The draft loss in the chimney stack is so dependent on conditions surrounding the stack itself, that it seems desirable to consider the loss in terms of percentage of total draft rather than in specific terms of velocity. This treatment will be understood by referring to formulae discussed later in this chapter.

Forced Draft

As the name implies, *forced draft* involves the use of a fan or blower for creating a pressure in the ash pit and forcing air through the fuel bed.

The draft required where *forced draft* is employed is the sum of items 3, 4 and 5; items 1 and 2 usually being taken care of by the forced draft apparatus.

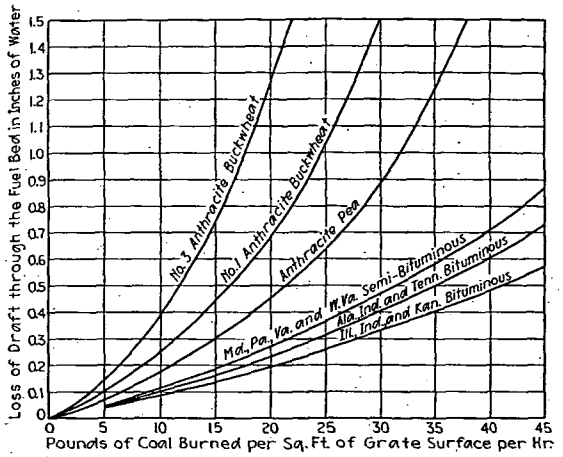

FIG. 1. DRAFT REQUIRED AT DIFFERENT RATES OF COMBUSTION FOR VARIOUS KINDS OF COAL

Induced Draft

With induced draft, the suction side of the fan is connected with the uptake or breeching of the boiler and the products of combustion are usually exhausted through a stub stack.

When *induced draft* is employed the entire draft required is generally taken care of by the induced draft apparatus.

In the case of either forced or induced draft any part of the required draft may be taken care of by the chimney and the remainder by the apparatus, but the exact conditions to be met in this respect should be known and the chimney should be proportioned accordingly.

The combination of natural and mechanical draft is frequently used, especially where loads are quite irregular, so that the plant may be run on natural draft during light loads and on mechanical draft during peak-loads, only. This combination also affords a factor of safety against breakdowns in the mechanical draft equipment, since at least a partial load may always be carried on natural draft.

Measurement of Draft

Draft is usually measured in inches of water, by which is meant that the static head of water (in inches) corresponding to the difference in pressure between any point in the heater, breeching or chimney, at which the draft is being measured, and the pressure of the surrounding atmosphere. One inch of draft is equivalent to 5.2 lb per square foot of pressure difference.

There is some likelihood of a misunderstanding concerning what is meant by draft through a boiler or furnace. Low pressure heating boiler manufacturers refer generally to the boiler as the complete unit so that the loss of draft through the boiler would consist of items (1), (2) and (3) under *Draft*, while manufacturers of power (high pressure) boilers refer to the furnace and boiler as separate units. In this chapter when *boiler* is referred to, these three items are taken into account.

Theoretical Draft

The theoretical draft of a chimney is the hypothetical draft that would be produced if the chimney were completely heated and filled with the normal gases of combustion, at the average temperature for which the chimney was designed, and then the flow of these gases was suddenly stopped. This theoretical draft can never be attained in practice, but it is the basis of all scientific chimney design.

Available Draft

The available draft of a chimney is the theoretical draft after deducting the various losses back to the point of reference, such as at the base of the chimney.

The losses which must be deducted from the theoretical to obtain the available draft at this point are the velocity and friction losses in the chimney.

The loss due to velocity and friction of the flue gases in the chimney is expressed by Formula 2 as a percentage of the total draft.

CALCULATING CHIMNEY HEIGHTS AND AREAS

It is desirable that practical chimney data be as free as possible from all purely theoretical considerations which are covered in most text books on this subject. Theoretical considerations have been eliminated from the following formula for calculating chimney areas and heights and it has been found sufficiently accurate for conditions generally found in practice:

$$H = \frac{M d_a}{1 - \frac{N W^2 p}{a^3}} \qquad (1)$$

where

H = height of stack above the grate in feet.
M = a constant (see Table 1 for values for varying conditions).
d_a = draft in inches of water available at smoke pipe inlet to stack.
N = a constant (see Table 2 for values for varying conditions).
W = weight of flue gases, pounds per hour.
p = perimeter of flue in inches.
a = area of flue in square inches.