the fuel bed and thus automatically causes a larger draft above the fuel bed, which draws in more secondary air through the same slot openings. In spite of this, a small size fuel requires a larger opening of the door slots; for a certain size for each fuel no slot opening is required, and for larger sizes too much excess air gets through the fuel bed.

It is impossible to establish a single rule for the correct slot opening for all types and sizes of fuels and for all rates of burning. Furthermore, the effect of slot opening is dependent on whether the ashpit damper is open or closed. It is better to have too much than too little secondary air; the opening is too small if there is a puff of flame when the firing door is opened.

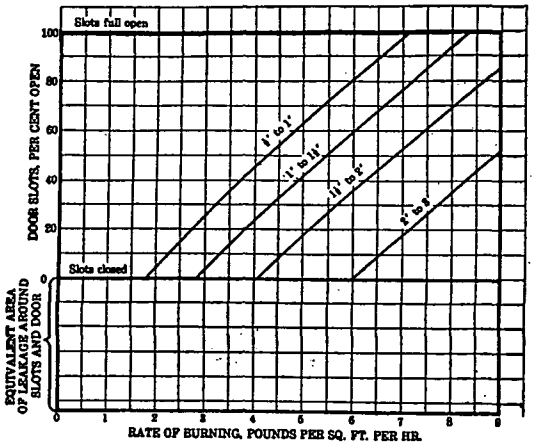

FIG. 3. RELATIVE AMOUNT OF FIRE DOOR SLOT OPENING REQUIRED IN A GIVEN FURNACE TO GIVE EQUALLY GOOD COMBUSTION FOR HIGH TEMPERATURE COKE OF VARIOUS SIZES WHEN BURNED AT VARIOUS RATES

The relationship of the slot opening, for a domestic furnace, to the size of coke and the rate of burning is shown in Fig. 3[3]. These openings are with the ashpit damper wide open, and would be less if the available draft permitted the damper to be partly closed. The same openings are satisfactory for anthracite.

Bituminous coals require a large amount of secondary air during the period subsequent to a firing in order to consume the gases and to reduce the smoke. The smoke produced is a good indicator, and that opening is best which reduces the smoke to a minimum. Too much secondary air will cool the gases below the ignition point, and prove harmful instead of beneficial. The following suggestions will be helpful:

1. In cold weather, with high combustion rates, the secondary air damper should be half open all the time.
2. In very mild weather, with a very low combustion rate, the secondary air damper should be closed all the time.
3. For temperatures between very mild and very cold, the secondary air damper should be in an intermediate position.

[3]From *Bureau of Mines Report of Investigations*, No. 2980.

4. For ordinary house operation, secondary air is needed after each firing for about one hour.

In the field of domestic heating the use of secondary air in the combustion of oil is generally restricted to the larger semi-commercial types of oil burners used in large heating boilers. This factor is discussed in Chapter 10, Automatic Fuel Burning Equipment.

The air that is supplied around the flame in a domestic heating gas burner is considered as secondary air. As it is drawn into the appliance by natural draft action, the need for proper draft control is evident.

Draft Requirements

The draft required to effect a given rate of burning the fuel as measured at the smokehood is dependent on the following factors:

1. Kind and size of fuel.
2. Combustion rate per square foot of grate area per hour.
3. Thickness of fuel bed.
4. Type and amount of ash and clinker accumulation.
5. Amount of excess air present in the gases.
6. Resistance offered by the boiler passes to the flow of the gases.
7. Accumulation of soot in the passes.

Insufficient draft will necessitate additional manipulation of the fuel bed and more frequent cleanings to keep its resistance down. Insufficient draft also restricts the control by adjustment of the dampers.

The quantity of excess air present has a marked affect on the draft required to produce a given rate of burning. If the excess is caused by holes in the fuel bed or an extremely thin fuel bed it is often possible to produce a higher rate of burning by increasing the thickness of the bed. The thickness of the fuel bed should not, however, be increased too much because the increased draft resistance will reduce the rate of primary air supply and the rate of burning.

DRAFT REGULATION

Because of the varying heating load demands present in most installations it is necessary to vary the rate of fuel burning. The maintenance of the proper air supply for the various rates of burning is accomplished by regulation of the drafts. Correct and incorrect methods of draft regulation are shown in Fig. 4. The air enters through the ashpit draft door, firing door and by leaks in the setting, whereas the gases leave only through the uptake. By throttling the gases with the damper in the uptake all the air entering by each of the three intakes is reduced in the same proportion. If the ashpit draft door is closed the air admitted through the ashpit is reduced and increased through the other two intake openings.

Methods of control of draft conditions when burning oil or gas are noted in Chapter 10, Automatic Fuel Burning Equipment.

CLASSIFICATION OF COALS

The complex composition of coal makes it difficult to classify it into clear-cut types. Its chemical composition is some indication but coals