normally designed on the basis of this criterion. Drains may be omitted in hospitals except in special areas where excessive latent loads may exist. In the case of hotels and apartments, where high latent loads occur frequently condensate drains are required.

Insulation

Economics normally govern the thickness and quality of insulation. The following are offered as guides for apparatus, ductwork, and piping.

Apparatus. Normal practice is to insulate from the outdoor air intake up to the dehumidifier with 1 in. of insulation and from the dehumidifier to the fan with 2 in. of insulation. A good grade of insulation should be used and it should be vapor-sealed and plaster-coated.

Ductwork. When headers are installed in any non-conditioned space, they should be insulated and vapor-sealed.

Long headers, passing through a conditioned space, should be insulated to avoid excessive heat loss or gain.

Risers are normally furred with metal lath and plaster, gypsum block and plaster, or as required by local codes. No insulation is required, provided all openings in the floors are sealed to eliminate stack effect and retard air circulation within the furred space. The material used for sealing the floor openings must be fireproof. It is sometimes desirable to insulate the last sections of risers.

For *nonchangeover systems* the temperature difference between the air in the riser and in the chase may be considerable. Insulation requirements of the risers should be carefully analyzed. Excessive heat loss can materially affect the performance of the system.

Piping. All chilled water piping other than the secondary water supply and return risers and run-outs should be insulated and vapor-sealed. Most installations should be designed so that the secondary water temperature is not more than 3 F deg below the design room dew point. If this principle is followed, it is not necessary to insulate the supply and return riser group. However, the risers must be sealed from unconditioned spaces, such as basement and attic. If the 3 F deg limitation is exceeded, supply and return risers should have a minimum of ½ in. of insulation and be vapor-sealed, and run-outs to the induction units should also be insulated.

All insulation applied to the secondary water circuit should be checked for temperature resistance and life at both chilled and hot water temperatures.

Controls

The central apparatus of the air-water induction unit system provides each induction unit with primary air at a pre-

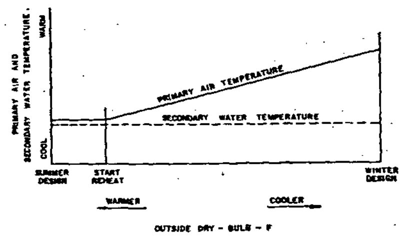

Fig. 27 .... Temperature Variations for Nonchangeover System

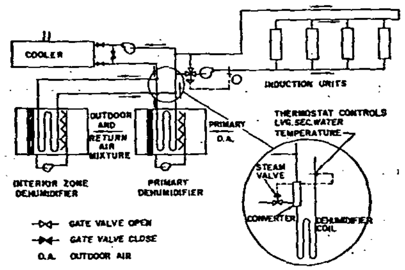

Fig. 28 .... Method of Intermediate Season Cooling

determined design temperature and dew point during the summer. As the weather becomes cooler, the primary air is reheated to a temperature which is keyed to the heat transmission component of the room load. Cooling capacity at the induction unit in this case is controlled by varying the secondary coil capacity. Fig. 27 illustrates the variation of the secondary water and primary air temperatures throughout the heating and cooling season for a typical nonchangeover system.

In a large building with multiple machines it may be expedient to run the refrigeration equipment to provide the secondary water cooling. But in most systems, this can be accomplished by circulating the secondary water through the primary air dehumidifier (and the interior zone dehumidifier if more capacity is required) where it is cooled by the primary air passing over the coil. Hence, the refrigeration machine can be shut off as soon as the dehumidifier capacity is adequate to provide the necessary cooling. Fig. 28 shows a typical arrangement.

Although the system can be operated throughout the heating season with warm primary air for heating and cold secondary water for cooling, installations may operate more economically if changed over. Fig. 29 illustrates variation of the

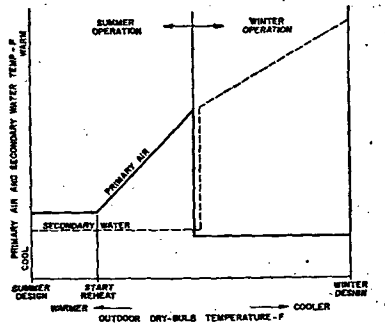

Fig. 29 .... Temperature Variations for Changeover System

secondary water and primary air temperatures throughout the heating and cooling season for a changeover system.

If the dehumidifier is used to provide cooling for the secondary water, the changeover process can be simplified. The refrigeration machine is turned off as soon as the outdoor temperature reaches the point at which the dehumidifier can provide the secondary water cooling required. The system, however, need not be changed over from summer to winter operation until the primary air temperature required to meet heating requirements becomes excessive. (Heat losses become a problem at the higher primary air temperatures. Hence they should be evaluated so that insulation can be added as required.)

Figs. 30 and 31 show control systems which can be used. The system operation is as represented in Figs. 27 and 29, respectively. Tables 5 and 6 outline the general function for *non-changeover* and *changeover* systems, respectively.

Two items that appear on Tables 5 and 6 should be emphasized.

1. A *non-changeover* system requires normally-open room unit controls for gravity or emergency heating.
2. *Changeover* and operation of refrigeration equipment are not necessarily related or coincidental on many systems.

Psychrometrics

The results that can be obtained with the air-and-water induction unit system can best be illustrated by an analysis of

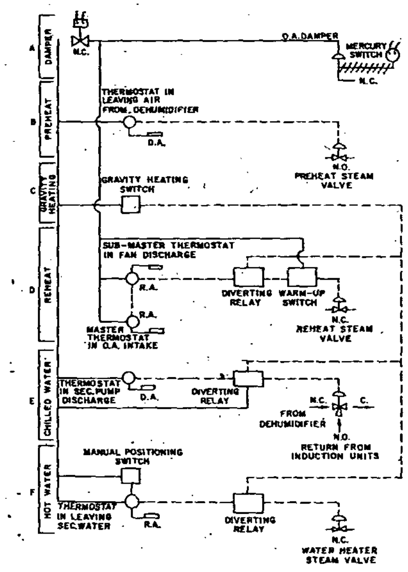

Fig. 30 .... Schematic Control Diagram for Nonchangeover System

the psychrometrics involved. Fig. 32 shows the peak and partial load psychrometric processes for a typical system. The letters *A*, *B*, *C*, etc. shown in the system schematic diagram correspond to the letters on the skeleton psychrometric charts on which these processes are shown, and reflect the condition of the air in the system.

Peak load. The psychrometrics of this process show that reheat is not required at design. As in the all-air induction unit the mixture of the induced room air and primary air results in a fairly high discharge temperature (see point I). Note that the allowance has been made for fan heat gain (3 F deg) and duct heat gain (4 F deg) to the supply air after it leaves the dehumidifying coil. Although these values will vary somewhat with system design, the variation is minor.

Partial load. The psychrometrics of this process show the conditions that can be maintained by the air-water induction unit system. Note that reheat is added to offset negative transmission on the basis of a 71 F room at no load, and control on the secondary coil capacity is imposed to keep the room from going above 75 F at full internal load.

Design Procedure

The procedure for designing an air-water system includes the following items:

1. Survey.
2. Preliminary layout.
3. Unit Selection:
   (*a*) Room load calculations, including cooling loads as well as heating loads for forced or gravity heating.
   (*b*) Preliminary selection of units.
   (*c*) Primary air requirements for ventilation and humidity.

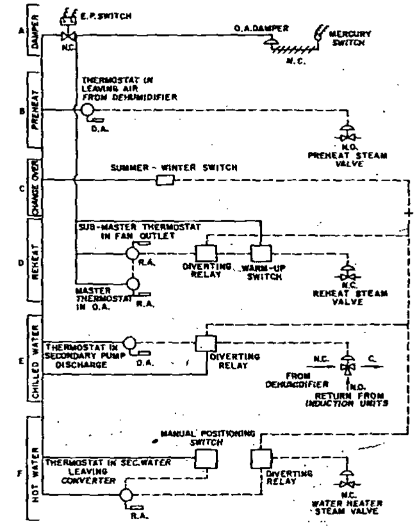

Fig. 31 .... Schematic Control Diagram for Changeover System