

nozzles to decrease the concentration of water per unit area, and (4) using smaller nozzles and increasing the pressure to maintain the same concentration of water per unit area.

It is usual practice to locate the nozzles from 5 to 12 feet above the surface of the water (dependent also upon depth of water and curb level) with water supply at 5 to 7 psig pressure at the nozzles. Nozzles spray from 25 to 60 gpm each and the nozzles are spaced so that the average water delivered to the surface varies from 0.1 gpm (small ponds) to 0.4 gpm (large ponds) per square foot. See Table 2 for additional spray pond design data. Best results are obtained by placing the nozzles in a long, relatively narrow area, located broadside to the wind.

Louver fences to prevent the carrying of entrained water beyond the edge of a spray pond by the air on the leeward side are required for all roof locations and for ground locations where space is restricted; the outer nozzles should be located at least 20 ft from the edge of the basin. Such fences up to 12 ft in height usually are constructed of horizontal overlapping

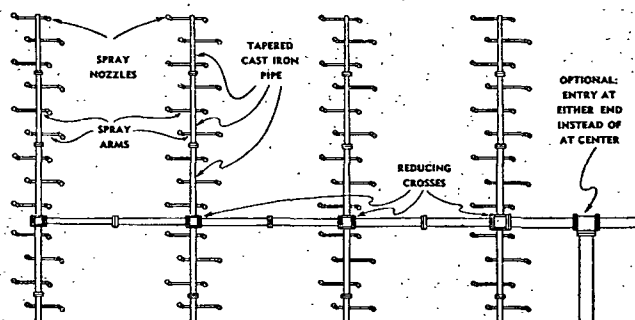


FIG. 4. TYPICAL NOZZLE ARRANGEMENT FOR A SPRAY POND

louvers supported between vertical posts. The air, in passing between these louvers, tends to be freed of the larger drops of water. The louvers also restrict the flow of air, particularly at the higher wind velocities, thus reducing the possibility of water being carried from the spray cloud. The height of an effective fence should be equal to the height of the spray cloud. Algae formations may be a nuisance in a spray pond. Such growths are minimized by the periodic addition of bromine, chlorine, chlorinated lime, copper sulfate, or various blends of chlorophenates (see Chapter 51).

The performance of a spray pond is limited because of space requirements and the probable high cost of piping and pumping. Water-cooling towers, however, allow the designer a wider range of performance within a given space because of the possibility of altering the smaller physical dimensions or varying the water concentration, measured in gallons per (minute) (square foot of tower area). In most cooling towers the water is broken up into drops many times whereas with the spray pond it is broken up only once and consequently in the latter the rate of cooling diminishes rapidly as the temperature of the surface of the drop approaches the wet-bulb temperature of the ambient air.

### ATMOSPHERIC COOLING TOWERS

*Spray-filled atmospheric cooling towers* are used for open-area installations because of their dependence upon the velocity and direction of the wind. Operation is not so limited as with spray ponds, but the design is generally based on a 3 mph wind and the performance falls off rapidly as the ambient air velocity decreases. These towers require less basin area, less piping, and no more mechanical equipment than spray ponds, but these savings may be largely offset by the extra cost of the structure. The drift nuisance is similar to that of spray ponds. The word *tower* used in this connection is a misnomer, as the design simulates a narrow spray pond with length twice the width, or more, having elevated nozzles and a high louver fence. As usually built, the nozzles spray downward from the top of the structure, and the distance from the center of the nozzle system to the louvers on either side is not more than half the distance that the nozzles are elevated

TABLE 2. SPRAY POND DESIGN DATA  
Conventional Up-Spray System

|                                               | UNITS | STANDARD | MINIMUM | MAXIMUM |
|-----------------------------------------------|-------|----------|---------|---------|
| Water Capacity per nozzle.....                | gpm   | 35 to 50 | 25      | 60      |
| Nozzles per 12 ft length of pipe.....         |       | 6        | 4       | 6       |
| Height of nozzles above water level.....      | ft    | 6        | 5       | 12      |
| Nozzle pressure.....                          | psig  | 6        | 5       | 7       |
| Size of nozzles and nozzle arms.....          | in.   | 2        | 1½      | 2       |
| Distance between spray lateral piping.....    | ft    | 25       | 13      | 38      |
| Distance nozzles from pond side unfenced..... | ft    | 25 to 35 | 20      | 50      |
| Distance nozzles from pond side fenced.....   | ft    | 15 to 20 | 15      | 25      |
| Height of louver fence.....                   | ft    | 12       | 12      | 12      |
| Depth pond basin.....                         | ft    | 4 to 5   | 2       | —       |
| Friction loss allowed per 100 ft pipe.....    | ft    | 1 to 3   | —       | —       |
| Design wind velocity.....                     | mph   | 5        | 3       | —       |

above the water-collecting basin. Heights range from 6 to 15 ft, with the total width of the structure usually not greater than the height. Loadings range from 0.6 to 1.5 gpm per sq ft of tower area, and hence require about one-fourth the area of an equivalent spray pond. As the louvers are wetted continuously they add to the surface of water exposed to the cooling air. The spray-filled atmospheric tower is shown in Fig. 5.

Much of the atmospheric water cooling for refrigeration work during the past 30 years has been done with natural-draft deck type towers, also referred to as *atmospheric deck towers*, see Fig. 6. These towers consist of a sturdy wooden or steel frame 20 to 50 ft high and 8 to 16 ft wide, carrying open horizontal wooden latticework or *decks* at regular intervals from top to bottom. The hot water is distributed over the upper part of the structure by means of troughs, splash heads, or nozzles, and drops from deck to deck enroute to the basin. The purpose of the decks is primarily to arrest the fall of the water, to break and re-break it into drops so as to present the most efficient cooling surface to the air, which is passing through the tower transversely to the decks. The wooden decks also add to the area of water surface exposed to the air, but since they offer resistance to the flow of air, the number and arrangement of the decks depend upon basic tests and operating experience.

To prevent loss of water on the leeward side of the tower, wide louvers