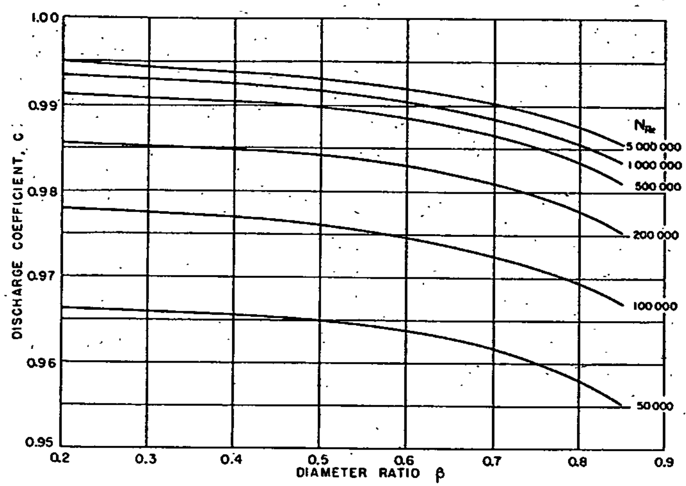

FIG. 16. RELATION OF NOZZLE DISCHARGE COEFFICIENT, C, FOR 2-INCH PIPE, TO DIAMETER RATIO AND REYNOLDS NUMBER

$$\varphi = \sqrt{\left(\frac{p_2}{p_1}\right)^{2/k}\left(\frac{k}{k-1}\right)\left(\frac{1-(p_2/p_1)^{k-1/k}}{1-p_2/p_1}\right)\left(\frac{1-\beta^4}{1-\beta^4(p_2/p_1)^{2/k}}\right)} \quad (71)$$

This formula is plotted for $k = 1.40$ (air and other diatomic gases) and 1.30 (steam, carbon dioxide, natural gas) in Figs. 19 and 20, respectively.

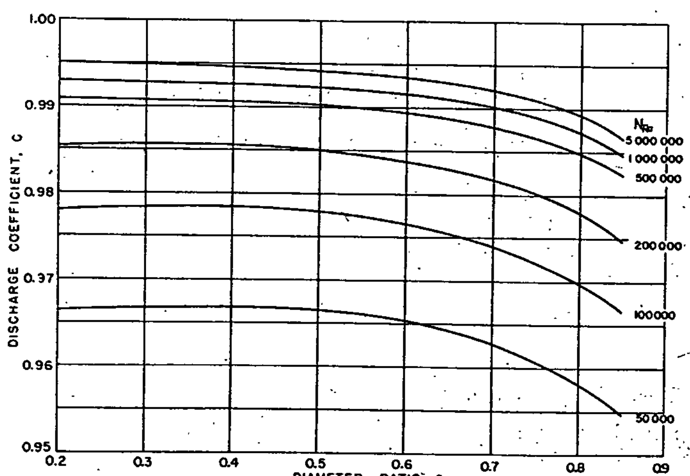

FIG. 17. RELATION OF NOZZLE DISCHARGE COEFFICIENT, C, FOR 6-INCH PIPE, TO DIAMETER RATIO AND REYNOLDS NUMBER

FLOW MEASUREMENT BY PITOT TUBE

There remains one other head type meter useful in ventilating work, the Pitot tube, named for the Frenchman who discovered the principle. The Pitot tube is essentially a bent tube with its open end pointed upstream, combined with another tube with its end pointed crosswise to the stream, combined with another tube with its end pointed crosswise to the flow or downstream, or connected to openings crosswise to the flow. Used with flowing liquid, the liquid will rise in each tube, but higher in the one pointed upstream. Used with a flowing gas, and the two tubes connected by a U-tube containing water, the liquid level in the U-tube will be displaced, with the lower level on the side connected to the tube pointed upstream. The tube directed upstream receives the impact pressure, which is the sum of the static and kinetic pressures, while the tube directed

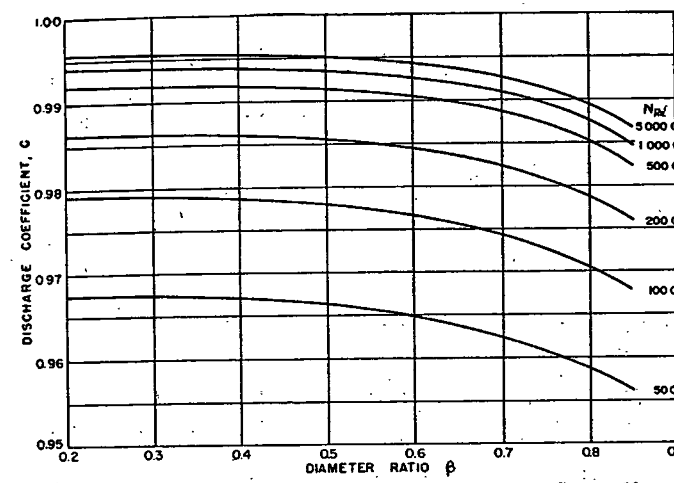

FIG. 18. RELATION OF NOZZLE DISCHARGE COEFFICIENT, C, FOR 10-INCH PIPE, TO DIAMETER RATIO AND REYNOLDS NUMBER

crosswise receives only the static pressure; the difference between the two, as read on the separate tubes or on the U-tube is, of course, the kinetic pressure. The velocity is expressed as

$$V = \sqrt{2gh_t} \quad (72)$$

Application of Equation 60 serves to make the formula general, assuming that water is used in the manometer connecting the two tubes. Using this equation, and multiplying by 60 to convert feet per second to feet per minute,

$$V_m = 1096.5\sqrt{\frac{h_{aw}}{\rho}} \quad (73)$$

in which V_m is the rate of flow in feet per minute.

It is often difficult to obtain the exact static pressure. In the usual construction of Pitot tubes, the static pressure openings are downstream from the impact pressure opening, and turbulence induced by the nose may affect the static pressure reading. If the static pressure openings point