United States Patent

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[54] FLAT SPRAY ASPIRATING NOZZLE
7 Claims, 5 Drawing Figs.

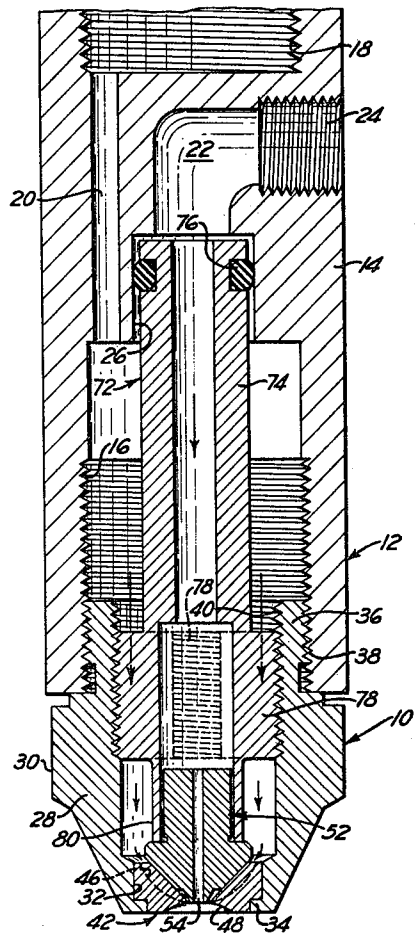
[52] U.S. Cl. 239/296, 239/424.5, 239/599
[51] Int. Cl. B05b 1/28
[50] Field of Search 239/291, 296, 424, 424.5, 599, 601

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ABSTRACT: A flat spray nozzle utilizing two flows, which may be of two different fuels, or of a fuel and air, and one or both of which may be pressurized. The nozzle includes a front end nosepiece which creates a region of low pressure in its exit orifice, and the exit end of the liquid fuel supply is located at that low-pressure region to thereby cause aspiration of the fuel into the gas as it exits from the nozzle in a flat, fan-shaped spray.



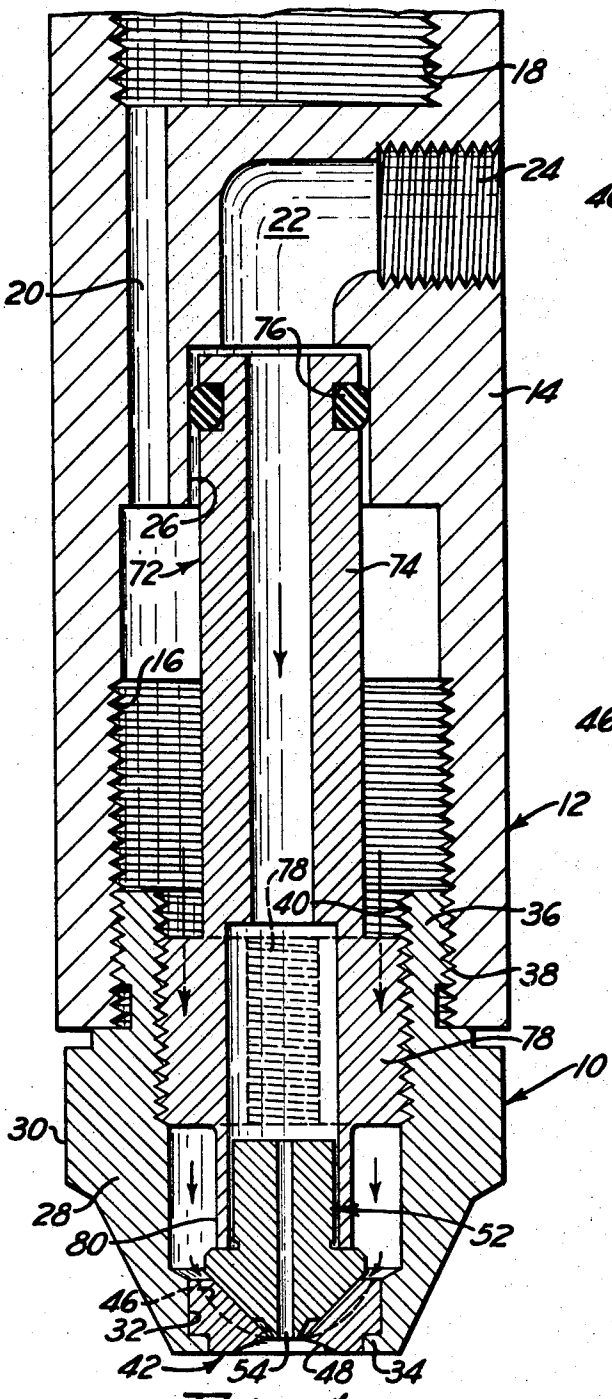


Fig. 1

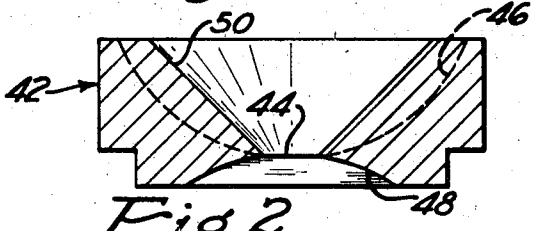


Fig. 2

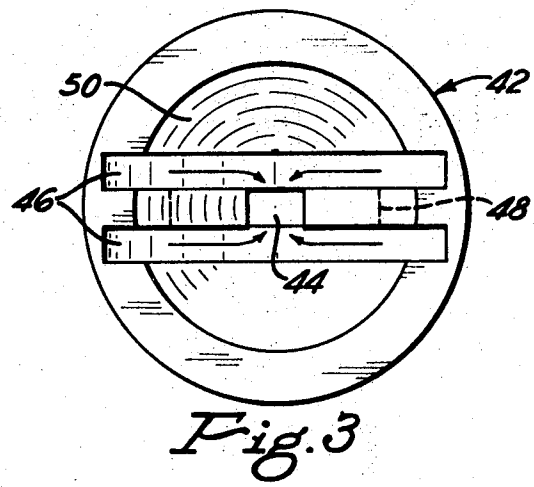


Fig. 3

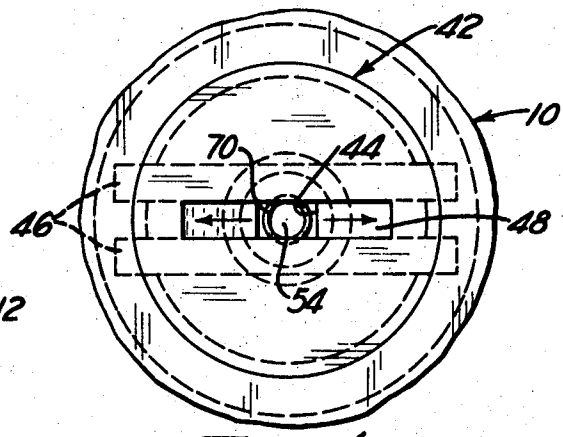


Fig. 4

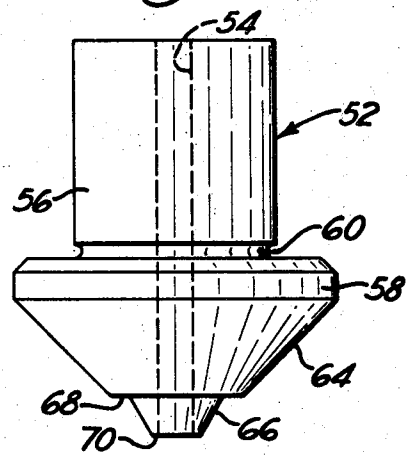


Fig. 5

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FLAT SPRAY ASPIRATING NOZZLE

This invention relates to the art of burner nozzles, and more specifically pertains to a nozzle for burning any one or two of a plurality of fuels, which produces a flat spray, and in which a flow of pressurized fluid aspirates unpressurized liquid fuel into the flow of pressurized fluid.

The invention is an improvement of my prior flat spray nozzle described and claimed in my U.S. Pat. No. 3,373,941, issued Mar. 19, 1968, and assigned to the same assignee as the present invention.

In the nozzle of said patent, fuel under pressure and air under pressure are supplied to the nozzle. That nozzle includes means to produce a conical spray of fuel, and means to cause the pressurized air to compress the conical spray of fuel without fracturing the spray, to thereby produce a flattened spray and a resultant flattened flame. My prior nozzle includes swirl chamber means to create a thin sheet of swirling fuel, which, upon exiting from a restricted orifice, breaks up into a cone of very small droplets. The air-handling front end nosepiece operates on the spray to flatten it after it issues from the swirl chamber means.

In the present invention, the same front end air-handling nosepiece is utilized, but the swirl chamber means are omitted, and in its place, fuel delivery means having an outlet end positioned in the exit orifice of the nosepiece is provided. Means are provided to delver liquid fuel to this outlet end, and the passage of the pressurized fluid around the outside of this outlet end aspirates the fuel into the flow of pressurized fluid, thereby eliminating the need to deliver the liquid fuel under pressure.

This difference in structure results in an entirely different manner of operation between my prior patented nozzle and the present nozzle. In my patented nozzle the cone of fuel is completely formed by the swirl means and has exited from the swirl means at the location at which the air acts on it to flatten it. In the present nozzle there is no independently formed cone of fuel. The air-handling front end nosepiece, by itself, produces a flat fan-shaped discharge of air or other fluid flowing through it. The exit end of the unpressurized fuel supply is located substantially in the rectangular exit orifice in the air-handling front end nosepiece. Thus, the pressurized air, or other fluid, passes over the fuel outlet and draws the liquid fuel into itself. In summary, in my prior patented nozzle, the air acts on a cone of fuel and shapes the cone of fuel, whereas in the present nozzle the air takes its own characteristic shape determined by the nosepiece, which is wide and flat, i.e., fan shaped, draws the fuel into itself, and thereby produces a fan-shaped spray of fuel and resultant flame.

The advantages of the present invention reside primarily in its simple construction and the fact that it requires only one pressurizing means. In my prior patented nozzle and in many other nozzles it is necessary that both fuel and air by supplied under pressure, requiring an air compressor and a fuel pump. In the present invention the fuel pump may be eliminated. This advantage is important in portable applications, such as an apparatus intended to be carried or drawn by a farm tractor for use in flame weeding.

The above and other advantages of the invention will be pointed out or will become evident in the following detailed description and claims, and in the accompanying drawing also forming a part of the disclosure, in which:

FIG. 1 is a cross-sectional elevational view of a nozzle embodying the invention;

FIG. 2 is a cross-sectional elevational view of the front end air-handling nosepiece;

FIG. 3 is an inside plan view of the front end of the nozzle;

FIG. 4 is an outside plan view of the front end of the nozzle; and

FIG. 5 is an external elevational view of the nozzle stem.

Referring now in detail to the drawing, **10** designates a nozzle embodying the invention. Nozzle **10** is mounted in an adapter **12** of substantially conventional configuration.

Adapter **12** comprises a body portion **14** formed with front end internal threads **16**. At its rear end adapter body **14** comprises threads **18** which communicate with a smaller passageway **20**. Means to supply a fluid under pressure, not shown, will be connected to adapter **12** via threads **18** in the usual manner. Body **14** is formed with a second rear end passageway **22** having threads **24** to one side of the adapter body. Passageway **22** is formed with an enlarged portion **26** for cooperation with the fuel-handling portions of the nozzle as will appear below. Passageway **22** may be connected to a source of unpressurized liquid fuel via threads **24**. Tests have shown that the fuel-aspirating effect of air will draw the liquid fuel against gravity. However, it is a more desirable practice to maintain the level of fuel substantially at or slightly below the level of the exit end of the nozzle, which is readily accomplished by a simple float and gravity feed device, all as will be well understood by those skilled in this art.

Nozzle **10** comprises a main nozzle body **28** which may be formed with a plurality of flat surfaces **30** to facilitate use of a wrench or other tool. The nozzle body **28** is conveniently of hexagonal cross-sectional shape at its greatest thickness which is at flats **30** to facilitate mass production from bar material. At its front end, body **28** is formed with a central opening **32** comprising an inwardly extending mounting ledge **34**. The rear end of nozzle body **28** comprises a sleeve portion **36** formed with external threads **38** and internal threads **40**. Nozzle **10** and adapter **12** are assembled together by cooperation of threads **16** and **38**.

Mounted in central opening **32** on ledge **34** is a front end air-handling nosepiece **42**. Externally, the nosepiece is so formed as to snugly fit in opening **32** and seat on ledge **34**. Internally, nosepiece **42** is formed with an exit orifice **44** of rectangular shape which is located in a transverse plane positioned closer to the front exit end of the nozzle than to the rear end, between the front and rear transverse faces of the nosepiece. Rectangular opening **44** is defined by a pair of slots **46** extending from the rear entrance end of the nosepiece towards the opening **44**, and by a front exit slot **48** located in planes between the planes of the two slots **46**. The inside of one slot **46** and one side of slot **48** lie in one plane, the inside of the other slot **46** and the other side of slot **48** lie in a second plane, and these two parallel planes define the long sides of the rectangular exit orifice **44**. Thus, the dimension of orifice **44** between these parallel planes is defined by the thickness of slot **48**. The second and longer dimension of opening **44** is defined by the amount of overlap between the two slots **46** on the one side and the slot **48** on the other side. The three slots **46** and **48** are shown as being arcuate on their bottoms with straight sides.

Extending from the inside towards opening **44**, nosepiece **42** is formed with a conical seat **50** to receive a nozzle stem **52**. Nozzle stem **52** is formed with an axial passageway **54** extending through its entire length. Beginning at the rear end, stem **52** comprises a rear stud portion **56** joined to an enlarged front end portion **58** by an undercut groove **60**. Front portion **58** comprises a conical portion **64** adapted to fit tightly against conical seat **50** of the nosepiece **42**. Forward of conical portion **64**, stem **52** comprises a front end tip **66** of reduced cross-sectional area. A ledge **68** is formed in the stem at the plane of juncture between portions **64** and **66**. Tip **66** is of conical configuration but is defined by a smaller included angle than the angle-determining conical portion **64**. The front end of tip **66** comprises an annular land **70** of narrow width surrounding the exit end of passageway **54**. It is this land **70** which is substantially coplanar with exit orifice **44** in nosepiece **42**.

Means are provided to hold body **28**, nosepiece **42**, and stem **52** in assembled relation, and, for example, to supply air under pressure to the slots **46**, fuel to passageway **54**, and to keep the air and fuel separate from each other within the nozzle. To these ends, a hollow nozzle plug **72** is provided. Plug **72** comprises a rear stem portion **74** which extends into enlarged opening **26**. Stem portion **74** is formed with a groove to carry suitable sealing means such as o-ring **76**. Forwardly of

stem portion **74**, plug **72** is formed with a plurality of arms **78** threaded at their outer ends to cooperate with threads **40** in the nozzle body. Passageways are provided between the arms **78**. Forwardly of arms **78**, plug **72** comprises a sleeve portion **80** which seats against the rear surface of front portion **58** of the stem **52**, and cooperates with suitable sealing means on the stem which may comprise an O-ring seated in groove **10**, thus, the nozzle **10** of the invention is assembled by first pressing the nosepiece through the nozzle body **28** to seal on the side of opening **32** and stop at its seat on ledge **34**, dropping the stem **52** onto the nosepiece to seat on its conical seat **50**, and then threading plug **72** into body **28** by cooperation between the threaded arms **78** and threads **40** hold the entire nozzle assembly tightly together.

The nozzle and adapter will be mounted on the apparatus with which it is to be used, such as a flame weeder, by holding it on the outside of adapted body **12** in the usual manner. Air under pressure is supplied via passageway **20** into the inside of the adapter body, and then passes between the arms **78** to the front of the nozzle. Passageway **22** may be exposed to a source of liquid fuel, such as fuel oil. If desired, a float device may be provided in the means connecting passageway **22** to the liquid fuel source to maintain a small gravity head or to maintain the level of liquid fuel substantially at the level of the outlet end of the nozzle.

Regarding fuels, it is noteworthy that tests have shown the nozzle of the invention may be used with a wide variety of different liquid and gaseous fuels. For example, the nozzle has operated well with No. 2 fuel oil, kerosene diesel fuel, or liquefied propane gas (LPG). In place of air, to further increase the heat output capacity, a second fuel in gaseous form such as propane gas may be supplied through passageway **20**. The pressurized gaseous fuel or air in passageway **20** aspirates whatever is in passageway **22** and, if air is not supplied through the nozzle, air to support combustion is provided by atmosphere surrounding the spray or some secondary air supply. Tests have shown that the nozzle will operate well with pressurized air or pressurized gaseous fuel in passageway **20** in combination with virtually any gas or liquid, with or without pressure driving it, supplied through passageway **22**. These tests have also shown that the nozzle will work well with the combination of liquid fuel under pressure in passageway **20** and gaseous fuel under pressure in passageway **22**.

For purposes of description, the following will proceed assuming air and a liquid fuel are being used. The air under pressure enters the rear end of the two inside nosepiece slots **46**. The air is able to clear the front end of the stem **52** because of the ledge **68** and the smaller tip. The airstreams in each of the two slots **46** impinge upon each other, combine, and reverse direction at the location of and within opening **44**. The resultant flow patterns are indicated by the arrows on FIGS. **3** and **4**. The two streams in each of the slots **46** combine together, to form a resultant stream. The two resultant streams tend to repel and are constrained to exit by way of the two sides of the front end slot **48**. These various changes of direction and combining and breaking of air streams occurs immediately surrounding the annular land **70** on the front end of stem **52**. The net result of these airflows is that a venturi effect or low-pressure region is created around the exit orifice defined by land **70** in the stem. This venturi or low-pressure region draws the liquid fuel into the air streams surrounding the exit end of passageway **54** thus drawing the fuel into the air. The air laden with fuel forms itself into a fan-shaped spray after exiting from front end slot **48**. Thus, no means to supply the liquid fuel under pressure is required.

While the invention has been described in detail above, it is to be understood that this detailed description is by way of example only, and the protection granted is to be limited only within the spirit of the invention and the scope of the following claims.

I claim:

1. A flat spray nozzle comprising a nozzle body, a front end nosepiece at the front end of said nozzle body formed with an exit orifice located in a plane transverse to the axis of said nozzle between the front and rear transverse faces of said nosepiece, a nozzle stem formed with a through opening having an inlet end and an outlet end, said through opening extending generally axially through the length of said nozzle stem to deliver a flow of fuel unchanged from said inlet end to said outlet end, means to mount said nozzle stem on said nosepiece with said outlet end of said nozzle stem through opening located substantially in said exit orifice, means to expose said inlet end of said opening to a source of fuel, means to supply a flow of pressurized fluid between said nozzle stem and said nosepiece and out said exit orifice of said nosepiece around said nozzle stem outlet opening; whereby passage of said pressurized fluid out of said exit orifice around said fuel carrying end of said through opening creates a region of reduced pressure in the vicinity of said outlet end of said through opening to thereby draw fuel out of said nozzle stem through opening into said flow of pressurized fluid; and means to constrain the flow of pressurized fluid carrying fuel into a fan-shaped spray.

2. The combination of claim **1**, said exit orifice being of rectangular shape, and the diameter of said outlet opening being substantially equal to the smaller dimension of said rectangular shaped exit orifice.

3. The combination of claim **1**, said pressurized fluid supply means comprising a pair of slots formed in said nosepiece extending from said rear transverse face of said nosepiece to said exit orifice, said constraining means comprising an outlet slot formed in said nosepiece extending from said front transverse face of said nosepiece to said exit orifice, said pair of slots being spaced apart from each other by a distance substantially equal to the thickness of said outlet slot, said outlet slot being located in planes between the planes of said pair of slots, and the intersections of said outlet slot with said pair of slots defining said exit orifice.

4. The combination of claim **3**, said means to mount said nozzle stem on said nosepiece comprising a conical seat formed in said nosepiece extending from said rear transverse face of said nosepiece to said exit orifice and a mating conical portion of said nozzle stem extending from rear portions of said stem towards said outlet end of said through opening and terminating short of said outlet end.

5. The combination of claim **4**, said pair of slots being of arcuate configuration and extending forwardly of said conical seat, and said outlet slot being of arcuate configuration.

6. The combination of claim **4**, said nozzle stem being formed with an integral reduced cross-sectional area portion extending forwardly of said conical portion to said outlet end of said nozzle stem through opening.

7. The combination of claim **6**, said nozzle stem being formed with annular land surrounding said outlet end of said nozzle stem through opening.