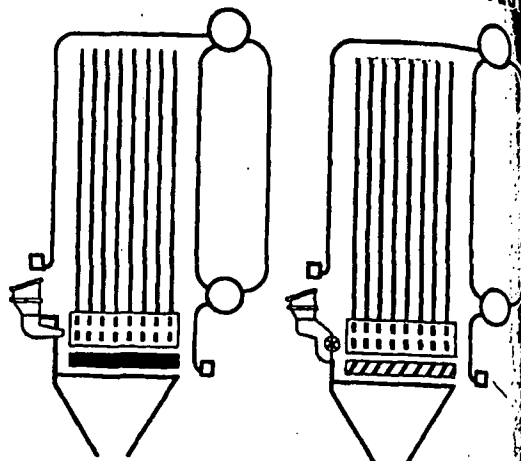


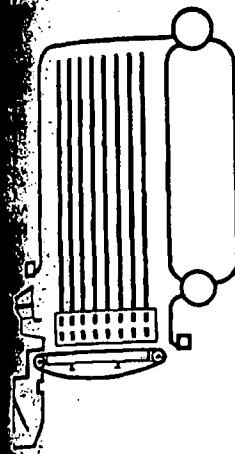


1 SPREADER-STOKER FURNACES EMPLOY



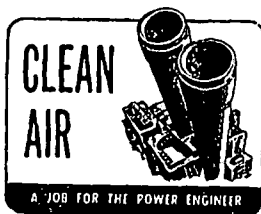
SPREADER STOKERS fire a wide range of coals. Choice of fuel-bed grate depends more on the steaming requirements than upon characteristics of coal.

VARIOUS FUEL BEDS



CONTINUOUS DISCHARGE of ash on moving grates aids large steaming units.

Want Your Overfeed Stoker to Be Smokefree?



Here are pointers that you can put to work to insure combustion without smoke. What's more, fundamentals of theory and operation are included for overfeed stokers—chain, traveling-grate or spreader—that add up to helpful operating know-how.

By L. N. ROWLEY, Managing Editor, and J. C. McCABE, Assistant Editor

WAY BACK in the August 1947 issue of *Power* when we talked of "How Fuel Burns" (p. 71), we set up two fuel-burning groups for solid fuels: (1) suspension and (2) fuel bed. An article on the first, suspension or pulverized-coal firing, appeared in January 1948 (p. 76).

Let's look now at the second, fuel-bed firing. It can be done by introducing coal mechanically with stokers, or by hand. With stoker firing, two major

methods of supplying coal are employed—overfeed and underfeed. By far the majority of overfeed stokers in power-plant service employ the spreader, chain- or traveling-grate arrangement.

Stoker firing. In all stokers firing proceeds in four steps: (1) Coal is pushed, dropped or thrown into a high-temperature region within a furnace. (2) A part of the coal is distilled off as a combustible gas (mostly hydro-

carbons and CO) and burned above the fuel bed just like a gaseous fuel. (3) Remaining solid or coke stays red hot and experiences a vigorous scrubbing by air until completely burned. (4) Ash is removed from the furnace zone.

Spreader stokers, Fig. 1, take raw coal (within definite size limitations) whirl it into suspension within the furnace by (1) pneumatic or steam nozzles or (2) paddles or wheels that throw the coal supplied from an over-

Tips for Smokefree Operation

- Watch fuel-size consist
- Avoid segregation of fuel
- Keep fuel bed level
- Hold overfire draft low
- Keep fire and ashpit clean
- Provide enough furnace volume
- Establish turbulence
- Guard against air leakage
- With spreaders, use controls

feed or underfeed hopper source. Fines tend to burn in suspension, larger sizes drop to the fuel bed.

The fuel bed may be one of three types—stationary, dump or continuous discharge, Fig. 1. Choice of grate type depends more on steaming requirements and less on coal characteristics.

Stationary grates prove satisfactory for small-capacity boilers, particularly those employing low-ash coals on hand-cleaned grates. Dumping grates fit well

into medium-sized installations; continuous discharge or traveling grates, into large-sized steam generators.

Dumping grates require certain conditions for best results. For instance, the grate should be power operated. Furnace should be designed in sections, that is, grate-surface sections should have separate forced-draft supply, grate and ashpit. This arrangement permits cleaning one section of grate without interrupting or disturbing firing on neighboring sections.

Continuous discharge units get around the problem of interrupting steaming capacity for ash cleaning by removing it continuously and automatically on a moving grate.

Class of fuel. Spreader stokers fire a wide range of coals (from lignite through bituminous). Anthracite—that is, 100% anthracite—has not yet proved successful as fuel. It piles up in front.

Other coals, however, as well as many byproduct fuels like coke breeze, burn well with spreader-stoker firing. Sizing of fuel is highly important. Top size, for coal, is about 1½ in. Coarse sizes wear the feeder, overload and clinker on the grate. Preferred size is ¾ in. x 0, nut and slack.

Size consist must be uniform. Segregation of coals can raise hob with the usual thin fuel bed. Avoid it by (1) maintaining hopper half full at all times (2) filling hoppers by mechanically operated spouts, traveling ladders or nonsegregating chutes.

So much for fuel and feed, now for firing. Fuel-bed thickness, grate speed, forced draft vary with steam demand and the particular coal. For instance, a high-ash low-fusion-temperature clinkering coal requires even distribution, uniform size consist and thickness on a thin, undisturbed fuel bed.

In general, keeping the fuel bed level and thin gives good performance and low maintenance. Good controls help achieve this. A heavy fire clinkers and smokes. Avoid particularly a heavy fire at front or bridgeway. At the front it causes overheating of arch, and at the bridgeway clinkering develops.

Ignition. Spreader stokers as a class enjoy the reputation of quick starters. Even with a cold setting, pressure builds up fast. So much so that it may exceed the rate considered safe for expanding parts of the boiler. It follows that the spreader-stoker fire comes up quickly on a live bank. But banking is something of a problem.

Be sure to leave a layer of ash on the grate. Cut down air flow, reduce feeder speed and supply coal to banking end

only. Cut off forced draft and stoker speed. Maintain a slight overfire draft. On low-load operation, remember rate of ignition drops, smoking can develop.

How about draft? Air at low pressure and at temperatures below 300 F (to avoid any coking problem) passes through the grate. Overfire draft is deliberately held low to prevent development of troublesome gas velocities. Air introduced by jets (see below) at the overfire level is usually held down to 10-20% of the total supplied for combustion. Its function at this level is one of mixing. Steam jets achieve essentially the same result.

A low overfire draft and low gas velocity improve operation. Here is why. The thin fuel bed offers little resistance to incoming air so cinder and flue dust are ever present in the furnace gas, and more so with high drafts. Somewhere between 30-50% of the ash content of the coal goes off with the gas stream leaving the furnace. Furthermore, combustible in this same flyash-and-cinder mix constitutes as much as 50% of its weight. It all points up the need of (1) low drafts (2) a cinder collection and return. With some, collectors are imperative.

Cinder collection. This system comprises (1) settling chambers somewhere within the boiler setting (2) a cinder collector usually before the induced-draft fan to save wear and tear on fan blades. All matter collected in the system is fed by mechanical means to the furnace for reignition and burning.

Returning cinder usually enters at a point above the fuel bed (but not too close to the boiler tubes) under the impulse of air or steam jets. These jets give an added overfire turbulence that promotes good combustion.

One operator in a large power plant believes in mixing the collected fines with the incoming coal in the stoker hopper. This procedure has two operating advantages: (1) uniform fire bed (2) reduction of fines in suspension by holding the recirculated dust at fuel-bed level.

Recirculation of cinders and flue dust has strong advantages: (1) reduces stack discharge and, therefore, "the smoke nuisance" (2) increases over-all efficiency of the individual steam generator (3) reduces maintenance on induced-draft fan, rotor and casing. These advantages apply to traveling- and chain-grate as well as to spreader-stoker installations.

We are now ready to score the points where smoke trouble could develop.

First fuel supply. Here size consist