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L. LEE II

2,660,474

NOZZLE

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Fig. 1

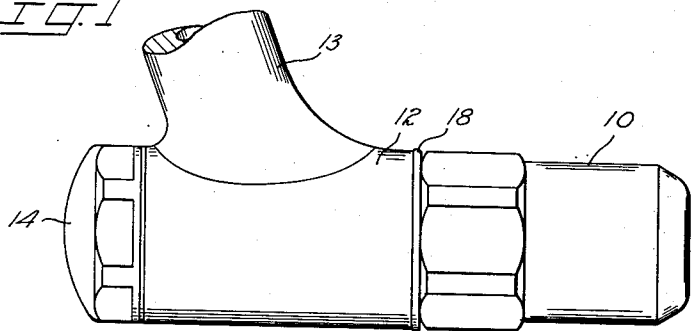


Fig. 2

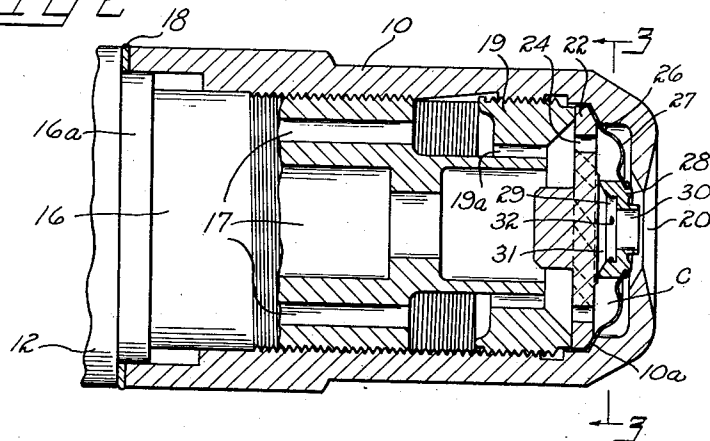


Fig. 3

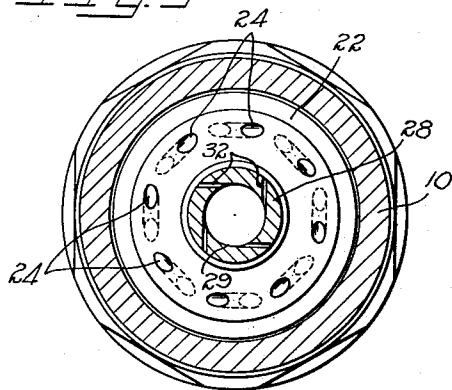
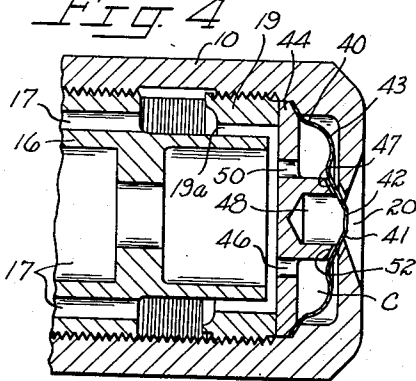


Fig. 4



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NOZZLE

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This invention relates to a nozzle and, more particularly, to a nozzle construction for usages requiring that the discharged fluids be released with a swirling motion.

Such diffuser nozzles, although having many applications, are particularly useful for injecting liquid fuel into the burning compartments of furnaces, engines, and the like. Normally such nozzles are designed to provide a swirling discharge under certain predetermined conditions of fluid flow into the nozzle. In general, however, the effectiveness of the nozzle is limited to the narrow range of flow conditions for which it has been designed and it has been difficult to design a nozzle which will properly discharge the fluid when the nozzle is required to operate over a wide flow range.

Accordingly, it is a general object of the present invention to provide a nozzle which will impart a swirling motion to fluids forced through the nozzle and which will discharge the fluids with a swirling motion throughout a wide flow range.

A more specific object is to provide a nozzle which will induce a swirling motion to fluid and discharge the fluid with a swirling motion and which will permit wide variations in flow rate without the need for excessive pressures.

A further object is to provide a nozzle having means for varying the effective size of the nozzle orifice responsive to fluid pressure and designed to maintain a swirling discharge of fluid during wide variations in flow rate and without the need for excessive pressures.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereafter set forth and the scope of the application of which will be indicated in the appended claims.

In the drawing:

Fig. 1 is a side elevational view of the nozzle of this invention coupled to a fluid conduit;

Fig. 2 is an enlarged vertical cross-sectional view of the nozzle of Fig. 1;

Fig. 3 is a vertical cross-sectional view of the nozzle of Fig. 2 taken on a transverse plane and viewed in the direction of the arrows 3-3 of Fig. 2; and

Fig. 4 is a fragmentary view similar to Fig. 2 but showing a modified nozzle construction.

Referring to the drawing in detail, the nozzle elements are housed within a casing 10 of gen-

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erally cup-shaped configuration which closes the open end of a fluid conduit 12. The conduit 12 receives fluid through a side duct 13 which is connected to a suitable reservoir or supply system (not shown) of fluid under pressure. The conduit 12 is closed at its other end by a cap 14 which is removably secured thereto in any conventional manner. The form of the conduit 12 is exemplary only, and if desired, it may take a variety of forms and may house auxiliary controls such as valves and the like for operation in connection with the inlet 13.

A core 16 having a plurality of longitudinal fluid passages 17 is disposed within the conduit 12 and projects therethrough to receive the cup-shaped nozzle casing 10 in threaded relation. A boss or shoulder 16-a on the core 16 adjacent the conduit 12 receives a seal 18 therearound against which the large diameter opening of the nozzle casing 10 abuts.

The casing 10 has a discharge opening 20 in its end wall which diverges outwardly so that swirling motion to discharged fluid will not be interrupted. The fluid is initially swirled after passing through the core ducts 17 by means of a swirl plate or disk 22 transversely disposed as a wall in the casing 10 against an internal shoulder 18-a therein and forced thereagainst by a nut 19 having an enlarged bore 19-a to provide an annular passage around the end of the core 16 and which is externally threaded for securement within the casing 10. The plate 22 has a plurality of diagonally directed passages 24 (shown eight) for creating the swirling motion as the fluid passes from the core ducts 17 to the other side of the plate 22.

A diaphragm 26 of saucer-like configuration, which may be formed of flexible sheet metal or other inherently resilient material, is secured at its peripheral portion between the plate 22 and shoulder 18-a. The diaphragm 26 and plate 22 cooperate to define a chamber C therebetween for receiving swirling fluid from the passages 24 in the plate 22.

In the embodiment shown in Fig. 2, the diaphragm 26 has a central opening in which is received a generally cylindrical orifice member 28 having an axial bore forming a through outlet opening 30 in register with the nozzle casing opening 20. The orifice member 28 is supported entirely by the diaphragm 26 and secured thereto as by swedging or the like so that it will shift with the diaphragm 26. The interior of the orifice member 28 is formed with a counterbore 29 and an outwardly diverging entranceway 31

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in communication with the discharge orifice 30. In the normal position of the diaphragm, the member 28 is held in abutting relationship against the swirl plate 22 so that the latter closes off the entranceway 31.

While the member 28 is held by the diaphragm against plate 22, communication between the chamber C and the outlet opening 30 is provided by a plurality of tangentially directed passages 32 extending into the counterbore 29 of the body 10 of the orifice member 28.

Thus, it can be seen that when the diaphragm 28 is in normal position, the fluid passing through the nozzle is swirled under the inducement of the diagonal openings 24 in the swirl plate 28 and is further swirled into the orifice member 28 through the tangentially directed passages 32. The swirling continues as the fluid is discharged through the orifice discharge passage 30 and the registering nozzle discharge passage 20. This double swirling inducement will be effective when the rate of volumetric flow from the inlet varies over a predetermined low range.

When the flow rate is increased beyond the range requiring the double swirling inducement of swirl plate 22 and the swirl passages 32 in the orifice member 28, the accompanying increase in pressure of the fluid is sufficient to displace or deflect the diaphragm 26 towards the nozzle opening. An annular bead 27 may be formed in the diaphragm for engagement against the casing 10 to keep the flexing of diaphragm 26 within safe limits. In the displaced position of the diaphragm 26, the orifice member 28 is accordingly displaced and the fluid from chamber C may directly enter the entranceway 31 and be discharged through the orifice passage 30 and the nozzle discharge opening 20 without passing through the passages 32. At such increased flow rate, the fluid is adequately swirled by the swirl plate 22 alone and the great increase in the effective orifice of the nozzle permits the increased rate of flow to be attained without excessive increase in pressure.

In the modified structure illustrated in Fig. 4, a stationary orifice member 46 is substituted for the movable orifice member 28 which shifts with the diaphragm 26, in the first embodiment described above, the member 46 being formed as a centrally located boss on the modified swirl plate 44. The member 46 is bored at 48 to form an outwardly facing central well at the center of the swirl plate. Diagonal swirl passages 50, extending through the plate 44 and which may be similar in all respects to the previously described swirl passages 24 of Figs. 2 and 3, are spaced about the central boss 46. In the modified structure, there is also utilized a modified diaphragm 40 having a generally conical central portion 41 defining a discharge orifice 42 in register with the nozzle discharge 20. As in the previous structure the diaphragm 40 may move relative to the swirl plate 44 in response to changes in volumetric flow rate and its accompanying pressure. During periods when the flow rate is relatively low, the diaphragm 40 presses against the conical face 47 of the member 46, and when the flow rate is increased, the accompanying increase in pressure will cause the diaphragm to flex outwardly away from the face 47. An annular bead 43 formed in the diaphragm 40 by abutment against the housing 10 will serve to limit flexing of the diaphragm to a safe limit. When diaphragm 40 is in its normal position against the member 46, as shown in Fig. 4, the swirling fluid

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from the chamber C is permitted to pass to the diaphragm orifice opening 42 and the well 48 by means of a plurality of tangential grooves 52 cut in the face 47. The fluid will thus receive further swirl inducement as it passes through the grooves 52 and the effective orifice of the nozzle is relatively small.

During periods when the flow rate is relatively high, the diaphragm is displaced toward the nozzle opening 20 so that fluid may pass directly from the chamber C to the orifice opening 42 in the diaphragm 40 without going through the grooves 52. At greater flow rates, the additional swirl inducement provided by grooves 52 is not required in order to produce the desired swirling of the fluid released through orifice 42 and the material increase in effective orifice opening of the nozzle makes it possible to obtain the desired greater flow rate without excessive increase in pressure.

It thus will be seen that there has been provided in accordance with the invention an improved nozzle construction in which the effective orifice and the swirl inducing means are automatically varied in accordance with flow rate through the nozzle, thus providing a nozzle which is effective for its intended purpose in installations requiring variation in flow rate over a wide range and which will permit such variation in flow rate without the need for excessive pressure ranges.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

I claim as my invention:

1. A diffuser nozzle construction comprising a casing having a discharge opening, a first member in said casing having swirl inducing passageways of predetermined size, a second member in said casing having swirl inducing passageways of smaller size, and means including a flexible diaphragm overlying the downstream ends of the passageways of said first member and movable responsive to fluid pressure in said nozzle from a first position for directing a fluid through said passageways in series and a second position for permitting the fluid to by-pass the passageways of the second member.

2. A diffuser nozzle construction comprising a casing having a fluid passage and a discharge opening, apertured means disposed in said fluid passage, said means having passages of a predetermined size for swirling fluid passing there-through, resilient means disposed in said fluid passage between said first mentioned means and said discharge opening, and means associated with said resilient means defining an orifice communicating with said discharge opening and defining a plurality of substantially transversely disposed fluid swirl passages of smaller size connecting said apertures and said orifice, said resilient means being responsive to increased fluid flow to shift toward said discharge opening and

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permit fluid to effectively by-pass said transverse swirl passages to said orifice.

3. A diffuser nozzle construction comprising a casing having an inlet opening and a communicating discharge opening, wall means disposed in said casing between said inlet and said outlet, said wall means having a plurality of angularly directed fluid passages of a predetermined size to induce swirling movement to fluids moving from said inlet to said outlet, resilient means disposed in said casing between said first mentioned means and said outlet, and means associated with said resilient means having a central opening in register with said outlet and having a plurality of substantially transverse fluid swirl passages of smaller size connecting said opening with the angularly directed passages in said wall means, said resilient means being responsive to variations in fluid flow to shift toward said outlet and permit fluid to by-pass said transverse swirl passages to said opening.

4. A diffuser nozzle construction comprising a casing having a discharge opening and an inlet opening in communication therewith, a transverse wall in said casing having a plurality of angularly directed fluid swirl passages of a predetermined size therethrough, a diaphragm transversely secured in said casing between said wall and the discharge opening, said diaphragm defining an orifice opening in register with the discharge opening, and means defining a plurality of fluid swirl passages of smaller size angularly directed toward said orifice opening, said diaphragm being responsive to increased flow to shift towards said discharge opening whereby fluid may by-pass said angularly directed fluid passages to said orifice.

5. A diffuser nozzle construction for injecting fuel to a combination chamber and comprising a casing defining a fluid passage having an outlet through a wall of said casing into the combustion chamber, a first means disposed in said fluid passage to induce fluids therein to follow a swirling path, a second swirl inducer in said passage to cooperate with said first means at low rates of fluid flow through said passage to further incite swirling of fluid therein, and by-pass means in said casing responsive to the differential between fluid pressure in said passage and fluid pressure in the combustion chamber for causing fluid to by-pass said second swirl inducer at relatively higher rates of fluid flow through said passage, said by-pass means including a diaphragm interposed between said first means and said outlet, said diaphragm having an aperture through which fluid is passed to said outlet.

6. A diffuser nozzle construction comprising an open-ended casing, one of said open ends being an inlet and the other of said open ends being an outlet, a plate disposed transversely of said casing having a plurality of angularly directed apertures therethrough to induce the swirling of fluids passing through said casing, a diaphragm transversely disposed in said casing between said plate and the casing outlet, said diaphragm having a central opening in register with the outlet, and means disposed in said diaphragm opening having an opening in register with the outlet, said means having a plurality of passages connecting its opening with the angularly directed plate apertures, and said diaphragm being movable during increased fluid flow to permit fluid to pass directly from said plate apertures to said outlet.

7. A diffuser nozzle construction comprising

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a casing having a fluid inlet and a diverging fluid outlet and a communicating passage therebetween, a core disposed in said passage having a fluid passage communicating said casing inlet with said casing outlet, a disk disposed in said casing between the outlet thereof and one end of the core, said disk having a plurality of diagonally directed fluid passages whereby fluid received from the core passage will be induced to follow swirling movements into a chamber, an orifice member having a central opening in register with the casing outlet and a plurality of spaced tangential passages connecting said central opening and said chamber, and diaphragm means engaging said orifice member and defining said chamber therearound, said diaphragm means being movable in response to fluid pressure to permit relatively free passage of fluid from said chamber to said central opening in said orifice member.

8. A nozzle comprising a hollow casing having an outwardly diverging discharge opening, means in said casing defining a fluid passage, a plate disposed in said casing in one end portion of the fluid passage, said plate defining a plurality of diagonally directed swirl passages therethrough, means on said plate defining a well and an orifice in register with the discharge opening of said casing, a diaphragm disposed in said casing having an aperture in register with said orifice and said discharge opening, said diaphragm and said means co-operating to define a plurality of fluid passages communicating said swirl passages and said orifice, said diaphragm being responsive to increased fluid pressure to shift to a second position whereby fluid may flow directly from said swirl passages to said discharge opening.

9. A nozzle comprising a hollow casing having an outwardly diverging discharge opening, core means in said casing defining a fluid passage, a plate retained in said casing adjacent the discharge end of said core, means on said plate defining a plurality of swirl passages, a boss on said plate defining a well and an orifice in register with the discharge opening of said casing, and a diaphragm disposed in said casing having an aperture in register with said orifice and said discharge opening, said diaphragm and said boss co-operating to define a plurality of fluid passages between said diaphragm and said well, said diaphragm being responsive to increased fluid pressure to shift toward said discharge opening whereby fluid may flow directly from said swirl passages to said discharge opening.

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