

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 Residence<sup>3</sup> have indicated that continuous fan operation provided better results than intermittent fan operation.

### Register and Grille Openings

Supply registers located in the floor are effective, but as they require attention to keep them clean they should be avoided where they can be placed in walls. Tests conducted in the Warm Air Research Residence<sup>4</sup> 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 throws the air downward toward the floor and diffuses 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*.

Velocities through registers may be reduced by the use of registers larger than the connecting ducts. Merely to use a larger register may not result in materially reduced velocities unless diffusers are used which 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

<sup>3</sup>Performance 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. JOURNAL SECTION, *Heating, Piping and Air Conditioning*, June, 1942, p. 375).

<sup>4</sup>Loc. Cit. Note 3.

TABLE 1. RECOMMENDED REGISTER SIZES

| WARM AIR REGISTERS, IN.<br>SIDEWALL AND BASEBOARD TYPES |                  |                  |                  | RETURN AIR GRILLES OR INTAKES, IN.<br>SIDEWALL AND BASEBOARD TYPES |                  |                  |                  |
|---------------------------------------------------------|------------------|------------------|------------------|--------------------------------------------------------------------|------------------|------------------|------------------|
| 8 x 4<br>10 x 4                                         | 10 x 5           | 8 x 6<br>10 x 6  | 10 x 8           | 8 x 4<br>10 x 4                                                    | 10 x 5           | 8 x 6<br>10 x 6  | 10 x 8           |
| 12 x 4<br>14 x 4                                        | 12 x 5<br>14 x 5 | 12 x 6<br>14 x 6 | 12 x 8<br>14 x 8 | 12 x 4<br>14 x 4                                                   | 12 x 5<br>14 x 5 | 12 x 6<br>14 x 6 | 12 x 8<br>14 x 8 |
|                                                         |                  |                  |                  | 24 x 4<br>30 x 4                                                   | 24 x 5<br>30 x 5 | 24 x 6<br>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 largely eliminated through proper care in the planning and installation of the control system<sup>5</sup>. The essential requirements of the control are:

1. To keep the fire burning when using solid fuel regardless of the weather.
2. To avoid excessive bonnet temperatures with resultant radiant heat losses into the basement.
3. To avoid the overheating of certain rooms through gravity action during off periods of blower operation.
4. To have a sufficient supply of heat available at all times to avoid lag when the room thermostat calls for heat.
5. To prevent cold air delivery when heat supply is insufficient.
6. To avoid heat loss through the chimney by keeping stack temperatures low.
7. To provide quick response to the thermostat, with protection against overrun.

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