and allowing return mains to be run overhead. The individual motor power requirements per unit are usually less than for other types.

The Vertical Type, as is implied by its name, provides for the air to enter near the floor level and pass vertically through a bank of steam or hot water heating coils. Movement of the air is produced by a power driven fan, and a sheet metal distributing outlet at the top directs the distribution. While this type unit is quite frequently suspended from overhead structural supports, it is primarily designed to rest on the floor level, from which position the most effective results are obtained.

The fans are of the multi-blade centrifugal type and are capable of operating against a static pressure of 1 in. of water or more.

When placed on the floor level these units take the air in at the lowest point where the air is coldest and discharge the heated air at a distance of from 8 to 12 ft. above the floor. The discharged warm air is dissipated in the space to be heated and as it cools, falls to the lower level and is again taken in at the base of the unit and reheated. When so desired the units may be provided with a fresh air connection so that either all outside, all inside, or a combination of both may be used through the heater. This arrangement proves most satisfactory for producing a circulation of outside air in the summer time for ventilation purposes, particularly in large open industrial buildings such as; machine shops, textile mills, foundries, warehouses, garages, mills, railway shops, armories and gymnasiums.

CHAPTER XIX

DESIGN AND CONSTRUCTION OF AIR DUCTS

THE successful operation of a mechanical or plenum heating installation, an exhaust system or a dust collecting plant is largely dependent upon the correct design of the duct system. Materials, proportions, friction, location and innumerable other items are factors in the correct operation of a duct system.

In the design of ducts and flues for the mechanical circulation of air, or by gravity, losses due to friction are the basis for figuring and these losses must be kept within the available pressure difference. This pressure difference in mechanical ventilation is that derived from the fan while in gravity ventilation it is the asperating effect due to the temperature and height of the column of heated air.

When attempting the design of a duct system the general rules to remember are:

1. The air should be conveyed as directly as possible at reasonable velocities to obtain the result desired with greatest economy of power, material and space.
2. Sharp elbows and bends are to be avoided.
3. All ducts or flues shall have sides as nearly equal in size as possible. (In no case shall the ratio between long and short sides be greater than 10 to 1.)

The piping systems for various operations must be of different design as the principal consideration for industrial work is for heating while in public buildings the air required for ventilation greatly exceeds the volume needed for heating. For instance, the ducts for a school, theatre or other public buildings, where freedom from noise and elimination of drafts is essential and where branch ducts serve individual rooms, is a much different problem in design than that involved in proportioning ducts intended for heating a factory, where a main duct of decreasing dimensions extends lengthwise of the building and gives a uniform distribution of air. For public buildings air velocities must, therefore, be kept low between 900 and 1200 ft. per minute while in industrial buildings they can range from 1500 to 2000 ft. per minute or even more with no other disadvantage than the difference in operating expense.

Standard velocities of air in public buildings are as follows:

1. Through the outside air intakes 1,000 ft. per min.
2. Through connections to and from heater 1,000 to 1,200 ft. per min.
3. Through the main discharge duct from 900 to 1,200 ft. per min.
4. In branch ducts 700 to 900 and vertical flues 400 to 600 ft. per min.
5. In registers or grilles 200 to 400 ft. per min. depending upon the size and location.
6. If diffusers of proper design are used, 25 per cent higher air velocities may be permitted.

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