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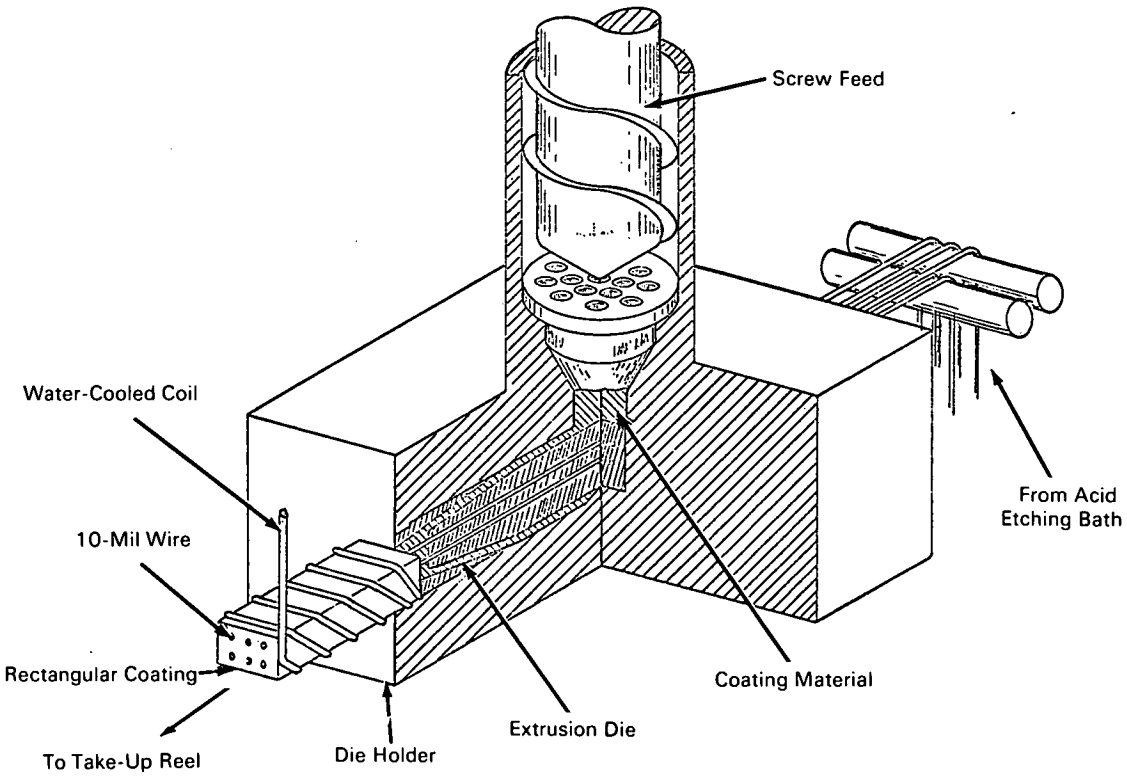
Rectangular Configuration Improves Superconducting Cable



The problem:

To design a superconducting cable for a cryogenic electromagnet with improved mechanical and thermal properties. The presently used, 10-mil, niobium–zirconium wire, coated with 3/4-mil copper and 1-mil organic insulation, has proved inadequate. The small wire diameter results in mechanical failures, breakages, undesirably high inductance, and difficulties in manufacture. Furthermore, the insulation currently in use provides inadequate cooling.

The solution:

An improved, rectangular cross-sectioned combination of superconductor and normal conductor for electromagnets. The conductor cable consists of superconductors embedded in a metallic coating having high electrical and mechanical conductivity at liquid helium temperatures.

How it's done:

The required number of superconducting wires are spatially mounted in a rectangular matrix. The wires

(continued overleaf)

are made from the required superconductor. The rectangular metallic coating in which the wires are embedded may be aluminum, cadmium, lead, indium, or copper.

The fabrication of the conductor cable is shown. The wires are fed by rollers from an acid bath into an extrusion die holder which is heated to maintain the insulation coating material at a plastic consistency. The coating is screw-fed into the die holder and formed around the wires. The cable is cooled as it leaves the die by a water-cooled coil.

The metallic coating provides improved thermal conductivity to the cable, and the rectangular design gives a high degree of mechanical rigidity when the cable is formed into windings. The finished cable has slow or negligible normal-region propagation characteristics.

Notes:

1. With a cable having a 0.1 inch × 0.6 inch aluminum coating on six, 10-mil, niobium–zirconium conductors, the following currents are attainable: with a 10-kilogauss center-of-field, 200 amperes per conductor; with a 35-kilogauss center-of-field, 140 amperes per conductor.
2. Other wire configurations within the coating may be equally acceptable as long as the spacing between the wires is uniform. This permits the coating to function as a heat shunt and to decrease the possibility of the development of hot spots.
3. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B68-10098

Source: C. Laverick and M. Foss
Particle Accelerator Division
and G. Lobell
Central Shops
(ARG-90088)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

Mr. George H. Lee, Chief
Chicago Patent Group
U.S. Atomic Energy Commission
Chicago Operations Office
9800 South Cass Avenue
Argonne, Illinois 60439