

Aug. 11, 1953

J. B. BRENNAN

2,648,567

METALLIZING GUN

Filed June 8, 1948

FIG. 1

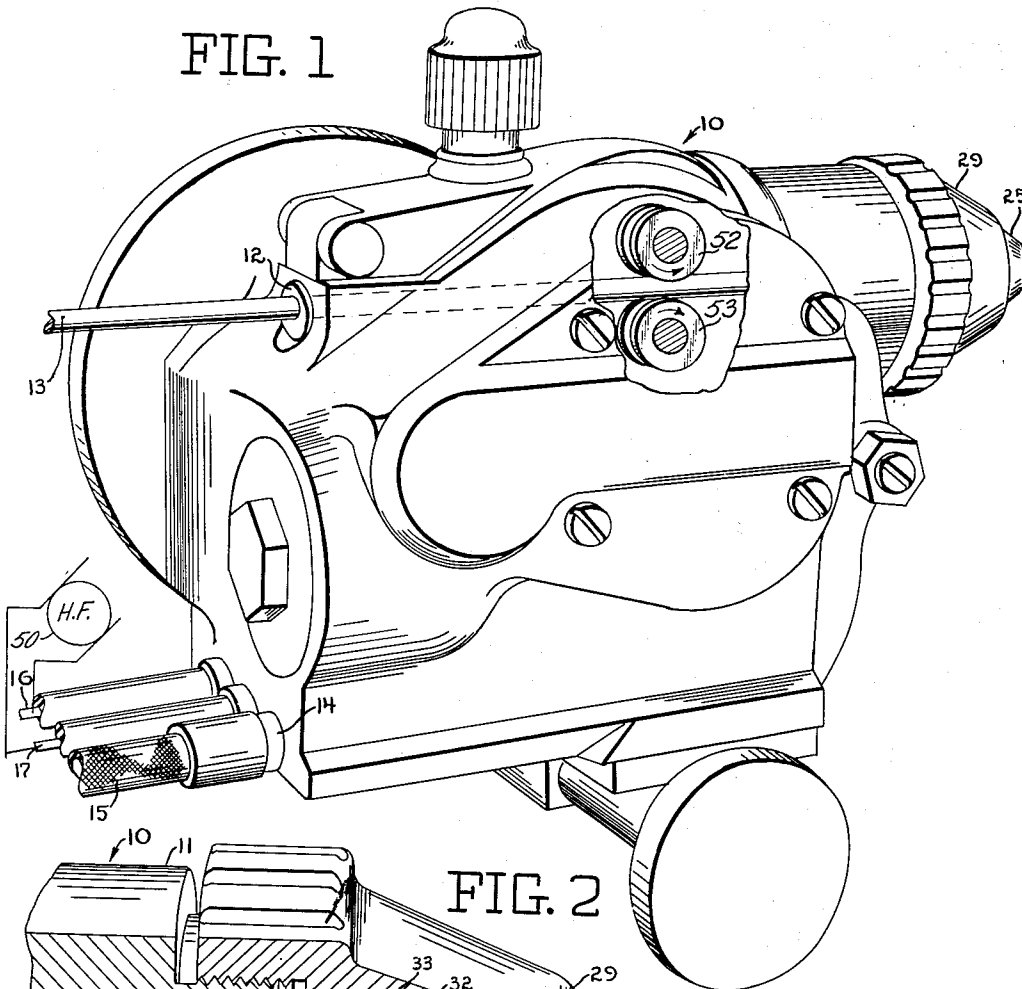
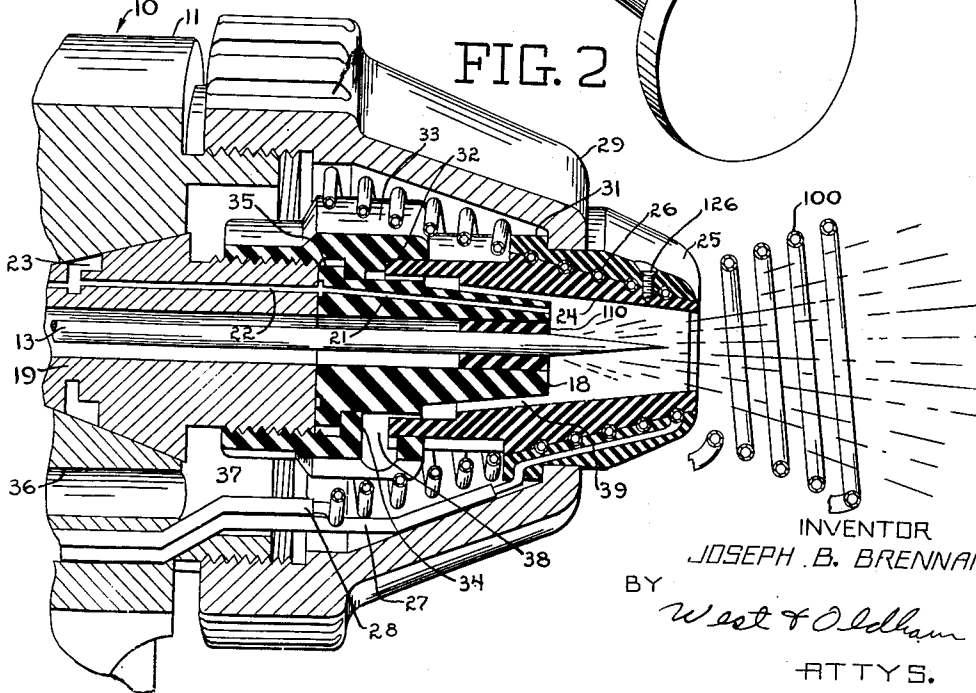


FIG. 2



INVENTOR
JOSEPH B. BRENNAN
BY *West & Oldham*
ATTYS.

UNITED STATES PATENT OFFICE

2,648,567

METALLIZING GUN

Joseph B. Brennan, Bratenahl, Ohio

Application June 8, 1948, Serial No. 31,690

7 Claims. (Cl. 299—28.8)

1

This invention relates to metallizing guns, especially to metallizing, or metal spray guns and to the particular means employed for liquefying the metal to be sprayed.

Heretofore there have been several types of metallizing guns provided wherein a metal feed wire is continuously supplied to the gun with the metal of the wire being melted in the gun by means of burning gases and with the molten metal being ejected from the gun by means of a compressed carrier gas that is supplied to the gun. Usually, the carrier gas is air, whereas the gases used to liquefy the wire have been mixtures of oxygen and propane, or of oxygen and other highly combustible gas, such as acetylene, natural gas, etc. The combustion of these gases with oxygen provides a continuous source of large amounts of heat sufficient to melt the feed wire rapidly and permit continuous deposit of a desired amount of metal.

One disadvantage with the metallizing guns that have been used heretofore is that they require large amounts of heating gases. In fact, the cost of the oxygen alone that is used in guns of this type may run as high as \$25 a day. The cost of both the oxygen and propane gas used may vary from about \$6 to \$10 an hour, depending upon the specific type of gun used and the amounts of metal that are deposited.

The general object of the present invention is to provide a novel type of metallizing gun which avoids the use of oxygen.

Another object of the invention is to provide a metallizing gun which can be operated successfully without the use of any gas as a source of heat supply.

A further object of the invention is to provide a metallizing gun which has a high frequency heating coil therein for use in liquefying metal to be deposited by the gun.

Another object of the invention is to provide a metallizing gun wherein the metal to be sprayed is liquefied by means of a high frequency induction heating coil together with the combustion of a relatively small and inexpensive quantity of gas.

The foregoing and other objects and advantages of the invention will be made apparent as the specification proceeds.

Attention is directed to the accompanying drawings wherein:

Fig. 1 is a perspective view of a metallizing gun embodying the principles of the invention; and

Fig. 2 is a fragmentary vertical section of the

2

discharge head of the gun of Fig. 1, which section is taken on two radial lines extending in opposite directions from the center axis of the gun with each such line being at an acute angle with the vertical.

Reference is now directed to the details shown in the structure illustrated in the drawings and a metallizing gun 10 is shown. This gun 10 includes a frame or body portion 11 which is of substantially conventional construction and which has the usual wire feeding mechanism, controls, etc. associated therewith. The frame 11 has a tubular fitting 12 provided at the rear thereof for receiving a continuous wire 13 the metal from which is to be sprayed from the metallizing gun 10. The gun has conventionally driven rollers 52 and 53 that engage the wire 13 to feed it through the gun. The rear portion of the frame 11 also is provided with a fitting 14 to which a flexible tube 15 connects for supply of a compressed carrier gas to the gun. Any desired substantially inert carrier gas, such as compressed air, may be supplied to the tube 15. Insulated and shielded conductors 16 and 17 connect to the rear portion of the frame 11 and connect to a suitable source of high frequency current supply indicated by the number 50. The high frequency current supply may be of any desired type and usually should be in the vicinity of about 10,000 cycles per second (for metals) for the purposes of the invention.

Fig. 2 best shows the specific novelty of the metallizing gun 10 and in this instance a wire receiving tube 18 is provided in the discharge cap section of the gun. The tube 18 is positioned centrally of the discharge head and it may be provided with a separate rear tube section 19, which section 19 connects to or is seated on the frame 11 and is adapted to receive the wire 13 therefrom. The tube 18 and tube section 19 are shown as provided, respectively, with apertures 21 and 22 that extend longitudinally thereof and are adapted to combine to form a gas conduit in the tubes whereby any desired gas can be supplied to a reservoir chamber or manifold 23 formed in the rear tube section 19 and in communication with the aperture 22. Such gas would be discharged at the end of the tube 18. An end cap, which is formed from an inner conical section 24 and an outer conical section 25, is provided and encompasses the outer end portion of the tube 18 and protrudes therebeyond a short distance, as shown to provide an additional melting zone for the gun. The sections 24 and 25 of the end cap are provided so as to receive

therebetween a high frequency induction coil 26 which is engaged between the end cap sections and which may extend inwardly of the metallizing gun 10 therefrom, as desired. Screws 126 may secure the sections of the end cap together. The induction coil 26 has leads 27 and 28 extending therefrom through the frame 11 to the conductors 16 and 17 that provide the power supply for the metallizing gun. The lead 27 is shown extending through the outer conical section 25 but it may be positioned in a longitudinally extending recess formed on the inner surface of such section so as to simplify assembly of the coil in the gun. The lead 27 will be spaced from the coil 26, in all instances. The coil 26 may be formed from a tubular conductor, as shown, whereas it also may be formed from a solid wire or bar, or other form, if desired.

The end cap for the metallizing gun is secured in position by means of a conical cover 29 which is in threaded engagement with the frame 11 and which receives and positions the sections of the end cap and means associated therewith. The outer conical section 25 is provided with an outwardly extending annular rib 31 that is engaged by the outer end of the cover 29 so as to draw the outer conical section 25 tightly back on the inner conical section 24. The inner end of the inner conical section 24 abuts against a shoulder 32 provided on an adapter 33 that is in threaded engagement with the rear tube section 19. The adapter 33 has a shoulder 34 thereon that engages with a base flange 35 formed on the tube 18 at the rear thereof, so as to draw the end of the tube 18 tightly against the end of the rear tube section 19.

Additional carrier gas for metal being ejected from the gun 10 is provided for the discharge section of the gun by means of a bore 36 formed in the frame 11. The bore 36 discharges into an annular chamber 37 provided within the cover 29. This chamber 37 is of appreciable length and gas received in said chamber is adapted to be discharged through the bore in the end cap. The chamber 37 connects through a plurality of radially extending, circumferentially spaced ports 38 formed in the adapter 33, to an annular feed chamber 39 provided between the periphery of the tube 18 and the inner surface of the inner conical cap section 24. This annular feed chamber 39 is of extended length and is of generally hollow frusto-conical shape with the smaller end of the cone being formed at the outer end of the tube 18.

Fig. 2 shows that the tube 18 terminates an appreciable distance within the inner conical section 24 from the longitudinal outer end of the same. Hence wire being fed through the tube 13 may start to be heated as soon as it enters the field of the induction coil 26 and then can be brought to a liquefying temperature before it leaves such induction field. Of course, the speed of the feed of the wire 13 through the gun must be correlated with the frequency supplied to the coil 26, with the size of wire used, composition of the wire, etc., so that the desired amount of heat can be supplied to the wire to liquefy the same in the gun. As soon as molten particles are formed from the wire 13, the high pressure gas supplied through the feed chamber 39 will converge in on such molten material, or else sweep by the wire as the gas passes through and from the metallizing gun and hence will carry molten metal particles from the gun.

Should the amount of heat supplied by the

inductive action of the induction coil 26 be insufficient for the desired uses of the gun 10, then a suitable heat supply gas may be supplied to the gun through the associated apertures 21 and 22 from the reservoir chamber 23. This chamber 23 then connects through suitable means (not shown) to a source of high pressure combustion gas, such as propane. The propane or hydrogen or other combustible gas fed through the aperture 21 will be ignited in the discharge area of the gun and the heat generated by the combustion of such gas will cooperate with the inductively generated heat in the wire 13 so as to liquefy the end portion of such wire continuously as it is fed along through the tube 18 and the molten metal will be continuously sprayed from the gun with the use, at most, of only one combustible gas in the metallizing and spraying operations of the gun.

It will be realized that the inductive coil 26 may be positioned in any desired portion of the discharge nozzle. All of the portions of the discharge cap of the gun must preferably be formed from suitable plastic, refractory or other insulation material, so as to avoid the liquefaction of such parts, or the loss of undesired energy in such parts due to their location in the high frequency field. In some instances it may be desirable to use carbon in forming parts of the discharge nozzle, or it might also be formed from split metal sections which are insulated from each other. If metal is to be used in a nozzle it preferably should be a very high melting point metal which would not be heated to a softened condition by normal use of the gun.

Fig. 2 of the drawing shows that the wire being melted has a conical tip formed on it and this conical tip is more or less inherently formed on the wire by use of the apparatus of the invention. This point on the wire end is substantially parallel to the induction coil provided. Of course, the metallizing gun may be of any desired size and any desired size of wire or rod, or bar can be processed therein. Variation in the frequency impressed upon the gun, together with a variation in the specific type of induction coil used will permit appreciable variation in the speed of liquefaction of wire to be sprayed. Hence the rate of feed of wire to the gun would vary appreciably depending upon the specific operating conditions.

Fig. 2 of the drawing also shows an induction coil 100 which is positioned adjacent the discharge nozzle beyond the extremity thereof. This coil 100 preferably is of conical shape and increases in diameter as its position from the end of the metallizing gun increases. Suitable high frequency current is supplied to the coil 100 to aid in retaining the sprayed metal particles in a desired molten condition. Usually the molten metal particles are deposited upon a base member, usually a moving base strip which preferably is cooled by suitable fluid means prior to receipt of sprayed metal particles thereon. While the high frequency induction coils of the gun are shown positioned within same, it would be possible to place such coils externally of the gun in some instances. Also, it might be desired to place the high frequency induction coil on the inside surface or supported inwardly from the inner conical section 24 of the metallizing gun. A guide bushing 110 may be positioned within the tube 18 to center the wire being processed therein. It will be realized that carrier gas normally is supplied through the feed

chamber 39 and that such gas and the heating action of the coil 26 may be supplemented by a gas, usually highly combustible, supplied through the apertures 21 and 22. If desired, the wire or rod 13 could be cooled in the rear portion of the gun 10 or immediately prior to its entrance into the gun.

While one complete embodiment of the invention has been disclosed herein, it will be appreciated that modification of this particular embodiment of the invention may be resorted to without departing from the scope of the invention as defined by the appended claims.

Having thus described my invention, what I claim is:

1. In metallizing apparatus, a device having a discharge end, an induction coil associated with said device adjacent the discharge end thereof, said induction coil having high frequency energy supplied thereto, and a rod receiving member positioned axially of said coil for receiving and accurately positioning a rod adjacent said discharge end, a rod in the device being advanced through said coil, said coil being conical in shape and tapering in toward the rod toward the discharge end of the device.

2. In a metal spray device having a discharge end, a conically shaped induction coil having its smaller end positioned adjacent the discharge end of the device, a bar, means for feeding said bar into the bore of the said induction coil, said induction coil increasing in heating intensity along the axis of the bar and melting the end of the bar progressively through the thickness of same as it is fed into the magnetic field of the coil, said melting action occurring at a substantially constant distance from said coil to form a tapered end on said bar, and a receiving and positioning device for said bar to maintain its position accurately with relation to said coil.

3. In a metal spray device having a discharge end, a tapered induction coil having its smaller end positioned adjacent the discharge end of the device, a bar, means for feeding said bar into said induction coil, said induction coil forming a melting zone increasing in heating intensity along the axis of the bar and conically melting the advancing end portion of the bar as it is fed through the magnetic field of the coil, said melting action occurring at a substantially constant distance from said coil to form a tapered end on said bar, gas feed means discharging gas that converges on the advancing tapered end of the bar being fed in the direction of movement of the bar, and a bar feeding member feeding it centrally with relation to said coil, said bar receiving member terminating in spaced relation to the discharge end of the device adjacent which the melting action of the bar is effected whereby said gas feed means converges gas on the end of a bar as it is melted by said coil.

4. In metal spray apparatus having a discharge end, a tapered induction coil having its smaller end positioned adjacent the discharge end of the apparatus, a bar, and means feeding the bar into the bore of the said induction coil, said induction coil producing an induction field of in-

creasing heating intensity along the axis of the bar and melting part of the end portion of the bar as it is fed into the magnetic field of the coil, said melting action occurring at a substantially constant distance from said coil thereby maintaining a tapered end on said bar.

5. In spray apparatus having a discharge end, a conically shaped induction coil having its smaller end positioned adjacent the discharge end of the apparatus, means connecting to said induction coil to supply high frequency electrical energy thereto, a bar constantly and continuously fed centrally and axially of the said induction coil, said induction coil increasing in heating intensity towards the axis of the bar from the outer surface thereof and melting the end of the bar as rapidly as it is fed into the magnetic field of said coil, said melting action occurring at a substantially constant distance from said coil thereby forming a tapered end on said bar, compressed gas feeding means for discharging gas in encompassing relation to the tapered end of said bar, said gas feeding means discharging gas that converges on said bar and removes the conical surface layer thereof as it is melted as particles, and a bar receiving and positioning means to constantly position said bar accurately with relation to said coil while being advanced and softened by the heating action of said induction coil.

6. In a metal rod melting process, the steps of continuously advancing at a uniform rate a bar of fusible material through an axially inwardly tapered induction heating field and thereby surface fusing a tapered end similar to the field in shape on the end of the advancing bar, centering the bar in the tapered intensity field, and maintaining the end of the advancing bar of constant shape and location by melting and removing the end of the bar as it is advanced.

7. In a molten metal spray process, the steps of continuously advancing at a uniform rate a bar of fusible material through a tapered intensity surrounding induction heating field and thereby surface fusing a tapered end similar to the field intensity in shape on the end of the advancing bar, and constantly and simultaneously removing and projecting the fused tapered layer from the end of the bar as the bar is advanced so that the end of the advancing bar is maintained of constant shape and locus.

JOSEPH B. BRENNAN.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,323,999	Baker	Dec. 2, 1919
1,721,092	Saeger	July 16, 1929
1,978,415	Collins	Oct. 30, 1934
2,227,752	Ingham	Jan. 7, 1941
2,411,409	Ballard	Nov. 19, 1946
2,423,490	Erhardt	July 8, 1947

FOREIGN PATENTS

Number	Country	Date
483,517	Great Britain	Apr. 21, 1938