April 16, 1963 K. W. KENSHOL 3,085,750

MOLTEN MATERIAL SPRAY GUN WITH LATERALLY DEFLECTING AIR CAP

Filed Dec. 29, 1960 2 Sheets-Sheet 1

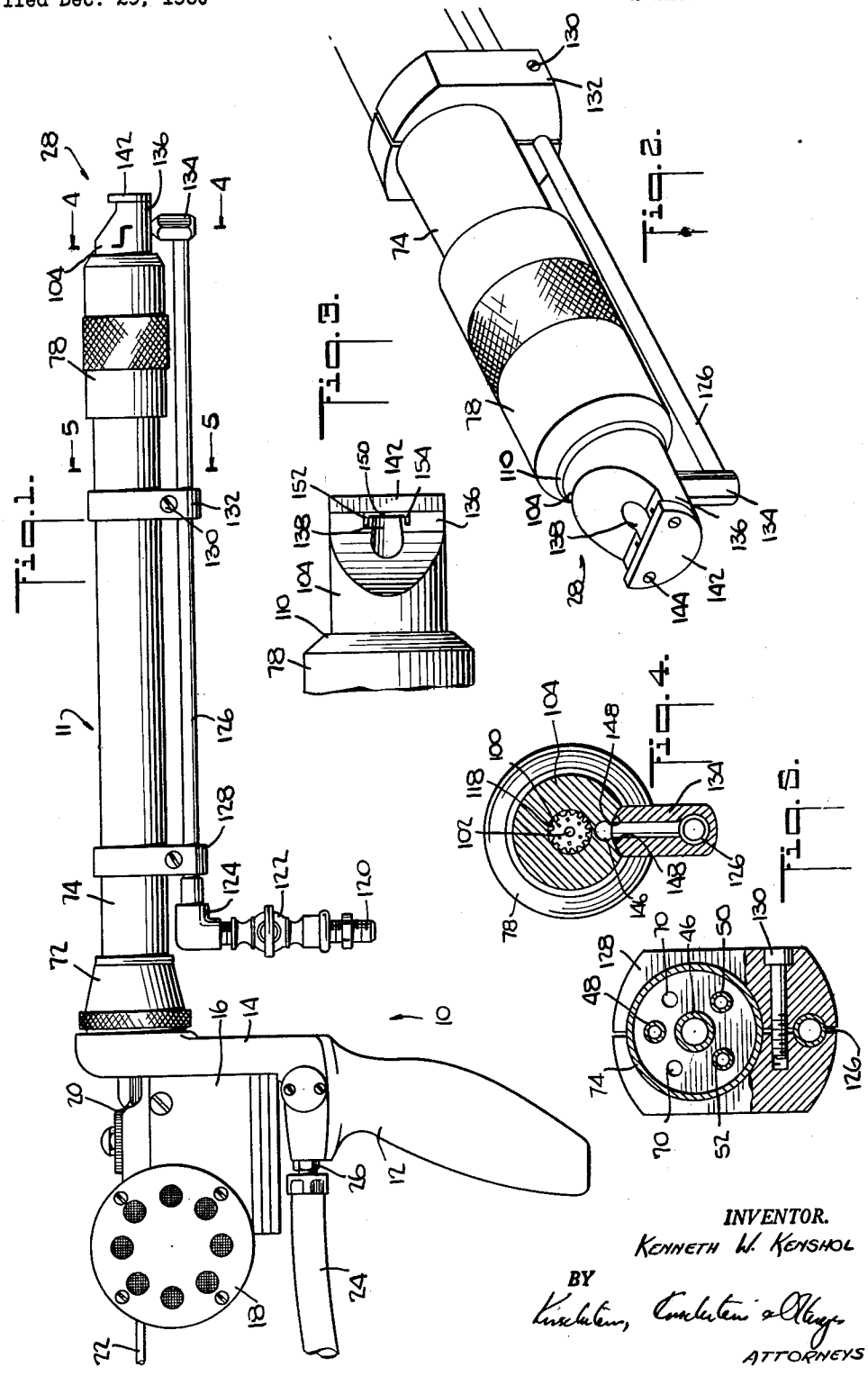

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

INVENTOR.
KENNETH W. KENSHOL

BY
Kirschstein, Kirschstein & Ottinger
ATTORNEYS

April 16, 1963 K. W. KENSHOL 3,085,750

MOLTEN MATERIAL SPRAY GUN WITH LATERALLY DEFLECTING AIR CAP

Filed Dec. 29, 1960 2 Sheets-Sheet 2

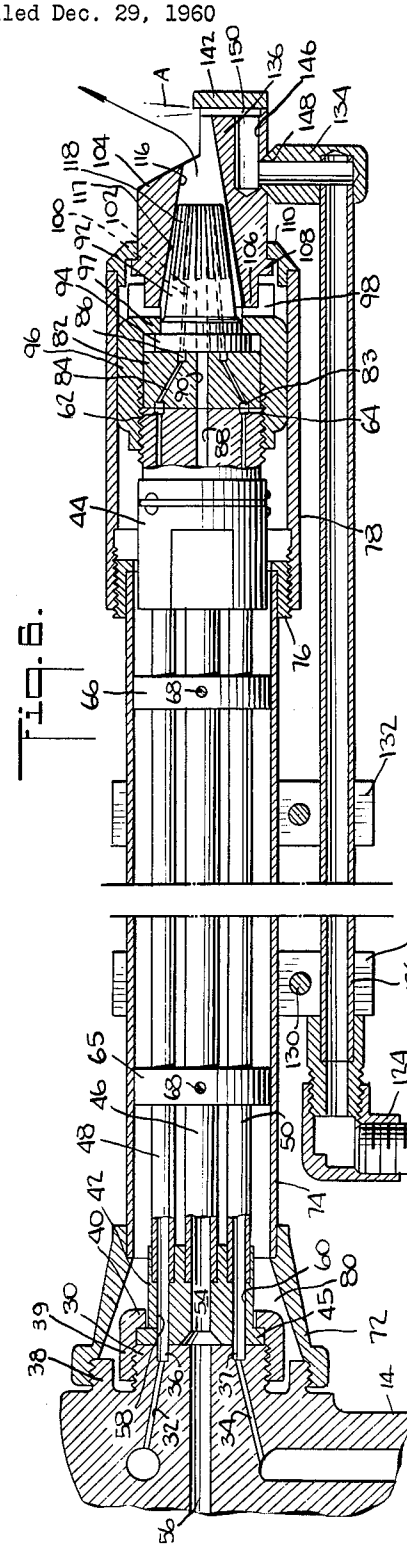

Fig. 6.

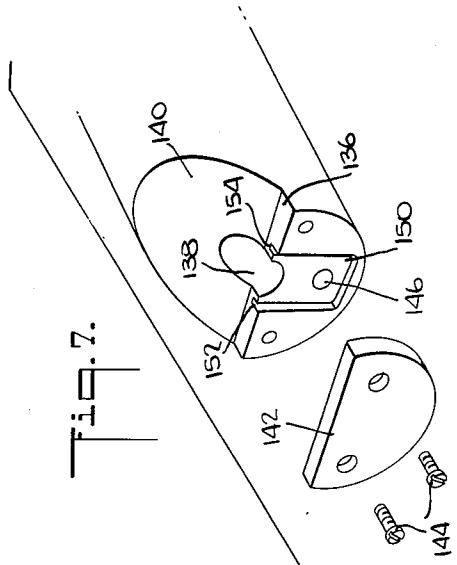

Fig. 7.

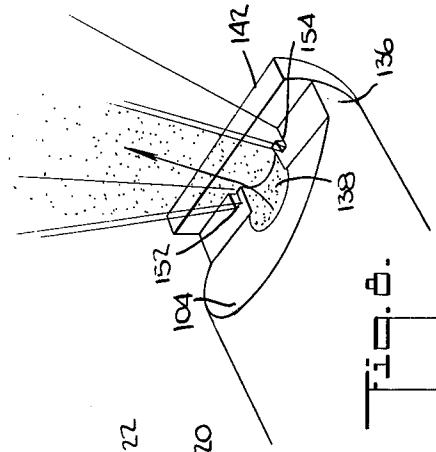

Fig. 8.

INVENTOR.
KENNETH W. KENSHOL

BY
Kinsbuters, Kinsbuters & Ottinger
ATTORNEYS

United States Patent Office

3,085,750

Patented Apr. 16, 1963

3,085,750

MOLTEN MATERIAL SPRAY GUN WITH LATERALLY DEFLECTING AIR CAP

Kenneth W. Kenshol, Berkeley, Ill., assignor to Metallizing Company of America, Inc., Chicago, Ill., a corporation of Illinois

Filed Dec. 29, 1960, Ser. No. 79,450
2 Claims. (Cl. 239—84)

This invention relates to a molten material spray gun with a laterally deflecting air cap.

It is an object of my invention to provide a molten material spray gun having an improved arrangement for laterally deflecting a stream of molten spray particles.

It is another object of my invention to provide a molten material spray gun of the character described in which I can vary the angle of lateral deflection without affecting the degree of atomization or materially decreasing the speed of projection of the molten spray particles.

It is another object of my invention to provide a molten material spray gun of the character described in which I can achieve steep angles of lateral spray deflection, e.g. as much as 70% deflection.

It is another object of my invention to provide a molten material spray gun of the character described having an improved extension which enables molten particle sprays to be directed to the sides of long bores or tubes such for instance as rocket tubes.

It is another object of my invention to provide a molten material spray gun of the character described which can achieve all the foregoing objects with a comparatively inexpensive structure employing relatively few and simple parts.

It is another object of my invention to provide a fused material spray gun of the character described which is rugged and foolproof and is easy to assemble and maintain.

Other objects of my invention in part will be obvious and in part will be pointed out hereinafter.

My invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts which will be exemplified in the spray gun hereinafter described, and of which the scope of application will be indicated in the appended claims.

In the accompanying drawings, in which is shown one of the various possible embodiments of my invention,

FIG. 1 is a side view of a molten material spray gun constructed in accordance with my invention;

FIG. 2 is a front perspective view of the nozzle of said gun;

FIG. 3 is a fragmentary face view of the tip of the nozzle;

FIGS. 4 and 5 are enlarged sectional views taken substantially along the lines 4—4 and 5—5, respectively, of FIG. 1;

FIG. 6 is an enlarged fragmentary longitudinal sectional view of the spray gun shown in FIG. 1;

FIG. 7 is an exploded perspective view of the tip of the nozzle; and

FIG. 8 is an enlarged perspective operational view of the nozzle.

Referring now in detail to the drawings, the reference numeral 10 denotes a molten material spray gun which is of basically conventional construction except for an extension 11 and a means for laterally deflecting the stream of molten atomized material.

Said gun 10 includes a handle 12 on which there is mounted a frame 14. A block 16 is secured to the back of the frame. Carried by the block is an air turbine 18 which rotates a pair of knurled drive wheels 20 that between them grip and feed forwardly an elongated length, e.g. rod or wire 22, of material that is to be fused, atomized and sprayed. A governor is located within the block 16 to regulate the speed of the turbine 18. A detailed description of the frame, block, feed rolls, turbine and governor will be found in my United States Letters Patent No. 2,963,033 issued December 6, 1960 for Spray Gun For Fusible Materials.

Three air hoses 24, of which only one is shown, are connected to nipples 26 at the bottom of the frame 14. One of the hoses conducts compressed acetylene to the gun 10, another conducts compressed oxygen and the third conducts compressed air. The air in part is used to drive the turbine 18 for feeding the wire 22. The balance of the air and acetylene are led through passageways (not shown) to the spray nozzle 28 of the gun.

A boss 30 extends forwardly from the front wall of the frame 14. Said boss is provided with a passageway 32 that is connected to the acetylene hose and with a passageway 34 that is connected to the oxygen hose. The two passageways terminate at the front face of the boss in sockets 36, 37, respectively.

The frame also is formed with a forwardly protruding male threaded annular flange 38 that is concentric with the boss 30.

The gun 10 includes suitable means for mounting the extension 11 thereon. Said means comprises, in part, a coupling 39 which is internally threaded to mesh with the threads on the boss 30. The forward end of the coupling has an inturned retainer lip 40.

The extension 11 consists of several elements which include a rear plug 42 and a forward plug 44. The rear plug has an outwardly extending rear flange 45 that is held against the front face of the boss 30 by the retainer lip 40 of the coupling 39. The two plugs 42, 44 are maintained in spaced relationship by several tubes. One of these is a central tube 46. The remainder are three equiangularly spaced outer tubes 48, 50, 52. The opposite ends of all the tubes are received in sockets in both plugs and are united to the plugs as by soldering, welding or brazing.

The rear plug 42 is centrally apertured as at 54 in alignment with the central tube 46. Said aperture 54 being aligned with a bore 56 in the frame 14 through which the wire 22 is fed by the rollers 20. Thus the material to be melted is fed through the extension by passage through the central tube 46.

One outer tube 48 is aligned and in communication with an opening 58 in the rear plug which is adapted to be registered with the acetylene socket 36. Another outer tube 50 is aligned and in communication with another opening 60 in the rear plug that is adapted to be registered with the oxygen socket 37. Thereby acetylene is fed forwardly through the extension via the outer tube 48 and oxygen via the outer tube 50.

The forward plug 44 is similarly apertured to provide longitudinal passageways for the wire 22, for acetylene and for oxygen, the acetylene and oxygen passageways terminating in sockets 62, 64 respectively which are at equal distances from the central wire tube 46.

It will be observed that the third outer tube 52 does not carry any combustion gas. It is provided simply to physically balance the extension structure, since the use of only two outer tubes, for example, would permit the extension to skew.

The four tubes 46, 48, 50, 52 are tied together at various points along their length as by collars 65, 66 provided with openings for the tubes. Optionally set screws 68 may be employed to secure the collars to the different tubes, or, if desired, the collars can be permanently secured to the tubes as by soldering, brazing or welding. As a result, the internal portion of the extension 11 which constitutes the back and front plugs, the four tubes and the collars are tied together as a single mechanical unit.

The collars 65, 66 include longitudinal openings 70 to permit the passage of compressed air therethrough.

The extension 11 further includes a shroud which in part constitutes a frusto-conical rear portion 72 the back of which is internally tapped to threadedly engage the flange 38 and thus secure the shroud to the frame 14 independently of the rear plug 42. The small diameter front end of the hollow portion 72 supports a forwardly extending thin tubular shell 74 which is concentric with the central tube 46 and snugly slidable on the collars 65, 66 whereby said collars function to support the shell 74 in its desired concentric relationship. An externally threaded ferrule 76 is secured, as by brazing, soldering or welding, to the front end of the shell and is adapted to be screwed into the internally tapped rear end of a tubular air sheath 78.

Compressed air is led from a nipple 26 through passageways in the frame 14 to enter the space 80 between the rear plug 42 and the frusto-conical rear portion 72 of the shroud. The compressed air thereafter flows forwardly around the tubes 46, 48, 50 and 52 and through the openings 70 to the space between the forward plug 44 and the tubular air shield 78.

A mixing disc 82 is disposed on the front surface of the forward plug 44. Said disc is formed to include an annular rear plenum mixing chamber 83 from which passageways 84 extend forwardly to an annular groove 86 in the forward face of the disc. The chamber 83 is fed with acetylene and oxygen from the sockets 62, 64. The forward plug 44 and the mixing disc are formed with central bores 88, 90, respectively, that are aligned with the central tube 46 in order to pass the wire or rod 22 fed by the rolls 20.

A burner tip 92 is seated on the forward face of the mixing disc 82. Said burner tip includes an outwardly extending flange 94 at the rear thereof.

To hold both the mixing disc and burner tip in place I provide a coupling 96 the rear end of which threadedly engages the threaded front of the forward plug 44. Said coupling includes an inwardly directed flange 97 that, when the coupling is screwed tight on the forward plug 44, presses against the flange 94 of the burner tip so as to force both said burner tip and the mixing disc against the plug 44. The body of the coupling 96 is hexagonal with the corners of the hexagon slidably engaging the internal surface of the tubular air shield 78 so as to support the front end of the shroud of which said air shield forms a part. However, due to the polygonal shape of the coupling, compressed air can flow forwardly past the same from around the forward plug 44 to around the front end of said coupling 96. The front end of the coupling is formed with radial slots 98 that pass compressed air to the interior of the coupling around the base of the burner tip 92.

The burner tip is formed with the usual forwardly converging internal gas passageways 100 so that the jets of mixed gas issuing from the front of the burner tip form a conical flame in a combustion zone converging to an apex in the path of travel of the rod or wire 22. This flame will fuse the rod or wire in the well known fashion. Said burner nozzle includes a central bore 102 for the passage of the rod or wire, this bore being in alignment with the bore 90.

The outer surface of the burner tip is forwardly tapering and frusto-conical. An air cap 104 surrounds said outer surface, the rear of the air cap being seated in a well 106 at the front of the coupling 96. The air cap is provided with an outwardly extending annular flange 108 which is engaged and pressed rearwardly against the coupling by an annular lip 110 at the front of the tubular air sheath 78.

The internal surface of the air cap is formed with a forwardly converging passageway 116 having approximately the same angle of taper as the external surface of the burner tip. However, the internal surface of the cap is spaced slightly outwardly from the external surface of the burner tip in order to define a frusto-conical annular passageway 117 through which compressed air flows forwardly. Forwardly extending grooves 118 located on the external surface of the burner tip and terminating at the front end thereof guide the converging flow of compressed air into proximity with the combustion zone. Said compressed air forms a blanketing sheath around the conical flame issuing from the front of the burner tip. The sheath aids in the combustion of the acetylene, provides sufficient agitation and turbulence to atomize the molten material fused by the flame and accelerates the molten atomized particles in a forward direction to provide a spray. If desired, a second compressed air blanketing sheath may be provided as shown in my copending application for Molten Material Spray Gun With Dual Zone Compressed Air Application, Serial No. 79,451, filed concurrently herewith.

Since the blanketing sheath flows in a generally axial direction (axially of the extension 11), the gun is not, as thus far described, capable of efficiently coating a laterally disposed object with the molten spray particles. However, the principal purpose for providing the extension 11 was to spray the inside of a tube or the like of rather small diameter so that a great deal of the spray would be wasted if the axial flow were allowed to persist. It has been proposed heretofore to laterally deflect the axial flow of molten material spray by means of an air blast blowing across the path of the spray, and for this purpose it has been suggested that a portion of the compressed air flowing through the extension, within the shell 74 and tubular air sheath 78 be diverted at or adjacent the burner tip for use as the deflecting blast. This arrangement however is subject to various drawbacks. For example, it has not been found practical heretofore to deflect the spray in such a manner for more than about 30°. This principally was due to the lack of sufficient pressure and volume of the air for the deflecting blast. If the pressure was sufficiently high it affected the operation of the gun since the same compressed air was employed both for the lateral blast and for the blanketing compressed air sheath. Moreover, where the same air was used for the deflecting blast as for the blanketing sheath it was not possible to vary the degree of deflection as sometimes was desirable. Still further, previously deflected molten spray particles were widely fanned out so that a great deal of the material sprayed was lost and precise control of the spray material was not possible. The construction which I have devised, and which now will be described, overcomes these drawbacks. In general, I accomplish these desirable ends by providing an air blast which is supplied from a source of compressed air that is led to the spray zone through passageways independent of those through which compressed air is led to the burner tip for the purpose of accelerating air, atomization and particle acceleration.

More specifically, I provide the spray gun 10 with a nipple 120 which is connected to a suitable local source of compressed air. This may be the same local source of compressed air, e.g. a pressure regulator, as that which is connected to one of the nipples 26 that furnishes air for the turbine and the blanketing compressed air sheath or it may be to a separate pressure regulator. The nipple 120 runs to a control valve 122 of any suitable type, e.g. a gas cock. The control valve leads compressed air to an elbow 124 that is connected to the rear end of an external tube 126 which is supported from the shroud as by a split clamp 128.

A nut 130 (see FIG. 5) secures the two parts of the clamp to one another and secures the proper degree of pressure to hold the external tube in place. One or more additional clamps 132 are included at spaced intervals along the lengths of the shell 74 and external tube 126. The foremost of the series of clamps 132 is positioned in

back of the rear end of the tubular air shield 78 so as to hold firmly in position the front end of the external tube 126 which terminates at a right angled head 134 that directs the flow of compressed air radially inwardly toward the air cap 104.

The air cap is formed with a forwardly extending lip 136 having an axial semi-conical trough 138 aligned with the forwardly tapering internal passageway 116 and constituting a smooth unbroken continuation thereof which in effect is interrupted by a laterally facing cutout 140. Thus the tendency of the spray of molten atomized particles will be to be deflected laterally out of the cutout. However this tendency is comparatively minor and only would result in a slight transverse deflection.

To abet this lateral departure I provide across the forward travel of the spray an obstruction and a laterally directed blast of air. The obstruction to the forward travel of the spray constitutes a stop plate 142 that is mounted on the front of the lip 136, being held thereto, for example, by screws 144, so that the stop plate can be replaced if it burns out. The stop plate lies against the front end of the trough 138 and lies athwart the axial path of travel of the forwardly traveling molten spray material particles which have been atomized by the blanketing sheath of compressed air. The stop 142 is slightly higher than the trough and, therefore, tends to deflect the spray laterally in the direction of the open side of the trough but its effect likewise is not by itself sufficient to turn the spray to a desired extent. This deflection is materially increased by the lateral blast of air.

A right angled passageway 146 is formed in the lip 136. At its back end the passageway 146 communicates through a laterally disposed opening 148 with the tip of the right angled head 134. To effect a good connection at this point I may chamfer the tip of the head 134 and matchingly bevel the opening 148. The passageway 146 terminates at its front end in a radially slotted passageway 150 running across the front face of the lip. Said passageway 150 extends perpendicularly across the forward end of the trough 138 adjacent this stop plate whereby the compressed air introduced into the tube 126 issues in a jet, as indicated by the arrow A, at right angles to the forwardly directed stream of atomized particles. This jet flows across the rear face of the stop 142 and, as indicated above, aids in laterally deflecting the stream of atomized molten particles. The jet issues in the same direction as that in which the open side of the trough faces. By varying the pressure of compressed air supplied to the jet, e.g. by manipulating the valve 22, I can obtain a wide range of lateral deflection for the spray, e.g. up to 70%.

It will be observed that the path of the auxiliary blast of compressed air, i.e. the air for the deflecting jet, is comparatively simple and takes place through passageways of ample size so that there is very little pressure drop between the entry nipple 120 and the exit passageway 150. If compressed air is admitted at a pressure, for example, of 80 p.s.i., in the nipple 120 it will be substantially 80 p.s.i. as it flows into the passageway 150; on the other hand, if air is introduced to one of the compressed air nipples 26 at about 60 p.s.i. its pressure will fall to about 30 p.s.i. by the time that a portion thereof is deflected at the nozzle for use at a laterally deflecting air blast, this being due to the tortuous travel of the compressed air within the extension and the restricted sizes of the openings and passageways through which it must flow. It also will be apparent that adjustment of the rate of flow of the auxiliary blast of air can be effected independently of adjustment of the rate of flow of the compressed air to the gun for the purpose of turning the turbine, aiding combustion and performing atomization and acceleration. Accordingly, in the preferred form of my invention, the local source of auxiliary compressed air is independent of the local source of compressed air for the turbine, burning and atomization.

To minimize fanning out of the deflected spray and thereby concentrate the spray and exert a control over the site of spray deposited, I desirably may employ secondary slots 152, 154, one located at each edge of the passageway 150, said slots being squat and perpendicular to the passageway 150. These slots and the passageway 150 conjointly define a channel shaped jet so that the lateral blast of deflecting compressed air is roughly U-shaped with the sides of the blast that issue from the slots 152, 154 tending to restrict the fanning out of the deflected spray as shown in FIG. 8.

It thus will be seen that I have provided a spray gun which achieves the several objects of my invention and is well adapted to meet the conditions of practical use.

As various possible embodiments might be made of my above invention, and as various changes might be made in the embodiment above set forth, it is to be understood that all matter herein set forth, or shown in the accompanying drawings, is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. In combination, means directing combustion gases forwardly to a combustion zone, means leading a fusible material forwardly to said combustion zone so as to melt the same, an air cap providing a forwardly directed blanketing sheath of compressed air around the combustion zone to atomize said molten material and accelerate the same forwardly as a spray of molten particles issuing from said cap, spray deflecting means directing a blast of compressed air from one side of said spray only as a thin broad sheet flowing laterally completely across the path of travel of the entire molten spray as it issues from the air cap, first means supplying compressed air to the blenketing sheath, and second means independent of said last named means for supplying compressed air to the air blast at a pressure substantially above the pressure of the compressed air supplied to the blanketing sheath.

2. In combination, means directing combustion gases forwardly to a combustion zone, means leading a fusible material forwardly to said combustion zone so as to melt the same, an air cap providing a forwardly directed blanketing sheath of compressed air around the combustion zone to atomize said molten material and accelerate the same forwardly as a spray of molten particles issuing from said cap, spray deflecting means directing a blast of compressed air from one side of said spray only as a thin broad sheet flowing laterally completely across the path of travel of the entire molten spray as it issues from the air cap, said spray deflecting means including means to form laterally rearward extensions on the sides of said sheet which extensions restrict fanning out of the deflected spray, first means supplying compressed air to the blanketing sheath, and second means independent of said last named means for supplying compressed air to the air blast.

References Cited in the file of this patent

UNITED STATES PATENTS

2,317,173	Bleakley	Apr. 20, 1943
2,643,955	Powers et al.	June 30, 1953
2,769,663	Jensen et al.	Nov. 6, 1956
2,960,275	Wolf	Nov. 15, 1960

FOREIGN PATENTS

162,626	Austria	Mar. 25, 1949