

2. The double-duct system furnishing warm air in one duct and tempered air in the other duct; the mixture to be secured near the room which is to be heated and ventilated.
3. The individual duct system with separate ducts to each room, providing mixture of warm and tempered air at the furnace casing.

The fan-furnace system utilizes automatic temperature and humidity controlling apparatus, air filters, air washers, ozone, etc., as well as does any other type of heating.

Automatic temperature control readily can be used on the trunk line system of ducts by volume control of the warm air at the supply openings, and on the double duct and individual duct systems by double-leaf mixing-damper control of the warm and tempered air. For mild climates the tempered air may be taken from the space under the furnaces; in which case the intermediate type thermostat is recommended. In colder climates the air may be tempered by conducting a portion of the warm-air supply from the plenum space over the heaters to the fan inlet, the duct connection having a damper controlled by a thermostat in the fan-outlet connection. Again, a tempered-air plenum chamber may be provided over the warm-air plenum chamber, arranged so that a double-leaf mixing damper regulates a mixture of air from the fan (by-passing the heater) and air from the warm-air plenum chamber controlled by a thermostat in the tempered-air plenum chamber.

For all plants a warm-air plenum chamber thermometer, of extension type, indicating the temperature of the air leaving the heater, is of great assistance for proper operation.

Humidifying pans connected to an outside water supply and regulated by a float-valve mechanism frequently are used for humidification. To accelerate vaporization, water coils, connected to humidifying pans, may extend inside the combustion chamber; but these must be proportioned carefully so as to prevent excessive generation of steam.

Automatic control of humidity can be secured by means of sprays or by air washers. When air washers are employed it is necessary to introduce a warm-air supply in front of the air washer or to use heated water to prevent freezing.

The use of air washers as heat transfer agents in conjunction with refrigeration installations is practical with this system for summer cooling, as with other mechanical ventilating plants. All styles of air filters not depending on water are well adapted to use with fan-furnace plants.

Wherever recirculation is used extensively, ozone may be applied with the utmost ease and facility.

FAN-FURNACE SYSTEMS FOR RESIDENCES AND OTHER SMALL BUILDINGS

The field of fan-furnace heating has been extended to include residences and other small buildings through the development of equipment which incorporates in single units all devices necessary for filtering, for humidifying, for temperature regulation, for forcing a positive delivery of the air. Some manufacturers enclose the heater, fan, filters and humidifier in a steel cabinet casing of neat appearance.

The most important advantages of the fan-furnace system for small buildings are as follows:

1. The registers may be placed in outside walls, or under windows; contrary to practice in fan gravity work.
2. The heater location need not be central, and its location may be determined by proximity to the chimney.
3. Pipes may be of small size and need not be given a slope to aid the flow.
4. Cold-air returns may be placed with a view to securing the most advantageous collection of return air without sacrificing efficiency.
5. Remote rooms may be heated satisfactorily because the system provides a positive delivery of conditioned air to each room.
6. All air may be filtered to remove dust.
7. The fan may be used for circulating air in the Summer.

Fan furnaces of this type are adaptable to either trunk line duct systems, or to central chambers or to individual pipe installations, the size and shape of the building being the governing factors. The supply of air to individual rooms may be made with small branches, 6-in. and 8-in. diameters being in common use. Risers and registers of commercial sizes in use in gravity warm-air heating practice are adequate. The general principles of proportioning ducts apply to this system as well as to other systems, but it has been found desirable to base the design on lower velocities than is the custom for larger buildings. The following velocities have been found satisfactory:

Over nominal area of registers.....	200-300 ft. per minute
Branches and stacks.....	400-600 ft. per minute
In main ducts of trunk system.....	500-800 ft. per minute
In returns.....	500-600 ft. per minute

On the basis of these velocities it has been possible to evaluate the air delivery, and hence the B.t.u. capacity of commercial pipes and fittings and, therefore, to simplify the design.

In order to secure a proper flow of air to the individual registers in a system having a central distributing chamber, orifices standardized and calibrated in terms of cubic feet may be used. In such a system the pipes may all be of one size, and balance or equalization of the flow may be fixed by the orifices.

Gas-Fired Fan-Furnace System

For gas fuel, high efficiencies have been obtained through the use of large areas of heating surface concentrated in banks of plate heaters through which the air is forced at high velocity. High operating efficiencies, further, are assured through the use of throttling gas valves, which, actuated by thermostats, proportion the consumption of fuel to the demand for heat, and thereby lessen the losses due to excessive flue temperatures and radiation. Units have been operated at efficiencies from 85 to 90 per cent.

When high efficiencies are attained in gas-fired units provision must be made for disposal of the condensation formed in the passages of the heater, and for protecting the surfaces from the corrosive action of the sulphurous or sulphuric acid formed. Further provision must be made