To determine the thickness of insulation necessary to prevent sweating for coverings having conductivity values differing from the value of 0.3 used in computing the curves, increase or decrease the values taken from the curves by the percentages indicated in the last column of Table 6. These percentages will give values approximately correct.

In Fig. 8: $t^o$ = temperature of air on warm side of insulation.
$t^{III}$ = temperature of the medium on cold side of insulation.

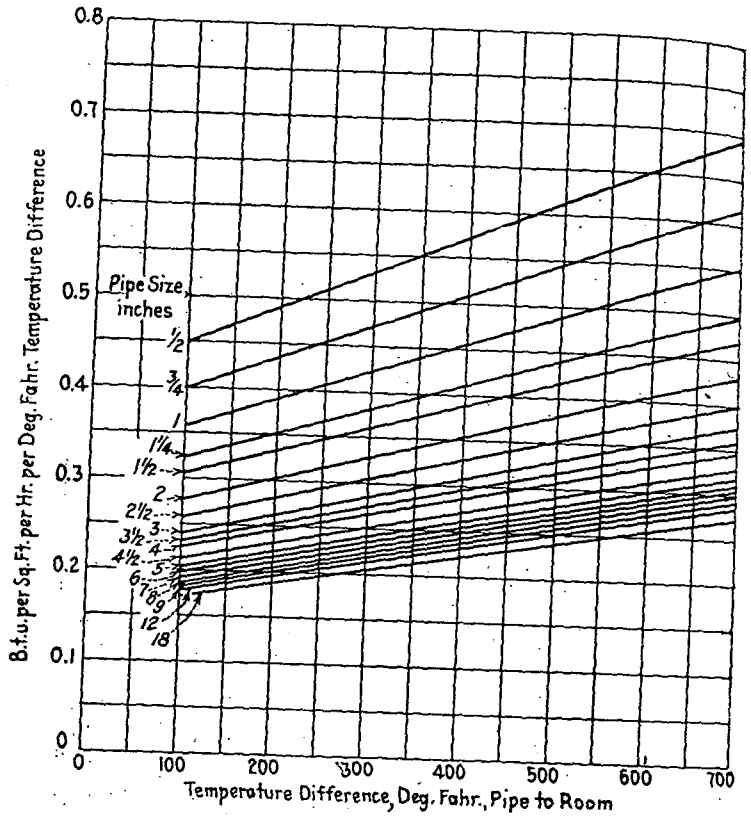


FIG. 7. HEAT LOSS THROUGH 2 IN. THICK COVERING

### *EFFECT OF AIR VELOCITY ON SURFACE LOSSES*

The rate of heat loss from a surface maintained at constant temperature is greatly increased by air circulation over the surface. Fig. 9 is based on Langmuir's equations (*Trans. Am. Electro-Chem. Soc.*, Vol. 23). Other investigators have shown even greater increases in rates of heat loss from bare surfaces due to air velocity.

In the case of well-insulated surfaces the increases in losses due to air velocity are very small as compared with increases shown above for bare





surfaces, because of the fact that air flowing over the surface of the insulation can increase only the rate of heat transfer from surface to air, and cannot change the internal resistance to heat flow inherent in the insulation itself. The maximum increase in loss due to air velocity ranges from about 30 per cent in the case of 1 in. thick insulation, to about 10 per cent in the case of 3 in. thick insulation, provided that the insulation is thoroughly sealed so that air can flow only over the surface.

If the conditions are such that the air may circulate through cracks and crevices in the insulation, the increases may be far greater than those given above. Therefore, it is essential that insulation be sealed as tightly

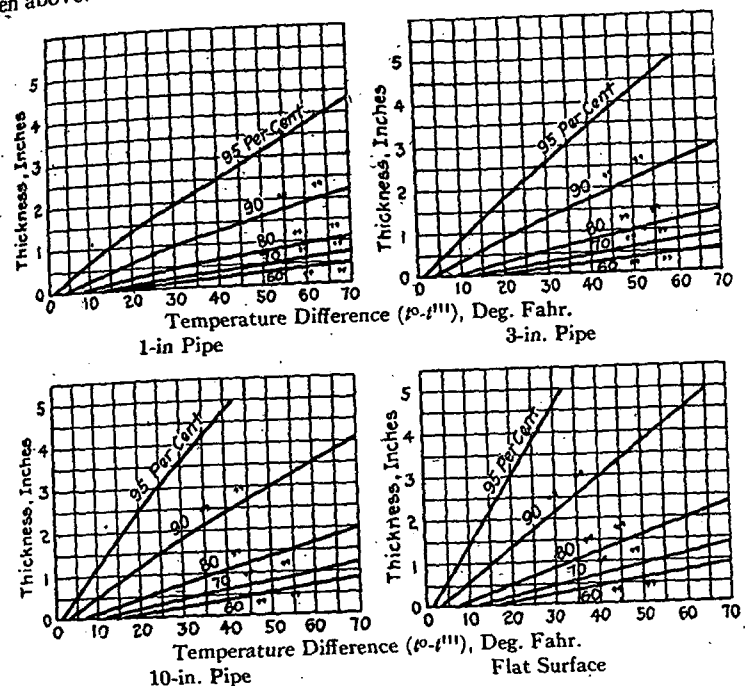


FIG. 8. THICKNESS OF INSULATION TO PREVENT SWEATING

as possible. Pipe insulation out-of-doors should be provided with a weather-proof jacket, and other outdoor insulation should be thoroughly weather-proofed.

### *ECONOMIC THICKNESS OF PIPE INSULATION*

Table 8 shows the thicknesses of insulation which ordinarily are used for various temperature conditions. Where a thorough analysis of economic thickness is desired, this may be accomplished through the use of the chart, Fig. 10.

The dotted line on the chart illustrates its use in solving a typical example. In order to use the chart, start at the lower left hand corner