cold air from infiltration thus effectively preventing drafts. This has been called perimeter heating. In any case, the warm air registers should be located so that the air stream never discharges directly against people at rest. Tests[2] in Warm Air Research Residence No. 1 at the *University of Illinois*, have indicated that continuous blower operation gave better results than intermittent operation.

Register and Grille Openings

Tests also conducted in Warm Air Research Residence No. 1 have indicated that comparable results are obtainable with either high side wall or baseboard registers, if proper registers and air velocities are selected. Baseboard registers should be of a deflecting-diffuser type which throw the

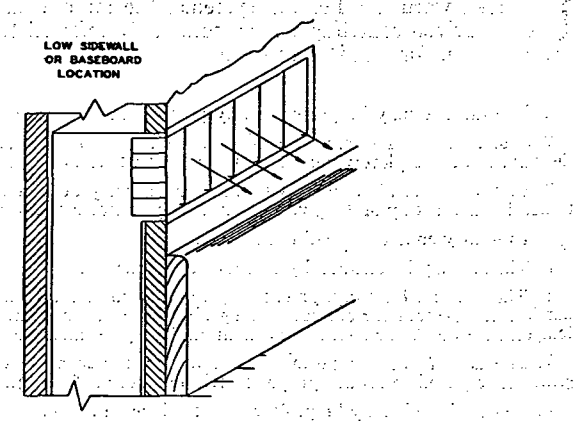

FIG. 1. RECOMMENDED TYPE OF BASEBOARD AND LOW SIDEWALL INSTALLATION ON WARM WALL[a]

[a] Vertical bars with adjustable deflection, or fixed vertical bars with deflections to right and left not exceeding about 22 deg. For low sidewall location, the deflection for horizontal, multiple vane registers should not exceed 22 deg. For baseboard locations, the deflection for horizontal, multiple vane registers should not exceed about 10 deg.

air downward toward the floor and diffuse it at the same time. For baseboard registers, air velocities over 500 fpm, should be avoided as they may cause discomfort.

High side wall registers should be of such type that the air is delivered horizontally or in a slightly downward direction, and should be so located as to avoid impingement of air on ceiling or wall. Directional flow diffusing type registers should be used to insure best results. Register air velocities should be such that the air velocity will be about 50 fpm three quarters of the distance from the register to the opposite wall.

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. Basic rules for the location and selection of registers, together with explanations of factors affecting operation, are given[3] in Section 6 of Manual 4, Sections 3 and 4 of Manual 10, or Section B

of Manual 7, these manuals being publications of the *National Warm Air Heating and Air Conditioning Association*.

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 edges. The register types shown in Figs. 1, 2 and 3 have been recommended as standard by the *National Warm Air Heating and Air Conditioning Association*.

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 where warm air registers are located on inside walls. Where perimeter heating is used, returns placed high on inside walls are preferred.

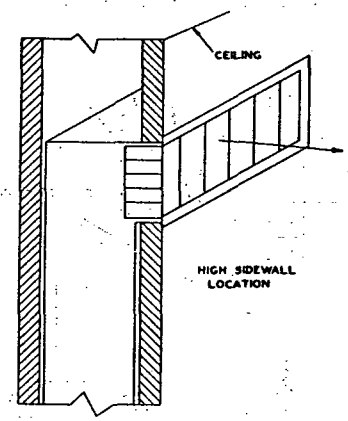

FIG. 2. RECOMMENDED TYPE OF HIGH SIDEWALL INSTALLATION ON WARM WALL[a]

[a] Horizontal vanes, in back or front, to give downward deflections not to exceed from 15 to 22 deg.

Dampers

Suitable dampers for air direction or volume control are essential to any duct system. Special care must be used in the design of any system, 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 ducts. *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 centerline radii of elbows should preferably be not less than one and one-half times the pipe diameter for round pipes. The throat radius of a turn