

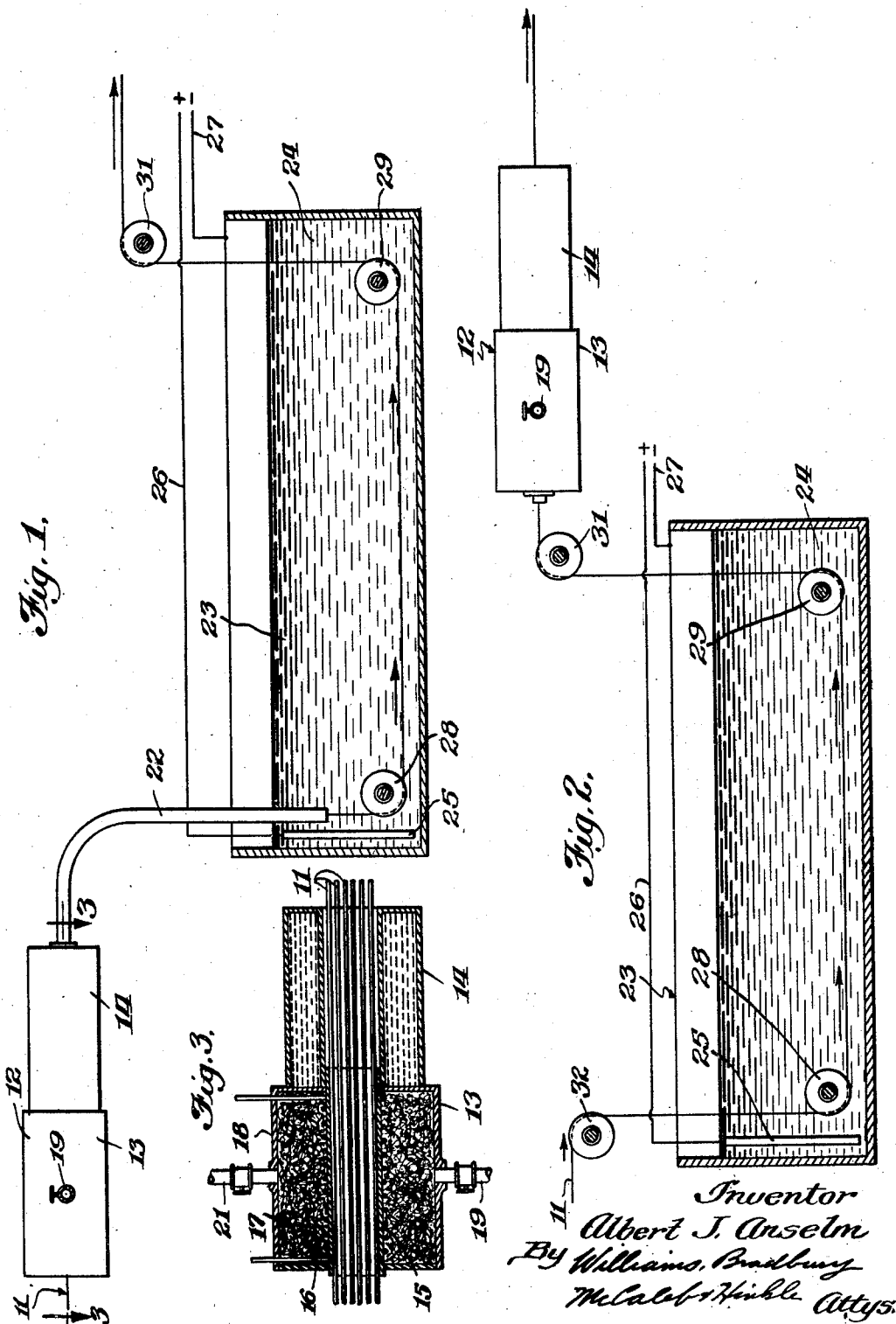
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METHOD OF DRAWING WIRE

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METHOD OF DRAWING WIRE

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This invention relates in general to drawn wire and a method of producing the same, and has more particular reference to a novel method of continuously drawing molybdenum.

A primary object of the invention is the production of drawn molybdenum wire.

An important object of the present invention is the provision of a novel method of treating refractory metals to permit drawing them into wire.

Another important object of the invention is to provide an economical method of drawing molybdenum wire which avoids the "skinning back" effect at the dies, and consequently, the breaking of the wire.

Still another important object of the invention is to provide a simple method of reducing the oxide skin or film formed on molybdenum wire preparatory to the drawing of the wire.

Other objects and advantages of the invention will be apparent from the following description and from the accompanying drawing, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the single sheet of drawings:

Figure 1 shows schematically the steps in the novel method of the invention;

Figure 2 is a modification of the method shown schematically in Figure 1; and

Figure 3 is a section taken substantially on the line 3—3 of Figure 1.

In drawing refractory metals into wire, serious difficulty is encountered due to the frequent breaking of the wire at the dies and due to the abrasive action on the dies. Such breakage is usually preceded by the wire "skinning back" until the tension in the wire is sufficient to sever it. It has been found that an oxide film or skin forms on the surface of the wire and this oxide film being hard causes abrasion or "pulling out" of the dies, thereby seriously handicapping the economy, simplicity and practicability of drawing refractory metals.

The present invention contemplates the provision of a novel method of treating the refractory metal prior to passing it to the die, whereby to remove this oxide film or skin and to permit of continuous drawing of such metals into wire.

To the attainment of the foregoing objects, the invention, briefly, comprises either the reduction of this oxide film by subjecting the wire to heat in an atmosphere of hydrogen and forming or depositing a coating of a ductile metal on the molybdenum prior to feeding it to the wire dies, or plating the molybdenum at a temperature

less than that of the melting point of the plating metal, and cooling it in an atmosphere of hydrogen, the wire as in the first case being subsequently passed to the dies.

To this end, a molybdenum wire 11 is fed through an electric furnace 12, where it is heated to about 1200° C. in an atmosphere of hydrogen. While the furnace 12 per se forms no part of the present invention, and its description is not necessary to a complete understanding thereof, it may be well to mention that the furnace 12 may include, briefly, a heating chamber 13 and a cooling chamber 14. A porous alundum cylinder 15 heated by a molybdenum coil 16 supplied with energy from a suitable source not shown, is embedded in a refractory material, such as magnesia 17, disposed in a suitable container 18, having hydrogen inlets 19 and 21 for supplying hydrogen to the alundum cylinder 15.

A single strand or a plurality of strands of wire 11 may be fed through the cylinder 15 and heated to the temperature already mentioned, after which the wire passes through the water-cooled chamber 14 supplied with hydrogen from the cylinder 15 for cooling the wire after the oxide film or skin has been reduced by the heating in the presence of hydrogen in the heating chamber 13. From the cooling chamber 14, the wire 11 passes through a spout or sleeve 22, which communicates with a plating bath for the purpose of coating the wire with a ductile metal, as will now be described.

While any suitable ductile metal which itself may be drawn into wire is here contemplated, copper is preferred and may be deposited on the molybdenum wire electrolytically. For this purpose a suitable container 23 is partially filled with an electrolyte 24 including a copper salt, such as copper cyanide 24, and provided with a copper anode 25 immersed in the electrolyte 24 and connected by a wire 26, together with a wire 27 connected to the container 23, to a suitable source of electric potential, not shown.

The spout 22, carrying the molybdenum wire 11, communicates at its free end with the electrolyte 24 below its surface for the purpose of guiding the wire from the cooling chamber 14 into the plating bath and for protecting it from the atmosphere prior to forming a copper plate on the wire. From the spout 22, the wire is fed through the plating bath at a velocity of about 24 feet per minute around rollers or pulleys 28 and 29, positioned near each end of the container 23 below the surface of the electrolyte 24

and over a pulley or roll 31 to the wire forming or drawing dies, not shown.

Thus the oxide film or skin is removed from the molybdenum wire and a copper coating is electrolytically formed which permits of drawing the molybdenum into wire. The copper coating may subsequently be removed in any desired manner, such as by passing the drawn wire through a sulphuric acid bath.

According to the embodiment of the invention shown in Fig. 2, the molybdenum wire 11 may be fed over a roll or pulley 32 directly into the plating bath in the container 23 and into the heating chamber 13, where the copper coated molybdenum wire is baked at a temperature of about 1100° C. in an atmosphere of hydrogen to reduce the oxide film on the molybdenum wire, and to bake the copper coating on the molybdenum. The copper coated wire may then be passed through the cooling chamber 14 and on to the dies.

This latter modification is simply a reversal of the method shown in Fig. 1 and serves to form a molybdenum wire having a coating of copper which tenaciously adheres to the molybdenum core, and which, as already mentioned, may be subsequently removed in any suitable manner.

The reduction or removal of the oxide film or skin and the copper coating reduces or eliminates the heretofore serious abrasion or "pulling out" of the dies and the molybdenum wire so treated is not subject to the frequent breakage partially caused by the "skinning back" effect at the dies. Thus, a simple, economical and practicable method has been provided for cold-drawing refractory metals into wire which avoids frequent breaking of the wire, thereby resulting in a saving of time and labor.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. A method of treating molybdenum preparatory to drawing it into wire which comprises heat-

ing it in the presence of hydrogen to reduce the oxide surface, cooling the molybdenum wire, isolating the molybdenum wire from the atmosphere while passing it to a plating bath and electro-plating the wire in said plating bath.

2. A method of treating molybdenum preparatory to drawing it into wire which comprises passing the molybdenum through a heating chamber, a cooling chamber, and an electric plating bath and the while isolating the molybdenum from the atmosphere.

3. A method of continuously, cold drawing molybdenum wire which comprises successively feeding the molybdenum wire through a copper plating bath, a heating chamber, and a hydrogen filled cooling chamber, and drawing it through dies the wire being provided with a continuous movement through the bath chambers and dies.

4. A method of continuously cold drawing a refractory metal, which comprises heating, cooling in a reducing atmosphere, and copper plating a moving refractory metal, and continuously drawing the cooled, copper plated refractory metal through a drawing die.

5. A method of cold drawing molybdenum wire which comprises electro-depositing a coating of copper thereon, reducing any molybdenum oxide which may be present, heating the copper coated wire to a temperature less than the melting point of the copper, whereby it is more firmly secured to the molybdenum, cooling the copper coated wire, and thereafter drawing the wire.

6. A method of cold drawing molybdenum wire which comprises applying to said wire a continuous integral coating of copper, reducing any oxides of molybdenum which may be present, subjecting the coated wire to a baking operation separate from the coating operation, the more effectively to secure the copper to the molybdenum, cooling the coated wire, and thereafter cold drawing the wire.

7. A method of drawing molybdenum wire which comprises passing the wire through a copper plating bath to deposit a continuous integral copper coating thereon, passing the copper coated wire into a heating chamber, maintaining a reducing atmosphere in said chamber, cooling the coated wire, and thereafter drawing it through a die.

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