and increasing the temperature differential, often is feasible. A saving in fan power can thus be effected, provided the air distribution remains adequate.

Extremes should be avoided in all cases. For summer air conditioning, low supply-air temperatures result in larger heat gains to the air passing through the ducts, as well as in poor control. Too high a supply-air temperature may result in excessive initial and operating costs. Suggested limits for the temperature differential are from 12 to 25 deg, the actual selection being based on the requirements of the particular case. For winter air conditioning, too high supply-air temperatures result in excessive heat losses from the ducts and stratification within the room unless thorough mixing is assured, while too low supply-air temperatures may cause drafts, high operating costs, etc. Suggested limits are from 15 to 35 deg. There can be no set rule, and each case should be judged according to its particular requirements of the installation.

Reference may be made to Chapter 30 for further discussion of the most satisfactory design difference between the entering air temperature and volume in relation to the desired room condition.

UNITARY-CENTRAL SYSTEMS

Many different types of units have been developed for use in central systems where a high degree of zoning or individual room control is required, such as in hotels, hospitals and office buildings. These types of buildings are further characterized as usually having a larger perimeter relative to the floor area. The units usually are installed beneath the windows. Where the spaces to be conditioned extend a considerable distance from the outer wall into the interior of the building, such as might be found in office buildings, a separate system or zone for the conditioning of the interior portions may be required. In these cases the interior system handles the relatively small and steady loads, due to such items as lights and people; whereas the exterior system must cope with the relatively large and variable loads imposed by sunshine and temperature difference through walls and glass. Descriptions of four common unitary-central systems follow.

Induction Convectors—Low Pressure Type

Induction convectors located in the room that is to be served, utilize a jet of primary conditioned air to mix with a stream of secondary room air as shown in Fig. 4. The mixture is discharged into the room through a grille at the top of the convector. Heating coils are located in the secondary air stream. The output is controlled either by manually or automatically throttling the air jet. Heat may be supplied to the coil in summer as well as in winter. These induction convectors present several advantages. Since the secondary air stream is thoroughly mixed with the high velocity low temperature air stream before leaving the discharge outlet of the device, the resultant temperature of the mixture is satisfactory even though the primary air is introduced at a temperature too low for ordinary methods of distribution. One of these devices usually is provided under each window in place of the customary direct radiator, and combines the air distribution system with the heating system. An air conditioning system without induction convectors may require installation of direct radiation for maintenance of minimum temperatures during air conditioning shut-down periods, but when induction convectors are used they may be selected with heating coils of sufficient capacity to maintain, by thermal circulation, a reasonable temperature when the pri-

mary-air supply system is shut off. The use of low temperature, dehumidified air which has not been reheated or mixed with room air before delivery to the room, may permit a reduction in fan capacity and the use of smaller ducts. In some cases a bypass may be desirable in order to maintain the primary air volume and to provide additional control. This system can provide a degree of zoning that is usually difficult with conventional design since the air delivered by each unit can be controlled individually. Selection of induction convectors should be made with due regard to noise level. The inductive capacity of the device increases with the jet velocity, but high jet velocities may result in objectionable noise.

The units are supplied with primary air from one or more central stations with the primary air providing all ventilation and handling the entire cooling load. The central apparatus is arranged in general conformity to

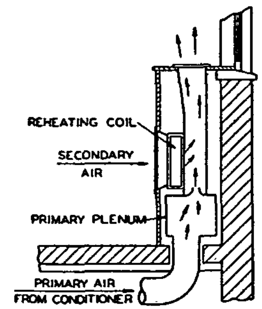

Fig. 4. Induction Unit (Low Pressure Type)

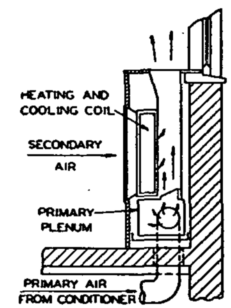

Fig. 5. Induction Unit (High Pressure Type)

Fig. 1 except that the central reheater is omitted since each unit has its own reheater. The controls are arranged to maintain a substantially constant supply air temperature equal to that required for maximum cooling. Final control is obtained by means of a room thermostat, or remote bulb thermostat in the unit having its measuring element in the recirculated air stream. The controlling thermostat operates the coil supply valve and a damper operator on the primary air damper in sequence. At maximum heating load the valve is wide open and the primary air quantity is at a minimum. As the space temperature tends to rise, the valve is first gradually closed, then the primary-air quantity is gradually increased from minimum to maximum. Alternately the primary-air quantity can be kept constant and all final control achieved by the individual heating coils. If variable air quantities are to be handled by the primary-air fan, some form of fan-capacity control is necessary.

Induction Convectors—High Pressure Type

Another type of induction convector, Fig. 5, employs nozzles which produce a high velocity air jet without objectionable noise. The term, high pressure, is to some extent inaccurate, since the air pressure at the nozzles, while several times that used with a low pressure induction convector, is still less than the total resistance pressure of a conventional central system. The high velocity jet of primary air induces a flow of air from the room through coils located in the secondary air stream and