SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPARATUS FOR THE DETERMINATION OF THE SOLUBILITIES OF GASES AT HIGH TEMPERATURES AND HIGH PRESSURES

The apparatus consists of a modified Ipatieff rotating bomb and a sampling arrangement separating the dissolved gas from the solvent in samples withdrawn from the bomb.

The rotating bomb (Fig. 1) is provided with two

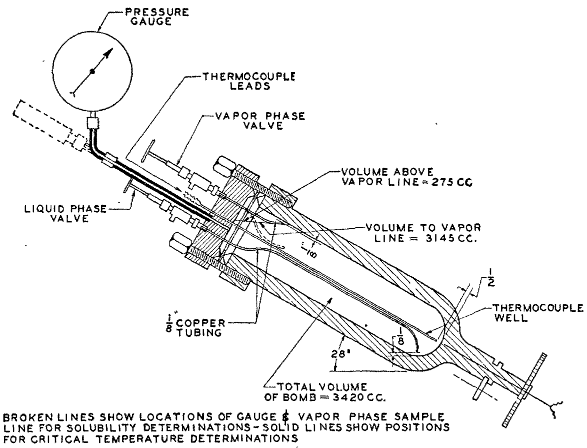

Fig. 1

needle valves attached to sampling lines, the shorter terminating just below the head of the bomb and the longer reaching the lower end or bottom of the bomb, making it possible to remove vapor phase and liquid phase samples when the bomb is operated at an angle of 20–30 degrees with the horizontal.

The sampling arrangement (Fig. 2) consists of a

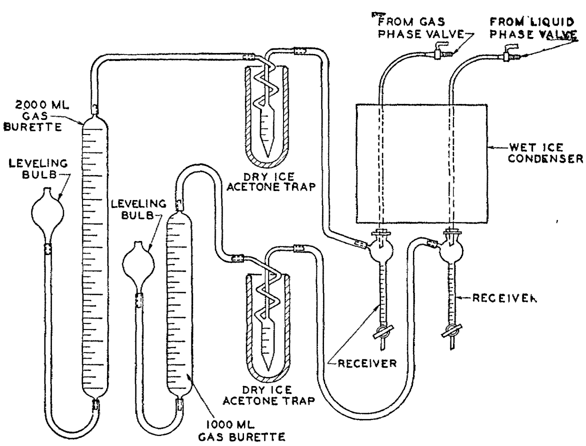

Fig. 2

wet ice condenser with receiver, trap and a gas burette of 1,000 cc capacity for liquid phase samples and a similar device for vapor phase samples but with a gas burette of 2,000 cc capacity. The traps are immersed in a cooling bath at a temperature sufficiently low to condense the solvent escaping condensation in the wet ice receiver but allowing the gas to collect as such in the gas burettes when the samples are released to atmospheric pressure through the needle valves on the bomb head. The gas is collected over saturated sodium chloride solution.

A similar but smaller apparatus is used for purging the draw-off lines before the main samples are taken.

In making solubility determinations the bomb is charged with solvent to about one half its total capacity (3,420 cc). The gas is then charged at room temperature, the initial pressure depending on the temperature and pressure range of the solubilities to be determined. The bomb is set in rotation and heated to the desired temperature level. The rotation is stopped after one half hour, sample lines purged, the vapor phase sample (700–1,000 cc gas) and the liquid phase sample (7–9 cc condensate) taken. When the composition of the vapor phase and liquid phase samples differ, a two-phase condition exists in the bomb and the solubility can be calculated from the composition of the liquid phase sample. When the composition of the two samples is the same a one-phase condition prevails and no solubility of gas in liquid as such exists.

If the bomb is charged at different initial pressures, *e.g.*, 10, 25, 50, 75 atms., and solubilities determined at various temperatures for each initial pressure, curves may be drawn plotting temperatures and corresponding pressures *vs.* solubilities. Isotherm or isobar curves may then be derived.

In the determination of critical temperatures, the bomb is charged with the material investigated, the charge may vary from 20 to 50 per cent. of the capacity of the bomb. The bomb is set in rotation and the temperature raised about 1° C. per minute, taking the pressure and temperature readings at not greater than five minute intervals. The pressure *vs.* temperature is plotted on uniform scale. The pressure-temperature curve will show a "break" or point of discontinuity which will be within $\pm 2°$ C. of the critical temperature of the material, as determined by the usual methods.

In case of pure substances the existence of a two-phase condition below the break and a one-phase state above the break may be confirmed by running the pressure-temperature curve in the presence of hydrogen (initial pressure < 10 atms.) and comparing the compositions of samples taken from the vapor phase and liquid phase sample lines, the presence of hydrogen in the amount given above not affecting the break on the pressure-temperature curve to any noticeable amount.

The critical temperatures of two-component systems may be determined by the same procedure.

This apparatus can be used for other studies such as the investigation of equilibria in heterogeneous systems.

V. N. IPATIEFF
G. S. MONROE

RESEARCH LABORATORIES,
UNIVERSAL OIL PRODUCTS COMPANY,
RIVERSIDE, ILL.

A SAFETY SWITCH FOR WATER-COOLED X-RAY TUBES

SINCE water-cooled x-ray tubes may be damaged if the flow of water is interrupted during operation, it is a common practice in physics laboratories to insert in the control circuits of x-ray machines so-called bucket switches which are held closed by the weight of the water that leaves the cooling system of the tube but which open automatically if for any reason this flow ceases. Such switches are satisfactory where the waste water can be dumped into a sink and where bulk is not a disadvantage. However, because they take up considerable space and can not be connected into a closed water system, it may be inconvenient or impossible to employ bucket switches in connection with medical x-ray apparatus.

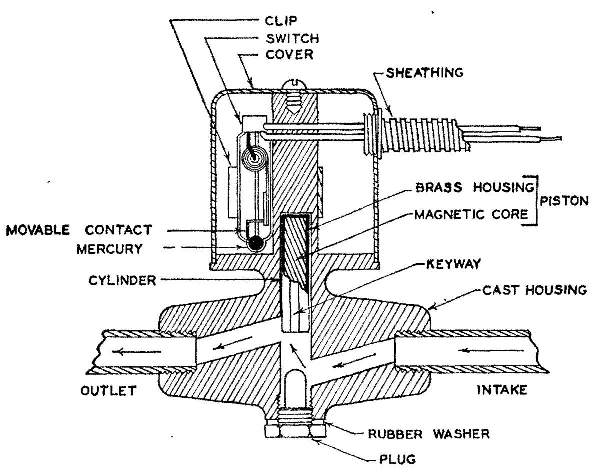

FIG. 1. Flow switch.

There is described here a simple, small, dependable flow switch which can be connected into a closed water-cooling system. The switch is normally open, closing when water flows through it and opening again when the flow stops, either because of pressure failure or a clogged waste line. The switch itself (a commercial product, Mercoid Magnetic Switch, No. 9-81R) consists of a glass capsule containing a pool of mercury and two electrodes. One electrode is permanently bathed in the mercury; the second is held away by means of a coil spring but makes contact with the mercury whenever a permanent magnet is brought up to the side of the capsule.

The mercury switch is mounted against the outside of a vertical brass cylinder within which lies a piston made up of a brass housing surrounding a magnetic core. The fit between piston and cylinder is purposely loose and to further facilitate leakage between the two a longitudinal keyway is cut in the piston.

The magnetic core of the piston consists of a cylindrical, cobalt-alloy steel, permanent magnet having a diameter of approximately 9 mm, a length of approximately 3 cm (one third of a commercial cylindrical magnet, Central Scientific Company of Chicago, No. 78295-B).

Operation: When no water is flowing through the switch, the piston under the action of gravity moves down until it strikes a mechanical stop, in which position direct communication between intake and outlet ports is cut off and the magnet is below the level at which it will operate the magnetic switch. The latter, therefore, is open and the x-ray machine can not be operated.

When water flows through the device, the piston moves upward until a free communication is established between intake port and outlet port in which position the armature of the magnetic switch is attracted, the second electrode makes contact with the mercury, the control circuit of the x-ray machine is completed and the x-ray tube can be operated.

PAUL C. HODGES

UNIVERSITY OF CHICAGO

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