pumping unit. The spray-generating nozzle which is of the impact type is located in a cylindrical casing. A drainage pan provides for the collection and return of unevaporated water which flows through a return pipe to a filter tank, from which it is recirculated. A powerful air current is forced through the humidifier by means of a fan mounted above the unit.

The air enters from above, is drawn through the head, charged with moisture, and cooled. It then escapes from the opening below at a high velocity in a complete and nearly horizontal circle. The spray is evaporated and the resulting vapor diffused. This distribution of fine spray over the maximum possible area promotes complete and rapid vaporization.

Spray Humidifiers

This type of humidifier consists of an impact spray nozzle in a cylindrical casing with a drainage pan below it. The aspirating effect of the spray nozzle induces a moderate air current through the casing which distributes the entrained spray. The general method of circulating and returning the water is similar to that employed for high-duty humidifiers. A suitable pump and centrally-located filter tank are required.

Self-Contained Humidifiers

The self-contained or centrifugal humidifier has the ability to generate and distribute spray without the use of air compressors, pumps, or other auxiliaries. These may be used either singly or in groups. In large installations, where suitable connections are provided to permit the cleaning and servicing of individual units without affecting the room as a whole, group control of the water and power may be employed.

ATMOSPHERIC WATER COOLING EQUIPMENT

In the operation of a refrigerating plant or a condensing turbine, one of the main problems is the removal and dissipation of heat from the compressed refrigerant or the discharged steam. This is accomplished ordinarily by first transferring the heat of the gas to water in a heat exchanger, from which water it may then be dissipated in a number of ways. If the plant is situated on the banks of a river or lake, an intake may be taken up-stream or at a considerable distance from the discharge, to prevent mixing of the heated discharged water with the inlet water. If the source of cooling water is a city supply or a well, the discharge water may be run into the nearest sewer or open waterway. Lacking an unlimited water supply, or in cases where purchased water is too expensive or where the water available contains dissolved salts which would form scale 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. The rate of heat dissipation is influenced further by many small factors[2] prevailing upon these primary ones, and complicating the design. Selection of equipment for any specified service must ultimately rest in over-all economic considerations established from reliable performance data.

As the heat content of the air increases, its wet-bulb temperature rises. (See Chapter 3.) Because it is impracticable 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 expenditure of power.

In an air washer, humidifier or dehumidifier, the air is first conditioned by water to change its temperature and moisture content before entering the place of use. In water cooling equipment the temperature of the water is reduced by air at a lower wet-bulb temperature and the cooled water is used for the purpose desired.

Both types of equipment have a common basis of design in that the size of the equipment is determined by the quantity of air to be handled as well as the quantity of water required. In atmospheric water cooling the purpose is to cool water and the actual quantity of air handled is only incidental to this purpose. In the air washer, the purpose is to condition a fixed quantity of air and the quantity of water is varied as required.

Selection of Water Cooling Equipment

The proper size and type of water cooling equipment for a given installation cannot be determined accurately without considering the characteristics of all types, together with all requirement factors and other matters which influence the selection. Very few installations are exactly alike in details of requirements, and conditions governing performance and operation of the several types of water cooling equipment vary widely with geographical location as well as other considerations. It necessarily holds, therefore, that requirement factors and equipment characteristics are closely interlocked and deserve careful study as a related whole.

Before the characteristics of a specific water cooling apparatus can be judged desirable or undesirable the survey must conclude definitely the importance of each of the following items: first cost including all necessary auxiliaries, area, height, weight, effect of wind velocity and direction, drift nuisance, make-up water requirements and cost of chemical treatment if needed, total power for pumping (plus fan operation in the case of mechanical draft), maintenance, available locations (with due thought to possible future expansion, wind restrictions, space cost, proximity and accessibility, etc.), appearance, the equipment's operating flexibility for most economical conformance to varying loads or seasonal changes, and other considerations occurring with regard to a specific application.

Sizes of Equipment

Assuming a definite quantity of water, the size and design of atmospheric cooling equipment are affected by the following primary conditions:

1. Temperature range through which the water must be cooled.
2. Number of degrees above the wet-bulb temperature of the entering air to which the water temperature must be reduced.
3. Temperature of the atmospheric wet-bulb at which the required cooling must be performed.
4. Time of contact of the air with the water. (This involves height or length of the apparatus and velocity of air.)
5. Surface of water exposed to each unit quantity of air.
6. Relative velocity of air and water.