

Fig. 3. It will suffice here to note that heating is generally accomplished by passing the water through closed hot water heaters or by injecting steam into the water circuit; cooling, by passing the water through closed coolers or over refrigerating coils in a Baudelot chamber. Often in a cooling and dehumidifying application, the refrigerating coils are located within the washer chamber.

Washers are sometimes arranged in two or more stages to cool through long ranges or to increase the over-all efficiency of heat transfer between air and the cooling or heating medium (water, brine, etc.). A multi-stage washer is equivalent to a number of washers in series arrangement. Each stage is in effect a separate washer.

Usually the catalog capacity of a washer is expressed in cubic feet of air per minute and is based upon an air velocity of 500 feet per minute through the gross cross-sectional area of the unit above the water level in its tank. At this rating spray type washers handle about  $2\frac{1}{2}$  gpm of

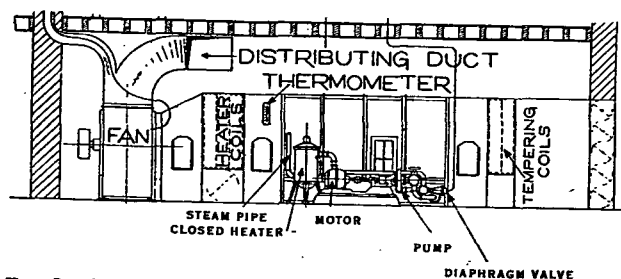


FIG. 3. AIR WASHER WITH SPRAY WATER HEATING ARRANGEMENT

water per bank per square foot of area, that is, about 5 gpm per bank per 1000 cfm. These proportions of air, water, area, and velocity may be departed from to meet the needs of some particular job, but certain limiting relationships should be observed. Two of the more important items are:

a. Choose a washer for air velocities above approximately 300 fpm and below approximately 600 fpm. Velocities outside this range are likely to result in faulty elimination of entrained moisture.

b. When a high saturating efficiency is required, select a two or three bank spray type unit, having a total water capacity of not less than 15 gpm per 1000 cfm.

For a single stage air washer, a 15 F drop in wet-bulb temperature of the air passing through the washer is about the maximum that should be anticipated. For greater decrease in wet-bulb temperature, multi-stage washers should be utilized. A rise of 6 F should be the calculated maximum for the spray water.

Brine has been utilized as a cooling medium in place of water in air washers to obtain low outlet temperatures impossible with water. However, proper elimination of brine spray carry over into the duct work is much more difficult than with water. A greater number of air deflections should be used in the eliminators, and the air velocity maintained at a minimum.

The area of a washer may be dictated by space limitations outside the

washer, such as headroom, or by space requirements inside washer, such as face area needed by a bank of cooling coils. The length of a washer is determined by the number of spray banks, or scrubber plates, and if cooling coils are installed in the unit, by the number of banks of coils. Roughly, a spray space of about 2 ft 6 in. in length is required for each bank of sprays, (the leaving eliminators require about 1 ft 6 in., entering eliminators about 1 ft).

The resistance to air flow through an air washer varies with the type of eliminators, number of banks of sprays, direction of spray, air velocity, type of scrubber plates, size and type of cooling coils if located in the washer. Manufacturers should be consulted to obtain the resistance for a particular installation.

### APPARATUS FOR DIRECT INDUSTRIAL HUMIDIFICATION

Apparatus for industrial air conditioning may be divided into two distinct groups, namely, (1) *humidifiers* for increasing the moisture content of the air and for producing cooling by evaporation and (2) *dehumidifiers* for removing moisture from the air and for producing cooling by contact with water or surfaces at a lower temperature than the air.

Strictly speaking, humidity control alone, whether it involves humidification or dehumidification, is not *air conditioning*. To be entitled to this classification according to the definition in Chapter 44, the process should include the *simultaneous control* of temperature, humidity and air motion.

Industrial humidifiers may be divided into the following general types, according to the method of operation: (1) *Direct*, which spray into the room; (2) *Indirect*, which introduce moistened air; and (3) *Combined* direct and indirect.

#### Spray Generation

Spray generation is obtained by (1) atomization, (2) impact, (3) hydraulic separation, and (4) mechanical separation.

*Atomization* involves the use of a compressed air jet to reduce the water particles to a fine spray. With the *impact* method, a jet of water under pressure impinges directly on the end of a small round wire. Where *hydraulic separation* is employed, a jet of water enters a cylindrical chamber and escapes through an axial port with a rapid rotation which causes it immediately to separate in a fine cone-shaped spray. In the *mechanical separation* process, water is thrown by centrifugal force from the surface of a rapidly revolving disc and separates into particles sufficiently small to be utilized in certain types of mechanical humidifiers.

#### Spray Distribution

Spray distribution is obtained by (1) air jet, (2) induction, and (3) fan propulsion.

The air jet which generates the spray in atomizers also carries the spray through a space sufficient for its distribution and evaporation, and this method of distribution is termed *air jet*. Where distribution is obtained by *induction*, the aspirating effect of an impact or centrifugal spray jet is utilized to induce a current of air to flow through a duct or casing, and