where

D_b = loss of draft in the breeching per foot of length and D_{br} = the width of the breeching in feet; all on the following basis: flue gas temperature of 600 deg. fahr. a flue gas density of 0.08071 lb. per cubic foot (at 32 deg.) coefficient of friction —0.016, standard atmospheric pressure and ratio of height to width of cross-section of a rectangular breeching of 2 to 1.

The correction factors for different atmospheric pressures and different flue gas densities are the same as given for the losses in the chimney.

The correction factor for different flue gas temperatures ranges from 0.8 at 400 deg. to 1.2 at 800 deg. based on the same weight of gas flowing per second.

The loss of draft in the turns of the breeching, including one right angle turn where the gases pass from the boiler to the breeching and another where they pass from the breeching to the chimney, is expressed in inches of water per right angle turn by equation (6).

$$D_{bt} = 0.0013 \frac{W^2 T_c}{A^2 W_g} \qquad (6)$$

where

A = area of breeching in square feet.

The loss of draft through the boilers varies very materially with the size and type of boiler, number of passes, sizes of tubes, etc., but may be taken from Table 2.

TABLE 2. AVERAGE FRICTION LOSS OF FLUE GASES IN PASSING THROUGH BOILERS

PER CENT RATING	100	150	200	250	300
Loss Ins., Water	0.1 to 0.3	0.2 to 0.6	0.3 to 0.9	0.5 to 1.4	0.7 to 1.9

By use of Tables 1 and 2 and equations (1) to (6) inclusive, the theoretical draft and the available draft of any chimney may be calculated under any given set of conditions.

The quantity of gases to be handled is quite variable, depending upon the fuel and the proportion of air used.

The theoretical amount of air required per pound of coal is approximately 12 lb. Fifty per cent excess air is generally allowed, which means that 19 lb. of flue gas may be used per pound of coal burned. The pounds of coal burned per horsepower developed will depend upon the efficiency of the boiler plant but will usually fall between four and five.

The horsepower rating of a chimney is usually a fallacy, except for the smaller plants operating under standard conditions for which the horsepower ratings of the chimney may have been computed. The horsepower capacity of a chimney depends not only upon the many variables already referred to, but also upon the efficiency of the boiler plant, the fuel used and the rate of combustion required to develop the required output.

For instance a chimney which would produce 1 in. of available draft under a load of 100 hp. in a plant using 4 lb. of coal per horsepower with

a combustion rate of 30 lb. of anthracite pea coal per square foot of grate, would prove entirely inadequate for a 100 hp. load on a boiler plant using 5 lb. of No. 3 buckwheat coal per horsepower at the same combustion rate.

While as can readily be seen this method of proportioning chimneys according to horsepower is very approximate, it is frequently used with a fair degree of safety for small plants operating under ordinary conditions.

Low-pressure heating plant chimneys of moderate capacities may be taken from Table 3 or the curves in Fig. 1 with very satisfactory results.

According to their height, heating plant chimneys are divided into three classes, the erratic, uncertain and reliable. Chimneys less than 36 ft. high are erratic in their action. The head produced by such a low height

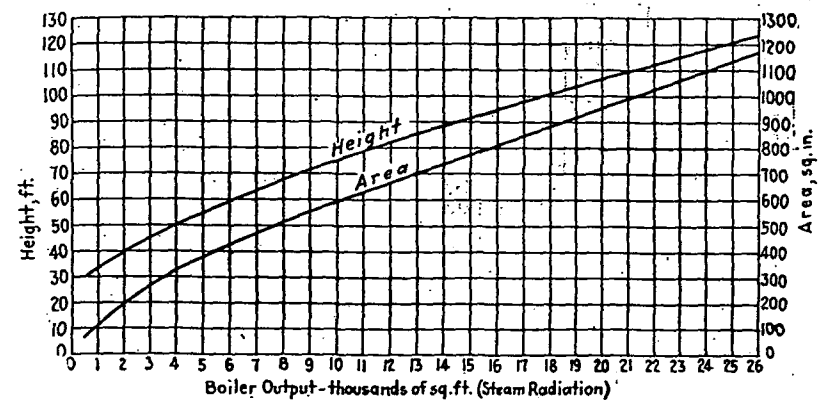

FIG. 1. CHART FOR DETERMINING CHIMNEY SIZE

Note 1.—It is impossible to make a rule for chimney dimensions which would apply to all boilers but it will be found that in general all heating boilers when burning any coal except smallest sizes will deliver more than the output shown at the bottom of the chart, Fig. 1, with the corresponding chimney dimensions, during the period when the boiler is likely to be in operation.

Note 2.—It is recommended that the manufacturer of the boiler be consulted in the case of exceptional boilers or where chimney dimensions are less than shown on chart for any given continuous output.

Note 3.—For battery installations the area of chimney is generally taken two-thirds to three-fourths the sum of the areas required for the same number of single boilers. The height is increased 5 to 15 ft. above the single boiler chimney height in order to compensate for additional turns and damper leakage.

Note 4.—Chimneys for oil-fired boilers may usually be taken 75 per cent of height and area of chimney for same output with solid fuel except that in cases where the possible change to coal is contemplated the chimneys should be selected as for solid fuel.

Note 5.—For gas-fired boilers the chimney dimensions may be selected from Fig. 1 but do not have to supply draft to move the products of combustion through the boiler or to supply air to the boiler. They serve only to remove the products of combustion from the boiler room. The draft diverter supplied with all gas boilers effectively limits the draft at the boiler outlet and also prevents a reversal of direction of flow in the chimney from effecting boiler operation.

is so small that the least unfavorable conditions or interference practically puts the chimney out of commission.

At best the head produced by chimneys up to 64 ft. in height is so small that the draft is frequently affected by surrounding conditions making the draft a doubtful one. Chimneys over 64 ft. in height are not usually so affected, because as a rule the chimney is designed by an