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2,472,930

ELECTRICAL HEATING UNIT

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FIG. 1

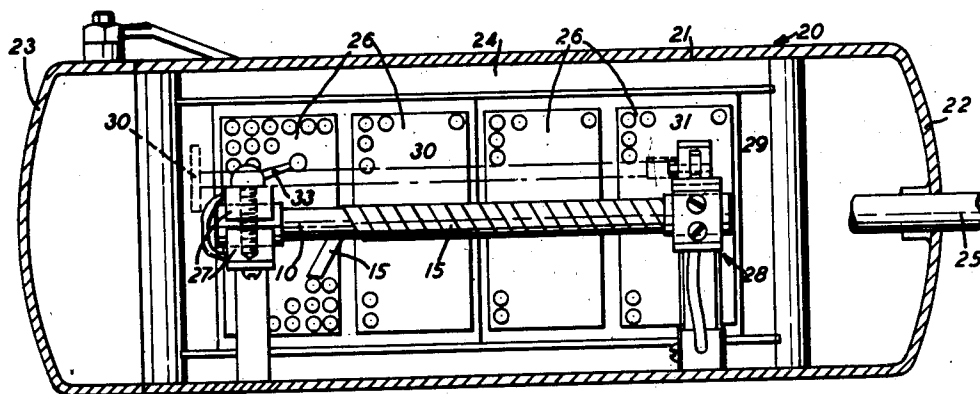


FIG. 2

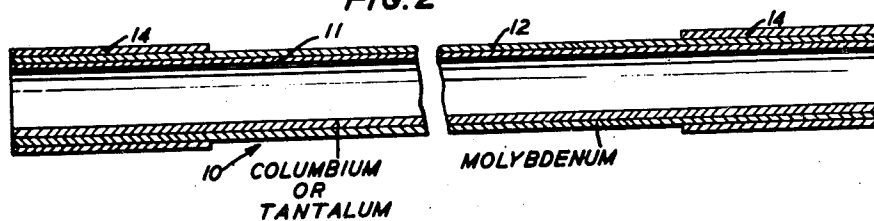


FIG. 3

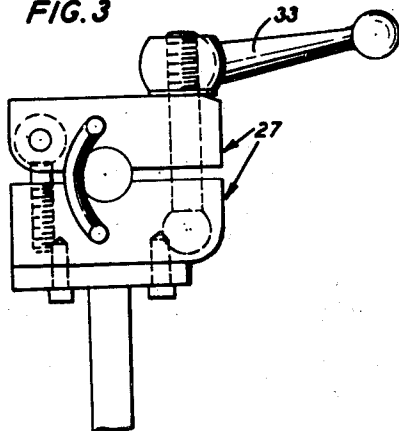
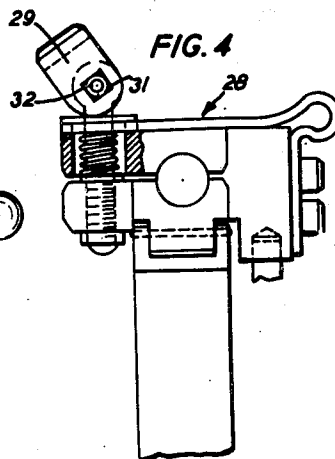


FIG. 4



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ELECTRICAL HEATING UNIT

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3 Claims. (Cl. 201—76)

1

This invention relates to an electrical heating element, and more particularly to an electrical resistance heating element for evaporating metals in a vacuum.

There are many instances in industry in which it is desired to coat an article with a film of metal and in which the article to be coated is placed in an evacuated chamber together with a supply of the coating metal, means being provided to heat the metal supply to a sufficient degree to convert the metal into a vapor which then deposits on the article. In particular, in very recent times and in connection with a variety of electrical apparatus employed in war, a great number of thin slices of crystalline quartz coated with such metals as silver, gold, aluminum, or others, are necessary. A generally satisfactory method of coating these "crystals" is to arrange them within an evacuable chamber in a hollow prism formation and position a suitable rod-like electrical resistance heating element in the axis of the prism, the coating metal being distributed and supported on the heating element, e. g. by winding a wire or tape of the coating metal in question helically about the element. Such apparatus and method are simple, convenient and operatively satisfactory, provided that a suitable and economically durable heating element can be provided. Since, however, the heating element may be subjected to temperatures upward 3400° F., for example when coating with gold, and at the same time is more or less covered with molten coating metal while in operation, and must be rapidly brought to maximum heat at the beginning of each cycle of operation and cooled again at the close, there are apt to be severe recrystallization embrittlement of the element by the rapid and great temperature changes, and erosion and alloying embrittlement because of the molten coating material. Many materials have been employed in such coating elements, notably the rare and heavy metals, e. g. tungsten, molybdenum, tantalum, and the like; but none has proven entirely satisfactory. One is found to be unworkably difficult to form, another is eroded too rapidly, a third becomes rapidly too delicately brittle in use, and so on. As all such materials are costly in themselves and often expensively difficult to form and shape, the rapid consumption hitherto of these costly elements has been a major problem.

An object of the present invention is to provide an electrical resistance element to support, melt and evaporate a supply of silver, gold, aluminum, or the like, and which element shall be durable for

2

a long term of operation under such conditions as are described above.

With the above and other objects in view, the invention may be embodied in an electrical heating element comprising two closely telescopically interfitted members of which the inner one, except for immaterial impurities, is composed of metallic tantalum or columbium, and the other one, except for immaterial impurities, is composed of metallic molybdenum.

Other objects and features of the invention will appear from the following detailed description of one illustrative embodiment thereof, taken in connection with the accompanying drawings, in which the same reference numerals are applied to identical facts in the several figures, and in which

Fig. 1 is a vertical, central, longitudinal section through an evacuable chamber of an apparatus for coating articles with evaporated metal;

Fig. 2 is a detached, enlarged, broken, central, longitudinal section of the externally rod shaped heating element of the apparatus;

Fig. 3 is a detail view with the heating element omitted of the left hand clamp for the heating element; and

Fig. 4 is a similar view of the right hand clamp.

The embodiment of the invention herein described and illustrated is best shown, per se, in Fig. 2, which is a detached sectional view of an electrical resistance heating element which may be employed usefully in the apparatus shown in Fig. 1. The essentials of the compound element, generally indicated at 10, are the two, snugly telescopically interfitted tubular members 11 and 12, of which the inner tube 11 is composed of metallic columbium or metallic tantalum, while the outer tube 12 is composed of metallic molybdenum. Preferably, contact sleeves 14, 14 of any suitable metallic material, e. g. copper, are fitted closely over the ends of the compound tube 10. For lightness and to provide maximum supporting surface, as well as maximum stiffness, with a given cross-sectional area, the inner member 11 is made tubular. However, since the function of the columbium or tantalum inner member is to afford mechanical support to the molybdenum outer member, it may well be possible in some instances to form the member 11 as a solid rod instead of a tube; but in general, a tubular inner member 11 is much to be preferred.

The apparatus disclosed in Figs. 1, 3 and 4 is shown only to illustrate one mode of use of the present invention. There is presented a tank-like structure 20 having a generally cylindrical

side wall 21 with an integral end wall 22 at the right and a hinged door 23 at the left end and enclosing a chamber 24. A tube 25 hermetically sealed through the end wall 22 may be connected to means not shown for evacuating the chamber 24. Racks or frames 26, to receive articles, e. g. quartz "crystals" to be metal coated, are removably supported within the chamber 24 in a cylindrical or prismatic array about the axis of the chamber as an axis.

A connector clamp, best shown in Fig. 3 and generally indicated at 27, is mounted near the left or forward end of the chamber; and a second connector clamp, best shown in Fig. 4 and generally indicated at 28, is mounted near the right or rear end of the chamber. The clamps 27 and 28 are so mounted and disposed that when the resistance heating element 10 is clamped and supported therein, the element 10 lies along the axis of the array 26, 26. The clamps 27 and 28 are constructed of electrically conductive metal and are arranged to be connected at will, by means not shown, to any suitable source, not shown, of suitable electric current. The clamp 28 can be opened to insert one end of the structure 10 shown in Fig. 2 or to remove this, and can be clamped down tight thereon by manipulation of the locking cam 30, which can be accomplished, when the door 23 is open, by inserting a socket wrench, as indicated in broken lines in Fig. 1 at 30, to turn the square head 31 of the shaft 32 on which the cam 29 is rigidly mounted. Similarly, when the door 23 is open, the clamp 27 may be opened or closed as desired by manipulation of the lever 33.

In operation, with the door 23 open, an array of racks 26 containing articles to be coated is placed in position in the chamber 24, as shown and described; and a wire or tape 15 (Fig. 1) of the coating metal to be evaporated is wound helically about the element 10. The door 23 is then closed and the chamber 24 evacuated via the tube 25. When a satisfactory degree of evacuation is attained, heating current is switched through the element 10, via the clamps 27 and 28, sufficient to heat the element to the temperature necessary to evaporate the metal of the tape 15. If the tape is gold, for example, this temperature will be upward of 3400° F. After a suitable time, dictated by experience, the heating current is cut off and the apparatus allowed to cool. Air is then admitted through the tube 25 to break the vacuum in the chamber and the door is opened. The racks of coated articles may then be removed, a new tape 15 wound on the heater 10, fresh racks of uncoated articles put in place, and the cycle repeated.

It is believed that the specific combination of materials employed in the manner herein described, provides a heater element 10 which is many times superior to any heretofore known for uses of the kind herein described. Compound elements, as herein described, with a molybdenum outer tube and an inner tube of columbium or tantalum have an operative life three and more times as long as the best previously available similar elements; and, in addition, when they

finally have to be replaced, are found to have absorbed gold, for example, from the tapes 15 in quantity comparatively negligible beside that absorbed by the toughest elements of the prior art.

No practicably usable substitutes or equivalents are believed to exist for the one member class (molybdenum) or the two member class (columbium and tantalum) of metallic elements which together characterize the present invention, and no claim is made to the invention as other than comprising parts made essentially of molybdenum and parts made essentially of columbium, tantalum or a mixture of these two.

What is claimed is:

1. An electrical heating element to endure the corrosive action of molten metal such as gold, silver, aluminum and the like in contact therewith at the vaporizing temperatures of the said molten metal, the said element comprising two telescopically interfitted members of which the outer member intended to be in contact with the said molten metal is essentially composed of metallic molybdenum and the inner member protected by the said outer member from contact with the said molten metal is essentially composed of metallic material selected from the class composed of columbium, tantalum and mixtures of columbium with tantalum.

2. An electrical heating element to endure the corrosive action of molten metal such as gold, silver, aluminum and the like in contact therewith at the vaporizing temperatures of the said molten metal, the said element comprising two telescopically interfitted members of which the outer member intended to be in contact with the said molten metal is essentially composed of metallic molybdenum and the inner member protected by the said outer member from contact with the said molten metal is essentially composed of metallic columbium.

3. An electrical heating element to endure the corrosive action of molten metal such as gold, silver, aluminum and the like in contact therewith at the vaporizing temperatures of the said molten metal, the said element comprising two telescopically interfitted members of which the outer member intended to be in contact with the said molten metal is essentially composed of metallic molybdenum and the inner member protected by the said outer member from contact with the said molten metal is essentially composed of metallic tantalum.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,023,485	Thowless	Apr. 16, 1912
1,180,614	Simpson	Apr. 25, 1916
1,226,471	Coolidge	May 15, 1917
1,539,266	Montford	May 26, 1925
2,281,843	Jira	May 5, 1942
2,298,254	Driggs	Oct. 6, 1942