TABLE 2. RETURN AIR DUCT SYSTEM COMBINATION OF PARTS SELECTED AS STANDARD

Combination No.	Return-Air Intake Size, In.		Riser Size, In. Where Stack is Used in Stud Space	Branch Pipe Size, In.		When Joist Lining is Used[b] Number of Joist Spaces Lined and Minimum Depth of Space Required	Required Increase in Width of Trunk Duct (for 8 In. Depth of Duct), In.
	Base-board	Floor[a]		Round	Rectangular		
1	2	3	4	5	6	7	8
51	10 x 6	6 x 10 or 4 x 14	10 x 3¼[c]	6	4 x 8	a space of 3 in. depth	1
52	10 x 6	6 x 10 or 4 x 14	10 x 3¼[c]	6	4 x 8	1 space of 3 in. depth	2
53	12 x 6	6 x 12 or 6 x 14	12 x 3¼[d]	7	5 x 8	1 space of 4 in. depth	3
54	14 x 6	6 x 14	14 x 3¼[d]	8	6 x 8	1 space of 5 in. depth	4
55	24 x 6 or 30 x 6	6 x 30	Two stacks each 10 x 3¼[c]	9	8 x 8	1 space of 6 in. depth or 2 spaces of 3 in. depth	5
56	30 x 6	6 x 30	Two stacks 12 x 3¼[d]	10	10 x 8	1 space of 7 in. depth or 2 spaces of 4 in. depth	7
57	—	8 x 30	—	12	15 x 8	1 space of 9 in. depth or 2 spaces of 5 in. depth	12

[a] Use these items only when building construction, or capacities, require the use of floor intakes. The sizes listed correspond to standard sizes for gravity installations, except floor box collars. The use of standard blind boxes is suggested.

[b] Based on 14 in. space between joists. Use full depth of joist, except when joist depth is less than minimum depth required, in which case a *drop pan must be used*. This may occur when two or more return ducts are connected to the same joist space.

[c] If it is desired to use 14 in. x 3¼ in. stud space, it makes no difference whether this space has protruding keys or not.

[d] If it is desired to use 14 in. x 3¼ in. stud space, the plaster base must be smooth, without any protruding plaster keys to interfere with the flow of air.

2. Location of registers and return intakes on floor plan, showing types of registers, with distance from register to opposite wall and deflection of registers desired.

3. Laying out a proposed duct system for both warm air and return air sides of the system, and including details of types of fittings and the actual and equivalent lengths of each branch line from bonnet to register, without sizes. (See Fig. 4, Groups 1 through 6, for equivalent length of fittings.)

4. Determination of bonnet temperature.

If rating sheet for furnace-blower unit specifies a *fixed value of bonnet temperature*, enter table at this value. If not specified, use the following procedure: Use Table 5 for buildings having a heat loss between 120,000 and 350,000 Btu per hr or Table 6 for buildings having a heat loss greater than 350,000 Btu per hr. Select *shortest actual length* and read downward in nearest column in Tables 5 or 6 until lower heavy diagonal line is reached, but do not cross line. Run horizontally to first column of table and note *bonnet temperature*. Also select *longest actual length* and read downward in nearest column in Tables 5 or 6, until upper heavy diagonal line is just crossed. Run horizontally to left to obtain value for *bonnet temperature* in first column. Select as the design bonnet temperature any value between these two limits.

5. Determination of air volume to be delivered through each register and the respective register air temperatures.

Using Tables 5 or 6 and the design bonnet temperature selected, find the values of cfm per 1000 Btu for each duct length, and the corresponding register temperature.

6. Selection of register sizes and pressure losses to produce necessary throw, for the air volumes handled.

Use Tables 7 or 8 to obtain required free area and pressure loss of register.

7. Design of duct system.

A. *Warm air branches.*

a. Use Table 9 to select maximum bonnet pressure *usually* required for the trunk carrying the maximum volume of air (cfm). If the maximum bonnet pressure is not high enough to accommodate the pressure loss through the registers, use a higher bonnet pressure. If the register pressure is critically large, it may be necessary to reduce it by either using two registers in place of one, or using smaller deflection angles.

b. Obtain actual duct loss by subtracting total register pressure loss, as determined from Tables 7 or 8, from maximum bonnet pressure.

c. Obtain the pressure drop in each duct per 100 ft by use of Table 10.

d. Determine duct size by means of air friction chart (such as Fig. 1, Chapter 32), volume (cfm), and pressure drop per 100 ft of duct.

B. *Return air branches.*

a. Select a low value of actual duct loss obtained from step b under item A for the suction loss of return duct system.

b. Proceed in sizing return air branches by the same method described for the warm air branches.

C. *Trunk ducts for warm air and return air sides of system.*

a. Add air volumes of branches to be handled by each trunk duct.

b. The friction loss per 100 ft of trunk duct is determined by taking the smaller of the two values for friction loss for the two ducts meeting at the junction.

e. Determine trunk duct size by using an air friction chart, volume (cfm), and pressure drop per 100 ft of trunk duct.

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;[6] desirable controls usually employed are:

1. A *thermostat* located in occupied space where maximum fluctuation in tempera-