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APPARATUS FOR COATING ARTICLES
BY THERMAL EVAPORATION
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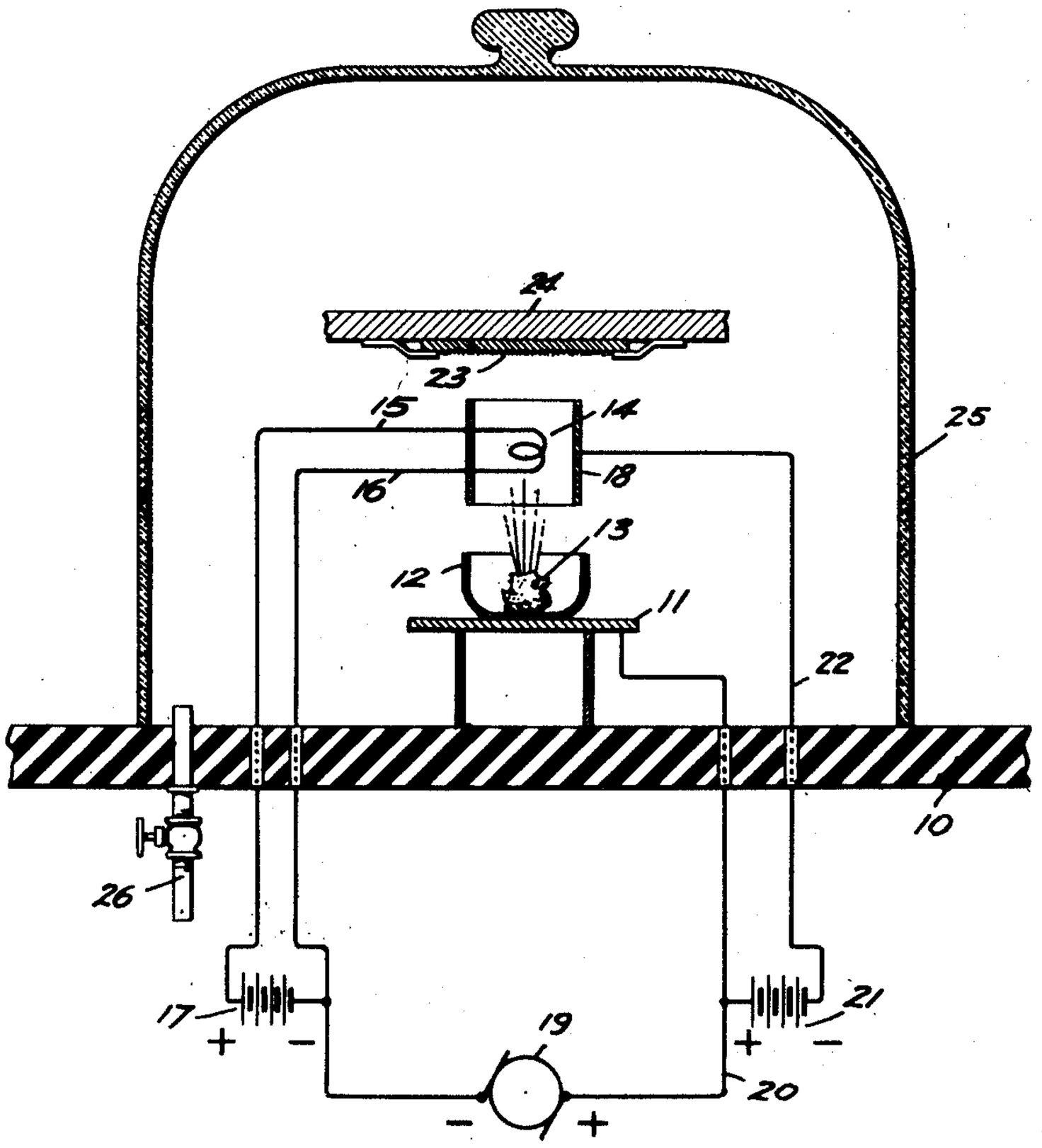

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APPARATUS FOR COATING ARTICLES BY THERMAL EVAPORATION

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1 Claim. (Cl. 91—12.2)

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This invention relates in general to methods and apparatus for coating, and more particularly to methods and apparatus for coating by thermal vaporization.

Heretofore, the thermal vaporization in a vacuum of metals such as germanium and silicon to produce a thin coating on a metal backing member has been done by heating a small quantity of such metal in a crucible by means of an ordinary resistance heating element. Such a method resulted in impurities in the film deposited on the backing member. Such impurities, it was found, emanated from the crucible material itself. For example, when a quantity of silicon or germanium was placed in a tantalum crucible and directly heated by passing an electric current through the crucible, it was found that the tantalum reacted with the silicon at the temperatures used. To prevent this reaction, beryllium oxide was tried as a crucible and heated by a tungsten wire coil. However, traces of beryllium were also found in spectographic pictures of the evaporated films.

In order to obviate the difficulties mentioned above, it was found that the metal to be vaporized in vacuo could be brought up to the required temperature by means of direct electron bombardment so that the evaporated films were free of any discernible impurities due to reaction of the coating metal with the crucible.

It is an object of our invention to provide an apparatus and method for coating by thermal vaporization in which the contamination of the evaporated film due to reaction between the coating metal and the crucible is avoided.

It is another object of our invention to provide an apparatus and method for coating by thermal vaporization in which the coating material is brought to its vaporization temperature while maintaining the crucible at a much lower temperature.

It is another object of our invention to provide a method of applying a coating in which the coating metal is vaporized in a vacuum by means of direct electron bombardment.

It is another object of our invention to provide an apparatus for coating in which the coating metal is vaporized in a vacuum by means of direct electron bombardment.

The above and other objects and advantages will become readily apparent from the following specification when read in conjunction with the accompanying drawing in which the single figure is a semi-diagrammatic view of one embodiment of our invention.

Referring to the drawing, it is seen that the

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reference numeral 10 refers to a rigid base member of electrical insulating material. A metal support or pedestal 11 carries a crucible 12 also made of metal, preferably tantalum. A quantity of the coating metal 13 which is to be vaporized is placed in the crucible 12.

A cathode 14 which is to be a source of electrons for bombarding the coating metal 13 is connected by means of the conductors 15 and 16 to a source of electrical energy 17. A focussing element 18, preferably of cylindrical configuration is so situated as to focus the electrons emitted from the cathode 14. In order to attract the electrons emitted from the cathode 14 to the metal 13 to be vaporized, a source of electrical energy 19 is provided, the positive side of which is connected through conductor 20 to the metal table or support 11. The negative side of the source of electrical energy 19 is connected to the negative side of the cathode potential supply 17.

The focussing element 18 is connected to the negative side of a source of electrical energy 21 by means of a conductor 22. The positive side of the source of electrical energy 21 is connected to the positive source of the source of electrical energy 19.

The article to be coated indicated by the reference numeral 23 is supported upon a backing member 24 by any suitable means. The entire apparatus is enclosed by a transparent bell jar 25, the interior of which may be evacuated by connecting a vacuum pump to the hose connection 26.

The degree of vacuum required for vaporization by electron bombardment must be such as to permit the establishment of a steady flow of electrons from the cathode to the coating metal 13 but need not be any higher than 10^{-3} mm. of mercury. The high voltage supply 19 should be such as to supply a direct current voltage of between 3,500 to 5,000 volts at 10 to 15 milliamperes. The negative potential at which the focussing element 18 is to be placed should be sufficient to cause a narrow beam formation of electrons emitted from the cathode 14 so that as far as possible substantially all of the electrons emitted from the cathode will impinge upon the supply of coating metal 13.

Our invention avoids the possibility of contamination of evaporated films due to reaction between the coating metal and the crucible. By bringing the coating metal to the evaporating temperature and maintaining the crucible at temperatures below the vaporization temperature

of the material forming the crucible, reaction between the coating metal and the crucible does not occur, and contamination of the evaporated film is obviated.

While we have disclosed one embodiment of our invention it is obvious that many changes may be made without departing from the scope of the invention as set forth in the appended claims.

Having thus disclosed our invention what is claimed is:

A device for coating an article by thermal evaporation comprising an evacuated chamber, supporting means within said chamber for said article, an electrically conducting base member in the chamber, a container in the chamber for a coating metal to be vaporized, said container being supported by said base member, electron emitting means including a cathode positioned intermediate said article supporting means and said electrically conducting member and in a straight line therewith, a first source of direct current potential, means connecting the positive terminal of said source of potential to said electrically conducting base member and the negative terminal to said cathode; means for focusing the electrons from said cathode on said material to be vaporized, said means for focusing comprising a metal cylinder having its axis on said straight line and positioned so as to surround the cathode, a second source of direct current potential and means connecting said second source between said focusing means and said electrically conducting base member.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,326,794	Larsen	Dec. 30, 1919
1,584,728	Case	May 18, 1926
2,103,623	Kott	Dec. 28, 1937
2,157,478	Burkhardt, et al.	May 9, 1939
2,239,642	Burkhardt, et al.	Apr. 22, 1941
2,435,997	Bennett	Feb. 17, 1948