Most summer and year 'round air conditioning systems should be so designed and arranged that a quantity of outside air at least equal to the quantity of cooled or dehumidified air can be taken in when desired. In the intermediate seasons and in the cooling season it is more economical to take all outside air into the dehumidifier when the outdoor air wet-bulb temperature is lower than the inside wet-bulb temperature to be maintained. Also, where using a spray type dehumidifier or air washer, whenever the outdoor wet-bulb temperature is below the apparatus dew-point temperature required, the system can be operated on an evaporative cooling basis, dispensing with the need for refrigeration though cooling may be required. Automatic controls are available for accomplishing this and on reasonably large systems are justifiable from an economic standpoint.

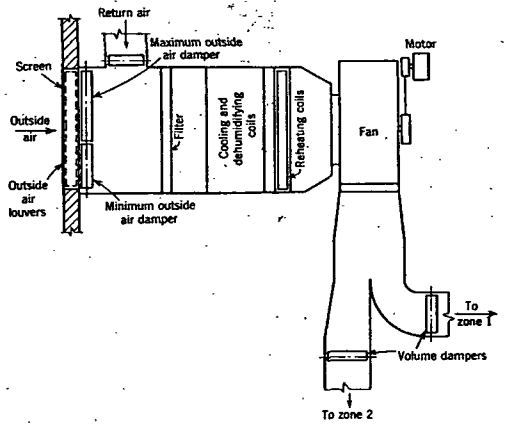

FIG. 8. CENTRAL SYSTEM WITH ZONING BY VOLUME CONTROL

Cooling Load

The method of determining the cooling load for a conditioned space or spaces is outlined in Chapter 7. As pointed out therein, many of the items of heat gain are variable and do not reach their maximum values simultaneously. Proper consideration of these *peaks* and the avoidance of pyramiding these peaks in the cooling load calculations is stressed. Maximum solar heat gain on an east exposure is seldom coincident with the maximum outdoor wet-bulb.

A large difference in the incidence of the peaks between various spaces or parts of the same space indicates the necessity for zoning. In a building having an east and west exposure where solar heat gain forms a fair share of the cooling load, the times of their individual peaks are apt to be hours apart, and the peak load of one plus the off peak load of the other will be substantially less than their combined peak loads. Proper zoning will permit taking full advantage of this condition or similar conditions of non-simultaneous peaks and will result in a lower total load, reflecting itself in savings in equipment.

A factor, similar in effect and closely related to the non-simultaneous occurrence of peak loads is *diversity*. Typical of this is the case of a large department store where the air handling equipment serving a certain space must be sufficient to handle the load created by the throngs of people attending sales in that space. Under such a condition the number of people in other spaces is usually normal or below. While this means that the air handling equipment for certain departments must be large enough to cope with the situation, the refrigeration equipment must be only large enough to handle the average maximum. If a system employing zone recirculating fans and a single central fan and dehumidifier were used, the saving would be reflected in the capacity of the central fan and dehumidifier. Another example of this diversity is found in an office building having restaurants and stores of certain types on the first floor

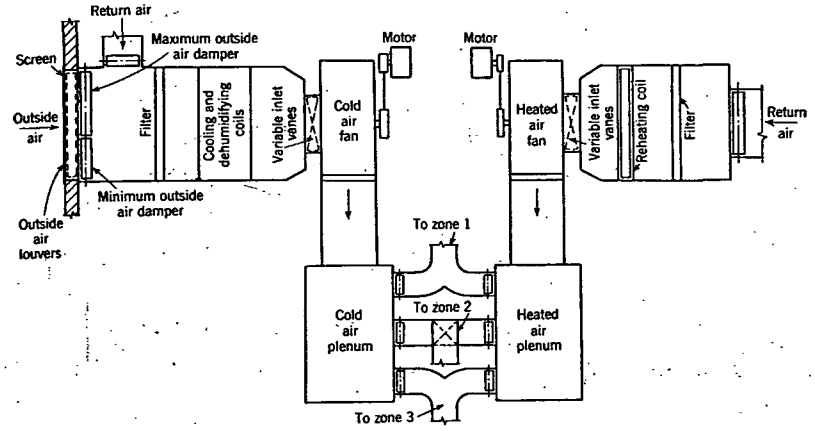

FIG. 9. CENTRAL SYSTEM USING DUAL DUCT METHOD OF ZONING

and basement. At noon, when the restaurants and stores are crowded, the offices are below normal occupancy.

Heat lag should be carefully considered in the cooling load calculations. In certain types of building construction the effect of solar radiation is still apparent hours after the sun has shifted from that exposure. In other types having a much lighter construction, the heat gain due to solar radiation decreases markedly with the passing of the sun. Some walls, having been warmed by the sun, may radiate heat long after the incidence of the sun, requiring lower inside temperatures to offset the radiant energy.

Storage effect is usually present in some degree. Often it can be utilized to great advantage and it has more than once provided an unknown safety factor. If a space is kept below the design inside temperature for a period of time, the interior walls, floors, furniture and fixtures begin to assume the temperature of the space. If the period of time is sufficient, the entire mass may reach the room temperature, rather than just the skin or surface of the item. If the space has been precooled below the design maximum