UCRL 8952

UNIVERSITY OF CALIFORNIA

Ernest O. Lawrence Radiation Laboratory

TWO-WEEK LOAN COPY

This is a Library Circulating Copy which may be borrowed for two weeks. For a personal retention copy, call Tech. Info. Division, Ext. 5545

BERKELEY, CALIFORNIA

DISCLAIMER

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

Lawrence Radiation Laboratory
University of California
Berkeley, California
J. O. Turner
October 27, 1959

UCRL-8952

(Item for use in "Insulation Forum" in the December issue of Insulation magazine in answer to the question "What do you think has been the most notable achievement in the field of insulation during the past decade?")

Epoxy resin is by all odds the most notable single achievement in electrical insulation in the past decade, at least for us. With it we have solved many problems that would have been very much harder and more costly without it, if not impossible.

We appreciate and use most of the wonderful things that have happened in many other materials such as ceramics, rubbers, fibers, fluids, and plastics such as polypropylenes, phenolics, and "Mylar". In fact, we depend almost completely on Mylar for wrapping large copper bar conductors (Fig. 1) and heavy electrical assemblies that cannot be potted but must be protected from rouch handling.

However, for sheer versatility and all-around sturdiness in uses around this laboratory, nothing else is in the same ball park with epoxy. We pot coils from thimble size to those weighing tons (Fig. 2). Long strings of fragile ceramic resistors are coiled up and imbedded in a soft epoxy compound to reduce corona at high voltage. Epoxy castings are used for voltage-gradient control in high-voltage cable pot heads (Fig. 3), and for high-voltage isolation in vacuum-tank walls. They are used for lead-through bushings in pressure and vacuum vessels, and in a good many other roles that once could be filled only by ceramics. (See Fig. 4.)

At one point we needed, on short notice, some lead radiation shielding for use in a rapidly changing magnetic field. It had to be nonconducting to prevent eddy currents. Epoxy bricks with lead powder filler provided a quick and easy answer. Corona-free high-strength insulating bolt anchors are made simply by setting ball-shaped bolt heads into holes filled with the resin. Where castings are not quite strong enough, we use epoxy resin and fiberglas layups, as in the main vacuum tank and magnet support ring for the electron synchrotron. (See Fig. 5.)

We build a lot of insulating structures from industrial laminate in sheet, rod, and tube form. Again the toughest jobs fall to epoxy in the form of NEMA grade G10 material. Its balance of electrical, mechanical, and vacuum properties is so good that we have an ironclad rule that no other nonmetallic may be used in and around the vacuum tank (the heart) of the big Bevatron without special permission. The printed circuits that we use are largely done on G10, for these same reasons.

I expect that high-volume producers will have other ideas, because of the high cost of epoxy. But for us, material cost is usually very small compared to labor cost. We can do so many things so easily with the use of epoxy, that it turns out to be quite economical. This, plus all its other magical properties, makes it just about our most useful electrical insulating material.

LEGENDS

Fig. 1. Machine wrapping 1.3-in.-square conductor with Mylar tape for large bubble chamber magnet coil.

Fig. 2. Sectionalized magnet coils of water-cooled conductor potted in epoxy.

Fig. 3. 500,000-volt cable terminator of epoxy with filler of microscopic glass beads.

Fig. 4. Cast epoxy grooved rings that must be both high-voltage insulators and high-vacuum barriers.

Fig. 5. Section of synchrotron ring vacuum tank, laid up of epoxy and fiberglas.

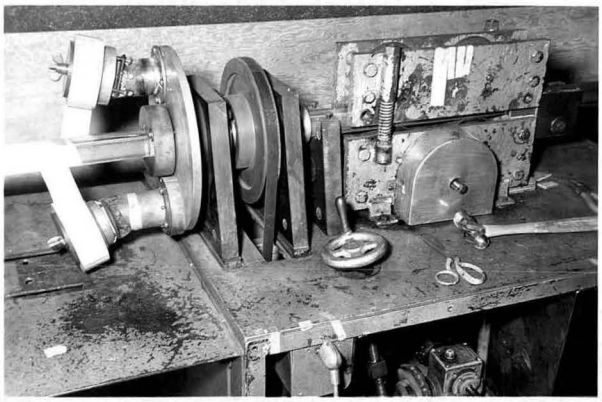

Fig. 1

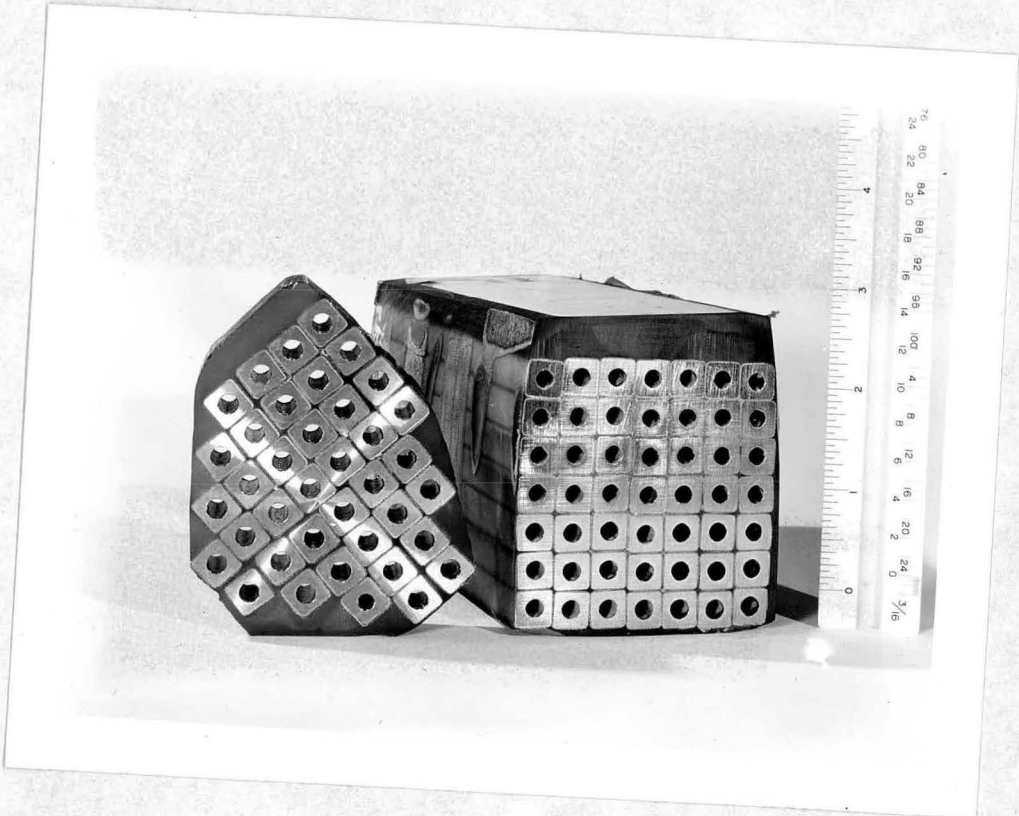

Fig. 2

Fig. 3

Fig. 4

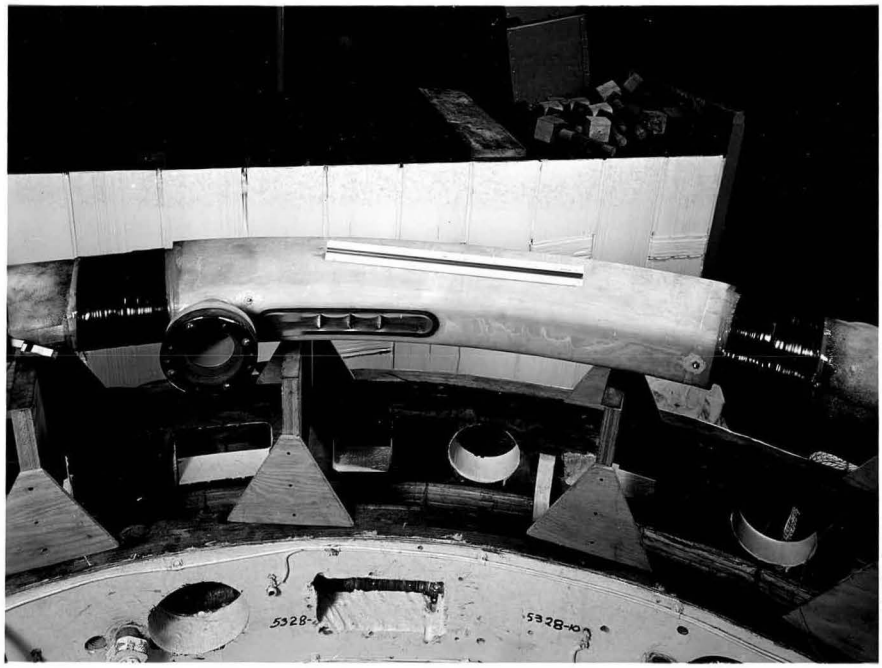

Fig. 5