type to be controlled by a diaphragm valve actuated by the pressure of the atomizing air.

High-Duty Humidifiers

Water is supplied to high-duty humidifiers under high pressure (usually about 150 lb per square inch) through pipe lines from a centrally-located 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.

WATER-COOLING TOWERS

The removal and dissipation of heat from a compressed refrigerant or from exhaust steam are important factors in the efficient operation of a refrigerating plant or an electric steam-generating station. This heat removal is generally accomplished by first transferring the heat of the *gas* to cooling water in a heat exchanger. The water, if cheap or plentiful, may be wasted to the nearest sewer or open waterway such as a river or lake. Where water usage is restricted or expensive or where the available water contains dissolved salts which would form scale on the heat-exchange apparatus, it is necessary to recirculate the water, and to cool it, after each passage through the heat-exchanger, by contact with moving air in some type of water-cooling apparatus.

Water Use and Conservation

Many communities have found that present water systems are not sufficiently large to satisfy the increasing demands of domestic and industrial users. The reasons for such shortages are primarily: (a) inadequate purification and water-distribution systems, (b) inadequate sanitary and storm-sewer disposal systems, or (c) inadequate sources of water.

Even when an adequate supply of water is available from the water mains or private wells, many cities do not have sufficient sanitary or storm sewer facilities to handle increasing demands. The sanitary systems are usually limited because of the capacity of the filtration plants, and therefore many cities restrict the use of the sanitary system to sewage.

Rivers and Lakes

Until the year 1920, large generating stations were usually located on the banks of rivers, lakes, or artificial ponds. The removal and dissipation of the heat from the Diesel cylinder or the exhaust steam of a turbine was accomplished by taking in the circulating water at a considerable distance from the discharge, thus preventing mixing of the heated discharge with the inlet water. The use of water from streams for this purpose has the following disadvantages: the site may be far removed from the fuel source or from power consumers; water supply may limit plant expansion; municipal restrictions on use of water may hamper operation; costly intake structures with screens and sediment basins may be required; drastic flood or drouth conditions, the vagaries of most rivers, upstream pollution, scale-forming constituents, debris, sand, algae, and formation of troublesome ice may cause operating difficulties.

When lakes and cooling ponds have been used as a source of circulating water, the hot water is discharged close to the surface at the shore line. Natural air movement over the surface of the water causes evaporation over that area, thus carrying the heat away at a rate of about 4 Btu per (hr) (sq ft) (F deg. temp. difference between air and water). Increased density of the water due to loss of heat causes the cooled water to sink to the bottom of the pond. The suction connection is therefore located as far below the surface as possible and at as great a distance from the discharge as practicable. The area required by such cooling ponds is about 50 times that of a spray pond or about 1000 times that of a water-cooling tower to dissipate the same quantity of heat and achieve equal operating costs. If the surfaces of such ponds were below the level of surrounding terrain and the shore were wind-sheltered by trees or other vegetation, so that natural air movement across the surface of the water would be retarded, the use of a spray pond or water-cooling tower would be indicated.

SPRAY COOLING PONDS

The spray pond consists of a water collecting basin, above which spray nozzles are located in an arrangement such as shown in Fig. 4 to spray the water upwards into the air. Properly designed spray nozzles break the water into small drops, but not into a mist. Since the objective is to cool the pond water, the individual drops must be heavy enough to fall back into the pond and must not float away in the air. The water surface exposed to the air passing over the pond becomes the integrated area of all the small drops. The spray pond requires about one-fiftieth of the space required by the cooling pond to dissipate the same quantity of heat with equal results, due to four factors: (1) the speed with which the drops are propelled into the air and fall back into the water basin; (2) the increased wind velocity at a point above the surrounding obstruction; (3) the increased volume of air delivery due to the greater vertical cross section of air permissible; and (4) the vastly increased area of contact between water and air.[2]

Spray pond effectiveness is increased by: (1) elevating the nozzles to a higher point above the surface of the water in the basin, (2) increasing the spacing between nozzles of any one capacity, (3) using smaller capacity