

July 15, 1969

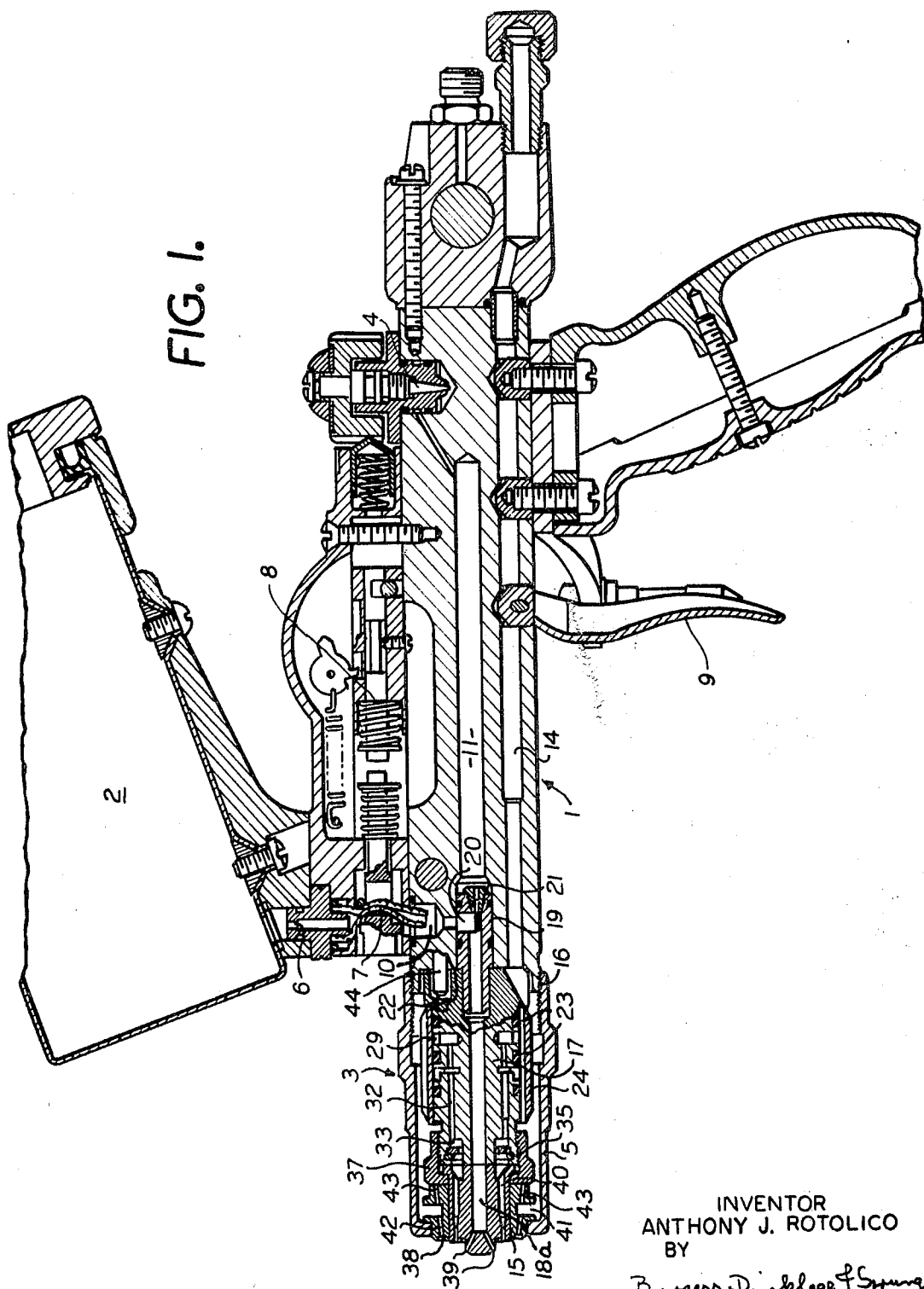
A. J. ROTOLICO
NOZZLE AND GAS MIXING ARRANGEMENT FOR POWDER
TYPE FLAME SPRAY GUN

3,455,510

Filed Nov. 14, 1966

2 Sheets-Sheet 1

FIG. 1.



INVENTOR
ANTHONY J. ROTOLICO
BY

Burgess, Dinklage & Spring

ATTORNEYS.

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FIG. 2.

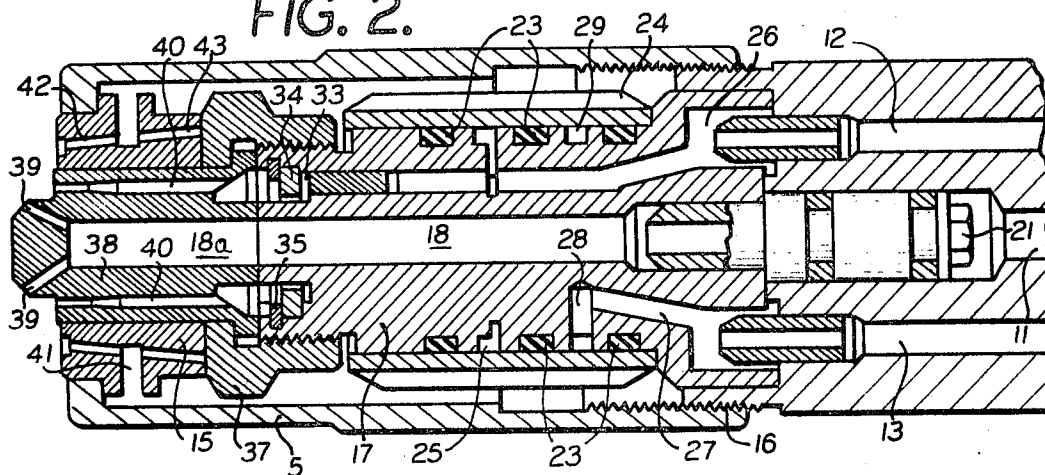


FIG. 3.

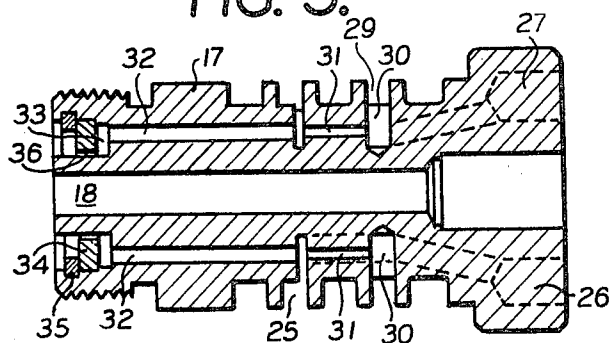


FIG. 4.

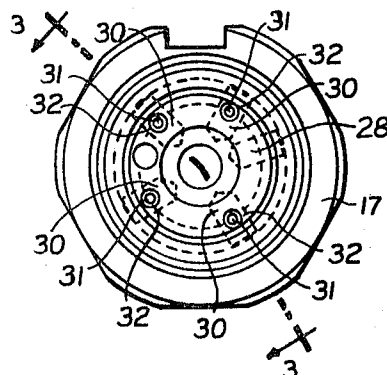


FIG. 6.

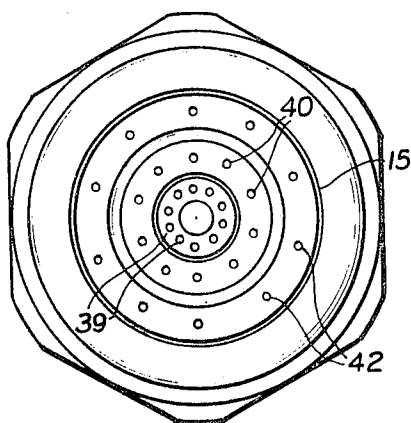
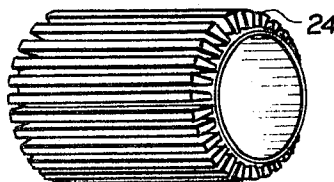


FIG. 5.



INVENTOR
ANTHONY J. ROTOLICO
BY

Bungers, Dinklage & Spang

ATTORNEYS.

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NOZZLE AND GAS MIXING ARRANGEMENT FOR POWDER TYPE FLAME SPRAY GUN

Anthony J. Rotolico, Hauppauge, N.Y., assignor to Metco
Inc., Westbury, N.Y., a corporation of New Jersey

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U.S. Cl. 239—85

9 Claims

ABSTRACT OF THE DISCLOSURE

A nozzle arrangement for a powder-type flame spray gun having an annular mixing chamber surrounding a central powder conduit of the nozzle, a gas passages for fuel and oxidizing gas leading into the mixing chamber, an annular baffle chamber positioned forward of the mixing chamber, a baffle positioned in the baffle chamber to force gas to flow therearound, and a burner nozzle with a ring of burner jets flow-connected to the baffle chamber, the annular chamber and mixing chamber being defined by annular grooves in the nozzle body and a sleeve which surrounds the body and is slidably removable therefrom.

This invention relates to a novel nozzle and gas-mixing arrangement for a powder-type flame spray gun.

In powder-type flame spray guns, as for example of the type described in U.S. Patents 2,820,670 and 2,961,335, a phenomena known as backfiring sometimes occurs during the spraying or lighting operation. During backfiring the combustion flame propagates back into the nozzle and body and may seriously injure or even destroy the gun.

It is an object of this invention to provide a nozzle and gas-mixing arrangement for a powder-type flame spray gun which is highly resistant to backfiring.

It is a further object of this invention to provide a nozzle and gas-mixing arrangement for a powder-type flame spray gun which in the event of the occurrence of a backfiring can withstand the same for an extended period of time without suffering extensive damage.

It is a still further object of this invention to provide a nozzle and gas-mixing arrangement for a powder-type flame spray gun which in the event of a backfiring will protect the expensive gun body against burn out.

It is still a further object of this invention to provide an air cap arrangement for a powder-type flame spray gun which allows controlled cooling of the work being sprayed, or controlled cooling of the powder being sprayed so as to allow the production of dense high quality fine textured coatings with the use of hotter burning gases, such as acetylene.

These and still further objects will become apparent from the following description read in conjunction with the drawings in which:

FIG. 1 is a vertical longitudinal section of a flame spray gun having an embodiment of a nozzle and gas-mixing arrangement in accordance with the invention;

FIG. 2 is a horizontal longitudinal section of the nozzle and gas-mixing arrangement shown in FIG. 1;

FIG. 3 is a vertical, longitudinal section of the mixing plug body of the gas-mixing arrangement shown in FIG. 2, additionally diagrammatically showing certain of the gas passages;

FIG. 4 is a front elevation of the plug body shown in FIG. 3, diagrammatically showing the position of certain internal passages;

FIG. 5 is a perspective view showing the covering sleeve for the plug body of FIG. 3, and

FIG. 6 is a front elevation of the nozzle shown in FIGS. 1 and 2.

Referring to the drawing, 1 represents the body of a

powder-type flame spray gun on which is mounted the detachable cylindrical powder container 2. A passage 6 leads from the container 2 into the pinch-type shut-off valve 7, which is controlled by the shut-off mechanism 8 and trigger arrangement 9, in the identical manner as described in U.S. Patent 2,820,670. With the shut-off valve 7 open, the passage 6 extends therethrough into the powder feed chamber 10 provided in the gun body 1. The gun body 1 is also provided with a carrier gas conduit 11, a fuel gas conduit 12, an oxygen conduit 13, and an auxiliary gas or air conduit 14, all of these leading partially axially through the gun body and terminating at the gun nozzle arrangement 3.

The rear of the gun is provided with connections for attaching fuel and oxygen lines, respectively, for feeding the conduits 12 and 13 and a connection attaching a compressed air line for feeding the auxiliary gas air conduit 14. A valving arrangement, such as a taper plug valve, is provided for shutting off the flow of gases through these connections into their respective conduits. A passage arrangement is also provided for bleeding off a portion of one of the fuel, oxygen or auxiliary gases supplied for passage through the adjustable valve arrangement 4 into the central powder conduit 11 to act as a carrier gas for the powder. The construction and operation of the portion of the powder flame spray gun behind the nozzle arrangement may thus be the same as described in U.S. Patents 2,820,670 and 2,961,335 and is preferably identical to the construction and operation as described in co-pending application Ser. No. 594,095 filed concurrently herewith.

The nozzle and gas-mixing arrangement in accordance with the invention is attached to the gun by means of the cylindrical casing 5 which with the annular jet ring 15 forms an air cap arrangement. The casing 5 is screwed to the forward end of the gun body by means of a screw connection 16.

The nozzle and mixing arrangement is provided with the mixing plug body 17, machined for example of solid brass or the like; the mixing plug body is provided with a central powder conduit 18 extending therethrough. A cylindrical tube 19 is inserted into the rear terminus of the central conduit 18 and forms an extension thereof. The tube 19 is provided with a notch 20 for receiving powder from the powder feed chamber 10 and a jet or spud 21 which is in communication with the central conduit 11 of the gun body.

The rear face of the plug body 17 is also provided with the drilled hole 22 for receiving the pin or dowel 44 extending from the gun body in order to hold the plug in proper alignment.

The outer circumference of the mixing plug 17 is provided with a number of annular grooves. In several of these grooves the O-ring seals of rubber or the like 23 are provided and a cylindrical sleeve 24 is slipped over the plug body in sealing contact with these O-ring seals. The sleeve 24, as may best be seen from FIG. 5, is fluted, being provided with longitudinally extending lands and grooves.

A groove provided in the intermediate portion of the plug body surrounding the central conduit 18 is sealed at its outer circumference by the sleeve 24 forming the annular mixing chamber 25. A gas passage 26 extends from the rear face of the plug body into the mixing chamber 25. This passage is in communication with the conduit 12 in the gun body. A separate gas passage 27 leads from the rear face of the plug in communication with the conduit 13 in the gun body through the lateral drilled passage 28 into the annular chamber 29 formed by a groove in the plug 17 and the sleeve 24. The passages 26, 27 are diagrammatically shown by dotted lines

in FIG. 3, rotated, however, out of their actual plane for purposes of illustration. A number of radial drilled holes 30 extend inwardly from the annular chamber 29. Intersecting each of the holes 30 is a longitudinal gas passage 31 leading into the mixing chamber 25. A number of gas passages 32 extend longitudinally through the mixing chamber 25 to the forward face of the plug 17. Each of the passages 32 is in axial alignment with a passage 31. The two passages 32, as shown on the left-hand side of FIG. 4, are only drilled as a machining expedient to allow the drilling of the passages 31 in alignment therewith, and are thereafter plugged so that only the two passages 32, on the right-hand side, of FIG. 4 provide a gas flow communication from the mixing chamber 25.

The forward face of the plug 17 is machined out so as to form the annular channel 33. A washer 34 is held in place in front of a channel 33 by means of the spring-type retaining ring 35. The central hole of the washer 34 is oversized so as to provide the annular space 36 through which gas may flow. The washer 34 thus acts as a baffle, with gas from the passages 32 being forced thereon out. The chamber 33 may be referred to as a baffle chamber.

Secured to the front of the plug body 17 by means of the coupling nut 37 is the nozzle proper 38. The nozzle is provided with a central conduit 18a in communication with the conduit 18 which terminates at its forward face with a number of divergent outlet passages 39 for the powder. The nozzle is also provided with a ring of burner jets 40 in communication with the outlet from the baffle chamber 33. The jet ring 15, which surrounds the nozzle, is provided with the annular groove 41, which is in communication with the space between the casing 5 and the plug body 17. This space is, in turn, in communication with the air auxiliary gas passage 14 of the gun body. A ring of converging jets 42 lead from the groove 41 to the forward face of the jet ring 15 surrounding the nozzle jets 40. On the opposite side of the jet ring are a ring of diverging jets 43. The jet ring 15 is reversible so that by unscrewing the casing 5, the ring 15 may be removed and reversed so as to provide converging or diverging jets as desired.

In operation, fuel gas, such as acetylene, hydrogen, or propane, passes from the conduit 12 into the passage 26, into the mixing chamber 25. An oxidizing gas, such as oxygen or air, passes from the conduit 13 into the passage 27 through the drilled passage 28 into the annular chamber 29. From the annular chamber 29, oxidizing gas passes into the radial drilled holes 30 at passages 31 into the mixing chamber 25. The fuel and oxygen are initially mixed in the mixing chamber 25 and thence pass through the longitudinally extending passages 32 into the baffle chamber 33. Due to the axial alignment of the passages 32 and 31, the flow of gas from 31 forces the flow of the mixture through passages 32. In the baffle chamber 33, the fuel and oxidizing gas is thoroughly completely mixed to a uniform combustible mixture as the same flows around the baffle 34. This combustible mixture then flows through the ring of jets 40 in the nozzle and is ignited at the nozzle face forming a flame sheath.

Carrier gas from the conduit 11 passes through the spud 21, picking up powder in the slot 20 and passing the powder forward through the conduit 18 and 18a out of the divergent passages 39 into the flame sheath where the powder is heat softened and melted and propelled against the surface to be coated. Air in the conduit 14 passes in the annular space between the casing 5 and the plug body 17 into the groove 41 and out through the converging jet 15. The converging stream of air from this jet is in the form of a converging cone which prevents overheating by the material being sprayed. This allows the obtaining of a high quality, fine-textured coatings with the use of fine-grained powders using a hotter burning gas, such as acetylene. In the past in order to spray such

powders it was necessary to use a cooler burning gas, such as hydrogen which was more expensive. This results in a gas-cost saving of several dollars per hour. The converging jet or cone of air also controls the spray pattern with the size being increasingly diminished as the air pressure is increased. This is useful in minimizing overspray when spraying small parts.

Where it is not necessary to so cool the powder being sprayed, the jet ring 15 may be reversed so that a diverging stream of air is produced which cools and prevents heating of the work without contacting the powder being sprayed, or, affecting the spray pattern. The passage of the air through the space between the casing 5 and the plug body 17 furthermore serves to cool the plug body, and thus prevent overheating, erratic flame characteristics, and backfiring. The cooling is aided by the longitudinally extending lands and grooves on the sleeve 24 which also serve as a flow guide for the air.

The mixing effect, assured by the combination of the mixing chamber and baffle chamber, assures a uniform flame emerging from the ring of burner jets and prevents unequal flame characteristics as between different individual jets and makes the device extremely resistant to backfiring.

However, in the unlikely event of a backfire, the flame can only proceed back to the mixing chamber as a combustible mixture does not exist upstream of the mixing chamber. The backfire is thus halted in the intermediate portion of the mixing arrangement and cannot proceed further upstream into the gun. Furthermore, due to the gas passage arrangement, the heat sink effect provided by the plug itself and the cooling effect of the air passing through the casing 5, the mixing arrangement can tolerate actual backfire for an extended period of time without suffering extensive damage.

It is, of course, possible to operate the gun so that oxidizing gas is initially passed from the conduit 12 and the fuel gas from the conduit 13. In general, however, the gas passed at the highest pressure should be the gas initially passed into the annular chamber 29, with the gas at the lower pressure being passed into the mixing chamber.

While the invention has been described in detail with reference to the embodiments shown in the accompanying drawings, various changes and modifications which fall within the spirit of the invention and scope of the appended claims will become apparent to the skilled artisan. The invention is, therefore, only intended to be limited by the appended claims or their equivalents wherein I have endeavored to claim all inherent novelty.

I claim:

1. A nozzle and gas mixing arrangement for a power-type flame spray gun comprising a mixing plug body, for attachment to the forward end of a flame spray gun, defining a central powder conduit extending therethrough, a sleeve surrounding said body and slidably removably therefrom, an annular mixing chamber defined by an annular groove in said body and said sleeve at an intermediate portion of said body surrounding said central powder conduit, separate gas passages for fuel and oxidizing gas leading from the rear end of said body into said annular mixing chamber, at least one of said passages leading into an annular chamber behind said mixing chamber and thence through a number of longitudinal passages flow-connected to said annular chamber by radially extending passages and extending into said mixing chamber, an annular baffle chamber defined by an annular groove in said body and said sleeve positioned forward of said mixing chamber, a baffle dimensioned and positioned in said baffle chamber to force gas flowing through said baffle chamber therearound, at least one gas conduit in axial alignment with a gas passage leading into said mixing chamber connecting said mixing and baffle chambers, and a burner nozzle having a ring of burner jets

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positioned in front of said baffle chamber in flow communication therewith.

2. A nozzle and gas mixing arrangement according to claim 1 in which said separate gas passage initially leading into said annular chamber is an oxidizing gas passage, and including at least two gas passages connecting said baffle and mixing chambers and in axial alignment with said longitudinally extending passages.

3. A nozzle and gas mixing arrangement according to claim 1 in which said baffle is a washer-shaped baffle positioned for the passage of gas down around through the central opening thereof.

4. A nozzle and gas mixing arrangement according to claim 1, including a casing surrounding said body in spaced relationship thereto, means at the forward end of said casing defining a ring of jets surrounding said nozzle in flow communication with the space between said casing and body and a gas flow passage leading to the rear of said space.

5. A nozzle and gas mixing arrangement according to claim 4 in which said ring of jets is a ring of converging jets.

6. A nozzle and gas mixing arrangement according to claim 4 in which said ring of jets is a ring of diverging jets.

7. A nozzle and gas mixing arrangement according to claim 4 in which said means at the forward end of said casing is a reversible annular jet ring having converging jets on one face and diverging jets on the opposite face.

8. A nozzle and gas mixing arrangement according to claim 7 in which said jet ring has a central groove in communication with said space with the jets on each face leading thereinto.

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9. In a nozzle and gas mixing arrangement for flame spray gun having a casing terminating at its forward end with a ring of jets surrounding the nozzle, the improvement which comprises the ring of jets being defined by a reversible annular jet ring with converging jets on one face and diverging jets on the opposite face, said jet ring having a central annular groove in communication with the interior of said casing with the jets on each face leading thereinto.

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EVERETT W. KIRBY, Primary Examiner

U.S. Cl. X.R.

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