the rectangular duct. On the other hand, the improved duct was handicapped by having a register grill, whereas the rectangular duct had none. This has been found to be a considerable handicap, amounting to 4 per cent of the furnace capacity at moderate register temperatures. The failure of the rectangular duct to handle the same quantity of air as the round duct may be ascribed to sharp right angle turns, greater length, and greater frictional surface for the same cross-sectional areas.

TABLE 49. COMPARISON OF FURNACE CAPACITIES FOR TWO TYPES OF RECIRCULATING DUCT

Air Temperature Average at Registers	Capacity B.t.u. per Hour* Rectangular Duct	Capacity B.t.u. per Hour* Round Duct	Per Cent Increase Round Duct
130 (Low)	62,500	71,000	13.6
160 (Moderate)	97,500	116,000	19.0
190 (High)	136,000	167,000	22.4

*These values were selected from the curves of Fig. 44. Capacity means B.t.u. (heat units) per hour added to the air as it passed through the furnace and measured *at the furnace bonnet*, just as the air enters the leaders.

SIGNIFICANCE OF THE AIR TEMPERATURE AT THE REGISTER ON THE RATING AND CAPACITY OF A WARM-AIR FURNACE[3]

One of the most important objects of the research work of the warm air furnace heating investigation, which is now in progress at the University of Illinois, has been the determination of the factors affecting the rating of a warm air furnace. Every manufacturer and installer is vitally concerned with the basis upon which furnace ratings are determined. Most manufacturers are agreed that the square inches of leader pipe area which a furnace can supply is a satisfactory basis for expressing the heating capacity of a furnace. Unfortunately, this is not the end of the story by any means, as such a basis of rating is still indefinite, unless the air temperature at the registers is also stated.

The real significance of this air temperature at the registers can be shown very easily by reference to any series of tests run at the University on piped furnaces. In fact, it is a very simple matter to show that a given furnace, connected to a given system of leaders, stacks, and registers as shown in Fig. 45 can be made to develop several different heating capacities when operating *with the same number of square inches of leader pipe area.* It is only necessary to increase the draft, thereby burning more coal per square foot, of grate, and as a consequence secure a higher air temperature at the register face. That the heating capacity of the furnace will be increased by such a procedure is obvious to anyone, and it should be equally obvious that any attempt to express the rating of a furnace in square inches of leader pipe area means nothing unless the register temperature is stated at the same time.

[3]From an article by A. C. Willard in the *American Artisan and Hardware Record*, December 30, 1922.

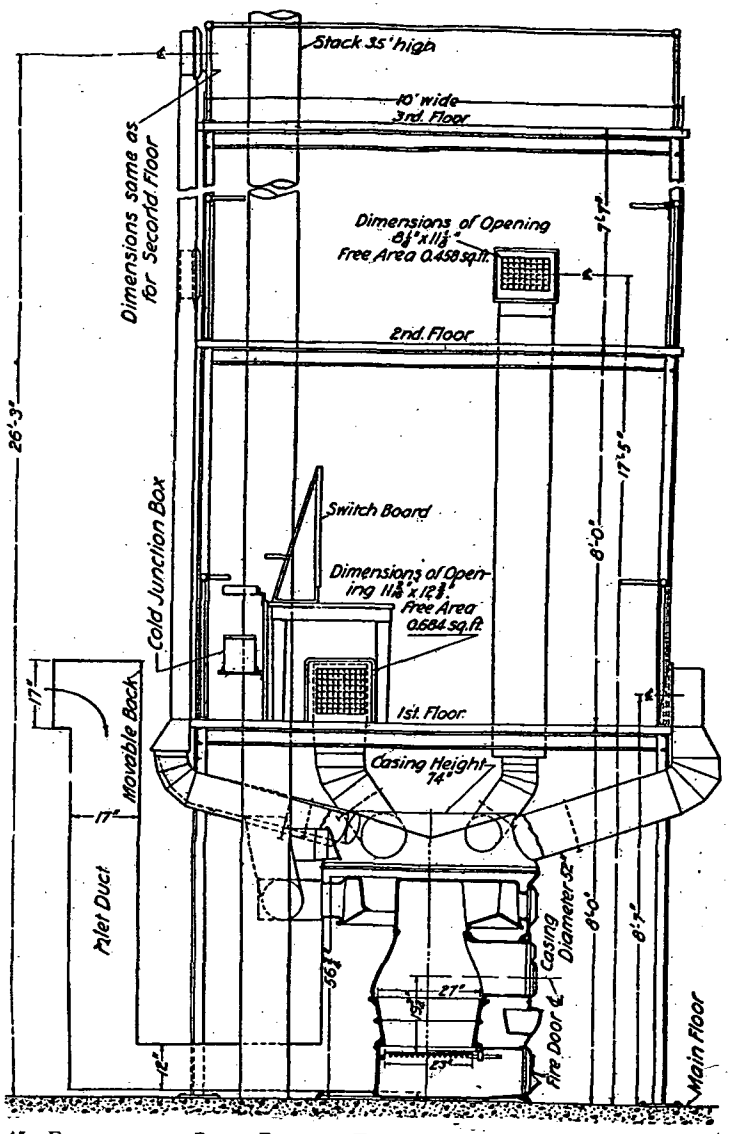

FIG. 45 ELEVATION OF PIPED FURNACE TESTING PLANT—NOTE ALTERNATIVE AND BETTER ARRANGEMENT OF RECIRCULATING DUCT IN FIG. 46