Nov. 16, 1965 O. A. DAVIS, SR., ETAL 3,217,986

NOZZLE

Filed March 20, 1964 4 Sheets-Sheet 1

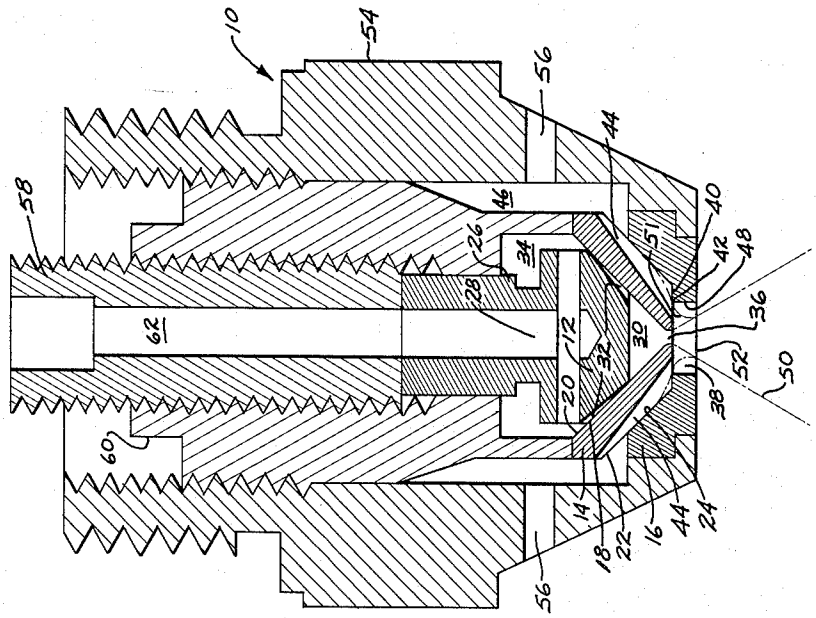


FIG. 1

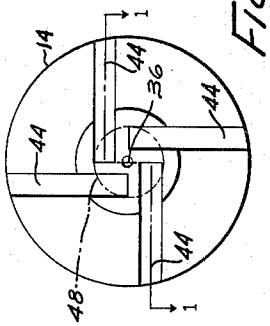


FIG. 2

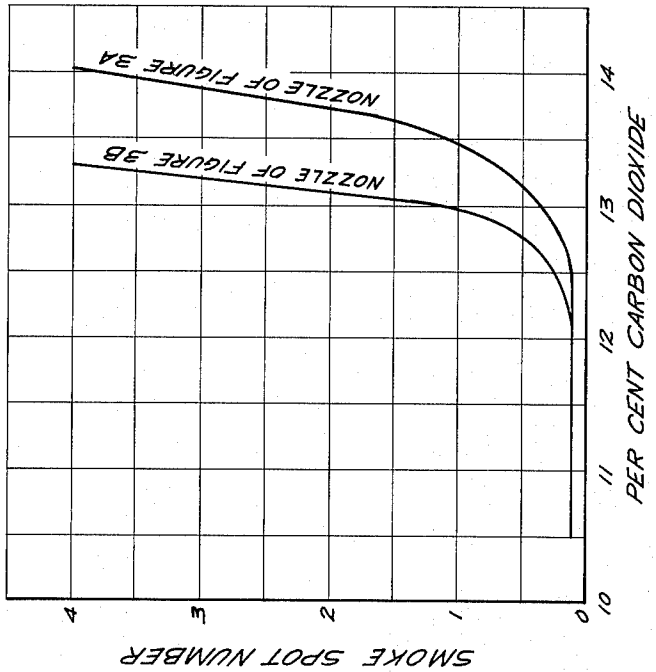


FIG. 4

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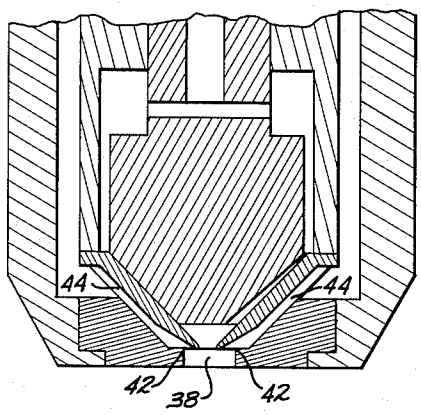


FIG. 3A

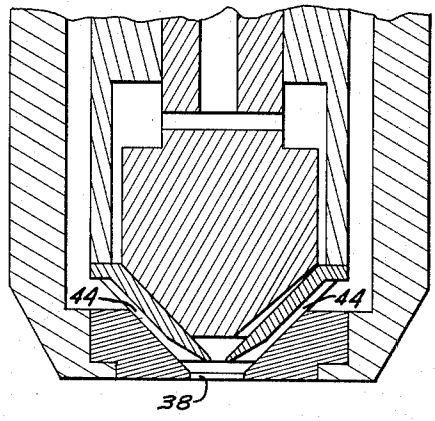


FIG. 3B

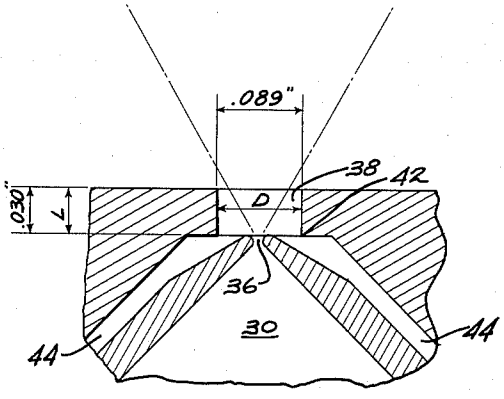


FIG. 5A

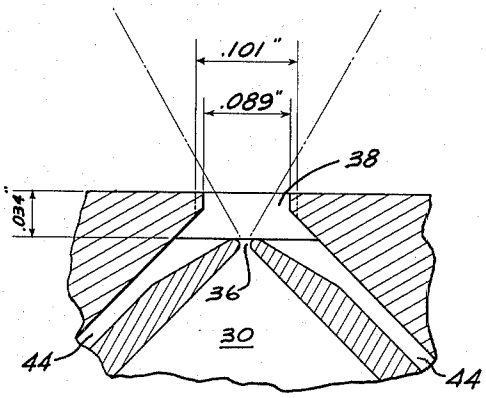


FIG. 5B

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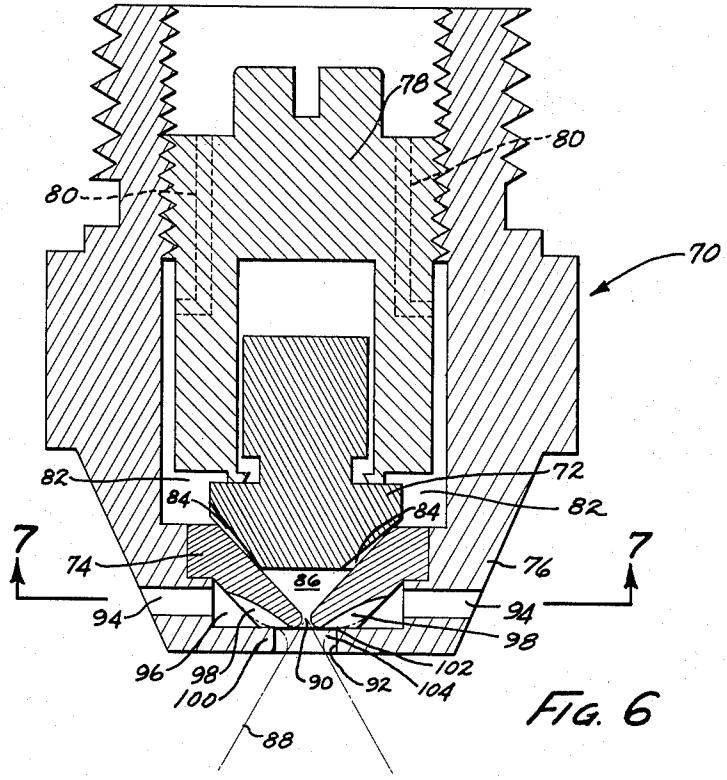


FIG. 6

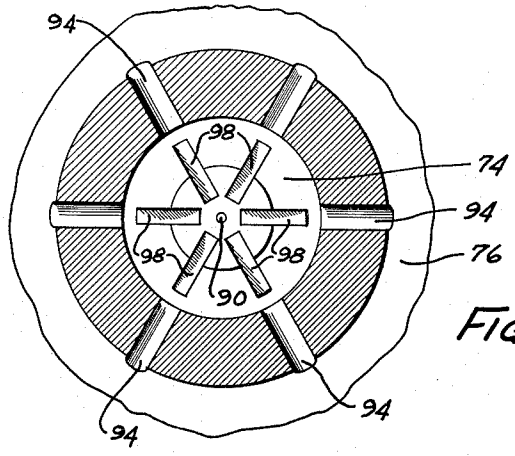


FIG. 7

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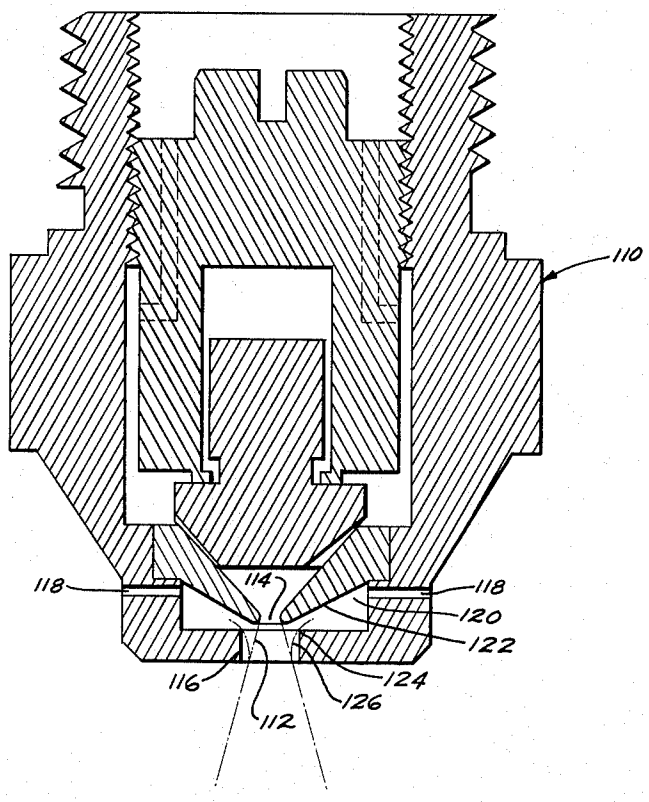


FIG. 8

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United States Patent Office 3,217,986 Patented Nov. 16, 1965

3,217,986
NOZZLE

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Filed Mar. 20, 1964, Ser. No. 354,506
22 Claims. (Cl. 239—403)

This application is a continuation-in-part of Serial Number 298,970, filed July 31, 1963, now abandoned.

This invention relates to a novel spray nozzle. More particularly, this invention relates to a burner nozzle adapted for superior admixing of air into an oil spray. Still more particularly, this invention relates to an oil burner nozzle adapted to aspirate atmospheric air into the nozzle and homogeneously admix the aspirated air into the oil spray.

It is advantageous in terms of combustion performance for pressurized oil burner nozzles to aspirate air directly into the burner nozzle. However, pressurized oil burner nozzles which aspirate air directly into the nozzle can advantageously aspirate only a small proportion of the total amount of air required for combustion and in in such nozzles increasing the quantity of air aspirated beyond a specific amount does not necessarily further improve nozzle combustion performance. For example, it is shown in this application that as the quantity of air aspirated into an oil burner nozzle increases in a specific range, combustion performance with the nozzle declines. The nozzle of this invention is adapted not only for aspiration of air directly into an oil burner nozzle but also to accomplish this aspiration in a manner which enables the aspirated air to exert a more beneficial effect upon combustion performance.

The nozzle of this invention aspirates one or a plurality of streams of air into a forward nozzle chamber surrounding a swirling conical spray of oil droplets. The air enters the rear of the chamber outside of the periphery of the oil spray. The air approaches the chamber in a generally forwardly direction, rather than from a completely lateral direction. Upon entering the chamber, the aspirated air traverses a relatively sharp edged obstruction which deflects the stream laterally, urging it into close proximity with respect to the oil spray. The deflection tends to shift each stream of air laterally in the direction of the oil spray without essentially interfering with the forward movement of the aspirated air. In this manner, in its forward flow, which is substantially concurrent with respect to the oil spray, the air is caused to tightly encompass the conical swirling spray of fuel oil droplets so that a supply of air is continuously available for incorporation into the swirling oil spray.

Generally, in order to achieve a high degree of mixing of air into an oil spray, it is necessary to force the air into the oil spray. However, if a jet of air is mixed into a swirling conical oil spray by forcing the air into the oil spray, disruption of swirling and distortion of the shape of the spray is likely. Since a fundamental feature of a swirling spray process is inducing a high degree of oil atomization, interference with the spray in this manner is likely to hinder the atomization procedure. In accordance with this invention, a high degree of mixing of air into an oil spray is achieved with a spray nozzle without interfering with the oil spray pattern or hindering the atomization procedure.

In operation, the nozzle of this invention induces aspirated air to flow in close proximity to an oil spray. In approaching the oil spray, the aspirated air is deflected laterally so that the air stream closely encompasses the oil spray during its travel. In this manner the oil spray

is enclosed by a continuous blanket of air and the air is facilely positioned to be caught up by the swirling droplets in the oil spray to provide a homogeneous admixture of oil and air with minimum disturbance of the oil spray.

This invention and the advantages thereof are illustrated by the following description in reference to the drawings in which:

FIGURE 1 is a cross-sectional view of the nozzle of this invention modified to show two tangential slots **44** in full view, and taken along the line **1—1** of FIGURE 2,

FIGURE 2 is a plan of member **14** of FIGURE 1,

FIGURES 3A and 3B are cross-sectional views of fragments of corresponding nozzles, the view of each nozzle being modified to show two tangential slots **44** in full, with FIGURE 3A showing a nozzle of this invention and FIGURE 3B showing a deviation therefrom for the purpose of demonstrating the advantage of the nozzle of this invention,

FIGURE 4 shows graphs illustrating the results of combustion tests obtained with the nozzles of FIGURES 3A and 3B,

FIGURES 5A and 5B are cross-sectional views of fragments of different nozzles, the view of each nozzle being modified to show two tangential slots **44** in full, with FIGURE 5A showing a nozzle of this invention and FIGURE 5B showing a deviation therefrom for the purpose of demonstrating the advantage of the nozzle of this invention,

FIGURE 6 is a cross-sectional view of another nozzle of this invention,

FIGURE 7 is a cross-sectional view indicated by the line **7—7** of the nozzle of FIGURE 6 showing the forward end of member **74** in full, and

FIGURE 8 is a cross-sectional view of the most preferred nozzle of this invention.

Referring to FIGURE 1, nozzle **10** is comprised in part of three coaxial concially shaped elements including an inner cone **12**, an intermediate cone **14**, and an outer conical housing **16**. Conical surface **18** of inner cone **12** and conical surface **20** of intermediate cone **14** abut firmly against each other in fluid tight engagement while conical surface **22** of intermediate cone **14** and conical surface **24** of outer conical housing **16** also abut firmly against each other in fluid tight engagement. The rearward portion of inner cone **12** comprises a stud **26** having a passageway means **28** extending axially and radially to zone **34**. A conically shaped axial swirl chamber **30** is defined between inner cone **12** and intermediate cone **14**. One or a plurality of shallow slots **32** extend the length of conical surface **18** connecting zone **34** and swirl chamber **30**. Slots **32** approach swirl chamber **30** in a direction which is substantially tangential with respect to the swirl chamber wall surface. A central opening at the forward end of intermediate cone **14** defines an axial discharge orifice **36** for swirl chamber **30** leading into a second or forward chamber **38**.

Second chamber **38** comprises a cylindrically shaped bore extending axially completely through outer conical housing **16**. The base portion of second chamber **38** is not coincident with but rather is removed from conical surface **24** by means of a continuoues ledge **40** lying on a plane substantially normal to the longitudinal axis of nozzle **10**. The interior surface of ledge **40** is coincident at one end with conical surface **24** and terminates at the other end with a relatively sharp edge **42**, for example, the right angle shown. Sharp edge **42** extends along a continuous circular path and defines the periphery of the base of forward chamber **38**. Slots **44** extend from zone **46** and open into the base of forward chamber **38**. The depth of slots **44** can be tapered along the length of the slots, as shown, or the depth of slots **44** can equivalently be uniform along the length of the slots. Ledge

40 is a partial barrier and partially obstructs the front or discharge end of slots 44 by covering the portion of the terminus of slots 44 which is remote from orifice 36. Ledge 40 is sufficiently wide in relation to the depth of slots 44 at their juncture with second chamber 38 that it constitutes a significant effect upon flow therefrom. For example, ledge 40 may obstruct about one third, one half, or more, of the portion of the forward opening of slots 44 most remote from orifice 36. This estimate is merely illustrative and the extent of obstruction of the terminus of air slots 44 by ledge 40 can vary widely depending upon the desired operating characteristics of the nozzle.

One or more slots 44 are provided. Slots 44 enter the bottom of forward chamber 38 in a generally forward direction, as shown in FIGURE 1, and also in a direction which is substantially tangential with respect to curved wall 48, as is shown in FIGURE 2. Orifice 36 enters chamber 38 axially at the base thereof. A swirling conical spray of oil droplets 50 from orifice 36 traverses the length of forward chamber 38 and leaves the nozzle through discharge opening 52 of forward chamber 38. Opening 52 is larger than orifice 36. The depth and diameter of forward chamber 38 is determined by the included angle of spray 50 and is such that the spray 50 passes close to but does not impinge upon the periphery of opening 52.

Nozzle 10 includes an outer nozzle body 54 having opening means 56 extending from the atmosphere to zone 46. The nozzle elements are secured fixedly into position by means of threaded member 58 and threaded member 60. Member 58 has an axial bore 62 in register with passageway means 28. Member 58, member 60 and outer nozzle body 54 are in threaded engagement, as shown, when the nozzle is assembled. Member 58 is threaded over its entire length to permit connection to a source of pressurized fuel oil and nozzle body 54 is provided with threads for mounting the nozzle during operation.

In the operation of the nozzle of FIGURE 1, oil under pressure is pumped through axial passageways 62 and 28 into zone 34, whence it passes through slots 32 which enter swirl chamber 30 in a forwardly and tangential manner with respect to the conical wall surface of swirl chamber 30. A thin film of swirling oil is discharged through orifice 36 which diverges conically in transit through forward chamber 38 and disintegrates into very small oil droplets.

Forward chamber 38 serves as both an air aspirating and air-oil mixing chamber. The relative depth and diameter dimensions of forward chamber 38 are determined by the included angle of conical oil spray 50. These dimensions are established so that oil spray 50 narrowly misses the forward edge of wall 48. In this manner, a suction is created within forward chamber 38 which draws atmospheric air through openings 56, zone 46 and elongated passageways 44. If oil spray 50 impinges upon wall 48, the nozzle drips liquid oil, aspiration fails, and the nozzle becomes inoperative for practical purposes. Also, if oil spray 50 clears the outer edge of wall 48 by too great a distance, the nozzle will be incapable of effective aspiration.

When the depth and diameter dimensions of chamber 38 are established in relation to the included angle of spray 50 so that spray 50 clears wall 48 by an amount resulting in substantially optimum aspiration, a stream of air flows forwardly through elongated passageways 44, past sharp edge 42, and into forward chamber 38. In passing sharp edge 42, the aspirated air is deflected so that as it enters forward chamber 38 it is urged close to oil spray 50, as indicated at 51. The air deflecting function of sharp edge 42 causes aspirated air stream 51 to be deflected laterally so that it closely encompasses oil spray 50 without disturbing the spray or hindering oil atomization. Air stream 51 travels with the spray in close proximity thereto so that the air is facilely available to be caught up by the oil spray to provide a homogeneous admixture of oil and air with minimum disturbance of the oil spray.

FIGURE 1 shows that the diameter of forward chamber 38 is sufficiently large not only for conical spray 50 to pass through without contact with the walls of forward chamber 38 but also for the air stream vena contracta indicated at 51 to develop around conical spray 50.

The air deflecting function of sharp edge 42 provides greatly improved combustion performance. In a nozzle which is otherwise incapable of inducing a high velocity in the aspirated air stream, both the number and the size of air passageways 44 are advantageously relatively small in order to maintain a relatively high air velocity through each of these passageways. A relatively high air velocity in the region of sharp edge 42 is necessary if sharp edge 42 is to function as an orifice and adequately deflect air stream 51 in the direction of oil spray 50. In a nozzle wherein the velocity of the aspirated air is not great, it is advantageous to minimize the number and size of air passageway slots 44 even to the extent of severely restricting the total volume of air aspirated by the nozzle, since the higher air velocity which results thereby induces a higher degree of air deflection with ensuing improved air-oil mixing.

The highly superior mode of mixing air and oil provided by the nozzle of this invention produces better combustion characteristics than is possible by merely aspirating a greater quantity of air in the absence of the superior mode of mixing. Data presented below show that in a nozzle devoid of the air deflecting means of this invention, a mere increase in the quantity of air aspirated does not necessarily improve combustion performance and, in fact, can hinder combustion performance. In contrast, superior combustion performance occurs as a result of the more thorough admixing with oil of a relatively small volume of aspirated air which is accomplished by employing, in combination, a forward chamber 38 in which the depth and diameter dimensions are conducive to optimum air aspiration for superior mixing of air and oil, together with one or a plurality of air slots 44, each of relatively small cross section to provide a high air velocity therein, and a sharp edge 42 at the discharge terminus of the air slots 44.

Tests were conducted to illustrate the advantage during combustion of the sharp edge air deflecting means 42. A first combustion test was made employing a nozzle generally similar to the nozzle of FIGURES 1 and 2 and having the specific construction as shown in FIGURE 3A, including a sharp edge 42 disposed at the discharge end of passageway means 44. Passageway means 44 approaches second chamber 38 in both a forwardly and a tangential manner. At the conclusion of the first combustion test, the nozzle of FIGURE 3A was modified for use in a second combustion test by eliminating sharp edge 42 by machining, as shown in FIGURE 3B. Except for this single change, the nozzle of FIGURE 3B is identical to the nozzle of FIGURE 3A and all conditions, including oil pressure, were otherwise held uniform in each test. The results of these tests are shown in the curves of FIGURE 4.

The curves of FIGURE 4 show the results of the combustion tests employing the nozzle of FIGURE 3A and the nozzle of FIGURE 3B in the form of a graph of smoke spot number versus percent carbon dioxide in a sample of flue gas produced during combustion with each nozzle in accordance with the method described in ASTM Standards on Petroleum Products, 1960, page 1041. For purposes of analyzing the test results, it is noted that best combustion results are indicated by the combination of a high carbon dioxide content, indicating a high degree of combustion, and a low smoke content. While the percent of carbon dioxide can be increased by reduction of air input, this will have the adverse effect of increasing smoke content. On the other hand, smoke content can

be decreased by merely admitting a large excess of air but this will have the adverse effect of greatly diminishing the relative content of carbon dioxide. Optimum results are achieved with the combination of relatively high carbon dioxide content and relatively low smoke content.

Referring to FIGURE 4, at the steep slope of the curves, it seen that at any particular percentage of carbon dioxide in the flue gas the lowest smoke content is achieved with the nozzle of FIGURE 3A having sharp edge air deflecting means 42. Therefore, the removal of sharp edge air deflecting means 42, as shown in the nozzle of FIGURE 3B, resulted in increased smoke content at any particular percentage of carbon dioxide or, conversely, a lower percentage of carbon dioxide at any particular smoke level.

Another series of tests was conducted to demonstrate the ability of the sharp edge air flow deflector of the invention to induce superior combustion characteristics as compared to the combustion characteristics achieved by similar nozzles which are devoid of the air flow deflector, even nozzles which actually aspirate a greater quantity of air at a given fuel flow rate. The nozzles utilized in these tests are shown in FIGURES 5A and 5B. FIGURE 5A shows a nozzle having a sharp edge **42** and having a forward chamber **38** whose depth, designated as L, is 0.030 inch and whose diameter, designated as D, is 0.089 inch. These dimensions show that the diameter of forward chamber **38** is greater than its length. The reason the diameter of forward chamber **38** is greater than its length is that if L were as great as D the conical oil spray would impinge upon the walls of forward chamber **38**, as is clear from observation of FIGURE 5A. Air slots **44** approach second chamber **38** in a substantially forwardly and tangential direction. As shown in FIGURE 5A, the surface of discharge orifice **36** is curved and tapers outwardly in the direction of forward chamber **38** and is in direct communication with forward chamber **38** for discharging a distinctly conical spray from swirl chamber **30** through forward chamber **38** without interference, obstruction, or contact with any part of said nozzle. The oil spray issuing from orifice **36** of oil swirl chamber **30** had a 70 degree included angle and was found to exert a suction upon tangential air passageways **44** equivalent to 0.6 inch of water. As shown in Table 1, the flue gas from the nozzle of FIGURE 5A contained 12.7 percent carbon dioxide at a smoke spot number of 1.

FIGURE 5B shows another nozzle used in the same series of tests. The nozzle of FIGURE 5B is similar to the nozzle of FIGURE 5A except that the passageways **44** are each devoid of sharp edge **42** and except that its forward chamber **38** has certain L and D dimensions which are slightly different than those of the nozzle of FIGURE 5A. The oil pressure and included angle of the oil spray in the tests with the nozzle of FIGURE 5A were the same as in the tests with the nozzle of FIGURE 5B. The nozzle of FIGURE 5B was utilized in two tests in which the D dimension was 0.089 inch and 0.101 inch, respectively. The results of these tests are shown in Table 1.

Table 1

Nozzle	Suction exerted upon the air passageways, inches of water	Percent of carbon dioxide in flue gas at a smoke spot number of 1
Figure 5A	0.6	12.7
Figure 5B (D=0.089 inch)	3.0	11.6
Figure 5B (D=0.101 inch)	0.3	12.2

It is seen from Table 1 that the aspirational suction exerted at air slots **44** of the nozzle tested of FIGURE 5B varied considerably with dimension changes in the second chamber, It was also seen from Table 1 that, in the tests made, an increase in air aspiration did not produce a corresponding improvement in combustion performance. In fact, the nozzle of FIGURE 5B which exerted an aspirational effect of only 0.3 inch of water was superior, in terms of combustion performance, to the other nozzle of FIGURE 5B which exerted ten times its aspirational effect upon atmospheric air. Table 1 also shows that better combustion performance was achieved with the nozzle of FIGURE 5A, equipped with sharp edge **42** at the air passageways, than was achieved with either of the nozzles of FIGURE 5B, even though one of the nozzles of FIGURE 5B exerted a much greater aspirational suction upon atmospheric air. Table 1 shows that sharp edge **42** exerts an influence upon combustion performance independent of the amount of air aspirated.

Combustion tests were made to determine the effect of air deflector **42** when air was pumped through air slots **44** under a small pressure, such as 1 or 2 pounds per square inch gauge. These tests showed combustion results are also improved by the provision of sharp edge air deflector **42** when air is pumped under pressure through air slots **44**.

FIGURES 6 and 7 illustrate a modified nozzle **70** of this invention. FIGURE 6 shows an inner member **72**, an intermediate member **74**, and an outer member **76**. Outer member **76** comprises the body of the nozzle. Inner member **72** and intermediate member **74** have facing conical surfaces in engagement while intermediate member **74** and outer member **76** have flat facing surfaces in engagement. The various facing surfaces are urged into fluid tight engagement with each other by means of plug **78** which is in threaded engagement with nozzle body **76**. Oil enters zone **82** through oil passages **80** in plug **78** whence it travels through slots **84** which enter swirl chamber **86** in a forwardly and tangential direction with respect to the conical wall surface thereof. A diverging, conical, swirling spray **88** of atomized oil droplets leaves axial swirl chamber discharge orifice **90**.

Oil spray **88** clears wall **92** defining the forward nozzle chamber by an amount adapted to aspirate atmosphere air through a plurality of atmospheric air openings **94** which have access to a continuous air zone **96**. Each air opening **94** is in general register with an arc-like groove **98** cut in intermediate member **74**. As shown in FIGURE 7, each groove **98** extends to the forward nozzle chamber in a generally forward and nontangential direction.

Although each groove **98** could also extend to the second chamber in a generally forward and tangential direction with respect to forward chamber wall **92**, a forward but nontangential direction is preferred. The front of nozzle body **76** is directed inwardly to form a continuous circular ledge **100** having a sharp right angle edge **102** at its interior face which partially obstructs the portion of each groove **98** remote from orifice **90** in the region of the juncture of each groove **98** with the forward nozzle chamber. Sharp edge **102** causes aspirated air to be deflected, as indicated at **104**, so that each air stream is urged laterally against oil spray **88**. The air flow deflection caused by sharp edge **102** causes the air streams to encompass oil spray **88** so that the swirling spray of oil droplets can accept the concurrently flowing air and become homogeneously admixed therewith without disruption of the oil spray.

FIGURE 8 shows a cross-sectional view of nozzle **110**, which is the most preferred nozzle of this invention. In nozzle **110**, a hollow, swirling, diverging oil spray **112** issuing from first orifice **114** narrowly clears the downstream end of second chamber **116** and thereby aspirates atmospheric air inwardly through a plurality of radial passageways **118**. Air passageways **118** lead into a continuous annulus **120** which completely surrounds conical member **122**. Air drawn inwardly through passageways **118** flows into annulus **120**, and thence flows past sharp right angle edge **124** which causes it to be deflected toward the oil spray **112**, as is shown in FIGURE 8. FIGURE 8 shows that the outer conical surface of member **122** is continuous with and tapers rearwardly and out-

wardly substantially conically from the curved and tapered surface of discharge orifice **114** toward the rearward end of anulus **120** with the forwardmost projection of the outer conical surface of member **122** being substantially at the curved and tapered surface of the discharge orifice so that an aspirated air stream drawn inwardly through passageways **118** and annulus **120** can approach discharge orifice **114** from the rear along the outer conical surface of member **122** and can closely encompass oil spray **112** directly upon discharge of said oil spray from discharge orifice **114**.

It is noted in regard to nozzle **110** of FIGURE 8 that oil discharge orifice **114** is disposed rearwardly with respect to the rearward end of second chamber **116**. This structure provides an important functional advantage because the portion of oil spray **112** closest to orifice **114** comprises a substantially continuous swirling film of oil. However, this film tends to quickly disintegrate, resulting in atomization into a great plurality of very small oil droplets. By virtue of the fact that oil discharge orifice **114** is disposed to the rear of sharp edged corner **124**, oil spray **112** has a chance to become atomized before reaching the vicinity of sharp edge **124** and therefore before reaching the zone wherein it becomes admixed with the air stream deflected toward it by sharp edged corner **124**. Since the oil is accorded an opportunity to become atomized before the aspirated air is deflected toward it, a high degree of admixture of air and oil is achieved. On the other hand, if oil discharge orifice **114** were disposed on the same plane with or forwardly with respect to air deflecting edge **124**, the air passing edge **124** would be deflected into an incompletely atomized film of oil and therefore could not admix as intimately and thoroughly with the oil spray, in which case the effectiveness of sharp edge **124** would be sharply diminished. In an actual test a marked improvement in combustion performance was achieved by disposing oil discharge orifice **114** about .015 inch to the rear of the plane of sharp edge **124**, as compared to the observed combustion performance when the oil discharge orifice was disposed on the same plane as the sharp edge.

It is important that air passageways **118** enter continuous annulus **120** at a position therein which is decidedly to the rear of the plane on which sharp edged corner **124** lies. Air passageways **118** should preferably enter annulus **120** at a position as close as possible to the rear of annulus **120** and should have a relatively small width so that air only enters annulus **120** near the rearward end of said annulus. This permits the aspirated air to travel in a forwardly direction past sharp edge **124** permitting sharp edged corner **124** to function as a sharp edged orifice plate. The forward or axial component of movement of air past sharp edge **124** permits sharp edge **124** to function as an orifice plate, deflecting the air stream and forming the vena contracta **126**. On the other hand, if air passageway **118** were disposed on about the same plane as sharp edge **124**, the aspirated air would approach sharp edge **124** from a direction which is substantially completely lateral with little or no forward or axial component of movement, thereby preventing formation of a vena contracta.

An advantageous feature of nozzle **110** is that air passageways **118** approach annulus **120** in a radial rather than a tangential direction. A tangential approach would impart swirling to the aspirated air and the centrifugal force of a swirling air stream passing through second chamber **116** would tend to fling the air away from the oil spray, thereby counteracting the effect of sharp edge **124** which is to deflect the aspirated air toward the oil spray.

Another advantageous structural feature of nozzle **110** is that the individual air passageways **118** each lead into a common annulus **120**, which annulus **120** is bounded by sharp edged corner **124**. In this manner a circumferentially uninterrupted stream of air is deflected toward and encompasses the oil spray providing a uniform admixture of air and oil, thereby insuring a uniform flame. In contrast, if continuous annulus **120** were absent and each air passageway **118** individually approached sharp edged corner **124**, a plurality of streams of air would be deflected toward the oil spray rather than a circumferentially continuous blanket of air. A plurality of individual jets of air would produce alternate air-rich and air-lean streaks in the oil spray and consequently could produce a nonuniform flame. Continuous annulus **120** is advantageously utilized in a nozzle in which the velocity of aspirated air through even an enlarged annulus is sufficiently high that sharp edge **124** can induce a vena contracta, while a plurality of individual air passages, as is shown in FIGURES 1 and 6, is required to produce individual high velocity air jets where the velocity of the total stream of aspirated air flowing in an enlarged annulus would not be sufficiently high for a sharp edge to induce a pronounced vena contracta.

We claim:

1. A burner nozzle comprising axial swirl chamber means, second axial chamber means of substantially cylindrical configuration disposed forwardly with respect to said swirl chamber means, said swirl chamber means having at its forward end axial discharge orifice means with the surface of said discharge orifice means being curved and tapered outwardly in the direction of said second chamber means and being in unobstructed communication with said second chamber means for discharging a swirling distinctly conical oil spray from said swirl chamber means through said second chamber means without interference or obstruction and without substantial contact with said nozzle so that said conical oil spray aspirates a stream of air through said second chamber means from the rearward end to the forward end thereof, air passageway means whose rearward end is open to the exterior of said nozzle and whose forward end is open to said second chamber means for channeling air into said second chamber means, surface means defining said air passageway means which is continuous with and tapers rearwardly and outwardly from said curved and tapered surface of said discharge orifice means toward the rearward end of said air passageway means with the forwardmost projection of said surface means being substantially at the curved and tapered surface of said axial discharge orifice for permitting said stream of air to approach said discharge orifice from the rear and closely encompass the oil spray directly upon discharge of said oil spray from said discharge orifice, flow deflecting means having a relatively sharp edge which is exposed to said air passageway means near the juncture of said air passageway means and said second chamber means in the region of said air passageway means remote from said swirl chamber discharge orifice means for inducing a vena contracta in said aspirated air stream which deflects the aspirated air stream into said conical spray, said cylindrical second chamber means having a diameter which is substantially greater than the length thereof and which is sufficiently large for both the conical spray from the swirl chamber means to pass through without substantial contact with the walls of said second chamber means and for the air stream vena contracta to develop around said conical spray.

2. The nozzle of claim **1** wherein said flow deflecting means is defined by a relatively sharp edged right angle juncture between the forward end of said air passageway means and the rearward end of said second chamber means.

3. The nozzle of claim **1** wherein said air passageway means extends to said second chamber means in a substantially forwardly direction.

4. The nozzle of claim **1** wherein said swirl chamber discharge orifice means is disposed substantially at the rearward end of said second chamber means.

5. The nozzle of claim 1 wherein said swirl chamber discharge orifice means is disposed substantially at the rearward end of said second chamber means and said air passageway means is a continuous annulus.

6. The nozzle of claim 1 wherein said surface means defining said air passageway means is conical.

7. The nozzle of claim 1 wherein said surface means defining said air passageway means is conical and said air passageway means is a continuous annulus.

8. The nozzle of claim 1 wherein said swirl chamber discharge orifice means is disposed rearwardly with respect to the rearward end of said second chamber means.

9. The nozzle of claim 1 wherein said swirl chamber discharge orifice means is disposed rearwardly with respect to the rearward end of said second chamber means, said surface means defining said air passageway means is conical, and said air passageway means is a continuous annulus.

10. The nozzle of claim 1 wherein said air passageway means is defined by slot means.

11. The nozzle of claim 10 wherein said slot means enters said second chamber means in a substantially tangential direction.

12. A burner nozzle comprising inner, intermediate and outer members, axial swirl chamber means defined by said inner and intermediate members, air passageway means defined by said intermediate and outer members, the rearward end of said air passageway means exposed to the exterior of said nozzle, axial swirl chamber discharge orifice means defined at the forward end of said intermediate member, said outer member inturned at its forward end to define axial forward chamber means of substantially cylindrical configuration the rearward end of which defines sharp edge flow deflecting means, said swirl chamber discharge orifice means disposed in the region of the rear of said forward chamber means, the surface of said discharge orifice means being curved and tapered outwardly in the direction of said forward chamber means and being in unobstructed communication with said forward chamber means for discharging a swirling distinctly conical oil spray from said swirl chamber means through said forward chamber means without interference or obstruction and without substantial contact with said nozzle so that said conical oil spray aspirates a stream of air through said air passageway means and said forward chamber means, surface means on said intermediate member defining said air passageway means which is continuous with and tapers rearwardly and outwardly from said curved and tapered surface of said discharge orifice means toward the rearward end of said air passageway means with the forwardmost projection of said surface means being substantially at the curved and tapered surface of said axial discharge orifice means for permitting said stream of air to approach said discharge orifice from the rear and closely encompass the oil spray directly upon discharge of said oil spray from said discharge orifice, said sharp edge flow deflecting means defining the juncture between said forward chamber means and said air passageway means remote from said discharge orifice means for inducing a vena contracta in said aspirated air stream which deflects the aspirated air stream into said conical spray, said cylindrical forward chamber means having a diameter which is substantially greater than the length thereof and which is sufficiently large for both the conical spray from the swirl chamber means to pass through without substantial contact with the walls of said forward chamber means and for the air stream vena contracta to develop around said conical spray.

13. The nozzle of claim 12 wherein said swirl chamber discharge orifice means is substantially at the rearward end of said forward chamber means.

14. The nozzle of claim 12 wherein said swirl chamber discharge orifice means is substantially at the rearward end of said forward chamber means and said air passageway means is a continuous annulus between said intermediate and outer members.

15. The nozzle of claim 12 wherein the outer surface of said intermediate member is conical.

16. The nozzle of claim 12 wherein the outer surface of said intermediate member is conical and said air passageway means is a continuous annulus between said intermediate and outer members.

17. The nozzle of claim 12 wherein said swirl chamber discharge orifice means is disposed rearwardly with respect to the rearward end of said forward chamber means.

18. The nozzle of claim 12 wherein said swirl chamber discharge orifice means is disposed rearwardly with respect to the rearward end of said forward chamber means, the outer surface of said intermediate member is conical, and said air passageway means is a continuous annulus between said intermediate and outer members.

19. The nozzle of claim 12 wherein said sharp edge is a right angle sharp edge.

20. The nozzle of claim 12 wherein said air passageway means extends to said forward chamber means in a relatively forwardly direction.

21. The nozzle of claim 12 wherein said air passageway means is defined by slot means in the outer surface of said intermediate member.

22. The nozzle of claim 21 wherein said slot means enters said forward chamber means in a substantially tangential direction.

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