pressures exist in the two ducts, is prevented by the combined action of the space thermostat and volume controller.

Figs. 10 and 11 are substantially the same. In Fig. 10 the cold and warm air dampers have separate operators, while in Fig. 11 the second operator, through a system of linkage, changes the travel or opening of the valves. The thermostat thus controls the flow of warm air and a static pressure regulator compensates for changes in warm air supply by varying the cold air flow. When the static pressure regulator is used as a flow control as shown, the sensitivity required will depend on the permissible volume variations. To limit flow variations to ± 5 percent, the regulator and operator combinations must limit static pressure variations across the resistance plate to ± 10 percent. With a normal control resistance of 0.5 in. of water, the permissible static pressure variation is ± 0.05 in. of water. With constant volume units of Figs. 10 and 11, care should be exercised in basic design of the system and in operating practices not to reduce excessively warm air pressures at the inlet to the unit. If the warm air pressure becomes excessively low, the heating function of the unit will be impaired or entirely lost. Any terminal device may require introduction of air check valves at the inlets to the unit under the following conditions:

1. When air mixing valves are hand operated.
2. When thermostats are not properly located or selected for proper sensitivity.

These terminal units may be applied to any dual-duct system whether high, medium or low pressure. This deficiency in control arrangement could be eliminated by inserting a relay in the control circuit of the unit. The relay will allow the thermostat to override the action of static pressure regulator and to close the cold damper when and if pressure in the warm duct is reduced excessively during the heating cycle.

Central System Control

The control of the central system apparatus covered in this section deals primarily with control problems which are typical of a dual-duct system and which require special consideration when designing a system of this type. Basically, the control of the central system is simple, since it is required only to serve as a source of warm and of cold dehumidified air. There are refinements available for operating economies, ventilation, etc.

In summer, the cold air supply temperature should be kept low enough to meet the space cooling and dewpoint requirements. For summer operation, the warm air supply temperature is governed by the return air from the conditioned spaces. In intermediate seasons and winter, the cold air supply temperature may be raised or may be kept constant the year around. The warm air temperature for winter operation can be readjusted from outdoor temperature.

Humidity Control

During the cooling operation in most portions of the country, dehumidification is a major problem. This is usually accomplished by controlling the cold duct temperature at the desired dewpoint. In some dry areas, however, moisture may be added.

During the winter cycle it is often desirable to add moisture. The amount of moisture to be added or the relative humidity which can be maintained within the space must be considered from the standpoint of type and amount of glass, outside exposure, etc. During the winter, humidity is usually added in the warm duct and the control of this pan or grid type humidifier is effected by a controller sensing relative humidity in the return air.

To reduce humidities in summer and intermediate seasons, it is often possible to install a humidistat in the return air to increase the warm duct temperature and force the room unit to take more dehumidified air.

Minimum Outdoor Air Control

In systems having constant volume terminal units for all outlets, the fan capacity and static pressures on the fan itself

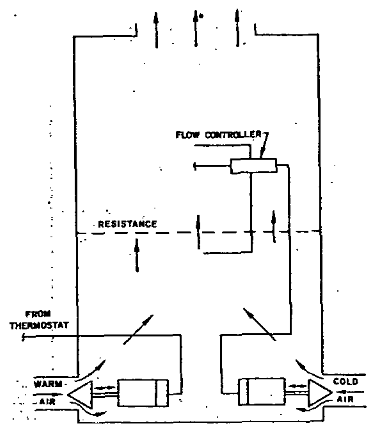

Fig. 10 .... Mixing and Volume Control Method Using Separate Controls for Warm and Cold Air Ducts

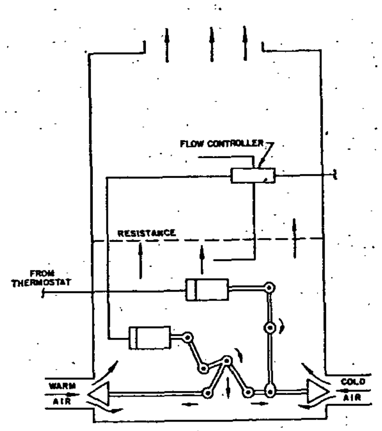

Fig. 11 .... Mixing and Volume Control Method Using Single Control for Warm and Cold Air Ducts

remain fairly constant and fixed minimum outside air dampers insure adequate ventilation. Where the static pressure on the fan suction is likely to vary, however, it is important that the minimum outdoor air quantity be controlled to maintain the ventilation needs. To do this, an instrument measuring the velocity pressure in the minimum outdoor air section or measuring the flow through the minimum outdoor air section by a pressure drop across the preheat coil can be used to operate inlet vanes on a return air fan or override the thermostat operating the return dampers to cause the proper amount of air to be drawn in through the minimum outdoor air connection.

Evaporative Cooling

When refrigeration is not required and outdoor air can be used for cooling, it is also possible to take advantage of city water sprays or recirculating pump sprays to produce evaporative cooling of as much as 8 to 12 F deg. The contamination of air in industrial areas makes recirculating sprays inadvisable for prolonged periods.

Control of the Distribution System

If room units without volume control are used, the system may be balanced manually for 100 percent flow in each duct. The pressures existing in the mains of a typical dual-duct system (Fig. 12) could then be represented by a gradient line 3-4-5-6 on Fig. 13. With 25 percent flow in either main the pressures would follow line 1–17 resulting in a serious flow unbalanced at some terminal units exposed to higher pressures.

If a static pressure sensing device is placed at point 5 of Fig. 12 controlling a throttling damper upstream at 9 the gradient line for 50 percent flow through such duct could be line 10-5-11, which would result in a decrease in air volume of approximately 20 percent on the unit at 10, and an increase of 60 percent at 11.

With 50 percent flow in each main and no volume control, the static pressure on the fan decreases and its total volume increases. Line 14-4-15 indicates the pressure variations of this condition and consequently the greater variations in air delivery for systems with fixed balancing dampers set for the one condition of maximum flow.

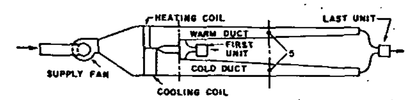

Fig. 12 .... Schematic Arrangement of Basic Dual-duct System

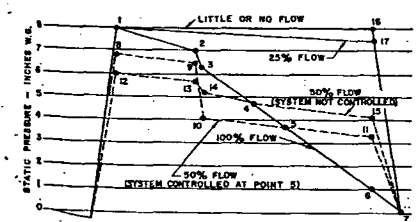

Fig. 13 .... Static Pressure Gradients for System of Fig. 12 (Uncontrolled or Controlled at One Point)

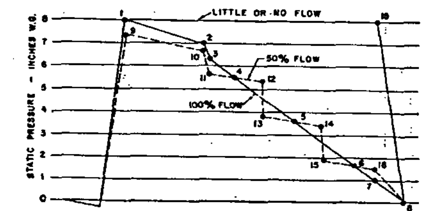

Fig. 14 .... Static Pressure Gradients for System of Fig. 12 (Controlled at 3 points in Series)

Theoretically, by installing several pressure controllers in series as shown on Fig. 14, the pressures in the duct system for 100 and 50 percent flow could be made practically constant. Due to noise regeneration in static pressure dampers and complexity this is an impractical arrangement. Individual terminal unit control is simpler and more direct.

Automatic Control for Dual-Duct Systems

The typical functions of automatic controls for dual-duct systems are shown in Fig. 15. The system is assumed to provide humidity control in winter and to include a preheat coil in the minimum outdoor air duct. When the supply fan is started, relay E-1, actuated by the fan motor starter, supplies compressed air to all controls.

Summer Operation. With summer-winter switch S-1 in summer position, cold duct thermostat T-1 controls chilled water valve V-3 to maintain the desired temperature in the cold deck.

Submaster warm duct thermostat T-2 is reset through cumulator C-1 by summer humidistat H-1 and controls steam or hot water valves V-4 and V-5. Summer humidistat H-1 adds heat to the warm duct only when and if low internal loads occur during humid weather and generally only if ventilation air volume is a large percentage of the total supply. During high summer load operation, control of temperature in the warm duct is not essential and the source of heat might be shut off.

Winter and Intermediate Season Operation. When refrigeration is not required, the summer-winter switch S-1 is placed in winter position allowing thermostat T-1 to modulate

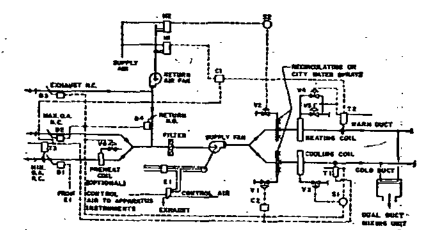

Fig. 15 .... Typical Automatic Control Diagram for Dual-duct System