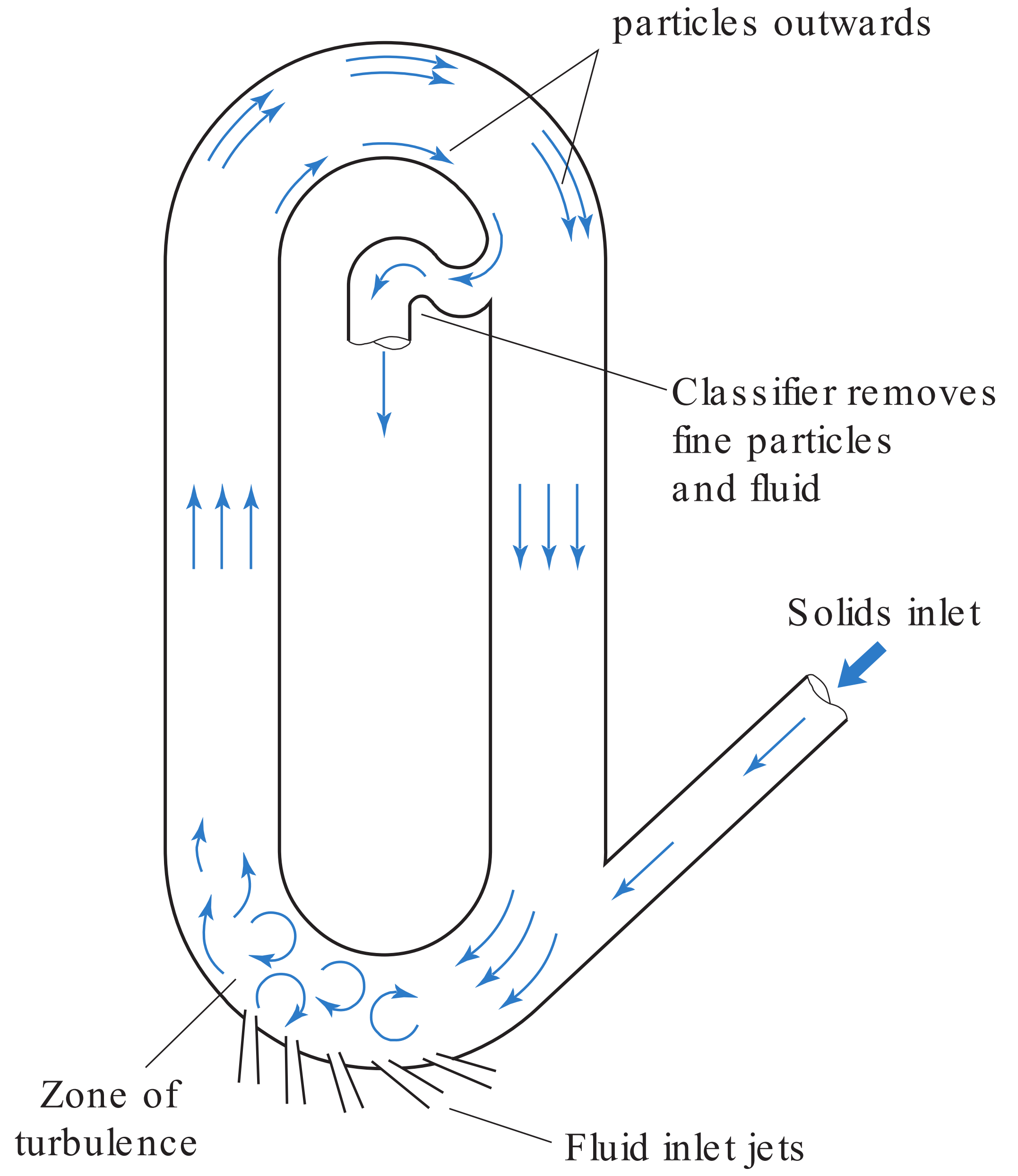

Fig. 10.14 • Fluid energy mill.

dynamic angle of repose is exceeded. At this point, they fall or roll back to the base of the drum in a cascade across the diameter of the mill. By this means, the most efficient size reduction occurs by impact of the particles with the balls and by attrition. The optimum rate of rotation is dependent on mill diameter but is usually of the order of 0.5 revolutions per second.

Fluid energy mill

Fluid energy milling is another form of size reduction method that acts by particle impaction and attrition. A form of fluid energy or jet mill or micronizer is shown in Figure 10.14. Both circular designs and oval-path designs (as shown in Fig. 10.14) are available. This circular design is now the most common. This consists of a hollow toroid which has a diameter of 20–200 mm. A fluid, usually air, is injected as a high-pressure jet through nozzles at the bottom of the loop. The high velocity of the air gives rise to zones of turbulence into which solid particles are fed. The high kinetic energy of the air causes the particles to impact with other particles and with the sides of the mill with sufficient momentum for fracture to occur. Turbulence ensures that the level of particle–particle collisions is high enough to produce

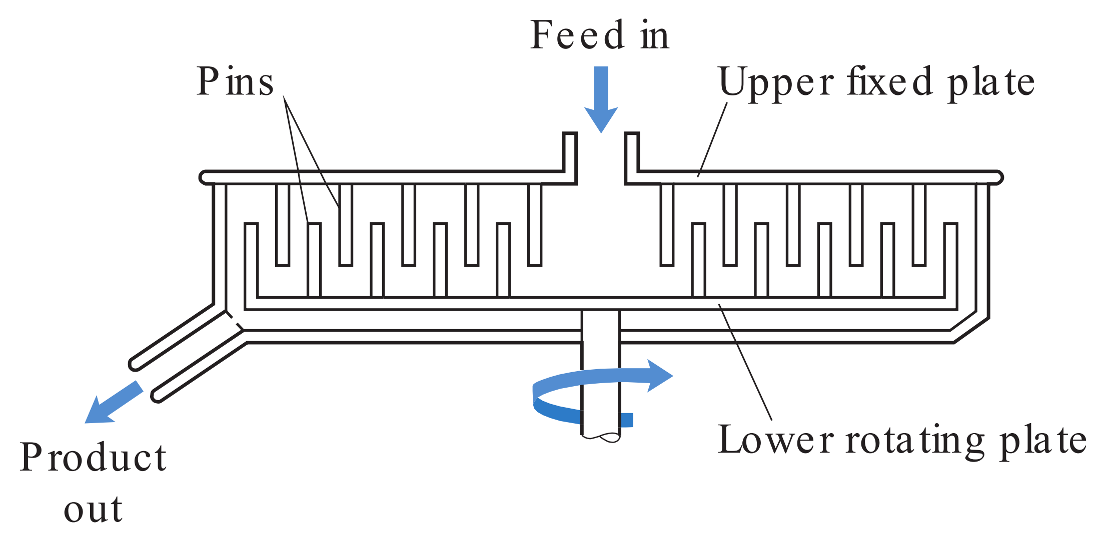

Fig. 10.15 • Pin mill.

substantial size reduction by impact and some attrition.

A particle size classifier is incorporated in the design so that particles are retained in the toroid until sufficiently fine and are then entrained in the air stream that exhausts from the mill

Pin mill

In addition to ball mills and fluid energy mills, there are other methods of comminution that act by producing particle impact and attrition. These include *pin mills* in which two discs with closely spaced pins rotate against one another at high speeds (Fig. 10.15). Particle size reduction occurs by impaction with the pins and by attrition between pins as the particles travel outwards under the influence of centrifugal force.

Selection of particle size reduction method

Different mills can produce differing end product from the same starting material. For example, particle shape may vary according to whether size reduction occurs as a result of impact or attrition. In addition, the proportion of fine particles in the product may vary, so that other properties of the powder will be altered.

The subsequent usage of a powder usually controls the degree of size reduction needed but in some cases the precise particle size required is not critical. In these circumstances, since the cost of size reduction increases as particle size decreases, it is economically undesirable to mill particles to a finer degree than is necessary. Once the particle size required has been established, the selection of mills capable of producing that size may be modified from knowledge of the particle properties, such as