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METAL SPRAYING APPARATUS

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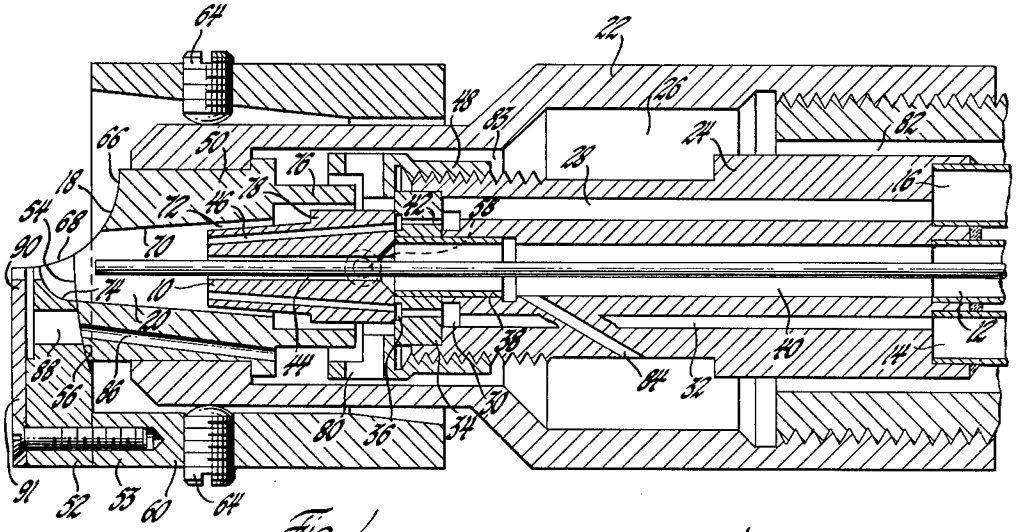


Fig. 1

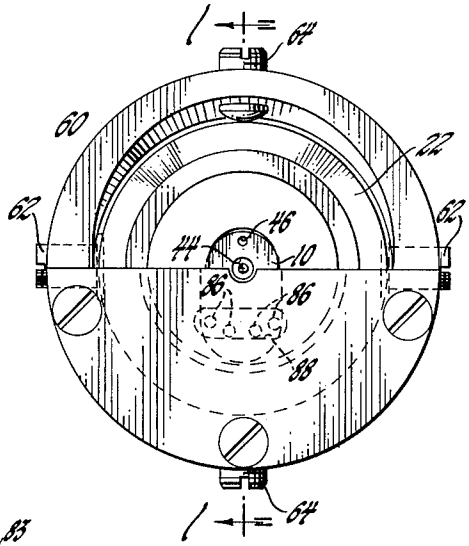


Fig. 2

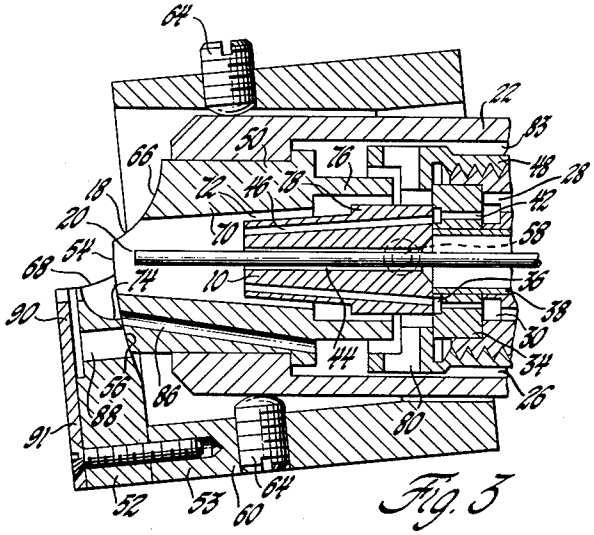


Fig. 3

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METAL SPRAYING APPARATUS

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This invention relates to metal spray guns and more particularly to metal spray guns which spray the molten metal at an angle to the longitudinal axis of the spray gun.

Metal spray guns of the wire feeding, gas blast type are devices in which a metal rod or wire is continuously fed into a combustion zone where the metal is melted and thereafter expelled from the gun in finely divided form by means of a blast of air or other suitable gas. A mixture of combustible and combustion supporting gases such as acetylene and oxygen or air respectively are fed into this melting zone through suitable jets or passages in a burner tip surrounding the feeding path of the metal rod or wire. When the combustible mixture is ignited, it melts the wire fed into the melting chamber. A stream of air or other gas is forcibly directed against the molten metal at the tip of the metal wire in a manner such that it impinges sharply against the tip to thereby blast the molten metal into fine particles. Metal powder spray guns are of a similar construction and operation and differ essentially only in that the metal is delivered to the melting zone in the form of a gas propelled powder.

The nozzle construction of metal spray guns of this type usually includes the above-mentioned burner tip which is provided with a wire feeding orifice centrally thereof and a plurality of burner jets substantially surrounding the longitudinal axis of the wire feeding orifice and passing therethrough. It includes an air cap enveloping the burner tip so as to form a combustion chamber between its inner walls and the burner tip and air blast passage. The materials to be sprayed may be fed into the combustion zone either in the form of rod or wire or a gas propelled powder as above indicated.

The metal spray gun of this invention includes an air cap tip which is constructed so as to direct the molten metal at an angle to the metal feeding orifice which is preferably rotatable with respect to the molten metal feeding orifice and the burner jets whereby in the operation of the spray gun the air cap tip is continuously rotated to direct a blast of the molten metal continuously in a 360° arc about the spray gun axis while the spray gun is in a fixed position. Heretofore, insofar as it is known, the air cap was constructed so that the molten metal could be directed at a single fixed angle with respect to the longitudinal axis of the spray gun. Usually this angle was approximately 45° to the longitudinal axis of the spray gun.

In operating metal spray guns of this type it has been found that the angle of spray which is ideally suited may vary depending upon the distance from the spray gun nozzle to the article to be sprayed and the angle which the surface to be sprayed bears with respect to the spray gun angle. Thus, for example, tubular articles to be sprayed having a relatively small diameter require a spraying angle which is more acute with respect to the longitudinal axis of the spray gun than those of a relatively larger diameter. In some instances the surface to be sprayed may most conveniently rest at an oblique angle with respect to the longitudinal axis of the spray gun and the ideal spraying angle would, of course, depend upon the angle the surface to be sprayed bears to the longitudinal axis of the spray gun. The angular seating faces of a poppet valve seat are illustrative of this type of surface.

It is the basic object of this invention to provide a metal spray gun which will direct the molten metal at a preselected angle to the longitudinal axis of the spray gun. It is a more specific object of this invention to provide an air cap construction which is adjustably mounted so that by a simple adjustment thereof the angle of spray may be varied on a relatively wide range.

Further objects and advantages of the invention will be apparent from the following description, reference being made to the accompanying drawings wherein a preferred embodiment of the invention is shown.

In the drawings:

FIGURE 1 is a fragmentary cross-sectional view of the spray gun nozzle portion of a spray gun taken along the line 1—1 of FIGURE 2;

FIGURE 2 is a nozzle end view of a spray gun; and

FIGURE 3 is a fragmentary portion of the spray gun nozzle shown in FIGURE 1 showing the air cap adjusted to cause the spray gun to spray molten metal at a different angle.

In general, it may be seen most clearly in FIGURE 1, the spray gun in accordance with the present invention involves a stationary burner tip 10, conduit means 12 for feeding a wire to the burner tip, a conduit 14 for feeding oxygen or air to the burner tip, a conduit 16 for feeding acetylene to the burner tip and an air cap 18 disposed forwardly of the burner tip and enveloping the burner tip to form the combustion chamber 20 and adapted to direct the molten metal spray at an angle with respect to the longitudinal axis of the spray gun. The air cap 18 is supported by a sleeve 22 which is preferably rotatably mounted within a housing (not shown) in which it may be rotated whereby the air cap 18 is caused to rotate about the burner tip 10. A suitable arrangement for rotatably supporting the sleeve 22 and rotating the sleeve 22 is disclosed in the copending patent application Serial No. 840,551, assigned to the assignee of the present invention. Suitable means for feeding a wire and the gaseous combustion components to the conduits 12, 14 and 16 are also disclosed in this patent application.

The ends of the conduits 16, 12 and 14 respectively are connected to an adapter 24 which is spaced from the sleeve 22 to form a passage 26 therebetween. The adapter 24 includes an actylene passage 28 in communication with the acetylene conduit 16 which leads to an annular groove 30 in the end face thereof. Similarly, the adapter 24 includes a passage 32 in communication with the oxygen conduit 14 which likewise leads to the annular groove 30. Adjacent the groove 30 is disposed an annular metering plate 34 which includes an annular groove 36 in the face thereof. The plate 34 is fixed to a bushing 38 which is held in a counterbore of the wire feeding passage 40 of the adapter. A plurality of openings 42 are provided through the metering plate 34 which communicate with the grooves 30 and 36.

The burner tip 10 includes a centrally disposed wire feeding passage 44 and a plurality of combustion gas feeding passages 46 disposed thereabout which converge about the passage 44 at the burner tip outlet. The burner tip is disposed against the metering plate 34 so that the combustion gas feeding passages 46 are in alignment with the grooves 36 of the metering plate. The openings 42 through the metering plate are preferably out of alignment with the combustible gas feeding passages 46 of the burner tip to insure proper metering and mixing of the gases. The metering plate 34 and the burner tip 10 are secured in position against the adapter 24 by a retainer 48 threaded to the adapter 24. Preferably the metering plate 34 is provided with a dowel (not shown) to insure that on assembly of the parts the openings 42 and passages 46 are not aligned.

The air cap 18 consists of two portions; a lower por-

tion 50 which is non-rotatably retained or supported within the rotatable sleeve 22 and an end portion 52 which is attached to and supported by means of a sleeve 53 tiltably attached to the rotatable sleeve 22. The end portion 52 of the air cap forms in effect a continuation of the base portion 50. The end face 54 of the lower portion 50 of the end cap preferably has a partially cylindrical configuration and the inner face 56 of the end portion 52 of the end cap likewise has a mating, partially cylindrical configuration. The surfaces 54 and 56 each describe a partial cylinder having an equal radius with respect to an axis 58 which is perpendicular to the face of the drawing and these surfaces engage snugly as they are moved relative to each other. The end portion 52 of the end cap is screwed to the sleeve 60 which in turn is pivotally mounted on the rotatable sleeve 22 by means of the mounting screws 62 along the axis 58. At opposed points removed 90 degrees from the mounting screws 62 are a pair of opposed set screws 64 by means of which the end cap 52 may be retained in any desired tilted position. As may be seen from FIGURE 1, the engaging surfaces 54 and 56 contact one another snugly as the sleeve 60 is moved pivotally on the mounting screws 62.

The lower portion 50 of the end cap has a cut away portion 66 and the end cap portion 52 likewise has a cut away portion 68. As shown in FIGURE 1, the cut away portions 66 and 68 have a common radius of curvature. These cut away portions provide an angular exit passageway for the molten metal as it is sprayed from the gun.

The lower air cap portion 66 is provided with conical interior walls 70 spaced from the burner tip 10 to provide the conical combustion chamber 20 therebetween and an air passage 72 between the burner tip and the air cap. The inner surface 74 of the end portion 52 of the air cap is provided with partially spherical curvature of a dimension such that when this surface is aligned with the edge of the surface 70 of the lower end cap portion, it will direct the molten metal at an angle of approximately 45 degrees with respect to the longitudinal axis of the spray gun. The air cap 18 also includes an air passage through which air is passed to cool the air cap which will be described more fully hereinafter and an annular flange 76 which extends between a shoulder 78 of the burner tip and the retainer 48. The retainer 48 includes a plurality of openings 80 therethrough in advance of the flange 76 of the air cap.

It will thus be seen that the rotatable sleeve 22 non-rotatably supports both the base portion 50 and the end portion 52 of the air cap 18 so that the sleeve 22 is operative to rotate the air cap and effect a metal spray in a 360° arc. The sleeve 22 also forms an air passage in cooperation with the adapter 24, the retainer 48, the shoulder 76 of the air cap and the burner tip 10. This air passage consists of the annular space 82 formed between the sleeve 22 and the conduits 12, 14 and 16 and the adapter 24, the enlarged annular passage 26 between the sleeve 22 and the adapter 24, and the annular space 83 between the sleeve 22 and the retainer 48. An air conduit 84 leading from the wire feeding conduit 40 to the air space 26 is provided to equalize the pressure in the wire feeding tube.

As mentioned above, the compressed air passage 82 and 26 continues as an annular space 83 between the retainer 48 and the sleeve 22. A portion of the air flowing through this passage passes through the openings 80 of the retainer 48 and thereafter through the space 72 to join with the combustible gases flowing to the combustion chamber 20 through the passages 46 in the burner tip 10. Another portion of the air stream is diverted by the shoulder 76 of the lower end cap portion 50 to cause it to pass through a plurality of passages 86 in the lower portion 50 of the air cap and on to an enlarged oval-shaped passage 88 in the end portion 52 of the air cap from whence the air passes out through the slit-like, semi-circular passage 90. The semi-circular coolant passage 90 is conveniently

formed by providing a semi-circular offset in the inface of the end portion 52 of the end cap adjacent the passage 88 and screwing thereto a plate 91. It will be observed that the air coolant passage consisting of the portions 86, 88 and 90 are in close proximity to the curved surface 74 of the air cap which directs the flow of molten metal and is subject to the most intense heat. It will also be observed that the portion 88 of this passage is enlarged so that the end portion 52 of the air cap may be tilted or rotated a considerable amount with respect to the base portion 50 of the air cap and yet maintain communication between the passages 86 in the base portion of the air cap and the passages 88 and 90 of the end portion of the air cap.

In the operation of the spray gun, the wire is fed through the passage 40 of the adapter 24 and through the burner tip 10. Acetylene, oxygen or air under pressure are admitted to the combustion chamber through the passages 14 and 16. The oxygen and acetylene are mixed in the groove 30 and are metered as they pass through the openings 42 of the metering plate 34. Thereafter the gases are passed through the passages 46 of the burner tip to converge at a predetermined point forward of the burner tip. Compressed air passes through the annular space 82, the enlarged annular space 26 and into the annular space 83. From thence, a portion of the air stream guided by the air cap flange 76 is directed through the air cap passages 86, 88 and 90. A major portion of the air passes inwardly of the flange 76 through the openings 80 of the retainer 48 through the annular passage between the flange 76 and the burner tip shoulder 78 and on through the conical passage 72 into the combustion chamber 20 wherein it is operative to atomize and propel the metal melted by the burning gases. The curved portion 74 of the air cap causes the molten metal to be sprayed at an angle depending upon the degree to which the end cap portion 52 is tilted with respect to the longitudinal axis of the spray gun. Preferably in the position shown in FIGURE 1, the molten metal is sprayed at an angle of approximately 45 degrees. When the air cap portion 52 is tilted to the maximum position as shown in FIGURE 3, the molten metal will be sprayed at an angle of approximately 20 degrees to the longitudinal axis of the spray gun whereas when the air cap portion 52 is tilted in the extreme opposite position (not shown) molten metal will be sprayed at an angle of approximately 70 degrees with respect to the longitudinal axis of the spray gun. The particular range of angles at which the molten metal may be sprayed may be varied considerably in accordance with suitable variations in the design features including the degree of curvature present at the surfaces 74. It is, of course, essential that the passage portion 88 be of sufficient size to at all times maintain communication between the air passage 86 and the air passage 88. The set screws 64 are, of course, effective in rigidly holding the supporting sleeve 60 in any desired position in an obvious manner.

While the embodiment of the present invention as disclosed herein constitutes a preferred form, it is to be understood that other forms may be adopted without departing from the spirit of the invention.

We claim:

1. In a spray gun construction of the gas blast type including a burner tip provided with a metal feeding orifice, a multiple number of burner jets substantially surrounding the longitudinal axis of said orifice, means for supplying a combustible gas through said jets and means for supplying metal to said orifice, the improvement comprising a sleeve surrounding said burner tip and an air cap mounted on said sleeve, said air cap including an end portion having a partially substantially spherical portion adapted to direct the molten metal at an acute angle with respect to the longitudinal axis of the spray gun, said end portion being pivotally mounted whereby said position of said partially spherical portion may be varied with respect

to the longitudinal axis of said gun to vary the said acute angle.

2. In a spray gun construction of the gas blast type including a housing, a burner tip provided with a metal feeding orifice, a multiple number of burner jets substantially surrounding the longitudinal axis of said orifice, means for supplying a combustible gas through said jets and means for supplying metal to said orifice, a sleeve surrounding said burner tip, the improvement comprising an air cap supported by said sleeve and surrounding said burner tip, said air cap comprising a base portion having a partially conical inner surface and forming a gas blast passage between it and said burner tip, said air cap including an end portion having a partially spherical internal configuration adapted to direct the molten metal spray at an acute angle with respect to the longitudinal axis of said spray gun, said end cap portion being pivotally mounted on said sleeve whereby the position of said partially spherical portion thereof may be varied with respect to the longitudinal axis of said spray gun.

3. In a spray gun construction of the gas blast type including a housing, a burner tip provided with a metal feeding orifice, a multiple number of burner jets substantially surrounding the longitudinal axis of said orifice, means for supplying a combustible gas through said jets and means for supplying metal to said orifice, a rotatable sleeve surrounding said burner tip forming a gas passage therebetween, the improvement comprising an air cap supported by said sleeve and surrounding said burner tip, said air cap comprising a base portion having a partially conical inner surface and forming a gas blast passage between it and said burner tip, said air cap including an end portion having a partially substantially spherical internal configuration adapted to direct the molten metal spray at an acute angle with respect to the longitudinal axis of said spray gun, said end cap portion being pivotally mounted on said sleeve whereby the position of said partially spherical portion thereof may be varied with respect to the longitudinal axis of said spray gun, and means for supplying a gas under pressure between said sleeve and said burner tip.

4. In a spray gun construction of the gas blast type including a housing, a burner tip provided with a metal feeding orifice, a multiple number of burner jets substantially surrounding the longitudinal axis of said orifice, means for supplying a combustible gas through said jets and means for supplying metal to said orifice, a sleeve surrounding said burner tip forming a gas passage therebetween, the improvement comprising an air cap supported by said sleeve and surrounding said burner tip, said air cap comprising a base portion having a partially conical inner surface and forming a gas blast passage between it and said burner tip, said burner tip including an end portion having a partially substantially spherical internal configuration adapted to direct the molten metal spray at an acute angle with respect to the longitudinal axis of said spray gun, said end cap portion abutting said base portion at a curved interface and having a circular cross section in at least one plane and being pivotally mounted on said sleeve on an axis perpendicular to said plane whereby the position of said partially spherical portion thereof may be varied with respect to the longitudinal axis of said spray gun.

5. In a spray gun construction of the gas blast type including a housing, a burner tip provided with a metal feeding orifice, a multiple number of burner jets substantially surrounding the longitudinal axis of said orifice, means for supplying a combustible gas through said jets and means for supplying metal to said orifice, a sleeve surrounding said burner tip forming a gas passage therebetween, the improvement comprising an air cap supported by said sleeve and surrounding said burner tip, said air cap comprising a base portion having a partially conical inner surface and forming a gas blast passage between it and said burner tip, said air cap including an end portion having a partially substantially spherical internal configuration adapted to direct the molten metal spray at an acute angle with respect to the longitudinal axis of said spray gun, said end air cap portion abutting said base air cap portion at a curved interface having a circular cross section in at least one plane and being pivotally mounted on said sleeve on an axis perpendicular to said plane whereby the position of said partially spherical portion may be varied with respect to the longitudinal axis of said spray gun, said air cap having a cooling air passage through said end and base portions thereof in communication with said gas passage, the cooling air passage in said end portion adjacent said base portion being of substantially greater cross sectional area than the air cooling passage within said base portion whereby communication between the cooling passage base and end air cap portions is maintained while said air cap portions are being pivoted relative to one another.

6. In a spray gun construction of the gas blast type including a housing, a burner tip provided with a metal feeding orifice, a multiple number of burner jets substantially surrounding the longitudinal axis of said orifice, means for supplying a combustible gas through said jets and means for supplying metal to said orifice, a sleeve surrounding said burner tip forming a gas passage therebetween, the improvement comprising an air cap supported by said sleeve and surrounding said burner tip, said air cap comprising a base portion retained within said sleeve and having a partially conical inner surface and forming a gas blast passage between it and the burner tip, said air cap including an end portion having a substantially spherical internal configuration adapted to direct the molten metal spray at an acute angle with respect to the longitudinal axis of said spray gun, said end air cap portion abutting said base air cap portion at a curved interface having a circular cross section in at least one plane and being pivotally mounted on said sleeve on an axis perpendicular to said plane whereby the position of said partially spherical portion may be varied with respect to the longitudinal axis of said spray gun, said end cap having a cooling air passage extending from said air passage through said end and base air cap portions, the cooling air passage in said end portion adjacent said base portion being of substantially greater cross sectional area than the cooling passage of said lower portion whereby communication between the cooling air passage of said base and end cap portions is maintained throughout the adjustable range of said air cap.

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