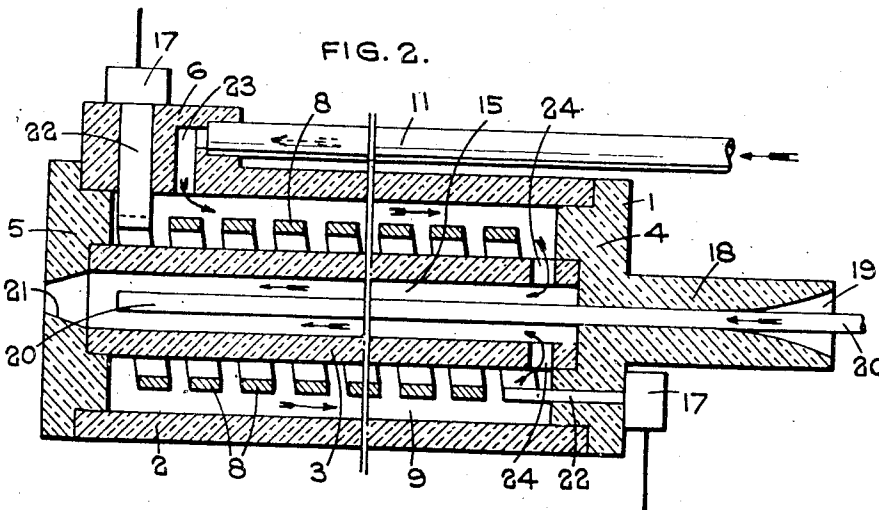
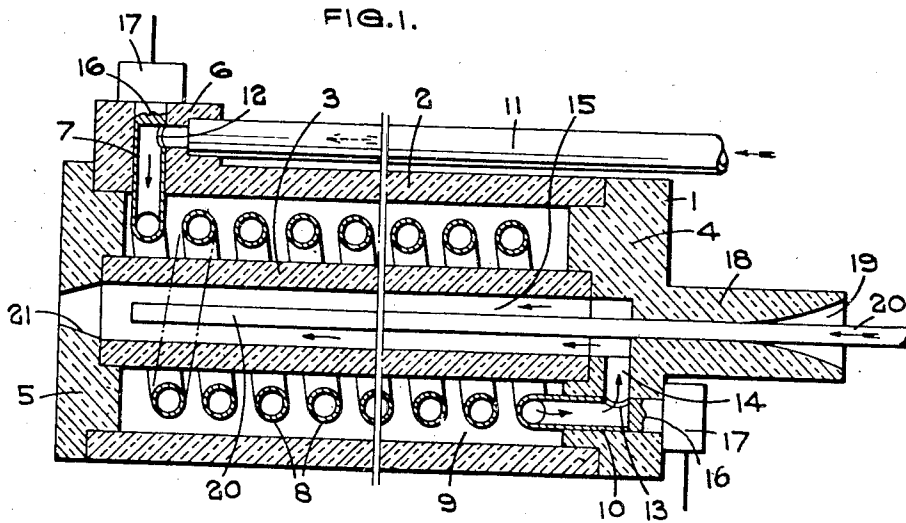


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METAL SPRAYING APPARATUS

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METAL SPRAYING APPARATUS

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7 Claims. (Cl. 91-12.2)

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The present invention relates to metal spraying, and is particularly concerned with a metal spraying apparatus in which the metal to be sprayed is passed through an electric field produced by a high frequency current and is melted by the consequent induced heating of the wire.

In practice it is found that the metal of a high frequency coil used to produce the aforesaid electric field becomes heated, and it is an object of the present invention to provide a means of adequately cooling this induction coil, and at the same time utilising the excess heat thereby developed.

According to this invention, therefore, I provide an apparatus for metal spraying, comprising a metal coil for connection to a source of high frequency current and adapted to melt the metal to be sprayed by induced heating, and means for passing a cooling gas under pressure into contact with said coil.

The apparatus may include a jacket surrounding the coil and the jacket may be of annular form, formed by a tube placed within the coil and another tube concentric with the first placed around the coil so that the coil is located in the annular space between the two tubes.

If the metal of the coil is itself of tubular form the cooling gas may be taken through this tubular metal. In this case no jacket need be used since the cooling gas may enter the metal of the coil at one end and leave it at the other end.

Instead of using an induction coil of tubular metal, an induction coil of solid metal may be used and in such a construction flat section metal with the major dimension of the section parallel to the axis of the coil may be used and the coil is placed in an annular jacket and the cooling gas is taken through the jacket in contact with the exterior surfaces of the metal of the coil.

The invention also includes an apparatus for metal spraying, comprising a pair of concentric tubular members of electrically insulating material, a coil of electrically conducting material located between said concentric tubular members and adapted for connection in a high frequency circuit, means for feeding a length of fusible metal wire into the interior of the inner of said concentric tubular members, and means for passing a cooling gas under pressure into contact with said coil.

The cooling gas may be passed through or around, or both through and around the metal of the coil.

The cooling gas is heated by its contact with the coil and may be used for projecting the spray

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or to assist in the projection of the metal spray on to the object to be sprayed.

The term "gas," used above and hereafter, includes gaseous mixtures.

In order that the invention may be fully understood and readily carried into practice, I have appended hereto a sheet of drawings illustrating, by way of example, two embodiments of apparatus in connection with which the invention will now be more specifically described. In the drawing:

Figure 1 is a longitudinal section of one form of apparatus according to the invention, and

Figure 2 is a similar section to that of Figure 1, but illustrates a modified apparatus.

In the drawing, like reference numerals are used to denote like parts.

Referring now to Figure 1, the apparatus here illustrated comprises a cylindrical casing generally designated 1, this casing including an outer tube 2 and an inner tube 3 spaced from tube 2. Tubes 2 and 3 are arranged concentrically and are supported by end walls 4 and 5 of the casing.

The outer tube 2 is provided with a protuberance 6 in which is fixed the inlet portion 7 of the coil 8 of tubular metal, the turns of this coil being arranged in the annular jacket 9 formed between the tubes 2 and 3 and having their common axis coincident with those of the tubes 2 and 3. The coil 8 is formed with an outlet portion 10 arranged in the end wall 4 of the casing.

Secured to the protuberance 6 is a gas conduit 11, this conduit communicating through an opening in said protuberance with the coil portion 7 through an orifice 12 in the latter. The coil portion 10 is likewise provided with an orifice 13, and this orifice is in communication, through a channel 14 in the end wall 4, with the hollow interior 15 of the tube 3. The coil portions 7 and 10 are each connected through conducting blocks 16 to high frequency terminals 17.

The end wall 5 has a projection 18 having an opening 19 therein, such opening being flared at its rear end, and towards its forward end forming a relatively close-fitting guideway or gland support for a wire or strip 20 of fusible metal which is adapted to be fed therethrough and into the space or conduit 15, so as to be coaxial with the coil 8, by means of rollers or like feeding means such as are described in my U. S. patent application Serial No. 550,508, filed August 22, 1944, entitled Metal spraying.

The conduit 11 communicates with a frusto-conical aperture 21, forming a nozzle, in the end wall 5 of the casing.

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In use, the terminals 17 of the apparatus are connected to a source of high frequency current, e. g. a valve-type frequency changer, and this current which may, for instance, have a frequency of the order of one million cycles per second passing through the coil sets up a field within the turns 8. The wire 20 cuts the lines of force in this field and a current is induced therein, producing a heating effect and consequent melting of the metal of the wire.

At the same time cooling gas is passed under pressure into the tubular coil 8 from the conduit 11, as indicated by the arrows, where it serves to cool the metal of the coil. As a result of the ensuing heat-exchange, the gas enters the conduit 15 under conditions of heat and pressure and forces the melted metal of the wire 20 in the form of a spray through the nozzle 21 on to the work. The fact that the gas is in a heated condition enables the particles of metal, if desired, to reach the work in the melted state, but if this is not required then the particles can be arranged to meet the work in a chilled condition.

It will be apparent from the foregoing that the temperature of the gaseous medium, supplied under pressure, is increased while traversing the induction coil, such increase in temperature, however, being insufficient to cause the fusible metal to become unduly softened; further, as such pressure supplied gaseous medium enters the chamber 15, its pressure is increased coincident with its increase of temperature, and further by its flow through the chamber 15 concentrically about the length of fusible metal, the medium serves to support the fusible metal in substantial rectilinear position in its progress through the chamber 15 until it enters the nozzle 21, whereat the fusible metal is broken into particles and projected by the pressure medium upon the work.

In the modification illustrated in Figure 2, the induction coil 8 is of solid, flat-section, metal with the major dimension of the section parallel to the axis of the coil. In this case the turns of the coil 8 are in electrical connection with terminals 17 through conducting bars 22.

Cooling gas from the pressure conduit 11 passes through a channel 23 in the protuberance 6 and into the annular space 9, where it contacts the coil 8 to cool the latter and itself become heated, thereafter passing through orifices 24 in the tube 3 so as to assist in spraying the melted metal of the wire 20 as described above in connection with Figure 1.

In both embodiments described, the two tubes 2 and 3 may be of any suitable insulating material, for example silica, porcelain, or asbestos and may, if desired, be in contact with the outer surfaces or walls of the coil 8. The induction coil itself may be of any convenient conducting metal, e. g. copper, silver, or copper plated with silver.

The cooling gas employed may be air, nitrogen, carbon-dioxide or other suitable gas or gaseous mixture, but preferably a neutral gas is employed.

It will be seen that the invention provides a method of conserving heat energy and at the same time adequately cooling the induction coil, and it also enables the number of feeds to the spraying apparatus to be reduced.

The invention may also be applied to metal spraying methods and apparatus such as are described in my copending applications said Nos. 550,508 and 551,736, filed respectively August 22, 1944, and August 29, 1944.

What I claim then is:

1. Apparatus for metal spraying, comprising a

pair of concentric tubular members of electrically insulating material, and walls closing the ends of the annular space between the tubes, one of said end walls having a central discharge opening and the other of said end walls having a tubular guide, an electrically conducting coil of hollow tubular metal adapted for connection in a high frequency circuit and located between said concentric tubular members, means for passing cooling gas under pressure through the interior of said coil, conduit means for leading the resultant heated gas from said coil to the interior of the inner of said pair of concentric tubular members at a position near the end wall having the guide, and means for passing a length of fusible metal wire through the guide into the interior of said inner concentric member for melting of the metal of said wire and spraying of the melted metal by said heated gas.

2. Apparatus for metal spraying, comprising a hollow tubular member of electrically insulating material; means for feeding a length of fusible metal wire into and through the interior of said tubular member; an electrical coil arranged for connection with a source of high frequency current disposed around said tubular member, said electrical coil serving to heat the fusible metal wire; an outer housing of electrically insulating material specially surrounding said electrical coil and enclosing said hollow tubular member; means for passing a cooling gas under pressure into said housing and in contact with said electrical coil, and means for thereafter conducting the thus heated cooling gas into the interior of said tubular member in envelopment of the metal wire.

3. Apparatus for metal spraying, comprising a hollow tubular member of electrically insulating material; a spray nozzle associated with said tubular member; means for feeding a length of fusible metal wire into and through the interior of said tubular member; an electrical coil arranged for connection with a source of high frequency current disposed around said tubular member, said electrical coil serving to heat the fusible metal wire; an outer housing of electrically insulating material specially surrounding said electrical coil and enclosing said hollow tubular member and means for passing a cooling gas under pressure into said housing and in contact with said electrical coil; and means for thereafter conducting the thus heated cooling gas into the interior of said tubular member in envelopment of the metal wire.

4. In an apparatus for spraying molten metal and the like, the combination of an induction coil; a tubular element embraced by said induction coil for the traverse therethrough of the metal in elongated solid status to be melted and sprayed, said tubular element being provided with a nozzle; means for feeding the elongated metal into and through said tubular element; means for passing under pressure a cooling gas in heat exchange relation with the induction coil; an outer housing of electrically insulating material specially surrounding said electrical coil and enclosing said hollow tubular member; and means for conducting the thus heated cooling gas into a forward part of said housing in contact longitudinally with the induction coil and thence into the rear of the tubular element whereby the heated gas envelopes the elongated metal and serves to spray the molten material.

5. Apparatus for use in the melting and spraying of metal and the like, comprising an outer

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tubular housing; an inner tubular member having a nozzle at one end; means for feeding metal into said inner tubular member toward its nozzle end; a hollow tubular induction heating coil disposed around said inner tubular member and enclosed within said tubular housing; a source of cooling gas under pressure; an inlet port for said gas approximate the forward end of said housing; means for connecting said source of pressure cooling gas with said inlet port; and means in the rear of said tubular member for conducting the gas after traversing the coil into and forwardly through said inner tubular member.

6. Apparatus for metal spraying, comprising in combination a hollow tubular member of electrically insulating material; means for feeding a length of fusible metal wire into and through the interior of said tubular member; a hollow tubular electrical coil arranged for connection with a source of high frequency current disposed around said tubular member; an outer housing of electrically insulating material specially surrounding said hollow tubular electrical coil and

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enclosing said hollow tubular member; means for passing a cooling gas under pressure into said housing, thence into said hollow tubular electrical coil and thereafter conducting the thus heated cooling gas into the interior of said tubular member in envelopment of the metal wire.

7. Apparatus for metal spraying, comprising in combination a hollow tubular member of electrically insulating material; means for feeding a length of fusible material into and through the interior of said tubular member; a hollow tubular electrical coil arranged for connection with a source of high frequency current disposed around said tubular member; an outer housing of electrically insulating material specially surrounding said hollow tubular electrical coil and enclosing said hollow tubular member; means for passing a cooling gas under pressure into said housing, thence into said hollow tubular electrical coil and thereafter conducting the thus heated cooling gas into the interior of said tubular member in envelopment of the fusible material.

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