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PROCESS AND APPARATUS FOR DEPOSITING METALS ON A SUPPORT BY THERMAL EVAPORATION IN A VACUUM

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FIG. 1.

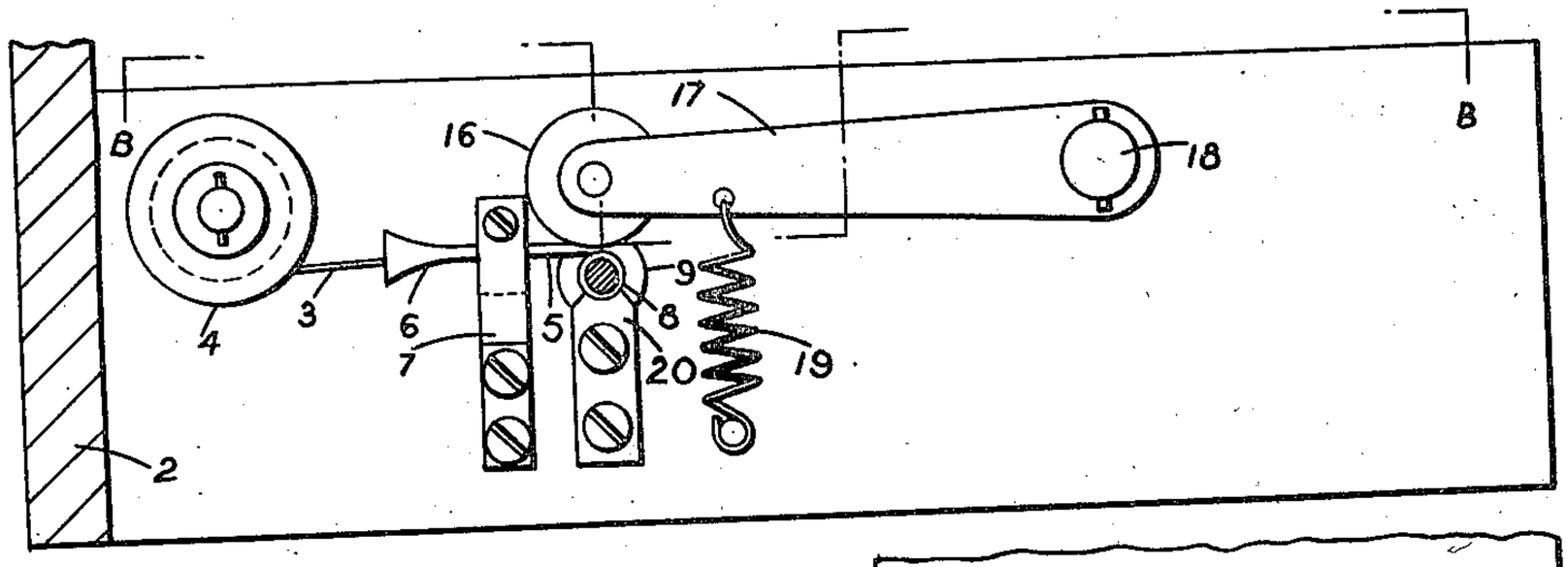

FIG 2.

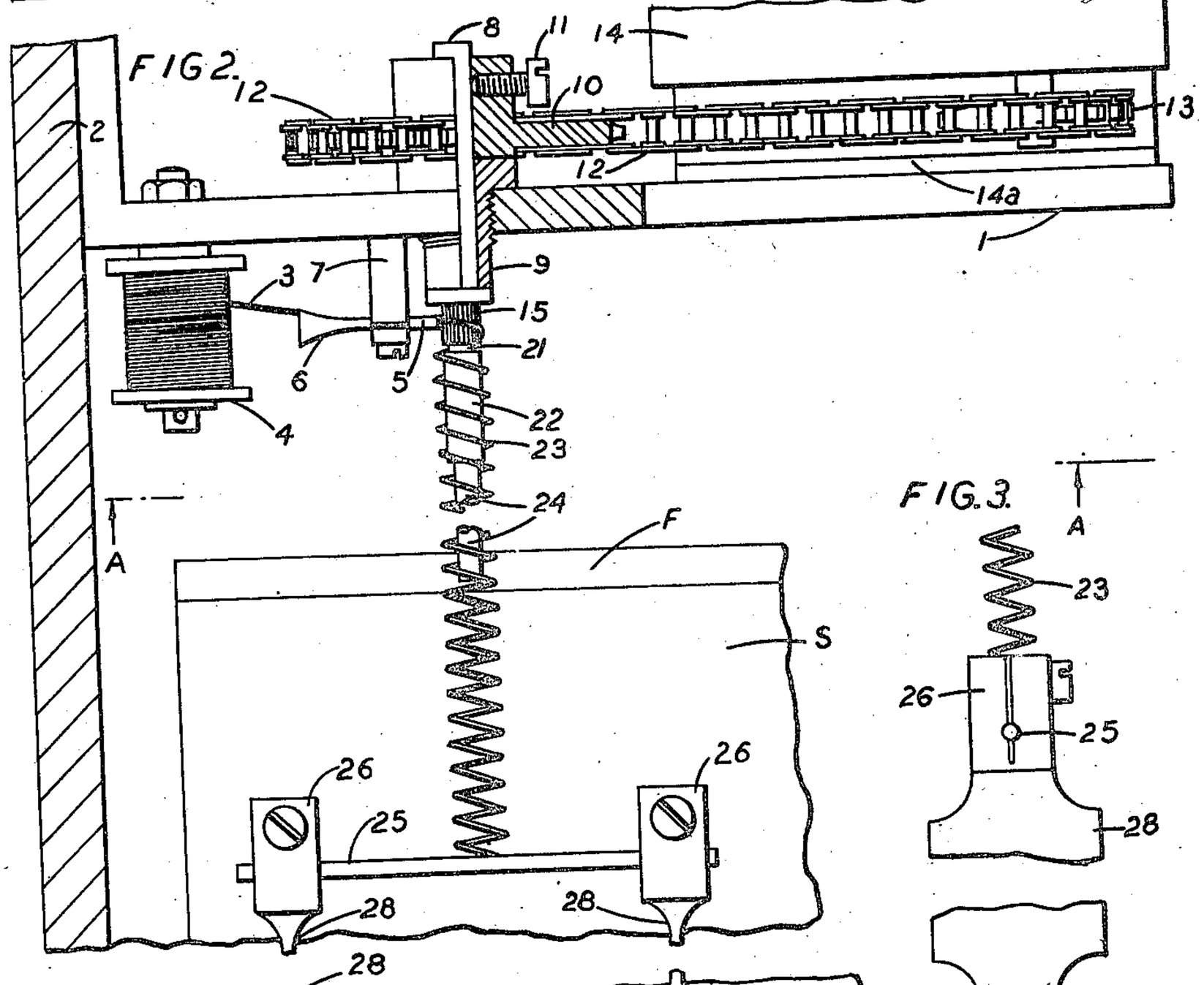

FIG. 3.

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PROCESS AND APPARATUS FOR DEPOSITING METALS ON A SUPPORT BY THERMAL EVAPORATION IN A VACUUM

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3 Claims. (Cl. 117—107)

1

This invention relates to processes and apparatus for depositing metals on a support by thermal evaporation in a vacuum.

The metal most commonly evaporated is aluminium and the heater required for its evaporation is one of the rafractory metals, tungsten being the most suitable.

Aluminium, however, at high temperature alloys with or dissolves tungsten, and the tungsten heater quickly becomes rotten and breaks if molten aluminium remains in contact with it.

In U. S. A. patent specification No. 2,153,786 there is disclosed a process of and apparatus for depositing aluminium on a support in a vacuum, the heater being made of tungsten, and in which a means avoiding the rapid disintegration of the heater is avoided by feeding aluminium to the heater in the form of a wire so that an end only of the wire came into contact with the heater, and was evaporated before there was time for a pool of molten aluminium to form on the bar. By this means the life of the tungsten heater can be very largely increased.

Nevertheless, the tungsten disintegrates in time, and the wastage of tungsten remains the most costly item in the process.

The principal object of the invention is to reduce the wastage of tungsten in heaters incorporated in apparatus of the kind described.

Another object is to avoid dense aluminium vapour in the vicinity of the heater.

Another object is to so feed a fine wire of the metal to be evaporated so as to assure that it is brought into contact with a tungsten heater of very small cross-section.

Another object is to lead current to a tungsten heater in rod or bar form by means which avoid stressing the heater when it lengthens or contracts on heating and cooling.

To avoid accumulation of vapour in the vicinity of the heater the aluminium wire must be so fine, that it is very flexible, and it has been found impracticable to feed such a wire, if straight, accurately to a given point.

Guiding means for the wire cannot be brought close to the heater bar, by reason of the high temperature radiation, and also because any such means, close to the point of evaporation, becomes covered with a growing layer of deposited aluminium. A length of wire of 2.5 to 5 cms. must therefore be allowed to descend free of any guiding means, and this length is liable to be deflected from a straight path by five or more millimetres.

Apparatus for depositing metal on a support by thermal evaporation of the metal in a vacuum, comprises a heater bar of refractory metal, winding means disposed with its axis vertically above the heater and perpendicular thereto for continuously drawing a wire of the metal to be evaporated from a storage spool and a coaxial former on which the wire is coiled into a continuously rotating and vertically descending helix, said former terminating at a point distant from the heater, whereby a free length of helix is disposed in the vicinity of the heater and the lower end only of the helix comes into contact with the heater bar.

2

Preferably the descending helix has a diameter which is larger than the width of the heater bar.

By the present invention, a fine aluminium wire may be fed to a heater rod or bar of tungsten of as small a cross section as is desired, with no risk of the wire failing to make contact with it. In practice a round rod of tungsten is the most economical form of heater bar, and a rod of only two millimetres diameter may be used. The invention, therefore, enables a small amount of tungsten in its most economical form to be used in metal depositing apparatus of the kind described.

The invention comprises also a process of depositing aluminium on a support by thermal evaporation in a vacuum wherein a tungsten heater is used to evaporate the metal and the metal in the form of a wire is continually advanced to the heater so that the end only of the wire touches the heater, characterised in that the metal is fed to the heater in the form of a freely depending helix rotating about its axis, the rate of descent of the wire in the helix being related to the temperature of the heater to effect instantaneous evaporation of the wire as it comes in contact with the heater, and the heater presents only a relatively small cross section to the helix, the radius of the helix being somewhat greater than the extent of maximum deflection of the free end of the helix laterally of the heater.

One preferred form of the invention which has been found successful in practice in the process of depositing aluminium on a support by thermal evaporation in a vacuum, will be described, by way of example, with reference to the accompanying drawings, of which—

Figure 1 is a view from below of the helix forming device, in which the helix itself is omitted, taken along the line AA of Figure 2.

Figure 2 is a side view of the device including the heater bar, a portion of the helix forming

device being in section as indicated by the line BB of Figure 1.

Figure 3 is a side view of the heater bar and its supporting means.

Fine aluminium wire of about ½ mm. diameter is first formed into a helix, and this helix is fed to the heater. The wire has less tendency to deflect when in the form of a helix than when straight, and the diameter of the helix is several times the diameter of the heater bar, so that a deflection of even several millimetres is permissible.

The helix making device is mounted on a plate 1 fixed to the wall 2 of the vacuum chamber, which latter may be constructed as described in the aforesaid United States patent, and comprises a floor 2*a* in which is a pipe 2*b* through which the chamber is evacuated. The wire 3 is taken from a spool 4 through a guide tube 5, with lead in bell-mouth 6, the tube being held in a support 7 fixed to the plate 1.

A spindle 8 is adapted to turn in a bush 9 which passes through the plate 1 and above the bush a chain wheel 10 is fixed by a set screw 11 to the spindle. The chain wheel 10, with the spindle 8 is turned slowly by a chain 12 from a driving chain wheel, 13, which may be driven in any convenient way, such as the clockwork shown diagrammatically by the casing 14, fixed to the plate 1 by the bracket 14*a*. A wire winding portion 15 of the spindle 8 is knurled, and the tube 5 is located so that the wire 3 issues tangentially to the winding portion 15. A roller 16 held in an arm 17, pivoted to the plate 1 at 18 is urged towards the knurled portion 15 of the spindle by a spring 19, and then presses the wire 3 against the portion 15. A guide nib 20 fixed to the plate 1, enters a groove 21 in the spindle and serves to guide the wire towards a lower portion 22 of the spindle, which portion functions as a former. A support S on which the vapour is to be deposited is carried in a frame F mounted on the floor 2*a*.

In operation, the wire is drawn by hand through the tube 5 between the knurled portion 15 and the roller 16, passed below the guide nib 20 and given one or two turns round the former portion 22. Then, when the spindle is turned counter-clockwise as seen in Figure 1, the wire 3 is drawn from the spool by the winding portion 15 and continuously transferred to the former 22 where it is coiled into a continuously rotating and vertically descending helix 23 of about 8 mms. diameter which extends beyond the former thereby providing a free length of the helix which reaches the heater only the free end of the wire touching the heater.

The helix-forming device is mounted 20 cms. or more above the point of evaporation to avoid its becoming thickly coated with the evaporated metal. The helix 23 tends to descend to the point of evaporation in a straight line, but it may be guided by a rod 24, forming an extension of the spindle to within 2.5 to 5 cms. of the point of evaporation.

The heater bar consists of a thin rod 25 of about 2 mms. diameter of tungsten and presents a relatively small cross section to the helix which has a diameter of 8 mm., and the invention comprises a novel means of supporting such heater. To this end the heater is gripped between blocks 26 of copper supported on posts 26*a* passing through the floor 2*a* and insulated therefrom. The blocks 26 are carried on supports 27 of copper comprising strip portions 28 which are thin enough to yield and permit the expansion and contraction of the tungsten rod 25. Each support 27 is electrically connected to a lead 29 by a bar so fitted to the respective post 26*a*, and is mounted in the bar 30, the lead being clamped to its post by a nut 31.

In operation, the rod 25 is heated to a temperature in its central part of some 2000° C., the wire in the helix 23 is fed at a rate related to the temperature of the heater so that the end of the helix melts and is evaporated as soon as it comes into contact with the rod 25, and there is no risk of the helix deflecting enough to make it fail to contact the rod.

I claim:

1. Apparatus for depositing a metal on a support by thermal evaporation of the metal in a vacuum, comprising a heater bar of refractory metal, winding means disposed with its axis vertically above the heater and perpendicular thereto for continuously drawing a wire of the metal to be evaporated from a storage spool and a coaxial former on which the wire is coiled into a continuously rotating and vertically descending helix, said former terminating at a point distant from the heater, whereby a free length of helix is disposed in the vicinity of the heater and the lower end only of the helix comes into contact with the heater bar.

2. Apparatus for depositing a metal on a support by thermal evaporation of a metal in a vacuum, comprising a heater bar of refractory metal, winding means disposed with its axis vertically above the heater and perpendicular thereto for continuously drawing a wire of the metal to be evaporated from a storage spool and a coaxial former on which the wire is coiled into a continuously rotating and vertically descending helix of a diameter larger than the width of the heater bar, said former terminating at a point distant from the heater, whereby a free length of helix is disposed in the vicinity of the heater and the lower end only of the helix comes into contact with the heater bar.

3. Process of depositing aluminium on a support by thermal evaporation in a vacuum wherein a tungsten heater is used to evaporate the metal and the metal is in the form of a wire continually advanced to the heater so that the end only of the wire touches the heater to evaporate the metal, characterised in that the wire is fed to the heater in the form of a freely depending helix rotating about its axis, the rate of descent of the wire on the helix being related to the temperature of the heater to effect instantaneous evaporation of the wire as it comes in contact with the heater, and the heater presents only a relatively small cross section to the helix, the radius of the helix being somewhat greater than the extent of maximum deflection of the free end of the helix laterally of the heater.

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