

and efficiency. The illustrations in this chapter are essentially of this type.

For engineering calculations it is found convenient to use the ratio of opening as abscissae and to plot the manometric effects as ordinates. Fig. 1 shows typical curves. In addition to the pressure curves it is customary to plot ratio of horsepower and efficiencies.

Two of the curves are of immediate value to an observer. The SP/PVP curve is an index of speed characteristics. The higher the value, the

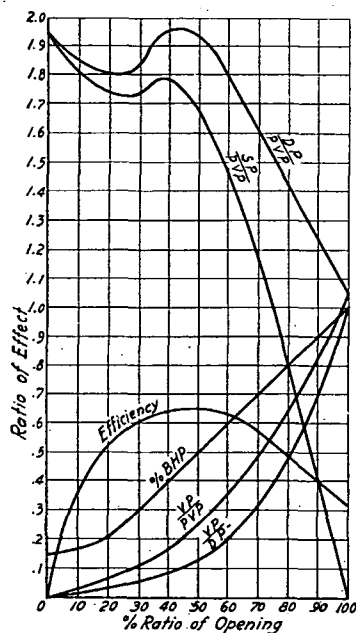


FIG. 1. TYPICAL CURVES SHOWING RELATION OF RATIO OF OPENING TO RATIO OF EFFECT

lower the required operating speed. The brake horsepower percentage curve is an index of variation of power requirement under varying ratios of openings. When the curve is flat, it is referred to as a *self-limiting power characteristic*. The efficiency has the same significance as it has on other mechanical appliances.

Disc and propeller fan characteristics are shown in Fig. 2. These fans, when properly designed, have a satisfactory efficiency at low resistance, comparing favorably in this respect with forward curved blade fans. They are low in cost and are economical in operation. Although this type of fan can operate against considerable resistance, the power increases rapidly and the noise often becomes objectionable, so that they do not always compare favorably with centrifugal fans for such service.

The curves (Fig. 2) show the rapid reduction in capacity and increase

in power as the resistance increases. The low efficiency when overcoming heavy resistance is due to the low speed of the blades near the hub as compared to the relatively high peripheral or tip speed. The air driven by the blade area near the rim can pass back through the less-effective blade area at the hub more easily than it can overcome the duct resistance.

The *straight blade (paddlewheel)* or partial backward curved blade type of fan is practically obsolete for ventilation. Its use is largely confined to such applications as conveyors for material, or for gases containing foreign material, fumes and vapors. The open construction and the few large flat blades of these wheels render them resistant to corrosion and prevent material from collecting on the blades. Fig. 3 shows the characteristic curves. This type of fan has a good efficiency, but the horsepower steadily increases as the static pressure falls off, which requires that the motor be selected with a moderate reserve in horsepower to take care of possible error in calculation of duct resistance.

The *forward curved multiblade fan* is the type most commonly used in heating and ventilating work, as it has a low peripheral speed, a large capacity and is quiet in operation. The point of maximum efficiency for this fan occurs near the point of maximum static pressure. The static pressure drops consistently from the point of maximum efficiency to full open operation. Fig. 4 shows that this type of fan will have a high and low delivery for a given static pressure at constant speed. The power curve rises continually from low to peak capacity, but if reasonable care is exercised in figuring resistance there is no danger of overloading the motor.

Multiblade fans with a forward angle at the heel and a slight backward angle at the tip of the blade have been used for some years in heating and ventilating work with entire satisfaction as to quiet operation. The speed is somewhat higher than that of the forward curved blade, but considerably lower than the regular backward curved types. (See Fig. 5).

The *radial tip blade type of fan* has an efficiency slightly higher than the forward curved blade type of fan. The horsepower curve indicates that a large reserve in horsepower of the motor is required as with the forward curved blade type of fan. Fig. 6 shows the characteristic curves of this type of fan.

The outstanding characteristics of the *full backward curve multiblade type fan* are the steep pressure curves, the non-overloading power curve, and the high speed. (See Fig. 7). This fan operates at a peripheral speed of approximately 250 per cent of the forward curve multiblade type for like results. The pressure curves begin to drop at very low capacity and continue to fall rapidly to full outlet opening. The steep pressure curves tend to produce constant capacity under changing pressures. Where wide fluctuations occur, the use of this type of fan is desirable to prevent overloading of motors. The maximum power requirement occurs at about the maximum efficiency. Consequently a motor selected to carry the load at this point will be of sufficient capacity to drive the fan over its full range of capacities at a given speed. The high speed of this type makes it adaptable for direct connected electric motor drives. The high speed necessitates heavier construction, and more operating attention and