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(Preliminary Abstract)

A bubble chamber is a laboratory device whose purpose is the analysis of high-energy high-velocity nuclear particles and their reactions. It may take any one of many forms, and may use any one of a variety of liquids as the bubble-forming medium. The development discussed here concerns chambers using liquid hydrogen at -246°C as the bubble-forming medium. In operation, the pressure in the chamber is quickly dropped from 90 psia to 30 psia, creating a momentary superheated condition. At this moment a pulse of charged particles accelerated in the Bevatron to energies around 6 Bev is passed through the liquid. The particles leave a trail of ions in the liquid on which tiny bubbles of vapor (gas) begin to form. The pattern of these bubbles reproduces closely the paths of the speeding particles, and more important, the paths of products of collision reactions with the hydrogen nuclei. The chamber is operated in a magnetic field so that the paths have curvatures from which information can be derived on the natures of the particles. At the optimum instant, a flash photograph of the pattern is made through a transparent window. Because of the necessity to "conserve cold" or keep heat out, the chamber is isolated as completely as possible by a surrounding vacuum.

Obviously, the combination of requirements--pressure, magnetic field, vacuum, extreme cold, necessity to see in--posed some formidable problems in material selection. Not the least of these problems was the dearth of information on which to base selections. Much of the information had to be developed "from scratch." Solutions to the problems

were found that were sufficiently good to allow operation, although considerable strides are still being made in improving both efficiency and scale of the operation.

For the body of the chamber itself, after consideration of a number of materials, both metallic and nonmetallic, OFHC copper was selected and is in successful use. The window material finally settled down at a borosilicate glass after consideration of other glasses and transparent plastics. The problem of sealing these windows was, and still is, a troublesome one. Various elastomers, plastics, and metals were tried and abandoned. We finally achieved a seal with pure lead, although it still gives trouble. Even the bolts used to clamp the windows had to be carefully selected with respect to coefficient of expansion, in addition to other properties, so as to hold correct tension during cool-down.

In addition to the usual mechanical, physical, and thermal properties, it was necessary to develop information on some little-known ones, such as heat radiation emissivity, permeability to liquid hydrogen, and others.

This work was performed under the auspices of the U. S. Atomic Energy Commission.

(The paper as finally submitted will discuss the details of these investigations, with photographs, graphs, and charts).