on the fundamental principle that the drop in temperature is proportional to the resistance.

The chart (Fig. 2) can be used for approximating the thickness of insulation required to prevent condensation on the interior wall or roof surfaces of a building. Although this chart is intended primarily for roofs, it can be used for walls by taking the dry-bulb temperature and the corresponding relative humidity near the walls at the point which will necessitate the maximum heat resistance to prevent condensation, instead of using the temperature and humidity near the ceiling.

Example 2. Determine the thickness of insulation required to prevent ceiling condensation for the following conditions: Dry-bulb temperature near ceiling, 85 F; Relative humidity, 70 per cent; Lowest outside temperature, − 10 F; Construction of uninsulated roof, 1 in. yellow pine sheathing and built-up roofing; Coefficient of transmission of roof, 0.49; Conductivity of insulation to be used, 0.30.

Solution. The solution of this problem is indicated on the chart (Fig. 2) by the dotted line:

1. Locate the inside dry-bulb temperature of 85 F on scale *A*, and draw a line horizontally to the 70 per cent relative humidity curve, indicated on scale *B*.
2. Draw line *2* vertically downward from the intersection located in item 1.
3. Locate on scale *D* the temperature difference of 95 F between the ceiling temperature of 85 F and the lowest outside temperature of − 10 F, and draw a line horizontally until it intersects with line *2*.
4. From the point of intersection of lines *2* and *3*, draw a line to the point *P*.
5. From the intersection of lines *4* and *AB*, draw a line horizontally until it intersects with the diagonal line corresponding to a coefficient of transmission of the roof of 0.49, located on scale *F*.
6. From the intersection found by paragraph 5, draw line *6* vertically downward.
7. Locate the conductivity of 0.30 Btu per hour per square foot per degree Fahrenheit of the insulation on scale *G* and draw a line to point *Q*.
8. From the intersection of lines *6* and *7*, draw a line horizontally to scale *H*, on which the thickness of insulation of this conductivity is indicated, which is 1.3 in. The nearest commercial thickness above 1.3 in. would, of course, be selected.

Chapter 8

THE COOLING LOAD

Conditions to be Maintained, Cooling Load, Transmission with No Sun Effect, Temperatures, Sun Effect, Transmission Through Glass, Heat and Moisture Leakage, Heat and Moisture Sources

THE cooling load may be calculated in a manner similar to that used in calculating the heating load as the conditions are much the same. The direction of the flow of heat is reversed, however, and in most cases additional factors must be considered, such as the sun effect and the heat from occupants, lights, motors, and other sources. The character of the load depends on the type of building to be cooled as, for example, in auditoriums and other places of assemblage where the maximum load usually is that due to the heat and moisture given off by the occupants, or in office buildings and residences where sun effect and the transmission and infiltration of heat through the building shell are most important.

While cooling is generally identified with the summer season, it is often necessary to cool in winter as well as in summer. In a crowded place of assemblage the heat given off by the occupants, together with that given off by the lighting and power equipment, may be more than the normal heat loss through the structure even in winter under cold climatic conditions. A typical case for winter might show about 300 Btu of body heat, plus 100 Btu per person from lights, etc., being given up to the building, compared with about 200 Btu heat loss from the building, per person per hour. This would mean that 200 Btu per person must be absorbed by the air conditioning system.

Much of the basic information for the design of comfort conditioning installations has resulted from research conducted at the A.S.H.V.E. Research Laboratory and at institutions with which cooperative research investigations have been carried on. These data include the effective temperature index, and heat and moisture loss data, given in Chapter 2.

CONDITIONS TO BE MAINTAINED

The conditions to be maintained in an enclosure are variable and depend on many factors, especially the season of the year and (during the summer) the outside dry-bulb temperature and the duration of the period of occupancy. Information concerning the proper effective temperatures to be maintained for various seasons is given in Chapter 2, where are also tabulated the most desirable indoor air conditions to be maintained in summer for exposures less than three hours. (See Table 2, Chapter 2).

In installations for auditoriums and theaters the requirements are