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NOZZLE

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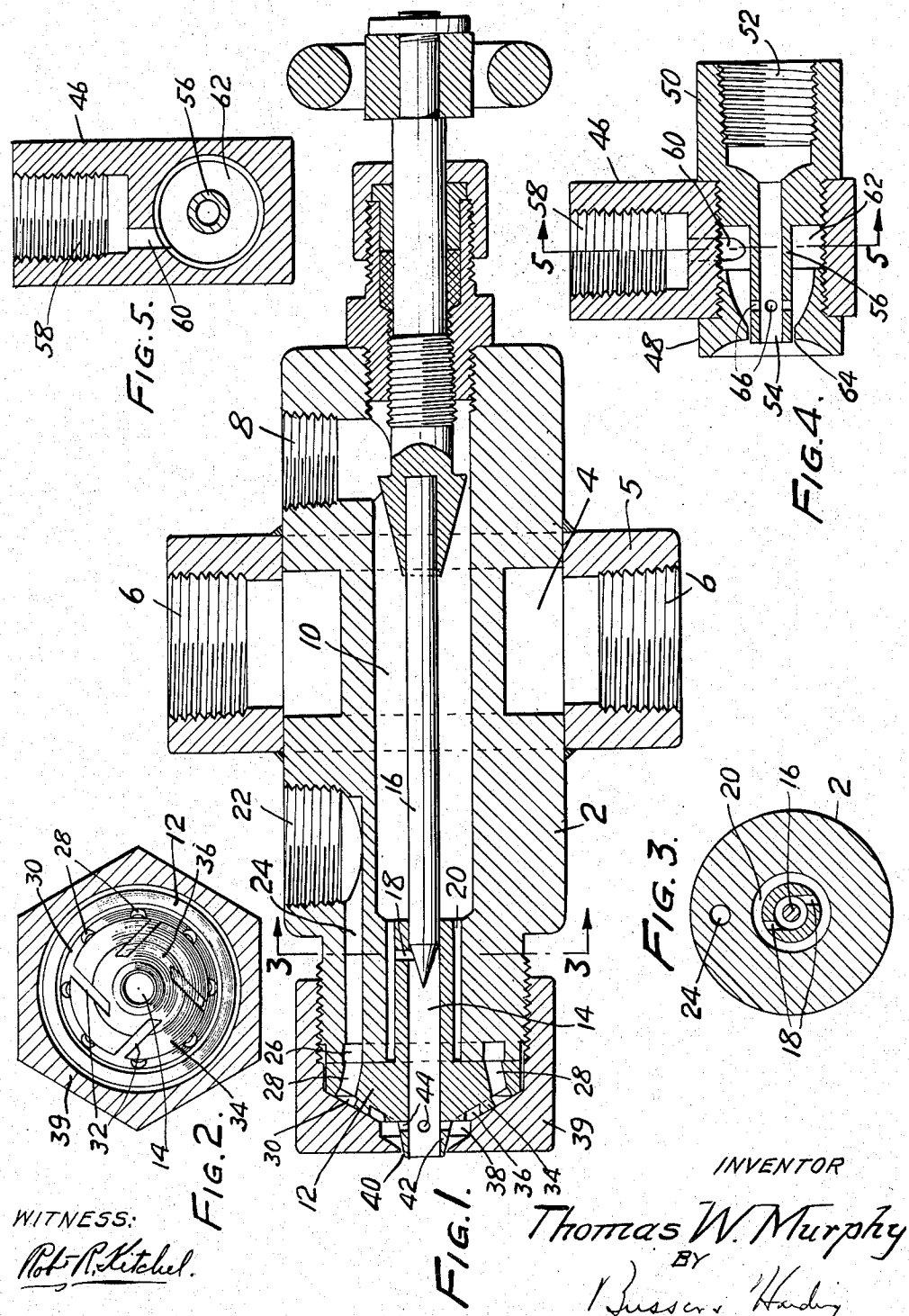

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NOZZLE

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This invention relates to spray or atomizing nozzles to be used for the dispersion of liquids for various purposes though the invention is particularly applicable to the atomization of fuel oil for oil burners.

Heretofore, nozzles for the spraying or atomization of liquids by the use of elastic fluids have usually involved the breaking up of the liquid by the elastic fluid within the body of the nozzle itself. Under such conditions it will be evident that the liquid, at the point where it meets the elastic fluid under pressure, must be under a corresponding pressure to prevent the forcing of the liquid back to its source. A difficulty arises whenever liquid is thus placed under pressure in that if, for any reason, the dispersing action is not perfect or for some reason the flow of elastic fluid momentarily ceases, the liquid will be projected, without being dispersed, in the form of large drops which, in the case of a furnace, may result in liquid striking a back wall thereof where carbonization and building up of carbon will result. In other nozzles jets of elastic fluid may break up liquid externally of the nozzle but these have not been completely satisfactory for various reasons.

In accordance with the present invention there is provided a spray or atomizing nozzle in which the dispersion may be effected by the action of elastic fluid supplied under high pressure without the necessity for imposing any corresponding pressure upon the liquid to be dispersed. In brief, this is accomplished by setting up exteriorly to the nozzle a swirling jet of elastic fluid creating a region wherein low pressure exists so that the liquid is drawn thereinto by ejector action and then is picked up by the elastic fluid and mixed therewith and dispersed by contact. The pressure existing in the region where the ejection occurs may be substantially subatmospheric to the end that not only may added pressure on the liquid be avoided but the liquid may be raised by suction from a supply below the level of atomization.

The foregoing general object of the invention together with specific objects particularly related to details will become apparent from the following description read in conjunction with the accompanying drawing in which:

Figure 1 is an axial section through a preferred form of nozzle constructed in accordance with the invention;

Figure 2 is a transverse section taken inside the conical surface of a cap member and showing in particular various elastic fluid passages;

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Figure 3 is a section taken on the plane indicated at 3—3 in Figure 1;

Figure 4 is an axial section taken through a modified form of nozzles also embodying the principles of the invention; and

Figure 5 is a transverse section taken on the plane indicated at 5—5 in Figure 4.

Referring first to the modification shown in Figures 1, 2 and 3, the nozzle comprises a main body 2 provided with an annular groove 4 surrounded by a metallic ring 5 having threaded inlet and outlet openings 6 for the entrance and exit of heated fluid, for example, steam. If the ring 5 is welded, as indicated, to the nozzle body, the arrangement provides a jacket for the heating of the nozzle and the liquid which is being fed therethrough. This is particularly desirable when the liquid is of a highly viscous material as in the case of heavy fuel oils. As will be evident hereafter, the nozzle is adapted not only for the dispersion of fuel oils but for any other liquids or mixtures of liquids and solids in the form of sludges which it may be desired to disperse.

The liquid enters the body of the nozzle at 8 and approaches the dispersing elements through a central passage 10.

The nozzle proper comprises an inner member 12 provided with a central bore 14 having tangentially arranged openings therein communicating with the passage 10 and adapted to be closed to the desired extent for control of the liquid flow by means of a needle valve 16 of conventional construction adapted to be moved axially by reason of its threaded mounting when rotated. A clearance space 20 about the shank of the member 12 permits the entrance of the liquid into the openings 18. Their tangential arrangement imparts some degree of rotation to the liquid in its flow through the passage 14. The passage 14, it will be noted, has an unrestricted exit as illustrated at the left of Figure 1.

The elastic fluid used for the dispersion, which may be air or other gas under high pressure or steam under high pressure, enters at 22 and passes through a connection 24 to an annular passage 26 with which communicate openings 28 extending to an annular groove 30 in the conical face of the member 12. A ridge 34 located inwardly of the groove 30 has a series of grooves or slots 32 cut tangentially therein and communicating with an annular groove 36 which, in turn, communicates with an annular space 38 in the central portion of a cap member 39. The tubular extension 42 of the passageway 14 has a slight clearance as indicated at 49 with the edges of a cen-

tral opening in the cap member through which it extends.

A group of openings 44 furnish communication between space 38 and the passageway 14.

In the operation of the nozzle the elastic fluid supplied at 22 under pressure enters the annular groove 30 and from it the slots 32, emerging in the form of a series of high velocity jets into the annular spaces 36 and 38. Accordingly, in these spaces a high rotational velocity is set up and the swirling elastic fluid emerges with the velocities thus produced while passing through the clearance 40 over the edge of extension 42 where final expansion to the surrounding atmospheric pressure occurs. As the elastic fluid thus emerges about the tubular extension 42 a low pressure region is created in the outlet of the passageway 14 giving rise to an effective ejector action, drawing from the passageway 14 the liquid which might be under atmospheric or subatmospheric pressure though, of course, some pressure may be imposed thereon, though generally speaking such pressure is desirably not high to avoid any possibility that drops may emerge without being dispersed. At any rate, the liquid ejected from the passageway 14 meets the high velocity elastic fluid and is almost immediately picked up by it and dispersed in the form of a very fine spray. Because of the vacuum produced in the center of the annular rotary jet issuing at 40, the rotation is maintained for some distance beyond the extension 42. This rotation added to that (described below) already existing in the mixture of elastic fluid and liquid which is emerging from 40 causes the liquid droplets to move outwardly centrifugally to be entrained by the elastic fluid thus providing the spray.

To render even more effective the atomization of the liquid the openings 44 are provided to permit a small portion of the elastic fluid to enter the passageway 14 at its outer end. While the elastic fluid as it enters may be at elevated pressure the entry occurs very close to the end of the passageway which is under a partial vacuum due to the ejector action, so that, as a matter of fact, no back pressure is set up upon the liquid in the passageway 14. The elastic fluid as it enters the liquid through the openings 44 will expand to the low pressure existing thereat and in doing so will effect primary atomization of the liquid so that the droplets of the liquid reaching the main jet of the fluid will already be very fine. The rate of feed of the liquid is, of course, under the control of the needle valve 16, adjustment of which will control concentration and to some extent the shape of the final dispersion. It will be evident that the arrangement precludes any possibility that the liquid may be projected from the passageway 14 without dispersion inasmuch as the pressure on the liquid in the passageway need be at most only slightly above atmospheric pressure and generally will be less than atmospheric pressure. Preferably, the liquid will not flow at all except due to the ejecting action of the elastic fluid jet.

The same general principles may be embodied in various types of nozzles of which a very simple form is illustrated in Figures 4 and 5, suitable, for example, for oil burning where a minimum complexity of structure is desired. According to the modification, a block 46 is provided with a threaded transverse bore in which are located the members 48 and 50. The latter is provided with a central passageway 54 extending through a tubular extension 56, liquid being fed to the passageway through the entrance 52. The elastic fluid enters at 58 and passes through an offset or tangential opening 60 into a swirl chamber 62 provided between the members 48 and 50 and extending into the member 48 as will be evident from the drawing. The member 48 is provided with a central opening through which the tube 56 projects with slight clearance as indicated at 64. A series of openings 66 serves to provide communication between the swirl chamber and the bore 54.

It will be evident that the operation of this nozzle is substantially identical with that previously described, a swirling action in chamber 62 being set up by the passage of elastic fluid through the tangential opening 60, the fluid emerging in the form of an annular high velocity jet through the clearance space 64 and exerting, as it leaves, an ejector action on liquid which may be partially dispersed through the action of elastic fluid entering it at 66.

It will be evident that numerous variations of the invention will be made without departing from the principles thereof as defined in the following claims.

What I claim and desire to protect by Letters Patent is:

1. A nozzle comprising means providing a passageway for liquid, said passageway having an open end, means for delivering liquid transversely tangentially to said passageway, means located adjacent to the open end of said passageway providing a swirl chamber annularly arranged with respect to said passageway and providing an annular passage extending from said swirl chamber toward the open end of said passageway, and beyond which said passageway extends, means for directing elastic fluid tangentially inwardly into said swirl chamber to set up a high speed of rotation of elastic fluid therein, issue of an annular jet from said annular passage with the creation of suction at the open end of the passageway to suck liquid from said passageway to be atomized in the jet, means providing communication between said swirl chamber and said passageway adjacent to said swirl chamber to admit elastic fluid into the passageway to aid in dispersing the liquid into the jet, said passageway having a constant diameter between the open end thereof and said communication providing means, and means for controlling the flow of liquid through said passageway.

2. A nozzle comprising an inner member having a conical end surface, having tangentially arranged grooves in said conical end surface, and having an axial passageway for liquid extending outwardly beyond said conical surface in the form of a tubular extension having an open end, means for delivering liquid to said passageway, a cap member arranged to surround said inner member and provided with a central opening and a conical seating surface surrounding said opening, the conical end surface of said inner member engaging the conical seating surface of said cap member, said inner member tubular extension extending through and beyond said central opening providing an annular passage of limited clearance between said tubular extension and said cap member, and means for delivering elastic fluid to said tangentially arranged grooves, said grooves defining passages for elastic fluid causing it to flow at high velocity to the central opening of the cap member and to emerge from said clearance about the tubular extension as a

jet creating a suction upon liquid in the passageway to suck liquid from said passageway to be atomized in the jet, said tubular extension being provided with at least one opening inwardly of its open end to receive elastic fluid to aid in dispersing the liquid into the jet, said passageway having a constant diameter between the open end thereof and said last mentioned opening.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
391,865	Schutte	Oct. 30, 1888
622,245	Luttrell	Apr. 4, 1899
920,818	Breckenridge	May 4, 1909
1,189,992	Nicholson	July 4, 1916
1,315,765	Eckart	Sept. 9, 1919
1,433,255	Binks	Oct. 24, 1922
1,456,266	Crane	May 22, 1923
1,462,680	Bliss	July 24, 1923
1,478,370	Adolphsen	Dec. 25, 1923
1,559,625	Kutis	Nov. 3, 1925
1,564,064	Hannah	Dec. 1, 1925
1,581,223	Moore	Apr. 20, 1926
1,592,982	Loepsinger	July 20, 1926
1,593,186	McKean et al.	July 20, 1926
1,641,581	Egan	Sept. 6, 1927
1,646,703	Mulholland	Oct. 25, 1927
1,792,929	Remey	Feb. 17, 1931
1,811,637	Ladisch	June 23, 1931
1,877,223	Buck	Sept. 13, 1932
2,050,368	Neely	Aug. 11, 1936