of public buildings, the fan frequently blows the warm air into a plenum chamber, from which the air ducts radiate to the various rooms of the building; this arrangement is sometimes called the *plenum system.* (See Chapter 31).

DESIGN OF FAN STEAM HEATING SYSTEMS

The design of a fan steam heating system is in many respects similar to that for a fan furnace system, the procedure for which is described on p. 113, Chapter 7. As in all problems involving the layout of a heating system, the first step is to calculate the heat losses of the building in accordance with the procedure set forth in Chapter 5. If all or a part outside air is to be used, the heat required to warm this incoming air must be added to the heat losses of the building.

Ducts and Outlets

The design of the duct system should be based on data contained in Chapter 31, Ducts, Registers and Grilles. The total friction against which the fan must operate is the sum of the following items:

1. Friction in ducts and through registers.
2. Friction through heater as determined from manufacturers' data for heater used.
3. Friction through air washer, air filter, etc.
4. Friction through inlet connection including recirculating ducts, if any.

Fans and Motive Power

The selection of fan and motor should be based on data contained in Chapter 32. Centrifugal fans are generally used as they are well adapted for working against the frictional resistance of the system, and reach their maximum efficiency when working against the resistance offered by the average fan steam heating system.

Selection of Heating Surface

Heaters for fan steam systems in use at the present time consist either of 1 in. or 1¼ in. pipe coils (generally four rows of pipe in a single base or section), cast-iron heating sections, tubular heaters with or without extended surface and arranged for the air to blow over the outside surface of the tubes, and cellular type of radiators where the air passes through the tubes.

In selecting a heater for any particular service, the choice should be based on the desired requirements as follows:

1. Final temperature desired.
2. Loss in air pressure (or friction) through the heater.
3. Velocity through the heater.
4. Free area or face area of heater.
5. Ratio of heating surface to net free (or face) area.
6. Air volume required.
7. Rows deep of pipe, tubes or sections.
8. Amount of heating surface.

Final Temperature Desired. The choice of a heater is largely influenced by the final temperature desired, when entering the air temperature and steam pressure available at the heaters are specified. These data are obtainable from manufacturers' catalogs for various types of heaters.

Loss in Air Pressure (or Friction). The pressure loss through the heaters builds up very rapidly with increasing air velocities. This pressure loss will vary approximately as the square of the velocity through the heaters. The loss in air pressure (or friction) through the heater should not exceed a pre-determined maximum allowable amount for economical operation and for moderate size and first cost of installation.

The allowable friction through the heater is one of the first factors to be determined in the selection of the apparatus. The velocities of air through various types of heaters will not necessarily be the same, but for any particular job the velocity through the heater should be a secondary consideration and the allowable friction or air pressure loss should be fixed approximately before proceeding with the selection of the heater.

In public building work, the maximum allowable friction through both tempering coil and reheater coils should never exceed ⅝ in. of water and it is advisable that the friction be kept considerably lower than this figure if possible. A tempering coil friction ranging from 0.10 to 0.20 in. of water is considered satisfactory. The air pressure loss for reheaters ordinarily ranges from 0.20 to 0.40 in. of water. In factory work, the maximum friction through the heater should never exceed 0.8 in. or 1 in. of water and it is advisable to figure the heaters at lower frictions if possible.

Velocity through Heater. This velocity has generally been given in manufacturers' tables as being measured at 70 F and in most cases refers to the velocity through the net free area of the heater, or through the net space between the pipes, tubes or sections. Although most manufacturers give suitable velocities measured at 70 F, certain manufacturers show velocities measured at 65 F and others indicate velocities measured at the average air temperature through the heater. Many new heaters, however, specify net face areas with corresponding velocities, instead of velocities through net free areas. In either case, manufacturers publish the corresponding friction or air-pressure loss in tables.

Temperature Control

Control of the temperature can be accomplished in a simple manner by a single thermostat placed in a suitable position in the heated space and actuating steam valves on the heater sections. A popular method of controlling the temperature is by mixing dampers, permitting the by-passing of a certain amount of air around the heaters and mixing with the heated air before it is admitted to the areas to be heated. In the operation of such a plant it is important to have the heating coil under entirely separate control from the tempering coil. By *tempering coil* is meant the heater which receives the cold air and raises its temperature to above 32 F. This tempering coil should be either under hand control so that it is entirely *on* when the outside temperature is 35 F or less; or it should be under the control of a snap action thermostat set to come on at 35 F and to insure steam being on the coils at all times that the temperature is below this point. Any control for the heated areas involving steam regulation, should be accomplished by regulating the supply to the reheaters.