THE STACK

The function of the stack under natural draft operation is threefold: (1) to eliminate the waste gases; (2) to circulate the hot gases through the heating surfaces of the boiler and (3) to draw the air, necessary for combustion, through the fuel bed. The fuel bed resistance varies with the type of fuel and the last function referred to, becomes the heaviest stack load on the finer grades of fuel and this load is applied at the point where the stack is least able to handle it. Increasing the stack pull to the point where sufficient air can be drawn through a heavy bed of fine fuel results in a waste of heat due to excess air and a tendency to lift a certain amount of unconsumed fuel, unless the draft be properly controlled, by dampers, according to the varying thicknesses of the fuel bed.

The draft from stacks also varies according to temperatures and wind conditions. This, coupled with the difficulties of control referred to above frequently brings up the question of using properly regulated mechanical draft.

MECHANICAL DRAFT

There is a certain draft which will give the best results for every kind of fuel and rate of combustion. The amount of fuel that can be burned per hour per square foot of grate surface is governed by the quality and the type of fuel as well as by the draft obtainable.

Mechanical draft is used to obtain economy of operation, increased capacity or both and may be accomplished by either the forced or induced method. The two common methods of producing mechanical draft are by means of fans or steam jets. Each method has its advantages and design conditions will govern the choice of apparatus.

Mechanical draft fans are usually either disc or centrifugal type and because of the severe service to which they are subjected they must be of rugged construction, well balanced, must be able to operate continuously, withstand high stresses, maintain the proper pressure and horse-power characteristics and show a good efficiency over a wide range of operating conditions.

Mechanical draft fans should be of such capacity that they will be able to handle the quantity of gases produced. If it is assumed that 5 lb. of coal per boiler horsepower at 24 lb. of flue gases per pound of coal there would be 120 lb. of flue gases per hour to handle.

The volume of flue gases may be easily computed from the density of gases at the room temperature for forced draft and at flue temperature for induced draft and the size of fan to be provided may be obtained from the fan maker's table.

Fig. 1 shows the difference in pressure required between the ashpit and the furnace in order to burn various classes of fuel at different rates on the grate.

FORCED DRAFT

This is usually applied by what is known as the direct method where air is piped directly to the ashpit through intervening duct work with a pressure maintained sufficient to force the air through the necessary duct system, stoker setting if installed, and the fuel bed. Excessive pressures

not only create an outrush of flame and smoke when fire doors are opened but also cause objectionable leakage of gases into the boiler room.

For best firing condition, a slight indraft of 0.05 in. to 0.10 in. of water should be maintained above the fire and the remaining losses through the boiler, breeching, etc. should be taken care of by the stack or induced draft fan.

The determining factors for the correct amount of air and static pressure for forced draft installations are: the boiler rating to be developed, grate area and kind of fuel to be used.

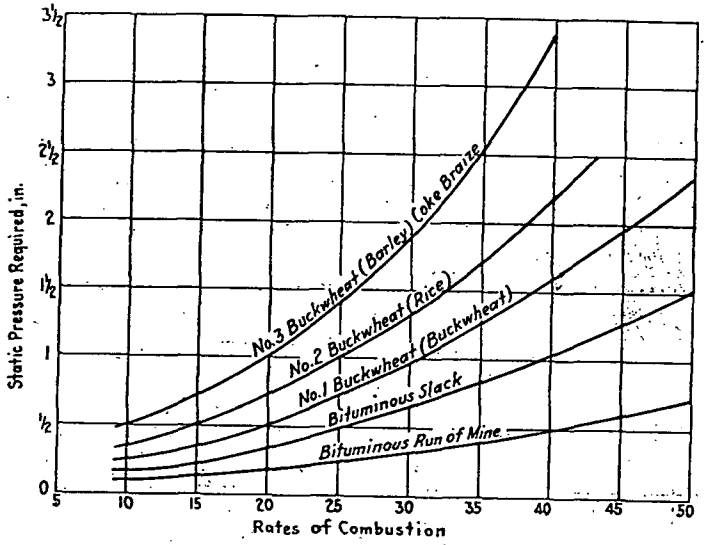

Fig. 1. Static Pressures Required to Burn Various Fuels at Various Rates of Combustion

For example:—On a 200 hp. boiler at 150 per cent rating with 45 sq. ft. of grate surface and using buckwheat coal it is found that by using 20 c.f.m. per hp. which would provide about 100 per cent excess air (a proper selection for hand fired conditions) 6000 c.f.m. would be required. Basing the calculations on 4½ lb. of coal per hp. developed would give 1350 lb. of coal fired per hour or 30 lb. of coal per square foot of grate per hour.

From Fig. 1 it will be noted that No. 1 Buckwheat would require 1 in. static pressure, and Barley, 2 in. static pressure. To this must be added the duct losses. The accompanying Table 2, gives the various velocities desirable for such an installation.

With low pressure heating boilers such as the steel firebox type and cast iron sectional boilers, observations show that 15 lb. of coal per hour per square foot of grate surface for the former and 10 lb. for the latter are reliable rates for burning.