a small percentage of time. Many items of equipment have been well standardized and are manufactured in certain definite sizes. The fullest advantage of this should be taken. One item that may be oversized of necessity may permit the use of a smaller piece elsewhere.

Fans operate at full capacity continually in many systems and therefore should be selected for good efficiencies. In winter where higher temperature differentials are used it is possible to use lower air quantities and a two-speed motor may be provided for the fan, resulting in a power saving. In such cases the air distribution under the reduced volume should be investigated before providing this feature.

In selection of the dehumidifier or conditioner the relation of this item to the refrigeration plant is to be given careful consideration. Frequently, it is possible to make a saving in the refrigeration plant by providing more surface in the dehumidifier or conditioner. On the other hand, an excess of capacity in the refrigeration plant can be used to lower the apparatus dew-point (if the lower room humidity is satisfactory) resulting in a reduced quantity of dehumidified air and smaller dehumidifier.

In winter, where preheating coils in outside air intakes are required and subjected to entering air temperatures below freezing, the coils should be selected for operation at full capacity whenever the entering air temperature is below 35 F or where throttling of the steam supply to the coils is desirable, a type of coil that is designed especially for this must be used. In many cases the use of preheaters is not justified since the temperature of the mixture of outside and return air may be entirely satisfactory.

Where reheating coils are used after the supply fan, either as zone control reheaters or boosters, and are relatively near outlets, care is to be used to install these coils so that any stratification of temperature produced by the throttling of the steam or water supply does not result in cold air being delivered to one outlet and warm air to another. Some types of coils that do not produce stratification under throttled conditions are commercially available.

The selection of the refrigerating plant is in itself an economic study. The availability, consumption, and costs of condenser water are to be compared to the initial costs involved and water savings produced by the use of cooling towers or evaporative condensers. Whether or not a direct expansion or flooded system, cold water or brine type of plant will be used is not only a matter of initial cost but one of overall performance, operating economy, compactness, and in some cases, one of safety. Where water or brine is used as a cooling medium, the possibilities of using lower temperatures and decreased quantities of water or brine, with resultant savings in pumping power and line sizes, are to be considered with relation to the increased power consumption and probable increased cost of the refrigeration machine.

Air cleaning devices are to be selected according to the particular requirements of the project as well as to existing atmospheric conditions. In some applications such as certain types of stores or departments in large stores, lint screens should be provided for the return air as well as filters. Whether or not return air is to be filtered will depend upon the individual case and will be related to the amount of dirt or dust generated in or brought into the conditioned space from various sources. The type

of filter or cleaning device to be used depends largely on economic considerations. Obviously an expensive high efficiency cleaning device is not warranted where atmospheric dust or dirt is of such a nature that a less expensive, less efficient device will remove the more objectionable matter. Interior cleaning costs, dust and dirt damage, and hazard due to an accumulation of inflammable dust or dirt within the system are most important factors.

Automatic instruments are nearly always used in present practice for the control of temperature and humidity and to an increasing extent in the control of large refrigerating plants as well as small ones. Whether electric or pneumatic controls are to be used is a function of the particular requirements of the application and with certain exceptions a function of economy. Either electrically or pneumatically operated controls can be made to serve the same purpose though the individual case may favor one or the other. A detailed discussion of automatic controls may be found in Chapter 34. One point is to be emphasized. In general, the simpler the control system the better it will perform. Control systems seldom receive the maintenance they deserve and the fewer the instruments and devices the better the care. Further, it is poor policy to provide, at additional expense, instruments of extreme sensitivity to devices incapable of responding to the control demands.

Insulation is an important factor in air conditioning systems. Its economics with regard to steam and water or brine piping are well known and need no comment. The insulation of duct work is not merely a matter of economics but sometimes is a necessity from the standpoint of limiting the temperature rise of the air even when the ducts are in conditioned spaces. This temperature rise of the air should always be taken into account when apportioning the air and sizing the ducts and will indicate the necessity for insulation. In some cases, leakage of air from the duct where the duct is in a furred space or chase will eliminate the need for insulation by maintaining a reasonable temperature surrounding the duct.

There are practically no items of equipment associated with central air conditioning systems that are not subject to economic limitations as well as those of performance and duty and all of them should be considered in the selection.

ARRANGEMENT OF EQUIPMENT

A proper arrangement of equipment is essential for the proper functioning of any system. Where systems are to be installed in existing buildings the arrangement of equipment may be limited by structural or space considerations, but no compromises that may prevent satisfactory operation or maintenance should be considered.

The location of the apparatus room is often determined by building construction or available space. The closer the apparatus room to the conditioned space, the less expensive is the duct-work. On the other hand if the equipment generates noises it may be necessary to locate the room some distance from the spaces or provide adequate sound and vibration treatment. The scattering of wet apparatus throughout a building is to be avoided unless suitable precautions are taken. It must