Blank-off Baffles. Blank-off baffles are used for minor adjustments of the air flow from a diffuser. These baffles blank off a sector of the diffuser, and prevent the supply air from striking an obstruction such as a column or partition or the wall of the conditioned space.

Blank-off baffles should be used only if absolutely necessary. By blanking off the area of the diffuser, baffles reduce the area and increase velocity of supply air. This must be taken into account when selecting diffuser size.

Anti-smudge rings are round or square metal frames, attached to and extending 4 to 12 in. beyond the outer edge of the diffuser. Their purpose is to prevent, or at least alleviate, ceiling smudging.

Special Construction Features

Ceiling diffusers are made of steel or aluminum. A great variety of finishes, such as paint, enamel, lacquer, electroplated and anodized, and polished finishes are used in their manufacture. In general, the configuration of ceiling diffusers does not lend itself to satisfactory polishing operations.

Modifications for Ceiling Systems. Because of the large variety of ceiling suspension systems which have come into common use in the past few years, many modifications of square and rectangular diffusers are available which meet contemporary architectural concepts. When diffuser size does not conform to tile increments, filler panels are available which do conform to tile sizes. Special adaptations are available for snap-in T-bar, lay-on T-bar, splined, and radiant ceiling constructions.

RETURN AND EXHAUST AIR INTAKES

Return air intakes may be connected to a duct, or they may be simple vents which transfer air from one area to another. Exhaust air intakes remove air directly from a building and, therefore, are always connected to a duct. Whatever the arrangement, intake size and configuration determine velocity and pressure requirements for the required air flow. See section Return and Exhaust Intakes in Chapter 29, for further discussion of these factors and of the effect of the location of the intake on the system.

In general, the same type of equipment, *grilles and registers, slot diffusers* and *ceiling diffusers* which is used for supplying air, may be used for air return and exhaust. Intakes do not require the deflection, flow equalizing, and turning devices which are necessary for supply outlets. Dampers, however, are necessary when it is desirable to balance the air flow in the return duct system.

GRILLES AND REGISTERS

Adjustable bar grilles. The same grilles as used for air supply are used, particularly when it is desirable to match the deflection setting of the bars with that of the supply outlets.

Fixed bar grilles. The same grilles as described in section Grille Outlets are used. This grille type is the most common return air intake. Vanes are straight or set at a certain angle, the latter being preferred when appearance is important.

The so-called *V-Bar grille*, with bars in the shape of inverted vees stacked within the grille frame, has the advantage of being *sight-proof*. It can be viewed from any angle without detracting from its appearance. Door grilles are usually *V-Bar* grilles. The capacity of the grille decreases with increased *sight tightness*.

A *light-proof* grille is used to transfer air to or from darkrooms. The bars of this type of grille form a labyrinth, and are painted black. The bars may take the form of several sets of V-bars, or they may be of some special interlocking louver design to provide the required labyrinth.

Stamped grilles are also frequently used as return and exhaust intakes, particularly in rest rooms and utility areas. They are relatively inexpensive.

Ceiling and Slot Diffusers. Ceiling and slot diffusers may also be used as return and exhaust intakes, although their cost frequently prevents such application. See manufacturers' catalogs for performance data.

Applications

Return and exhaust intakes may be mounted in practically any location: in ceilings, high or low in side walls, in floors and in doors. See section Return and Exhaust Intakes in Chapter 29 for their selection and location.

Accessory Devices

Dampers. The dampers shown in Fig. 1 are used in connection with grille and register return and exhaust intakes. The damper type does not affect the performance of the intake. No other accessory devices are required.

EQUIPMENT FOR ALL-AIR HIGH-PRESSURE SYSTEMS

In all-air high-velocity, high-pressure air distribution systems the duct velocities and static pressures are such that special control and acoustic equipment is required for proper introduction of the conditioned air into the space to be served. This chapter deals with control equipment for single-duct and dual-duct air-conditioning systems; refer to Chapter 31, Air Duct Design, for design of high-velocity ducts, and duct construction details. Relevant material on sound control in air-conditioning systems, and sound rating methods for air outlets, will be found in Chapter 14, Sound Control.

TYPES OF EQUIPMENT

Control equipment for all-air high-pressure systems may be classified as follows: (1) pressure reducing valves; (2) single-duct terminal units; (3) dual-duct terminal units; and (4) high-capacity dual-duct units. They provide all or some of these functions: *pressure reduction, volume control, temperature modulation, air mixing, and sound attenuation.*

Pressure-Reducing Valves

Pressure-reducing or air valves consist of a series of gang-operated vane sections mounted within a rigid casing, and gasketed to reduce air leakage between valve and duct as much as possible. They are usually installed in rectangular ducts between a high-pressure trunk duct and a low-pressure branch duct for manual, remote manual, pneumatic, or electric control. The simplest arrangement uses a pressure-reducing valve behind each sidewall diffuser.

Pressure reduction is effected by partial closing of the valve, and results in high-pressure drop through the valve. This action generates noise, which must be attenuated in the low-pressure discharge duct. The length of duct lining depends upon the amount of noise to be attenuated, and the frequency of the noise source which determine the efficiency of a given length of sound lining.

Volume control is obtained by adjustment of the valve either manually or by a pneumatic or electric control motor actuated by a static pressure regulator or a thermostat.

Pressure-reducing valves are generally equal in size to the low-pressure branch duct connected to the valve discharge. This arrangement provides minimum pressure drop with valves fully opened. Also, with valves fully closed, there is little air leakage, even with high inlet static pressures.

Single-Duct Terminal Units

The term *high-pressure unit* commonly implies a unit with integrated sound chamber to reduce the noise generated in the unit. The single-duct terminal unit generally consists of a pressure-velocity reducing air valve and a sound attenuation chamber lined with heat and sound insulating material, and equipped with baffles for sound reduction. Special sound attenuation in the air discharge ducts is generally not required with units of this type. The pressure-velocity reducing air valve or dampering device of these units can be adjusted either manually or by means of a pneumatic or electric motor, actuated by a thermostat or volume regulator, depending upon the desired function of the unit. Well-designed valves or dampers should close tightly with less than 2 percent leakage of the design volume of the unit at static pressures up to 8 in. wg. The minimum static pressure of the unit, with the damper or valve wide open, should be less than 1 in. wg at rated unit volume. The unit casing should be nearly airtight for unit static pressures up to 1 in. wg.

Air may be discharged through a single rectangular opening suitable for low-pressure rigid branch duct connection, or through a supply outlet connected directly to the unit. Several outlets may be connected to the unit by means of flexible ducts.

Dual-Duct Terminal Units

The construction of this type of unit is essentially the same as that of the single-duct high-pressure unit, but these units have two pressure-velocity reducing air valves. The units under control of the room thermostat draw warm and cold air from warm- and cold-air supply ducts in accordance with the room requirements to obtain individual room control without zoning.

When individual modulating dampers are used to regulate the amount of warm and cold air, it is common practice to vary the size of the damper opening to effect both pressure reduction and volume control with the same damper. When a single modulating damper is used to regulate the amount of both warm and cold air, a pressure-reducing damper is needed in the unit to reduce pressure and limit air flow. Well-designed modulating dampers should close tightly to limit leakage through the closed duct to less than 2 percent of the unit volume at static pressures up to 8 in. wg. The unit casing should be nearly airtight for unit static pressures up to 1.0 in. wg. Rapid mixing of warm and cold air in the unit is achieved by suitable construction of air baffle arrangement. A mixed-air discharge with less than 1 F deg stratification for each 10 F deg inlet temperature difference between the air streams in the two ducts is desirable.

Noise generated in the units is generally attenuated by the sound absorption material and the sound baffles within the unit itself. Special sound treatment of the low-pressure discharge duct should not generally be necessary. Air may be discharged through a single rectangular opening suitable for low-pressure rigid branch duct connection, or through a supply outlet connected directly to the unit. Several outlets may be connected to the unit by means of flexible ducts.

Constant Volume Control

The use of terminal units incorporating a means of maintaining constant volume flow is increasing. The constant volume function may be obtained by means of a *mechanical volume control* device contained within the unit which is actuated by static pressure in the primary duct system without an outside source of power, or by a *pneumatic volume regulator* and selector devices which are actuated by outside pneumatic pressure and an internal calibration pressure drop.

Static Pressure Control

To prevent *static pressure unbalance* in single-duct and dual-duct high-pressure systems, some control of static pressure is necessary in systems operating with variable air flow.

In single-duct systems, variations in static pressure can be limited by: (1) static-pressure controllers, operating dampers in the air-distribution system, (2) static-pressure controllers, operating inlet vane dampers on the fan, and (3) by zoning and changing air supply temperature in response to static-pressure changes.

In dual-duct systems, the following methods of controlling static pressure are used: (1) by dampers operated by static-pressure regulators located at critical points in the air distribution system, (2) by static-pressure controllers, regulating warm and cold air temperatures in order to limit the variations in the air flow in individual ducts, and (3) by constant-volume regulators in each individual air-mixing valve or acoustic terminal device.

High-Capacity Dual-Duct Units

In high-capacity dual-duct units, the functions of pressure reduction, volume control, temperature modulation, air mixing, and sound control are achieved in connection with the use of a lined low-pressure duct. High-capacity units have large pressure-velocity reducing air valves for warm and cold air operated by pneumatic or electric control motors. When a single modulating damper is used on both ducts, an additional control valve for pressure reduction and constant volume control is required; individual modulating dampers on both ducts effect temperature modulation, pressure reduction and constant volume control. Well-designed dampers should be capable of minimizing leakage in the closed duct; the unit casing should be essentially leak-proof.

Air mixing is generally started in the high-capacity unit, but the mixing action continues in the low-pressure distribution duct for a distance of 5 to 15 ft before the first outlet. A mixed-air discharge with less than 1 F deg stratification for each 10 F deg inlet temperature difference between the air streams in the two ducts is desirable.

Sound attenuation is provided by insulating the low-pressure duct connected to the discharge end of the high-capacity unit on the inside. The length of duct lining depends upon the amount of noise to be attenuated, and the frequency of the noise source which determine the efficiency of a given length of sound lining. The duct lining attenuates the noise generated in the high-capacity unit, which generally feeds two or more supply outlets, so that the recommended length of duct lining should be installed before the first outlet connection.

BIBLIOGRAPHY

Alfred Koestel, Philip Hermann, and G. L. Tuve: ASHVE Research Report No. 1404—Comparative study of ventilating jets from various types of outlets (ASHVE Transactions, Vol. 56, 1950, p. 459).

D. W. Nelson and D. J. Stewart: ASHVE Research Report