

mostat must be removed, or protected from damage, in sub-freezing weather. A dry-bulb thermostat is the most dependable under all conditions, and is generally sufficient for small installations. However, the considerably greater economy of wet-bulb or similar control justifies its use for the larger installations.

Limit Controls. There are certain limiting devices which are not concerned primarily with final room conditions but are necessary safety features. High and low limits for refrigeration pressures are described under Control of Refrigeration Equipment. Limit temperature controls are often used with heating coils exposed to sub-freezing air, to prevent freezing the condensate. Where there is danger of lack of steam pressure, a thermostat should be placed in the system to stop the fan or close the outdoor air damper when heat is not available.

The tempered air thermostat described under the Heating Cycle serves as a low limit for air introduced in winter. When cold outside air is used for cooling, this same thermostat is used to restrict the amount, while inside conditions call for full cooling. A low limit fan discharge thermostat is sometimes operated in conjunction with the refrigerating cycle, although this is usually unnecessary.

A thermostat can also be placed in the fan discharge to stop the fan in case of fire. The maximum temperature setting is often determined by local regulations, but the most protection comes from the lowest feasible setting and a point is recommended only a few degrees higher than the highest temperature of normal operation. Safety measures to prevent gravity as well as forced flow of air, in case of fire, often require various dampers throughout the fan distribution system to be closed by fusible links or by thermostats.

Static Pressure Control

As described and illustrated in Chapter 31, the discharge of air through outlets must be carefully studied for proper results. Control systems that depend upon varying the air quantities are apt to upset the design conditions. Even where the dampers are located so as to maintain proper outlet velocities, as well as possible, by closing off portions of the grilles, there is a general increase in static pressures when most of the dampers reach their minimum positions. This tends to defeat the operation of the damper and magnify the danger of noise.

Air filters, commonly used in central fan systems, vary the operating static pressure in two ways. Reduction of air quantity tends to reduce the static drop through them as through all other resistances to air flow, but accumulation of dust increases this static drop. Thus filters add to the need for static pressure control.

This control consists generally of a device operating one or more dampers. If filters are not used and the only function of the controller is to reduce high pressures caused by reduction in amounts of air delivered, the dampers may be in the side of the main duct downstream from the fan, and arranged for opening enough to relieve the excess pressure. In this case, if the controller is of the differential type, affected by ambient pressures, care must be used to prevent distortion due to slight building up of pressure in the room outside the duct.

Whether or not filters are used, dampers may be installed across the area of the duct on either side of the fan. One type is of special design for attachment to the fan intake. Closing such dampers reduces the pressure in the distribution ducts. When filters are used, the systems may be designed for operation with the dampers partially closed while the filters are clean, so the pressure controller can automatically open them to correct for the gradually increasing resistance caused by dust accumulation.

Air distribution systems designed for high velocities and consequent high pressure drops are not entirely corrected for action of volume dampers by static pressure control at the fan, because varying pressure drops through the ducts follow changes in quantities of air delivered. Therefore, where relatively constant pressures are important it may be necessary to use controllers at several carefully selected points.

Back pressure dampers, commonly used to prevent down drafts through vent flues, may be employed to relieve objectionable pressures in rooms or other spaces, under certain conditions.

UNIT SYSTEMS

A unit system provides for the same functions as a central fan system except that the actual conditioning is usually done within the space being conditioned instead of at some central location outside of the space. The automatic control problems, therefore, become exactly the same as for central fan conditioning systems except that compactness, ease of installation and control cost often assume somewhat more importance.

Because of the usual segregated location of unit equipment throughout a building and its consequent lack of competent supervision, complete automatic control is essential to its satisfactory operation.

Unit Heaters

In its simplest form, unit heater control consists of a room thermostat to start the unit heater motor when heat is required and shut it off when the demand is satisfied. With this limited control, it is possible in some instances that, with no steam available at the heater, the operation of the fan would cause objectionable drafts. To avoid this, limit controls are available which will prevent the operation of the fan at the command of the room thermostat except when steam is available, as determined by the temperature of the steam or return pipe or the pressure of the steam supply.

Where several unit heaters serve a limited area, they may be grouped for purposes of automatic control, and several heaters placed in operation at the command of one thermostat. By properly grouping the units which will operate together, the benefit of zone control can often be obtained with a minimum of control equipment. Where such group operation is utilized, the thermostat and limit control usually function through a relay, as the combined load of the several motors may exceed the current capacity of the thermostatic control device.

In some cases where cold drafts will not result, it is desirable to operate the unit heaters continuously for circulation of air. In such instances the