

load imposed at maximum fan speed. Two-speed motors have given successful operating results and are recommended.

Special attention should be given to the problem of noise elimination. The metal duct connection to and from the furnace casing and fan housing should be broken by strips of canvas. Motors and their mountings must be carefully selected for quiet operation. Electrical conduit and water piping must not be fastened to, nor make contact with fan housing. The installation of a fan directly under a cold air grille is usually not recommended. (See also Chapter 32.)

FILTERS

Several types of filters are available for mechanical warm air furnace applications and are discussed in Chapter 28. For maximum efficiency and life under operating conditions, filters should not be subjected to a temperature in excess of 150 F. Filters should have at least 80 per cent average efficiency on an 8 hr test. Filter resistance rises rapidly with the accumulation of dirt, and may reduce the air circulation over heating surfaces.

For domestic furnaces, the maximum velocity should not exceed 300 fpm based on nominal filter area.

AIR DISTRIBUTION

The conditions of comfort obtained in a room are greatly influenced by the type of register used and the locations of the supply registers and return grilles. In general it has been found that changes in the type, air velocity, and location of the supply register affect the room conditions much more than the changes in the location of the return grilles. One method is to locate the supply register near the floor so that the warm air from the register *blankets* a cold wall, and mixes with the cold air dropping off from the exposed walls and glass. Another method is to locate the supply openings near the floor on the inside wall and the return openings near the greatest outside exposure. Tests in the Warm Air Research Residence³ have indicated that continuous fan operation provided better results than intermittent fan operation.

Register and Grille Openings

Supply registers located in the floor require attention to keep them clean and are usually avoided.

Tests conducted in the Warm Air Research Residence⁴ have indicated that comparable results are obtainable with either high side wall or baseboard registers, providing proper registers and air velocities are selected. Baseboard registers should be of a deflecting-diffuser type which throw the air downward toward the floor and diffuse it at the same time. For baseboard registers air temperatures under 125 F and air velocities over 500 fpm should be avoided as they may cause drafts.

High side wall registers must be of such type that the air is delivered horizontally or in a slightly downward direction, and must be so located as to avoid impingement of air on ceiling or wall. Directional flow diffusing type should be used to insure best results. Register air velocities should be such that the air stream carries to the opposite exposure. Velocities under 500 fpm are not recommended. In general better air

³Performance of a Forced Warm-Air Heating System as Affected by Changes in Volume and Temperature of Air Recirculated, by A. P. Kratz and S. Konzo (A.S.H.V.E. TRANSACTIONS, Vol. 48, 1942, p. 393).

⁴Loc. Cit. Note 3.

and temperature distribution is obtainable by using baseboard registers for heating and high side wall registers for cooling.

Registers should be well proportioned and decorated to harmonize with the trim. Air supply registers should be equipped with dampers and all registers should be sealed against leakage around the borders or margins. The register sizes shown in Table 1 have been recommended as standard by the *National Warm Air Heating and Air Conditioning Association*.

Velocities through registers may be reduced by the use of registers larger than the connecting ducts. Diffusers should be used to spread the air uniformly over the register face.

Return air grilles may be located in hallways, near entrance doors, under windows, in exposed corners, or inside walls, depending on location of supply registers. Baseboard returns are preferable to floor grilles.

Dampers

Suitable dampers for air direction or volume control are essential to any trunk or individual duct system. Special care must be used in the design

TABLE 1. RECOMMENDED REGISTER SIZES

WARM AIR REGISTERS, IN. SIDEWALL AND BASEBOARD TYPES				RETURN AIR GRILLES OR INTAKES, IN. SIDEWALL AND BASEBOARD TYPES			
8 x 4 10 x 4	10 x 5	8 x 6 10 x 6	10 x 8	8 x 4 10 x 4	10 x 5	8 x 6 10 x 6	10 x 8
12 x 4 14 x 4	12 x 5 14 x 5	12 x 6 14 x 6	12 x 8 14 x 8	12 x 4 14 x 4	12 x 5 14 x 5	12 x 6 14 x 6	12 x 8 14 x 8
				24 x 4 30 x 4	24 x 5 30 x 5	24 x 6 30 x 6	

of any system to avoid turbulence and to minimize resistance. Sharp elbows, angles, and offsets should be avoided. Three types of dampers are commonly used. *Volume dampers* are used to completely cut off or reduce the flow through pipes. *Splitter dampers* are used where a branch is taken off from a main trunk. *Squeeze dampers* are used for adjusting the volume of air flow and resistance through a given duct. It is essential that a damper with positive locking device be provided for each main or duct branch. Labels placed on ducts should indicate the room being served. Damper positions should be marked for summer and winter operation, and to avoid tampering.

Ducts

The ducts may be either round or rectangular in cross section. The radii of elbows should preferably be not less than one and one-half times the pipe diameter for round pipes, or the equivalent round pipe size in the case of rectangular ducts. Warm air ducts passing through cold spaces, or where located in exposed walls, should have $\frac{1}{2}$ to 2 in. of insulation.

AUTOMATIC CONTROLS

Air stratification, high bonnet temperatures, excessive flue gas temperatures, and heat overrun or lag in a properly designed system can be