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.

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 eliminators, number of banks of sprays, direction of spray, type of scrubber plates, and, if cooling coils are located in unit, by their size and type. Washers should be selected to limit static resistances below 0.50 in.

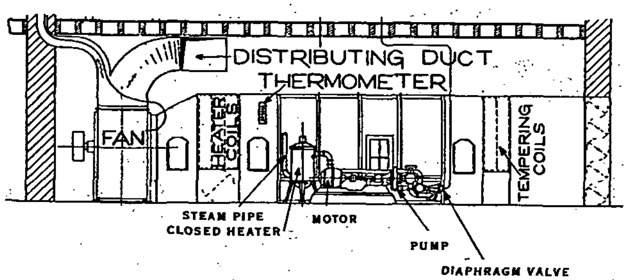

Fig. 3. Air Washer with Spray Water Heating Arrangement

Power Requirements

The approximate power requirement for passing 10,000 cfm of air through a humidifier of the spray type by a fan of 78 per cent mechanical efficiency is given in Table 1, this being the fan brake horsepower for various velocities and static pressure losses. Allowance should be made for variations in static pressure due to the use of different diffuser plates or inlet louvers and for variations in fan efficiencies.

ATMOSPHERIC WATER COOLING EQUIPMENT

To successfully operate a refrigerating plant or a condensing turbine, the heat from the compressed refrigerant or the discharged steam must be removed and dissipated. This is accomplished ordinarily by first transferring the heat of the gas to water in a heat exchanger. If the plant is situated on the banks of a river or lake, an intake may be had upstream or at a considerable distance from the discharge, to prevent mixing of the heated discharged water with the inlet water. If the source of water is a city supply or well water, the discharge water may be run into the nearest sewer or open waterway. Lacking an unlimited water supply, or in cases where city water is too expensive or where the water available contains

dissolved salts which would quickly form scales on the heat-exchanging apparatus, it is necessary to recirculate the water, and to cool it after each passage through the heat-exchanger by exposure to air in an atmospheric water cooling apparatus.

Air has a capacity for absorbing heat from water when the wet-bulb temperature of the air is lower than the temperature of the water with which it is in contact. The rapidity with which this transfer of heat occurs depends upon (1) the area of water in contact with the air, (2) the relative velocity of the air and water, and (3) the difference between the wet-bulb temperature of the air and the temperature of the water. Because the changes in rate do not occur in direct proportion to changes in the governing factors, data on the performance of atmospheric water cooling equipment are largely empirical.

Table 1. Approximate Fan Brake Horsepower

Requirements for passing 10,000 cfm of air through humidifiers at various velocities and static pressures. Mechanical efficiency of fan—78 per cent.

Velocity fpm	30 Deg Eliminators Spaced on 1-½ in. Centers		45 Deg Eliminators Spaced on 2-¼ in. Centers	
	Static Pressure In. Water	bhp	Static Pressure In. Water	bhp
500	0.20	0.40	0.40	0.80
550	0.24	0.48	0.48	0.97
600	0.29	0.58	0.58	1.15
650	0.34	0.68	0.68	1.35

As the heat content of the air increases, its wet-bulb temperature rises. (See Chapter 1.) Because it is impractical to leave the air in contact with water for a long enough time to permit the wet-bulb temperature of the air and the temperature of the water to reach equilibrium, atmospheric water cooling equipment aims to circulate only enough air to cool the water to the desired temperature with the least possible expenditure of power.

Cooling Towers

In an air washer, humidifier or dehumidifier, the air is first conditioned by water to change its moisture and temperature, and it is then sent to the place where it is to be used. In water cooling equipment the temperature of the water is reduced by air, and the cooled water is carried to its point of usage. In the air washer, an excess of water is used to condition a fixed quantity of air, while in water cooling equipment, an excess quantity of air is used to cool a fixed quantity of water.

Both types of equipment have a common basis of design, however, in that the size of the equipment is determined by the quantity of air that must be handled. With the air washer, the size of the equipment is fixed by the quantity of air to be conditioned, and the amount of conditioning is controlled by the quantity and temperature of the water supplied and its method of application. With water cooling apparatus, its size and the quantity of air required bear no direct relation to the quantity of water being cooled, but vary through a wide range for different services and conditions.