1. Fan system for supplying both heating and ventilation.
2. Fan system for supplying air for ventilation, with direct radiation for supplying heat.
3. Fan system for supplying air for ventilation and a portion of the heating, with direct radiation for supplying the remainder of the heating.
4. Fan system for supplying entire heating (no ventilation supplied).
5. Fan system for supplying ventilation only.

Typical installations of the first type of system will be found in churches, theatres, auditoriums and other places of assembly requiring a relatively large amount of ventilation and little heating. The second type of system is usually provided in hotels and office buildings where only certain rooms need ventilation. Experience has shown that the third type is economical for schools, manufacturing plants doing special work, hotels and other places where a properly controlled air volume is essential. The fourth type of system is especially adapted to industrial plants and shops to convey heat to the points desired and to create an effective air motion and uniform temperature with minimum heat loss. Unit heaters are an adaptation of this system. When the fan is required to do both heating and ventilating it is necessary to keep it in operation. Great success has been reported in school work with systems of this kind, particularly because of flexibility, easy temperature and humidity control, and economy of operation.[1] The fifth type of system is used in connection with the ventilation of kitchens, restaurants, dining rooms, some places of assemblage and in industrial plants where exhaust or fresh air dilution systems are employed for the removal of heat, vitiated air or other objectionable atmospheres.

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. 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 will either blow 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 on account of the advantage gained by connecting directly to the piping system. In this case the temperature of the air delivered will be the same for all parts of the building. The blow-through apparatus is used in public buildings, or wherever different air temperatures and independent air temperature regulation are required for different rooms of the building. The use of a 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, one from the heater, and one from the by-pass, join to form one duct leading to the room. In the case of public buildings, the

[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.

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.

Air supply systems may be distinguished as upward and downward systems; the former being sometimes used in such buildings as theatres and auditoriums where people are associated closely. Air is supplied near the floor and exhausted through grilles in or near the ceiling.

The downward plan is used in schoolrooms, hospitals, and other public buildings, air being introduced about 8 ft. above the floor and drawn out near the floor. This system is frequently used in theatres where the air is introduced downward from the ceiling and removed from under the seats. The selection of either system depends upon conditions confronting the engineer.

The amount of heat to be supplied is governed by the losses from transmission plus those from infiltration, with proper allowances for heat supplied by persons, lights, mechanical apparatus, or processes. Temperatures usually specified for various types of buildings are to be found in Table 1, Chapter I.

The amount of air to be supplied depends largely upon the type of service required, the amount of heat to be supplied or removed, the perfection of ventilation 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 set forth in the Fig. 1, Cases 1 to 6, page 383 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.)

Note 1.—The mean temperature (t_2) if the air leaving gravity indirect pin type cast-iron heaters may be taken from the data in Chapter II.

Note 2.—The mean temperature (t_2) of the air leaving all other types of indirect heaters including blast heaters, reheaters, tempering heaters and unit heaters should be taken from reliable published data of the manufacturer of the particular type of heater to be used.

Note 3.—The calculated amount of heat (H) in B.t.u. per hour to be supplied any type of indirect radiation by the boiler equipment may be ascertained by the following formula:

$$H = 0.24\ M_h\ (t_2 - t_1)$$

Note 4.—The amount of steam condensed per hour, per square foot, or per lineal foot of surface in a heater unit or battery, may be taken from manufacturers' tables for the