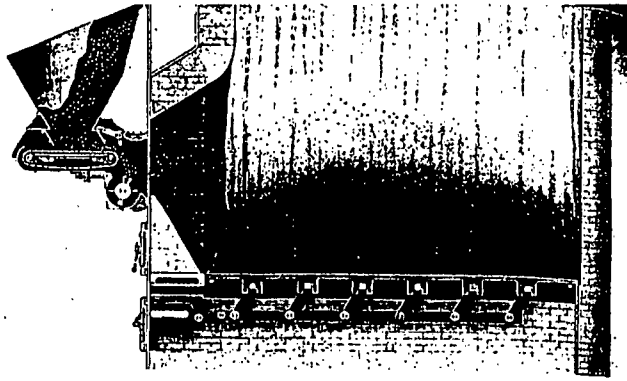
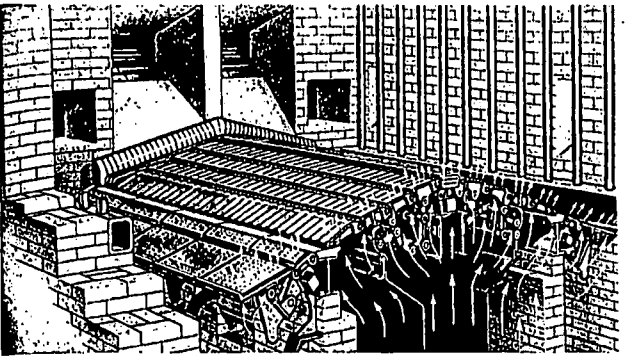


1 In spreader-stoker firing part of fuel is burned in suspension, part on a grate. Coal is projected across the furnace; fine particles burn during travel but the larger pieces fall to grate, forming an overfeed fuel bed on it. The stoker shown feeds coal by a chain to an overthrow distributing rotor, to be propelled into the furnace. The grate is arranged for dumping by steam, air or hydraulic operating devices



2 In this design, feeder rams supply coal to a split plate where spring-loaded equalizer plate reciprocates at a right angle to it, shredding off fuel. Overthrow rotor spreads coal over central portion of grate, which has link construction to give a wave-like motion that keeps the fuel bed active and moving to ash-discharge grates. Dumping doesn't interrupt feeding

Burning Coal on Overfeed Stokers

In terms of number of applications, fuel-bed firing takes the lead over suspension firing, the method of burning solid fuels we have just discussed. In modern practice, this means *stoker* firing, as mechanical methods have made obsolete less-efficient hand firing. Stoker operation, we have seen, consists of: (1) pushing, dropping or throwing coal on a grate within a high-temperature region of the furnace (2) distilling off part of the coal as a combustible gas (mostly hydrocarbons and CO), which burns above the fuel bed just like gaseous fuels (3) exposing the remaining red-hot solid, coke, to vigorous scrubbing by air coming up through the fuel bed until it is burned, and (4) removing the resulting ash from the furnace zone.

Stoker Types. Stokers accomplish these steps in a variety of ways, and the nature of the fuel bed may differ considerably in actual fact from the simplified bed with clearly defined zones illustrated on page 76. Stokers may be divided into two general classes, depending on the direction from which raw coal reaches the fuel bed: (1) *overfeeds*, in which the fuel comes from above, and (2) *underfeeds*, in which it comes from below. In turn, current overfeed designs may be divided into two broad groups: (1) *spreader* stokers, and (2) *chain-grate* or *traveling-grate* stokers. Let's look at the spreaders first, because their combination of suspension and fuel-bed firing forms a logical bridge from the pulverized-coal firing just discussed, and also because their fuel beds most closely resemble the idealized fuel bed set up for earlier basic consideration.

Spreader Operation. These stokers take raw coal (within definite size limits) and whirl it into suspension within the furnace by paddles or wheels, Fig. 1-7, or by air or steam jets, Fig. 8-10. The fines in the incoming stream of coal tend to burn in suspension during their travel across the furnace, while the larger pieces fall to the grate to form a fuel bed there. To a limited extent, then, spreader firing partakes of the characteristics of pulverized-fuel burning.

The fuel bed is normally rather thin but, since raw coal is distributed over it relatively evenly, it is not unlike the idealized fuel bed, with distillation, reduction, oxidation and ash zones one on top of the other. Actual thickness of the bed varies with steam demand and class of coal. Usually there is never more than a few minutes' supply of fuel on the grate. Underlying the thin, active fuel bed is a layer of ash. This, together with flow of air up through the grate, serves to keep metal parts to safe operating temperature. Air can usually be preheated to 300-350 F without creating a maintenance problem.

Underfire Draft. The characteristically thin fuel bed offers relatively light resistance to underfire air flow. Keeping resistance of the grates themselves fairly high and holding windbox pressure relatively low avoids heavy fluctuations as fuel-bed thickness changes, and also avoids heavy cinder carryover or, in extreme cases, blowholes.

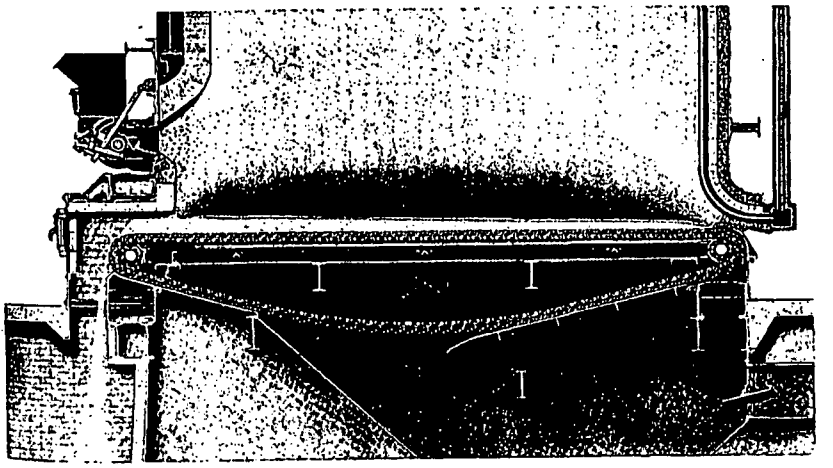
Normal operation calls for relatively low overfire draft and gas velocity. This precaution becomes doubly important when it is realized that an estimated 30 to 50% of the coal's ash content may go off with the furnace gas.

As much as half of this carryover may be unburned combustible. Hence, installation of a cinder reinjection system often proves desirable. Such a system comprises settling chambers somewhere in the boiler setting and, usually, a cinder collector ahead of the induced-draft fan to save wear and tear on fan blades. Particles collected are fed to the furnace for reignition and burning. Returned cinder usually enters at a point above the fuel bed, but not too close to boiler tubes, under impulse of a jet. The jet gives added overfire turbulence and helps promote good combustion.

Furnace Design. Usual furnace arrangement follows simple lines with little or no arch construction. As with all fuel beds, composition of the gas released varies somewhat from point to point, and there is a tendency for gas, and secondary air, to take the most direct way to the furnace exit. High-velocity overfire jets prove effective in combating possible stratification. The turbulence they create not only improves mixing and increases time for combustion, it helps to reduce cinder carryover as well. Location of these jets should be worked out carefully, giving due consideration to relation to the coal's travel path.

Grate Arrangements. A variety of grate constructions are available and, by and large, plant operating conditions determine the most suitable one for any given installation. Simplest form is the stationary grate, which is cleaned manually. For dumping operation, grates are sectionalized so that one part of the fuel bed may be cleaned without affecting the others. In both, fuel feed stops during the cleaning operation. But the dumping arrangement minimizes the interruption by the sectionalizing feature and by the greater ease with which fire-cleaning may be carried out. Stationary grates prove entirely satisfactory in small plants, particularly where low-ash coal is used. Dumping grates find wide acceptance in somewhat larger installations.

In the stoker of Fig. 2, coal is thrown evenly over the entire central portion of the grate. This is constructed to give a wavelike motion to the fuel bed, keeping it active and porous as it slowly moves toward the ash-cleaving discharge grates at either side. The hydraulically operated discharge breaks off the burned-out refuse and drops it to the ashpit. With this central firing and moving grate, there is no need to interrupt fuel feed during ash discharge.



3 Revolving rotor takes coal fed from a hopper over a split plate. This overthrow rotor hurls coal back over a chain grate which moves toward the furnace front. This movement of the grate makes ash-discharge continuous and fully automatic