June 22, 1965 H. CHARLOP 3,190,559

FLAME SPRAY CONSTRUCTION

Original Filed Jan. 16, 1962 4 Sheets-Sheet 1

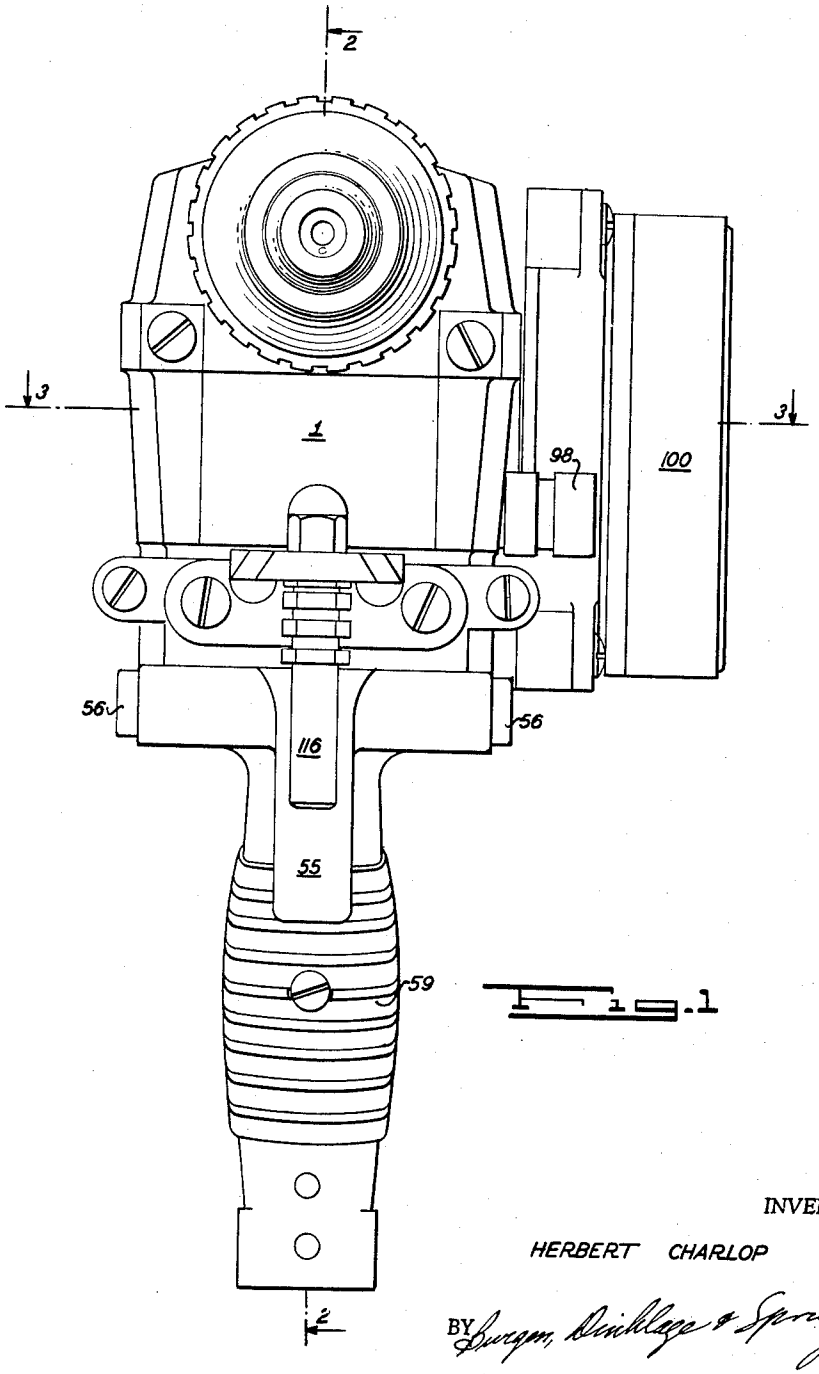


Fig. 1

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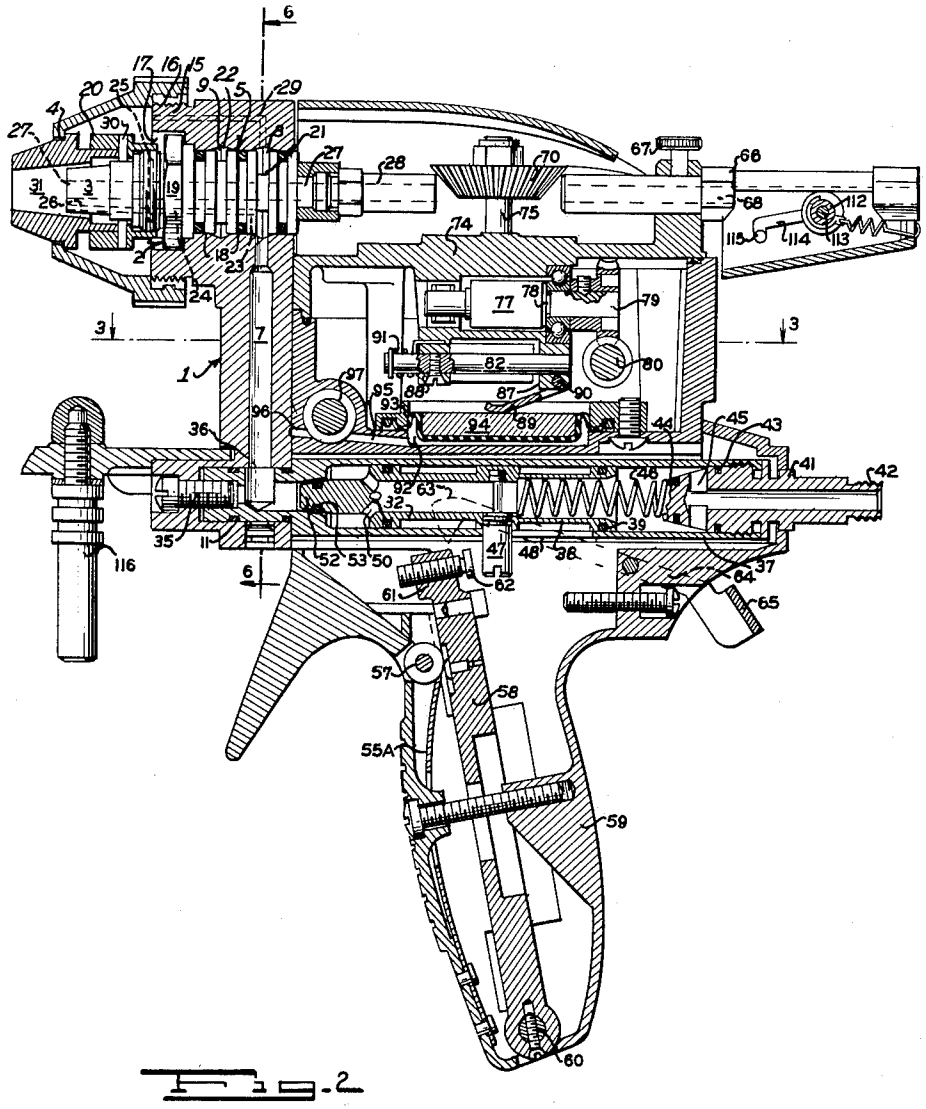


Fig. 2

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Original Filed Jan. 16, 1962 4 Sheets-Sheet 3

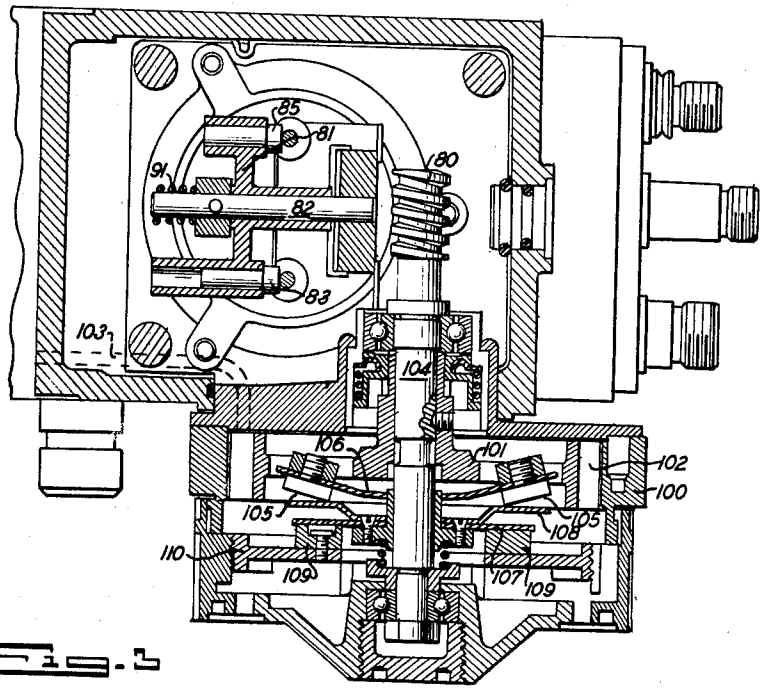


Fig. 3

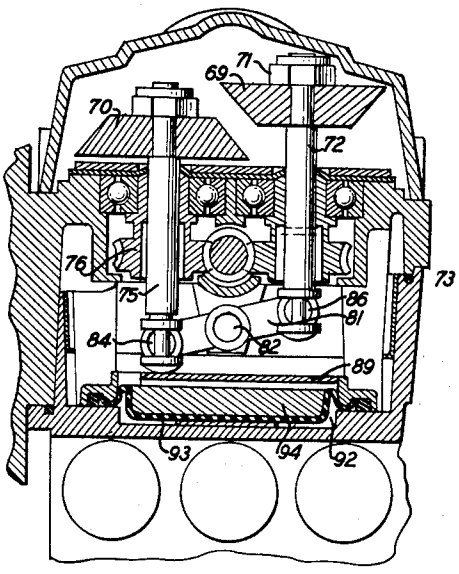


Fig. 4

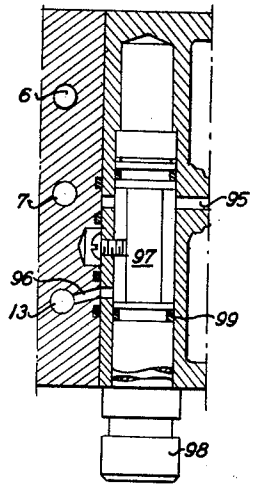


Fig. 5

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FLAME SPRAY CONSTRUCTION

Original Filed Jan. 16, 1962 4 Sheets-Sheet 4

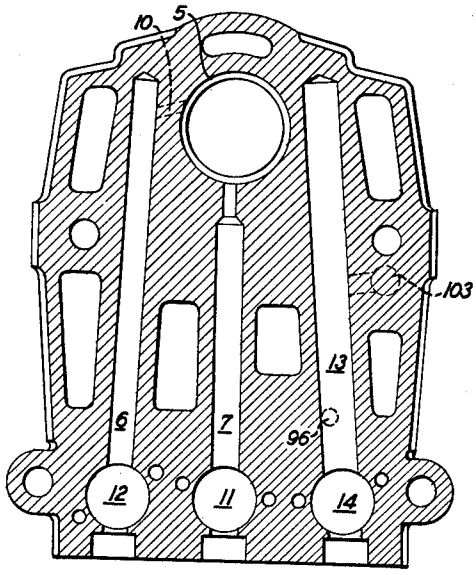


Fig. 6

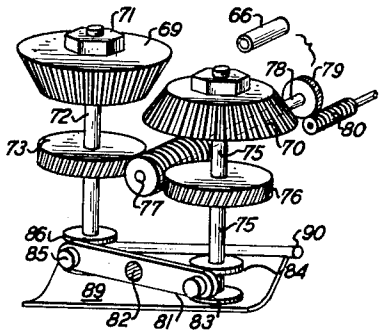


Fig. 8

Fig. 7

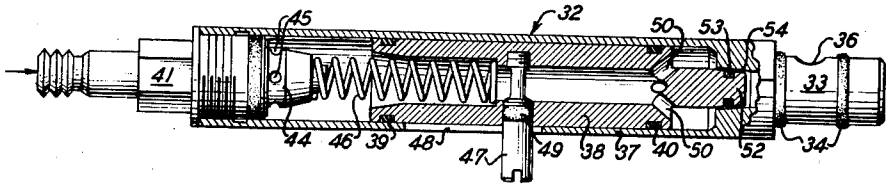
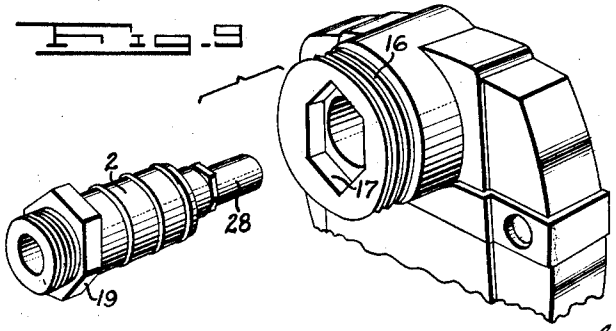


Fig. 9



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3,190,559

FLAME SPRAY CONSTRUCTION

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Original application Jan. 16, 1962, Ser. No. 166,614. Divided and this application Oct. 30, 1962, Ser. No. 238,822

12 Claims. (Cl. 239—84)

This application is a division of application Serial No. 166,614, filed January 16, 1962.

This invention relates to an improved flame spray gun construction. The invention more particularly relates to an improved construction of a flame spray gun of the wire type.

Flame spray guns are well known and widely used in industry. The same basically consist of an arrangement for forming a heating zone, as for example, by means of a combustion flame or a plasma arc flame and a mechanism for feeding a heat-fusible material, such as a metal or ceramic, into this heating zone, to be melted or at least heat-softened and propelled away from the gun, for example onto a surface to be coated.

The heat-fusible material is generally fed to the gun in the form of a powder or in the form of a wire or rod (the term "wire" being used generically herein and in the claims to designate rods or wires). Flame spray guns which utilize a heat-fusible material in the form of a powder are generally referred to as powder-type guns, and those which utilize a heat-fusible material in the form of a wire are referred to as wire-type guns.

The improved construction in accordance with the invention is primarily intended in connection with a wire-type gun utilizing a combustion flame burner as the heat source, but various novel features of the invention are applicable to other type guns and to guns utilizing different types of heat sources.

The invention and its objects will be more fully understood by reference to the following description read in conjunction with the accompanying drawings, in which:

FIG. 1 is a front elevation of an embodiment of a wire-type flame spray gun in accordance with the invention;

FIG. 2 is a vertical section of the gun shown in FIG. 1;

FIG. 3 is a partial, cross-sectional view of the embodiment shown in FIG. 1;

FIG. 4 is a further partial vertical section of the gun shown in FIG. 1;

FIG. 5 is a partial section showing the wire feed control valve of the gun of FIG. 1;

FIG. 6 is a vertical section of a portion of the gas head of the gun shown in FIGS. 1 and 2;

FIG. 7 is a vertical section of an embodiment of a gas control valve of the gun of FIG. 1;

FIG. 8 is a diagrammatic perspective view of the feed mechanism for the wire of the gun of FIG. 1; and

FIG. 9 is a partial exploded perspective view showing details of the hexagonal head and socket for the siphon plug of the gun shown in FIG. 1.

The embodiment of the wire-type flame spray gun as shown in the accompanying drawings may be basically characterized as having a burner mechanism for supplying the necessary heat for operation and propelling the melted heat-fusible material, a valving arrangement for controlling the combustible and combustion-supporting gases and blast gas, a feed mechanism for the wire, a drive for this feed mechanism, and a housing for the various components mounted on a handle with an operable trigger for controlling the gun's operation.

The burner mechanism is positioned on the portion of the gun generally referred to as the gas head and designated as 1. The burner mechanism includes the siphon

plug 2, the burner nozzle 3 and the air cap 31. The gas head 1 is preferably constructed of metal, such as aluminum, and is provided with various passages and bores, as may best be seen from FIGS. 2 and 6. Thus the central main bore 5 is provided for the siphon plug and vertically extending passage 6 and 7, for fuel and combustion-supporting gases respectively, communicate with this passage. The passage 7 communicates with a groove 8 in the main bore, and the passage 6 communicates with the groove 9 in the main bore by means of the small lateral drill passage 10, shown by dotted lines in FIG. 6. The lower end of the passage 7 is in communication with the bore hole 11, and the lower end of the passage 6 is in communication with the corresponding bore hole 12.

A further vertical passage 13 is provided in the gas head for a blast gas, and this communicates at its lower end with the bore hole 14. The forward end of the main bore 5 is provided with the flange 15 having an external male thread 16, and a polygonal shaped interior, such as a hexagonal shaped socket 17.

The siphon plug 2 is, for example, constructed of metal, such as brass, and provided with a multiple number of grooves in which are inserted the O-rings 18. The forward end of the siphon plug 2 is provided with a hex nut 19 which is dimensioned so that the same will slide into 17, but cannot rotate therein. The siphon plug is merely slid into the main bore 5 and seals in place by means of the O-rings. Due to the hex nut 19 and its fit within the socket 17 of the flange 15, the nozzle 3 may be screwed and unscrewed on the threads by means of the threaded flange nut 20 without causing a corresponding rotation of the siphon plug 2. The siphon plug 2 has a deep groove 21 which mates with the groove 8 in the main bore, and a deep groove 22 which mates with the groove 9 in the main bore. A multiple number of axial flow passages, as for example four evenly spaced passages 23, communicate the groove 21 with the groove 22.

Corresponding axial flow passages 24, which may be somewhat larger in diameter, communicate the groove 22 with an annular groove 25 formed at the mating point between the front end of the siphon plug and rear end of the nozzle. The nozzle 3 has a multiple number of jet passages 26 in communication with the groove 25. Thus, for example, six equally spaced jet passages may be provided. An axial wire guide bore 27 extends through the siphon plug and the nozzle, and a wire guide tube 28 with a corresponding mating wire guide passage is secured by screwing to the rear end of the siphon plug.

The vertical blast gas passage 13 is in communication with the interior of the air cap retaining flange 4 by means of the drilled hole 29. The interior of the air cap retaining flange is in communication with the small annular space between the nozzle 3 and air cap 31 by means of the radial holes 30 provided through the flange nut 20. The air cap 31 of the gun is held in place by the air cap retaining flange 4 being screw-threaded at 16.

The valving arrangement for controlling the combustible combustion-supporting and blast gases fed through the passages 6, 7 and 13 respectively, consists of three substantially identical parallelly positioned tubular valve members 32. As shown in FIG. 7, the forward ends of these valve members are in the form of a plug insert 33 provided with O-rings 34. Thus, the plug insert 33 of one of the valves is positioned in the bore 12, the other in the bore 11, and the third in the bore 14. The valves are screw-held in position by means of screws, such as the screw 35. The plug insert 33 is provided with a lateral opening 36 which, in the case of the combustion-supporting gas valve as shown in FIG. 2 is in communication with the passage 7. The opening 36 of the valve inserted in the bore 12 is in communication with the passage 6,

and the opening 36 of the valve inserted in the bore 14 is in communication with the passage 13. The opening 36 is in flow communication with the hollow interior of the tubular valve housing 37. The piston 38 is slidably positioned within the bore of the housing 37 and sealed in a gas-tight manner by means of the O-rings 39 and 40. The rear end of the housing 37 is sealed by the plug 41 provided with the threaded connection 42 for the conventional gas line hose. The plug is sealed in a gas-tight manner by means of the O-ring 43 and is provided with the tapered end 44, provided with the lateral holes 45, so that gas passed in through a hose attached to the threaded connection 42 will flow into the interior of the valve body 37. The piston 38 is axially slidable and urged toward its forward position by means of the spring 46. A pin 47 is connected to the piston and extends through a slot 48 in the valve housing so as to allow external actuation of the piston. The O-ring seals 39 and 40 and the seal 49 prevent leakage through the slot 48. The forward end of the piston 38 is provided with the holes 50 extending through the piston wall communicating the interior and exterior of the piston and with the tapered valve member 52 provided with the O-ring seal 53. With the valve in its normal position the spring 46 urges the piston 38 forward, so that the valve member 52 seals against the valve seat 54 at the forward end of the valve body, sealing the valve shut. When the piston is moved partially toward its rear position the valve member 52 is removed from the valve seat, opening the valve wide. As the piston is further retracted, the tapered portion at the rear of the piston bore engages the tapered end of the plug 41, restricting the gas flow, the degree of restriction being controlled by the amount the piston is retracted. The piston and the 3 valves positioned side-by-side in the gun are simultaneously actuated by the trigger 55. The trigger 55 is pivoted at the joints 56, and when pressed back, the roll 57 connected thereto forces the pivot bar 58 on the gun handle 59 to pivot rearwardly about the pivot joint 60. The pivot bar 58 is provided with crossbar 61 having three spaced-apart screw adjusting studs 62, each of the studs 62 being positioned to engage a pin 47 of the valve. The trigger 55 is spring-loaded to its forwarded position by means of a spring 55A. Thus when the trigger 55 is depressed, the pivot bar 58 is pivoted causing the studs 62 to engage the pins 47, forcing the pistons 38 of each of the valves toward their rearward position. As the trigger is released to its forward position, the cross-bar 61 is caught by the sear 63 of the pivoted lever 64 and retained in this intermediate position until the sear 63 is released by the finger lever 65. The pivot lever 64 is biased by a spring (not shown) forcing the sear 63 downwardly toward the cross-bar 61.

The wire feed mechanism consists of the rear wire guide tube 66 which is removably held in place by means of the thumb screw 67, and which has a central wire guide bore 68 in axial alignment with the forward wire guide tube 28, and a pair of wire feed rolls, and the drive mechanism for these rolls. The wire feed rolls are in the form of opposed, bevelled rolls 69 and 70, as may best be seen from FIG. 8. The bevelled roll 69 is mounted by means of the nut 71 on the shaft 72 for rotation with this shaft. A worm gear 73 is keyed to the shaft so as to rotate with the shaft, but allow the shaft to axially slide therethrough. The worm gear 73 is mounted on a bearing connected to the plate 74 (FIG. 2). The feed roll 70 is bevelled in the same manner as the feed roll 69, but mounted in the opposite direction on the shaft 75, which has a worm gear 76 corresponding to the worm gear 73 and keyed to the shaft 75, to cause rotation of the worm gear with the shaft but allow the shaft to slide through the worm gear. The worm gear 76 is also rotatably mounted on the plate 74, so that in effect the mounting of the gear 76 constitutes a rotational bearing for the shaft 75, and the mounting of the gear 73 constitutes a rotational bearing for the shaft 72. A worm 77 is mounted between the worm gears 73 and 76 in engagement therewith and is connected to shaft 78, on which is mounted the worm gear 79, which is in engagement with the worm 80 of the drive turbine. A lever arm 81 (see FIG. 3 also) is pivotably mounted on the shaft 82 and is provided with the pin 83 at one end, which engages in a groove 84 of the shaft 75, and is provided with a pin 85 at the opposite end, which engages in a groove 86 in the shaft 72. The shaft 82 is mounted at its opposite ends in the bearing pillows 87 and 88 which are integrally cast with the plate 74. The worm 77 is also rotationally mounted in bearings provided in these members. A pivot plate 89 is pivotably connected at 90 and engages the lever arm 81. When the pivot plate 89 is pivoted upwardly, it pivots the lever arm 81, forcing the shaft 75 to move axially upwardly and causing the shaft 72 to move axially downwardly an equi-distant amount and thus causing the opposed bevelled surfaces of the rolls 69 and 70 to firmly grasp a wire which may be positioned in their gap. A spring 91 normally biases the lever arm 81 to force the shaft 72 upwardly and the shaft 75 downwardly, thus forcing the rolls 69 and 70 apart. A chamber 92 (FIG. 2) is sealed at its upper end by means of the rubber diaphragm 93, on which is positioned the plunger 94 in the form of a metal disc. A gas passage 95 leads into the chamber 92, so that when gas under pressure is forced into the chamber 92, the plunger 94 connected to the diaphragm is forced upwardly by the pressure acting on the pivot plate 89, causing the rolls 69 and 70 to axially move toward each other. In place of the diaphragm other pneumatic actuating means such as a piston and cylinder may, of course, be used. The gas passage 95 is connected to the passage 13 by means of the passage 96 as shown in FIG. 5. Thus, as the valve in the bore 14 is opened and blast gas passes through the passage 13, a portion of this gas will pass through the passage 95 into the diaphragm chamber 92, forcing the plunger 94 upwardly. The communication between the diaphragm chamber 92 and the passage 13 may be shut off by means of the valve 97, the construction of which may be seen from FIG. 5. Thus, when the valve 97 is actuated by pulling or pushing the knurled knob 98, the passage 95 is in flow communication with the passage 96 or sealed from this passage when the O-ring 99 on the valve extends between the passages 95 and 96.

The drive for the feed rolls 69 and 70 acting through the worm 80 consists of a conventional gas turbine 100, as may best be seen from FIG. 3. The turbine consists of the rotor 101 provided with the turbine blades 102. A gas flow passage 103 feeds actuating blast gas from the passage 13 to the turbine blades, causing rotation of the turbine and the shaft 104, causing rotation of the worm 80 and drive of the feed rolls through the mechanism previously described. A pair of flyweights 105 are mounted on the spring arms 105, which are connected to the rotor 101 by a similar pair of cross-arms (not shown). The flyweights 105 press against the spring-loaded brake plate 107 by means of the spring plate 108. The brake plate 107 is axially movable on the shaft 104 and rotatable therewith. The brake plate 107 presses against the brake shoes 109 mounted on the screw plate 110, the position of which may be screw-adjusted by turning the knurled ring 111. The faster the shaft 104 rotates, the greater is the centrifugal force with which the flyweights 105 are thrown outward, and thus the greater the braking force between the brake plate 107 and shoes 109, so that the device acts as a centrifugal governor, with the drive speed being accurately controlled by the position of the screw plate 110.

In operation the device is first set up for the spraying of a specific size wire by insertion of appropriate size wire guides 66 and 28. Oxygen, for example from any source, is connected to the connection 42 by means of a hose, as for example from a conventional pressure tank. In the same manner a fuel, such as acetylene or propane, is connected to the connection 42 of the valve positioned in the bore hole 11, and compressed air from a tank or compressor is connected to the connection 42 of the valve

positioned in the bore hole 14. The trigger 55 is depressed and released so that the pivot bar 58 will be retained by the sear 63, forcing the valves by the action of the stud 62 on the pins 47 to their open position. The flow of the gases may then be adjusted to the appropriate values with the use of the conventional flow and pressure meters and valves in the lines. The gun may then be stopped by depressing the lever 65.

The lighting of a flame spray gun involves a specific sequence of operational steps entailing first opening the gas flow supplies to the maximum value to purge the line, then reducing the flow to a restricted value to allow lighting, and then reopening the valves to the operational flow value. This normally entailed separate manual operational steps, utilizing for example plug or cock valves.

The valve construction in accordance with the invention, however, allows this lighting sequence to be effected in a single operational step by simply completely depressing the trigger, lighting the gun, and releasing the trigger. As the trigger is pulled back, each of the pistons 38 of the valves is moved rearwardly by action of the stud 62 on the pins 47, and the pistons first pass through the intermediate position, which corresponds to a completely open position of the valves, causing purging of the lines. As the trigger is further depressed to its most rearward position, the tapered portions 44 of the plugs 41 engage in the tapered rear of the bore of the piston, restricting the gas flow and permitting the lighting operation. The exact degree of the restriction for optimum lighting conditions may be initially set by means of adjusting the threaded studs 62. As the trigger is released, the sear 63 catches the cross-bar 61, so that the studs 62, acting on the pins 47, hold the pistons 38 in the intermediate or fully-open position for the operational spraying. A conventional metal spray wire, often referred to as a metallizing wire, is initially fed through the bore 68 of the rear wire guide 66. The rear wire guide 66 is provided with the spring-loaded roll 112, which is mounted on the shaft 113 which moves in the inclined slots 114 but which may be retained in the catch 115. With the shaft freely movable in the slot 114, the wire may be fed in a forward position, but when it is attempted to pull the wire back the roll jams the same as the shaft tends to move up the inclined slot. For pulling the wire out again, the shaft 113 may be locked in the catch 115. The wire extends through the gap between the rolls 69 and 70, through the forward wire guide 28 and out through the central bore of the nozzle 3. As long as the valve positioned in the bore 14 is shut or in its restricted flow position, or if the valve 97 is shut, the chamber 92 will not be pressurized, and the spring 91 will maintain the rolls 69 and 70 apart. For the spraying operation the valve 97 is opened, and with the gun in its normal operating position, with the cross-member 61 retained by the sear 63, pressure from the blast gas passing through the passage 13 will, acting on the diaphragm 93, force the plunger 94 upwardly, pivoting the pivot plate 89 and forcing the rolls 69 and 70 toward each other, so that the same firmly grip the wire. A portion of the blast gas also passes through the passage 103, actuating the turbine and causing rotation of the rolls 69 and 70, feeding the wire forward through the gun, at a rate controlled by the governor on the turbine. Due to the bevelled shape of the rolls 69 and 70 and their particular positioning, the wire, irrespective of its size, will always be exactly centered therein and there will be no tendency of the wire to vary its position on the rolls due to the differential peripheral speeds along each of the roll surfaces. However, when using the conventional cylindrical and similar rolls, the wire showed a tendency to wander during operation.

At the same time the wire is firmly gripped between the rolls by the action of the resilient pneumatic pressure.

Simultaneously the fuel gas passes upward through the passages 6 and 10 into the groove 22 and the combustion supporting gas, such as oxygen, passes upwardly through the passage 7 into the groove 8 and through the passages 23, where the same mixes with the fuel gas in the passage 22. The combustible mixture then passes forward through the passages 24 and into the groove 25 and thence through the burner jets 26, where the same are ignited in the form of a hot combustion flame, melting off or at least heat-softening the tip of the wire as it is fed forward through the nozzle 3. The blast gas passes up through the passage 13 and passage 29 and through the openings 30, passing along the outer surface of the nozzle 3 and impinging on the melted or heat-softened tip of the wire, atomizing the metal from the wire and propelling the same away from the gun at spray velocity. When it is desired to temporarily interrupt the spraying operation, it is merely necessary to press back on the trigger, which restricts the gas flow, reducing the same to a pilot value while at the same time interrupting the wire feed as sufficient pressure is not fed into the chamber 92 to retain the rolls 69 and 70 in wire-gripping engagement, and the spring 91 forces the rolls apart. If it is desired to interrupt the wire feed while maintaining gas flow at their normal full value, this may be done by shutting the valve 97. In operation the gun may be hand-held by the handle 59 or mounted by means of the mounting bracket 116.

It is believed apparent that the wire feed mechanism as described, is applicable and offers advantages not only in connection with the particular gun as shown, but in connection with any conventional wire type flame spray gun. The use of the pair of bevelled feed rolls positioned to grip a wire between their bevelled surfaces and provide for axial moving of at least one of the rolls toward and away from the other, in and out of gripping-engagement with the wire, offers substantial advantages over the conventional feed rolls. The bevelled rolls are preferably of frusto-conical shape and are preferably so bevelled that the same make an angle of 30° to 60°, and preferably 45° with their axes of rotation.

The nozzle and siphon plug construction also offer substantial advantages and are applicable with any known or conventional flame spray guns, including those of the powder type. By providing the siphon plug with the polygonal nut at its forward end, which slides in a corresponding socket the plug may be very simply inserted and removed from the gun by simply sliding the same axially in and out, as for example, for exchange of wire guide tubes or cleaning and yet the nozzle may be firmly screwed on and removed without difficulty.

The valving arrangement furthermore offers substantial advantages and may be used with other types of guns and equipment.

While the invention has been described in detail with reference to the specific embodiments shown, various changes and modifications will become apparent to the skilled artisan which fall within the spirit of the invention and scope of the appended claims. 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. In a flame spray gun having a conduit for supplying combustion gas to a burnerhead and valve means for controlling the gas flow through said conduit, the improvement which comprises said valve means comprising a hollow cylindrical valve housing having an inlet at one end and an outlet at its opposite end, a hollow piston defining a gas flow passage therethrough slidably mounted in said valve housing, one end of said piston being dimensioned for gas-tight sealing engagement with one end portion of the interior of said housing, the other end of said piston being dimensioned to define a restricted gas flow passage with the other end portion of the interior of said housing, and means for axially sliding said piston in said housing.

2. In a flame spray gun having a burner head and a conduit for supplying a combustion gas to said burner head, the improvement which comprises valve means for said conduit having a shut-off, full flow and restricted-flow position, and trigger means for actuating said valve means between said positions, said valve means comprising a hollow cylindrical valve housing having an inlet at one end and an outlet at its opposite end, a hollow piston defining a gas flow passage therethrough slidably mounted in said valve housing, one end of said piston being dimensioned for gas-tight sealing engagement with one end portion of the interior of said housing, the other end of said piston being dimensioned to define a restricted gas flow passage with the other end portion of the interior of said housing, and means for axially sliding said piston in said housing upon actuation of said trigger means.

3. Improvement according to claim 2 in which said trigger means has a release position corresponding to said shut-off position of said valve, with said hollow piston in gas-tight sealing engagement with said one end portion of the interior of said housing, intermediate position corresponding to said full-flow position with said piston intermediate the end portions of said housing, and a fully depressed position corresponding to said restricted flow position with said piston in contact with the other end portion of the interior of said housing, and including catch means for holding said trigger means in said intermediate position upon release of said trigger means from said fully depressed position.

4. Improvement according to claim 2 in which said gun has a separate conduit for supplying fuel gas, oxidizing gas and blast gas with one of said valve means for each of said conduits, and single trigger means for simultaneously actuating all said valve means.

5. Improvement according to claim 4 in which said piston is movable in sealing engagement with the outlet end of said housing, and including spring means biasing said piston toward said outlet end.

6. Improvement according to claim 5 in which said outlet end of said housing has a tapered gas flow passage forming a valve seat, and in which the adjacent end of said piston is formed as a tapered valve member, the inlet end of said housing including a tapered plug extending thereinto, and in which the end of said piston adjacent

the inlet end of said housing has a tapered bore leading into its hollow interior.

7. Improvement according to claim 6 in which said means for axially sliding said piston includes a pin connected to said piston and extending through an axially-extending slot in said housing.

8. Improvement according to claim 7 in which said valves are parallelly positioned, side-by-side, and in which said trigger means includes a cross-bar for simultaneously contacting and actuating the pin on each said valve means.

9. Improvement according to claim 8 including catch means for holding said cross-bar in an intermediate position upon release of said trigger means.

10. Improvement according to claim 9 in which the outlet end of the housing on each said valve means is formed as a plug and inserted in a corresponding bore of the gun housing and sealed, in gas-tight contact therewith, with an O-ring seal.

11. In a flame spray gun having a gas head provided with a siphon plug and a burner nozzle removably secured to the forward end of the siphon plug by a screw and nut connection, the improvement which comprises the siphon plug being sealed in gas-tight contact with a bore in the gas head by O-ring seals, and being axially slidably removable therefrom, the forward end of the siphon plug being formed as a polygonal nut and the forward end portion of said bore in the gas head being formed as a corresponding polygonal socket into which said polygonal nut slidably fits.

12. Improvement according to claim 11 in which said plug has a multiple number of spaced-apart O-ring seals with grooves therebetween and in which said gas head has gas flow passages in communication with said grooves.

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