adapted to use when it contains a large percentage of lumps or when it is uniformly sized, since the fine coal will cause a considerable loss by falling through the grates.

Semi-bituminous coal, because it has only a small percentage of smoke forming gaseous matter, is easily burned without smoke and is an excellent fuel. As a rule it is very easily broken up in handling and may therefore be quite fine. This coal forms a cake like caking soft coal and consequently requires the same attention.

If the coal is very fine so that a considerable percentage falls through the grate it will be advantageous to wet the coal before firing, in order to hold the fuel particles together until it cakes.

Lignite

Lignite is a free burning coal containing a high percentage of volatile matter in addition to a high percentage of moisture. The high percentage of moisture prevents easy ignition and causes breaking of the coal, when heated, into fine particles which may fall through the grate. For general use this coal is most satisfactory if broken into lumps of 3 in. size soon after mining and dried by exposure to the air. The ash from lignite resembles wood ash, does not clinker and generally falls through grate without shaking. Grates with small air spaces, especially those preventing falling of fuel into ashpit, are preferred for lignite.

HOW TO FIRE BITUMINOUS COAL

Bituminous coal should never be fired over the entire fuel bed at one time. A portion of the glowing fuel should always be left exposed to ignite the gases leaving the fresh charge.

Air should be admitted over the fire through the special secondary air device, or the slide in fire door or by opening the fire door slightly. If the quantity of air admitted is too great the gases will be cooled below ignition temperature and will fail to burn. The fireman can best judge the quantity of air to admit by noting when the air supplied is just sufficient to make the gases burn rapidly and smokelessly above the fuel bed.

The red fuel in the firebox, before firing, excepting for a shallow layer of coke on the grate, should be pushed to one side or forward or backward to form a hollow in which to fire fresh fuel. (Some manufacturers recommend that all red fuel be pushed to rear of firebox and that the fresh fuel be fired directly on the grate and allowed to ignite from the top. The object of this is to reduce the early rapid distillation of gases and to reduce the quantity of secondary air required for smokeless combustion.)

It is well to have the bright fuel in the firebox so placed that the gases from the freshly fired fuel, mixed with the air over the fuel bed, pass over the bed of bright fuel on the way to the flues. The bed of bright fuel then supplies the heat to raise the mixture of air and gas to the ignition temperature, thereby causing the gaseous matter to burn and preventing the formation of smoke.

The fuel bed should be carried as deep as the size of fuel will permit in order to have as much coked fuel as possible for pushing to the rear of the firebox at the time of firing. A deep fuel bed obtains the longest firing intervals.

If coal is of the caking kind the fresh charge will fuse into one solid mass which can be broken up with the stoking bar and levelled from 20 minutes to one hour after firing, depending on the temperature of the firebox. Care should be exercised when stoking not to bring the bar up to the surface of the fuel as this will tend to bring ash into the high temperature zone at the top of the fire, where it will melt and form clinker. The stoking bar should be kept as near the grate as possible and should be raised only enough to break up the fuel. With fuels requiring stoking it may not be necessary to shake the grates as the ash is usually dislodged during stoking.

The output obtained from any boiler with soft coal will usually exceed that obtainable with anthracite since soft coal burns more rapidly than hard coal and with less draft. Soft coal however will require quite frequent attention to fuel bed because it burns unevenly, even though the fuel bed is level, forming holes in the fire which admit too much air, chilling the gases over the fuel bed and reducing the available draft.

PREPARING FOR PICK-UP LOAD

The period of maximum heat demand should be anticipated in order that ash and clinker can be removed and enough fuel fired to have a deep

fuel bed well ignited at the beginning of this period. This is even more important with anthracite than with bituminous due to the slower ignition of the former.

In extremely cold weather, which occurs at most only during the few days per season, it is advisable, *if the reserve output of the boiler is small*, to keep the room temperature normal continuously to eliminate the peak demand due to pick-up of temperature.

CLEANING FLUES

All boilers are provided with flue clean-out openings through which the heating surface can be reached by means of brushes or scrapers. Flues of solid fuel boilers should be cleaned often to keep surface free of soot or ash. Gas-boiler flues and burners should be thoroughly cleaned once a year. Oil-burning boiler flues should be examined periodically to determine when cleaning is necessary.

CARE OF HEATING BOILERS WHEN NOT IN USE

During summer months more damage is frequently done to heating boilers than during the period of operation. This is due chiefly to acid formed by deposits on the surface of sulphur from the fuel and the moisture in the cellar air during summer. At the end of the heating season the following precautions should be taken:

1. All heating surfaces should be thoroughly cleaned, steel boiler being given a coating of lubricating oil.
2. All machined surfaces should be coated with oil or grease.
3. Connections to chimney should be thoroughly cleaned and in case of small boilers the pipe should be placed in a dry place after cleaning.
4. If there is much moisture in the boiler room, it is advisable to drain the boiler to prevent condensation of moisture on surface when boiler temperature is lower than the dew-point. In steel boilers kerosene poured on surface of water will form a protecting film over the inside surface as the water is drained out.
5. When the boiler room is comparatively dry, in the case of cast-iron boilers, the water level should be raised into the steam riser to exclude air from the boiler. A hot-water system is usually left filled to the expansion tank.
6. The grates and ashpit should be thoroughly cleaned.

Enough water only should be added to heating boilers to keep the level, when water is heated, at the height established by the manufacturer. Raising the water to a higher level may result in carrying of moisture with the steam. Water should not be used or allowed to be lost by leakage from heating systems as the fresh water required to make up the loss may introduce scale forming or corrosive matter.

HOT WATER SUPPLY BOILERS

Boilers for hot-water supply are classified as direct if the water heated passes through the boiler and as indirect if the water heated does not come in contact with the water or steam in the boiler.

Direct heaters are built to operate at the pressures found in city supply mains and are tested at pressures from 200 to 300 lb per square inch. The life of direct heaters depends on corroding properties of the water