

UNITED STATES PATENT OFFICE

2,586,768

VACUUM TUBE ELECTRODE ELEMENT

Francis E. Bash, Morristown, N. J., assignor to
Driver-Harris Company, Harrison, N. J., a corporation of New Jersey

No Drawing. Application February 24, 1949,
Serial No. 78,233

6 Claims. (Cl. 313—346)

1

This invention relates to electron discharge devices and particularly to the manufacture of electrode elements, such as cathodes of vacuum tubes. As is well known, the cathode is formed of a base element, such as nickel, having an electron emissive coating, generally an alkaline earth oxide on its surface.

With the high amplification factors in vacuum tubes employed today electron emission from the grids and anodes of the tubes must be reduced to a minimum as this emission causes considerable background noises and a reduction of efficiency. The electrode elements, such as a cathode, are usually formed of a sleeve or wire of nickel coated with active oxides, such as barium or strontium oxide. The nickel used in the production of such cathodes will, of course, vary in composition. The preparation of the nickel in the form in which it is to be used for the manufacture of cathode elements requires the melting of ingots and in this melting operation there is a tendency to form oxides. Heretofore it has been the usual practice to add various deoxidizing agents, such as magnesium, silicon, calcium or the like to the melt to keep the formation of nickel oxides at a minimum. However, to effectively deoxidize the nickel, it has been found necessary to use an excess of such deoxidizers with the result that small amounts of these deoxidizers remain in the melt. It has been established that emissions of electrons from the oxide coated cathode are increased by the presence of such deoxidizing elements in the nickel from which the cathode is made.

Sub-Committee VIII on Metallic Materials for Radio Tubes and Incandescent Lamps, of Committee B-4 on Electrical Heating, Resistance, and Related Alloys, of The American Society for Testing Materials, has classified cathode materials into passive, normal and active. In the passive type the base nickel metal is substantially free of silicon, magnesium, titanium, aluminum and similar deoxidizers. These are the deoxidizers which are normally used in melting nickel to produce a malleable material which can be rolled to thin sheets of the order of .002" to .005" thick. Inactive metals, such as iron and cobalt, are not considered harmful if not present in too large quantities.

The necessity of deoxidizing any nickel oxides formed during the melt and at the same time of producing a final nickel product from which the usual deoxidizing elements are absent, has resulted in the practice of manufacturing the passive type electrodes from electrolytically de-

2

posited nickel. The slabs of electrolytic nickel are melted with carbon additions, the carbon being added to reduce the oxides in the molten bath to produce the nickel in a form which can be hot and cold rolled to produce thin sheets. Here again, the deoxidizer must be used in an excess so that at the end of the melt the nickel contains from .20 to .50 percent carbon. It is then necessary to later remove the carbon from the nickel by heating it in the presence of wet hydrogen. This operation is a long and expensive one and again has a tendency to oxidize the nickel sheet after the carbon has been removed.

I have found that slabs of electrolytically deposited nickel can be melted to produce a malleable metal which can be hot and cold worked without adding either the usual deoxidizers, the presence of which in the final nickel product is objectionable, or without adding carbon in excess. I accomplish this by the addition of rare earth metals, such as are found in the alloy known as Misch metal. While the composition of Misch metal varies, generally speaking, it consists essentially of 40 percent cerium, 30 percent lanthanum, and 30 percent didymium, balance yttrium and iron. The lanthanum and didymium proportions of the Misch metal may contain small quantities of the other rare earth metals.

In carrying out the invention, slabs of electrolytically deposited nickel are melted in the usual manner, the normal procedure being followed up to the point where the metal is completely molten. At that point I add a small quantity of Misch metal to the bath. In actual practice, I have employed one pound of Misch metal to a 1300 pound melt. This figure may, of course, vary. If the melting of the slabs is carried out in a manner that would normally result in the production of a minimum amount of nickel oxides, the quantity of Misch metal added may be less. Greater quantities of Misch metal up to as much as three pounds may be added. The rare earth metals added to the melt reduce the nickel oxides to nickel and the resulting rare earth oxides disappear from the molten bath. Spectrographic analyses of the cast and processed metal show traces of cerium and lanthanum. The amounts of cerium and lanthanum present do not exceed .2 percent. Likewise, if iron is present in the Misch metal, it is retained in the nickel forming about .12 to a maximum of .20 percent of the final product. The presence of such a quantity of iron or the traces of cerium and lanthanum in the final product has no detrimental

3

effect and the nickel so produced is entirely satisfactory for the manufacture of passive cathode elements.

The nickel so produced contains no more impurities than are present in the nickel slabs with the exception of the small amount of iron referred to. It is malleable, easily worked and annealed and therefore does not require the annealing treatments which are necessary with a nickel of high carbon content.

Instead of adding the rare earth metals in the form of Misch metal, the desired quantities of rare earth metals, such as cerium, lanthanum and didymium may be added directly. In such case the nickel produced would not contain the slight contamination of iron.

I claim:

1. A vacuum tube having electrode elements at least one of which is composed of nickel and traces of rare earth metals.

2. A vacuum tube having electrode elements at least one of which is composed of nickel and traces of cerium and lanthanum.

3. A vacuum tube having electrode elements at least one of which is composed of nickel, a trace to 0.2 percent cerium and a trace to 0.2 percent lanthanum.

4. A cathode element for a vacuum tube consisting of nickel containing traces of rare earth metals, and an activating agent comprising an oxide coating thereon.

4

5. A cathode element for a vacuum tube consisting of nickel containing traces of cerium and lanthanum, and an activating agent comprising an oxide coating thereon.

6. A cathode element for a vacuum tube consisting of nickel containing a trace to 0.2 percent cerium and a trace to 0.2 percent lanthanum, and an activating agent comprising an oxide coating thereon.

FRANCIS E. BASH.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,689,338	Harris -----	Oct. 30, 1928
1,753,298	Miesse -----	Apr. 8, 1930
1,916,410	Brace -----	July 4, 1933
2,075,718	Hessenbruch -----	Mar. 30, 1937
2,204,391	Allen -----	June 11, 1940
2,246,162	Benjamin -----	June 17, 1941
2,304,353	Griffiths et al. -----	Dec. 8, 1942
2,456,370	Buck -----	May 10, 1948

FOREIGN PATENTS

Number	Country	Date
101,032	Australia -----	May 10, 1937