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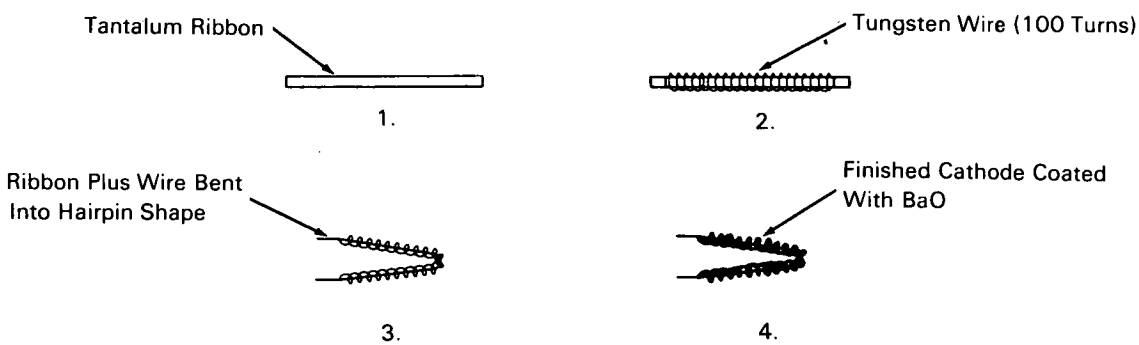
NASA TECH BRIEF

Wire Winding Increases Lifetime of Oxide-Coated Cathodes



The problem: Increasing the lifetime of cathodes used in rocket ion engines. Tests on a number of different cathodes under development for use in rocket ion engines showed that oxide-coated cathodes are the most efficient producers of electrons. A cathode in such an engine must be sufficiently hot to emit electrons and hence will lose material by evaporation. The cathode will also be coupled to or immersed in the plasma discharge and it will therefore also lose material because of sputtering erosion due to positive-ion bombardment. The oxide coatings must therefore be sufficiently thick to maintain a source of active material over relatively long periods of time. The thickness of such coatings is limited, however, by the ohmic resistance of the oxide material, which when subjected to the emission current, causes overheating and destruction of the cathode. Research was therefore required to find a means of reducing the resistance of the thick coatings and thereby increasing the lifetime of the cathodes.

The solution: Winding the refractory-metal heater base of the cathode with a thin refractory-metal wire and impregnating the wire-wound unit with the required thickness of metal oxide.

How it's done: The heater base, consisting of a 0.013- by 0.36- by 5.1-centimeter tantalum ribbon is wound with approximately 100 turns of 0.007-centimeter tungsten wire. The wire-wound ribbon is then bent into a hairpin shape, and its entire surface is coated with a paste consisting of barium carbonate in water or in a solution of nitrocellulose and butyl acetate. The cathode is conditioned and partially activated by heating it in steps to approximately 1300° K and holding this temperature for 5 to 20 minutes without a discharge. During the heating the water and organic constituents of the paste are either evaporated or decomposed, and the barium carbonate is converted to barium oxide. Final activation of the cathode is accomplished by exposing it to the ion-chamber discharge.

Notes:

1. Suggested applications for this cathode are in magnetohydrodynamic systems and in high-power, long-life electron tubes.
2. Further information concerning this invention is described in AIAA Paper No. 64-683, "Cathode

(continued overleaf)

Durability in the Mercury Electron-Bombardment Ion Thrustor," by William R. Kerslake, August 31–September 2, 1964. Inquiries may also be directed to:

Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio, 44135
Reference: B65-10032

Patent status: NASA encourages the immediate commercial use of this invention. Inquiries about obtaining rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

Source: Don Vargo and William Kerslake
(Lewis 154)