blow air through heaters rather than to draw through by suction and most fan furnaces are designed for this arrangement.

The fan-furnace system can be readily applied to each of the following standard duct systems or any combination thereof:

1. The straight fan blast trunk line system carrying heated air only for a series of rooms on any one run.

2. The double duct system furnishing warm air in one and tempered air in the other, the mixture to be secured near the room 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.

In general the fan blast duct design follows standards set forth in Chapter XXVIII (Air Duct Design and Construction). The use of fan-furnace system enables the same freedom of design in ducts as does any other blast method of heating.

The fan-furnace system can also utilize many of the well known devices which will greatly improve its operation. Several of these additions are as follows:

First.—Automatic temperature control.
Second.—Humidifying apparatus.
Third.—Use of air washer.
Fourth.—Humidity control.
Fifth.—Use of air filters.
Sixth.—Use of ozone.

Automatic temperature control can readily be used on the trunk line system of ducts, the double duct or the individual duct. See Chapter XVI for control of tempered air.

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

Humidifying pans connected to outside water supply and regulated by a float valve mechanism are frequently used for humidification. To accelerate vaporization, water coils, connected to humidifying pans, extend inside the combustion chamber, but must be carefully sized to prevent excessive steaming.

Automatic control of humidity can be secured by means of sprays or air washers controlled through humidistats. It is necessary to introduce a warm-air supply in front of the air washer or to use heated water to prevent freezing.

The further use of air washers in conjunction with refrigeration installations is practical with this system as in other blast plants. This is also true with all styles of air filters. See Chapter XXV (Air Conditioning and Cooling) and XXIX (Air Cleaners).

Wherever recirculation is used extensively, ozone may be applied. See Chapter XXX (Ozone in Ventilation).

FUEL

Coal, oil and gas fuels are commonly used with fan furnaces and there are many heaters particularly designed for the use of a particular fuel. Anthracite, semi-anthracite, semi-bituminous and bituminous coals are suitable when selected in the proper sizes. The fan-furnace system lends itself to the burning of buckwheat coal by using forced draft from fan

and grates with small air spaces. For burning small sized bituminous coal, a stoker or Dutch oven can easily be added. See Chapter VII (Mechanical Draft).

Where oil fuel is used in larger buildings using batteries of heaters, manually controlled mechanical atomizing oil burners are generally used. Care must be exercised in selecting the proper size oil burner and baffling arrangement to produce a clean fire. Burners are generally inserted in the ashpit door to secure greater combustion space. For smaller installations the automatic type of burner may be applied. With either type of burner it is desirable to supply fan motor with automatic starter governed by plenum room temperature and a time limit control for burner cut off in case of fan failure.

It is also advisable to install an electric oil preheater in connection with fan-furnace systems unless steam is available for warming the oil. This applies more particularly to those installations using heavier grades of fuel oil.

In connection with the burning of gas, good results have been obtained with a burner having a number of jets, or burning points, spread out in horizontal plane and approximating a coal fire on grates. Nozzle type burners inserted through the ashpit door with grates removed work satisfactorily if proper baffling is employed to secure a maximum impingement of the hot gases on the heating surface.

In any case it is important to have a damper in the smoke connection from each heater to the breeching for the purpose of adjusting the draft conditions to suit whatever gas burner is selected but in no case should such damper restrict the entire area of the smoke connection.

Another wise precaution is to provide ample air supply for combustion from outside the building to the firing space in front of the heaters, this would also dilute any accumulation of gas which might originate from leaks in pipe or valves.

As safety features, each installation of gas burners should be fitted with safety pilot lights and a temperature limit control in the warm-air plenum space in conjunction with an automatic snap valve. These last will function to shut off all gas to the burners in the event the pilot lights go out or in the event the temperature in the warm-air plenum exceeds any set point.

See Chapter XIV for further information on gas burning.

APPLICATIONS OF FAN FURNACE HEATING

The fan-furnace system is adapted to public and industrial buildings including schools, churches, theatres, auditoriums, convention halls, factories and garages. In each case the building plans largely determine which type of duct system can be most advantageously used. State laws, city ordinances, or the wishes of the owner dictate the percentage of outside air to be figured. Insofar as the design of the ducts is concerned, the engineer has only to follow his customary practice in ventilating work. That is to say, he can calculate the ducts either on the velocity basis or the pressure loss basis, using the same velocities, data, temperature ranges and methods he would in planning any other system of forced air circulation for heating and ventilation. (See Chapter XXVIII.)