

**CONTROL OF THE DRYING OPERATION****Circulation Control**

Circulating air or gas currents must have a sufficient velocity over the surface of the material being dried to transfer the heat required for evaporation, with the exception of that provided by conduction and radiation and at the same time to carry away the water evaporated. The volume needed for moisture removal will correspond roughly with the volume needed for heat transfer. A third requirement is that the velocity should be sufficient to carry away the film or layer of nearly saturated air that is apt to remain in close contact with the evaporating surface and whose high vapor pressure retard further evaporation. During the saturated surface drying stage, the drying rate will vary directly with the velocity of circulation over the material. When the stage of sub-surface drying is reached the velocity of circulation becomes of less importance, since the drying cannot proceed any faster than the moisture vapor can transfuse from the interior to the surface.

Circulation is expressed either by the rate of air flow over the material per minute, or by the number of air changes in the dryer per minute or per hour. The former is the logical method as it expresses positive drying power while the latter may be misleading because of possible short-circuiting of some of the circulating medium without coming in contact with the material.

Circulation by gravity, due to the rising tendency of heated air and the falling tendency of cooled air, is the only means of circulation in many of the older and simpler forms of dryers. In the more modern forms of high-speed dryers, mechanical circulation is produced either by blowers of the centrifugal type outside of the dryer, or by multiple fans of the propeller type inside the dryer, or by a combination of both. In addition, a certain amount of internal gravity circulation is sometimes provided in mechanical draft kilns where direct radiators are located within the dryer.

In some mechanical systems the general volume movement is taken care of by an external blower and the required high velocity over the surface of material is obtained from internal fans, placed to furnish a transverse and more or less local recirculation. A good example of this type of dryer is a tunnel dryer for light leather. The skins are hung on sticks which are carried through the dryer on a conveyor, the plane of the skins being at right angles to the axis of the dryer. In order to provide the velocity of 5 ft. per second over the surface of the skins necessary to complete the drying in a minimum time, a series of propeller fans, equipped with long blades, few in number, and rotating at slow speeds, are placed above the skins from end to end of the dryer blowing downward. (See Fig. 2).

Mechanical systems are best suited to rapid drying under close control and may be designed with automatic control instruments which will hold the temperature within 2 deg. Fahr. and the humidity within a 4 per cent relative humidity. Indirect heaters of high efficiency are usually placed in the blower ducts and the humidity is controlled either by steam jets, air washers, refrigerating coils, or cold water coils, supplemented by ventilation. In addition, provision is often made to recirculate part of

the outgoing moist air coming from the dryer in case a high humidity is desirable. In such dryers a higher thermal efficiency may be obtained by the use of interchangers, by which the saturated air coming from the washers is partially heated by absorption of heat through contact with the ducts containing warm, moist air, returning from the dryer.

Natural draught circulation has the advantage of simplicity and low cost of installation and operation and can be utilized to very good advantage for many kinds of drying. Such dryers are usually of the ventilated type in which a minor part of the moisture-laden air in the dryer is discharged by means of ventilating flues or chimneys and is replaced by fresh air coming in through special flues or through cracks and openings

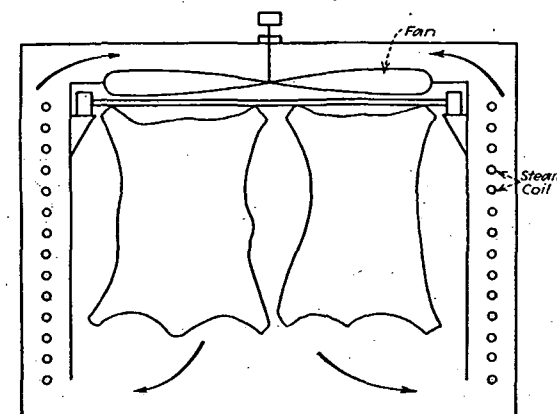


FIG. 2. SECTION THROUGH A TYPICAL LEATHER DRYER

around the doors. In some types, cold water coils or sprays are used to create a positive movement of air within the dryer. Convection currents, circulating from the radiators to the material and back again, provide the principal volume of circulation in dryers of the gravity type. Best results in securing a uniform circulation throughout the dryer are usually obtained by placing the radiators beneath the material at intervals, with baffles of various types arranged in such a way as to guide the air currents over and through the material.

**Heat and Humidity Control**

Steam is used as a source of heat and humidity in most modern dryers and lends itself readily to automatic control by means of thermostatically operated valves. Direct fired dryers are less easily controlled but are used for products which do not ordinarily require close control. For many types of dryers, hand operation of valves and the maintenance of a uniform steam pressure in the mains will give sufficiently close control, if checked by the periodic reading of temperatures within the dryer. In other cases such crude control would result in serious losses of material.