

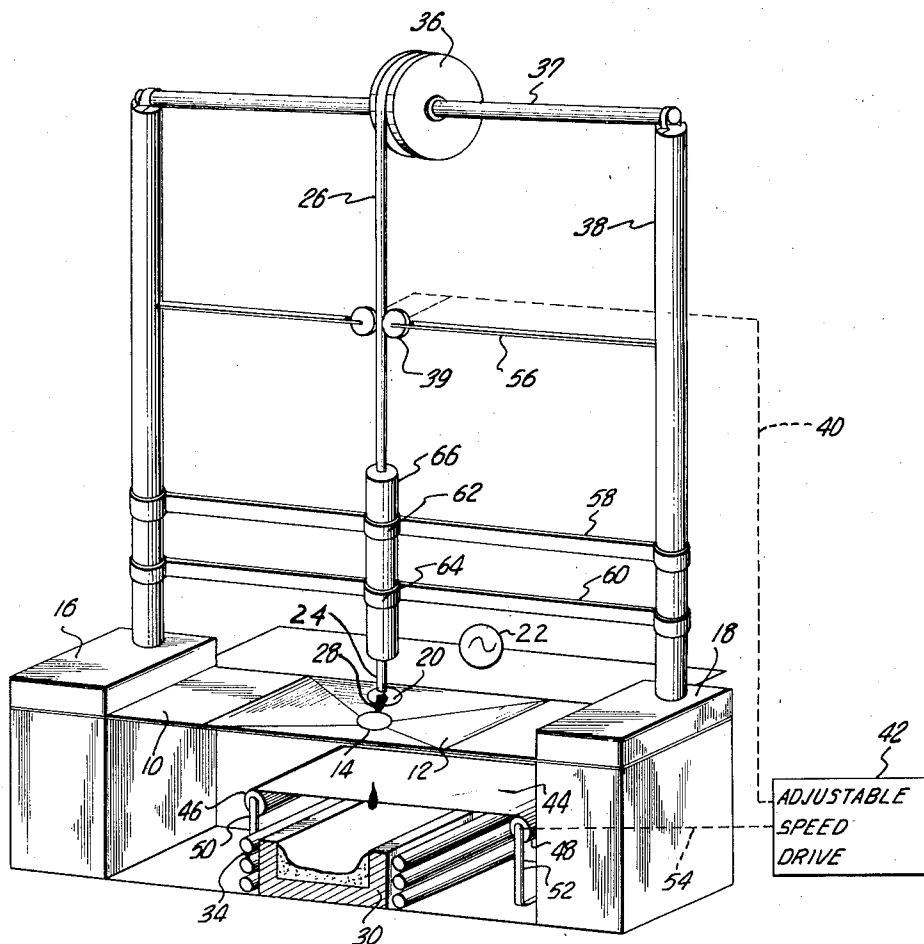
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METHOD AND APPARATUS FOR SUPPLYING MATERIAL TO AN EVAPORATOR

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METHOD AND APPARATUS FOR SUPPLYING MATERIAL TO AN EVAPORATOR

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This invention relates to a method and apparatus for supplying molten coating material to an evaporator in vacuum coating equipment.

In many instances, particularly for the vacuum coating of long sheets of substrate, it is desirable to provide means for continuously supplying molten material to the evaporator or vapor source. Usually, continuous supply means for molten coating material block off an essential part of the evaporation area or they do not permit wide sheets of substrate to be coated, or the uniform temperature distribution about the evaporator is disturbed by strong local cooling of the supply means.

These difficulties have been overcome by the present invention in which the end portion of a length of coating material is fed to a heated metal strip. The metal strip is heated by an electrical current to a temperature which melts the end portion of the continuous length of coating material to provide a continuous supply of molten coating material for an evaporator.

In the preferred form of the invention, the apparatus for continuously melting and supplying molten coating material to an evaporator comprises a strip of refractory metal supported in predetermined space relation to an evaporator and which drains liquids from the upper surface of the strip into the evaporator. The length of coating material is continuously fed to the metal strip whereby the end portion of the length of coating material is melted at the upper surface of the metal strip to provide a continuous supply of molten coating material to the evaporator.

Referring to the drawing, a sheet of refractory metal 10, such as tantalum, is formed to provide a trough 12 and an aperture 14. The metal sheet 10 is shown supported between clamps 16 and 18 to provide a horizontal upper surface including the trough section 12. The upper surface of the metal sheet 10 with the exception of area 20 is coated with a heavy oxide layer. A metal sheet 10 of tantalum would include a heavy oxide layer of Ta₂O₅. The oxide layer on the surface of the metal sheet 10 prevents wetting of the surface by the molten coating material for improved draining of molten coating material from the surface.

In order to melt the material fed to the surface of the metal sheet 10, an electrical current source 22 is connected to the end portions of the metal strip 10 by heating current supply lines which are secured to the respective metal strip end portions between sections of the clamps 16 and 18. Preferably, the small area 20, free of the oxide layer, is wetted by the molten coating material from the end portion 24 of the length of coating material 26. The melted or molten coating material indicated by reference number 28 drains from the area 20 along the upper surface of trough 12 to the aperture 14. The molten material passing through the aperture 14 is received in the evaporator or crucible 30 and evaporated by the heat produced by the inductive heating coil 34.

The length of material 26 is stored to be readily ac-

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cessible, such as by a reel 36, supported for rotation on lateral member 37 of the support 38. The length of material 26 may be drawn from the reel 36 in a continuous or intermittent manner by feed rollers 39 and fed to the area 20 of the metal sheet 10 for melting. The rollers 39 are mechanically coupled to the adjustable speed drive 42 by the mechanical linkage 40 for feeding the length of material 26 from the reel 36 to the metal strip 10 as indicated in the drawing.

The sheet or length of substrate 44, to be coated by the vapors of coating material emanating or rising from the evaporator 30, is positioned adjacent the path of molten material falling into the evaporator and coupled to reels 46 and 48 supported by vertical support members 50 and 52, respectively. The sheet 44 is passed over the evaporator 30 by the wind-up reel 48 mechanically coupled to the adjustable speed drive 42 by a mechanical linkage 54.

The support 38 includes a lateral member 56 supporting feed rollers 39 for rotation. The lower lateral supports 58 and 60 include brackets 62 and 64 surrounding the hollow cylindrical insulating member 66. The cylindrical insulating member shields a portion of the length of material adjacent the end portion 24 from the heat radiated by the metal sheet 10.

In operation, a length of coating material is continuously fed to a small oxide free area 20 of metal sheet 10 for melting and thereby continuously supplying molten coating material 28 to an evaporator 30. The feed rollers 39 drive the length of coating material 26 to continuously supply a solid end portion 24 of the length of material at the surface of the metal sheet 10. The melted material 28 drains down the trough 12 to the aperture 14 where it falls or is fed to the evaporating chamber of the evaporator 30.

The sheet of refractory material 10 has a higher melting temperature than the coating material to be melted. The current source 22 regulates the heating current to the metal sheet 10 to maintain its temperature above the melting temperature of the coating material but below the melting temperature of the refractory metal, such as tantalum, forming the sheet 10. The oxide layer on the metal sheet 10 increases the draining efficiency of the trough 12 while the bare metal area is wetted by the coating material to increase its melting efficiency.

I claim:

1. In the vacuum evaporation process, the method of continuously supplying melted coating material to evaporator which comprises supporting a metal strip in spaced relation to an evaporator whereby molten material from the upper surface of the metal strip drains into the evaporator, continuously feeding a portion of the length of coating material to the metal strip whereby at least the end of coating material strip contacts the surface of the metal strip, and heating the strip to melt the portion of the strip of coating material contacting the heated metal strip thereby continuously supply molten coating material to the evaporator.

2. In a vacuum coating process, the method of continuously supplying melted coating material to an evaporator which comprises supporting a metal strip in spaced relation to the evaporator whereby molten coating material on the strip drains into the evaporator, continuously feeding the end of a length of coating material to an exposed surface of the metal strip, and heating the metal strip to continuously melt the end of the length of coating material providing a continuous source of molten coating material for the evaporator.

3. In a vacuum coating process, the method of continuously supplying molten coating material to an evaporator which comprises supporting a preformed strip of refractory metal to drain liquids into the evaporator,

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continuously transporting the end portion of the length of coating material to a predetermined exposed area of the refractory metal strip, and passing an electric current through the refractory metal strip to heat the strip to continuously melt the end portion of the length of coating material.

4. In a system for depositing a coating material in a vacuum the combination which comprises, means including an evaporator for evaporating the coating material, a strip of refractory metal secured above the evaporator and arranged so that material melted on a portion of the upper surface of the strip will fall into the evaporator, a length of coating material, means for continuously feeding the end portion of the length of coating material to said portion of the upper surface of a strip and means including a source of electric current for heating the strip to continuously melt the end portion of the length of coating material whereby molten coating material is continuously fed to the evaporator.

5. In combination with an evaporator for continuous coating of long sheets of substrate, means for continuously melting and supplying molten coating material to the evaporator comprising a strip of tantalum adapted to be connected to a source of electrical current for heating the strip and melting the coating material, means for supporting said strip in predetermined spaced relation to the evaporator for draining liquids from upper surface of the strip into the evaporator, a length of coating material, means for continuously feeding the end portion of the length of coating material to the upper surface of the strip whereby the end portion of the length of coating material is melted to continuously supply molten coating material to the evaporator.

6. In combination with an evaporator for continuous coating of long sheets of substrate, means for continuously melting and supplying molten coating material to the evaporator comprising a strip of tantalum adapted to be connected to a source of electrical current for heating the strip and melting the coating material, means for supporting said strip in predetermined spaced relation to the evaporator for draining liquids from upper surface of the strip into the evaporator, a length of coating material, means for continuously feeding the end portion of the length of coating material to the upper surface of the strip whereby the end portion of the length of coating material is melted to continuously supply molten coating material to the evaporator, the upper surface of the strip of refractory metal having a predetermined area of metal surface for engaging the end portion of the length of coating material and the remainder of the upper surface including a layer of tantalum oxide.

7. In combination with an evaporator for continuous coating of long sheets of substrate, means for continuously melting and supplying molten coating material to the evaporator comprising a strip of refractory metal adapted to be connected to a source of electrical current for

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heating the strip and melting the coating material, means for supporting said strip in predetermined spaced relation to the evaporator for draining liquids from upper surface of the strip into the evaporator, a length of coating material, means for continuously feeding the end portion of the length of coating material to the upper surface of the strip whereby the end portion of the length of coating material is melted to continuously supply molten coating material to the evaporator, the upper surface of the strip of refractory metal having a predetermined area of metal surface for engaging the end portion of the length of coating material and the remainder of the upper surface including an oxide layer of the refractory metal.

8. In combination with an evaporator for continuous coating of long sheets of substrate, means for continuously melting and supplying molten coating material to the evaporator comprising a strip of refractory metal adapted to be connected to a source of electrical current for heating the strip and melting the coating material, means for supporting said strip in predetermined spaced relation to the evaporator for draining liquids from upper surface of the strip into the evaporator, a length of coating material, means for continuously feeding the end portion of the length of coating material to the upper surface of the strip whereby the end portion of the length of coating material is melted to continuously supply molten coating material to the evaporator, the strip of refractory metal being formed to provide a trough having an aperture therein for draining the molten coating material from the strip.

9. In a system for depositing a coating material on a substrate in a vacuum the combination which comprises, means including an evaporator for evaporating the coating material, a strip of refractory material having a trough-like shape and a centrally disposed aperture therein secured above the evaporator whereby material melted on the upper surface of the strip will flow through the aperture and fall into the evaporator, a length of coating material, means for continuously feeding the end portion of the length of coating material to the upper surface of the strip and means including a source of electric current for heating the strip to continuously melt the end portion of the length of coating material whereby molten coating material is continuously fed to the evaporator.

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