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G. N. MILES

2,524,820

LIQUID ATOMIZING NOZZLE

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Fig. 1.

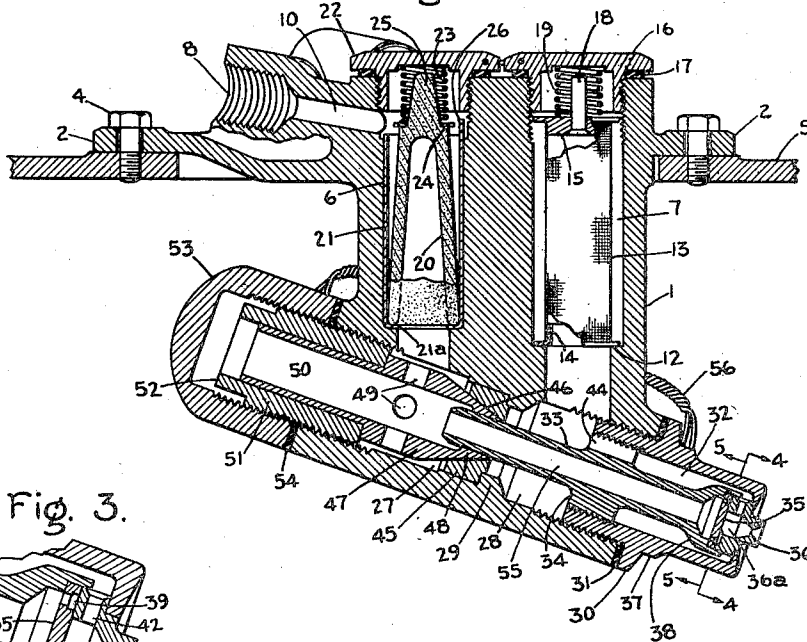


Fig. 3.

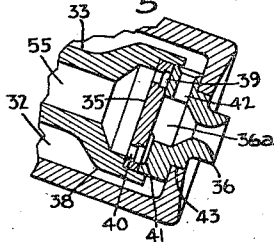


Fig. 2.

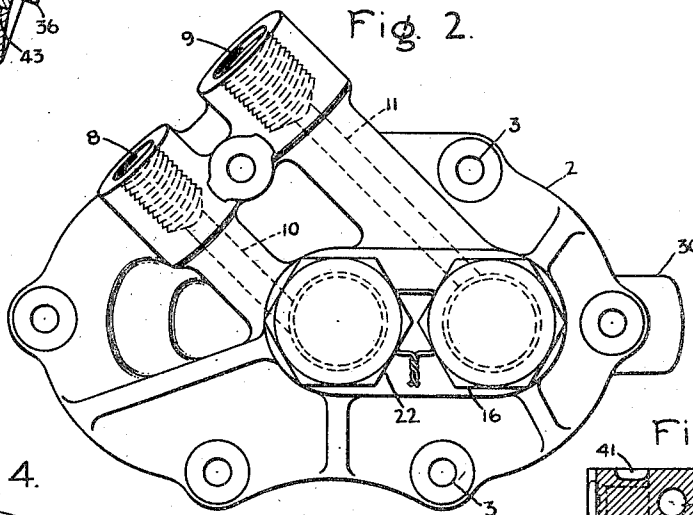


Fig. 4.

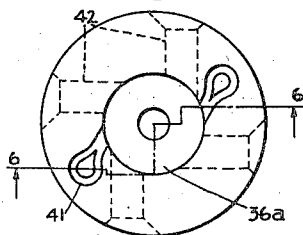


Fig. 5.

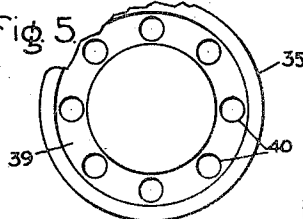
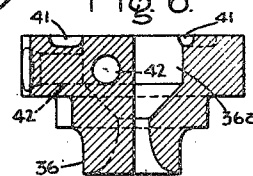


Fig. 6.



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UNITED STATES PATENT OFFICE

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LIQUID ATOMIZING NOZZLE

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3 Claims. (Cl. 299-140)

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My invention pertains to liquid atomizing nozzles, particularly those used in connection with fluid fuel burners. Specifically, it relates to a vortex spray nozzle of the "duplex type," especially adapted for use in connection with a combustor of a gas turbine powerplant.

An object of the invention is to provide an improved liquid spray nozzle of the duplex type.

A further object is to provide an improved spray nozzle for use in liquid fuel combustors, such as those of gas turbine powerplants.

Another object is to provide a fluid fuel spray nozzle having an improved arrangement of filter elements intimately associated with the nozzle.

A still further object is to provide an improved nozzle tip arrangement for a nozzle of the type described.

Another object is to provide a duplex type nozzle having an improved arrangement of the fuel passages to the spray tip.

Other objects and advantages will be apparent from the following description taken in connection with the accompanying drawings, in which Fig. 1 is a sectional view of my improved nozzle; Fig. 2 is a top view of the nozzle assembly shown in Fig. 1; Fig. 3 is an enlarged sectional view of the nozzle tip arrangement; Fig. 4 is a still further enlarged end view of the nozzle tip taken in the direction of the arrows 4-4 in Fig. 1; Fig. 5 is a view of the nozzle tip backplate taken in the direction of the arrows 5-5 in Fig. 1; and Fig. 6 is a sectional view of the nozzle tip, taken on the irregular plane 6-6 in Fig. 4.

The general characteristics and operation of the duplex type of vortex spray nozzle is more specifically described in an application Serial No. 622,604, filed October 16, 1945, in the names of C. D. Fulton and D. C. Ipsen. It is sufficient to note here that this type of nozzle has a vortex whirl chamber associated with the spray orifice and two independent sets of tangentially arranged holes or "slots" for supplying liquid to the vortex chamber in such a manner as to produce a high whirl velocity in the chamber. At low rates of total flow, liquid is supplied only through the small slots; while for larger rates of flow liquid is supplied through both sets of supply passages. Independent paths are provided in the nozzle assembly for supplying liquid to the two separate sets of slots. It should be understood that the term "slots" as used herein is intended to represent, generically, orifices of any shape whatever for supplying liquid tangentially to the whirl chamber of the nozzle tip.

Referring now to Fig. 1, my improved nozzle comprises a body member 1, which may be cast of a light metal such as aluminum or magnesium alloy. Adjacent the upper end of the body is a transversely extending flange 2 completely surrounding the body, in a manner which will be

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apparent from Fig. 2, and provided with a circumferential row of holes 3 adapted to receive suitable threaded fastenings indicated at 4 in Fig. 1 for securing the nozzle to a combustor wall 5, or to some other suitable support means. The opening in wall 5 is of course made sufficiently large that the nozzle can readily be inserted and removed therethrough; and the flange 2 serves as a closure for the opening in wall 5. The arrangement of the nozzle relative to the combustor is more fully disclosed in an application, Serial No. 644,888, filed February 1, 1946, in the name of Walter L. Blatz. Arranged longitudinally in the body 1 are two parallel cylindrical recesses 6, 7. The upper portion of the body is provided with two tapped openings 8 and 9 adapted to receive fittings for connecting the fuel supply lines. Inlet 8 communicates by way of a drilled passage 10 with the upper portion of cylindrical recess 6. Likewise inlet 9 communicates by way of drilled hole 11 with the upper portion of recess 7, in a manner which will be obvious from a comparison of Figs. 1 and 2.

Adjacent the bottom of the recess 7 is an annular shoulder 12 which serves as a seat for the cylindrical strainer 13. This strainer consists of a fine wire mesh screen supported on a ring 14 at one end and secured to a solid disk 15 at the other end. The upper end of recess 7 is threaded to receive a closure plug 16 provided with a hexagonal head, as will be apparent from Fig. 2. A suitable gasket, such as a neoprene washer 17, may be provided as shown in Fig. 1 to prevent leakage of fuel through the threaded joint between the body 1 and plug 16. It will be obvious from a consideration of Fig. 1 that when plug 16 is removed from the body 1, then the strainer 13 can be easily lifted out by means of the pin 18 riveted into the solid end disk 15. A coil spring 19 engaging the inner end surface of plug 16 and the outer surface of the strainer end disk 15 serves to bias the strainer downwardly so that the end ring 14 is held in sealing engagement with the annular seat 12. It will be readily understood that liquid enters through the opening 9, passes through the drilled passage 11 into the annular space defined between the strainer 13 and the recess 7. Thence liquid passes through the mesh of the strainer and out through the central opening in the end ring 14. As will appear more clearly hereinafter, the comparatively coarse strainer 13 and the liquid passages associated with it furnish liquid to the "large slots" of the spray nozzle tip.

To provide the more careful filtering required by the "small slots" of the nozzle tip, a special filter 20 is provided in the recess 6. This filter is a conical body composed of granular bronze particles molded and sintered to provide a porous

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mass, known to those skilled in the art by the trade name "Porex."

A cylindrical filter retainer cup 21 is seated in the recess 6 and has an inwardly flanged bottom end portion 21a which serves as a seat for the open end of the filter cone 20. A threaded plug 22, similar to plug 16, serves as a closure for the filter recess end opening. A biasing spring 23 engaging the under side of plug 22 serves to hold filter cone 20 with its open end in sealing engagement with the retainer cup end flange 21a. A suitable washer 24 may be interposed between the end of coil spring 23 and the upper end of filter cone 20. It will be obvious from Fig. 1 that liquid enters the inlet 8, passes through the hole 10 to the upper portion of recess 6, thence inward through the porous walls of cone 20, out the open end of the filter cone, and through the central opening in the bottom end of the filter retainer cup 21. With plug 22 removed, the filter cone 20 may be readily removed by means of the axial filter extension 25, which projects inside the spring 23. If necessary, one or more projecting tabs 26 may be provided on the upper end of cup 21 to facilitate its removal from the recess 6. The closure plugs 16 and 22 may be safety-wired by means of holes drilled in the hexagonal heads of the plugs in a manner which will be obvious from the drawing and readily understood by those skilled in the art.

The end of the nozzle body 1 remote from the mounting flange 2 is provided with a transversely extending cylindrical bore passing entirely through the body and divided by an annular shoulder 29 into two portions 27 and 28. The forward end of the bore portion 28 is threaded to receive the front end cap 30. Cap member 30 is provided with a flange arranged to clamp an aluminum gasket 31 against the end surface of the housing. The end cap may also be provided with a hexagonal section at 37, to which a wrench may be applied in assembling or disassembling the front end cap. Threaded into the rear end portion of a cylindrical recess 32 in cap 30 is a nozzle tip retainer sleeve 33 having a plurality of radially extending arms 34 threaded for engagement with the recess in cap 30. The forward end of the tip retainer 33 is enlarged at 38 to receive the backplate 35 and nozzle tip 36, in a manner which will be more readily apparent from Fig. 3.

As can be seen by reference to Fig. 3 and Fig. 5, the backplate 35 consists of a disk having in one surface an annular groove 39 communicating with a plurality of circumferentially spaced holes 40 which project entirely through the plate.

The nozzle tip 36 may be designed and arranged in accordance with the above-mentioned application of C. D. Fulton and D. C. Ipsen. The shape and arrangement of the small slots 41 and the four drilled holes constituting the "large slots" 42 may be seen in Figs. 3, 4, and 6.

As indicated in Fig. 3, the nozzle tip 36 is received in a central opening 43 of the end cap 30, and both the nozzle tip 36 and the backplate 35 are held within the recessed enlarged end 38 of the nozzle tip retainer member 33.

From the above, it will be seen that liquid leaving the strainer 13 through the central opening in end ring 14 passes into the bore portion 28, thence through one or more axial passages 44 defined between the arms 34, through the annular space 32 and around the outside of the enlarged head 38 to the large slots 42.

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Seated in bore portion 27 against the annular shoulder 29 is a bushing 45 which is provided with a tapered bore 46. A sealing cone member 47 has a tapered apertured end portion 48 which surrounds the end of nozzle tip retainer sleeve 33, with the outer tapered surface of the sealing cone portion 48 engaging the tapered bore 46 of bushing 45. One or more radial openings 49 communicate between the bore 50 of the cone member 47 and the discharge end of the filter recess 6. A sealing nut 51 is threaded into bore portion 27 and is provided with a polygonal end section 52, to which a wrench may be applied so as to force the tapered end portion 48 of sealing cone 47 into wedging engagement between bushing 45 and sleeve 33. It will be seen from Fig. 1 that movement of the sealing nut 51 into the bore 27 forces the members 51, 47, 45 and 33 into tight sealing engagement with each other. The threaded exterior of sealing nut 51, projecting from the bore 27, receives a rear end cap 53. An aluminum washer 54 between cap 53 and housing 1 serves to make fluid-tight the leakage path through the threaded joint connecting parts 1, 51 and 53.

It will now be apparent that liquid discharged from the open end of filter cone 20 passes through the radial holes 49 into the bore 50 of sealing cone member 47, thence through the bore 55 in sleeve 33 into the recessed end of enlarged portion 38, through holes 40 to groove 39 (Fig. 3) and from there through the small slots 41 into the whirl chamber 36a of the spray tip 36.

Except for the body 1 and the rear end cap 53, which may be made of aluminum or magnesium alloy, and the bushing 45 which is brass, the other principal components of the nozzle assembly may be made of suitable stainless steels which will resist corrosion, erosion and the comparatively high temperatures and pressures to which the parts may be subjected in operation.

The method of assembly of my improved nozzle is as follows: The nozzle tip 36 and the backplate 35 are inserted in the enlarged end portion 38 of the tip retainer sleeve 33. The sleeve member 33 is then inserted into the front end cap 30 and the arms 34 are screwed into the mating thread in the bore of cap 30. The filter cone 20 and its retainer cup 21 are then placed in the recess 6, and the washer 24, spring 23, and closure cap 22, assembled as indicated in Fig. 1. Similarly, the mesh screen 13 is placed in recess 7 and the biasing spring 19 and cap 16 assembled. With the brass bushing 45 pressed into place against shoulder 29 in housing 1, the front end cap 30 can be threaded into the bore 28, with the end of sleeve 33 projecting rearwardly through bushing 45 as shown in Fig. 1. The sealing cone 47 is then inserted with its end portion 48 between the sleeve 33 and the tapered bore of bushing 45. The sealing nut 51 may then be threaded into bore 27 and tightened to force cone portion 48 into sealing engagement with sleeve 33 and bushing 45 as described above. It will be seen from Fig. 1 that cone portion 48 is connected to member 47 by a section of reduced thickness, so that the wedging action produced when nut 51 is tightened will cause some slight deflection of portion 48 so as to compress it into tight contact with the outer surface of sleeve 33. Rear end cap 53 may then be assembled with the gasket 54 arranged as in Fig. 1. A suitable safety wire 56 may be passed through holes drilled in the front end cap 30 and the rear end cap 53 to prevent accidental loosening thereof.

It will be noted that with the nozzle assembly secured to the wall 5 of a combustion device, as in Fig. 1, caps 16 and 22 may be readily removed for inspection, cleaning or replacement of strainer 13 and filter 20. This servicing of the filters is possible without disturbing any other parts of the nozzle assembly. In removing the cone filter 20, the cylindrical retainer cup 21 is removed with it so that any dirt particles adhering to the outer surface of cone 20 will be retained within cup 21 and not permitted to fall into the recess 6. This prevents any loose dirt on the outside of the filter from getting into the passages leading to the small slots 41 of the nozzle tip 36.

The small slots 41 may be readily cleaned by removing plug 22 and filter cone 20, securing a hose over front end cap 30 and pumping kerosene or other cleaning liquid backwards through the small slots and out through the recess 6. This cleaning operation may also be performed without disturbing the nozzle assembly except for removal of the filter cone 20.

My invention provides a liquid spray nozzle of the duplex type which is convenient to assemble and disassemble for servicing, yet which satisfactorily meets the exacting requirements for devices of this type, as used for instance in aircraft gas turbine powerplants. The arrangement of the filter units associated with the nozzle permits frequent cleaning and/or replacement of the filters with a minimum amount of disassembly.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A duplex type fluid spray nozzle comprising a body having two recesses opening through one end of the body and separate inlet passages for admitting liquid to the respective recesses, the body having also a transverse bore extending therethrough at the other end thereof and including a first bore portion communicating with the first of the recesses and a second bore portion communicating with the second recess, the body being provided with an annular shoulder intermediate the first and second bore portions and defining a central opening between said bore portions, filter means in each of the recesses, means secured to the body adjacent the open ends of the recesses for retaining the filters in the recesses and for closing the open ends of the recesses, a front end cap containing a spray nozzle tip and a tip retaining sleeve and being secured in the first bore portion with the tip retaining sleeve extending rearwardly through the central opening in said annular shoulder, the bore through said sleeve being arranged to serve as the supply conduit for one set of orifices in the spray tip and at least one passage defined by the sleeve and the end cap for supplying liquid from the first recess to a second set of orifices in the spray tip, a hollow cylindrical sealing cone member in the second bore portion and having an apertured tapered end portion engaging the outer surface of the rearward end of the tip retaining sleeve and an inner surface of said annular shoulder, said sealing cone member having a passage communicating between the interior thereof and said second recess, the interior of said cone member also communicating with the bore of said sleeve, a hollow cylindrical sealing member secured in the rearward end of the second bore portion and arranged to force the cone member into wedging relation between said sleeve and said shoulder to provide a fluid-tight seal between the first and second bore portions, and a rear end cap secured to the body to form a

closure for the rearward open ends of said cone member and said sealing member.

2. A sealed casing assembly for a pressure fluid device comprising an elongated body having a central bore and an annular shoulder in the body forming forward and rearward bore portions, a tubular member secured in and having an outside diameter smaller than that of the forward bore portion whereby the passage through the tubular member forms part of a first fluid passage and the outer surface of the member forms a second annular fluid passage with the forward bore portion, said tubular member having a portion extending rearwardly through the central opening defined by said annular shoulder, a cylindrical sealing cone member disposed in the rearward bore portion and having an apertured tapered forward end portion closely surrounding the outer surface of the rearward end of the tubular member and sealingly engaging an inner surface of the annular shoulder, and a sealing nut member having a threaded connection with the rearward bore portion and adapted to force the sealing cone member into wedging relation with said tubular member and shoulder to provide a fluid-tight seal between the forward and rearward bore portions and between said bore portions and said first fluid path.

3. A sealed casing assembly for a pressure fluid device having two separate fluid passages there-through, comprising an elongated body having a central bore and an annular shoulder in the body forming forward and rearward bore portions, a tubular member secured in the forward bore portion and defining therewith an annular space forming a portion of one of the fluid paths, the passage through the tubular member forming part of the other fluid passage, the tubular member having a portion extending rearwardly through the central opening defined by said annular shoulder, a hollow cylindrical cone member in the second bore portion having an apertured tapered end portion closely surrounding the outer surface of the rearward end of the tubular member and sealingly engaging an inner surface of the annular shoulder, the interior of said hollow cone member being in communication with the passage through the tubular member, the cone member having also a passage communicating between the interior thereof and said rearward bore portion, a hollow cylindrical sealing member threadedly engaging the second bore portion and adapted to force the cone member into wedging relation with the tubular member and annular shoulder to provide a fluid-tight seal between the first and second bore portions and between said bore portions and the interior passages of the tubular member and sealing cone member, and a rear end cap threadedly engaging the end of said sealing member and forming a closure for the rearward open ends of the cone member and sealing member.

GEORGE N. MILES.

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