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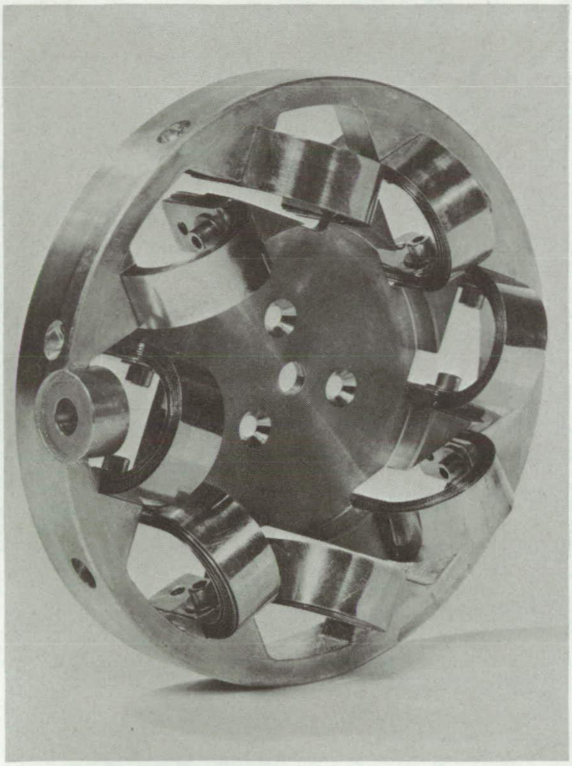
Flexible Electrical Conductors for High-Temperature Switchgear



The problem:

To develop a flexible electrical connector capable of operating in the 1000°F temperature range, under vacuum conditions for long periods (10,000 hours or more) without failure. The oxygen-free high-conductivity copper conventionally used in connectors operating at ambient temperatures lacks the necessary strength to endure repeated flexing at the required operating conditions. A material was needed which not only met the operating conditions, but also retained high electrical conductivity. Configuration of the connector required that one end be fixed and the other end, approximately one inch away, be fastened to a contact which moved a minimum of 0.25 inch between its open and closed positions.

The solution:

Arch-shaped conductors fabricated from flat strips of commercially available beryllium oxide dispersion-strengthened copper alloy (see fig.).

How it's done:

A review of available materials identified beryllium oxide dispersion-strengthened copper as a material having all of the necessary properties. However, beryllium oxide dispersion-strengthened copper is conventionally fabricated only in wire and rod form. It was not possible to manufacture the connector from this material in wire or rod form with a stress level low enough to ensure the required durability with repeated flexing, and a cross-sectional area large enough to attain the required electrical conductivity.

A manufacturer of beryllium oxide dispersion-strengthened copper successfully rolled the wire form into flat strips 0.006-inch thick. After determining the physical properties of this flat material, eight rolled strips, 0.50-inch wide, were cut, formed, and then staked into an arch shape. This design provided both a low stress level and sufficient cross-sectional area. The arch-shaped connectors were tested for 1000 hours at temperatures from 500°F to 1200°F in a vacuum of 1×10^{-6} torr. During the test, the connectors were flexed 1000 times, i.e., one end was fixed and the other end was moved vertically 0.25 inch. In a later test at 1000°F and a vacuum of 1×10^{-6} torr, the conductor assembly carried over 1800 amperes while flexing. The arch-shaped beryllium oxide

(continued overleaf)

dispersion-strengthened copper connectors performed satisfactorily without noticeable deterioration. Tensile strength of the strip material was reduced from 82,000 psi to 71,500 psi during the first 500 hours of a room temperature test, and only negligibly thereafter.

Notes:

1. These flexible electrical conductors could replace conventional electrical braiding and leads operating at high temperatures. In strip form, the material could be utilized for electrical conductors requiring high strength at temperatures to 1800°F.
2. The following documentation is available from:
   Clearinghouse for Federal Scientific
   and Technical Information
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.65)
   Reference:
   NASA-TM-X-1986 (N70-23527), Flexible Electrical Conductors for High-Temperature Switchgear
3. Technical questions may be directed to:
   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B70-10569

Patent status:

No patent action is contemplated by NASA.

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