and the exhaust steam may be used in the heating apparatus. In selecting engine driven fans for drying processes, where a large quantity of exhaust steam is used in the heaters, a smaller fan and greater power consumption may be used, because power economy is not essential under this condition.

Where static pressure in a dryer varies, and where battery operation is required, the full backward curved fan is preferred. This type is well adapted for direct-connected motors of the higher speeds.

Fans for Dust Collecting and Conveying

The application of fans or exhausters for handling refuse, dust, and fumes generated by machine equipment is covered in Chapter 21. Information is given regarding the methods for determining air quantities, the velocity required for carrying various materials and the method of determining maintained resistance or total static pressure at which the fan is to operate. The selection of a proper size fan or exhauster is at times governed by the future requirements of the plant. In many instances, additional future capacity is anticipated and should be provided for.

Having determined the necessary volume of air and the maintained resistance or static pressure required, the proper size fan may be selected from the fan manufacturers' performance charts or capacity tables. The fan chosen should be the size that will provide the required ultimate quantities with the minimum power consumption.

FAN CONTROL

Some method of volume control of fans usually is desirable. This may be done by varying the peripheral velocity, or by interposing resistance, as by throttling-dampers. Both methods, since they reduce the volume of air, reduce the power required, except in the control of disc fans where an increase in resistance produces an increase in the power required. In many installations adjustments of volume are desirable during varying hours of the day. In others an increased supply of air in summer over that needed for winter is demanded. Experience is required in deciding whether speed-control or damper-control shall be used for specific cases. Where noise is a factor, it may be exceedingly desirable to reduce the speed at times, while on the other hand, any fan which has its normal speed reduced as much as 50 per cent without *change in resistance* will move only 50 per cent of the air.

DESIGNATION OF FANS

Facing the driving side of the fan, blower or blast wheel, if the proper direction of rotation is clockwise, the fan, blower or blast wheel will be designated as *clockwise*. If the proper direction of rotation is counter-clockwise, the designation will be *counter-clockwise*. (The driving side of a single inlet fan is considered to be the side opposite the inlet regardless of the actual location of the drive)[3].

This method of designation will apply to all centrifugal fans, single or double width, and single or double inlet. Do not use the word "hand," but specify "clockwise" or "counter-clockwise."

[3]Recommendations adopted by the *National Association of Fan Manufacturers.*

The discharge of a fan will be determined by the direction of the line of air discharge and its relation to the fan shaft, as follows:

Bottom Horizontal: If the line of air discharge is horizontal and below the shaft.
Top Horizontal: If the line of air discharge is horizontal and above the shaft.
Up Blast: If the line of air discharge is vertically up.
Down Blast: If the line of air discharge is vertically down.
All intermediate discharges will be indicated as angular discharge as follows:
Either top or bottom angular up discharge or top or bottom angular down discharge, the smallest angle made by the line of air discharge with the horizontal being specified.

In order to prevent misunderstandings, which cause delays and losses, the arrangements of fan drives adopted by the *National Association of Fan Manufacturers* and indicated in Fig. 5 are suggested.

Single inlet, single width fans should be selected wherever possible. If double width, double inlet fans are selected, care must be taken that both inlets have the same free area. If one inlet of a *forward curved blade* type of fan is obstructed more than the other, the fan will not operate properly, as one half of the wheel will deliver more air than the other half. The *backward curved* and *double curved* type with backward tip operate satisfactorily in double or in parallel operation.

MOTIVE POWER

It is no easy matter to predetermine the exact resistance to be encountered by a fan, or having determined this resistance, to insure that no changes in construction or operation shall ensue which may increase air resistance, thus requiring more fan speed and power to deliver the required volume, or which may reduce air resistance, thus causing delivery of more air and a consequent increase of power even at constant speed.

It is recommended, therefore, for centrifugal type fans that the rated power to be supplied shall exceed the rated fan power by a liberal margin, when *forward curved* types are used. When *backward* or *double curved* blade types are used, motors with ratings very close to that of the fan horsepower can be employed.

Justification for liberal power provision exists also in the possibility of varying demand due to changes in ventilation requirements, intensity of occupation, and weather conditions.

The motive power of fans should be determined in accordance with the Standard Test Code for Disc and Propeller Fans, Centrifugal Fans and Blowers, as adopted by the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS and the *National Association of Fan Manufacturers.*

Fans may be driven by electric motors, steam engines (either horizontal or vertical), gasoline or oil engines and turbines, but as previously stated the drive most commonly used is the electric motor.

ELECTRIC POWER

Electric power is almost the universal solution for fan operation, as electric motor speeds are flexible for adaptation to direct-connected fans. Electric motors are readily suited to various types of drives, such as belts, chains or gears.