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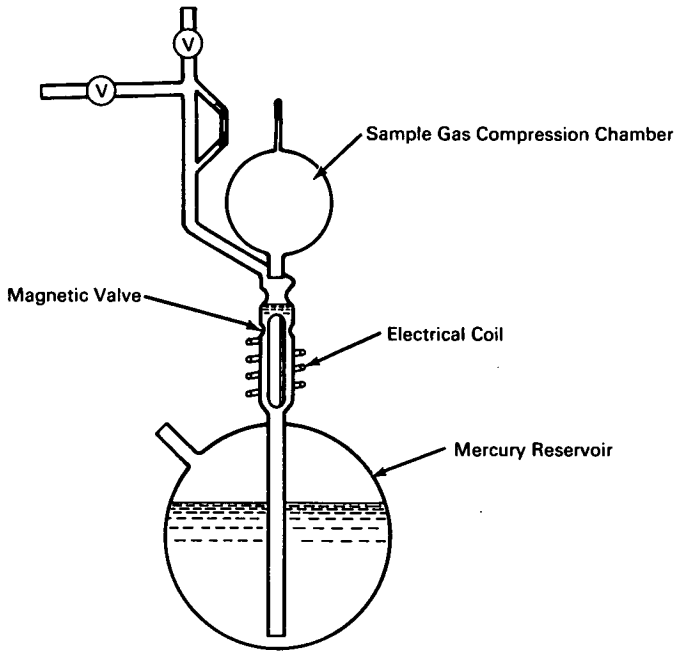
NASA TECH BRIEF

Modified McLeod Pressure Gage Eliminates Measurement Errors



The problem:

Conventional McLeod gages, which measure the absolute pressure of gases in the vacuum range, are subject to errors due to diffusion of mercury used in the gage. This is particularly a problem when a cold trap is used to prevent mercury vapor from getting into the system being measured; mercury vapor molecules streaming toward the cold trap "capture" molecules of the sample gas in a "pumping" action which results in an erroneous pressure reading. This error has previously been controlled by refrigerating the entire gage and by limiting the glass tubing size in order to limit the diffusion surface area of the mercury.

The solution:

Modify a conventional McLeod gage by introducing a valve between the mercury reservoir and the sample gas chamber. The valve isolates the mercury from the sample gas during equilibration, preventing the "pumping" action from taking place. It also opens the way for elimination of the cold trap. The valve is internal to the gage and is magnetically actuated, hence introduces no danger of leakage or contamination.

How it's done:

The conventional McLeod gage includes a reservoir containing mercury and a compression chamber of

(continued overleaf)

known volume positioned above the reservoir and connected to it by a passageway which permits the flow of mercury from the reservoir to the compression chamber and back again. A conduit from the system whose pressure is to be measured is connected to the passageway between the reservoir and the compression chamber.

The conventional McLeod gage is modified by the addition of a valve, containing a floating valve member, between the mercury and the compression chamber, which eliminates "pumping" error and the need for refrigeration. If suitable line valves are provided, the cold trap may be eliminated. The floating valve member is actuated magnetically through a coil or permanent magnet located on the outside of the McLeod gage, hence no danger of leakage or contamination exists. After equilibration, operation of the modified McLeod gage is identical with the conventional gage. The modified McLeod gage is illustrated.

To operate the McLeod gage, the level of the mercury is brought up to the neck of the passageway to a position just below the point of entrance to the upper compression chamber where the passageway opens to the conduit from the system whose pressure is to be measured. The magnetic valve is then closed, isolating the mercury surface from the system but leaving the sample gas free to travel into the compression chamber in the equilibration phase of the pressure measurement. When the pressure in the system and the pressure in the compression chamber are equal, the magnetic valve is opened and the level of the mercury raised, thereby cutting off the source of the pressure and compressing the gas in the compression chamber. The gas is compressed to a known volume at a known pressure, from which the pressure of the gas sample before compression can be calculated with the aid of Boyle's law.

Notes:

1. Several variations in operation of the valve are possible, including one based on the "cartesian diver" principle, which is nonmagnetic.
2. The McLeod gage modification does not increase the time required for pressure measurement or introduce the need for other corrections.
3. The modifications do not affect the volume stability of the gage.
4. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: B66-10481

Patent status:

This invention is owned by NASA, and a patent application has been filed. Royalty-free, nonexclusive licenses for its commercial use will be granted by NASA. Inquiries concerning license rights should be made to NASA, Code GP, Washington, D.C. 20546.

Source: Milton C. Kells
(ARC-62)