Greater care must also be taken to obtain the elimination of free water than with the humidifier, as an entrainment beyond the eliminator defeats the purpose of the equipment.

Dehumidifier systems usually are provided with two essential control elements; a dew-point control at the apparatus and a room control. The former maintains a uniform temperature of saturated air leaving the dehumidifier at all times of the year. In summer, in industrial work, this is so constructed as to use nearly all return air, thus reducing the refrigerating load required, while when the wet-bulb temperature outside is below the dew point required within the room the latter is controlled by the dew-point thermostat which brings about a mixture of fresh and return air as required. The room temperature is controlled independently at a definite point above the dew-point or saturation temperature either by a thermostat or by a hygrostat, depending upon whether the more important factor is the temperature or the relative humidity. Frequently the nature of the process is the governing factor in the selection of control. For example, if moisture is given off or taken up by the materials in the process of manufacture, and if the relative humidity is the more important factor, then the hygrostat would be used. The amount of infiltration, which affects both temperature and humidity, may also be the governing factor in the selection of control, and the instrument selected would depend on whether the control of temperature or humidity is the more important. The control operates either with volume dampers controlling the quantity of air introduced, or with valves or dampers which govern the heat output from local heaters such as radiators. Usually the control is a combination of both volume control and of air temperature control.

In installations for auditoriums and theaters the requirements are different from those in factories, since there must be a considerable volume of air circulated in order to provide ventilation and cooling. The moisture content of this air must be relatively constant, but its temperature must be variable. A satisfactory solution of this problem has proved difficult, but special systems of control are now in general use which permit the temperature and humidity of theaters to be controlled independently and at the same time, to be immediately responsive to changes in occupancy. Some of these arrangements are successful in operation without the use of any external heat whatever.

AIR WASHERS

Air washers clean the air by bringing it in contact with a large water area,

1. By passing it through a fine spray,
2. By passing it over wet surfaces, or
3. By passing it both through a spray and over wet surfaces.

By this air cleaning method the dust particles are wetted and discharged with the spray water or retained on the wet surfaces of the eliminator plates. After the air is washed it is freed from entrained water. In addition to air cleaning, the air washer has certain distinct advantages in air conditioning work. A well designed washer is effective in the maintenance of proper temperature and humidity conditions.

The moisture content of air usually is changed when it is passed through water sprays or over wet surfaces. Both the dry and wet-bulb temperatures of the air approach that of the water at which temperature the air tends to become saturated. The moisture content of the air may, therefore, be controlled by controlling the water temperature. By using water at a temperature below the dew-point temperature of the entering air, the washer becomes a dehumidifier; or by heating the water to a temperature above the dew-point of the entering air the humidity or moisture content of the air may be increased. By raising the dry-bulb temperature of the air after leaving the washer, its relative humidity may also be controlled.

Humidifying Efficiency

The humidifying efficiency of any air washer may be expressed as:

$$E = 1 - \frac{\text{Final wet-bulb depression}}{\text{Initial wet-bulb depression}}$$

For example, with an initial wet-bulb depression of 20 deg and a final wet-bulb depression of 5 deg, the humidifying efficiency is:

$$E = 1 - \frac{5 \text{ deg}}{20 \text{ deg}} = 0.75$$

The usual humidifying efficiency of a good air washer is 70 per cent. The humidifying efficiency of air washers of the commonly termed humidifier type should range from 95 to 98 per cent.

Control of Temperature and Humidity

Air washers require a method of control of temperature to prevent freezing by too low an initial temperature, and to prevent over-humidification by too high temperatures of the air coming in contact with the water. There are available one method of hand control and five methods of automatic or semi-automatic control. The method of hand control is by the use of tempering heaters, divided into two or more sections in series, the outer section being turned on by hand whenever the outside temperature approaches freezing and the successive sections being turned on as the temperature drops below freezing. Where two sections are available it is usual to turn on the second section when the outside temperature goes below zero, and to turn on the third section, where necessary at temperatures below zero. The first, or outside section, must always be turned on full in cold weather to prevent freezing of the heaters. The steam supply to the second, or inside section, may be hand-regulated at all temperatures higher than about 10 F.

The five systems of automatic regulation are:

1. The sections of the tempering heater are controlled both by variations in the outside temperature conditions and by an auxiliary control for one inside section from a thermostat located on the discharge side of the air washer. (It is not possible ordinarily to control the temperature of the air entering the washer, except where there is an unusually long tunnel or duct for the thorough mixture of the air leaving the tempering heaters before it comes in contact with the thermostat).