where

C_g = pounds of fuel burned per square foot of grate surface per hour.
G = total grate surface of boilers, square feet.
W_{tp} = total weight of products of combustion per pound of fuel.

Fig. 6 is a typical chimney performance chart giving the available draft intensities for various amounts of gases flowing and sizes of chimney. This chart is based on an atmospheric temperature of 62 F, a chimney gas temperature of 500 F, a unit chimney gas weight of 0.09 lb per cubic foot, sea level atmospheric pressure, a coefficient of friction of 0.016 and a friction duct length equal to the height of the chimney above the grate level. These curves may be used for general operating conditions. For specific operating conditions, a new chart should be constructed from Equation 1.

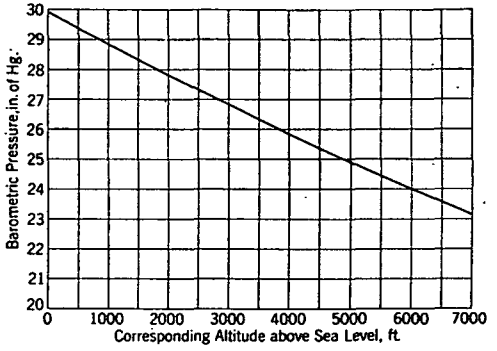

FIG. 5. RELATION BETWEEN BAROMETRIC PRESSURE AND ALTITUDE

ECONOMICAL CHIMNEY SIZES

It has been the usual custom, and still is to a lamentably great extent, to select the required size of a natural-draft chimney from a table of chimney sizes based only on boiler horsepowers. After the ultimate horsepower of the projected plant had been determined, the chimney size in the table corresponding to this figure was then selected as the proper size required. Generally, no further attempt was made to determine if the height thus selected was sufficient to help create the required draft demanded by the entire installation, or the diameter sufficiently large to enable the chimney quickly, efficiently and economically to dispose of the gases. Since the operating characteristics of a natural draft chimney are similar in all respects to those of a centrifugal pump, or a centrifugal fan, it is no more possible to select a proper size chimney from such a table, even with correction factors appended, than it is to select the proper size pump, or fan, from tables based only on the amount of water or gases to be delivered. Just as it is necessary to know the total dynamic head against which a pump and a fan are to operate, so it is necessary to know the total required draft against which the chimney is to operate.

The required diameter and height of a natural-draft chimney is given by the following equations:

$$H = \frac{D_r}{2.96B_o\left(\frac{W_o}{T_o} - \frac{W_c}{T_c}\right) - \frac{0.184fW_cB_oV^2}{T_cD}} \qquad (6)$$

$$D = 0.288\sqrt{\frac{WT_c}{B_oW_cV}} \qquad (7)$$

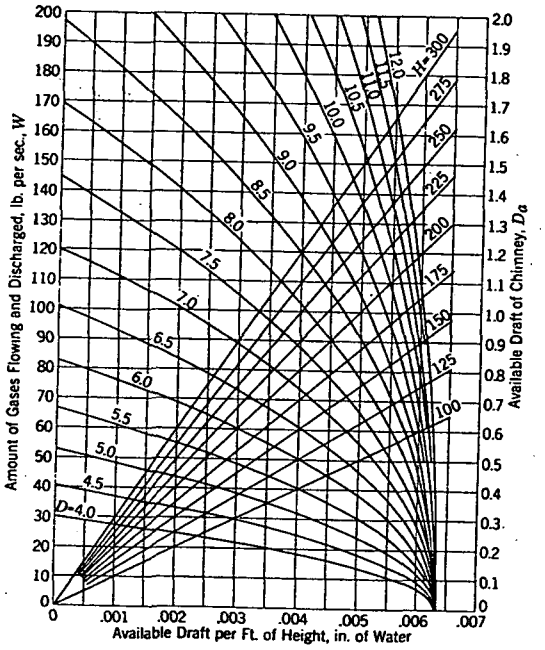

FIG. 6. CHIMNEY PERFORMANCE CHART

where

H = required height of chimney above grate bar level, feet.
D = required minimum diameter of chimney, feet.
V = chimney gas velocity, feet per second.
D_r = total required draft demanded by the entire installation outside of the chimney, inches of water.

Equations 6 and 7 give the required size of a natural-draft chimney with all of the operating factors taken into consideration. Values for all of the factors with the exception of the chimney gas velocity may be either observed or computed. It is, of course, necessary to assume an arbitrary value for the velocity in order to arrive at some definite size. For any one set of operating conditions there will be as many sizes of chimney as there are values of reasonable velocities to assume. Of the number of sizes