Aug. 27, 1957 I. H. MARANTZ 2,804,337

SPRAY NOZZLE

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Fig. 1.

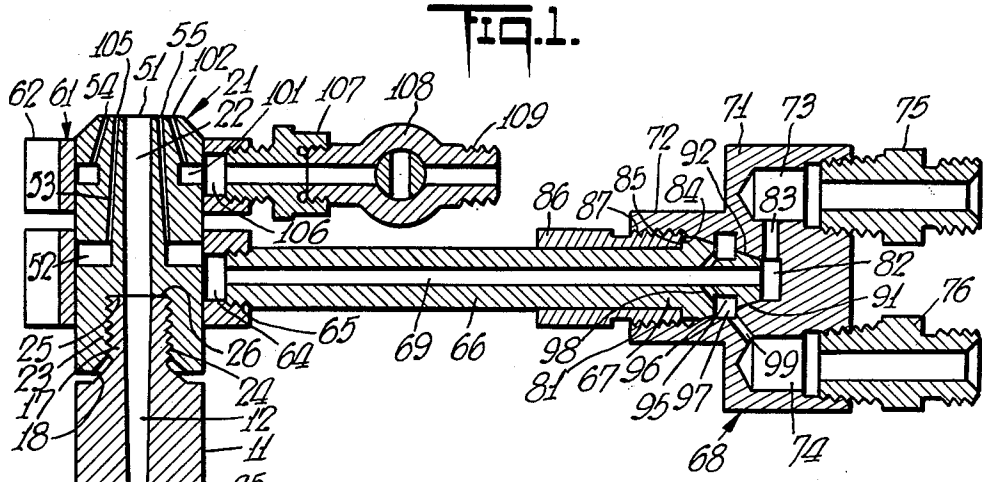

Fig. 2.

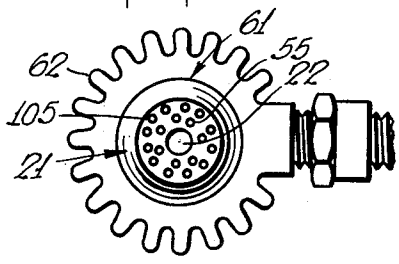

Fig. 3.

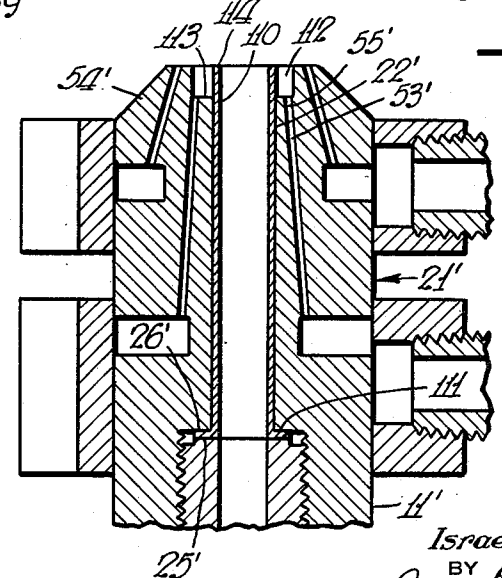

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FIG. 4.

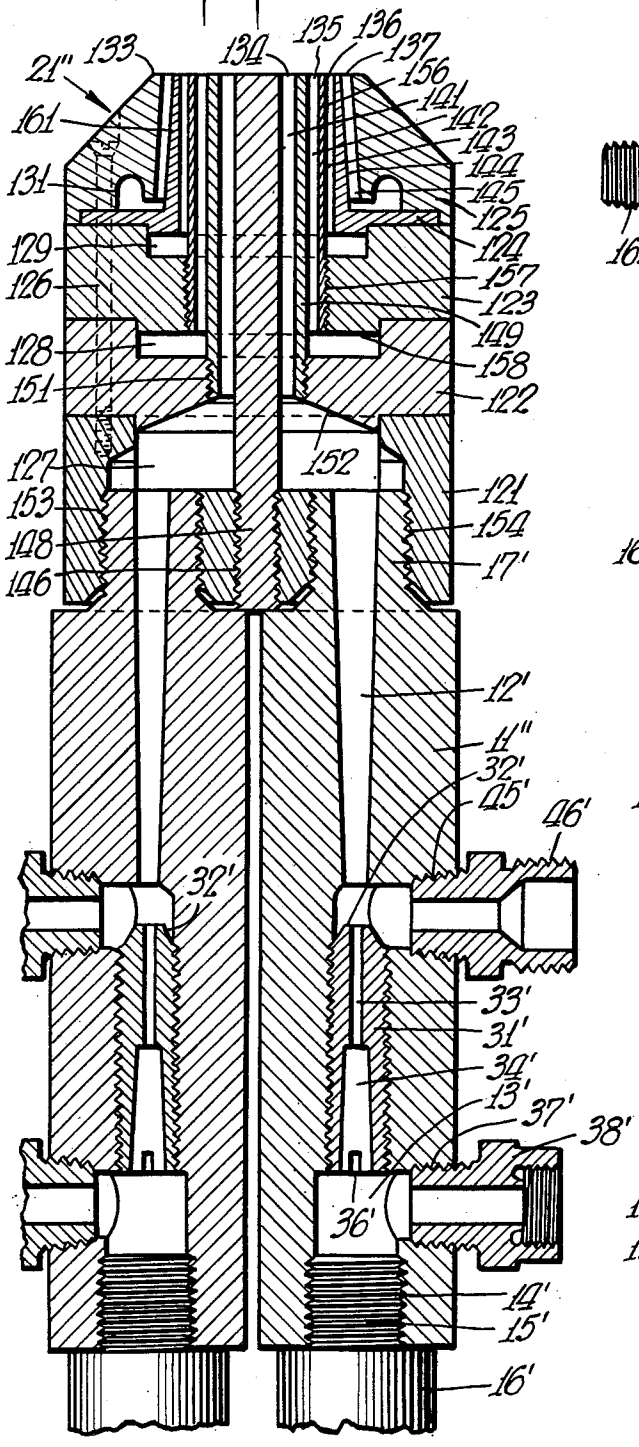
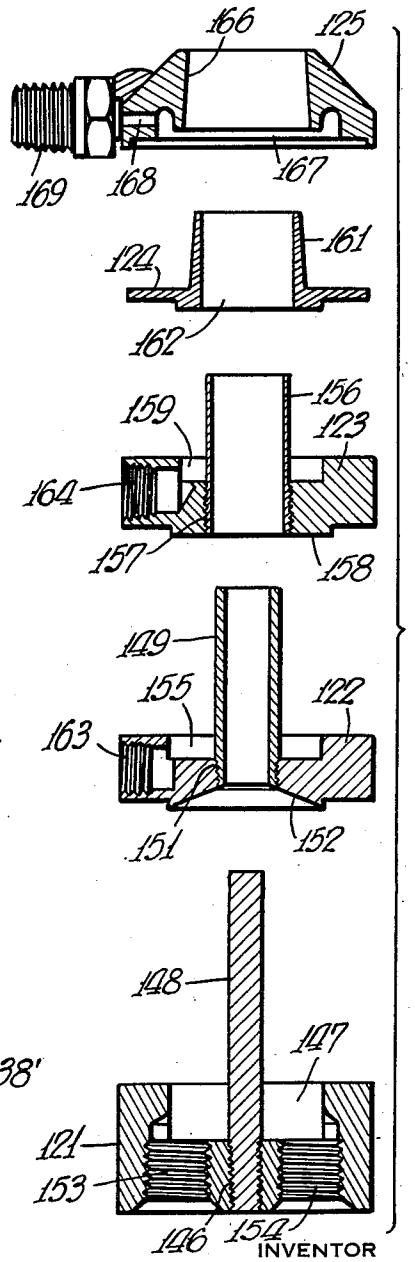


FIG. 5.



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2,804,337

SPRAY NOZZLE

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Application February 28, 1955, Serial No. 491,151

9 Claims. (Cl. 299—28.7)

It is noted that in nozzles of the type to spray particles of metal for example, which are heated by an inflammable gas to a highly plastic state almost reaching molten condition, the abrasive action caused by the movement of the particles through the nozzle will, after a long period of use, wear away the walls of the passageway through which the particles are forced with resultant inoperativeness of the nozzle and need for replacement of the entire unit with resultant relatively high cost.

It is accordingly among the objects of the invention to provide an inexpensive spray nozzle that is neat, compact and sturdy, that has but few parts and which is not likely to clog or become out of order, which is substantially devoid of gaskets which are likely to become defective and cause leakage in the nozzle with resultant inefficiency thereof and which is designed to eliminate wear of the main portion of the nozzle tip so that replacement costs will be reduced to a minimum.

Where to increase the output of a spray nozzle of the above type, the outlet is enlarged to increase the diameter of the stream of particles expelled therefrom, as the particles in the core of the stream will be substantially unaffected by the ignited inflammable gas associated with the stream of particles, such substantially unheated particles will not adhere to the article being sprayed with resultant inefficiency of the nozzle.

Where the particles expelled from the nozzle are heated to the highly plastic condition as soon as they emerge from the nozzle, such particles may adhere to the nozzle with resultant clogging of the latter.

It is accordingly another object of the invention to provide a spray nozzle of the above type that will have a relatively high output yet with assurance that all of the particles expelled therefrom will be uniformly heated to the desired condition for optimum adhesion to the object being sprayed and with assurance that the particles will not be heated sufficiently immediately upon emergence from the nozzle to clog the latter.

This application is a continuation-in-part of copending application Serial No. 290,764, filed May 29, 1952, now abandoned.

According to the invention, these objects are accomplished by the arrangement and combination of elements hereinafter described and particularly recited in the claims.

In the accompanying drawings in which are shown one or more of various possible embodiments of the several features of the invention,

Fig. 1 is a longitudinal sectional view of the nozzle,

Fig. 2 is an end view of the nozzle,

Fig. 3 is a fragmentary longitudinal sectional view of another embodiment of the nozzles,

Fig. 4 is a longitudinal sectional view of still another embodiment of the nozzle, and

Fig. 5 is an exploded view of the embodiment of Fig. 4.

Referring now to the drawings, the spray nozzle shown in Fig. 1 desirably comprises a substantially cylindrical rod 11 which forms the body portion of the nozzle and

which desirably has an axial bore 12 extending therethrough. The rear end of bore 12 is desirably of enlarged diameter as at 13 and is internally threaded as at 14 to receive the threaded reduced end 15 of a handle 16.

The front end of the body portion 11 is desirably of reduced diameter as at 17 forming a beveled shoulder 18. Affixed to such reduced end 17 is the nozzle tip 21 which desirably is substantially cylindrical as shown and has an axial bore 22 therethrough of enlarged diameter at its rear end 23, said enlarged diameter end of bore 22 being internally threaded as at 24 so that it may be screwed on the correspondingly externally threaded end 17 of the body portion 11. Desirably the nose of reduced end 17 has an outstanding annular flange 25 against which the shoulder 26 formed by the enlargement of bore 22 may abut, to provide a tight seal.

Means are desirably provided to propel a stream of particles through the aligned bores 12 and 22 in the body portion 11 and the tip 21 respectively. To this end the bore 12 desirably has a plug 31 affixed therein near the enlarged portion 13 thereof, said plug 31 having a substantially conical nose 32 and desirably having an axial bore 33 therethrough of enlarged diameter as at 34 at its rear end. Although the plug 31 may be affixed in bore 12 in any suitable manner, in the embodiment herein shown, the plug 31 is externally threaded so that it may be screwed into the correspondingly threaded bore.

The inlet 36 of bore 33 desirably is positioned adjacent a transverse passageway 37 extending through the wall of body portion 11 into the enlargement 13 of bore 12. Affixed in passageway 37 is a fitting 38 to which the outlet 39 of a suitable gas regulating valve 41 may be affixed, the inlet 42 of said valve desirably being connected to a source of compressed gas (not shown). The nose end 32 of plug 31 is desirably positioned adjacent a transverse passageway 45 extending laterally through the wall of body portion 11 into bore 12 adjacent said nose 32. Affixed in passageway 45 is a fitting 46 which is connected to a source of particles, illustratively of zinc, to be sprayed.

The tip 21 is desirably formed so that a suitable gas may be forced therethrough to be ignited at the outlet 51 thereof to develop an intense heat whereby the particles propelled through the bore 22 may be transformed to a highly plastic state almost reaching the molten condition. To this end, the tip 21 desirably has an annular groove 52 adjacent its rear end and a plurality of gas outlet passageways 53 encompassing the axial bore 22 of the tip and converging at their outlet ends 55.

Encompassing the tip 21 is a sleeve 61 which desirably has a plurality of radiating fins 62 to provide a large surface area for cooling of such tip, said sleeve 61 encompassing said annular groove 52 to form a gas inlet chamber. Means are desirably provided to force a mixture of suitable highly inflammable gases into the groove 52. To this end the sleeve 61 has a lateral passageway 64 therethrough in communication at one end with said groove 52, the other end of said passageway having the end 65 of a tube 66 affixed therein. The other end 67 of tube 66 has a manifold 68 suitably affixed thereon so that a mixture of inflammable gases such as oxygen and acetylene may be forced through the bore 69 of tube 66.

As shown in Fig. 1, the manifold 68 desirably comprises a circular block 71 having an axial extension 72 of reduced diameter. The block 71 desirably has two bores 73 and 74 leading thereinto, the inlet ends of which have fittings 75 and 76 secured therein respectively, to which sources of oxygen an acetylene gas may be connected respectively.

The axial extension 72 of the manifold desirably has a bore 81 therethrough, the inner end 82 of which is connected by passageway 83 to the bore 73 of the mani-

fold. Although the manifold may be affixed to tube **66** in any suitable manner, in the embodiment shown, a sleeve **86** encompassing tube **66** has its externally threaded end **87** screwed into the corresponding threaded bore **81**. Thus when the sleeve is rotated in bore **81** and abuts against an annular shoulder **84** formed on tube **66**, the conical end **91** of bore **81** will be pressed tightly against the conical end **92** of tube **66** securely to retain the manifold affixed to the tube.

The conical end **92** of tube **66** desirably has an annular groove **95** in its periphery which coacts with a corresponding annular groove **96** in the bore of manifold **68** to form an annular gas chamber **97**, said chamber being in communication with the bore **69** of tube **66** by means of a plurality of inclined passageways **98** and being supplied with gas from bore **74** through a passageway **99**.

Means are desirably provided to cool the tip **21** and to prevent spreading of the stream of particles emerging from the outlet **51** thereof. To this end, the tip **21** has an annular groove **101** therein which is encompassed by the sleeve **61** to form an air chamber. The tip **21** desirably has a plurality of passageways **102** leading from said groove **101** to the outer end of the tip, said passageways converging at their outlets ends **105** which form a ring encompassing the outlets **55** of the passageways **53** and the outlet **51** of the tip.

In order to supply the air chamber defined by annular groove **101**, the sleeve **61** has a lateral passageway **106** therethrough in communication at one end with groove **101**. The other end of said passageway has a fitting **107** therein to which the outlet of a suitable air regulating valve **108** may be affixed, the inlet **109** of said valve desirably being connected to a source of compressed air (not shown).

In the operation of the nozzle shown in Figs. 1 and 2, as compressed air is forced through fitting **38** into the enlarged portion **13** of bore **12**, such air will pass through the bores **34** and **33** of plug **31** and emerges from the outlet end **32** thereof as a high velocity jet. This jet will create a suction at the adjacent end of passageway **45** so that particles will be sucked into bore **12** and be propelled through the aligned bores **12** and **22** to emerge from the outlet **51** of tip **21**.

The mixture of inflammable gases forced into groove **52** will pass through the passageways **53** and emerge from the outlets **55** thereof as a circular stream encompassing the stream of gas and particles. The inflammable gases may be ignited by any suitable means causing the particles to soften to a highly plastic, though not molten state.

By reason of the converging passageways **102** connected to annular groove **101**, excessive spreading of the spray of particles and gas emerging from outlet **51** of tip **21** is prevented. Thus the high velocity jets from the outlets **105** of passageways **102** will strike the periphery of the stream of particles and air emerging from outlet **51** thereby substantially preventing spreading of such stream.

In addition, as the air emerging from outlet **105** is relatively cool, as the heated particles strike the article being sprayed, they will rapidly cool and congeal thereby preventing dripping of such plastic particles from the article and ensuring adherence of such particles thereto.

It has been found that as the particles are forced through the bore **22** in the tip **21**, the abrasive action caused by such moving particles will, after a long period of use, wear away the inner wall of the bore **22**. Such wearing may cause the passageways **53** to be exposed to the bore **22** with resultant inoperativeness of the device as the flame caused by the gases would cause the particles to become plastic in the bore **22** with resultant congealing of such particles in such bore **22** and clogging thereof. However, by reason of the ease by which the relatively inexpensive tip **21** may be removed, it is a relatively simple matter to replace the latter without need for discarding the entire nozzle. Thus maintenance costs of such nozzle are relatively low.

The embodiment of the nozzle shown in Fig. 3 is designed to eliminate entirely the need for replacement of the nozzle tip **21**. This nozzle is substantially identical to that shown in Fig. 1 and corresponding parts have the same reference numerals primed. Thus, the nozzle shown in Fig. 3 has a metal tube **110** positioned in the bore **22'** of the tip **21'**. The tube **110** is of diameter such that it fits snugly in said bore, and desirably has an outwardly extending annular flange **111** at the rear end thereof which may be clamped between the shoulder **26'** of tip **21'** and flange **25'** of body portion **11'** thereby securely retaining the tube in position.

Desirably the end of bore **22'** in tip **21'** adjacent the nose **54'** of said tip, is of enlarged diameter as at **112** forming an annular shoulder **113** through which the outlets **55'** of passageways **53'** extend, the end **114** of tube **110**, which extends beyond said shoulder **113**, guiding the mixture of inflammable gases as they emerge from the outlets **55'** of the tip.

With the nozzle shown in Fig. 3, the operation of which is substantially identical to the nozzle shown in Figs. 1 and 2, the abrasive action of the particles will wear away only the tube **110**. When this occurs, it is a relatively simple matter to remove the tip from the body portion **11** and then remove the tube **110** from the tip and replace the worn tube. As the tubes **110** are relatively inexpensive, it is apparent that the nozzle shown in Fig. 3 may be used for long periods with only a minimum of maintenance cost.

In the embodiment shown in Figs. 4 and 5, the nozzle tip **21''** is substantially cylindrical being formed from a plurality of elements, illustratively five in number and designated respectively the base **121**, intermediate elements **122**, **123** and **124** and the nose element **125** which, when secured together as by screws **126**, define a powder chamber **127**, an air chamber **128**, a gas chamber **129** and a second air chamber **131**.

The end **133** of the nozzle tip **21''** has four concentric annular outlets **134**, **135**, **136** and **137** in communication respectively with the chambers **127**, **128**, **129** and **131** through annular passageways **141**, **142**, **143** and **144**. The passageways **141**, **142** and **143** extend parallel to the axis of the nozzle and the passageway **144** is inclined inwardly from its inner end **145** to its outlet end **137** for the purpose hereinafter set forth.

Removably mounted at one end as at **146** in the base **121** and extending axially therefrom through a central recess **147** therein, is a rod **148** which extends through a sleeve **149** screwed into a threaded axial bore **151** in intermediate element **122**, the annular passageway **141** being defined by said rod **148** and the inner surface of sleeve **149**.

The surface **152** of element **122** adjacent bore **151** is desirably concave and such concave surface and the recess **147** in base **121** define the powder chamber **127**. By reason of such concavity, when powder is forced under pressure into chamber **127** through threaded bores **153** and **154** in base **121**, in the manner hereinafter described, it will be deflected thereby into the passageway **141**.

The sleeve **149** extends through a recess **155** in element **122** and through a sleeve **156** screwed into a threaded axial bore **157** in intermediate element **123**, the annular passageway **142** being defined between said sleeves **149** and **156** and the air chamber **128** being defined by the recess **155** and the adjacent surface **158** of element **123**.

The sleeve **156** extends through a recess **159** in element **123** and through a sleeve **161** illustratively formed integral with element **124** and aligned with the bore **162** therethrough, the annular passageway **143** being defined between said sleeves **156** and **161** and the gas chamber **129** being defined by the recess **159** and the adjacent surface of element **124**.

To provide a passageway for air and gas into chambers

128 and 129, the elements 122 and 123 each has a radial bore 163 and 164 respectively extending into the associated chamber.

Sleeve 161 which has a tapered outer surface, extends through the correspondingly tapered bore 166 of nose element 125, the passageway 144 being defined between the sleeve 161 and bore 166.

The portion of nose element 125 adjacent element 124 has a recess 167 which, when in juxtaposition with element 124 defines the air chamber 131. To provide a passageway into chamber 131 the nose element 125 has a radial bore 168 leading into chamber 131 and a fitting 169 is connected to said bore 168.

The dimensions of the rod 148, the sleeves 149, 156 and 161 and the nose element 125 are so selected in the embodiment shown that the outlets 134, 135, 136 and 137 all lie in the same plane.

In the operation of the embodiment shown in Figs. 4 and 5, as compressed air is forced through fittings 38' of both body portions 11'' in the manner described with respect to the embodiments of Figs. 1 and 2, a suction will be created at the end of passageways 45' adjacent the outlet end 32' of plug 31' to suck particles from the source of supply connected to fitting 46' and to force such particles into powder chamber 127. The particles will be deflected by concave surface 152 and be forced through annular passageway 141 to be expelled from outlet 134.

A mixture of suitable highly inflammable gases is forced through bore 164 into chamber 129 and it will pass through annular passageway 143 to be expelled as an annular stream from annular outlet 136 encompassing the annular powder stream expelled from outlet 134. The gases may be mixed in a suitable manifold similar to that shown in Fig. 1 and designated by the numeral 68, and which is connected to bore 164.

A source of air under pressure is connected to bore 163 and to fitting 169 and such air will flow into the associated chamber 128 and 131, through annular passageways 142 and 144 to be expelled from annular outlets 135 and 137.

When the sources of air, gas and powder particles are thus connected, the inflammable gases emerging from annular outlet 136 may be ignited by any suitable means causing the particles to soften to a highly plastic, though not molten state.

By reason of the relatively cool air emerging from annular outlet 135 which is between the powder stream and the stream of inflammable gases, such gases will not heat the particles sufficiently to reduce them to highly plastic conditions until they are sufficiently spaced from the nose of the nozzle tip to prevent clogging of the outlets therein.

As the annular stream of air expelled from annular outlet 137 is also relatively cool, the nozzle tip 21'' will not get excessively hot and as the heated particles strike the article being sprayed, they will rapidly cool and congeal thereby preventing dripping of such plastic particles from the article and ensuring adherence of such particles thereto.

Furthermore, due to the fact that the stream of air expelled from outlet 137 is directed toward the stream of particles and gas, excessive spreading of such particle and gas streams is prevented so that a maximum amount of gas will be in juxtaposition to the particles for heating thereof. In addition, the stream of particles will be relatively concentrated so that substantially all of the particles will strike the article being sprayed with resultant elimination of waste.

By reason of the relatively large diameter of the annular outlet 134 from which the particles are expelled, even though the outlet is relatively narrow, the quantity of particles expelled is relatively great. As the thickness of the annular particle stream is relatively small, substantially all the particles in such stream will be uniformly heated by the gases with assurance that such particles will be reduced to the desired molten state for optimum adherence to the article being sprayed.

In the event of wear of the rod 148 and sleeve 149 after long use of the nozzle tip, due to the abrasive action of the particles through passageway 141, as such rod and sleeve are removably mounted in the base 121 and the intermediate element 122 respectively, they may readily be replaced so that maintenance costs of the nozzle are relatively low.

As many changes could be made in the above construction, and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having thus described in my invention, what I claim as new and desire to secure by Letters Patent to the United States is:

1. A powder spray nozzle comprising a casing having an annular outlet for expelling a stream of powder therefrom, and a second annular outlet encompassing said powder outlet for expelling a stream of inflammable gas in direction substantially parallel to the direction of such powder stream, and a third annular outlet encompassing said first and second annular outlets for expelling a stream of air toward said first two streams so as to strike said second stream at an angle of less than 90 degrees with respect thereto.

2. A powder spray nozzle comprising a casing having an outlet for expelling a stream of powder therefrom, an annular outlet encompassing said powder outlet for expelling a stream of air in direction substantially parallel to the direction of such powder stream, a second annular outlet encompassing said first annular outlet for expelling a stream of inflammable gas in direction parallel to such air stream and a third annular outlet for expelling a stream of air.

3. The combination set forth in claim 2 in which said third annular outlet is designed to expel the stream of air therefrom toward said gas, air and powder streams so as to strike the latter at an angle of less than 90 degrees with respect thereto.

4. The combination set forth in claim 2 in which said powder outlet is in the form of an annulus and in which said third annular outlet is designed to expel the stream of air therefrom toward said gas, air and powder streams so as to strike the latter at an angle of less than 90 degrees with respect thereto.

5. The combination set forth in claim 2 in which three annular chambers are provided in said nozzle, each of said chambers having an inlet, three passageways in said nozzle provide communication between said chambers and said three annular outlets, the passageways providing communication to said first and second annular outlets extending parallel to the longitudinal axis of said nozzle and the passageway providing communication to said third annular outlet tapering inwardly toward said third annular outlet from its associated chamber.

6. A powder spray nozzle comprising a nose element having an axial bore therethrough, a rod axially positioned in said bore and having its outer end aligned with the outer surface of said nose element, three spaced concentric annular members in said bore encompassing said rod, the outer ends of said annular members being aligned with the outer surface of said nose element, and defining four concentric annular outlets, and four chambers in said nozzle in communication respectively with said annular outlets, each of said chambers having an inlet.

7. The combination set forth in claim 6 in which each of said annular members is a sleeve, the innermost sleeve defining a passageway with respect to said rod extending parallel thereto, the intermediate sleeve defining a passageway with respect to the innermost sleeve

extending parallel to said rod, the outermost sleeve defining a passageway with respect to said intermediate sleeve also extending parallel to said rod, the outer surface of said outermost sleeve, and the wall of the bore in said nose element defining a fourth passageway, said four passageways providing communication from the associated chamber to the innermost, second innermost, third innermost and outermost outlets respectively, said fourth passageway tapering inwardly from its associated chamber to its associated outlet.

8. The combination set forth in claim 7 in which said nozzle has four elements in addition to said nose element, said four elements including a base element and three intermediate elements, said intermediate elements being positioned between said nose and said base elements, the element adjacent said base element carrying said innermost sleeve, the element adjacent said nose element carrying the outermost sleeve and the third intermediate element carrying the intermediate sleeve.

9. The combination set forth in claim 8 in which the chamber in communication with the innermost outlet is between the base element and the adjacent intermediate element, the chamber in communication with the second innermost outlet is between the intermediate element adjacent the base and the adjacent intermediate element, the chamber in communication with the third innermost outlet is between the last named intermediate element and the third intermediate element and the chamber in communication with said outermost outlet is between the third intermediate element and the nose element.

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