

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 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*.

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		8 x 6		8 x 4		8 x 6	
10 x 4	10 x 5	10 x 6	10 x 8	10 x 4	10 x 5	10 x 6	10 x 8
12 x 4	12 x 5	12 x 6	12 x 8	12 x 4	12 x 5	12 x 6	12 x 8
14 x 4	14 x 5	14 x 6	14 x 8	14 x 4	14 x 5	14 x 6	14 x 8
				24 x 4	24 x 5	24 x 6	
				30 x 4	30 x 5	30 x 6	

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.

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.

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 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 largely eliminated through proper care in the planning and installation of the control system⁵.

Controls which are considered desirable for this system are:

1. A *thermostat* located in a living room where maximum fluctuation in temperature can be expected, in order to secure frequent operation of fans, drafts, and burners. The thermostat location should not be on an outside wall, in a bed room, bath room or sun room, or in a location where it will be affected by direct radiant heat from the sun or from a fireplace, or by direct heat from any warm air duct, register or chimney.
2. A *fan switch* control located in the bonnet to start blower operations at temperatures between 120 and 150 F, and to stop the blower at about 25 to 30 F below the cut-in point. The lower settings are used for high side wall register installations, and the higher settings for baseboard register installations. For most satisfactory results these settings should be as low as is feasible.
3. A *protective high limit control* located in the bonnet to stop the system independently of the thermostat if the bonnet temperature exceeds 200 F.
4. On oil and gas burner installations, a protective control should be included which will stop the system if the fire is extinguished or if there is a failure of the ignition system.
5. On automatic stoker installations, a control is usually included which will start the operation regardless of thermostat settings whenever the bonnet temperature indicates that the fire is dying, or a time interval contactor is used that will start the stoker to run a few minutes out of each hour.
6. A *humidistat* to regulate the moisture supplied to the rooms, located either in one of the rooms or in the main return duct near the furnace.

⁵Automatic Controls for Forced-Air Heating Systems, by S. Konzo and A. F. Hubbard (A.S.H.V.E. TRANSACTIONS, Vol. 40, 1934, p. 37).