HEAT TRANSFERS ACROSS CAVITIES

S. D. PROBERT, R. M. EDWARDS and M. DIXON

Division of Mechanical Engineering, University College, Swansea

IN PREVIOUS experiments [1] a minimum in the heat leak (between two bodies at different temperatures) versus air pressure curve was obtained when the horizontal hot wire (o.d. 0·49 mm) was 5° skew to the axis of a surrounding cylinder (i.d. 1·9 cm) at 16°C, the temperature difference being 100°C.

The present experiment measured the rate of heat transfer across the gap between two vertical plane, nickel plated, copper surfaces which were maintained at $22(\pm 2)$°C and $200(\pm 2)$°C. The height and surface separation of the test cell were 15 cm and 1 cm respectively, the cell having an enclosed top and bottom, but open ends, as shown in Fig. 1. The rate of passage of heat to the water cooled plate for

such an arrangement is shown by the lowest curve of Fig. 2. A minimum occurred between the continuum conduction and free convection dominant regions. (No such minimum was found for the arrangement when the plate separations were either two or three centimetres, the hot and cold wall temperatures remaining unchanged). The dashed curve (Fig. 2) is for the same cell but with one end closed by a tightly fitting sheet of asbestos card fixed in position. The uppermost curve is for the cell with both ends closed in this manner. The imperfect fit between the cards and the cell permitted the gas pressure within, and surrounding the cell to be identical yet adequate to inhibit sideways convection out of the cell. In this case no minimum is apparent in the
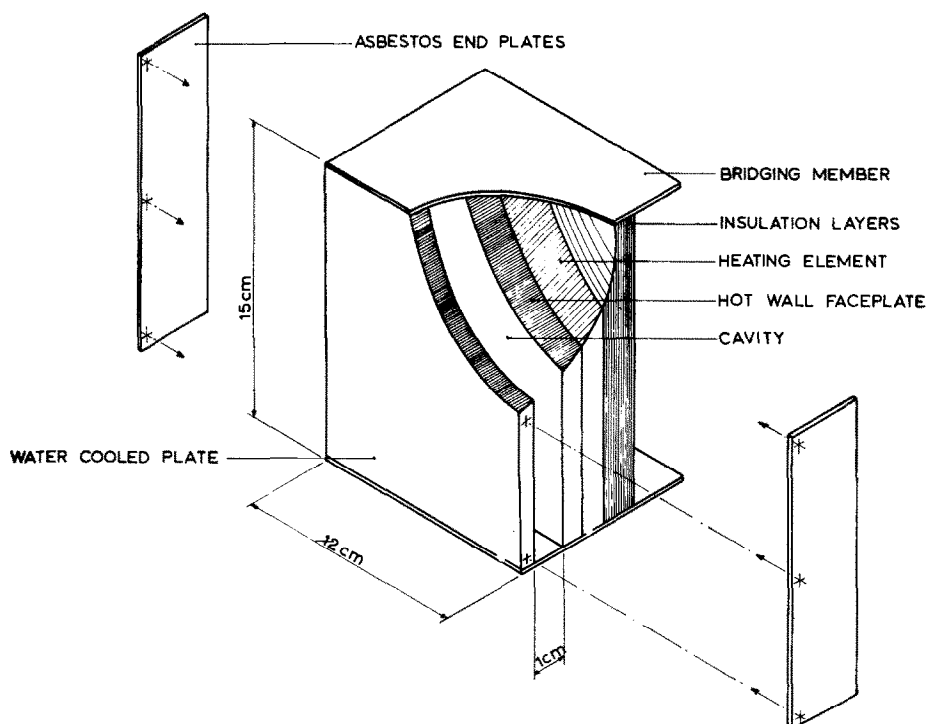

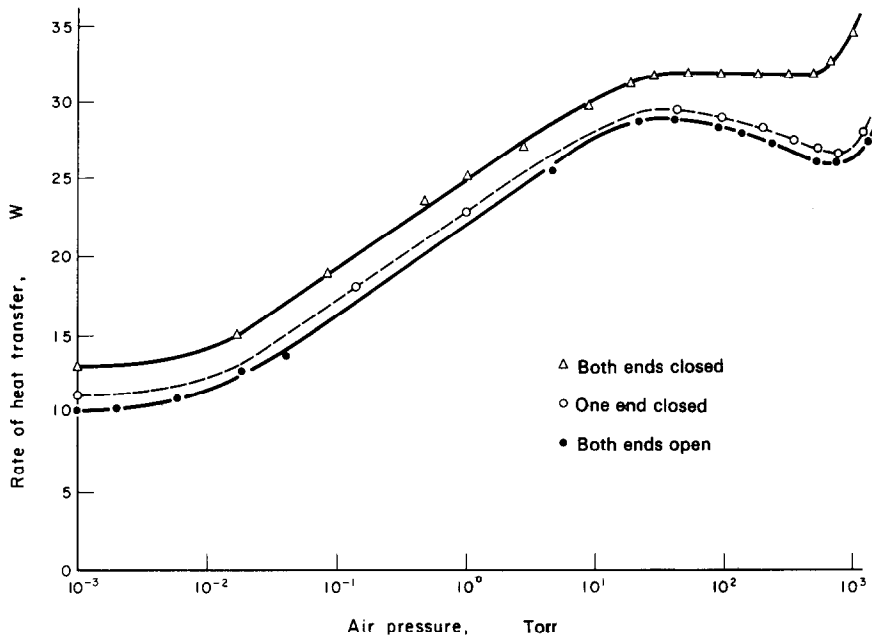FIG. 1. Cutaway representation of the test cell with end plates not in position.

FIG. 2. Effects of closing the ends of a vertical cavity of aspect ratio 15.

rate of heat leak. The ordinate displacement of one curve from another throughout the radiation and free molecular conduction regions corresponds exactly to the rate of heat conduction through the appropriate asbestos card. The critical pressure region, over which transition from free molecular to continuum conduction occurs, is shifted to slightly higher pressures upon closing the ends of the cell, as would be expected because of the mean free path restriction.

REFERENCE

1. S. D. PROBERT, R. G. BROOKS, T. R. THOMAS and J. MAXWELL, Heat losses through rarefied fluids, *Int. J. Heat Mass Transfer* **10**, 135 (1967).