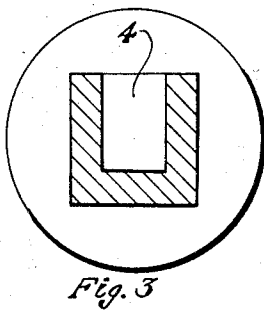
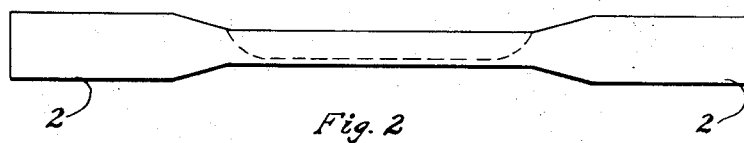
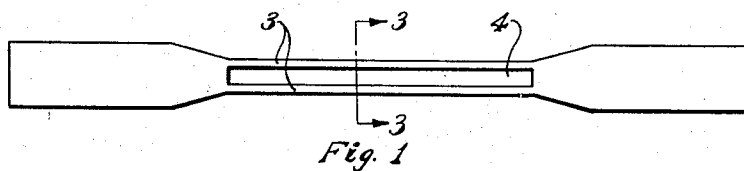


June 19, 1951

G. H. BANCROFT
ELECTRIC HEATING ELEMENT

2,557,530

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UNITED STATES PATENT OFFICE

2,557,530

ELECTRIC HEATING ELEMENT

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2 Claims. (Cl. 13—25)

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This invention relates to an improved filament for use in a coating machine which operates by the vaporization and condensation of substances in a low pressure chamber and more particularly to an improved filament for evaporating aluminum in a lens coating machine.

The prior art includes many inventions dealing with vacuum coating apparatus. For example, Patents 2,401,433 and 2,384,576 disclose apparatus for the production of mirrored surfaces in which a wire filament is used. In Patent 2,387,970, vacuum coating apparatus is described in which the filament is the metal to be evaporated in a refractory vessel. Vacuum coating apparatus of this type comprises an evacuable chamber, means for evacuating the chamber, holding means for the articles to be coated, filament means for holding and vaporizing coating material, and means for energizing the filament means.

The usual types of filament used in vacuum coating machines have consisted of a thin coating of the metal to be evaporated on a short length of wire of tungsten or some other high-melting material in the form of a helix or conical spiral. These filaments are resistance heated by the passage of a suitable electric current. If the coating substance is a nonconductor a small quantity of it may be placed in the center of a spiral of tungsten wire and resistance heated. Another type of filament may be formed of thin sheets of tungsten in the shape of boats or receptacles which are filled with metal to be evaporated and heated by electrical resistance. A further type of filament consists of a non-conducting material, for example, alumina, in the shape of a boat in which metal may be placed for resistance heating. In this arrangement conducting wires must make contact with the melt. Disadvantages of these various filaments are the limited capacity of a coated tungsten wire and the short life of the receptacle in the case of both tungsten and nonconducting materials due to alloying or combination of the material being evaporated with the receptacle.

The object of this invention is to provide a filament which will have a long life. Another object is to provide a filament of large capacity. A further object is to provide a filament composed of material which will not readily react with material being evaporated. Still another object is to furnish a filament which will act as a conductor in the resistance heating of non-conducting materials. Another object is to improve the state of the art. Other objects will appear hereinafter.

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These and other objects are accomplished by my invention which includes an elongated carbon filament with a center section of small cross-sectional area containing a cavity in which material to be evaporated may be placed for resistance heating.

In the following description I have set forth several of the preferred embodiments of my invention but it is understood that these are given by way of illustration and not in limitation thereof.

In the accompanying drawing I have set forth a preferred form of my invention. Figure 1 is a top view of the carbon filament which may be constructed of a cylindrical carbon rod. Figure 2 is a front view of the filament. Figure 3 is a cross-section taken at plane 2—3.

Numerals 2, 2 designate the end sections of the carbon filament. Numeral 3 designates the center section of the filament which may be given a narrower cross-section by tapering or which may be cut down abruptly to the narrower cross-section. Numeral 4 designates the cavity in center section 3 in which the substance to be evaporated may be placed.

In operation the carbon filament is placed between electrical terminals within a vacuum chamber (not shown) and the cavity filled with aluminum or other substance to be vaporized. After the vacuum chamber has been evacuated an electric current is run through the filament. The resistance at the center section is greater due to the narrower cross-sectional area and this section heats up to a higher temperature than do the end sections. The temperature may be controlled by varying the current flowing through the filament.

To maintain the end sections cool, the electrical resistance of the center section including the charge must be greater than the resistance of the end sections. A cross-sectional area of section 3 must be considerably less than the cross-sectional area of the end sections in order to effect this, but the exact dimensions will vary with the substance to be vaporized. If a non-conductor is being vaporized the cavity and center cross-sectional area may both be comparatively large since the resistance of the carbon alone is the source of heat. If a metal, such as aluminum, is vaporized both the cavity and center cross-sectional area must be comparatively small as the aluminum offers less resistance to current flow than does the carbon of the cavity wall. If the cavity is too large the end sections will heat more than the center sections.

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By the use of my invention it is possible to evaporate as much as 15 times the load of material using a coated tungsten filament. Carbon has very little tendency to alloy and a carbon filament lasts over 12 times as long as a tungsten filament of the cavity type.

What I claim is:

1. A filament for vacuum coating apparatus, said filament comprising a unitary elongated member formed of carbonaceous resistance material and comprising spaced apart terminal zones and an intermediate vaporizing zone therebetween, said intermediate zone having an unlined cavity therein arranged to receive vaporizable solid coating material, said intermediate zone throughout its extent having a relatively small cross-section as compared to said terminal zones and said cavity having a relatively small cross-section as compared to said intermediate zone, the combined cross-sectional area of said intermediate zone and said cavity being substantially less than the cross-sectional area of each said terminal zone, the cross-sectional dimensions of said zones and of said cavity being so correlated that the electrical resistance of the carbonaceous material of said intermediate zone is substantially higher than of said terminal zones when said cavity contains relatively low resistance electrically conductive coating material, whereby said terminal zones remain substantially cooler than said intermediate zone when said intermediate zone is heated, by passage of current through said filament, to a temperature sufficiently high to evaporate said coating material.

2. Coating apparatus comprising a vacuum chamber arranged to receive a succession of objects to be coated with volatilizable solid coating material, an electrically heated unitary filament arranged within said chamber for volatilizing said material, and terminal means for supplying electric current to said filament, said filament consisting essentially of carbon and having a generally elongated configuration, said filament being formed with spaced apart terminal zones of relatively large cross-section for respective connection with said terminal means and also having an intermediate vaporizing zone connecting

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said terminal zones and having throughout the extent of said intermediate zone a substantially narrower cross-section than said terminal zones, said intermediate zone having therein an unlined cavity arranged to receive said volatilizable solid coating material for evaporation therefrom onto said objects, the combined cross-sectional area of said intermediate zone and said cavity being less than the cross-sectional areas of said terminal zones and the cross-sectional area of said cavity being relatively small as compared to the cross-sectional area of the carbon in said intermediate zone and all said cross-sectional areas being correlated so that the electrical resistance of said intermediate zone is substantially greater than the resistance of said terminal zones when said cavity contains either electrically conductive material or electrically nonconductive material, whereby said terminal zones remain substantially cooler than said intermediate zone when said intermediate zone is heated, by passage of current through said filament, to a temperature adequate to vaporize said coating material.

GEORGE H. BANCROFT.

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Certificate of Correction

Patent No. 2,557,530

June 19, 1951

GEORGE H. BANCROFT

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 1, line 9, for the patent number "2,401,433" read 2,401,443;
and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of August, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.

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