozzle of claim **9**, wherein the first and second spray adjustment arms are pivotally mounted at downstream ends thereof to the actuator.

11. The adjustable nozzle of claim **10**, wherein the actuator is rotatably mounted on the nozzle body such that rotation of the actuator relative to the nozzle body pivots the first and second spray adjustment arms toward and away from the first and second side walls, respectively.

12. The adjustable nozzle of claim **11**, wherein the first and second spray adjustment arms engage an eccentric groove formed in the actuator, such that the rotation of the actuator causes the eccentric groove to move relative to the first and second spray adjustment arms, thereby pivoting the first and second spray adjustment arms toward and away from the first and second side walls, respectively.

13. The adjustable nozzle of claim **12**, wherein the first and second spray adjustment arms include first and second downstream cam tabs, respectively, shaped to fit within the eccentric groove.

14. The adjustable nozzle of claim **13**, wherein the first and second spray adjustment arms include first and second upstream cam tabs, respectively, and the first and second side walls include first and second sockets shaped to receive the first and second upstream cam tabs, respectively, for pivotal movement of the first and second spray adjustment arms relative to the first and second side walls, respectively.

15. The adjustable nozzle of claim **5**, further comprising a divergent section upstream of the outlet section, the divergent section having first and second opposed planar diverging side walls;

and the first and second spray adjustment arms include first and second planar interior walls facing the center of the fluid flow path, respectively; wherein the first and second interior walls are adjacent the first and second diverging side walls.

16. The adjustable nozzle of claim **15**, wherein the divergent section includes opposed planar top and bottom walls contiguous with the first and second planar diverging side walls, the top and bottom walls terminating adjacent the first and second spray adjustment arms at an upstream end of the terminal segment.

17. An adjustable nozzle, comprising:

a nozzle body having an inlet section with an inlet opening, an outlet section with an outlet opening, the outlet section including a terminal segment having opposed planar, parallel top and bottom walls and first and second opposed planar side walls contiguous with the top and bottom walls, wherein the top and bottom walls are greater in length than the first and second side walls such that the outlet opening is oblong, and a fluid flow path extending from the inlet opening to the outlet opening such that fluid exits the outlet opening in a rectangular stream;

first and second opposed spray adjustment arms attached to the outlet section and extendable into the fluid flow path, the spray adjustment arms each having a planar body terminating in an upstream cam tab and a downstream cam tab and having a rectilinear edge facing a center of the fluid flow path, the upstream cam tabs being received for pivotal movement of the first and second spray adjustment arms in first and second sockets formed in the first and second side walls, respectively; and

an actuator ring rotatably mounted on an end of the nozzle body, the actuator ring having an elliptical groove concentric with a center of the fluid flow path that receives the downstream cam tabs attached to the spray adjustment arms such that rotation of the actuator ring relative to the end of the nozzle body pivots the spray adjustment arms toward and away from the center of the fluid flow path, thereby varying a width of the rectangular stream of fluid from the outlet opening.

18. A method of varying a width of an oblong stream of fluid exiting an oblong outlet opening in an outlet section of a nozzle body, the method comprising:

actuating an actuator in the outlet section to displace a spray restrictor segment toward and away from a center of the fluid flow path to vary an effective width of the oblong outlet opening, thereby varying the width of the oblong stream of fluid exiting the outlet opening.

19. The method of claim **18**, wherein actuating the actuator to displace the spray restrictor segment includes pivoting first and second opposed spray adjustment arms attached to the outlet section and extending into the fluid flow path toward and away from the center of the fluid flow path, thereby varying the effective width of the oblong outlet opening to vary the width of the rectangular stream of fluid from the outlet opening.

20. The method of claim **19**, wherein actuating the actuator to displace the spray restrictor segment includes rotating an actuator ring rotatably attached to the nozzle body to pivot the first and second opposed spray adjustment arms toward and away from the center of the fluid flow path.

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