April 2, 1957 H. V. KOUGH 2,787,497

MULTI-TIP TORCH FOR APPLYING HARD FACING MATERIAL

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Fig. 1

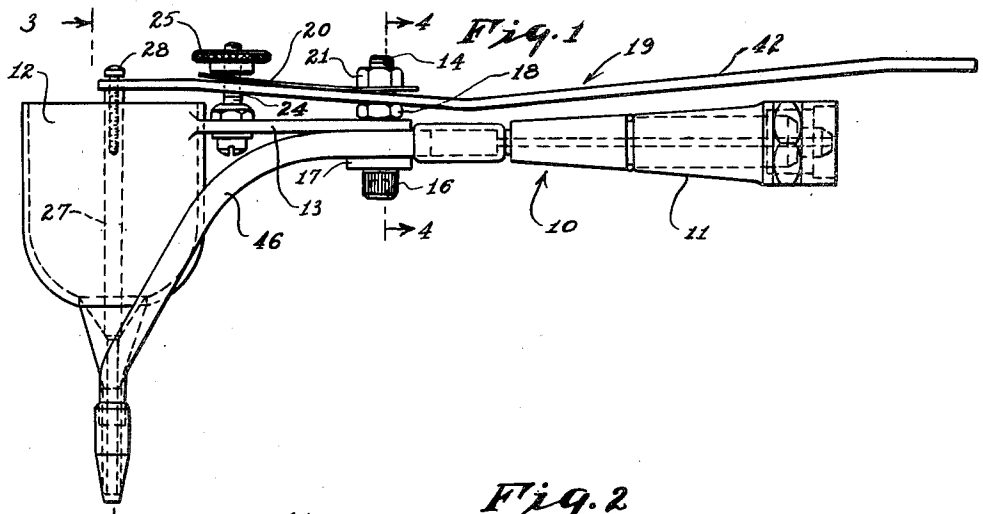


Fig. 2

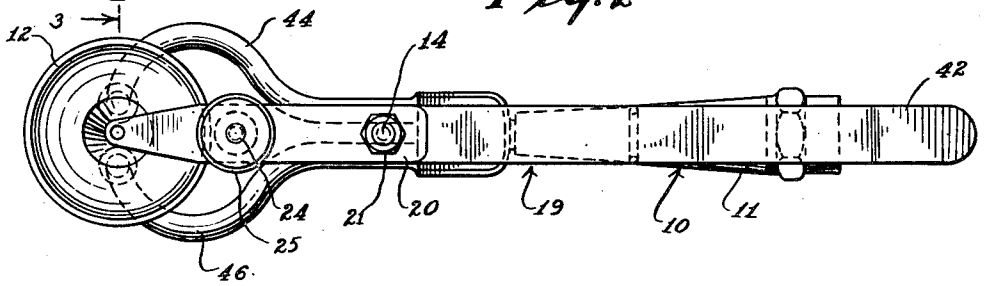


Fig. 3

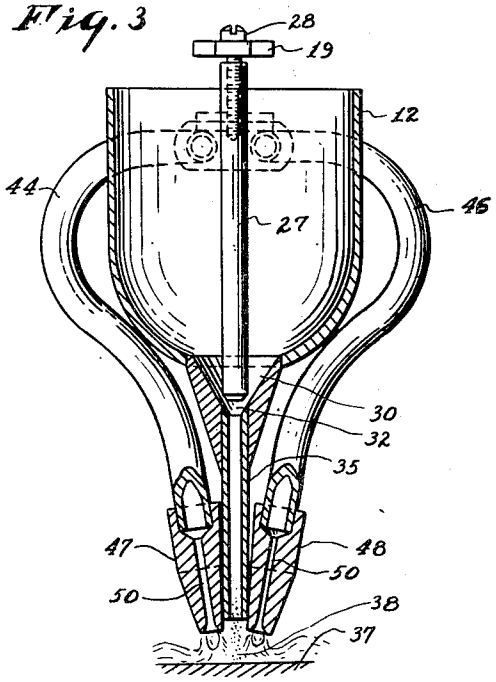


Fig. 5

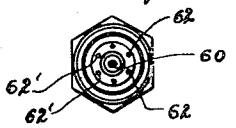
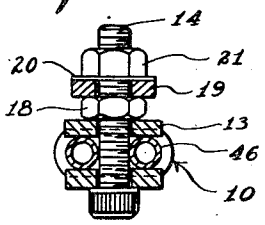


Fig. 4



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MULTI-TIP TORCH FOR APPLYING HARD FACING MATERIAL

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This invention relates to the application of hard surfacing material to metal bodies, and more especially to the application of hard surfacing alloys which are applied as powder.

Various devices have been used for applying powdered metal to the heated surface of a work piece. One of the problems encountered is the distribution of the powder over the surface. Some powder guns entrain the powder with a combustible mixture such as an oxy-acetylene mixture, and the powder passes through the flame and impinges on the surface of the work piece within the flame envelope. For some uses, this type of gun is one of the most satisfactory.

Another type of powder gun discharges a stream of powder against the work piece in the vicinity of the flame orifice, and sometimes an attempt is made to discharge the powder stream into the flame envelope. These guns have experienced difficulty in controlling the powder flow. Unless they are used carefully with the work piece highly heated, and the flame jet orifices correctly spaced from the work piece, a substantial portion of the powder is blown away and much of it distributed over various areas of the work piece out of the control of the operator.

The application of a powder stream to the work piece with flames on different sides of the powder stream has been used, particularly with a circle of flames surrounding the powder stream. Fish tail burners have been used with the powder introduced into the flame system between the jets that produce the fish tail flame. Such flames have distributed the powder unevenly by carrying too much of it around the outer edges of the flame where it bounces off the work piece unless the work piece was highly pre-heated and the powder particles fused, or substantially so.

It is an object of this invention to provide an improved powder gun or torch, for applying hard surfacing material to a work piece, and to provide apparatus which distributes the powder uniformly, under the control of the operator, under a wide variety of operating conditions.

Another object of the invention is to provide a torch, for applying hard surfacing powder, with tips on opposite sides of a powder stream in position to control the distribution of the powder on the work piece. In the preferred construction of the invention, the tips are made so that they are adjustable for operating under different working conditions.

According to one feature of the invention, the torch is made with a tip which pre-heats the work ahead of the powder stream, and another tip which moves across the work piece progressively behind the powder stream for smoothing the surface. In accordance with another feature, the pre-heating tip is larger and capable of greater heat output than the torch which follows the powder stream.

Other objects, features and advantages of the invention will appear or be pointed out as the description proceeds.

In the drawing, forming a part hereof, in which like reference characters indicate corresponding parts in all the views;

Figure 1 is a side elevation of apparatus for applying powdered hard surfacing alloy in accordance with this invention;

Figure 2 is a top plan view of the apparatus shown in Figure 1;

Figures 3 and 4 are enlarged sectional views taken on the line 3—3 and 4—4, respectively, of Figure 1; and

Figure 5 is an end view of a modified form of the invention.

The invention includes a torch body **10** having a handle portion **11**. A powder container **12** is connected with the torch body **10** by a bracket **13**. The bracket **13** is held by fastening means comprising a bolt **14** which extends through the torch body and the bracket **13**.

The bolt **14** has a head **16** which clamps a washer **17** against the under side of the torch body; and there is a nut **18** screwed on the bolt and clamped against the bracket **13**. Above the clamping nut **18**, the bolt **14** extends through a valve operator **19**; and above the valve operator **19**, the bolt **14** extends through a leaf spring **20**. Another nut **21** is threaded on the upper end of the bolt **14**; and this nut **21** is adjusted toward and from the clamping nut **18** to regulate the tension of the spring **20** and to adjust the valve operator **19**.

A bolt **24** is secured to the bracket **13** near the powder container **12**. This bolt **24** extends upwardly through the valve operator **19** and through the spring **20**. The spring **20** is normally bowed upwardly at its opposite ends, and it is held down, at the end nearest the container **12**, by a nut **25** threaded over the upper end of the bolt **24**.

One end of the valve operator **19** extends to a position above the middle of the powder container **12** and this end is connected to a valve element **27** by a screw **28** which threads into the upper end of the valve element **27**. The powder container **12** has a hopper bottom **30** (Figure 3); and the lower end of the valve element **27** extends into the hopper bottom **30** above an outlet opening **32**. The valve operator **19** is operated to raise and lower the valve element **27** to control the discharge of powder from the container **12** through the outlet opening **32**. A powder discharge nozzle **35** is attached to the lower end of the hopper bottom **30** and communicates with the opening **31**. Powder flows downwardly through the discharge nozzle **35**, and the powder from the discharge nozzle **35** impinges against a work piece **37**. The stream of powder from the nozzle **35** is indicated by the reference character **38**.

Referring again to Figure 1, the valve element **27** is normally held in its downward position, to shut off the flow of power from the nozzle **27**, by the pressure of the leaf spring **20**. The valve operator **19** has a handle portion **42** which extends across the handle portion **11** of the torch body so that a person using the apparatus can grip the handle portions **11** and **42** with the same hand. Whenever the valve element **28** is to be moved into position to inaugurate a flow of powder to the work piece, the handle portion **42** is squeezed in closer to the handle portion **11** of the torch body. This rocks the valve operator **19** on the nut **18** as a fulcrum and lifts the other end of the valve operator, and the valve element **27**, against the pressure of the spring **20**.

At the forward end of the torch body **10**, there are two tubes **44** and **46**. These tubes curve outwardly and downwardly, and at their lower ends they support torch tips **47** and **48**. Each of the tubes **44** and **46** communicates with a mixer from which it receives oxygen and fuel gas, preferably oxy-hydrocarbon fuel gas such as acetylene. In the preferred construction, each of the tips **47** and **48** has a single jet passage **50** opening through

its end face; but tips having more than one jet orifice can be used.

The torch tips 47 and 48 are located on opposite sides of the powder discharge nozzle 35. In the operation of the apparatus, it is moved in a direction that locates the torch tip 47 in front of the powder stream 38, and the other torch tip 48 trails behind the powder stream. Thus, the tip 47 pre-heats the work piece, and the flame from the tip 48 smooths the applied powder and fuses the powder, if it is not already fused. The invention can be used with or without previous pre-heating of the work piece, such as furnace pre-heat, but it is desirable to have a substantial degree of pre-heat of the work piece so that the hard surfacing applicator of this invention can be advanced more rapidly across the work piece.

In the construction illustrated, the torch tip 47 has a larger jet passage 50 so that it is of greater heating capacity for pre-heating the work ahead of the powder stream 38. The tips 47 and 48 can be made the same size, but the use of a larger tip ahead of the powder stream makes it possible to apply the powder more rapidly if any substantial pre-heat needs to be added to the surface of the work piece ahead of the powder stream.

The torch tips 47 and 48 can be made with more than one jet passage 50, but in the preferred construction of the invention all of the jet orifices are located either ahead of or behind the powder stream; that is, any additional flames from the torch tip 47 are preferably located in a straight line extending transversely of the intended direction of movement, and any additional flames from the tip 48 are located along a similar straight line behind the powder stream 38. Thus, these additional flames are the equivalent of merely using wider flames from the tips 47 and 48.

The flame jet passages 50 are spaced a substantial distance from one another. In the illustrated construction, these passages 50 converge at an acute angle to one another, but their angle of convergence and their spacing from one another are correlated so as to leave a clearance between the flame jets for some distance below the tips and to bring only the envelopes of the flames into contact with one another. This is important in contrast with fish tail tips which direct the primary combustion cones of the flames into contact.

The stream of powder, discharging downwardly into the clearance between the flames, is entrained in the boundary layers of the flames which constitute part of the envelope flames. This entrained powder is directed against the work piece 37, and the powder stream is also flattened and spread by the flames so that it covers a wider band of the work piece as the apparatus is advanced across the work piece with one tip ahead of the powder stream and the other tip trailing behind the powder stream.

Oxy-acetylene torches are generally held at about the same distance from a work piece when using the torch to impart as much heat as possible to the surface of the work piece. In order to make the apparatus of this invention suitable for different kinds of work, where the operator may wish to hold the tips closer to or farther from the work piece, the tubes 44 and 46 are made of malleable material, such as copper, so that they can be bent to adjust the spacing of the tips 47 and 48 from one another and to adjust the angle of convergence, if any, of the jet passages 50.

Figure 5 shows a modified construction of the invention. This construction uses a single tip having a central orifice 60 through which the powder stream is discharged from the container 12; and in place of the flame jet orifice ahead of and behind the powder stream, the construction in Figure 5 has a ring of jet orifices 62 around the powder stream. This construction does not obtain most of the advantages of the construction shown in the other figures, but it does have the flame jets from the orifices 62 spaced from the central orifice 60 so that

the powder is entrained in the envelope or boundary layers of the flame jets, and some of the orifices 62', are larger than the other flame jet orifices for applying more heat to the work piece on the side of the powder stream which constitutes the front of the flame system when the apparatus is moved across the work piece in the direction intended.

The preferred embodiment and one modification of the invention have been illustrated and described. Other modifications and changes can be made, and some features can be used in different combinations without departing from the invention as defined in the claims.

I claim as my invention:

1. Apparatus for applying hard surfacing material to a work piece including, in combination, an oxy-fuel gas torch having a plurality of flame jet orifices spaced from one another and with flame jet orifices converging, the angle of convergence being correlated with the spacing of the jet orifices so that projections of the jet orifices meet at a point beyond the intended surface of the work piece with which the apparatus is to be used, a powder container, a powder nozzle with an outlet opening into the space between the jet orifices, and means supplying powder from the container to the powder nozzle at substantially lower velocity than that of the flame jets from said orifices, the convergence of the flame jet orifices being correlated with the powder torch nozzle so that at least a substantial part of the powder passes through the envelope flames of the flame jets while falling to the surface of the workpiece.

2. A torch for applying hard surfacing material to a metal surface including a torch body, a powder container at an elevated location, a nozzle below the powder container, a conduit leading downwardly from the powder container to the nozzle and through which powder from the container flows through the nozzle by gravity in a low velocity powder stream, a valve at the bottom of the container and movable between different positions to open and close the powder entrance of the conduit, a torch having a plurality of flame jet orifices located on different sides of the powder nozzle, the flame jet orifices being directed toward a work piece along longitudinal axes which are spaced from one another throughout the entire distance to the intended location of the workpiece, the spacing and direction of the flame jet orifices locating the flame jets on different sides of the stream of powder from the powder nozzle with the spacing of said flame jets from one another less than the width of the powder stream and in position to entrain some of the powder from the powder stream in said flame jets.

3. A hard surfacing applicator torch including two tips with jet orifices for directing oxy-hydrocarbon fuel gas flames against a work piece to which hard surfacing alloy is to be applied, the flame jet orifices being spaced from one another and directed to maintain the primary combustion cones of the flames at a substantial spacing from one another and to bring the envelope flames adjacent to one another at a distance from the tips approximately corresponding with the intended spacing of the work piece from the tips, a powder discharge nozzle located between the tips and extending in a direction to discharge a stream of powder in substantially the same direction as the flame jets and into the space between the flame jets for contact with the adjacent edges of the envelope flames and passage of at least a part of the powder through said envelope flames and into contact with the work piece, a powder container at a level above the nozzle and from which powder drops by gravity through the nozzle to the work piece, and means for controlling the discharge of powder from the container to the nozzle.

4. Apparatus for applying powdered hard surfacing alloy to a work piece including a nozzle for discharging a stream of the powder alloy against the work piece, a torch tip located on one side of the powder stream in the direction in which the apparatus is intended to be moved

across the work piece, another torch tip located on the other side of the nozzle in position to trail behind the powder stream when the apparatus is moved across the work piece, the leading torch tip being of greater heating capacity than the trailing torch tip, and said tips constituting the only means around the powder stream for directing jets of fluid against the work piece, and means for supplying powdered hard surfacing alloy to the nozzle.

5. Apparatus for applying a powdered hard surfacing alloy to a work piece including a torch body, a powder torch nozzle carried by the torch body, in position to direct a stream of powdered hard surfacing alloy against the work piece, a powder container also carried by the torch body at a level above the nozzle and from which powder drops by gravity through the nozzle to the work piece, means for controlling the discharge of powder from the container through the nozzle, torch tips connected with the torch body and including one tip which is located ahead of the nozzle in the direction in which the apparatus is intended to be moved across the work piece, and another tip located in position to trail behind the powder stream as the apparatus is moved across the work piece, said tips having jet orifices for directing oxy-hydrocarbon fuel gas flames toward the work piece, and said tips constituting the only means around the powder stream for directing jets of fluid against the work piece, the orifices being spaced from one another at a substantial distance to leave clearance for the powder stream between the flame jets for a distance beyond the lower ends of the tips.

6. Apparatus for applying powdered hard surfacing alloy to a work piece including a powder nozzle, a powder container located above the nozzle, means through which the powder drops by gravity from the container to the nozzle and from the nozzle to the work piece, torch tips located in front of and behind the nozzle and only in front of and behind the nozzle in the direction of the intended travel of the nozzle across the work piece, the torch tips having flame jet orifices which direct flame jets toward the work piece, and the jet orifices being spaced from one another and on opposite sides of the powder stream and in position to entrain a portion of the powder stream in the boundary layers of the flame jets on the sides of the flame jets that confront one another, and means for adjusting the spacing of the torch tips from one another to regulate the relation of the flames to the stream of powder falling by gravity from the nozzle for controlling the distribution of the powder transversely of the direction of intended movement of the apparatus across the work piece.

7. Apparatus for applying powdered hard surfacing alloy to a work piece including a powder container, a nozzle connected with the powder container at a level below the powder container, a conduit leading downwardly from the powder container to the nozzle and through which powder from the container flows through the nozzle by gravity in a low velocity powder stream, the nozzle having a discharge outlet with its longitudinal axis extending toward the work piece, and torch means for heating the work piece and the powder, said torch means having a plurality of jet orifices for directing oxy-hydrocarbon fuel gas flames toward the work piece, the jet orifices having longitudinal axes on different sides of the powder stream from the nozzle, and the jet orifices being spaced from one another but extending toward the work piece in the same general direction as the powder stream, the spacing of the flames from the jet orifices as measured across the powder stream being less than the width of the powder stream whereby at least a substantial part of the powder on different sides of the low velocity powder stream is entrained in the boundary layers of the flame jets that are located on different sides of the stream from the powder nozzle.

8. Apparatus for applying powdered hard surfacing alloy to a work piece including a torch having two tips that are spaced from one another and each of which has a single flame jet orifice opening through its end face, the orifices converging toward one another at an acute angle, tubing by which each of the torch tips is connected with a body of the torch, the tubing being malleable so that the tips can be adjusted to different spacing from one another to space flames that are directed from the torch tip with a clearance from one another for some distance beyond the ends of the tips, a powder discharge nozzle having its outlet located between the torch tips and its longitudinal axis substantially in the plane with the longitudinal axes of the jet orifices of the tips, the discharge end of the nozzle being spaced above the clearance between the flames that issue from the tips, a powder container located directly above the nozzle and to which the nozzle is connected, and means in the container for controlling the flow of powder from the container to the nozzle.

9. The apparatus described in claim 7 and in which the powder container has a hopper bottom with a tapered outlet that communicates with the inlet end of the nozzle, a valve element that extends downwardly through the container, into the powder space in the hopper bottom, and into a position directly over the outlet from the hopper bottom, a handle connected with the upper end of the valve element and extending in a direction to be gripped and operated by the same hand with which the operator supports the torch.

10. Apparatus as described in claim 7 and in which the torch means have an annular face through which the jet orifices open, said orifices being located around a circle on the annular face, and in which the nozzle for the powder is an opening through the face of the torch means surrounded by the annular face and of substantially larger cross section than the jet orifices.

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