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NASA TECH BRIEF

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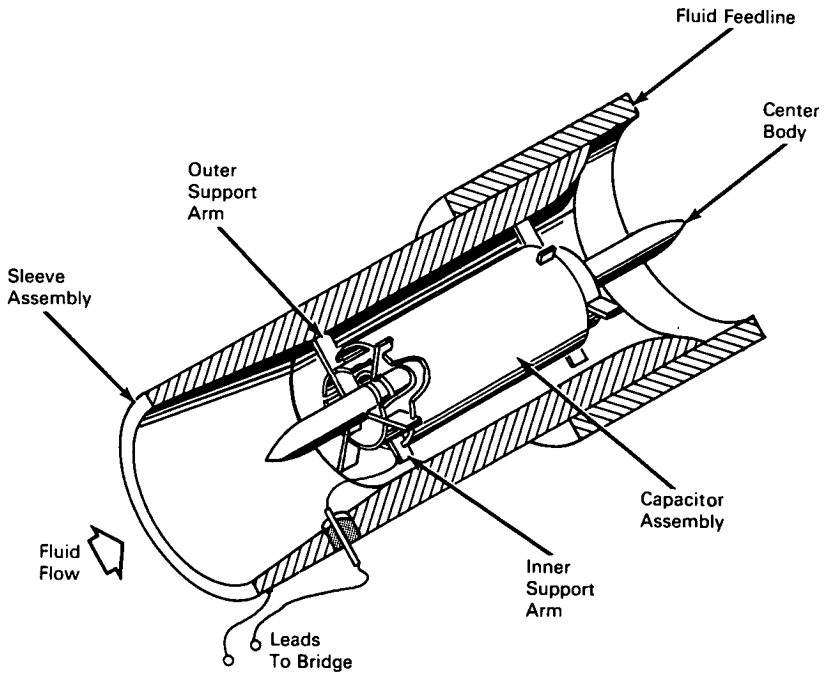
Coaxial Capacitor Used to Determine Fluid Density



The problem: To measure directly the density of compressible fluids existing simultaneously in both liquid and gaseous phases. Previous methods involve both pressure and temperature measurements, and because the density of each phase is different, separate pressure and temperature measurements had to be made. This complicated procedure does not lend itself to rapid and accurate measurements.

The solution: A system comprised of a capacitor connected as one leg of a bridge circuit, a power source, and an indicator calibrated to indicate density as a direct measurement. The system and its operation are based upon the relationship, discovered by Clausius and Mosotti, between the dielectric constant of a fluid and its density.

How it's done: The sensing device consists of a sleeve assembly that is postioned in a section of line in the fluid system and contains the capacitor assembly. The center capacitor plate is held in place by outer radial support arms that are in electrical contact with the center body and sleeve assembly and maintained at ground potential. Two additional capacitor plates are held in place by inner radial support arms that are insulated from the center body. These two plates are

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electrically connected, as one leg of the bridge circuit, through a glass-to-metal seal in the sleeve assembly. The Clausius-Mosotti relation considers the dielectric constant, the molecular polarizability, and the absolute density of the fluid. Because the dielectric constant is a function of the density, the indicator in the bridge can be calibrated to read the fluid density directly. Because the polarizability constant varies from fluid to fluid, the indicator is calibrated for each fluid to be measured.

Notes:

1. This device performs equally well in a static or a flow system because fluid flow has no effect on its measuring ability.
2. This invention has measured the density of liquid hydrogen over a temperature range of 20°K to 33°K, and of liquid nitrogen over a temperature range of 77°K to 112°K, each over a pressure range of 1 atmosphere to 70 atmospheres with an accuracy of ±1 percent.
3. This invention should be of interest to organizations working with compressible fluids, particularly in the cryogenic range.
4. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
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   Cleveland, Ohio, 44135
   Reference: B65-10296

Patent status: NASA encourages the commercial use of this invention. It has been patented by NASA (U.S. Patent No. 3,176,222), and royalty-free license rights will be granted for its commercial development. Inquiries about obtaining a license should be addressed to NASA, Code AGP, Washington, D.C., 20546.

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