Dec. 30, 1941. W. M. BRITTON 2,268,202

METAL SPRAY GUN

Filed Nov. 22, 1935 4 Sheets-Sheet 1

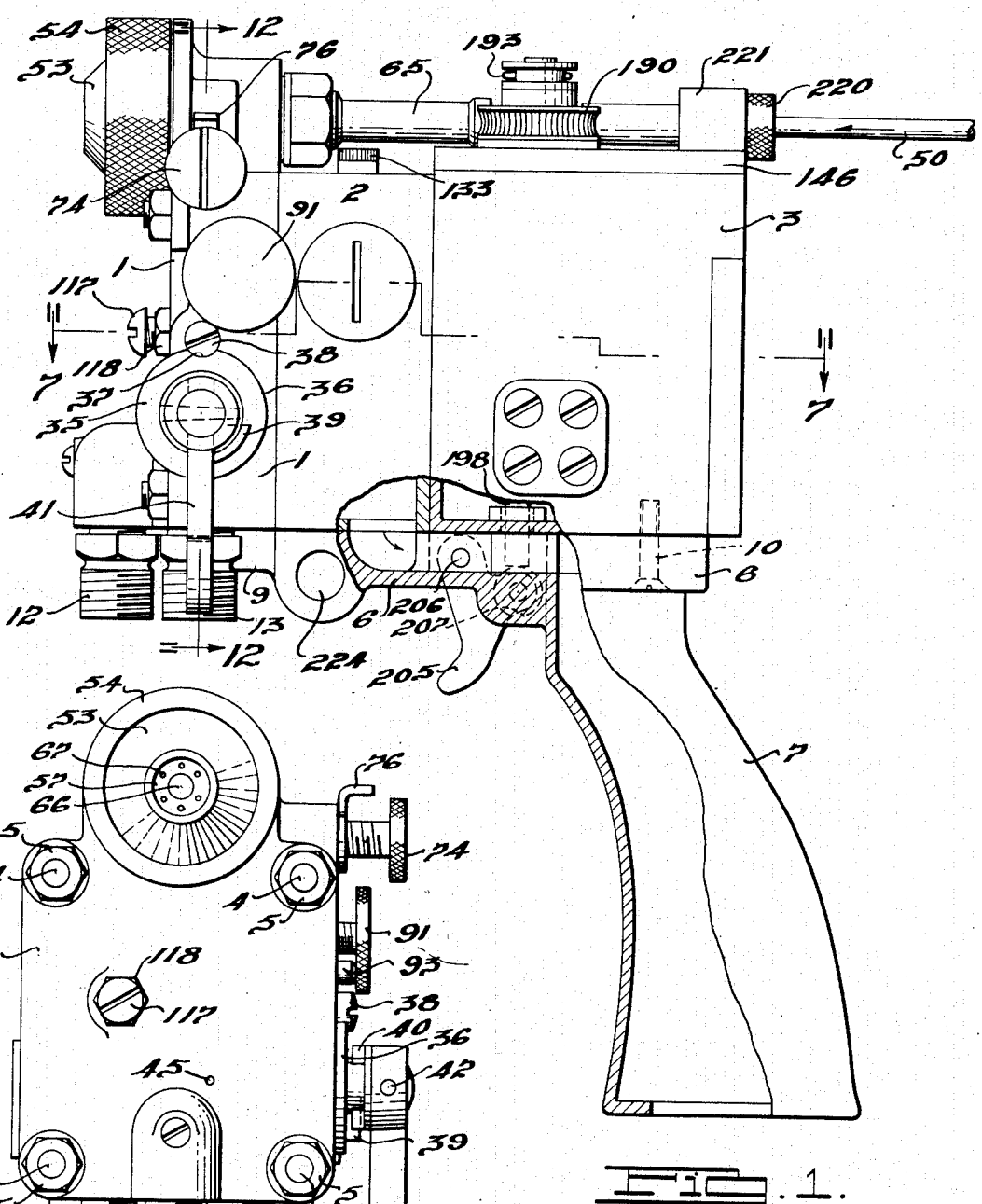

FIG. 1.

FIG. 2.

INVENTOR.
William M. Britton
BY Dike, Calver & Gray
ATTORNEYS.

Dec. 30, 1941. W. M. BRITTON 2,268,202

METAL SPRAY GUN

Filed Nov. 22, 1935 4 Sheets-Sheet 2

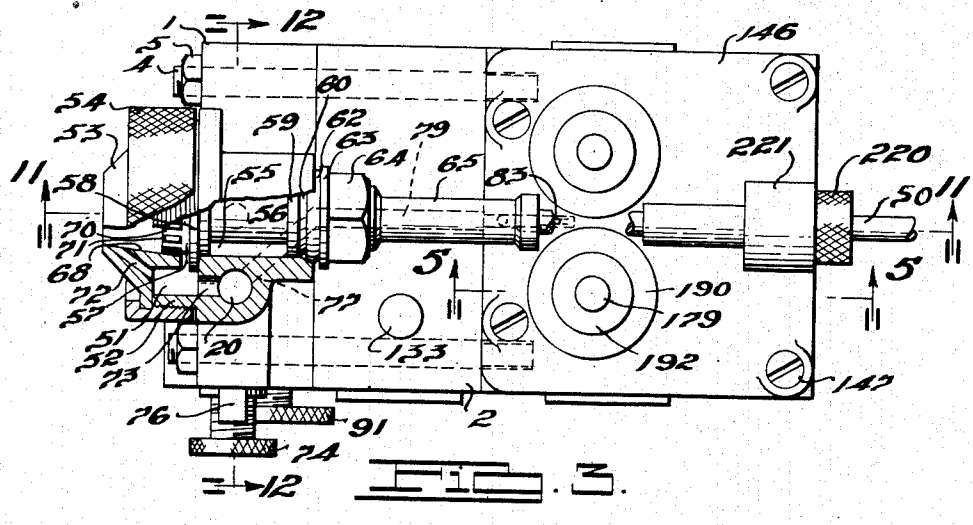

FIG. 3.

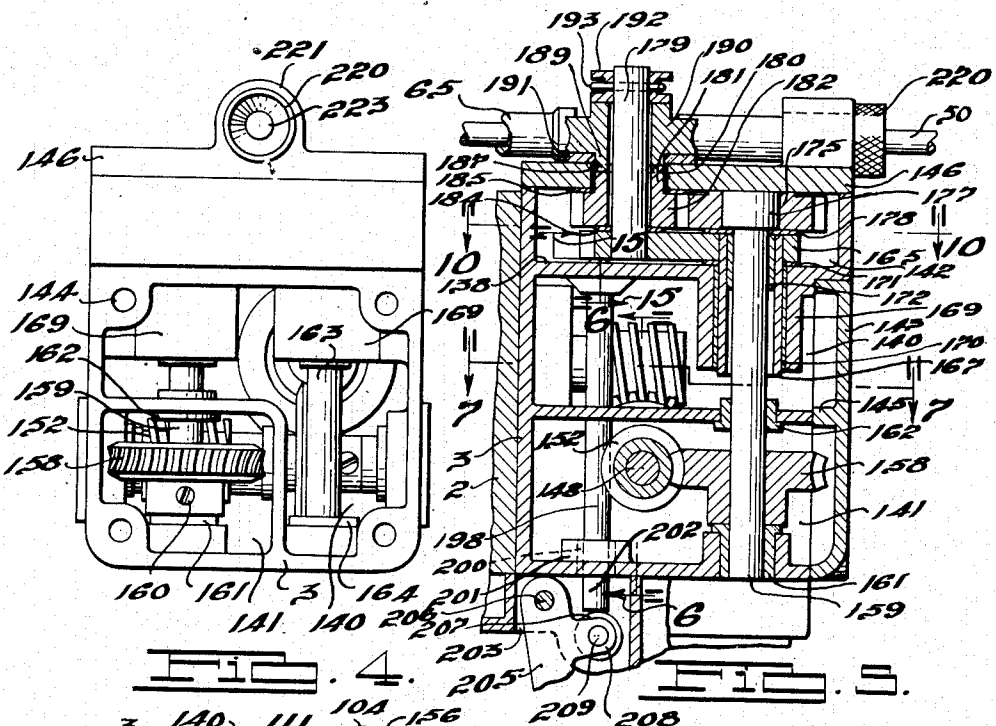

FIG. 4.

FIG. 5.

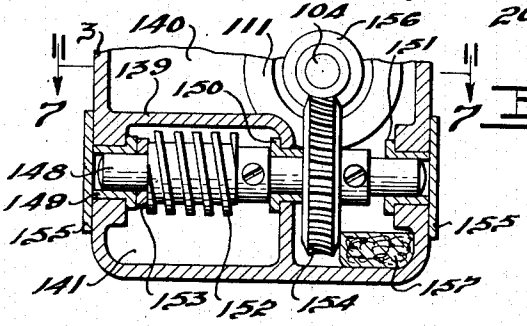

FIG. 6.

INVENTOR.
William M. Britton
BY Dike, Calver & Gray
ATTORNEYS.

Dec. 30, 1941. W. M. BRITTON 2,268,202

METAL SPRAY GUN

Filed Nov. 22, 1935 4 Sheets-Sheet 3

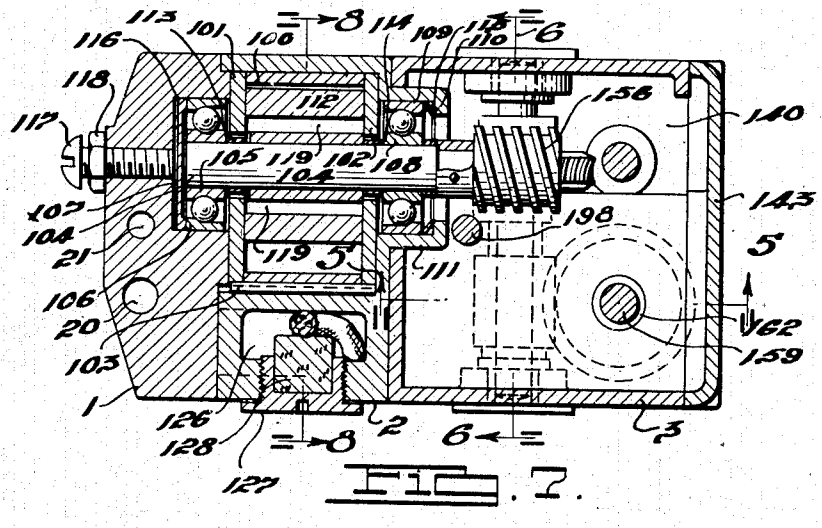

FIG. 7.

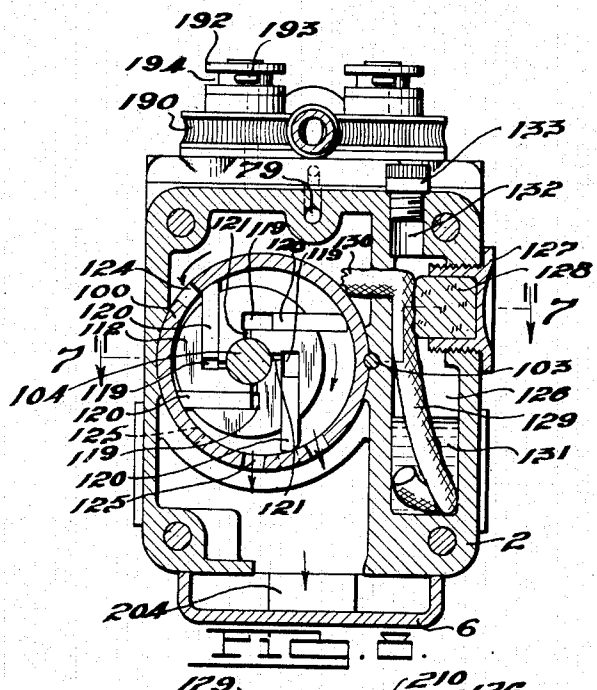

FIG. 8.

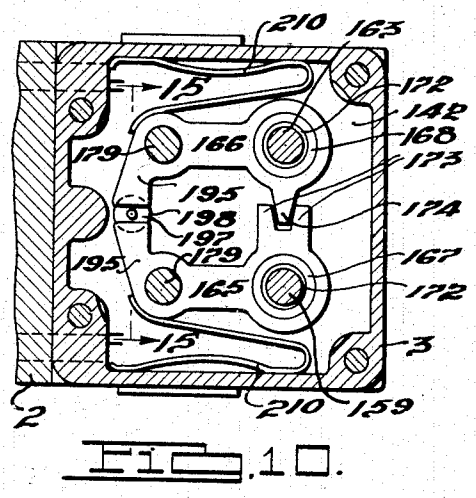

FIG. 10.

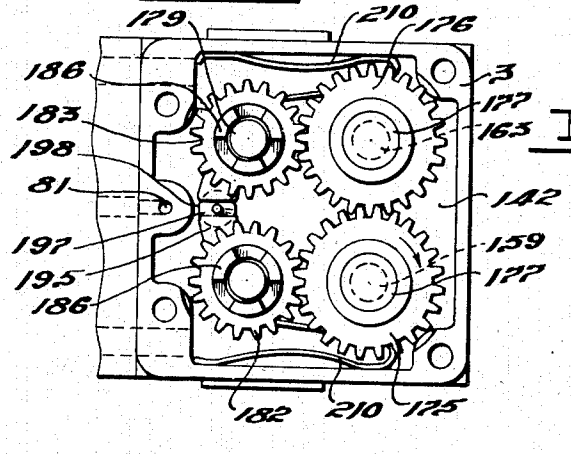

FIG. 9.

INVENTOR.
William M. Britton
BY Dike, Calver & Gray
ATTORNEYS.

Dec. 30, 1941. W. M. BRITTON 2,268,202

METAL SPRAY GUN

Filed Nov. 22, 1935 4 Sheets-Sheet 4

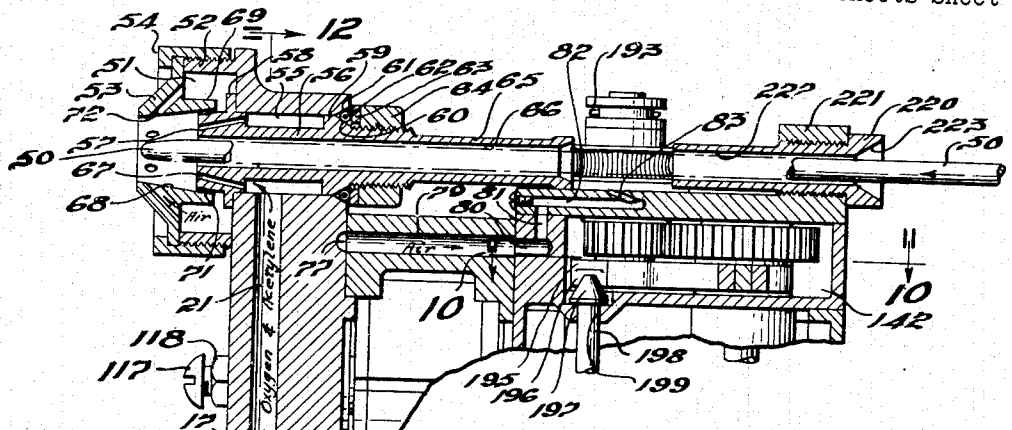

FIG. 11.

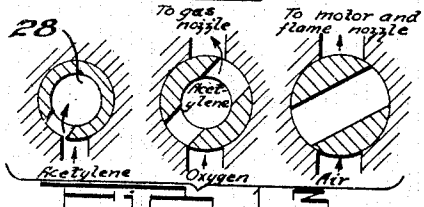

FIG. 13.

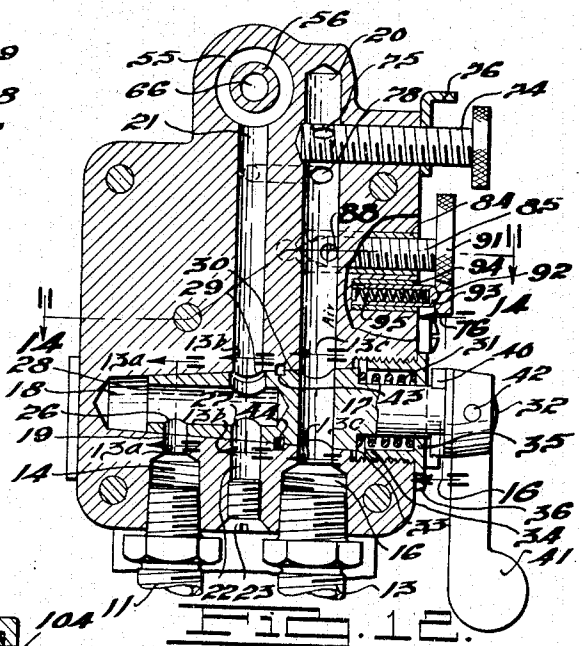

FIG. 12.

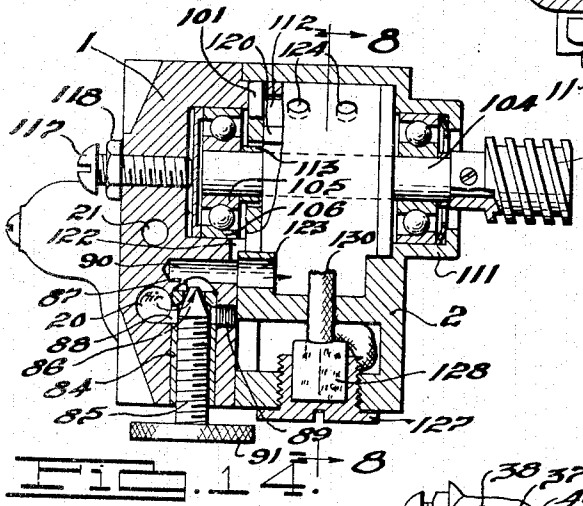

FIG. 14.

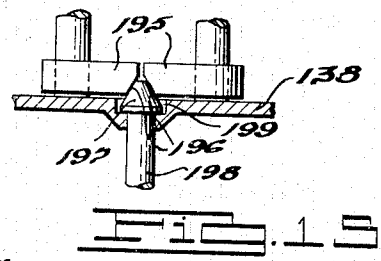

FIG. 15.

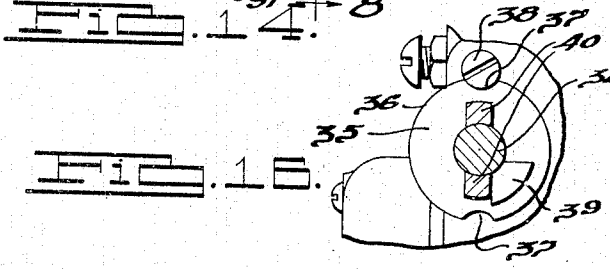

FIG. 16.

INVENTOR.
William M. Britton
BY Dike, Calver & Gray
ATTORNEYS.

Patented Dec. 30, 1941 2,268,202

UNITED STATES PATENT OFFICE

2,268,202

METAL SPRAY GUN

William M. Britton, Detroit, Mich.

Application November 22, 1935, Serial No. 50,997

9 Claims. (Cl. 91—12.2)

This invention is an apparatus for spraying molten metal commonly known as a metal spray gun, and is used for applying and intimately bonding a layer of metal to the surface of any metallic or non-metallic object. It is particularly, but not exclusively, useful in applying corrosion-resisting and heat-resisting metal coatings to ferrous objects, or in the coating of a base metal with a more valuable metal, or in the coating of a part made of a tough or of a soft cheap metal with a hard wear-resisting metal, or in the coating of a strong metal with a bearing metal, or in the applying of coatings of alloys, such as leaded bronze, by spraying a wire made up of a lead or lead-tin inner wire with a copper strip folded around the inner wire. This method of alloying gives a thoroughly uniform mixture of the metals, which result is difficult to obtain in any other way. It is also useful in coating non-metallic surfaces with metal, as in putting a metal finish on stone, concrete, plaster, or other surfaces, as is sometimes required in modern decoration, or in putting a metal finish on non-metallic decorative objects such as statues.

Metal spray guns prior to the gun of the present invention generally have been driven by air turbines which stall easily by kinks in the wire to be melted and sprayed by the gun. In contradistinction to conventional practice, the gun of the present invention utilizes a positive displacement air motor to drive the feeding mechanism and thus provides a gun which does not easily jam due to irregularities in the feed wire.

In metal spray guns made prior to the present invention it is necessary to insert a wire in the wire passage of the gas nozzle before lighting the oxyacetylene gas, in order to prevent the gas pressure in the wire-melting chamber from forcing the flame back through the wire passage of the gas nozzle and thereby overheating and burning other parts of the metal spray gun. In the present invention the flame in the wire-melting chamber is prevented from flowing back through the wire passage in the gas nozzle, and thus prevents the flame in the wire-melting chamber from overheating the empty gun.

An object of the present invention is to provide a metal spray gun in which the oxyacetylene flame in the wire-melting chamber will be directed forward into the flame nozzle at all times and not flow back through the wire passage when the gas is burning and the wire passage in the gas nozzle is not filled with wire.

Another object of the present invention is to provide a self-contained metal spray gun in which the metal wire or rod is fed by means of a positive displacement air motor whose torque will increase as the motor is slowed down by external resistance, the torque rising to its maximum as the speed of the motor approaches zero, so that the material-feeding means will be able to overcome such irregularities as kinks in the wire.

Another object of the present invention is to provide a metal spray gun having a positive displacement air motor which actuates a wire-feeding mechanism which will permit the gun to spray effectively, at the proper rate of wire feed, all of the different kinds of metal without changing gears or making changes in the wire-feeding mechanism.

Another object of the present invention is to provide a self-adjusting mechanism for feeding the wire or rod to be melted and sprayed which automatically accommodates selected different sizes of materials fed therethrough so that variations in the size of the wire or rod being fed to the gun will not affect its operation and so that the size of material being fed can be changed without it being necessary to replace or adjust the feeding mchanism. More specifically, an embodiment of the present invention provides a spray gun which can take in, melt, and spray any wire or rod from $\frac{1}{32}$ of an inch to $\frac{3}{16}$ of an inch in diameter, or even larger if desired, without it being necessary to change or adjust any parts of the gun except the flame nozzle and the gas nozzle, the wire-feeding mechanism being sufficiently flexible to accommodate without manual adjustment the varying sizes of wire or rod within selected limits for which the gun is designed.

Another object of the present invention is to provide a metal spray gun in which the feeding means can adjust itself to variations in the size of the wire or rod being fed while feeding the wire or rod forward on a predetermined straight path and without deviating therefrom.

Another object of my invention is to provide a metal spray gun in which the feeding means grips the wire or rod being fed with a force which is directly proportional to the resistance to feeding and which automatically increases as the resistance to feeding increases.

Another object of the present invention is to provide a metal spray gun in which the air motor is properly lubricated by a novel arrangement for automatically and continuously supplying a predetermined amount of oil thereto.

Another object of the present invention is to provide a metal spray gun in which separate

compartments are provided for separate kinds of lubricants adapted to particular purposes; for example, a fast turning worm on the motor shaft and its accompanying worm wheel can be supplied with light oil while slower turning gears can be packed with the proper kind of heavier grease.

Another object of the present invention is to provide a metal spray gun in which the hollow handle serves as a muffler and as a passage for the air exhausted from the motor, the interior of the handle being arranged with sound absorbing material or baffles if desired.

Another object of the present invention is to provide a metal spray gun in which the feeding of metal is under the instant control of the operator, the gun being provided with a trigger in front of the handle which stops the feeding when it is pulled back by forcing the drive wheels apart. This trigger control of the drive wheels also permits the wire to be readily inserted in the gun or withdrawn.

Another object of the present invention is to provide separate valves for controlling the air which operates the motor and the air which atomizes the molten metal so that the rate of feed can be easily regulated and the degree of atomization can also be regulated, independently of each other. This feature of the invention is particularly valuable in the spraying of metals which have a low melting point, and when it is desired to deposit the molten metal as hot as possible so that the metal being sprayed will fuse with the metal already deposited. The spraying of metal of low melting point requires the highest rate of feed of the metal wire being sprayed, which in turn requires a high air pressure for the air motor. In order to deposit the molten metal so that it will fuse with the metal already deposited it is necessary to use a lower pressure and volume of the atomizing air. This result is accomplished in the present invention by the use of the separate air control valves for the air motor and for the atomizing air.

Another object of the invention is to provide a metal spray gun in which there are positive means to hold the motor throttle in adjusted position so that the vibration, if any, of the motor and other mechanism will not change the adjustment of the valve controlling the air passing to the air motor.

Another object of the present invention is to provide a metal spray gun which is designed to provide fixed atomizing air jets which do not require adjustment and which are so placed as to discharge into the bore of the flame nozzle and so close to the molten metal that atomization of the metal is positively and quickly accomplished by the air passing through such jets.

Another object of the present invention is to provide a mixing valve in the nature of a stop cock for a metal spray gun which permits the fuel, oxygen and compressed air required by the gun to be turned on or off by a single control lever, and in which provision is made to prevent leakage of the compressed air into the passages carrying fuel and oxygen at a lower pressure.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification, in which is shown one preferred embodiment of the invention and wherein like reference characters designate corresponding parts in the several views.

Fig. 1 is a side elevation of a spray gun of the present invention, with a part of the handle and base broken away to show the exhaust passage from the air motor.

Fig. 2 is a front elevation of the spray gun of the present invention.

Fig. 3 is a plan view of the gun shown in Figs. 1 and 2, with part of the flame nozzle and spray head broken away to show the air and gas passages therein, and to show more clearly the structure of the gas nozzle.

Fig. 4 is a rear elevation with the rear gear case cover plate removed to show the arrangement of the gearing.

Fig. 5 is a section taken substantially on the line 5—5 of Fig. 3 in the direction of the arrows.

Fig. 6 is a section taken substantially on the line 6—6 of Figs. 5 and 7 in the direction of the arrows.

Fig. 7 is a section taken substantially on the lines 7—7 of Figs. 1, 5, 6 and 8, in the direction of the arrows.

Fig. 8 is a section taken substantially on the lines 8—8 of Figs. 7 and 14 in the direction of the arrows, but with the rotor and blades of the motor shown in elevation.

Fig. 9 is a plan view of the back part of the gun with the top gear case cover and the parts above it removed to show the parts inside of the upper compartment of the gear case.

Fig. 10 is a section taken substantially on the lines 10—10 of Figs. 5 and 11 in the direction of the arrows.

Fig. 11 is a central vertical section taken substantially on the line 11—11 of Fig. 3 in the direction of the arrows.

Fig. 12 is a section taken substantially on the lines 12—12 of Figs. 1, 3 and 11 in the direction of the arrows.

Fig. 13 is a diagrammatic sectional view taken substantially on the lines 13*a*, 13*b* and 13*c* of Fig. 12 showing the relative positions of the ports in the stop cock and the relations to the gas, oxygen and air ducts in the spray head when the stop cock is in the position to supply only acetylene to the gas nozzle at a time prior to ignition and formation of the melting flame.

Fig. 14 is a section taken substantially on the line 14—14 of Fig. 12 in the direction of the arrows.

Fig. 15 is a section taken substantially on the line 15—15 of Fig. 5 in the direction of the arrows.

Fig. 16 is a section taken substantially on the line 16—16 of Fig. 12 in the direction of the arrows.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation, and it is not intended to limit the invention claimed herein beyond the requirements of the prior art.

The preferred form of the gun illustrated by way of example in the accompanying drawings (see Fig. 3) has three main parts, a spray head 1, a motor case 2, and a gear case 3, which are secured together by means of studs 4 which are screwed into the front of the gear case 3 and extend through the motor case and spray head.

Nuts 5 on the ends of the studs hold these three main parts tightly together. The spray head 1, the motor case 2, and the gear case 3 are mounted on top of a one-piece base 6 and handle 7 by means of a screw 8 (Fig. 11) which extends up through a lug 9 at the front of the base into the bottom of the spray head 1, and a pair of screws 10 at the back of the base (Fig. 1), one on each side of the handle, extending up into the gear case 3.

Three nipples 11, 12 and 13 for acetylene, oxygen and air respectively, are screwed into three holes 14, 15 and 16 respectively in the bottom of the spray head at the front of the gun. The acetylene and air nipples are side by side and the oxygen nipple lies between and in front of them.

A main stop cock 17 (see Figs. 11 and 12) lies in a conical seat or bore 18 in the lower part of the spray head 1 and is directly above the acetylene and air nipples 11 and 13. A short drilled acetylene duct 19 leads up from the hole 14 into which the acetylene nipple 11 is screwed and serves to conduct acetylene from the nipple to the stop cock. A main air duct 20 extends vertically up from the hole 16, into which the air nipple 13 is screwed, through the seat 18 of the main stop cock, and up to the top of the spray head 1. A drilled passage 21, 22 extends up from the bottom of the spray head 1 to the top, passing through the seat 18 of the main stop cock. The upper part of this passage forms the gas duct 21, while the lower part forms the oxygen duct 22 whose lower end is plugged by a screw 23. A horizontally drilled hole forms a connecting duct 24 between the hole 15 into which the oxygen nipple is screwed and the oxygen duct 22, the forward end of the drilled passage being plugged by a screw 25.

The stop cock 17 has an acetylene hole 26 and an oxygen hole 27 which are placed so as to register with the acetylene and oxygen ducts 19 and 22 respectively as the stop cock is turned. These two holes 26 and 27 lead to a gas mixing chamber 28 which is bored in from the end of the stop cock 17. On the other side of the stop cock and opposite the acetylene and oxygen holes is a gas hole 29 which is located so as to register with the lower end of the gas duct 21. An air hole 30 extends directly through the stop cock 17 and is placed so as to be aligned with the main air duct 20.

As shown in Figs. 11, 12 and 13, the various holes 26, 27, 29 and 30 in the main stop cock are of different sizes and are not parallel, the gas hole 29 in particular being larger than the oxygen hole 27. They are so arranged that as the stop cock is rotated from its closed position with the handle 41 extending straight forward, towards its open position with the handle extending straight down, the acetylene hole and the gas hole begin to come into registry with their respective ducts first. This allows acetylene to reach and flow out of the nozzle before oxygen is supplied thereto and before air is supplied to either the motor or the nozzle, so that the gas can be easily lit. Further rotation of the stop cock 17 opens the oxygen duct so that the flame is supplied with oxygen and is burning properly before the atomizing air is supplied to the nozzle, which otherwise might blow it out.

The stop cock 17 is retained in its seat or bore 18 by means of a coil spring 31 which surrounds the stem 32 and presses against a shoulder 33 on the stop cock. This spring lies in a counter-bore 34 in the side of the spray head 1 and concentric with the stop cock 17. The spring is held in place by a hollow cup-shaped retainer 35 which screws into the counter-bore 34 and encloses the spring 31, the stem of the valve extending through the head of the retainer. The head of the retainer (see Fig. 16) has a flange 36 which lies against the side of the spray head 1 and which has two notches 37 into either of which the lock screw 38 fits to keep the retainer from rotating. A stop 39 on the head of the retainer 35 cooperates with two lugs 40 on the stop cock handle 41, which is secured to the stem 32 of the stock cock by a tapered pin 42 to allow the stop cock to be turned through only 90°.

If the stop cock 17 is not a perfect fit in its bore 18, a slight leakage will occur along the bore from the air hole 16 to the oxygen hole 14, unless means are provided to prevent it. Such leakage occurs because the air is at a much higher pressure than the oxygen and the acetylene and results in dilution of the oxygen and acetylene so that the flame will not burn properly when the gases are first turned on, and, if allowed to continue so that the pressure builds up in the gas holes, may cause damage. Such leakage can be prevented by careful periodical lapping of the valve, but these operations are costly and unsatisfactory in a commercial gun. To eliminate such lapping, I provide two small grooves, one 43 extending around the stop cock 17 between the air hole 30 and the oxygen and gas holes 27, 29, and the other 44 extending around the inside of the bore 18 and being so placed as to form with the groove 43 an annular duct lying half in the stop cock and half in the wall of the bore. This annular duct is vented toward the front of the spray head by a vent 45 so that any air which leaks along the stop cock is vented to the exterior of the gun.

The upper part of the spray head 1 (see Figs. 3 and 11) carries on its front face the atomizing air chamber 51 which is formed by a forwardly projecting annular wall 52 and a flame nozzle 53. The nozzle is secured to the front of the atomizing air chamber by means of a cylindrical cap 54 which fits over it and screws on to the exteriorly threaded wall 52 of the atomizing air chamber. Extending rearwardly through the spray head 1 from the atomizing air chamber is a cylindrical gas chamber 55 into which the gas duct 21 opens. A gas nozzle 56, preferably of stainless steel, extends through the gas chamber 55, and the rear end of the head 57 of the nozzle 56 fits into the front end of the gas chamber 55. The head 57 of the gas nozzle 56 has a circumferential flange 58 which lies against the back of the atomizing air chamber 51 and which holds the head of the nozzle from sliding into the gas chamber 55. A collar 59 surrounds the stem of the gas nozzle and fits into the rear part of the gas chamber 55. The back of the collar 59 is tapered, forming a conical shoulder 60, and the extreme rear end 61 of the hole forming the gas chamber 55 flares out so that a rearwardly facing annular V-shaped groove is formed. This groove serves to receive an annular copper-asbestos gasket 62 which prevents gas from leaking back out of the gas chamber. The gasket is pressed into the groove by a washer 63 and the nut 64 screwed on to the gas nozzle 56. The entire length of the gas nozzle, including an extension 65 which extends out in back of the nut 64, is

pierced by a bore 66 through which the wire 50 is fed into the flame nozzle 53.

The head 57 of the gas nozzle (see Fig. 11) is pierced by six small jet holes 67 which extend forward from the gas chamber 55 to the front of the nozzle and converge towards the end of the wire 50. The gas in the gas chamber 55, a mixture of acetylene and oxygen, flows out of these jet holes and forms upon ignition an oxy-acetylene flame which converges upon and melts the end of the wire 50.

A tapered bore 68 concentric with the gas nozzle 56 extends back through a stainless steel flame nozzle 53 and a cylindrical projection 69 on the back thereof. The front of the head 57 of the gas nozzle projects forward into the bore 68 of the flame nozzle and has an annular series of lands 70 (see Fig. 3) on its rim, the tops of the lands fitting against the surface of the bore 68. The grooves 71 between the lands form air passages opening from the atomizing air chamber 51 into the bore of the flame nozzle and serve to direct a thin annular sheet of air along the surface of the bore to protect the flame nozzle from the heat of the flame which is melting the wire 50. The flame nozzle (see Fig. 11) is pierced by six sharply converging air jet holes 72 leading from the atomizing air chamber 51 to the bore of the nozzle. The atomizing air jets issue from these holes and impinge upon the molten end of the wire 50 and atomize it and spray it on the work to be coated. The atomizing air reaches the atomizing air chamber (see Fig. 3) through a duct 73 leading from the upper end of the main air duct 20. The atomizing air is controlled by a cock 74 (see Fig. 12) which screws into the side of the spray head and intercepts the duct 20. The end of the cock 74 has a hole 75 through which the atomizing air can flow when the hole is aligned with the air duct 20. A lock nut 76, threaded onto the atomizing air control cock 74 and screwing up against the side of the spray head 1, serves to hold the cock in its adjusted position.

A drilled passage 77 (see Figs. 3, 11 and 12) leads diagonally back to the rear face of the spray head from a point 78 in the air duct 20 just below the atomizing air control cock 74. This passage connects with a series of passages 79, 80, 81 and 82, which terminate in a jet hole 83 and form a duct to lead compressed air thereto. This jet hole 83 lies in back of and below the end of the bore 66 in the flame nozzle 56 and is aimed so as to direct a jet of air into the bore of the flame nozzle when the wire 50 is withdrawn. This jet of air entering the rear end of the gas nozzle prevents the flame in the bore of the flame nozzle from flowing back through the gas nozzle when the gun has been lit and before a wire is inserted or when the gun has used up a piece of wire and a new piece has not yet been fed into place. When a wire is in place, the jet strikes the bottom of the wire and is deflected to the sides so that it does not flow through the wire passage in the nozzle and lower the temperature of the oxyacetylene flame.

The flame nozzle is kept from overheating by the atomizing air jets which flow through it and cool it and by the jets of air from the grooves 71 which shield it from the heat of the flame. The gas nozzle is kept from overheating by the gas flowing through the jet holes 67 and by the air flowing through the grooves 71 between the lands 70 on its rim (see Figs. 3 and 11).

The spray head 1 (see Fig. 14) carries the means for controlling the supply of air to the motor. This consists of a throttle sleeve 84 pressed into a transverse horizontal hole just in back of the main air duct 20. The throttle 85 screws into the threaded bore of the sleeve 84 and has a conical end 86 which fits into the hole 87 in the end of the sleeve, forming a needle valve. Air reaches the interior of the sleeve around the base of the conical end 86 of the throttle through a connecting duct 88 which is drilled from the back of the spray head 1 after the sleeve 84 has been pressed into place and before the throttle 85 is screwed in, the end of the duct near the motor case 2 being plugged by a screw 89. The hole 87 in the throttle sleeve connects to a motor air duct 90 which serves to lead the air from the throttle to the motor case.

The shell of the motor (see Figs. 7 and 8) is composed of a cylindrical motor liner 100 and circular front and rear end plates 101, 102. These three circular parts are prevented from rotating by a key 103 which lies partly in a groove in the motor case and partly in a groove in the motor liner and in notches in the edges of the motor end plates 101, 102. The shaft 104 of the motor extends horizontally through the motor liner and end plates and is eccentric thereto. The front end of the shaft is carried by the inner race 105 of a ball bearing whose outer race 106 is slidably mounted in a cylindrical recess 107 in the back face of the spray head 1. The rear part of the shaft 104 passes through and is supported by the inner race 108 of a second ball bearing at the back of the motor. The outer race 109 of this second bearing is slidably supported in a cylindrical recess 110 which is coaxial with the recess 107 in the spray head and is formed in a boss 111 which projects rearwardly from the main body of the motor case 2 into the gear case 3. The rotor 112 of the motor is pressed onto the shaft and lies between the two inner bearing races 105 and 108, being separated therefrom by sleeves 113 and 114. A spring washer 115 rests in the back of the recess 110 at the back of the motor case and presses the outer race 109 of the rear ball bearing forward. The outer race 106 of the front bearing is held back by an adjusting plate 116 which lies in front of the front bearing in the recess 107 and which has a rim which bears against the outer race. This adjusting plate is positioned by means of an adjusting screw 117. This screw screws in from the front of the spray head 1 and bears against the center of the adjusting plate 116 and is secured in position by a lock nut 118. The inner and outer races 105, 106, 107, 108 of both bearings are so formed that they will transmit thrust from the spring washer 115 to the adjusting plate 116. Thus, by turning the adjusting screw 117 in and out, the rotor 112 can be adjusted back and forth so that it will have equal clearance at both ends.

The rotor 112 has four slots 119 spaced equally around its circumference and extending parallel to and at one side of the shaft 104. Each of these slots contains a rectangular vane 120 made of Bakelite or other suitable material which can slide in and out of the slot with its rounded outer edge bearing against the inner surface of the motor liner 100 as the rotor turns. The front end of the rotor has four small groves 121 which lead from the shaft 104 to the bottoms of the slots 119. These grooves serve to admit air to the space in the bottom of the slots 119 under

the vanes 120. The air reaches these grooves from the throttle opening 87 (see Fig. 14) by passing successively through the motor air duct 90, through a connecting slot 122 in the back of the spray head 1 between the motor air duct 90 and the front motor bearing recess 107, through the clearance space between the front motor bearing 105—106 and the front motor end plate 101, and through the clearance space between the front motor shaft sleeve 113 and the sides of the shaft hole in the front motor end plate 101. The air thus admitted under the vanes 120 pushes them out against the inner surface of the motor liner when the throttle is opened to supply air to the motor, preventing the air from flowing around the rotor without acting on it.

The air which turns the rotor enters the upper part of the motor case 2 from the duct 90 in the spray head through the duct 123 which registers with it. This air passes through the inlet ports 124 in the motor liner and, being under pressure pushes against the vanes at each side of the port. Due to the relative position of the ports 124 and the shaft 104, the vane which lies to that side of the port in which it is desired that the motor turn, presents a larger area to the pressure of the air than the other. The unbalanced force, resulting from the unequal areas, turns the rotor. Similar unbalanced forces on the opposing faces of adjacent blades lying between the inlet ports 124 and the exhaust ports 125 in the direction in which the rotor turns also cause rotation of the rotor. A large number of exhaust ports 125, spaced around the lower part of the motor liner 100, are provided so that the air in the space between the vanes can escape as that space becomes smaller as it approaches the inlet ports 124.

One side of the motor case 2 forms an oil chamber 126, access to which is provided by means of a removable plug 127 screwed in the side of the motor case 2. The plug is hollow and contains a piece of cork 128 which serves to frictionally hold an oil wick 129 in place. The upper end 130 of this wick projects through the wall of the oil chamber 126 and rests on the motor liner 100 directly in line with the motor air duct. The oil chamber 126 contains a quantity of light oil, such as spindle oil, into which the lower end of the wick dips, thus keeping the wick saturated. The air entering the motor case through the duct 123 impinges upon the end of the wick and picks up minute drops of oil which are carried into the motor and serve to lubricate it. In order that the oil supply may be replenished without removing the plug 127 and disturbing the wick, an oil chamber filling hole 132 is provided in the top of the motor casing which is closed by a plug 133 which screws into it.

The gear case 3 (see Figs. 4, 5 and 6) is divided into three compartments by an upper horizontal partition 138 and a lower longitudinally extending L-shaped partition 139. The space between the two partitions forms a high speed gear compartment 140. The rectangular space at one side of the lower part of the gear case enclosed by the L-shaped lower partition forms an intermediate speed gear compartment and the space in the top of the gear case whose bottom is formed by the upper partition 138 forms a low speed gear compartment 142.

The back of the gear case is closed by a removable rear gearcase cover 143 secured in place by screws extending into the tapped holes 144 in the body of the gear case. This rear cover has a rib 145 on its forward face which is shaped to fit against the rear end of the lower gear case partition 139. A top cover 146 is secured to the top of the gear case 3 by means of screws 147 and serves to enclose the upper low speed gear compartment 142.

A jack shaft 148 (see Fig. 6) extends transversely through the lower part of the gear case, part of the shaft being in the small intermediate speed gear compartment 141 and part of the shaft being in the high speed gear compartment 140. This shaft is journalled in bronze bushings 149, 150 and 151 which are inserted in holes in the sides of the motor case 3 and in the partition 139. The part of the shaft in the intermediate speed compartment 141 carries a worm 152 which is secured thereto by means of a set screw. One end of the worm bears against a collar on the bushing 150 and the space between the other end of the worm and the collar on the bushing 149 is filled by a washer 153 whose thickness may be varied to secure the proper end clearance. This arrangement positions the shaft axially. The part of the shaft in the high speed gear compartment carries a worm gear 154, and the ends of the shaft lying in the bushings 149 and 151 in the sides of the gear 3 are enclosed by cover plates 155 screwed onto the sides of the gear case. The worm gear 154 is driven by the worm 156 which is secured onto the rear end of the motor shaft 104 which projects into the high speed gear compartment 140 of the gear case 3 from the rear motor bearing boss 111. The worm gear 154 and the worm wheel 156 are lubricated by means of a felt pad 157 in the bottom of the gear case. This pad is kept saturated with thin oil, such as spindle oil, and bears lightly against one side of the worm gear 154. The oil thus applied to the side of the worm gear runs out onto the teeth of the gear and serves to lubricate them and the worm 156 which engages them.

The jack shaft worm 152 (see Figs. 4, 5 and 6) in the intermediate speed gear compartment 141 meshes with a worm gear 158 mounted on a vertical drive gear shaft 159, being secured thereto by means of a set screw 160. The lower end of this shaft is journalled in a bushing 161 pressed into a hole in the bottom of the gear case 3 and the central portion is journalled in a bushing 162 pressed into the part of the partition 139 forming the top of the intermediate speed gear compartment 141.

The drive gear shaft 159 lies in the rear portion of and to the left of the center of the gear case 3. A similar drive gear shaft 163 is disposed symmetrically with respect to the drive gear shaft 159, the lower end of the shaft being journalled in a bushing 164 similar to the bushing 161. This shaft, however, lies wholly in the high speed gear compartment 140 and in the low speed compartment 142, and does not carry a worm wheel.

Two yoke arms 165, 166 (see Figs. 5 and 10) are located in the upper low speed gear compartment 142 and are carried by depending sleeves 167, 168 which are journalled in bearing bosses 169. These bosses project downwardly from the upper gear case partition 138 into the large high speed gear compartment 140. The holes in the bearing bosses 169 are lined by bronze bushings 170 which form bearings for the yoke arm sleeves 167, 168 and bearing washers 171 around the yoke arm sleeves space them from the partition 138. The bosses 169 and the yoke arm sleeves 167, 168 are coaxial with the

vertical drive gear shafts 159 and 163 which project up through the sleeves 167, 168 into the upper gear compartment 142. The upper end of the sleeves 167 and 168 are lined with bronze bushings 172 which form bearings which support the upper ends of the drive gear shafts 159 and 163. The ends of the yoke arms 165, 166 which are secured to the sleeves 167, 168 are provided with engaging gear teeth 173, 174 which make the two arms move the same amount when they swing in or out.

A pair of drive gears 175, 176 (see Figs. 5 and 9) are securely pressed onto the enlarged upper ends 177 of the drive gear shafts 159, 163 above the yoke arms 165, 166, being spaced therefrom by means of bronze bearing washers 178. These gears mesh so that the right drive gear 176 is driven from the left drive gear 175, which in turn is driven through the left gear shaft 159 by the worm gear 158. The forward ends of the yoke arms carry upwardly extending vertical drive wheel supporting pins 179 which are pressed into holes in the yokes. These pins (see Fig. 5) project through transverse oval apertures 180 in the top gear case cover 146. These apertures are large enough to also accommodate the upwardly projecting hubs 181 of a pair of drive wheel pinions 182, 183 which are journalled on the two drive wheel supporting pins 179. Washers 185 serve to close the part of the aperture not occupied by the drive wheel supporting pins 179 and the hubs 181 of the drive wheel pinions 182, 183. The tops of the hubs 181 are each formed into three upwardly projecting clutch teeth 186 which engage similar downwardly projecting clutch teeth 187 which are formed on the bottoms of the hubs 189 of a pair of drive wheels 190. The rims of the drive wheels are concave and are serrated so as to center the wire placed between them and secure a driving engagement with it. These drive wheels are journalled on the drive wheel supporting pins 179 and are supported by bronze washers 191 which rest upon the upper surface of the top gear case cover plate 146. They are held in place by means of retaining collars 192 secured to the tops of the drive wheel supporting pins 179 by means of cotter pins 193. The collars are provided with circumferential grooves 194 into which the heads and the spread ends of the cotter pins fit.

The front ends of the yoke arms have inwardly directed projections 195 (see Figs. 10 and 15) which almost meet in the central vertical plane of the gun. The bottom edges 196 of these projections 195 are beveled and rest against a conical head 197 on a vertically extending yoke control rod 198. The head normally rests in a recess 199 in the partition 138 forming the bottom of the upper gear compartment 142. The yoke control rod (see Fig. 5) extends down through the gear case 3 and projects out from the bottom thereof through a bushing 200 into a hollow boss 204 within the base 6 (see Fig. 8). The lower end 202 of the yoke control rod 198 lies in a vertical slot 203 in a central boss 204 on top of the floor of the hollow base 6.

The trigger 205 has its upper end projecting up into the slot 203 and is journaled on a transverse pivot pin 206 whose ends extend into the side walls of the boss 204. A trigger roller 207 is rotatably mounted between two lugs 208 on the back of the trigger 205 by means of a pin 209 which extends through the lugs and the roller.

The ends of the drive wheel yoke arms 165, 166 carrying the drive wheels are pressed towards each other by means of U-shaped springs 210 (see Fig. 10) which rest against the sides of the gear compartment 142. Pulling the trigger raises the yoke control rod 198 whose conical head 197 (see Fig. 15) wedges the two yoke arms apart. This separates the drive wheels 190 and moves them away from the wire 50. Thus, pulling the trigger stops the feeding of wire to the nozzles and stops the spraying of metal. When the trigger is released and the drive wheels engage a wire or rod between them, they automatically grip the wire or rod tightly, because the drive gears 175, 176 act on the drive wheel pinions 182, 183 and push them and the yoke arms toward each other.

The wire guide 220 (see Fig. 11) screws into a boss 221 on the top of the top gear case cover. The bore 222 of this wire guide is aligned with the bore 66 of the gas nozzle 56 and its rear end 223 is flared so as to facilitate the insertion of the wire therein. The forward end of the wire guide 222 is spaced from the rear end of the extension 65 on the gas nozzle 56, the space between the two lying between the drive wheels 190 so that the drive wheels pressed together by the spring 210 can engage the wire 50.

In the forward part of the base 6 (see Fig. 1) there is a transverse horizontal hole 224 by means of which the spray gun can be mounted on a support when it is not desired to hold it in the hand. This facilitates mounting the gun on the tool carriage of a lathe to deposit a uniform layer of metal on an article being rotated in the lathe and in mounting it on an extension handle or other support.

Although they have not been shown in the the drawings, in order to avoid complication, the gun is provided with suitable gaskets under all the various cover plates and between the various parts of the gun which are bolted or screwed together so that all the compartments, ducts, and chambers in the gun are proof against the leakage of oil, grease, air or gas, whichever they may contain.

A metal spray gun of the present invention is is very desirable from the standpoint of operation in that it provides a compact and easily handled device which is readily operated by the operator and which requires the minimum of attention from the operator during the metal spraying operation.

The flame in the flame nozzle is controlled by a manually operable valve 17 which acts as a mixing chamber or valve for the fluid fuel which is supplied to the flame nozzle, this fluid ordinarily being a mixture of oxygen and acetylene, the proportions and amounts of which are regulated by the pressure-reducing valves (not shown) on the supply tanks or cylinders commonly used for storing such fluids. After the proper mixture is obtained, the operator turns the valve 17 to the "on" position and the mixture of oxygen and acetylene passes through ducts in the body portion of the gun to the gas nozzle 56. After passing through the gas nozzle 56, the fuel is ignited in the flame nozzle 53 and the heat resulting therefrom is brought to bear upon a metal, such for example as the feed wire 50, causing it to become melted as it passes continuously into the flame. The metal becomes melted in the flame nozzle bore 68 and is there atomized by the atomizing air passing through the atomizing air jets 72. Air is supplied to the atomizing air jets from the atomizing air chamber 51, to which air is supplied through the

atomizing air duct 73. The air passing through the atomizing air jets 72 forms a spray which thereafter carries the molten metal in finely comminuted form to the article or object upon which the metal is to be deposited. The metal at this time is in the condition of a fluid mist or spray and becomes solidified almost immediately upon coming in contact with the article or object upon which it is to be deposited.

The metal is fed to the atomizing nozzle by means of feeding wheels 190 which are power driven by means of a positive displacement fluid pressure motor mounted in the body of the spray gun and operatively connected with said feeding wheels by means of a speed reduction gearing mechanism. The drive wheels are mounted on pins 179 which are movable relative to the wire in such a manner that variations in sizes of the wire are accommodated by movement of the dive wheels relative to the longitudinal axis of the wire. The feeding wheels 190 may be moved outwardly away from the wire at the will of the operator, and so out of driving relation to the wire, by manipulation of the trigger 205 which moves a pin 198 carrying a conical head portion 197 in an upward direction and so causes an outward movement of the pins 179 and the attached feeding wheels 190 away from engagement with the wire. During the time of this movement, however, the drive wheels 190 are still in the positive driving relation with the fluid pressure motor but do not engage the wire which is to be fed therethrough.

The fluid pressure motor which is herein provided is of the positive displacement type and is provided with exhaust ports which communicate with a chamber in the interior of the hollow handle 7 wherein the sounds carried by the exhaust are muffled. Thus the gun of the present invention is comparatively silent in operation, noises attendant upon the operation of a positive displacement fluid pressure motor being largely attenuated in the muffling chamber inside the handle 7.

I claim:

1. A metal spray gun comprising means for melting, atomizing and spraying a metal, and a metal feeding device adapted to feed metal to said means for melting, atomizing and spraying metal and actuated by a motor, said feeding device comprising opposed movable feeding rolls located on opposite sides of the path of the metal to be fed through the gun, said rolls being resiliently mounted and maintained in a position to yieldingly grip the metal passing therethrough and to move synchronously in response to variations in sizes of the metal to be fed therethrough.

2. A metal spray gun comprising a spray head having metal melting and fluid pressure atomizing jet holes therein, a metal feeding passage in said spray head, a metal feeding device for feeding metal through said passage, and a control interposed between said passage and said feeding device and adapted to keep the melting flame forward of said passage, said control comprising means forming a passageway leading to said metal feeding passage and means for directing fluid under pressure to said passageway.

3. A metal spray gun comprising a spray head having metal melting and fluid pressure atomizing jet holes therein, a metal feeding passage in said spray head, a metal feeding device for feeding metal through said passage, and a control interposed between said passage and said feeding device and adapted to keep the melting flame forward of said passage, said control comprising a jet discharging at a point between said passage and said feeding device, and a port communicating with said jet to supply a flow of fluid under pressure which is discharged as a fluid curtain between said passage and said metal feeding device.

4. A metal spray gun having a spray head, fuel jet holes in said spray head, a fuel supply system communicating with said jet holes, a valve forming a part of said system and comprising a movable valve member having a chamber therein for admixing fluids to provide the fuel supplied to said jet holes, and ports extending through said member and communicating with said chamber to supply unmixed fuel forming fluids thereto.

5. A metal spray gun comprising a spray head, a flame nozzle therein, atomizing jets associated with said head, a fuel supply system for furnishing a fluid fuel to said flame nozzle and a fluid supply system for furnishing a fluid to said atomizing jets at pressures different from the fluid pressures on the fuel supplied to said flame nozzle, a control valve associated with said systems and adapted to control by a single operation the flow of fuel to said nozzle and of fluid under pressure to said atomizing jets, and a duct discharging to the atmosphere concentric with said valve and interposed between ports communicating with said fuel supply system and ports communicating with said atomizing fluid supply system whereby fuel or atomizing fluid seepage around said valve is entrapped and carried away from said valve without affecting the relative differences in pressures between said fuel and said atomizing fluid.

6. A metal spray gun of the class described comprising a body, a burner, a movably mounted feed roller adapted to feed a wire to said burner, means to drive said feed roller comprising a power actuated shaft having its axis eccentric with the axis of said feed roller and means adapted to transmit power from said shaft to said feed roller, the shaft being so located that the driving force transmitted to said feed roller presses said feed roller towards the wire.

7. A metal spray gun of the class described comprising a body, a handle, a burner, a movably mounted feed roller adapted to feed a wire to said burner, means to drive said feed roller, a trigger forward of said handle adapted to move said feed roller in relation to said wire.

8. In a metal spray gun adapted to melt unmelted material and to atomize and spray the molten material, a substantially cylindrical gas nozzle associated therewith and having a channel in the outside cylindrical surface and between the ends of said nozzle, and material melting fuel jet holes in said nozzle communicating with said channel.

9. A metal spray gun comprising means for melting a metal wire, and for atomizing and spraying the molten metal, and a wire feeding device adapted to feed wire to said means for melting, atomizing and spraying, said feeding device comprising feeding rolls adapted to rotate on movably mounted non-rotating pins, means for driving said feed rolls, and means for moving said pins in reference to said wire.

WILLIAM M. BRITTON.