

admitting and shaking grates. These grates permit a large part of the ash to be shaken into the ash pit beneath, while the clinkers are removed through the fire doors. With this type of grate, the main air chamber extends only under the retort while the side grates receive air by natural draft from the ash pit.

In still other stokers of this class, the main air chamber extends beyond the retort and is covered with fuel-bearing, air-supplying grates. With this type of grate, the fuel is supplied with air from the main air chamber throughout combustion. Also with this type of grate, dump plates are provided beyond the grates where the ash accumulates and from which it can be dropped periodically into the ash pit beneath.

Stokers in this class are compactly built in order that they may fit into standard heating boilers and still leave room for sufficient combustion space above the grates. The height of the grate is approximately the same as that of the ordinary grates of boilers, so that it is usually possible to install such stokers with but minor changes in the existing equipment. In some districts, there are statutory regulations governing such settings.

These stokers vary in furnace dimensions from 30 in. square to approximately 66 in. square. The capacity of the stokers is measured by the amount of coal that can be burned per hour. In general, manufacturers recommend that, for continuous operation, the coal burning rate shall not exceed 25 lb of coal per square foot of grate per hour, while for short peaks this rate may be increased to 30 lb per hour. Although these stokers were designed to burn bituminous coal, they can also be used to burn the small sizes of anthracite but at a somewhat lower rate. It is often customary to have the janitor or some other attendant care for the boiler as one of his duties. Under these conditions the heating plant does not receive the same careful attention as it would if a man devoted his entire attention to the fire. With periodic hand-firing, the boiler is operated inefficiently much of the time. With a stoker, the boiler is operated at the rate that the conditions require so long as there is coal in the hopper. With hand firing, it is customary to use the more expensive sizes of fuel, while with a stoker the smaller sizes are used at a considerable saving in the cost per ton. Because the stoker responds promptly to automatic regulation, it is possible to maintain a reasonably constant standard. Also because the stoker feeds the fuel regularly and in small quantities without losses due to opening doors, it must of necessity be more efficient than hand firing. This increase in efficiency depends entirely on conditions, with a minimum of about 10 per cent and a maximum of about 25 per cent.

Class 3 Stokers, General Commercial

These stokers are suitable for the heating plants of large schools, hotels, hospitals, or other large institutions as well as industrial plants. This class is served both by overfeed stokers and by underfeed stokers. The overfeed stokers are in general of three types, (1) the chain grate, (2) the rear cleaning inclined grate, and (3) the center cleaning inclined grate or V-type.

Stokers of this type are usually operated by natural draft, although in some cases conditions permit the operation of forced draft under the

grates. With most fuels, it is not advisable to operate overfeed grates at too high a combustion rate because of the greater difficulty of cleaning and the higher maintenance, but where the fuel is free burning and has a high ash fusion temperature, the combustion rate is not so restricted. The operation of the chain grates and the rear cleaning type of inclined grates has already been described.

The V-type stoker is practically obsolete although many are still in operation. In this stoker, the grates are inclined downward from both sides of the furnace to a low point at the middle where there is either a dump plate for periodic disposal of the ash or a rotary ash grate for continuous discharge of ash. In this stoker, the fuel is fed into a hopper at the top of the grate on each side of the furnace and advanced down the grates to the center where the refuse is accumulated. This stoker is always provided with a combustion arch over the entire furnace for the purpose of assuring thorough combustion of the solid fuel and providing a furnace temperature sufficiently high to burn the volatile gases. Because of this high furnace temperature and because so little of the boiler surface is exposed to the fire to assist in carrying off the heat by radiation, this stoker is characterized by severe clinking in the ash area. With all types of overfeed stokers, the most desirable installations are in boilers which are operated with comparatively uniform loads and moderate rates of combustion, since, even with good combustion arches, fluctuating loads or high combustion rates result in free volatile gas and this in turn means smoke.

The underfeed stokers in this class were the first of the type to be developed as at the time of their development very few large boilers were in use. The stokers are not so varied in design as those in the smaller class although in principle they are much the same. Practically all of them are of the plunger coal feed type with retorts extending the entire length of the furnace, with air supplying grates adjacent to the retorts, and with manually-operated dump plates at the sides of the furnace. The coal feeding plunger is operated by a steam or electric driver through a reduction gearing, or by a steam or hydraulic piston connected directly to the coal feeding plunger.

These stokers are heavily built and designed to operate continuously at high boiler ratings with a minimum amount of attention. Because of the fact that all volatile gas must pass through the fire before reaching the combustion chamber, these stokers will operate smokelessly under ordinary conditions. Also because of the fact that these stokers are always provided with forced draft, they are the most desirable type for fluctuating loads or high boiler ratings.

In the design of the grates for supporting the fuel between the retort and the ash plates, the stokers differ in providing for movement of the fuel during combustion. Some stokers are designed with fixed grates of sufficient angle to provide for this movement as the bed is agitated by the incoming fuel, while others have alternate moving and stationary bars in this area and provide for this movement mechanically. In either type, with proper operation, all refuse will be deposited at the dump plate. Another difference in these stokers is that some makes use a single air chamber under the whole grate area thus having the same air pressure