GROUP 7. REGISTERS (INCLUDING LOSSES IN STACKHEAD AND VELOCITY PRESSURE).

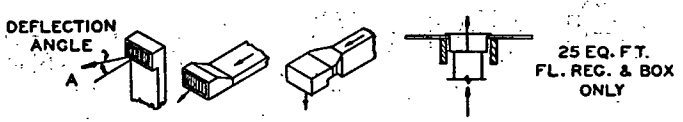

TABLE A. EQUIVALENT LENGTH FOR REGISTERS

Deflection Angle A	0°	15°	22°	30°	45°
Baseboard, High or Low Sidewall Registers	Eq. Ft. 35	40	45	60	115
Floor Registers with Box only	25				

For 2-way deflection registers, add the vertical and horizontal deflection angles together and multiply by 0.7. Select closest angle A in Table A. For diffuser type registers see manufacturers' catalogs.

FIG. 7. EQUIVALENT LENGTH OF FITTINGS (Concluded)

8. Selection of Blower.
   A. Determine total cfm air delivery (the sum of all branch cfm values).
   B. Determine static pressure requirement.
      a. For furnace-blower combination units it is the sum of bonnet pressure and suction pressure.
      b. For blowers separately selected from the furnace it is the sum of bonnet pressure, suction pressure, filter loss, casing loss, losses through air washers, coils, and other devices.

9. Selection of Furnace.
   A. Determine register delivery (the sum of room Btu losses).
   B. Determine bonnet capacity.
      Bonnet capacity = (total cfm) × (temperature rise) × 1.089.
   C. Determine allowance for pick-up load. For buildings which are heated intermittently, such as churches and auditoriums, it is customary to add from 10 to 25 percent extra furnace capacity for warming of the structure.

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.[10] Best results are obtained when the fan is operated as continuously as possible, coupled with frequent, short cycles of burner operation. Controls usually employed are:

1. A *room thermostat* located in the occupied space at a point where there is good air circulation and where the temperature is representative of the area being controlled. It is the operating control which initiates the starting and stopping of the burner. It is frequently of the timed, two-position type. Refer to Chapter 38 for more information on types of room thermostats.

2. A *fan thermostat* located in the bonnet of the furnace to start the fan at a bonnet temperature between 110 and 130 F and stop the fan at about 15 deg below the cut-in point. The lower settings are used for high sidewall register installations and the higher settings for baseboard register installations. For most satisfactory performance these settings should be as low as is feasible without resulting in drafts.

3. A *high limit control*, also in the bonnet of the furnace, to stop the burner independently of the room thermostat if the air temperature exceeds 175 F. The fan thermostat and high limit control are sometimes combined into a single unit.

4. A *humidistat* to regulate the moisture supplied to the rooms on systems which are equipped with humidifying means. This may be of the room type, usually located adjacent to the room thermostat, or it may be of the insertion type located in the main return air duct.

5. Primary and limit controls for the various types of gas burners, oil burners and coal burners (stokers) should be provided as required, and are discussed in Chapter 38.

ADJUSTMENT OF SYSTEM

More even room temperatures will result if the controls are adjusted to produce long period fan operation. This is accomplished in automatically-fired forced warm air heating systems when the control arrangement is of the type where the room thermostat controls the fire, and the blower control (fan switch) controls the blower operation. This procedure as outlined in detail in Manual 6 of the *National Warm Air Heating and Air Conditioning Association*, is as follows:[3]

1. Adjust the fuel input in proper relation to the heat loss of the structure.

2. Determine the temperature rise through the furnace.

3. Adjust the air volume to produce a temperature rise through the furnace of about 90 deg.

4. If adjustable, set the fan switch differential to a minimum of about 15 deg.

5. Adjust the fan switch cut-out point as low as practicable.

6. Balance the system by adjusting dampers to produce even temperature distribution between rooms.

7. Set the room thermostat at the desired room temperature.

Close control of room temperature is facilitated by the use of a room thermostat having a narrow operating differential. The heat anticipating thermostat is an example of such a device.

WARM AIR CEILING PANEL SYSTEMS

Warm air ceiling panel heating systems utilize a false ceiling suspended 3¼ in. from the ceiling joists which have previously been covered on the bottom with sheets of plasterboard. Special hangers are used to suspend the false ceiling or heating panel from the joists. Steel supporting rods are installed through these hangers and metal lath is attached to the rods. The lath is then plastered to a thickness of ¾ in., making a completely sealed air space above the ceiling. Warm air is delivered to this sealed space through a standard warm air duct, installed in the usual manner. The air is then circulated over the entire ceiling being guided by sheet-metal baffles. After the air has passed over the ceiling, it is returned to the furnace through a return air duct for reheating. The system is closed, and no air is introduced into the heated space from the panel. (See also Chapter 23, Panel Heating.)

Because a warm air ceiling panel system involves a different type of ceiling construction, its installation is practically limited to new construction. Only automatically-fired and thermostatically-controlled furnace-blower units may be used with this system. The standard automatic heating controls consisting of a room thermostat, temperature limit control, blower control (fan switch), and primary control are all that are required. While warm air ceiling panel heating has particular advantages in one-story utility room houses, it can be just as effectively installed in one- and two-story houses with basements.