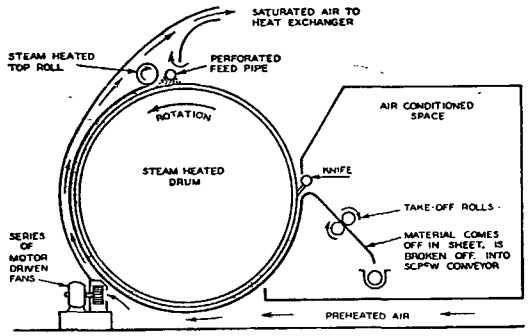

FIG. 11. DRUM DRYER[3]

classified as a convection dryer the principal source of heat is the heated air or other gases circulated in the dryer. There are a number of mechanical means of accomplishing this circulation of air or gases, each of which has some particular virtue. Brief descriptions of some important types of convection dryers follow:

Rotary Dryers. These dryers are cylindrical drums which cascade the material being dried through the air stream. (See Fig. 12). The driers may be heated directly or indirectly, and the air circulation may be parallel or counter-flow. A variation is the rotating louver type dryer, which introduces the air beneath the flights thus securing very intimate contact.

Cabinet and Compartment Dryers. These are generally considered batch dryers wherein each charge is dried to completion before removal.[8] A wide range includes types from the heated loft with only natural convection, and usually poor and non-uniform drying, to the self-contained units with forced draft and properly designed baffles which give positive results. It is also possible to evacuate some of the systems for low temperature drying of delicate or hygroscopic materials. These dryers are usually loaded with material spread in trays to increase the exposed surface. The trays are loaded directly into the dryer or may be stacked on trucks which are wheeled in. (See Fig. 13)

Tunnel Dryers. Tunnel dryers are a modification of the compartment dryer, and as a rule are continuous or semi-continuous in operation. Heated air or combustion gas is usually circulated by means of fans, although a few natural draft units are still in use. The material is handled on trays or racks on trucks, and moves through the dryer either intermittently or continuously. The air flow may be parallel, counter-flow or a combination of the two, obtained by center exhaust. Further, the air flow may be across the surface of the trays or up or down through the bed, or in any

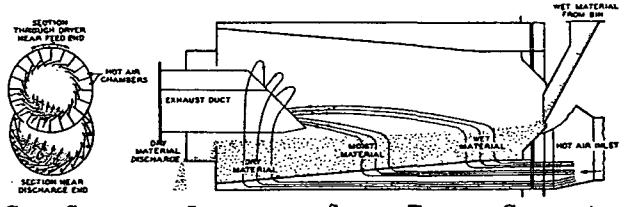

FIG. 12. CROSS SECTION AND LONGITUDINAL SECTION THROUGH CIRCULATION DRYER[8]

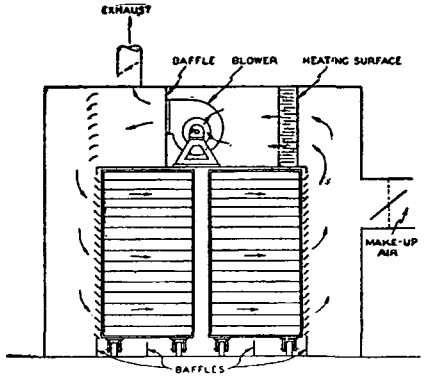

FIG. 13. COMPARTMENT DRYER, SHOWING TRUCKS, WITH AIR CIRCULATION[8]

combination of directions. By reheating the air in this type of dryer or recirculating it, a high degree of saturation is achieved before exhausting the air. This reduces the waste of sensible heat.

A variation of this type dryer is the strictly continuous type having one or more mesh belts which travel through the dryer carrying the product, such as Fig. 14. Innumerable combinations of temperature, humidity and air direction and velocity are possible. The labor requirement is low on such a dryer, as it can be loaded and unloaded mechanically. There is the disadvantage of hot air leaks at the entrance and exit, although these can be minimized by means of baffles or inclined ends where the material enters and leaves from the bottom.

Spray Dryers. In recent years the spray dryer has become important for the drying of liquids in many fields, especially in the food industry.

The liquid is atomized by means of pressure nozzles, air jets or centrifugal bowls into the air stream of a tower or chamber. Inlet air temperatures may run from 250–300 F up as high as 1200 F. Drying times are very short because of the minute particle size. Particles as small as 5 to 10 microns are formed in spray dryers. The dry powder is separated from the air by cyclone separators which are sometimes followed by cloth bags or scrubbing towers.

Because of the high inlet temperatures and the relatively large volume of air required, the efficiency of the spray dryer is not too good and, consequently, is seldom used for dilute solutions (less than 30 percent solid). Fig. 15 shows a typical arrangement for a spray drying system.[8]

A common and important feature of all spray processing is the direct conversion of the spray liquid to a granular product suitable for packaging

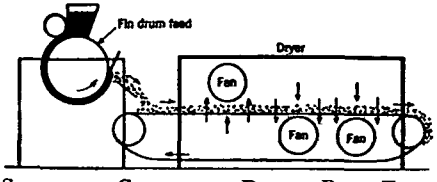

FIG. 14. SECTION OF CONTINUOUS DRYER, BLOW-THROUGH TYPE