particularly because of its flexibility, absolute temperature and humidity control and economy of operation.[1]

The Fan System for Heating and Ventilating consists of a combination of a fan operating in conjunction with a blast heater, with or without a system of air distributing ducts. An air washer or humidifier may be added when required without otherwise changing the type of system. For heating purposes only, the fan system may or may not be used, depending on circumstances and the requirements to be met. The fan system may be used to supply both heat and fresh air for ventilation, or it may be used in conjunction with some form of direct radiation which is to care for the heat losses. When used for ventilating purposes, the fan will be required to supply whatever amount of air is specified to meet the ventilation requirements. The system may be arranged so that the fan may blow the air through the heaters, or draw the air through the heaters. Each arrangement possesses its own peculiar advantages, but the selection depends largely upon the individual requirements of the installation.

The draw-through apparatus is usually employed in factory buildings on account of its compactness as well as the advantage gained by connecting directly to the piping system. In this case the temperature of the air delivered will be the same to all parts of the building. The blow-through apparatus is used in public buildings, or wherever different temperatures and independent temperature regulation are required for different rooms of the building. The use of the by-pass around the heating coils permits the mixture of hot and cold air in any desired proportions, by the use of a mixing damper at the point where the two ducts from the heater, and from the by-pass, join to form one duct leading to the room. In the case of public buildings, the fan frequently blows the warm air into a space termed a plenum chamber, from which the air ducts radiate to the various rooms of the building; this arrangement is sometimes called the plenum system of heating and ventilating. They are often designated single or double type.

The air supply systems may be distinguished as upward and downward systems the former being used in such buildings, as theaters, auditoriums where people are closely associated. Air is supplied near the floor and exhausted through grilles in or near the ceiling. The downward plan is used in school-rooms, hospitals, and other public buildings, air being introduced 8 ft. or more above the floor and drawn out near the floor. The selection of either system depends upon conditions confronting the engineer.

The amount of heat to be supplied can be determined as outlined in Chapter I and briefly stated amounts to the losses from transmission, from infiltration, with proper allowances for heat supplied by persons or processes. Temperatures usually specified for various types of buildings are to be found in Table 1 (p. 6).

The amount of air to be supplied depends largely upon the type of service required, the amount of heat needed, the perfection of ventilation

[1]AMERICAN SOCIETY HEATING AND VENTILATING ENGINEERS TRANSACTIONS, Vol. 25, 1919. Comparative Study of Natural and Mechanical Ventilation for School Rooms, Legg & Walker; Vol. 28, 1922, Intermediate and Junior High Schools in Detroit, H. W. Anderson; Vol. 29, 1923, Heating and Ventilating Chicago Schools, John Howatt.

demanded, etc. The total quantity of air to be circulated in an indirect heating system either mechanical or gravity type is demonstrated in the seven cases as follows:

- H = heat loss of room or building as determined by formulae and data given under Chapter I (B.t.u. per hour)
- M = weight of air passing into room per hour in pounds from the heating system
- M_r = weight of air recirculated per hour, pounds
- M_o = weight of air drawn into the system from the outside for the ventilation requirements per hour lb. and passed through the indirect radiation system
- M_b = weight of tempered air by-passed around the reheater per hour, pounds
- M_h = weight of air passed through heater or reheater per hour, pounds
- t = mean air temperature of the room of building
- t_o = mean outside air temperature
- t_1 = mean temperature of the air entering the heater
- t_2 = mean temperature of the air leaving the indirect radiator
- t_x = temperature loss assumed in the air duct system
- t_y = temperature of the air entering the room or building
- 0.24 = specific heat air of constant pressure. (B.t.u. required to raise 1 lb. of air 1 deg. fahr.)

The mean temperature t_2 of the air leaving the indirect radiator (blast heater, tempering coil, reheater, unit heater or gravity indirect radiator) should be learned from the makers, tables for the heater or indirect radiator or heater it is proposed to use.

Case 1—When all of the air passing through indirect heater is recirculated air:

$M_o = 0$; $M_h = M_r = M$; Temperature of air entering heater, $t_1 = t$; $M = \dfrac{H}{0.24\,(t_y - t)}$ ....(1)

Case 2—When all of the air passing through the indirect heater is drawn from the outside:

$M_r = 0$; $M_h = M = M_o$ Temperature of air entering heater, $t_1 = t_o$ $M = \dfrac{H}{0.24\,(t_y - t)}$ ....(2)

Case 3—When a portion of the air passing through the indirect heater is outside air and the remainder recirculated air:

$$M_h = M = M_r + M_o = \frac{H}{0.24\,(t_y - t)} \qquad (3)$$

In this case M_o is known from the ventilating requirements and the amount of air to be recirculated is ascertained by the following formula: $M_r = M - M_o$ or $M_r = \dfrac{H}{0.24\,(t_y - t)} - M_o$ ....(4)

The mean temperature of the air entering the indirect heater is ascertained by the following formula:

$$t_1 = \frac{M_o\,(t_o + 460) + M_r\,(t + 460)}{M_o + M_r} - 460 \qquad (5)$$

Case 4—When all of the air circulated is drawn from the outside and passed through a tempering coil, air washer or humidifier and reheater.

The temperature of the air t_1 entering the reheater will have the same dewpoint temperature as the air in the room or building to which the air is delivered, having temperature t and relative humidity as specified. If the relative humidity is not specified it shall be assumed as 35 per cent. If the room temperature is not specified it shall be assumed as 70 deg. fahr.

A relative humidity of 35 per cent for a room temperature of 70 deg. has been selected because this is the highest percentage of moisture which the air can hold without producing dripping on single-thickness windows in cold weather.

In this case: $M = M_o = M_h = \dfrac{H}{0.24\,(t_y - t)}$ ....(6)

If it is desired to maintain a room temperature of 70 deg. with 35 per cent relative humidity from an outside temperature of zero and with simply an air washer without