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Early Thermal Spray Application— *JTST* Historical Patent #11*

UNITED STATES PATENT OFFICE
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METAL-SPRAYING EQUIPMENT
2,143,232. Patented 10 Jan 1939. Application 9 May 1936,
Serial No. 78,908. Renewed 4 June 1938. In Great Britain 13 June 1935.

My invention relates to improvements in metal spraying equipment and has to do, more particularly, with improvements in pistols for spraying such metals as lead, tin, zinc and the like, either pure or alloyed. While not necessarily so restricted, in many aspects the present invention may be regarded as an improvement upon the general type of metal spraying devices disclosed and claimed in my prior U.S. Patent Nos. 1,968,329 and 1,979,179, granted July 31, 1934, and October 30, 1934, respectively.

It is a primary object of the present invention to provide a metal spraying device which may be fabricated and assembled at extremely low cost.

It is another object of my invention to provide a pistol-type metal spraying device which, while extremely light and easily operated, is amply sturdy to withstand the abuse to which such devices are subjected in use by unskilled operators.

It is an object of my invention to provide a metal spraying pistol of the "stick feed" type which is equipped with means for steadying and guiding the stock during feeding thereof and which permits the manual release of the stick of stock metal before it has been consumed to such an extent that the free end thereof is uncomfortably hot to the touch.

It is an object of my invention to provide a simple metal spraying pistol of the "turnhead" type convertible to constitute a preheating torch, which device is provided with simple locking means for maintaining proper alinement of torch and stock-melting chamber.

It is an object of my invention to provide a simple metal spraying pistol of the "turnhead" type convertible to constitute a preheating torch, which device is provided with a novel self-sealing swivel joint of leak proof construction.

It is an object of my invention to provide a simple metal spraying pistol of the "turnhead" type convertible to constitute a preheating torch, the melting chamber of which pistol is provided with a heat insulated handle for shifting the melting chamber with respect to the torch, and available, during the metal spraying operation, as a supplemental grip for steadying the device when working to close limits.

It is a further object of my invention to provide a novel, highly efficient air nozzle structure for metal spraying equipment which nozzle, in addition to its efficient distribution of air about the metal-spraying jet, serves to maintain alinement of such jets even in instances where the parts are not manufactured to close tolerances.

Further objects, and objects relating to details and economies of manufacture and operation will definitely appear from the detailed description to follow. In one instance, I accomplish the objects of my invention by the means described in the following specification. My invention is clearly pointed out in the appended claims. A preferred embodiment of my invention is illustrated in the accompanying drawings forming a part of this specification in which:

Figure 1 is a view, partly in side elevation and partly in cross section, of a preferred form of metal spraying pistol embodying the present invention;

Fig. 2 is a front view of the pistol illustrated in Fig. 1;

Fig. 3 is a view, in top elevation, of the front portion of the pistol illustrated in Fig. 1;

Fig. 4 is a view, in side elevation, of the forward portion of the device shown in section in Fig. 1;

Fig. 5 is a detail sectional view of the same device taken on the line **5—5** of Fig. 1 and viewed in the direction of the arrows;

Fig. 6 is a detail sectional view of the melting chamber of the same gun, the melting chamber having been shifted, 90 degrees, about its journaled mount upon the air tube, to render the torch usable as a preheating or reheating device, this view otherwise being taken on the line **6—6** of Fig. 1;

Fig. 7 is a detail view, on an enlarged scale, of the nozzle of the pistol shown in Fig. 1; and

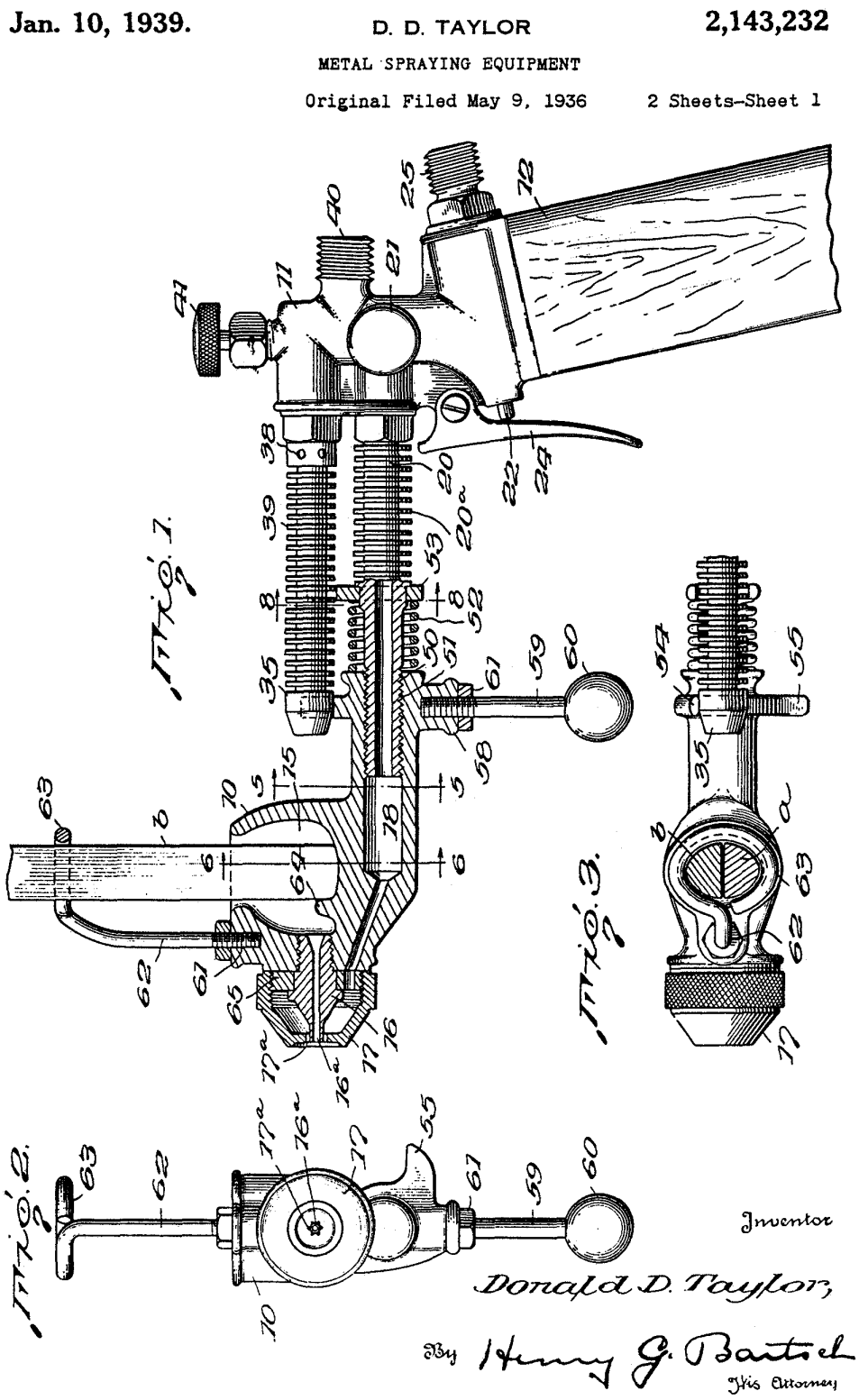
Fig. 8 is a detail sectional view taken on the line **8—8** of Fig. 1, showing the rear spring support of the journaled mount of the device illustrated in Fig. 1.

In the application drawings, Figures 1 to 6 and Figure 8 are drawn to full scale. Throughout the drawings the same reference numerals refer to the same parts.

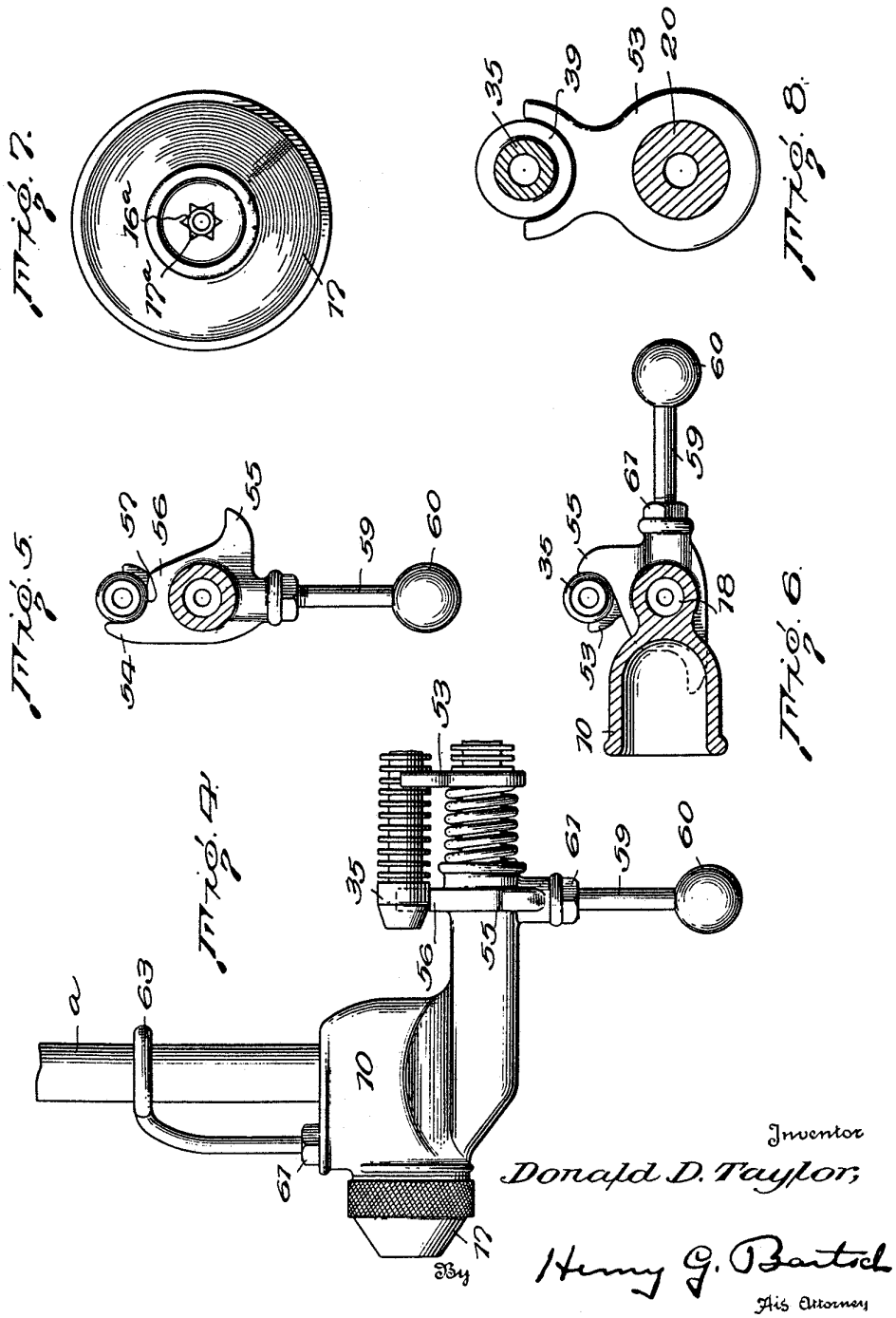
In the broad sense, but not by way of limitation, my invention may be said to reside in improvements and refinements upon a device of the general type disclosed and claimed in my Patent No. 1,979,179, granted October 30, 1934. The present invention has especial application to metal spraying pistols of the turnhead type in which the heating torch and the melting chamber for the stock metal are relatively displaceable to permit use of the torch per se as a means for preheating objects to be coated or filled or as a means for reheating sprayed coatings or fillings after their application. One feature of my invention as applicable to spraying apparatus of the patented type aforesaid consists in the provision of a journaled-mounting for the rotatable head, which mounting is provided with latch means for maintaining positive alinement of the head with the torch member employed

*This series of historical patents concerned with thermal spray technology has been compiled by C.C. Berndt (SUNY at Stony Brook, NY) and K.A. Kowalsky (Flame-Spray Industries, Inc., NY).

for the heating thereof. Another feature of the present invention, as applied to such patented spraying apparatus, consists in the elimination of fibrous packing between the compressed air tube and the rotatably journaled spray head, and the substitution therefor, of a simple swivel mounting including abutting flange surfaces maintained in substantially leakproof association by resilient means such as a helical spring carried by the air tube. In metal spraying apparatus of the stick-feed type such as described in my aforesaid prior patent, the stock metal employed commonly has the form of a stick or rod of approximately ten inches in length and weighing approximately one pound. Where such stock is employed, the lower end thereof, which rests in the



melting chamber of the spray head, is progressively reduced to the molten state, and a considerable portion of the heat transmitted to the melting lower end travels upwardly through the stick with the result that, when the major portion of the stick has been consumed, the upper end thereof becomes quite hot to the touch. Moreover, because of the fact that, in the prior apparatus mentioned, the free hand of the operator is relied upon for steadying the upper end of the stick, and said upper end finally reaches the melting chamber which is in proximity with the flame emanating from the torch of the apparatus, the steadying of the stick by the operator's hand during this period is liable to occasion considerable discomfort. The present invention, accordingly, fur-



ther consists in the provision of guide means for said stock as fed, which guide means eliminate the requirement that the operator steady and otherwise assist in the feeding of the stock with his free hand. The liberation of the operator's free hand from the duty of steadying and feeding the metal stock is further availed of by the provision, in accordance with the present invention, of a supplemental handle adjacent the forward end of the metal spraying pistol, which supplemental handle may be grasped by the hand of the operator to steady the equipment to a marked extent, reducing fatigue upon the operator's hand which grasps the grip portion of the device as well as rendering possible a more accurate projection of sprayed metal. Finally, the present invention solves a problem in previous constructions which sometimes arose where the apparatus had been subjected to excessive abuse, and the perfect alinement of the jets of the device had been disturbed. In accordance with the present invention such injury or misalinement of the jets is positively precluded, the walls of the orifices of the air nozzle or jet being in positive contact with the metal jet.

More specifically, and with particular reference to the accompanying drawing in which I have illustrated a preferred embodiment of the present invention, there is shown in Fig. 1 a metal spraying pistol consisting of a spraying head **10** having formed therein a melting chamber or pot **15** adapted to receive stock metal in stick form, and carrying threadedly mounted jets **16** and **17** for molten metal and compressed air, respectively; a control head **11,** a manual grip **12,** and a compressed air conducting tube **20** by which the spraying head **10** and control head **11** are held in assembly. As in the pistol construction of my prior patent previously mentioned, compressed air is supplied to the device by the connection, to the threaded nipple **25,** of a flexible air supply hose (not shown). Thence, air is conducted, subject to control by the trigger **24,** past the trigger valve **22** and through a duct in the control head metered by a needle valve **21,** to the compressed air conducting tube **20.** The air thus supplied to the tube **20** passes through the duct **18** in the spraying head and thence to the jet **17** of the metal atomizing nozzle. A nipple **40** is formed integral with the control head **11,** and to this nipple a supply of compressed acetylene, or similar inflammable gas, is fed by means of a flexible hose (not shown). By means of a regulating valve **41** generally similar to the valve **21,** the inflammable gas is allowed to pass at a desired rate to the torch tube **35** having conventional air inlet ports **38** by which ingress and mixing of atmospheric air with the inflammable gas is effected to provide a mixture which will burn with a tongue-like flame at the mouth of the torch tube **35.** For the purpose of dissipating heat and lessening the tendency toward heating of the control head **11,** fins **39** and **20***a* are provided upon the torch and air tubes, respectively. Thus broadly described, the illustrated device is identical with the structure enclosed in my prior Patent No. 1,979,179.

The compressed air tube **20** is reduced at its forward end and provided with an externally threaded portion **50** the threads of which are mated with internal threads **51** formed in the complementary portion of the spraying head casting **10.** Disposed about the unthreaded reduced portion of the tube **20** is a helical spring **52** the ends of which abut, respectively, the rear face of the casting **10** and a saddle member **53** mounted on the tube **20.** The helical spring **52** is placed under compression by the threaded assembly of the casting **10** upon the tube **20,** whereby faces of the threads **50** and **51** are maintained in a snug contact, reducing leakage of compressed air past said threads to a minimum. The saddle member **53** serves the function of a strut inasmuch as its upper portion is engaged with the flanges **39** of the torch tube **35.** Preferably, although not essentially, the intermediate portion of the saddle member **53,** which portion bridges the tubes **20** and **21,** is of such length as to place these tubes under a slight stress. Alternatively, the upper portion of the saddle member **53** may be formed integral with the tube **39** by welding or silver-soldering (not shown), thus providing a rigid structure.

The helical spring **53** tends to provide resistance to turning or rotative movement of the spraying head **10** upon the air tube **20.** Moreover, a pair of stop members **54** and **55** are provided which are engageable with the tip end of torch tube **35** and limit the extent of rotative movement to approximately 90 degrees, as illustrated in Figs. 5 and 6, Fig. 5 showing the stop element **54** engaged with the tip of the torch tube, in which position the melting chamber **15** of the device is disposed for heating by the torch **35,** and Fig. 6 illustrating the stop **55** engaged with the tip of the torch tube, in which relation the flame emanating from the torch **35** clears the melting chamber and may be employed for preheating or reheating purposes. Intermediate the stops **54** and **55,** and integral therewith and with the casting **10** is a cam portion **56** provided with a slightly reentrant section **57** adjacent the stop **54** and engageable with the undersurface of the tip of the torch tube in such fashion as to slightly upwardly flex the relatively rigid torch tube **35** and restrainingly retain the melting chamber **15** in alinement with the torch **35** when said reentrant cam portion is engaged with the torch tube.

Diametrically opposite the reentrant portion **57** of the cam **56** is provided a boss **58,** integral with the casting **10.** This boss is internally threaded to receive the threaded end of the shank **59** of a handle member which terminates in an enlarged ball **60** of non-metallic material. A nut **61,** also threaded upon the shank **59,** abuts the boss **58** and locks the handle against dissociation from the casting **10.** This handle serves two functions: First, it affords a ready means of effecting rotation of the spray head upon the torch tube **20** and second, it may be employed as a supplemental grip for steadying the gun during the spraying operation, particularly where the object to be sprayed requires accurate manipulation of the device. Particular attention is called to the fact that the boss **58** is not only removed from the direct zone of heating effected by the torch member **35** but, in addition, is located closely adjacent the portion of the casting **10** which is in proximity with the stream of cool compressed air delivered by the tube **20.** As a result, the boss **58** is not at any time rendered excessively hot, despite the fact that it is an integral part of the casting **10,** and, therefore, the shank **59** and the non-metallic ball **60** which it carries do not attain a temperature such that discomfort is experienced by the operator in employing this supplemental handle as a means of steadying the device during spraying, or converting the device to perform either of its intended functions.

The forward portion of the casing **10,** adjacent the spraying nozzle which it carries, is of relatively increased thickness and is tapped out to provide a threaded vertical socket **61** which receives the threaded end of an upstanding rod **62** extended rearwardly at its upper end and looped to constitute a guide member **63** through which the stick of stock to be sprayed extends in snug but non-binding relation. Preferably, but not by way of limita-

tion, the stick of stock metal is in reality two sticks *a* and *b* arranged in abutting relation and jointly being of elliptical cross-section. Such a "double" stick has been found to feed by gravity through the guide member **63** with facility and to be readily reduced to the molten state at its lower end. The formation of the guide **63** of round stock assures frictionless passage or slipping of the stick *a, b,* therethrough as the lower end of the stick is consumed. It will be noted that a rib **64** extends across the bottom of the stock heating chamber and defines therein a sump in which a small quantity of molten metal is maintained, which metal envelops the lower end of the stick of stock metal *a, b,* and transmits heat from the walls of the melting chamber **15** directly to the immersed though, as yet, unmolten stock. This rib **64** serves the skimming function of the similar rib disclosed and claimed in my prior Patent 1,968,329, granted July 31, 1934. In addition, the rib **64** coacts with the guide **63** alined therewith, and eliminates the requirement that the operator grasp the upper end the stick *a, b,* with his free hand in order to steady, guide and facilitate feeding thereof. As a result, this hand of the operator may be placed upon the knob **60** of the supplemental handle to assist in the support of the device during the spraying operation. It will be noted that the stock guide **63** is remote from the flame projected from the torch **35** and that the support **62** is shielded from heat emanating from the torch by reason of the interposition of the stick *a, b,* of stock metal. As a result, the portions **62** and **63** of the device never become heated to such an extent that accidental blows thereon can deform or disturb the alinement thereof to such an extent as to impair the function thereof as a substantially frictionless feed guide.

The forward end of the casting **10** is faced-off square with the longitudinal axis of the device as a whole and carries a ring **65** provided with a peripheral thread upon which is mounted the air jet **17,** which jet is fed by the duct **18** which is extended through the ring member **65,** as shown in Fig. 1. The jet **16** for molten metal extends through the ring **65** and into threaded engagement with the casing **10.** The jet **16** is provided with a reduced tip **16***a* of relatively thin cross-section which extends through the orifice **17***a* of the air jet **17.** The orifice **17***a* is of star-like, polygonal form and of a size such that the tip **16***a* of the jet for molten metal is snugly received therein when the gun is in spraying operation and the jet **17** is hot. As a result, the discharge orifice of the nozzle is, in reality, a plurality of closely adjacent air passages, each of which is of substantially triangular form, and all of which constitute a circular series of air passages concentrically disposed about the central orifice through which molten metal is drawn by induced vacuum through the jet member **16.** This polygonal opening in the jet **17,** the walls of which constitute a tubular passage of polygonal form which circumscribe the tip **16***a* of the jet for molten metal, I regard to be a salient improvement in metal spraying apparatus broadly inasmuch as this construction assures positive concentricity of the air and molten metal streams at their point of juncture immediately forward of the nozzle. In previous manufacture of devices of this type, extreme accuracy has been necessary to attain exact concentricity of these jets which is essential to the production of fine-grained sprayed coatings. It has been found that misalinement of these jets inevitably results in the production of a spray and resultant coating the composite particles of which are flaky and non-uniform. Despite extreme care in machining and assembly, in a large number of instances use and abuse of portable pistol-like equipment of this type has resulted in displacement of one or the other of these jets and resultant impairment of their operation. Through the incorporation of jets embodying the structure and relationship herein disclosed, the requirement of precision machining and assembly, as well as extremely careful treatment of the device in use and storage has been eliminated to a marked extent. The star-like polygonal opening in the jet **17** may be readily formed by broaching and it should be explained that a small amount of clearance between the jets when assembled is permissible inasmuch as the inner jet **16** expands slightly due to heating when the gun is in operation. The threads of the ring member **65** and the jet **17** are sufficiently relatively displaceable with respect to each other to assure centering of the jet **17** with respect to the tip **16***a* of the jet **16.**

I am aware that numerous changes and modifications of the device herein illustrated and described as a preferred embodiment of the invention are possible without departure from the broad concepts thereof. For example, means other than the helical spring **52** may be employed for resiliently maintaining the faces of the mated threads **50** and **51** in relatively air-sealing contact. Moreover, means other than the cam arrangement illustrated may be employed for latching the shiftable spray head in proper alinement with the torch **35.** While the particular positively-alined jet structure herein disclosed has especial application to a portable metal spraying device of the type disclosed, it is by no means so limited in its field of application. Similarly, in lieu of the mated threads **50** and **51,** flanges of another form might be employed to similar advantage.

While the present device has been described as a spraying pistol for metals, obviously, equivalent fusible solid material, such as ceramics for the production of vitreous enamel coatings, may be employed as stock therein.

The foregoing and other changes and variations will readily appear to one skilled in the art when acquainted with the present invention and I, therefore, claim my invention broadly as indicated by the appended claims.

What I claim is:

1. A metal spraying pistol comprising a manual grip member, a torch tube carried thereby and extending forwardly therefrom, a compressed air tube carried by said grip member and extending forwardly therefrom, a stock chamber journaled for rotation upon the forward end of said air tube and having a compressed air duct and metal spraying nozzle in communication therewith, and means for yieldably maintaining said stock chamber positioned for heating by said torch tube, said means comprising a cam element integral with said stock chamber and provided with a slightly re-entrant portion adapted for snap-engagement with said torch tube.

2. A metal spraying piston comprising a manual grip member, a torch tube carried thereby and extending forwardly therefrom, a compressed air tube carried by said grip member and extending forwardly therefrom, a stock chamber journaled for rotation upon the forward end of said air tube, a stay member bridging said torch and air tubes intermediate the ends thereof, and a helical spring disposed, under compression about said air tube intermediate and abutting said stay member and stock chamber.

3. A metal spraying pistol comprising a manual grip member, a torch tube carried thereby and extending forwardly therefrom, a compressed air tube carried by said grip member and extending forwardly therefrom, a stock chamber journaled for rotation upon the forward end of said air tube, a stay member bridging said torch and air tubes intermediate the ends thereof and maintaining said tubes in spaced, slightly stressed relation, and means for yieldably maintaining said stock chamber positioned for heating by said torch tube, said means comprising a cam element integral with said stock chamber and provided with a slightly re-entrant portion snap-engageable with the forward end of said torch tube by placing said tubes under further stress.

4. A metal spraying pistol comprising a manual grip member, a torch member carried thereby, a compressed air tube carried by and extending forwardly from said grip member, a head member journal-mounted upon the end of said air tube and rotatable into and out of heating relation with said torch member, a metal spraying nozzle associated with said head member and fed by said compressed air tube, a stock-melting chamber in said head member and a handle member attached to said head member at a point which is remote from heating by said torch member, and which is cooled by contact of atomizing air conveyed by said compressed air tube.

5. A metal spraying piston comprising a manual grip member adapted for grasping by one hand of the operator, a torch tube carried thereby, a compressed air tube disposed beneath said torch tube and similarly carried by said member, a head member mounted upon the end of said air tube and disposed in heating relation with said torch tube, a metal spraying nozzle associated with said head member and fed by said compressed air tube, a melting chamber in the upper portion of said head member for supporting the lower end of an upstanding stick of stock metal to be sprayed, and a handle member attached at its upper end to the lower portion of said head member and extending downwardly in diametrical opposition to a stick of stock supported in said melting chamber, said handle terminating in a grip element adapted to be grasped by the other hand of the operator for steadying the device in delicate spraying operations.

6. A metal spraying pistol of the stick-feed type comprising a manual grip member, a compressed air tube extending forwardly from said grip member, a head member mounted upon said compressed air tube and having a metal-spraying nozzle associated therewith, a shallow, open-mouthed stock-melting chamber in said head member adapted to closely receive and support the lower end of a stick of stock metal to be sprayed, a torch for heating said stock chamber, and substantially frictionless guide means for supporting said stick of stock metal in substantially vertical position for effecting automatic gravity feeding thereof into said chamber as melting and spraying thereof is accomplished, said guide means comprising an annular member having an interior size and shape corresponding to the cross-sectional size and shape of the stick of stock to be fed and snugly receptive thereof without binding upon said stick, and means carried by said head member and extending upwardly therefrom for rigidly supporting said annular member in alinement with said melting chamber at a point removed from direct heating proximity with respect to said torch member.

7. A metal spraying piston of the stick-feed type comprising a manual grip member, a compressed air tube extending forwardly from said grip member, a head member mounted upon said compressed air tube and having a metal-spraying nozzle associated therewith, a shallow, open-mouthed stock-melting chamber in said head member adapted to closely receive and support the lower end of a stick of stock metal to be sprayed, a torch for heating said stock chamber, and substantially frictionless guide means for supporting said stick of stock metal in substantially vertical position for effecting automatic gravity feeding thereof into said chamber as melting and spraying thereof is accomplished, said guide means comprising an upstanding rod member attached at its lower end to said head member forward of said melting chamber and terminating at its upper end in a horizontal loop snugly receptive of a stick of metal stock without binding thereon, said loop being disposed out of direct heating relation with respect to said torch member.

8. A metal spraying piston comprising a grip member, a head member carried by said grip member, a compressed air duct in said head member, a compressed air nozzle mounted upon said head member, fed by said air duct and provided with a discharge opening of symmetrical star-shaped polygonal form, means for supplying molten metal, and a cylindrical jet member for molten metal fed by said metal-supplying means and coaxially extending snugly through the star-shaped opening of said compressed air nozzle in circumscribed relation with the walls thereof, defining therewith a circular series of uniformly arranged air-jetting passages concentrically disposed about the discharge passage of said molten-metal jet member.

9. A metal spraying pistol comprising a manual grip member, a torch tube carried thereby and extending forwardly therefrom, a compressed air tube carried by said grip member and extending forwardly therefrom, a stock chamber so journaled for rotation upon the forward end of said air tube as to be disposable in or out of heating relation with respect to said torch tube, said stock chamber having a compressed air duct and metal spraying nozzle in communication therewith, interengageable annular flanges upon said air tube and stock chamber for retaining said stock chamber against dissociation from said air tube, and a spring take-up element carried by said air tube and resiliently maintaining faces of said annular flanges in snug and frictional, interengaged, air-sealing contact regardless of flange wear, rotative position, or movement of said stock chamber with respect to its supporting air tube.

10. A metal spraying pistol comprising a manual grip member, a torch tube carried thereby and extending forwardly therefrom, a compressed air tube carried by said grip member and extending forwardly therefrom, a stock chamber journaled for rotation upon the forward end of said air tube and having a compressed air duct and metal spraying nozzle in communication therewith, means for retaining said stock chamber in rotatably-journaled assembly with said air tube such that said stock chamber may be optionally disposed in and out of heating relation with respect to said torch tube, and automatic latch means for positively retaining said stock chamber against inadvertent displacement from said heating position, said latch means comprising a cam element integral with one of the relatively rotatable elements and having a slightly re-entrant portion adapted for snap engagement with the other of said relatively rotatable elements.

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