Most large continuously operated theaters are provided with complete downward systems of air distribution similar to the one shown in Fig. 9. With this system a large number of inlet openings is provided, each of which discharges air in a thin horizontal stream at high velocity in order that the cool air will be mixed with the air in the theater before it reaches the patrons.

13 ● What system of air distribution is frequently used in smaller theaters?

The system used, particularly where artificial cooling is had, brings air in at high velocity through a large number of small horizontal nozzles located in the rear of the auditorium near the ceiling. This high velocity air mixes with a much larger quantity of air and causes circulation within the theater before it comes into contact with the occupants. With this method care must be exercised not to discharge the air against ceiling beams or projections which may give a downward direction to the cool air before it is thoroughly diluted.

Chapter 20

AIR DUCT DESIGN

Pressure Losses, Friction Losses, Friction Loss Chart, Proportioning the Losses, Sizes of Ducts, General Rules, Procedure for Duct Design, Air Velocities, Proportioning the Size for Friction, Main Trunk Ducts with Branches for Public Buildings, Equal Friction Method, Details of Duct Construction

THE flow of air due to large pressure differences is most accurately stated by thermodynamic formulae for air discharge under conditions of adiabatic flow, but such formulae are complicated, and the error occasioned by the assumption that the gas density remains constant throughout the flow may be considered negligible when only such pressure differences are involved as occur in ordinary heating and ventilating practice.

In the development of the formulae, diagrams, and tables for the flow of air, use is made of the following basic equation for the flow of fluids:

If H_v be the velocity head in feet of a fluid, and the velocity, V, be expressed in feet per minute, the fundamental equation is

$$V = 60\sqrt{2g\,H_v}$$

The factor g is the acceleration due to gravity, or 32.16 ft per second per second.

It is usual to express the head in inches of water for ventilating work and, since the heads are inversely proportional to the densities of the fluids,

$$\frac{H_v}{\frac{h_v}{12}} = \frac{62.4}{\rho}$$

or

$$H_v = 5.2\,\frac{h_v}{\rho}$$

therefore,

$$V = 1096.5\sqrt{\frac{h_v}{\rho}} \qquad (1)$$

where

V = velocity in feet per minute.
h_v = velocity head or pressure in inches of water.
ρ = weight of air in pounds per cubic foot.

For standard air (70 F and 29.92 in. barometer) ρ = 0.07495 lb per cubic foot. Substituting this value in Equation 1:

$$V = 1096.5\sqrt{\frac{h_v}{0.07495}} = 4005\sqrt{h_v} \qquad (2)$$