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FLAME SPRAY GUN CONSTRUCTION
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This invention relates to an improved flame spray gun construction. The invention more particularly relates to an improved arrangement for maintaining the wire feed rolls of a flame spray gun in gripping contact with a wire being fed through the gun by the rolls. Flame spray guns are devices for spraying heat-fusible materials in order, for example, to coat a surface with a coating or layer of such material. Flame spray guns are most commonly used for spraying metals and ceramics and in view of the former utility which by far was initially the most common, the devices were often referred to as metalizing guns.

Flame spray guns basically consist of an arrangement for feeding a heat-fusible material into a heating zone where the same is melted or at least heat softened and propelled or sprayed in this molten or heat-softened form. The heating means of flame spray guns are most commonly in the form of gas burners utilizing propane or acetylene as fuel, and oxygen or air as a combustion supporting gas. Other heating arrangements may, however, be used for heat softening the material being sprayed, and in recent years the use of a plasma flame, formed from an electric arc, has come into use.

In flame spray guns of the wire type, the heat-fusible material is fed through the gun in the form of a wire, the term “wire” being generically used herein to designate both wires and rods. The wire is generally fed through the gun by a pair of feed rollers which grip the wire therebetween and which are rotated by a suitable drive arrangement, as for example a gas turbine or electric drive. In the most common wire gun constructions, the feed rollers feed the wire axially through the gun at a controlled rate, through the gun’s gas head nozzle arrangement and air cap. The nozzle arrangement generally consists of a ring of burner jets surrounding the wire passage through which the combustible gas mixture is passed and burnt. The heat of the flame heat-softens the wire tip as the same passes into the air cap and a high velocity stream of blast gas, generally air, is directed against and impinges on this heat-softened tip atomizing the metal or other heat-fusible material in the form of fine droplets or particles and propels the same away from the gun, as for example against the surface being coated.

Some arrangement must be provided in order to allow an adjustment of the gap between the wire feed rollers so as to allow the initial insertion and the final removal of the wire and to ensure that the rollers will grip the wire with a force suitable for reliable feed without slippage and without injury to the wire or the rollers.

It has been common practice to provide for this feed roller adjustment by means of a simple hand screw arrangement. Thus, for example, one of the rollers of the roller pair may be mounted in a shell or housing which is hinged to allow pivoting of the roller carried therein toward and away from the other roller. The housing or shell is provided with a thumb screw extending through its top which screws into a threaded socket on the gun’s body.

In operation the wire is inserted in the gun and the housing is swung about its hinge to its closed position so that the two rollers are opposed with the wire therebetween. The thumb screw is then tightened so that the wire is firmly gripped between the rollers, and the spraying operation commenced. If it is desired to remove the wire at any time, it is necessary to loosen the thumb screw in order to allow the sliding of the wire out from the gun. If the thumb screw is not properly adjusted, difficulties may be encountered in operation, as for example wire slippage or wire deformation in connection with softer wires. The adjusting of the thumb screw may constitute a troublesome operation, particularly when a large number of wire changes are involved, and an initially satisfactory adjustment does not ensure that the adjustment will so remain during the entire spraying operation. Furthermore, the screw adjustment is an operation on which the skill and care of the operator must be depended on, and thus creates a possibility of operational failure which is a result of the human factor over which the gun manufacturer has no control.

One object of this invention is a novel flame spray gun construction which ensures an accurate and automatic gripping of the wire by the feed rollers during the spraying operation.

A further object of this invention is a pneumatic arrangement for a flame spray gun which assures a uniform and correct wire gripping by the feed rollers and which allows the operator to very quickly and easily effect the roller gripping or release of the wire.

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

FIG. 1 is a side view of an embodiment of a 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 side elevation on an enlarged scale of the gun shown in FIG. 1 with the pneumatic actuating arrangement and valve in accordance with the invention being shown in section,

FIG. 4 is a perspective view of the cam of the valve shown in FIG. 3 with the cam pattern being diagrammatically shown, and

FIG. 5 is an exploded perspective view showing the mounting and drive of the wire feed rolls of the embodiment of FIG. 1.

In accordance with the invention, the flame spray gun is provided with a pneumatic arrangement for urging the wire feed rolls together in gripping contact with the wire and to allow release of the wire from between these rolls.

In accordance with the preferred embodiment of the invention, one of the rollers is positioned in the conventional manner in a housing pivotally mounted for pivoting this roller toward and away from the other roller, and a pneumatic arrangement, as for example a pneumatic piston cylinder arrangement having a plunger is provided for pivoting the housing so that the rollers are moved in gripping engagement with the wire.

In order to allow the operator quick and easy control of the roller gripping action, a valve is provided which controls the flow of gas to the pneumatic actuating device. Preferably, this valve is of the push-button type.
so that upon one push actuation a flow of gas to the pneumatic device occurs and upon an alternate actuation, this flow is interrupted and the pneumatic device is vented from the gas pressure.

The embodiment will be described in detail with reference to the embodiment shown in the accompanying drawing which is given by way of illustration and not limitation.

The embodiment of the wire type flame spray gun, as shown in the drawing, is of the conventional and well-known construction except for the particular pneumatic arrangement for actuating the wire feed rolls into wire gripping engagement.

The gun basically consists of the gun body proper 1 provided with the handle 2 and mounting post 3, the gas head 4 with the air cap 5 mounted thereon, and the valve arrangement 6. The valve arrangement has the hose connection or nipple 7 for air, a connection or nipple 8 for oxygen, and the connection or nipple 9 for fuel gas, such as acetylene or propane. A single taper plug valve 10 controls the flow of the respective gases from their connections into the gun. A cylindrical syphon plug 12 is fitted in a corresponding bore in the gas head and the O-rings 13 maintain a gas-tight seal. The syphon plug is provided with a central wire passage 14, a groove 15, and a further groove 16 with the inter-connecting passage 17. With the taper valve 10 in the open position as shown in FIG. 2, oxygen flows by means of a connecting hose through the connection 8 in the valve 10 and into the passage 18 from whence it flows into the groove 15 and through the passage 17. A substantially identical arrangement is provided connecting the connection 9 with the groove 16 so that oxygen from a suitable source may be passed by means of a connecting hose through the connection 8 in the valve 10 and into the passage 18 from whence it flows into the groove 15 and through the passage 17. The combustible mixture from the mating grooves 20 flows through these burner jets and is ignited at the face. The nozzle is also provided with a corresponding annular groove 20 at the rear face of the nozzle 21 which is provided with a ring of equidistantly spaced burner orifices 22. The combustible mixture from the mating grooves 20 flows through these burner jets and is ignited at the face. The nozzle is also provided with a central passage 23, for the wire, corresponding to the passage 14. The burner nozzle 21 extends into the air cap 5 which is held in place by means of the cap band 24. Air is passed from a suitable source and hose through the connection 7, taper valve 10, and passage 25 (FIG. 3) to the space 26 in the interior of the air cap body 24. The upper portion of the passage 25 (not shown) extends forward at right angles into the space 26. The lateral openings 27 communicate the space 26 with the interior of the air cap 5 so that the air may flow from the space through these lateral passages 27 along the outer surface of the nozzle 21 and through the air cap. Positioned behind the syphon plug 12 is the forward wire guide tube 28. A heat-fusible wire, as for example a metal wire, fed through the gun passes through the wire guide tube 28, the passage 14, and the passage 23, into the central bore of the air cap. The combustion flame emerging from the jets 22 heats the wire tip and the blast gas flowing through the air cap impinges on the softened tip atomizing metal particles therein from and spraying the same away from the gun, as for example against the surface to be coated. The wire is initially fed through the gun from the rear through the rear wire guide tube 29, through the nip of the rollers 30, 31, into the forward wire guide tube 28. The roller 30 is driven by a suitable drive, as for example an electric motor or gas turbine, in a direction of the arrows. A gear 32 is connected to along side the roller 30 and a corresponding gear 33 is connected to along side the roller 31. The gears 32 and 33 mesh so that in effect the gear 33 is driven by the gear 32 and in turn drives the roller 31 so that both the rollers 30 and 31 may be considered positively driven.

As shown in FIG. 5, the drive is provided by means of a turbine wheel 34. This turbine wheel is driven by a jet of gas directed thereagainst from a nozzle which is fed from a suitable gas passage connected to the passage 35. Connected to the turbine through a shaft is the worm 36 which drives the worm gear 37 which, in turn, drives the worm 38 driving the worm gear 39 and thus the roller 39 and gear 32 through the connecting shaft.

The rollers 30 and 31 are of the conventional and well-known construction being provided with gripping teeth. The shaft on which the roller 30 and gear 32 are secured is mounted in suitable fixed bearings in the gun body. The roller 31 and gear 33 are rotatably mounted on the shaft 39 which is secured in the housing or shell 40. The housing 40 is pivotally connected to the gun body by means of the spring 41. When the housing 40 pivots in a counter-clockwise direction, the roller 31 is moved toward the roller 30, and when the housing 40 is pivoted in a clockwise direction, the roller 31 moves away from the roller 30. The teeth of the gears 32 and 33 are of sufficient length that the same may remain mated over a given adjustment of the distances between the rollers 30 and 31. An adjustable set screw 42 contacting a pad on the gun body limits the degree of pivoting of the housing 40 in counter-clockwise direction.

Mounted on the gun body behind the housing 40 is a pneumatically actuated cylinder arrangement. The arrangement consists of a piston 43 mounted in the cylinder 44 which is screwed to the end of the block 45. A piston rod 46 terminating as a plunger 47 extends through a corresponding bore in the block 45. The central portion of the rod 46 between the rear O-ring seals 48 and 49 has a reduced diameter, and the lateral bore 50 and axial bore 51 connect this segment of reduced diameter, which is sealed by means of the O-ring seals 48 and 49, with the cylinder space 52. A coil spring 53 urges the piston to its retracted position and an adjustment screw 54 limits this rearward travel as urged by the spring 53. The space in front of the piston is vented by means of a hole 55. The block 45 is secured to the gun body by means of the screws 56 and the pivot pin 41 extends through the forward portion of the block. The block is provided with a vertical gas flow passage which communicates with the space around the rod 46 between the rings 48 and 49. A corresponding passage 57 extends through the gun body and the mating points of the passage are sealed by means of the O-ring seal 58.

The portion of the paper plug valve 10 controlling the connection between 7 and the interior of the air cap 5 is provided with an O-ring seal 59 which leads to the rearwardly extending passage 60. Communication between the passage 60 and 57 is controlled by means of the valve member 61 which is in the form of a push-button valve, having the finger actuating extension 62. The valve 61 is axially movable and when in the position shown in FIG. 3, the passage 63 communicates the passage 60 with 57. When, however, the valve is axially moved inward, passage 64 which leads to the ambient atmosphere may be brought in register with the passage 57 and the passage 57 will be sealed from the passage 60 by means of the O-ring seal 59. The valve member 61 is spring loaded by means of the spring 66 and urges the same in a rearward direction. A cam follower 67 and cam 68 control the axial position of the valve member 61 so that as the button 62 is repeatedly pressed, the valve member will alternately take the position as shown in FIG. 3 and a position in which the register with the passage 64 and 57.

The cam 68 rotates freely on the valve member 61 and is secured against axial movement with respect thereto by means of the clip or washer 77 and the enlarged rear portion of the valve member 61. The cam, is shown in detail in FIG. 4, with the cam diagram being designated as 68a. The cam 68 is thus a rotary cam which is provided with an endless zig-zag cam slot 69 of alternate
varying lengths in the axial direction. Assuming that the cam follower 67 is engaged at the point 70 in the cam slot, the spring force acting in the direction indicated will hold the same at this point, and the valve member will be held in position with the passage 64 in communication with the passage 57. When the push-button 62 is pushed in, axially moving the valve member and cam, the cam follower will rise up along the inclined surface 71 causing the cam to rotate until the follower contacts the point 72 at which further movement is not possible. When, at this point, the button 62 is released, the spring 66 will push the cam in the opposite direction causing the inclined surface 73 to run 31 on the cam follower rotating the cam until the follower contacts the point 74 at which point the valve assumes the position of Fig. 3. On again pushing button 62 and axially moving the cam member, the inclined surface 75 contacts the cam follower again rotating the cam until the point 76 contacts the follower. At this point, button 62 cannot be pushed any further, and when released, the valve member and cam move axially so that the notch 70 engages in the cam follower again holding the valve member in the position so that the passage 64 is in register and communication with the passage 57. This repetition continuously occurs as the button 62 is pushed and released.

When the valve member is in the position shown in FIG. 3, the blast gas passing through the connection 7 to the air cap and turbine also flows through the T 59, passage 60, passage 63, and through the passage 57 and 56 to the space surrounding the rod 46 between the rings 48, 49. The gas then flows through the lateral passage 56, and axial passage 51 to the cylinder space 52 and acts on the piston 43 pushing the same against the spring 53, and thus axially moving the rod 46 and plunger 47 so that the plunger 47 contacts the housing 40 pivoting the bracket 28 so that the roller 36 firmly gripping the wire therebetween. The set screw 42 may be adjusted to limit the gap between the rollers. Upon pushing push button 62, the valve will operate in the manner previously described so that passage 64 will be in communication with the passage 57, venting the pressure from the cylinder space 52 to the ambient atmosphere through the passage 64. With the valve in this position, the O-ring 65 seals the passage 57 from the passage 60, and the spring 53 forces piston 43 rearward with the pressure from the interior of the piston flowing out through passage 64 to the ambient atmosphere. The amount that piston 43 may move rearwardly may be controlled by a suitable adjustment of the screw 54, and preferably this adjustment should be made so that the rolls 30 and 31 move sufficiently apart to allow the wire to slide freely therebetween without the gears 32 and 33 becoming disengaged.

In operation, with the valve member 61 positioned with the passage 64, in registry with the passage 57, but the valve 10 in the closed position, there is no pneumatic pressure on the piston 43 so that the same is forced to its rearward position by means of a spring 53. The operator inserts the wire into the gun, and by merely sliding the housing 70 to the guide 71, the wire 31 will move forwardly and feed wire from the roller 46 right 32 into the gun, causing the gun to move forwardly and project the wire forwardly. When the wire is cut, the wire backwards will force the roller 77 up the slot, thus wedging the wire in place. In order to inactivate the roller, the same may simply be snapped into the catch 80.

The operator then lights the gun in the conventional manner and when he desires to operate the gun, he simply presses the button 62 so that the same will assume the position shown in FIG. 3. This automatically pneumatically actuates the piston 43, pivoting the housing 40 so that the roller 36 moves towards the roller 32 engaging the wire therebetween and feeding the wire through the gun and spraying in the normal manner. At any time the operator can interrupt the feed of the wire without otherwise effecting the operation of the gun by simply pressing the button 62 in order to depressurize the piston space 52 and thus relieve the gripping pressures between the rolls 30 and 31. This allows a very simple and convenient way of interrupting the wire feed and spray without otherwise varying the gun settings.

In all other respects, the construction and operation of the gun is conventional.

While the invention has been described in detail with reference to the specific embodiments shown, 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 thus only intended to be limited by the appended claims or their equivalents wherein I have endeavored to claim an inherent novelty.

I claim:

1. In a flame spray gun having a blast gas conduit and a pair of wire feed rollers for feeding wire being sprayed through the gun with one of said rollers being positioned in a housing pivotally mounted for pivoting said roller toward and away from the other, the improvement which comprises a pneumatic piston cylinder arrangement having a plunger for actuation contact with said housing to pivot the same in the direction moving the roller positioned therein toward the other, a branch gas passage operationally connecting said blast gas conduit and said piston cylinder arrangement, and valve means mounted on said gun controlling the flow of gas through said branch gas passage.

2. Improvement according to claim 1 including spring means for urging said plunger in the opposite direction.

3. Improvement according to claim 2 in which said valve means comprise push-button valve means having a first position of actuation flow connecting said gas passage and blast gas conduit, and a second position of actuation sealing said gas passage from said blast gas conduit and ventilating the same.

4. Improvement according to claim 3 in which said valve means comprises a valve member axially movable between said first and second positions, a substantially cylindrical rotary cam coaxially surrounding said valve member, an endless zig-zag cam slot of alternate varying length in the axial direction of said valve member defined in said cam, means for manually forcing said valve member in one direction, spring means urging said valve member in the opposite direction and a fixed cam follower extending in said cam slot, whereby upon axially moving said valve member against said spring means, said cam rotates alternately locking said valve member in said first and second positions.

5. Improvement according to claim 1 including releasable lock means preventing rearward movement of the wire through said gun.

6. A push button valve for a flame spray gun comprising a valve member axially movable between an open and closed position, a substantially cylindrical rotary cam coaxially surrounding said valve member, an endless zig-zag cam slot of alternate varying length in the axial direction of said valve member defined in said cam, means for manually axially forcing said valve member in one direction, means resiliently urging said valve member in the opposite direction, and a fixed cam follower extending in said cam slot whereby upon axially moving said valve member said cam rotates alternately locking said valve member in said open and closed positions.

7. In a flame spray sprayer comprising a gas passage leading thereto and a pair of wire feed rolls for feeding the wire being sprayed through the gun, the improvement which comprises one of said rolls being po-
sitioned in a housing pivotally mounted for pivoting said roller toward and away from the other, pneumatic actuating means operationally connected to pivot said housing in the direction for moving the roller positioned therein toward the other, a branch gas flow passage leading from said first-mentioned gas passage to said pneumatic actuating means and a hand operated valve mounted on said gun controlling the flow of gas through said branch gas flow passage.

8. Improvement according to claim 7 in which said valve comprises a push button valve having a first position of actuation allowing the flow of gas through said branch gas flow passage to said pneumatic actuating means and a second position of actuation interrupting the flow of actuating gas through said branch gas flow passage to said pneumatic actuating means and venting the gas pressure therefrom.

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