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[33] **South Africa**
[31] **68/2980**

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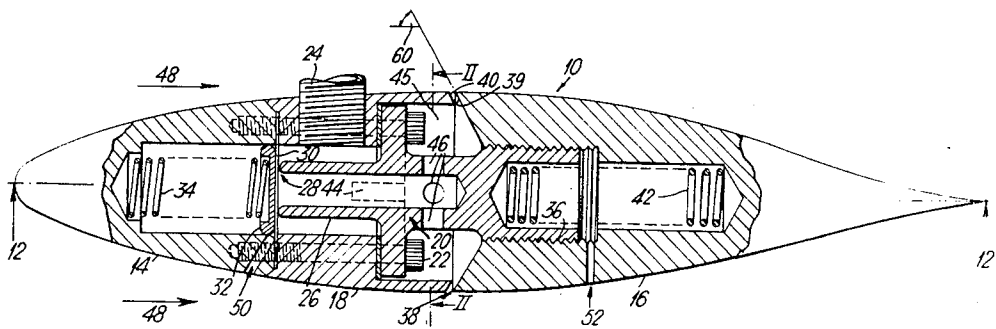
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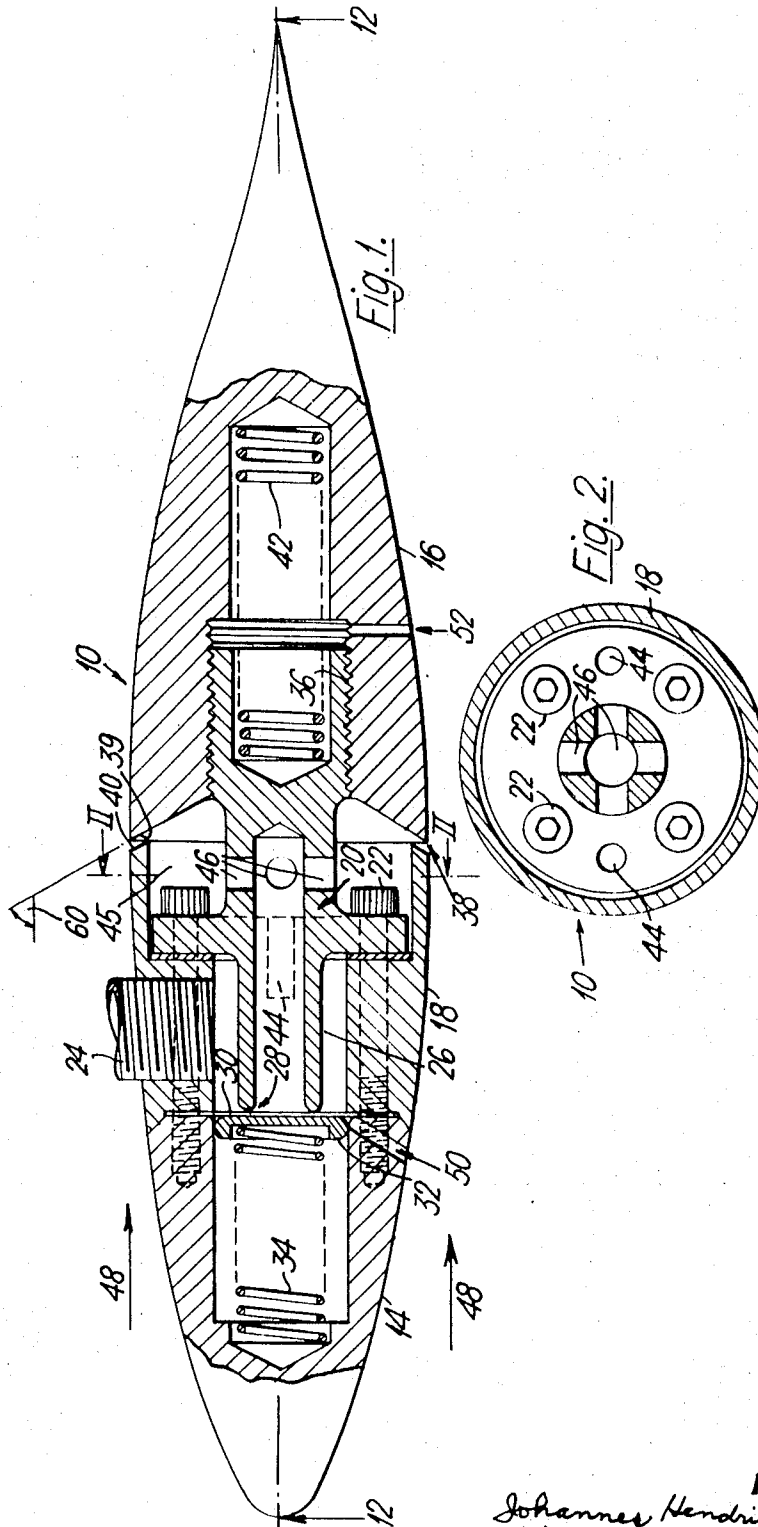
[54] **SPRAY NOZZLE**
4 Claims, 3 Drawing Figs.

[52] U.S. Cl. **239/11,**
239/171, 239/456, 239/581
[51] Int. Cl. **B05b 1/06**
[50] Field of Search **239/11,**
171, 456, 457, 451, 569, 570, 571, 581, 582;
244/137; 134/166 C; 60/39.74 S

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ABSTRACT: A spray nozzle the body of which is provided with a circumferential spray orifice. The orifice is defined by faces on two pieces which are adjustable relatively to one another so that the width of the orifice can be varied. The body is formed by rotating an aerofoil section about a chord of the section and the orifice is positioned so that spray fluid is directed in a dish-formation towards the end of the body which, in aerial spraying, is the leading end. If the nozzle is used in a stationary condition, then an airstream is caused to flow over the body from said leading end. A one-way valve is provided which is adapted to be opened by the pressure of the spray liquid fed to the nozzle.





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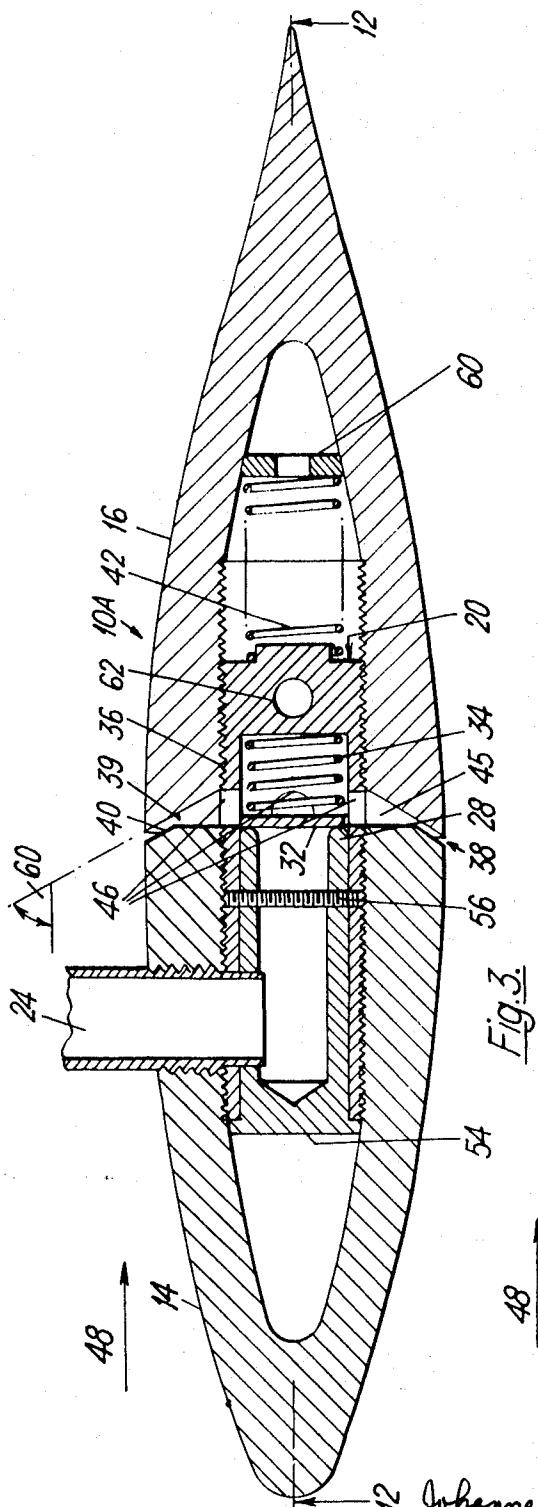


Fig. 3

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SPRAY NOZZLE

BACKGROUND TO INVENTION

This invention relates to spraying and to nozzles for use in spraying.

A requirement for the efficient spraying of liquid dispersoids from an aircraft in flight is that the liquid particles should be relatively small, constant in size and uniformly spaced throughout the swath area. Then the number of particles of a selected size per unit area deposited upon the surface will be principally a function of the volumetric flow rate of liquid from the nozzle. This flow rate may vary from 2 to 4 ounces per acre with the ultra-low-volume technique to ten gallons or more per acre with the high volume system of crop spraying.

Spray nozzles presently in use for aerial spraying purposes have had only a limited measure of success. Moreover, they present problems in adjustment and in cleaning and tend to clog when discharging solutions of wettable powder. In general these nozzles have been adapted from nozzles used for spraying liquid into still air and when used in a high-speed airstream their effect is inhibited because there is a tendency for some of the fine liquid particles to agglomerate into larger liquid particles. This can be undesirable for the larger particles of the chemical fluids being sprayed may damage the crops.

A further disadvantage of the types of spray nozzle which are in general use is that they have high drag characteristics which impair the speed and performance of the aircraft to which the nozzles are attached. Some known nozzles use rotating parts which require regular maintenance.

A primary object of the present invention is to provide an improved form of spray nozzle which is specifically designed for use in a rapidly moving airstream. Specifically, the nozzle has been designed for the aerial crop spraying of agricultural insecticides, fungicides and fertilizers in the form of a liquid concentrate, solution or dispersion. The nozzle is suitable for other duties involving the dispersion of liquids in airflows such as in open circuit cooling towers, in spray painting, for the spraying of detergents over oil slick at sea and similar operations. Another important application envisaged is the use of the nozzle as a liquid fuel atomizer in gas turbine engines.

SUMMARY OF THE INVENTION

According to the invention, there is provided a nozzle having a body formed with a circumferential spray orifice.

The body may be elongated and the spray orifice may be situated roughly about midway along the length of the body between its front and rear ends. If desired, the body may be a solid of revolution and obtained by revolving an aerofoil section about a chord of the section. The aerofoil section may conveniently be that known as NACA 65,-021 section. The maximum cross-sectional diameter of the body is about one-fifth its length, and occurs about halfway along the length of the body.

The circumferential spray orifice may conveniently be located at the position of maximum diameter of the body. The nozzle body may include two pieces with the spray orifice defined between axially spaced, circumferential faces. The orifice may communicate with a cavity adapted to receive spray fluid under pressure. The faces may conveniently be frustoconical, and may be disposed at an inclination to the axis of the nozzle. The faces conveniently diverge forwardly towards the front end of the nozzle. The inclined angle between the axis and the faces may be of the order of 60°. The axial width of the spray orifice may conveniently be adjustable by having the piece on which one of the faces is formed mating screw-fashion with a further piece.

The nozzle may conveniently be provided with an inlet connection communicating with the cavity, this inlet connection being provided ahead of the spray opening and preferably at a position about one-third back from the front of the nozzle. More particularly, the inlet connection can be provided about 32½ percent of the body length inwardly from the nose. If desired, a nonreturn valve may be provided in the body.

Further according to the invention, a method of spraying includes discharging spray liquid, in the form of a generally dishlike curtain, into an airstream. The airstream may result from the forward motion of the nozzle such as occurs in aerial spraying. If the nozzle is stationary, as in spray painting, when used in a cooling tower or when used as a fuel atomizer for a gas turbine engine, then the airflow must be induced.

Conveniently, the curtain is concave against the direction of flow of the airstream, i.e. flow takes place into the dished formation. Preferably, the curtain is frustoconical.

According to another aspect of the invention, a method of spraying includes directing a flow of gaseous fluid into a dished formation of spray liquid, the flow of gaseous fluid striking the concave face of the dished curtain.

The slope of the dished curtain may conveniently be about 60° to the direction of airflow.

SPECIFIC DESCRIPTION

The invention will now be described in more detail, and by way of example, with reference to the accompanying drawings in which;

FIG. 1 is an axial section of one form of nozzle in accordance with the present invention;

FIG. 2 is a cross section taken along line II—II of FIG. 1; and

FIG. 3 is an axial section of a further form of nozzle in accordance with the present invention.

Referring firstly to FIGS. 1 and 2, the nozzle is generally indicated by the reference numeral 10 and the overall shape of the elongated body of the nozzle is that obtained by rotating an aerofoil section about a chord 12 so that the chord constitutes the axis of the resultant solid of revolution. If the section is the one known as NACA 65,-021 then the maximum cross-sectional diameter of the body is about 21 percent (i.e. approximately one-fifth) of its length and occurs at a distance from the leading edge or nose of the body equal to about 45 percent of the length of the body.

The nozzle is made up of a number of different parts including a nosepiece 14, a tailpiece 16, a centerpiece 18, and a boss 20. The boss, centerpiece, and nosepiece are secured together by means of screws 22. An inlet connection 24 is provided into the centerpiece 18.

The boss 20 has a cylindrical portion 26 terminating in a rounded, annular seat 28. A diaphragm 30 is clamped between the centerpiece 18 and the nosepiece 14. The diaphragm is urged against the annular seat 28 by means of a disc 32 and a spring 34. The diaphragm 30 may be reinforced and may be of neoprene or other suitable material. The spring 34, the disc 32, and the diaphragm 30 together form a nonreturn valve.

The boss 20 has a fine male thread on a tail portion 36 which mates with a fine female thread in the tailpiece 16.

A circumferential spray orifice 38 is defined by the longitudinally spaced, circumferential faces 39 and 40 of the tailpiece 16 and the centerpiece 18 respectively and is situated in the region of maximum diameter of the body, that is, in the region midway between the front and rear ends of the body. It is possible to obtain infinite adjustability in the width of the circumferential spray orifice 38 by longitudinally adjusting the faces 39 and 40 with respect to one another. This is effected by rotating the tailpiece 16 and the boss 20 with respect to one another so that the fine threads convert this motion to longitudinal motion and cause the faces 39 and 40 to move together or apart. Undesirable movement between the tailpiece 16 and the centerpiece 18, i.e. after manual setting of the orifice gap by calibrated markings, is prevented by a stiff compression spring 42 located between the tailpiece 16 and the boss 20 and serving to urge the flanks of the threads against one another.

Dowels 44 serve to locate the boss and centerpiece relatively to each other.

A cavity 45 communicating with the spray orifice 38 is fed from the inlet connection 24 via the annular seat 28 and via radial holes 46 leading into the cavity 45. The inlet connection

is between the front end and the orifice 38 and is approximately one-third of the length of the body away from the front end (32½ percent of the length to be precise). It will be noted that the faces 39 and 40 are frustoconical and are so positioned that the orifice is directed towards the front end of the body. The slope of the faces 39, 40 defining the spray orifice 38 is about 60° to the axis 12 and the faces diverge slightly towards said front end. Openings 50 and 52 serve as air bleed passages.

In use, the nozzle body is mounted such that its axis 12 is parallel to the direction of air flow, shown by arrows 48. In operation, the spray liquid enters the nozzle under pressure through the inlet connection 24. The liquid pressure opens the nonreturn valve by deflecting the diaphragm 30 which allows the spray liquid to flow through the central stem of the boss 20 and out through the radial holes 46 into the cavity 45 communicating with the spray orifice 38. The faces 39 and 40 defining the spray orifice are so positioned that the spray liquid is ejected in a forwardly inclined sheet in the form of a generally dishlike curtain. The curtain is in this case frustoconical. As the spray liquid leaves the spray orifice, it strikes the air flowing over the outer surface of the nozzle body, and the relative motion between the airflow and the sheet of liquid gives rise to a shearing action which shatters the liquid sheet into particles whose size varies with the annular gap setting for particular conditions of liquid pressure, liquid properties, and rate of airflow over the nozzle.

FIG. 3 illustrates a modified form of nozzle, generally referenced 10A, and which has many parts in common with the nozzle of FIG. 1. Where applicable the same reference numerals have been applied to these parts.

In the nozzle 10A, a major constructional difference is that the boss 20 directly connects the nosepiece 14 and tailpiece 16 to one another without the interposition of a centerpiece equivalent to the centerpiece 18. The spray orifice 38 is again formed between faces 39 and 40 which, in this construction, are on the tail and nose pieces 16 and 14 respectively. The width of the orifice 38 is controlled by rotating the tailpiece 16 with respect to the boss 20 so that the fine threading on the tail portion 36 of the boss 20 and on the tailpiece 16 causes relative axial movement between the pieces 14 and 16.

The other major constructional difference between the embodiment of FIG. 1 and the embodiment of FIG. 3 is that the nonreturn valve is arranged somewhat differently. The seat 28 is formed not on the boss 20 but on a cylindrical component 54 which is rigidly secured by means of a pin or a grub screw 56 to the boss 20. The seat 28, has, however, the same rounded configuration as the seat 28 of the embodiment of FIG. 1. The valve does not include a diaphragm (equivalent to the diaphragm 30) but instead the disc 32 is pressed directly against the seat 28 by the spring 34. The valve functions to permit flow of spray liquid to the orifice 38 but to prevent flow of gas or liquid in the reverse direction therethrough.

The inlet connection 24 leads to the hollow interior of the component 54 so that the inlet connection 24 is placed in direct communication with one face of the disc 32.

Another slight difference between the construction of FIG. 3 and the construction of FIG. 1 is that the spring 42, instead

of bearing on the end of the bore in the tailpiece 16, bears against a washer 60 located in the bore.

A transverse bore 62 is provided in the boss 20. This bore 62 has no function during use of the nozzle but is provided so that it can receive a tommy bar or the like during assembly of the nozzle. This greatly facilitates the act of screwing the boss 20 into the nosepiece 14.

The operation of the nozzle 10A is substantially identical to the operation of the nozzle 10, the disc 32 being displaced from the seat 28 when fluid under pressure is supplied to the inlet connection 24 thereby permitting the spray liquid to flow through the radial holes 46 to the cavity 45 and thence to the spray orifice 38.

The nozzles indicated in the drawings are particularly suitable for use in aerial spraying. It will, of course, be understood that for variations in rates of airflow, wide variations in construction and proportions will be permissible.

The faces 39 and 40, defining the spray orifice 38, are forwardly inclined in order to counter the Coanda effect between the spray fluid and the faces 39 and 40, and the adjacent surfaces of pieces 18 and 16 (FIG. 1) or 14 and 16 (FIG. 3) in close proximity to the orifice 38.

When used for aerial spraying, the airflow across the nozzle is, of course, produced by the forward motion of the aircraft. When the nozzle is used in an application wherein it is stationary, the airflow is induced so that the flow of air into the concave side of the dishd curtain occurs in the desired manner. Thus an airflow is induced if the nozzle is used in paint spraying, in a cooling tower or as a liquid fuel atomizer for a gas turbine engine.

We claim:

1. A nozzle comprising an elongated body of a streamlined form having a front end and a rear end, an inlet for feeding spray liquid to the interior of the nozzle, and a circumferential spray orifice positioned intermediate said ends and defined between two facing surfaces of the body, each of said surfaces being generally frustoconical in form with the outer periphery of each surface closer to said front end than its inner periphery, and said inlet being forward of said orifice.

2. A nozzle as claimed in claim 1, wherein said surfaces diverge slightly towards said front end.

3. A nozzle according to claim 2, wherein the angle between each of said faces and the axis along which the body is elongated is approximately 60°.

4. A method of spraying which comprises feeding spray liquid to the interior of a nozzle having an elongated body of streamlined form, the body having a front end and rear end, feeding the spray liquid from the interior of the nozzle to the exterior thereof through a circumferential spray orifice defined between two frustoconical surfaces of the body, the frustoconical surfaces being positioned so that the emerging spray liquid is in the form of a generally conical curtain which diverges towards said front end, the included angle between said curtain and the line along which the body is elongated being approximately 60°, and shattering the curtain of spray liquid by means of an airstream flowing over the nozzle.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,618,857 Dated November 9, 1971

Inventor(s) Johannes Hendrik RAUTENBACH and Maitland REED

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In column 1, line 8, the name of the assignee should read:

Aviation Design & Engineering Company South Africa

(Proprietary) Limited.

Signed and sealed this 18th day of April 1972.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents