Surge Control Unit for Mercury Manometers

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The reading of a mercury meniscus can be critical to obtaining correct pressure and volume measurements. Sometimes corrections have to be applied for local gravity, temperature, capillary depression, the height of a cylinder equivalent to the volume of a curved section, glass refraction, static electricity, and dryness of the gas exposed (*1*, *2*). These factors can produce errors, but these can be reduced or eliminated by the use of wide-diameter glass tubing where the meniscus is read. Such tubing is also desirable for obtaining large displacement volumes for McCleod gauges, hydrogenation apparatus, Toepler pumps, and other gas handling systems.

However, glass walls of large chambers cannot well survive the liquid hammering action of large masses of surging mercury, which often occurs through careless handling of valves or other accidents. The usual provision for surge control has been a constriction in the lower connections, but this, if small enough, may retard normal flow and may result in long delays in reading the meniscus.

A simple glass unit (Figure 1) that provides division and reunion of a liquid stream has been designed to overcome these difficulties. Diameters of the channels can be chosen to fit particular circumstances. Normally, the unit would be placed in the lower part of a glass structure. Connecting units in tandem may be used to enhance the dampening effect.

Glass tubing may be bent to form a unit. A somewhat less efficient unit may be made more easily by blowing a bulb, flattening it, and pushing in each side with carbon to form an island-like structure encircled by channels. The glass units should be annealed well to overcome local stresses that are likely to occur if one branch contracts more than the other.

The unit does not trap bubbles, avoids the need for narrow constrictions, and offers resistance to flow that is an increasing function of the mercury velocity. Thus, surging is prevented without appreciable effect on normal flow rates. Resistance to mercury motion approaches zero as the velocity approaches zero, and the meniscus settles to the correct level with negligible hysteresis. Surges upward and downward are dampened alike. For example, on upward flow, collision of the mercury streams produces a resistance to flow at the top

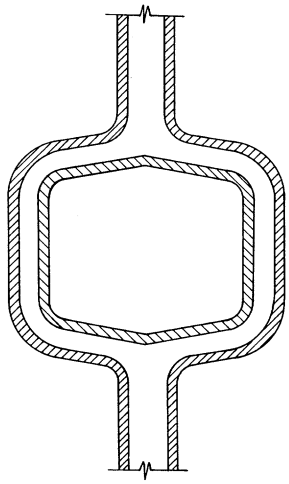

Figure 1. Glass unit for mercury surge control by divergent-convergent actions

juncture. At the same time, the velocity is attenuated at the bottom juncture because of the division of the mercury into two streams. This attenuation not only minimizes the forces from the moving mercury but also nearly balances the lateral forces through opposing symmetry. In actual operation, no tendency for the unit to jump could be observed, and the small glass structure withstood the internal forces well.

These units have served for manometers, hydrogenation apparatus, and large fixed McCleod gauges. For example, a surge control unit measuring 40 mm across the squared part and containing channels 2.7 mm in diameter for the divided stream proved satisfactory in controlling mercury hammer in a 200-mL volume bulb and overshoot in the comparison column of a McCleod gauge.

LITERATURE CITED

(1) "International Critical Tables," H. H. Kimball, Ed., No. 1, Maple Press Co., York, Pa., 1926, p 68.
(2) W. Cawood and H. S. Patterson, *Trans. Faraday Soc.*, **29**, 514 (1933).