May 1, 1962 C. M. CZARNECKI 3,032,279

NOZZLE CONSTRUCTION

Filed Nov. 21, 1960 2 Sheets-Sheet 1

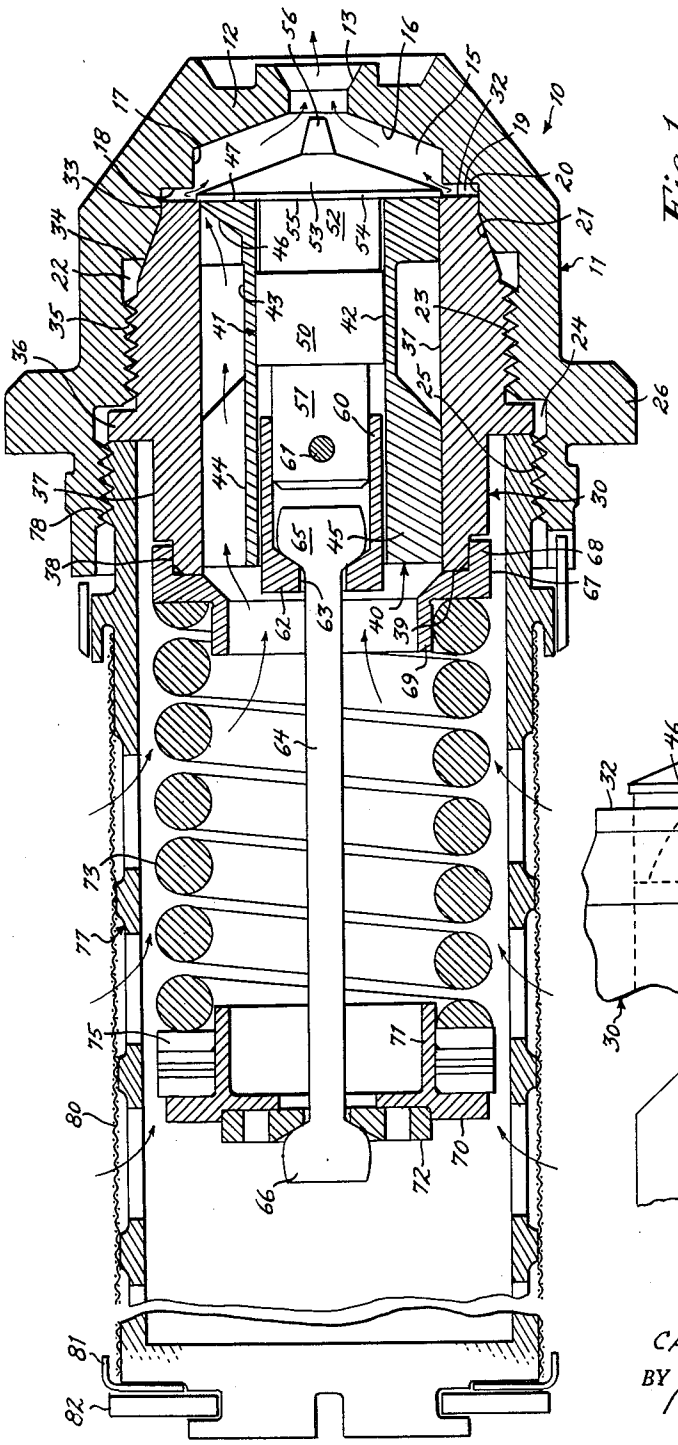

Fig. 1.

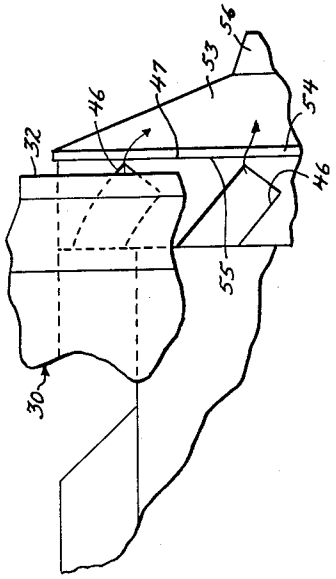

Fig. 2.

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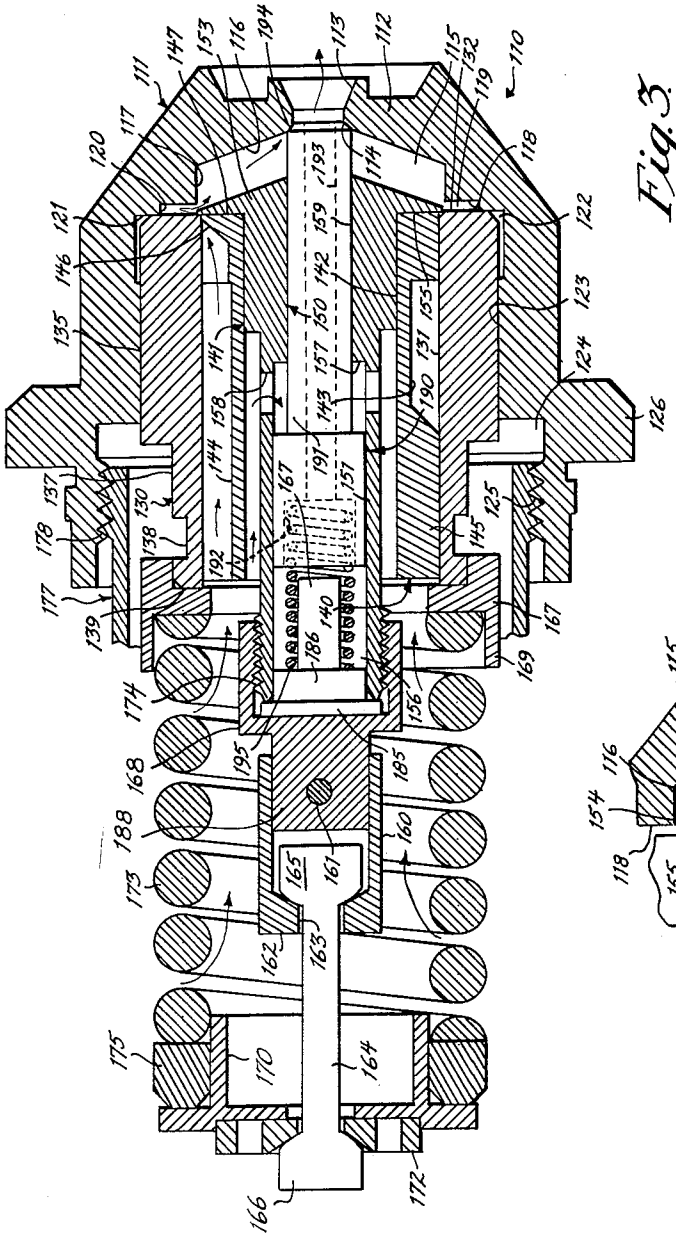

Fig. 3

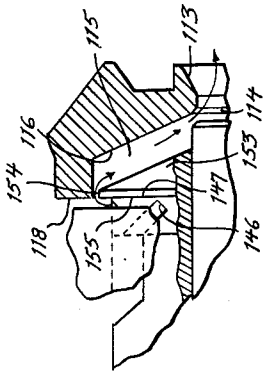

Fig. 4

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3,032,279

NOZZLE CONSTRUCTION

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This invention relates generally to nozzles, and is especially concerned with improvements in metering liquid-spray nozzles.

While the device of the instant invention has been primarily developed for metering atomized fuel into the combustion chamber of a prime mover, and will be illustrated and described hereinafter with reference thereto, it is appreciated that the instant invention is capable of many varied applications all of which are intended to be comprehended herein.

As is well-known, in different types of present-day engines, such as gas turbines and jet engines, it is desirable or essential that the rate of flow of fuel fed to the combustion chamber be accurately controlled or metered. Toward this end, it has heretofore been necessary to provide fuel nozzles of relatively complex and extremely precise construction, frequently requiring tolerances of .00010 inch, or less. Of course, these prior constructions were extremely expensive, necessarily involving considerable machining, including grinding. Further, even when prior fuel nozzles were manufactured to such tolerances with all possible care, the finished product was often unsatisfactory, say by uncontrollable distortion, or the like.

It is, therefore, one object of the present invention to provide a fuel spray nozzle which is of greatly simplified construction, employing considerably less parts than heretofore required, and wherein the need for close manufacturing tolerances is obviated, to eliminate precision grinding in manufacture and distortion in assembly and use.

Also required of such fuel nozzles is a wide range of flow rates along a specified curve, and proper atomization of the fuel throughout the flow range. In order to achieve this desiderata, the prior-art devices necessarily employed separate low- and high-capacity flow passages, and usually required means for closing the high-capacity flow passage in the low-flow range.

It is another object of the present invention to provide a fuel spray nozzle of the type described, which is adapted to produce a properly atomized discharge cone throughout a wide flow range along a specified flow curve, and wherein the same passageways are employed throughout the entire flow range.

It is still a further object of the present invention to provide a liquid-spray nozzle having the advantageous characteristics mentioned, which is extremely simple in construction, durable and reliable throughout a long useful life, and which can be more economically manufactured for sale at a reasonable price.

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings, which form a material part of this disclosure.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, which will be exemplified in the construction hereinafter described, and of which the scope will be indicated by the appended claims.

In the drawings:

FIGURE 1 is a longitudinal sectional view showing a liquid-spray nozzle of the present invention, illustrating the same in closed condition;

FIGURE 2 is a fragmentary elevational view showing the construction of FIGURE 1 in an open condition;

FIGURE 3 is a longitudinal sectional view showing a slightly modified construction of nozzle according to the teachings of the present invention, illustrating closed condition; and

FIGURE 4 is a fragmentary elevational view showing the construction of FIGURE 3 in an open condition, and partly in section for clarity of understanding.

Referring now more particularly to the drawings, and specifically to FIGURES 1 and 2 thereof, a nozzle is there generally designated **10** and includes a generally cylindrical outer shell **11** having its forward end closed by a front-end wall **12** which is provided with a central or axial through opening or discharge orifice **13**. The rearward end of the outer shell **11**, the left-hand end as seen in FIGURE 1, is open.

The cylindrical outer shell **11** is provided interiorly in its forward region with an interior space or chamber **15** of generally cylindrical configuration, opening forwardly through the orifice **13**, and bounded on its forward end by a generally conical internal front wall **16** axially converging to the orifice. The internal space or chamber **15** is further bounded by a generally cylindrical internal wall **17** extending coaxially with and rearward from the radially outer circumferential extremity of the internal wall surface **16**. The cylindrical side wall **17** terminates rearwardly at an internal rearwardly facing annular shoulder **18** defining a circumferentially enlarged chamber region **19**. That is, the internal rearwardly facing annular shoulder **18** is formed in the outer shell **11**, extending radially outward from the rearward edge or corner of the cylindrical internal side surface **17** and terminating at a cylindrical internal side surface **20** of greater diameter than the cylindrical surface **17**.

From the internal cylindrical surface **20**, the outer shell **11** flares rearwardly, being formed with a conical surface **21** of rearwardly increasing internal dimension. Rearwardly of the internal conical surface **21**, the outer shell **11** is internally enlarged, as at **22**, and provided in the enlarged region **22** with internal screw threads **23**. Rearward of the screw threads **23** the outer shell **11** is further enlarged, as in the region **24**, and there provided with additional internal screw threads **25**. The rearward end of the outer shell **11** may remain open; and, an annular extension collar **26** may be provided on the outer shell **11**, medially between the ends thereof, as for mounting the outer shell in an engine combustion chamber.

Axially received within the cylindrical outer shell **11** is a generally cylindrical inner shell **30**. The inner shell **30** is located concentrically or coaxially within the outer shell **11**, and is formed with an internal axial through opening or bore **31**. The inner shell **30** extends forwardly into the interior of the outer shell **11**, terminating at its forward end in an annular forwardly facing end surface **32**, which surface is advantageously generally flat and normal to the axis of the inner shell. It will be observed that the internal diameter of the through opening **31** is less than the internal diameter of the chamber side wall **17**, so that the radially inner edge of the inner-sleeve forward end surface **32** is located radially inward of the chamber side wall **17** and the radially inner edge of the annular rearwardly facing chamber surface **18**. Further, the inner-sleeve end surface **32** intersects with the surface of bore **31** at substantially a right angle. The inner-shell forward end surface **32** may be considered as an internal, annular forwardly facing shoulder and combines with the rearwardly facing shoulder **18** and circumferential side wall **20** to define an internal annular groove or chamber communicating with the main cylindrical region of chamber **15**.

Formed exteriorly of the inner cylindrical shell 30 is a generally cylindrical external surface 33 extending rearward from the forward end surface 32 and terminating at a rearwardly flaring conical external surface 34. The cylindrical external surface 33 engages slidably within the cylindrical internal surface 20, while the conical external surface 34 is in forwardly abutting engagement with the conical internal surface 21.

Rearward of the external conical surface 34, the inner cylindrical shell 30 is provided with external screw threads 35 in threaded engagement with the internal screw threads 23 of the outer shell 11. Rearward of the screw threads 35 there is provided exteriorly on the inner shell 30 an annular circumferential shoulder or collar 36 which is received in spaced relation within the enlarged region 24 of the outer shell 11. Rearward of the collar 36, the inner shell 30 is reduced to provide a cylindrical external surface 37 extending rearward from the collar 36, and is further reduced at 38 to provide a cylindrical surface proximate to the annular end surface 39.

The outer shell 11 and inner shell 30 may be considered as combining to define a generally cylindrical housing of the nozzle 10, wherein the forward internal space or region 15 defines a swirl chamber for fuel prior to discharge through the orifice 13, and the annular internal groove 19 may be considered as a preliminary swirl chamber, as will appear more fully hereinafter.

A generally cylindrical piston sleeve is slidably engaged within the bore 31 of the inner housing shell 30, and generally designated 40. Located within the sleeve 40 is a piston core, generally designated 41. The sleeve 40 and core 41 combine to define a piston slidable in the housing 11, 30.

More specifically, the sleeve 40 is formed with a central or axial, longitudinally extending through bore or opening 42, and is formed externally with a circumferentially extending groove 43 located medially between the forward and rearward ends of the sleeve. Extending inward from the rearward end of the sleeve 40, longitudinally thereof, are a plurality of external, longitudinally extending grooves or slots 44 which open forwardly into the circumferential groove 43. The grooves 44 may be arranged at equally, circumferentially spaced locations about the sleeve 40, the material remaining between the slots 44 defining longitudinally extending, radially projecting ribs 45. Forward of the circumferential groove 43, the sleeve 40 is formed externally with a plurality of spaced, circumferentially arranged grooves 46, preferably extending generally spirally or helically about the axis of the sleeve and terminating just short of the forward sleeve end 47. The annular surface of the forward sleeve end 47 is preferably substantially flat and disposed in a plane normal to the axis of the sleeve. Thus, it will now be appreciated that the sleeve 40 is slidable longitudinally within the inner housing shell 30, and that the slots 44, groove 43 and grooves or slots 46 combine with the internal surface of inner shell 30 to define rearwardly opening fluid passageways, which passageways are adapted to communicate with the chambers 19 and 15 upon forward movement of the sleeve beyond the shoulder 32.

The core 41 includes an enlarged medial region 50 which may be force fit in the central bore 42 of the sleeve 40, spaced between the rear and front ends of the latter. Extending rearward from the medial core portion 50 is a reduced rearward extension 51, preferably terminating short of the rear sleeve end, while a forward extension 52 extends from the medial core portion forwardly to and terminating substantially flush with the forward sleeve end 47. On the forward extension 52 of the core 41, forward and exteriorly of the sleeve 40 is an enlargement or head 53. The head 53 is of generally circular-outline configuration, extending radially beyond the sleeve 40, and includes a generally cylindrical rear portion 54 having its rear surface 55 substantially flat and normal to the axis of sleeve 40 in facing engagement with the forward sleeve surface 47. The cylindrical head portion 54 extends radially beyond the sleeve 40, the surface 55 combining with the external surface of the sleeve to define a sharp internal angle of approximately ninety degrees. The rear cylindrical head portion 54 is of a diameter less than the internal diameter of chamber wall 17, and extending forwardly from the cylindrical portion is the conical, forwardly convergent head portion 53, which is provided centrally at its forward end with an elongate, conical tip 56 adapted to enter in spaced relation within the orifice 13. The entire core 41, including the portions 50, 51 and 52 received within the sleeve 40, and the head portions 53, 54 and 56 are all fixedly secured together, preferably being integrally formed.

It will now be appreciated that the rear surface 55 of the head 53 is adapted to conformably seat on the forwardly facing shoulder 32, a maximum of seating engagement therebetween being obtained by utilization of the right-angle external corner on the inner edge of the shoulder, and the right-angle internal corner at the juncture of surface 55 with the exterior of the sleeve 40. This seating engagement provides an effective seal against the passage of fluid from the passageways 44, 43 and 46 into the chambers 19 and 15, while opening such passageways to communication with the chambers upon forward movement of the sleeve 40 and core 41 with its head 53. Thus, a highly effective seal is obtained by seating engagement of the rear head surface 55 on the forwardly facing shoulder 32, without frictional or wedging engagement therebetween. This permits unseating of the head from the shoulder without resistance for opening fluid communication and discharge of the nozzle at a precise pressure, as desired.

Thus, the sleeve 40 and core 41 combine to define a piston within the housing 11, 30 movable forward from the illustrated, closed position. Circumposed about and extending rearward beyond the rear core portion 51 is a tubular member or cap 60 which is anchored to the core 41 by a transverse pin 61 extending through the cap and rear core portion 51. The cap 60 extends rearward beyond the rear end of sleeve 40 and has its rear end closed, as at 62, except for a central through opening 63. A connector element or rod 64 is provided on its forward end with an enlargement or head 65 received within the cap 60, and extends rearward therefrom through the opening 63. The forward end of connector rod 64 is thus retained within the cap 60, while the connector rod is of elongate configuration and provided on its rear end with an additional enlargement or head 66. Spacedly circumposed about a forward region of the elongate connector rod 64 is an annular member or guide 67 which seats on the rear end 39 of the inner housing shell 30. The guide member 67 includes an annular forward flange 68 circumposed about the reduced inner-shell portion 38 to locate the guide axially of the housing 11, 30, and also includes an annular rear flange 69 of a diameter less than the internal diameter of inner shell 30.

A rear annular member or guide 70 is spacedly circumposed about the rearward region of connector rod 64, just forward of rear-end head 66, and is provided with an annular forwardly extending flange 71 of a diameter approximately equal to that of flange 69. An annular retainer 72 is circumposed about the connector rod 64, being interposed between the rearward side of guide member 70 and the rear head 66 to prevent rearward removal of the guide from the connector rod; and, suitable resilient means, say in the form of a coil compression spring 73 may be interposed between the guides 67 and 70 to resiliently bias the connector rod 64 rearward. That is, the helical coil compression spring 73 may be circumposed about the rear flange 69 of the spring guide 67 having its forward end in bearing engagement with the spring guide,

and the rear end of the compression spring may be circumposed about the forward flange 71 of the rear spring guide to insure proper axial circumposition of the spring about the connector rod. Suitable spacer elements 75 may be engaged between the rear spring guide 70 and rear end of spring 73 to insure maintenance of the spring under proper compressive force. The spring 73, while in compression, is operatively connected through the rear spring guide 70, connector rod 64 and cap 60 with the core 41 of piston 40, 41 to constantly resiliently urge the entire piston rearward. Further, the spring 73 is connected as noted above more directly to the core 41 than the sleeve 40, to apply a rearward force to the core and its head 53 in opposition to the forward force of fluid on the rear side of the piston, and specifically on the rear side of the piston sleeve 40. This action serves to more effectively insure maintenance of the rear head surface 55 in firm abutting engagement with the forward end surface 47 of the sleeve.

In addition, a generally cylindrical, open cage or strainer support 77 is provided on its forward region with external screw threads 78 for threaded engagement with the internal screw threads 25 of the outer housing shell 11. That is, the forward end of the strainer cage or support 77 engages interiorly within the inner end of the outer shell 11, in threaded connection therewith, and has its forward end in forward abutting engagement with the rear side of collar 36. This serves to effectively lock the inner housing shell 30 in position within the outer housing shell 11 and prevent disengagement of the surfaces 34 and 21 even under high fluid pressure. Thus, the strainer support or cage 77 serves as locking means for the inner housing shell 30.

A cylindrical strainer 80 is engaged exteriorly about the locking strainer support 77 and retained in position thereon by a cap 81, which is in turn secured by a retaining ring 82.

In operation, fluid under pressure enters radially inward through the strainer 80 and strainer support 77 to apply pressure on the rear side of the piston 40, 41. The fluid passes into the passages 44, 43 and 46, applying forward pressure to the piston 40, 41, against the rearward-biasing force of spring 73. The rearwardly facing effective pressure area of the piston 40, 41, as well as the strength of spring 73, are selected so that unseating of the piston head 53 from the shoulder 32 occurs at a precisely desired pressure. Upon initial opening of the nozzle, as shown in FIGURE 2, a relatively low rate of fluid flow is metered from the slots 46 into the swirl chamber 19, from which it continues its helical motion through the main swirl chamber 15 and out in an atomized conical form through the discharge orifice 13. The proportions of the piston, chambers and orifice of the instant construction are readily capable of selection and change to produce a wide range of properly atomized fluid discharge along any desired flow curve within wide limits.

Referring now to the embodiment of FIGURES 3 and 4, a nozzle is there generally designated 110 and includes a generally cylindrical outer housing shell 111 having its forward end closed by an end wall 112 which is provided with an axially extending through aperture or discharge orifice 113. The forward interior region 115 of the outer housing shell 111 is of generally cylindrical configuration, having its forward end bounded by the interior, generally conical surface 116 of the outer-shell end wall 112. The internal conical wall surface 116 converges axially toward the discharge orifice 113, being provided at the juncture thereof wtih an annular conical valve-seat surface 114. The forward region or chamber 115 of the outer shell 111 is further bounded by a generally cylindrical internal wall surface 117 extending rearward from the rear, large end of the conical surface 116 and terminating at a generally flat, rearwardly facing annular surface or shoulder 118. That is, the cylindrical surface 117 extends rearward to intersect with the annular generally flat surface 118, which extends radially outward from the cylindrical surface and terminates in an internal cylindrical surface 120 of a diameter greater than the cylindrical surface 117. Thus, the internal rearwardly facing shoulder 118 and cylindrical surface 120 define an enlarged region 119 within the outer shell 111, corresponding to the enlarged region 19 of the first-described embodiment.

Proceeding rearward from the enlarged internal region 119, the outer shell 111 is further internally enlarged at 122 by the formation of an annular, generally flat shoulder 121 intersecting with and extending radially outward from the internal cylindrical wall 120. The internal region 122 may be provided with a generally cylindrical land 123 spaced rearward from the shoulder or abutment wall 121.

Rearward of the enlarged region 122, beyond the rear end of the cylindrical land 123, the outer shell 111 is further enlarged in the region 124, and there provided wtih internal screw threads 125. For mounting the outer shell 111 in a combustion chamber, there may be formed circumferentially about the exterior of the outer shell a mounting shoulder 126.

A generally cylindrical inner housing shell 130 extends forward through the rear open end of the outer housing shell 111 axially of the latter. The inner shell 130 is formed with an axial through bore or opening 131, which terminates at the forward end 132 of the inner shell. The forward end 132 is defined by an annular, generally flat surface disposed in a plane normal to the inner shell and in forward abutting engagement with the internal rearwardly facing shoulder 121 of the outer shell 111. The forward end surface 132 of the inner shell 130 is thus disposed in facing spaced relation with respect to the rearwardly facing internal outer-shell shoulder 118 and combines with the latter to define an internal annular groove or chamber of the enlarged region 119. The internal diameter of the bore or opening 131 is preferably less than that of the internal cylindrical surface 117, so that the forward inner-shell end surface 132 may be considered as an internal annular forwardly facing shoulder corresponding to the shoulder 32 of the first-described embodiment. Exteriorly, the inner shell 130 is of cylindrical formation, as at 135 for snug force-fit engagement in the outer-shell region 122. The rearward external region of inner shell 130 is reduced, as at 137, which reduced region is provided with an annular external groove 138 proximate to and spaced forward from the rear end 139 of the inner shell.

A generally cylindrical piston sleeve 140 is arranged longitudinally of and slidably within the opening 131 of the inner shell 130. Fixed to the piston sleeve 140 is a piston core 141, which core and sleeve combine to define a main piston. The piston sleeve 140 is formed internally with a through axial opening or bore 142, and is formed externally with a circumferentially extending outwardly opening groove 143. The piston sleeve 140 is further formed with a plurality of longitudinal external slots 144 located in circumferentially spaced relation about the sleeve each extending inward through the rear sleeve end and opening into the annular groove 143. Formation of the slots 144 serves to define between each adjacent pair of said slots a longitudinally extending external rib or fin 145. Extending forward from the annular groove 143, the piston sleeve 140 is formed with a plurality of external helically or spirally extending radially outwardly opening grooves 146, which grooves communicate at their rear ends with the annular groove 143 and terminate at their forward ends short of the forward end 147 of the piston sleeve. The forward sleeve end 147 may be substantially flat and located in a plane normal to the longitudinal axis of the sleeve. Thus, the piston sleeve 140 may be substantially identical to the previously described piston sleeve 40 of FIGURES 1 and 2.

The core 141 includes a generally cylindrical body

portion 150 conformably force fit in the forward region of the sleeve opening 142, and includes a reduced cylindrical rearward region 151 extending in spaced relation rearwardly through and beyond the rear end of the piston sleeve 140. Preferably integrally formed on the forward end of the core body 150 is an enlarged head 153 of forwardly convergent conical formation and having a generally cylindrical rear portion 154 in surface-abutting engagement with the forward-end surface 147 of the piston sleeve 140. That is, the rear surface 155 of the forward-end enlargement or head 153 is generally flat and disposed in a plane normal to the axis of sleeve 140, while the diameter of the cylindrical portion 154 is greater than the diameter of bore 131, so that the head 153 extends radially outward beyond the sleeve 140 for surface-seating engagement with the forwardly facing inner-shell end surface or shoulder 132. As in the first-described embodiment, the rear surface 155 of the enlargement or head 153 defines a substantially right angle at its juncture with the external surface of the piston sleeve 140, while the internal surface of bore 131 and the end surface or shoulder 132 define a substantially right angle at their juncture, for maximum seating engagement between the head 153 and shoulder 132.

The rear core portion 151 is formed internally with a generally cylindrical chamber 156 terminating at a front wall 157 rearward of the core body 150 and opening rearward from the reduced rear core portion. Apertures or ports 158 are formed in the rear core portion 151 opening radially inward into the forward region of the chamber 156, while a reduced cylindrical bore 159 is formed extending forward through the end wall 157, the core body 150 and opening forward through the forward side of head 153. The piston bore 159 is axially located and may be of a diameter slightly larger than that of the orifice 113.

A closure or cap 168 is secured over the rear end of the rear core portion 151, as by screw threads 174 and provided with a rearward axial extension 188. A connector cap 160 is engaged over the extension 159, and a pin 161 passed transversely through the extension and connector cap to positively secure the same together. The connector cap 160 has its rear end 162 closed except for a central opening 163 which receives the forward end of a connector rod 164. The connector rod is provided on its forward end interiorly of the connector cap with an enlarged head 165, and provided on its rear end with an enlarged head 166.

An annular spring guide 167 is circumposed about and engaged over the rear end of inner shell 130, having an annular rearwardly extending flange 169. A rear, annular spring guide 170, substantially identical to the spring guide 70 of FIGURE 1, is arranged about the rear end of connector rod 164, and provided with a rod retainer 172, while a coil compression spring 173 and spacer means 175 are interposed between the spring guides 167 and 170. A strainer support 177, which may be the same as strainer support 77 of FIGURE 1, is engaged into the rear open end of outer housing shell 111 and provided with external threads 178 in threaded engagement with the internal outer-shell threads 125. The remainder of the strainer assembly, including a strainer proper and retaining means therefor are also provided in the same manner as FIGURE 1, so that a detailed description thereof is not necessary.

Interposed in the chamber 156 between the rear end of rear core portion 151 and the closure cap 157 is a gasket 185. The gasket 185 serves to seal the rear end of the chamber 156 and may be provided with a centering boss 186 engageable in the rear end of the chamber to properly locate the gasket. The gasket is further formed with a forward, axial projection 187 located in concentrically spaced relation within the chamber 156.

Slidably received in the chamber 156 is a subpiston 190. Specifically, the subpiston 190 is located rearward of the ports 158 and includes a forward reduced extension 191 passing slidably forward through the bore 159 of the piston core 141. The piston 190 is formed in its rear end with a generally cylindrical, centrally located recess 192 adapted to receive the forward gasket extension 189, and an elongate hole or passageway 193 extends forward from the recess 192 and opens through the forward end of the reduced subpiston extension 191. The forward end of the subpiston extension 191 may be provided with a bevel or chamfer 194 shaped to conformably seat on the bevel 114 of the outer shell 111. A coil compression spring 195 is axially arranged in the chamber 156, being circumposed about and guided by the gasket extension 187, having its rearward end engaging the gasket boss 186, and its forward end extending into and in engagement within the recess 192 of the subpiston 190. Thus, the subpiston 190 is slidable forwardly and rearwardly relative to the main piston 140, 141, being movable rearwardly against the force of spring 195.

In operation, at a preselected fluid pressure, as determined by the force of spring 173 and the rearwardly facing effective pressure area of piston 140, 141, the latter piston will be urged forwardly to unseat the rear surface of piston head 153 from shoulder 132 and thereby open the passageways 144, 131 and 146 to communication with the chambers 119 and 115. To prevent the ineffective discharge of an improperly atomized spray, the subpiston 190 temporarily remains in its forwardmost position closing the orifice 113. However, just subsequent to unseating of the piston head 153 from the shoulder 132, when the swirl chamber 119, 115 is sufficiently full, the subpiston 190 retracts, to open the orifice 113 and permit properly atomized spray discharge of fluid therethrough. This rearward movement of the subpiston 190 is automatically effected by the pressure of fluid entering into the chamber 157 through the openings 158 forward of the enlarged part of the subpiston. That is, the pressure of fluid to be discharged operates to move the subpiston 190 rearward against the force of coil spring 195. The selection of effective pressure area of the subpiston 190, and the force of spring 195 is made in corresponding relation with the size of rearwardly facing effective pressure area of the main piston 140, 141 and the strength of spring 173, so that as the fluid pressure rises the main piston moves further forward and the subpiston further rearward away from the orifice to maintain proper atomization and rate of flow in accordance with a desired curve. The subpiston 190 by its restriction of the discharge 113 insures fine spray and a full discharge cone in the low range of fluid flow, and is fully retracted rearward during the high rates of flow.

The central bore 193 through the subpiston 190 permits the free discharge of any fluid which may leak into the chamber 156, so that any fluid in the chamber may not lock the subpiston or prevent full retraction thereof.

From the foregoing, it is seen that the present invention provides a spray nozzle which fully accomplishes its intended objects and is well-adapted to meet practical conditions of manufacture and use.

Although the present invention has been described in some detail by way of illustration and example for purposes of clarity of understanding, it is understood that certain changes and modifications may be made within the spirit of the invention and scope of the appended claims.

What is claimed is:

1. A nozzle construction comprising a generally cylindrical housing having a closed forward end provided with a discharge orifice, an internal forwardly facing shoulder in said housing spaced from the forward housing end, a piston slidable in said housing having on its forward side an enlarged head located between said shoulder and forward housing end and movable into and

out of seating engagement with said shoulder, said piston being provided with passage means communicating between opposite sides of said piston when said piston head is out of said seating engagement, said passage means being closed when said piston is in said seating engagement, resilient means operatively connected between said housing and piston to bias the latter rearward and urge said piston head into said seating engagement, said resilient means being of a strength such that a desired piston pressure on the rear side of said piston unseats said piston head and opens said passage means, a subpiston slidably mounted longitudinally of and within said first-named piston and having its forward end extending beyond said head for closing engagement with said orifice, said subpiston being formed with a forwardly facing effective-pressure-area surface communicating with said passage means for effecting movement of said subpiston relative to said first-named piston away from said orifice, and additional resilient means operatively connected between said first-named piston and subpiston for urging the latter forward toward closing engagement with said orifice, said effective-pressure-area surface being of a size and said additional resilient means of a strength to retain said subpiston in said closing engagement after movement of said first-named piston out of said seating engagement to insure proper atomization of fluid upon discharge from said orifice.

2. A nozzle construction according to claim 1, said subpiston including an enlargement on its rear end defining said forwardly facing effective-pressure-area surface, said first-named piston being provided with a rear chamber slidably receiving said subpiston enlargement, and said subpiston being formed with a longitudinally extending through passage for conducting leakage fluid from said chamber outward through said orifice.

3. A nozzle construction according to claim 2, said additional resilient means being located in said chamber in bearing engagement with said subpiston enlargement.

4. A nozzle construction comprising a generally cylindrical housing having a closed forward end provided with a discharge orifice, an internal annular forwardly facing shoulder in said housing spaced from the forward housing end, an annular internal rearwardly facing shoulder spaced intermediate the forward housing end and said forwardly facing shoulder and in facing relation with the latter to define therebetween an internal annular groove, a piston slidable in said housing having on its forward side an enlarged head located between said shoulder and forward housing end and movable into and out of seating engagement with said shoulder, said piston being provided with external longitudinally extending grooves defining fluid-passage means communicating between opposite sides of said piston when said piston head is out of said seating engagement, said passage means being closed when said piston head is in said seating engagement, said groove serving as a preliminary swirl chamber for fluid passing forwardly through said passage means to effectively swirl and atomize fluid at relatively low flow rates, and resilient means operatively connected between said housing and piston to bias the latter rearward and urge said piston head into said seating engagement, said resilient means being of a strength such that a desired fluid pressure on the rear side of said piston unseats said piston head and opens said passage means.

5. A nozzle construction according to claim 4, said forwardly facing shoulder having an internal corner of substantially 90 degrees on its forwardly facing side, and said piston head having a rearwardly facing surface combining with the rearwardly adjacent external surface of said piston to define an angle of substantially 90 degrees, for nonfrictional mating engagement of the rearwardly facing head surface with said forwardly facing shoulder.

6. A nozzle construction according to claim 4, said housing comprising a generally cylindrical outer housing shell having an internal axial rearwardly facing taper, and an inner housing shell engaged in said outer housing shell and having an external axial forwardly facing taper in abutting engagement with the taper of said outer shell, to thereby insure proper axial alignment of said inner and outer housing shells without excessively close manufacturing tolerances.

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