done throughout the year and where air requirements change as the drying conditions change, the drying can be speeded up or reduced through control of the fan capacity. This may be done by changing the fan speed or by varying the outlet area with dampers.

Due to the low speeds of forward curved multiblade or paddle wheel type fans, these can be direct-connected to reciprocating steam engines 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 recommended. 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, fumes, etc., generated by machine equipment is covered in Chapter 31. Information is given regarding the methods for determining air quantities, velocity required for carrying various materials and 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. If the fan is to be pulley-driven, its selection is a simple matter. The fan chosen would be the size that will provide the required ultimate quantities with the minimum power consumption.

MOTIVE POWER

Motive power for fans should be determined in accordance with the Standard Code of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, TRANSACTIONS, Vol. 29, 1923; p. 442.

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, depending on the type of blade, of from 10 per cent minimum, to about 25 per cent maximum.

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

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. 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.

ELECTRIC MOTORS

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

Each type of electric motor and kind of electric current has its advantages and disadvantages as applied to a fan application.

Direct-connected electric motors usually are very efficient for fan driving because there is no slippage due to belts, and no wear or noise due to chains or gears. There is less maintenance and upkeep to a direct-connected unit, and with an overhung fan wheel on the motor shaft, the usual fan bearings are eliminated.

The disadvantage of a slow-speed direct-connected motor is that it may be unduly large and heavy as well as costly, but this may be offset by the compactness of the unit as a whole due to limited space for fan equipment.

Should anything go wrong with a slow-speed direct-connected motor there may be a considerable delay in securing replacements, as these motors are not usually carried in stock, as is the case with moderately high-speed motors.

If a change of speed is found necessary with a direct-connected motor, it will mean a change of motor, which may necessitate a change in the motor foundation usually built with the fan in such cases. On the other hand, non-direct-connected motors have transmissions subject to wear and slippage, and chains or gears may be noisy with this latter type. However, should a change in speed be necessary where the motor is not direct-connected, changes in speed ratio can easily be accomplished by changing pulleys, sprockets or gears on either the fan or the motor. In the case of a motor breakdown a standard stock motor may easily be substituted.

A type of drive using wedge-shaped rope-like belts, often in multiple, has become very popular recently as it enables the use of high speed motors with slow speed fans. These motors are less expensive and more efficient, and further allow very short belt centers, saving floor space, thus making the fan unit and the motor much more compact than the usual belt drive. The compactness secured by this equipment compares