March 19, 1968 O. A. DAVIS, SR 3,373,941

NOZZLE

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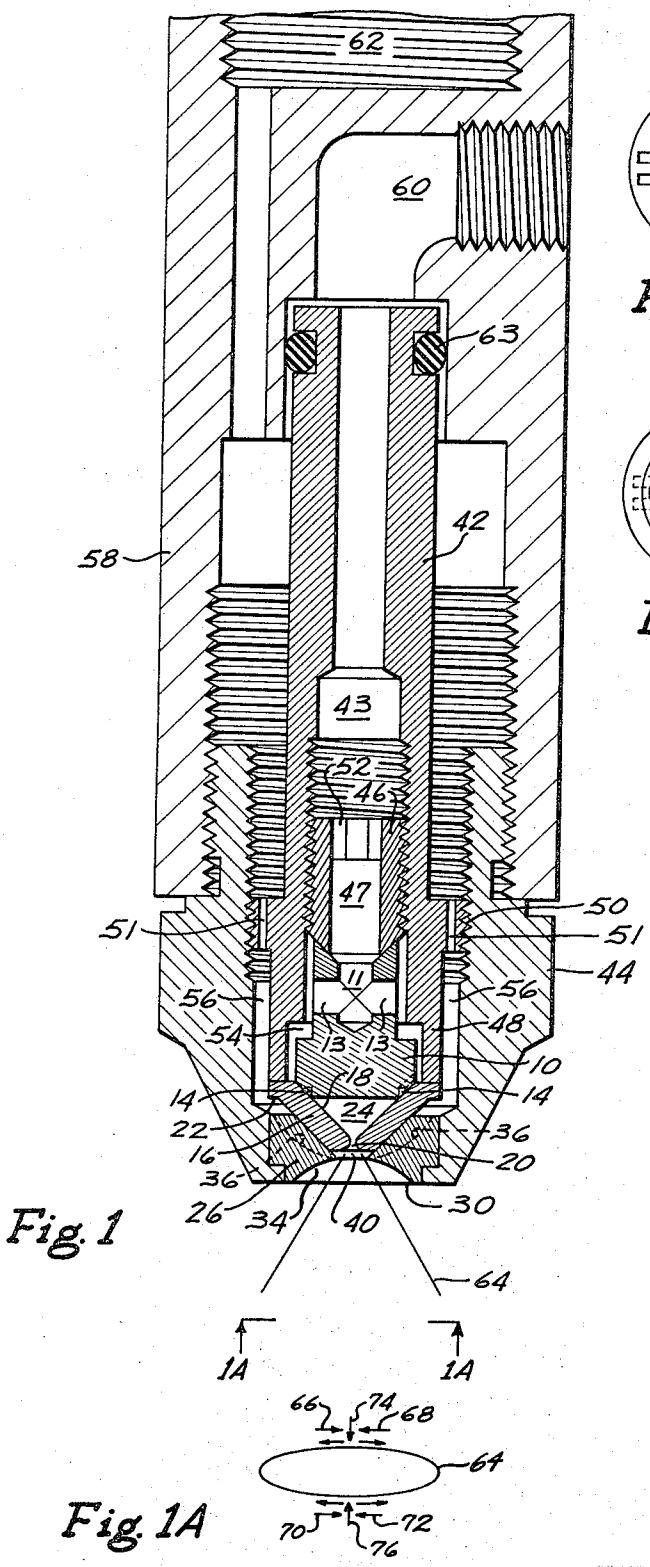


Fig. 1

Fig. 1A

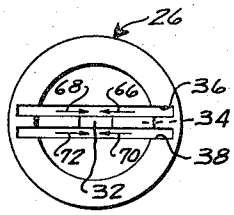


Fig. 3

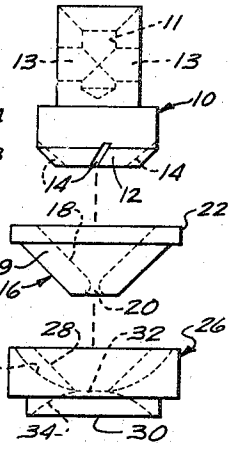


Fig. 2

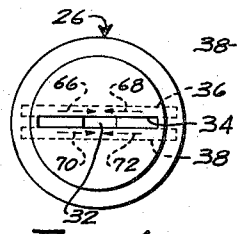


Fig. 4

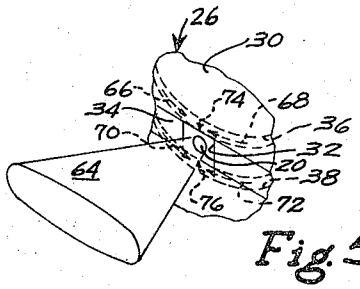


Fig. 5A

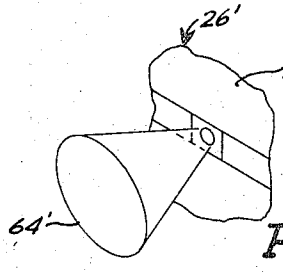


Fig. 5B

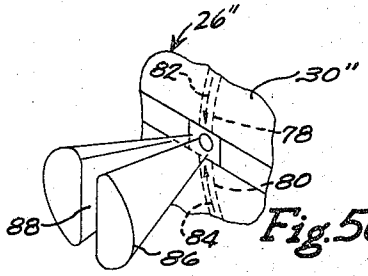


Fig. 5C

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NOZZLE

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This invention relates to spray nozzles such as oil burner nozzles. More particularly, it relates to nozzles for producing a spray of a primary fluid, such as fuel oil, having means for introducing a jet or a plurality of disjunct jets of a secondary fluid, such as air, to the periphery of said spray or the flame produced upon combustion thereof without permitting said jet or jets to divide or split the spray of primary fluid or the flame produced upon combustion thereof upon impingement thereon.

Conventional oil burner nozzles have a swirl chamber wherein liquid oil is swirled as a thin film at high velocity. Upon discharge from the discharge orifice of the swirl chamber, the swirling film is suddenly released from the confines of the swirl chamber wall surface whereupon it disintegrates into a spray of highly atomized oil droplets. The spray is substantially circular in cross section and, upon ignition, the resulting flame is also circular in transverse section.

In conventional nozzles wherein one or more separate jets of pressurized gas, such as air, are charged from within the spray nozzle to the periphery of an atomized spray or the flame produced upon combustion thereof, the pressurized jets travel at a high velocity and penetrate the spray, or the flame produced upon combustion thereof, and split or divide it at the point of impingement. In accordance with the present invention, a single relatively narrow jet or a plurality of disjunct narrow jets of pressurized air are charged directly to the periphery of the flame produced by the nozzle oil spray substantially without said air jets splitting the body of said flame. In the practice of this invention each jet of pressurized air reaching the flame is the resultant of two substantially equal streams of pressurized air which are charged at high velocity and pressure in a collision course directly into each other and the impact of the two high velocity streams occurs close to a lateral nozzle opening or passageway which is in close proximity to and facing the periphery of the flame. Following the high velocity impact of the two colliding air streams, a resultant stream is formed having a substantial pressure but having a very low velocity as a result of the impact. Since the lateral resultant stream travels toward the periphery of the flame at a low velocity, impingement thereof upon the flame does not split the flame. The two colliding air streams prior to impact travel in channels directed substantially transverse with respect to but offset from the longitudinal axis of the nozzle. The stream formed as a result of impact is charged in a direction which is substantially radial but which can also be somewhat forwardly with respect to the nozzle axis.

The nozzle of this invention has particular utility for use as an oil burner nozzle for flame wedding. When utilizing a flame to destroy weeds growing along the ground near desired crops, it is customary to attach a series of burners to the rear of a tractor. The burners are arranged in a row laterally along the rear of the tractor and spaced apart from each other by a distance corresponding to the spacing between the rows of crops. The flame weeder burners are inclined downwardly at an angle toward the ground at the side of a row of growing crops so that as the tractor travels in the direction of the row the flame can scorch any ground weeds growing in the vicinity of the crops. In order to confine the flame to the ground with a minimum of impingement upon the upper

regions of the desired plant which are particularly heat sensitive because they contain the foliage and flower of the plant, the flame is advantageously oblong, being flattened or elongated in the direction of movement of the tractor. By utilizing a nozzle of this invention, a flattened or oblong flame is produced without splitting the flame or otherwise destroying the uniform texture thereof by compressing the flame between a pair of low velocity pressurized air streams, each of said pair of air streams being the resultant of a pair of colliding air streams as described above. Two air streams collide in the nozzle on one side of the burner flame to produce a resulting low velocity jet thereat while two other air streams collide in the nozzle on the diametric opposite side of the flame to produce a second low velocity jet thereat. These two low velocity jets are directed axially outwardly toward the periphery of the flame, sandwiching the flame therebetween, and compressing said flame to produce an oblong flame configuration without fracturing said flame. The oblong flame thus produced is highly suitable for purposes of flame weeding.

This invention is further explained by reference to the accompanying drawings in which:

FIGURE 1 is a longitudinal sectional view of an assembled burner nozzle of this invention,

FIGURE 1A is a view of the flame produced by the nozzle of FIGURE 1 as seen from the position 1A—1A of FIGURE 1,

FIGURE 2 is an exploded view of certain elements of the nozzle of FIGURE 1,

FIGURE 3 is a plan view of the interior of nozzle element **26**,

FIGURE 4 is a plan view of the exterior of nozzle element **26**, and

FIGURE 5A is an isometric view of a segment of the front face of element **26** showing the flame configuration produced during combustion therewith. FIGURES 5B and 5C are isometric views of the corresponding region of two nozzles not of the present invention showing their respective flame configurations to illustrate the advantageous effect upon flame configuration accomplished with the nozzle of this invention.

Referring to both FIGURES 1 and 2, inner conical member **10** has a conical surface **12** having a plurality of slanted surface slots **14**. Inner member **10** also has a central bore **11** and lateral passageways **13** radiating therefrom. Intermediate conical member **16** has an interior conical surface **18**, an exterior conical surface **19**, a forward axial orifice **20** having a curved and tapered surface, and an upper ledge **22**. Conical surface **12** of inner conical member **10** abuts in fluid-tight engagement against interior conical surface **18** of intermediate conical member **16** to define swirl chamber **24** therebetween.

Outer conical member **26** is shown in side view in FIGURES 1 and 2 and is shown in interior plan view in FIGURE 3 and exterior plan view in FIGURE 4. The inner surface **28** of outer member **26** is conical while the outside surface **30** is flat. Axial opening **32** defines an elongated discharge orifice. The exterior of orifice **32** is at the center of groove **34** which is cut into the flat surface **30**. The interior of orifice **32** is sandwiched between a pair of parallel arcuate grooves or slots **36** and **38** and is disposed at the center of said parallel grooves. As indicated in FIGURES 3 and 4, exterior groove **34** becomes substantially contiguous with interior grooves **36** and **38** at the elongated sides of orifice **32**. Interior conical surface **28** of outer member **26** abuts in fluid-tight engagement against outer conical surface **19** of intermediate member **16** to define enclosed channels of slots **36** and **38** and to define a small chamber **40**.

The conical surfaces of inner conical element **10**, intermediate conical element **16** and outer conical element **26**

are in fluid-tight abutting engagement in the assembled nozzle, as shown in FIGURE 1. In assembling the nozzle, hollow interior plug **42** is screwed into outer nozzle body **44**. Interior plug **42** has a central bore **43** into which a set screw **46** is screwed. Set screw **46** has a central bore **47**. When the nozzle is assembled cylindrical prong **48** is pressed tightly against ledge **22** of element **16** by screwing threaded shoulder **50** into nozzle body **44**. Threaded shoulder **50** has a plurality of longitudinal passageways **51** extending therethrough. Set screw **46** is then urged tightly against member **10** by utilizing an elongated wrench in hex **52**.

In the assembled nozzle a passageway **54** is defined between member **10** and prong **48** of plug **42**. Another passageway **56** is defined between prong **48** of plug **42** and nozzle body **44**. The assembled nozzle is screwed into an adaptor **58** having a lateral fuel oil inlet passageway **60** and an axial pressurized air inlet passageway **62**. The oil and air passageways are sealed off from each other by means of O-ring **63**.

In the operation of the nozzle, fuel oil under a pressure of about 80 to 100 pounds per square inch is charged through passageways **60**, **43**, **47**, **11**, **13** and **54** to tangential slots **14**. Tangential slots **14** cause the oil to swirl as a thin film within swirl chamber **24**. When the swirling film is discharged through orifice **20** and thereby released from the confines of conical surface **18** it disintegrates and becomes atomized into small droplets of oil in a conical diverging spray. Upon ignition, the resulting flame has a configuration as indicated at **64**.

Pressurized air at a pressure of between about 30 and 50 pounds per square inch is charged through passageways **62**, **51** and **56**. In annular passageway **56** the pressurized air is admitted to opposite ends of each arcuate channel or groove **36** and **38** so that the air destined to travel through each groove is divided into substantially equal portions, the first of which enters its groove from one end thereof and the second of which enters the same groove from hte opposite end thereof. The two portions of air flow toward each other in a collision course from opposite ends of the same groove as indicated in FIGURES 1A, 3, 4 and 5A by arrows **66** and **68** in groove **36** and arrows **70** and **72** in groove **38**. The momentum of impact of streams **66** and **68** in groove **36** and streams **70** and **72** in groove **38** is great because it is established by the impact of two moving streams and results in stopping the forward movement of the colliding streams. Thereupon, air streams **66** and **68** combine to form a new stream **74** which travels in a direction which is 90 degrees lateral with respect to streams **66** and **68**. Similarly, air streams **70** and **72** combine to form a new stream **76** which travels in a direction which is 90 degrees lateral with respect to streams **70** and **72**. Because streams **74** and **76** are each the resultant of two streams colliding head-on at high velocity, streams **74** and **76** at the moment of formation have a relatively low velocity and therefore are capable of flattening the opposite ends of flame **64** without otherwise violently disrupting flame **64**, as shown in FIGURE 1A.

The comparative flame configurations presented in FIGURES 5A, 5B and 5C illustrate the advantageous effect of parallel grooves **36** and **38**. FIGURE 5A is an isometric view of a segment of the front face **30** of element **26** showing the flame configuration produced during combustion. FIGURES 5B and 5C are isometric views of the corresponding region of two nozzles not of the present invention showing their respective flame configurations. Referring first to FIGURE 5B, front face **30'** of an element **26'** is shown which differs from element **26** of the nozzle of this invention in that it possesses no grooves corresponding to grooves **36** and **38**. Element **26'** therefore does not admit pressurized air and a flame **64'** is produced which has a conventional round cross-sectional configuration.

Referring next to FIGURE 5C, front face **30''** of element **26''** is shown which differs from element **26** of the nozzle of the invention by employing a pair of grooves **78** and **80** which approach the axial discharge orifice radially. Approach of high velocity air streams **82** and **84** from a radial direction permits streams **82** and **84** to impinge upon opposite sides of flame **86** at a very high velocity and impart a fissure **88** in the flame, thereby splitting flame **86** into two segments. This is contrasted to the operation of the nozzle of the invention, as shown in FIGURE 5A, wherein the air streams impart a flattened configuration to the flame without creating a fissure therein. As shown in FIGURE 5A, air streams **66** and **68** collide with each other to form a lateral air stream **74** having a very low velocity. Streams **70** and **72** collide with each other to form a resulting lateral air stream **76** whose velocity is also very low. Air streams **74** and **76**, each having a low velocity, are directed toward the opposite sides of flame **64** to convert the flame from a round configuration as shown in FIGURE 5B to the oblong configuration shown in FIGURE 5A, without dividing the flame into two segments as shown in FIGURE 5C.

Various changes and modifications can be made without departing from the spirit of this invention and the scope thereof as defined in the following claims.

I claim:

1. A nozzle comprising first means for discharging an axial spray, second means in said nozzle for charging a pressurized fluid in the direction of the periphery of said spray, said second means comprising channel means for charging separate streams of said fluid in collision course toward each other to form a resultant stream of said fluid having a low velocity, said second means also comprising passageway means in the zone of collision of said fluid streams which is substantially lateral with respect to said channel means to direct said resultant fluid stream in the direction of the periphery of said axial spray.

2. The nozzle of claim **1** wherein said channel means is transverse to and offset from the longitudinal axis of said nozzle.

3. The nozzle of claim **1** wherein said channel means comprises groove means having opposite ends open to said pressurized fluid and said passageway means comprises lateral opening means substantially at the middle of said groove means.

4. The nozzle of claim **1** including a plurality of said second means.

5. The nozzle of claim **1** including a pair of said second means positioned for directing a pair of said resultant fluid streams in the direction of the periphery of said axial spray on diametrically opposite sides of said spray to impart an oblong configuration to said spray substantially without splitting said spray.

6. The nozzle of claim **5** including oblong discharge opening means for the discharge of said oblong spray.

7. A nozzle comprising first means for discharging an axial spray of atomized oil droplets, a pair of diametrically oppositely disposed second means in said nozzle, said pair of second means positioned for charging a pair of pressurized air streams in the direction of the periphery of said spray on diametrically opposite sides thereof for compressing said spray without imparting a fissure therein, each of said second means comprising groove means extending substantially transverse to and offset from the longitudinal axis of said nozzle and open to pressurized air at opposite ends thereof for charging separate streams of pressurized air in collision course toward each other to form a resultant stream of pressurized air having a low velocity, passageway means in each groove means comprising a lateral opening substantially at the middle of each groove means to direct each resultant pressurized air stream in the direction of the periphery of said oil spray.

8. A burner nozzle comprising an inner conical member, an intermediate conical member, and an outer conical member, the conical surfaces of said members abut-

ting in fluid-tight engagement, axial swirl chamber means defined by said abutting inner and intermediate members for producing an atomized spray, air passageway means defined by said intermediate and outer members, first opening means at the apex of said intermediate member defining swirl chamber discharge orifice means, second opening means at the apex of said outer member defining nozzle discharge means, continuous groove means defined by said intermediate and outer members for admitting separate pressurized fluid streams into opposite ends thereof so that said separate streams approach each other and collide near the center of said groove means to produce a resultant stream, third opening means substantially at the center of said groove means to discharge said resultant stream toward the periphery of said atomized spray.

9. The nozzle of claim **8** including a plurality of said continuous groove means.

10. The nozzle of claim **8** including a pair of said continuous groove means disposed in parallel and on opposite sides of said second opening means.

11. The nozzle of claim **10** wherein said second opening means is elongated and is substantially contiguous with each of said groove means along the elongated sides thereof.

12. A burner nozzle comprising an inner conical member, an intermediate conical member, and an outer conical member, the conical surfaces of said members abutting in fluid-tight engagement, axial swirl chamber means defined by said abutting inner and intermediate members for producing an atomized oil spray, air passageway means defined by said intermediate and outer members, first opening means at the apex of said intermediate member defining swirl chamber discharge orifice means, elongated second opening means at the apex of said outer member defining nozzle discharge means, a pair of parallel continuous groove means in the abutting conical surface of said outer member disposed on opposite sides of said second opening means, each of said groove means for admitting separate pressurized air streams into opposite ends thereof so that said separate air streams approach each other and collide near the center of their respective groove means to produce a resultant air stream, a pair of third opening means associated with said pair of groove means each substantially at the center of its respective groove means to discharge each resultant air stream toward the periphery of said atomized oil spray, said resultant air streams compressing opposite sides of the flame produced upon combustion of said oil spray to produce an oblong sectional configuration therein substantially without imparting a fissure to said flame.

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EVERETT W. KIRBY, *Primary Examiner.*