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APPARATUS FOR BURNING WIRE METAL

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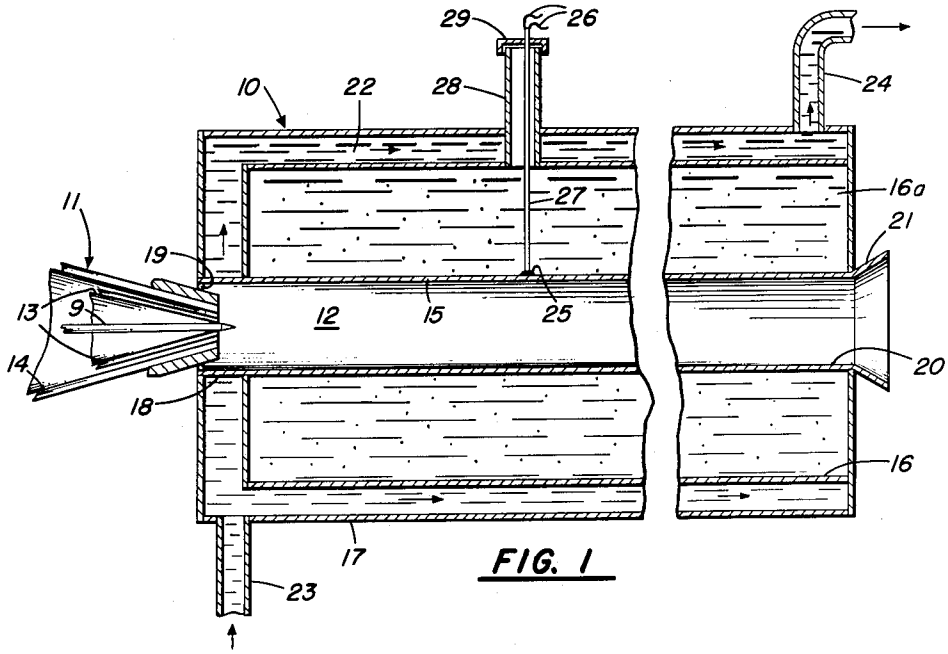


FIG. 1

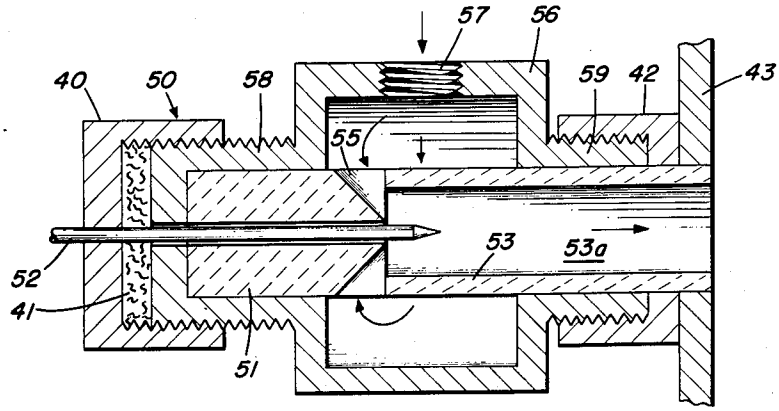


FIG. 2

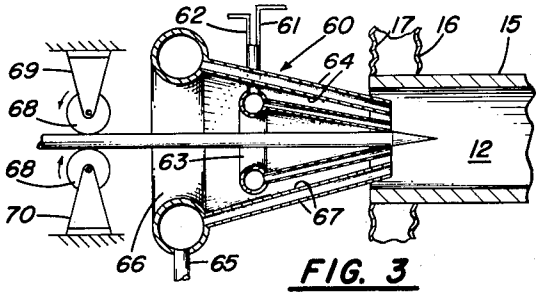


FIG. 3

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APPARATUS FOR BURNING WIRE METAL

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7 Claims. (Cl. 263—1)

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to a method and apparatus for burning solid substances such as metals, and various metallic or non-metallic composites. Since the invention may have broader application to the burning of metals, the description will be directed primarily to metal burning, with specific reference to aluminum.

Heretofore, metals have been atomized for the purpose of use as sprays, whereby coatings may be applied to various structural substances. In such atomizers the metal is heated to the point of fusion and then subjected to a pressurized flow which atomizes the metal and permits application to the surface to be coated.

In the present invention the process includes not only the fusion and atomization of the metal but also the combustion of the atomized particles.

The objects of the invention, therefore, include provision of means for atomizing the metal; the provision of means for holding the atomized particles at or above ignition temperature; and the provision of means for metal burning without preliminary granulation of the metal in a separate process step.

Other objects and many of the attendant advantages of this invention will be appreciated on reference to the following detailed description in connection with the drawings wherein:

Fig. 1 is an elevational view in section showing the furnace construction;

Fig. 2 is a sectional view of a modified furnace construction; and

Fig. 3 is a sectional view of a modified form of atomizer.

In metal burning it is desirable first to atomize the metal by an appropriate disintegrator, the metal particles being then readily heated and ignited and easily controlled by a gas stream. After atomization, the metal particles are led into a furnace chamber wherein the wall is maintained above the metal particle ignition point. Consequently, on ignition, the metal burns as long as the metal particles are fed to the furnace and the furnace wall temperature is maintained.

In Fig. 1 is shown a form of furnace **10** which may be used for metal burning. The furnace includes the atomizer **11** and the furnace chamber unit **12**, these two units being connected in series with the chamber being in line with and succeeding the atomizer.

An oxyhydrogen type atomizer is indicated, with the converging oxygen inlet **13**, the coaxial converging hydrogen inlet **14** and the wire **9** axially positioned for sliding movement at the inlet axis.

The furnace chamber unit **12** includes the furnace chamber tube **15** and dual heat exchange casings **16** and **17** concentrically placed around the chamber tube, casing **16** directly surrounding furnace chamber **12** and casing **17** surrounding casing **16**. The furnace chamber **12**

at end **18** is adapted to receive the conical end of atomizer **11**, a sealing ring **19** insuring adequate end closure. At end **20** the furnace tube diverges in a flare **21**. Casing **16** at the atomizer end stops short of the end of the furnace chamber **12**, so that the jacket **22** formed between casings **16** and **17** extends over the atomizer end of the furnace. The walls of both casings **16** and **17** at the atomizer end may be corrugated circularly so as to permit easy expansion and contraction in accordance with heat variation in the contained fluids. At the atomizer end, also, an inlet for the jacket space **22** is provided at **23**, the outlet **24** being positioned at the other furnace end.

To obtain median furnace chamber temperature a thermocouple **25** is secured to the chamber adjacent its mid-length point, the connecting wires **26** and a protecting tube **27** extending outwardly from the thermocouple through vent tube **28** and vent tube cap **29**. The cap **29** is formed with open edge spaces to permit easy gas escape.

To prevent fusion of the furnace wall, the inner casing **16** is filled with a salt coolant **16***a* consisting of a mixture of potassium chloride, sodium chloride and barium chloride, so proportioned as to give a melting point between 800 and 1000 degrees Fahrenheit. The jacket **22** is adapted to receive cooling water through inlet **23**, the water flowing along the surface of casing **16** and thereby controlling the temperature of the salt coolant in accordance with the speed of water flow and temperature.

In operation, the gases are led through the atomizer and ignited thus melting the metal of the wire. The gas pressure atomizes the metal which is carried by the draft to the furnace exit where it is ignited by an acetylene flame or by insertion of a gunpowder squib through the outlet opening. The burning metal heats the burner wall **15** until it becomes incandescent but is prevented from melting by the coolant action of the fused salt. At this temperature the atomized metal burning is maintained as long as the atomized metal supply continues, the salt coolant temperature being observed by means of the thermocouple **25** and the salt temperature controlled by the water coolant temperature and rate of flow.

For certain uses the atomizer unit **50** of Fig. 2 has important values. In this type of atomizer, a refractory nozzle **51** which is axially apertured to receive the metal wire **52**, is placed in alignment with the refractory tube **53**, the nozzle end **54** adjacent tube **53** being formed with converging channels **55** constituting the inlet to the burner chamber **53***a* of tube **53**. A manifold **56** provided with a main inlet **57** is adapted for reception of a gas such as air, heated sufficiently to maintain the burner chamber wall at particle ignition temperature. As shown, the manifold **56** is cylindrical in shape with threaded end extensions **58** and **59**, extension **58** being adapted to receive the gland cap **40**, holding packing material **41**, and extension **59** receiving the retaining cap **42**. Both the burner chamber **53***a* and the terminal plate **43** may be integrated with a unit such as the furnace unit of Fig. 1, placed in axial extension of the burner tube **53**.

In use, as in the burning of aluminum, for example, pressurized air, preheated to a temperature above the melting point of the aluminum wire **52**, is piped into the manifold **56** through inlet **57**. The air is permitted to flow through the nozzle openings **55** and out of the burner chamber **53***a* until the nozzle and the entire tube wall **53** is heated to incandescence. The wire is then advanced into the chamber and the atomized particles ignited by means of an acetylene flame or gunpowder squib, as in the method applied to Fig. 1. Maintenance of the metal ignition point may be obtained through use of a salt coolant as in Fig. 1, also.

Fig. 3 illustrates diagrammatically an atomizer **60**

adapted for use of acetylene in order to increase the atomizer temperature. This atomizer includes the oxygen and acetylene pipe lines 61 and 62 leading from sources of these fluids to the mixing ring 63 and thence through the channel formed by converging truncated conical walls 64 to a point inside the inlet end of burner chamber 12. An air supply 65, piping air to the interior of hollow ring 66, is also connected to the burner chamber 12 by truncated converging walls 67 concentric to the oxy-acetylene passageway and to the axially placed metal wire. An appropriate mechanism for supporting and advancing the feed wire, such as rollers 68, mounted on fixed supports 69 and 70, is, also, indicated.

In using the atomizer of Fig. 3, the oxyacetylene gases are ignited at the burner end and, at the same time, air under pressure forced through the channel of supply cone 64. The wire is advanced through this forced flame causing melting and atomization of the metal, and the atomized metal is led into a furnace chamber, as shown in Fig. 1, for ignition and maintained burning.

In all forms of the disclosed invention it is apparent that the hazard of storing or handling combustible powders is avoided, and that by use of the metal in wire form less storage spaced is needed than would be required for an equal weight of powdered metal. Also, with wire burning, the rate of fuel flow is more easily and accurately controlled than in the case of powdered fuel.

Modifications of the present invention are possible in the light of the above teachings; and it is, therefore, to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. Apparatus for burning metal in wire form comprising a wire support nozzle, means for moving said wire through the nozzle, means for applying metal fusing gases to the tip of said wire, gas pressure means for spraying the fused metal, a chamber for receiving said sprayed metal, a jacket surrounding said chamber, and a coolant in said jacket, said coolant having a fusing point not less than 800 degrees Fahrenheit and in excess of the ignition point of said metal particles.

2. The apparatus as defined in claim 1 with additional coolant temperature control means including a second jacket surrounding said first named jacket, said second jacket having inlet and outlet ducts for passage of a control fluid therethrough.

3. Apparatus for burning metal in wire form comprising a nozzle axially apertured to form a passageway for wire fuel, means for advancing said wire through said nozzle, a burner tube in extension of said nozzle, having

annular ports at the junction of tube and nozzle, a manifold shell having an inlet opening enclosing said annular ports and an extended adjacent section of said burner tube, whereby on supply of pressurized pre-heated air to said manifold both the wire is fused and atomized and the burner temperature held at a point maintaining metal particle burning.

4. Apparatus for burning solids in wire form comprising a wire support nozzle, means for moving said wire through the nozzle, means for supplying fusing gases to the tip of said wire, gas pressure means for spraying the fused solids, a chamber for receiving said sprayed solids, a jacket surrounding said chamber, and a heat reservoir in said jacket for holding said solids at a temperature in excess of the ignition point of said solids.

5. The apparatus as defined in claim 4 with control means including a second jacket surrounding said first named jacket for holding the temperature of said reservoir and chamber at the temperature of combustion of said solids.

6. Apparatus for maintaining solid gas-supported particles at a temperature in excess of the ignition point thereof, comprising a source of supply of said supported particles, a tubular combustion chamber for containing said supported particles, a coolant jacket surrounding said chamber, a coolant permanently contained in said jacket, and means in close proximity and direct heat transfer relationship to said coolant for controlling the variation in temperature thereof, said coolant consisting of a salt formed of a mixture of potassium chloride, sodium chloride and barium chloride.

7. Apparatus for maintaining solid gas-supported particles at a temperature in excess of the ignition point thereof, comprising a source of supply of said supported particles, a tubular combustion chamber for containing said supported particles, a coolant jacket surrounding said chamber, a coolant permanently contained in said jacket, and means in close proximity and direct heat transfer relationship to said coolant for controlling the variation in temperature thereof, said coolant controlling means comprising a jacket surrounding and in proximity to said coolant jacket.

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