on the driving motor, or fan, may be changed to vary the speed of the fan thus altering the air volume. Dampers may be placed in the duct system to vary the volume. Variable speed pulleys or transmissions, such as fan belt change boxes or hydraulic couplings, may be used to vary the fan speed. Variable speed motors and variable fan inlet vanes may also be used to adjust the fan volume. All of these methods will give control. From a power consumption standpoint, a reduction of the fan speed is most efficient. Inlet vanes save some power and dampers save the least. From the standpoint of first cost, dampers usually are the lowest in cost. In some installations adjustments of volume are desirable at various times during the day or continuously. In others an increased supply of air in summer over that needed in winter is demanded. The demands of each case will dictate which type of control is most desirable. Where noise is a factor, lowering the fan speed if possible is preferred as a control means, because of the resulting reduction in sound level.

## MOTIVE POWER

Heating and ventilating fans are usually driven by electric motors, although they may be driven by gasoline or oil engines, steam engines or turbines. Fans may be direct-connected to the operating unit, but it is the usual practice to use belt driven fans for large units.

In selecting the size motor to be used, it is general practice to provide a rather liberal allowance over the actual fan power required when fan has a rising horsepower characteristic. Actual static pressures may vary from those estimated and if less than estimated, the fan may deliver more air than required and take more power. Justification for liberal power provision exists also in the possibility of varying demand, due to change in ventilation requirement, intensity of occupation and weather conditions. The degree of allowance may vary with fan types due to their inherent characteristics. The backward curved blade type fan requires maximum power at or near the peak of the efficiency, hence this fan would require less allowance in driving power than other types not having this characteristic. Reference to Fig. 5 indicates that there is no justification for allowing large spare motor capacity, and it is generally more economical to operate motors well loaded.

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CHAPTER 31

# Air Distribution

*Standards for Satisfactory Conditions, Definitions, Mechanics of Air Distribution, Types of Supply and Return Openings, Outlet Locations, Return and Exhaust Grilles, Specific Applications, Balancing the System*

CORRECT air distribution contributes as much or more to the success of a forced air heating, ventilating, cooling or air conditioning system as does any other single factor. The scope of the chapter is limited to the air distribution within the conditioned space. Reference is made to the distributing duct system only insofar as it affects the performance of the air distribution outlet. See Chapter 32 for information on air duct design.

## STANDARDS FOR SATISFACTORY CONDITIONS

The air distribution problem consists of distributing air as a cooling, heating, drying, moistening or ventilating medium in a designated space within accepted limits of air motion, temperature variation, temperature fluctuation, direction, humidity and noise. Reference should be made to Chapter 2, Physiological Principles, for the accepted standards on room temperature, humidity, air motion and direction. Material in Chapter 33, Sound Control, covers acceptable room noise levels and noise generated by air outlets.

Variations from accepted standard limits of each element may result in discomfort to the occupants. Neglecting noise, discomfort complaints usually arise from draftiness, or stuffiness. A draft may be defined as an air current which, due to its temperature, humidity, or motion, removes more heat from a body surface than is usually dissipated. Although stuffiness may be attributed to odors, the complaint of stuffiness usually results from a person feeling too warm. Outside of localized sensation, such as caused by a single down draft, draftiness and stuffiness may be considered functions of effective temperature, which of course takes in the factors of air temperature, motion and humidity. Draftiness can be associated with too low an effective temperature, and stuffiness with too high an effective temperature. Therefore, satisfactory comfort conditions are the result of minimizing the factors of temperature variation, temperature fluctuation, gusts, air motion and noise.