NEED FOR INCREASED WALL STACK SIZES

One phase of the furnace business, which has not yet been reported on by the University, but which has a very important bearing on the satisfactory operation of furnaces, is the size of the flues in the walls for conveying the heat to the upper stories. The Code Committee made practically no recommendations on this point at all.

The average wall in houses heated by furnaces is framed with studs known commercially as 2 x 4's; they are more often 1⅞ in. x 3¾ in. and are usually spaced 16 in. centers. Thus the maximum space for a sheet metal flue is 3¾ in. x 14½ in.; therefore, it is hardly practical to figure on a flue being more than 3½ in. deep x 13¾ in. wide and experience shows the standard maximum width to be about 13 in.

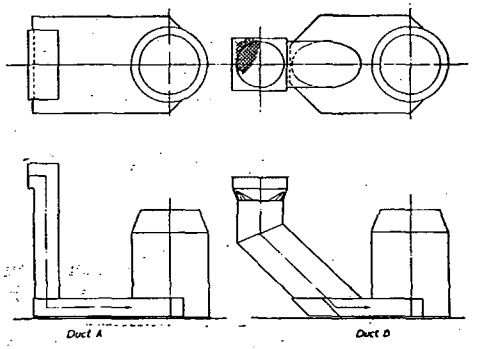

FIG. 2. TWO TYPES OF RECIRCULATING DUCTS CHANGE FROM "A" TO "B" WILL SHOW SURPRISING RESULTS

A round pipe offering the same friction for the same capacity as a rectangular duct of the above dimensions, would be 7⅛ in. in diameter or it would have an equivalent area of 40 sq. in., whereas it has an actual area of 48.25 sq. in. Many are the instances where an 8 in. or a 9 in. leader is carried from the furnace to a riser of no greater dimensions than above mentioned, which only has the carrying capacity of a 7 in. round pipe. It is no wonder that it is so often difficult to heat rooms in the upper stories of buildings under these circumstances.

The way to overcome this, is to insist that all walls carrying warm air flues are to be built of studs not less than 2 in. x 6 in. spaced 20 in. centers. If 6 in. studs are used in such partitions or walls, even though the studs are set 16 in. centers, which is unnecessary, then a flue measuring 5½ x 13 in. could be built which is equivalent to 8¼ in. diameter pipe. When the studs are spaced 20 in. centers then a flue 5½ x 17 in. can be built in, which is equivalent to a round pipe 10 in. diameter in carrying capacity.

In Bulletin No. 120, issued by the University of Illinois, is a chart on page 21 which is herein reproduced in Fig. 3. By means of this chart the size of the furnace can be readily determined, also the amount of the fuel to be burned, the draft necessary to burn that amount of fuel, the maximum temperature attainable, the heating capacity and the overall efficiency.

As previously stated, the code as adopted, makes it necessary to carry a temperature of 195 deg. in order that the required amount of heat is supplied to first story rooms, when the leaders are determined by allowing only 8 sq. in. of area to each 1,000 heat units of exposure in the building.

Comparing the effect this high temperature has, as compared with what would be the result if only 176 deg. had to be attained, it is found that the rate of combustion must be 6.75 lb. of coal per sq. ft. of grate surface per hour. This will necessitate a draft of 0.085 in. The heating capacity of the furnace is 140,000 B.t.u. per hour, and the overall efficiency will be 56 per cent.

At 176 deg., the rate of combustion will be only 5.5 lb. per sq. ft. of grate surface per hour. The draft need only be 0.07 in.; the heating capacity is 120,000 B.t.u. per hour and the overall efficiency will be increased to 60 per cent.

Assume a house has a total exposure of 120,000 B.t.u. and compare the operating results at the two temperatures, first determining the requirements for 195 deg.

$$\frac{120{,}000}{0.56 \times 12{,}000 \times 6.75} = 2.66 \text{ sq. ft. of grate surface, or 22.10 in. diameter.}$$

Heating 1 lb. of air from 65 deg. to 195 deg., or through 130 deg. will require 31 heat units; therefore, 120,000 heat units exposure will require 3,870 lb. of air per hour or about 860 cu. ft. per minute at 70 deg. temperature.

For 176 deg. temperature the following results are obtained:

$$\frac{120{,}000}{0.60 \times 12{,}000 \times 5.5} = 3.03 \text{ sq. ft. of grate surface, or 23.6 in. diameter.}$$

Heating one pound of air from 65 deg. to 176 deg., or through 111 deg., will require 26.4 heat units; thus, 4,550 lb. of air per hour must be heated, or about 1,000 cu. ft. of air per minute.

In the first case the coal burned will amount to 17.86 lb. per hour; in the second, 16 2/3 lb. per hour. From this it will be noted that the rate of combustion is about 23 per cent higher to get the high temperature, and the coal consumed to give off the same amount of heat is 7 per cent more.

The volume of air at high temperature is less by about 14 per cent, hence smaller pipes are required. The grate area is about 7 per cent more for the lower temperature; in other words, the furnace having a larger grate surface would proportionately have more heating surface; thus, the same transmission could be effected at lower temperatures, by the circulation of more air, requiring less coal and still have a reserve