controls, must be added. With few exceptions, systems designed to meet summer capacity requirements will have ample capacity for winter and intermediate season conditioning.

A common arrangement of a central station spray type system for cooling and dehumidifying is illustrated in Fig. 1. The plant may be designed to condition 100 per cent outside air, 100 per cent return air, or a mixture of outside and return air. Further, part of the air returned from the conditioned space may be by-passed[1] around the conditioner as illustrated in Fig. 2. The reheater may be installed in the fan inlet chamber as shown, in the by-pass air duct, or in the fan discharge duct, depending upon apparatus space and other design conditions. Still another arrangement of equipment will result if the dehumidified air fan delivers the conditioned air to several other fans rather than to the con-

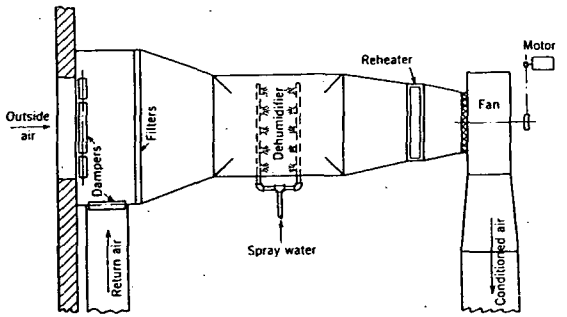

Fig. 1. Spray Type Air Conditioning Apparatus

ditioned space directly. These booster fan equipments may use part by-pass air as illustrated in Fig. 3 or 100 per cent dehumidified air and reheaters. The main apparatus, in either case, may or may not have a by-pass connection, depending on load conditions and other design factors.

The systems illustrated in Figs. 1 and 2 may be converted into the surface cooling type by merely replacing the dehumidifiers with surface cooling coils which use cold water or direct expansion of refrigerant to accomplish the required cooling and dehumidifying. The coils may also be installed within the spray chamber, either in series with the spray or below them.

DEHUMIDIFIERS

Information on spray type dehumidifiers is given in Chapter 11.

Surface cooling type dehumidifiers generally consist of extended-surface coils within which the water or refrigerant is circulated or the refrigerant is expanded. The air to be cooled and dehumidified is drawn or blown over the coils. This system is generally comparatively low in initial cost and has low operating costs. For comfort cooling, water is usually used to

[1]Patents exist covering the use of the by-pass for cooling and dehumidifying systems.

bring the refrigeration effect to the coils. Many localities have refrigeration codes which restrict the use, in comfort conditioning applications, of refrigerants acting by direct expansion in coils exposed to the air stream. Therefore, local codes should be consulted by the designer before he plans a system employing direct-expansion methods. Close humidity control cannot be maintained during the cooling season by the surface cooling type of equipment. Winter humidification may be accomplished by use of evaporating pans or spray nozzles. The cooling coils serve no purpose during the intermediate or heating seasons, so in this respect the spray type equipment is often preferred, in that during certain seasons evaporative cooling will be sufficient to produce the cooling desired. Effective cooling and dehumidification accomplished by surface units are dependent upon many variable factors. The air velocity through the unit, air

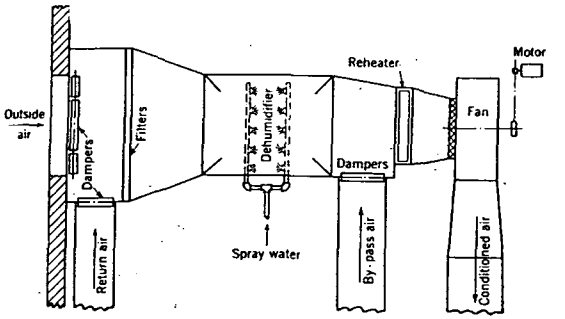

Fig. 2. Spray Type Air Conditioning Apparatus with By-Pass

temperature, moisture content of the air, water or refrigerant temperature, and velocity of the water or refrigerant through the tubes must be considered in selecting the proper unit for a given design load. If any of these factors vary without a corresponding variation of the other factors, the effective work of the coil will increase or decrease, as the case may be.

DESIGNING THE SYSTEM

The general procedure for the design of a central cooling and dehumidifying system is as follows:

1. Calculate the heat gain for each room or space to be conditioned. (See Chapters 5 and 8.)
2. Determine the volume of outside air to be introduced. (See Chapter 2.)
3. Assume or calculate the temperature of air leaving the supply outlets.
4. Calculate the quantity of air to be circulated.
5. Estimate the temperature loss in the duct system.
6. Calculate the heat to be removed by the cooling and dehumidifying apparatus.
7. Calculate the size of the reheating equipment.
8. Select cooling equipment and heating equipment from manufacturers' data and performance curves.
9. Calculate total tonnage.