INDECK®

KEYSTONE ENERGY, LLC.

ERIE CITY IRON WORKS

SINCE 1840

Spreader Stokers

IKE, under the former boiler company names of; "Erie City Iron Works", "Zurn Energy", "Aalborg Industries", and "Erie Power Technologies", has designed and produced hundreds of spreader stokers for a variety of solid fuel applications for over fifty years.

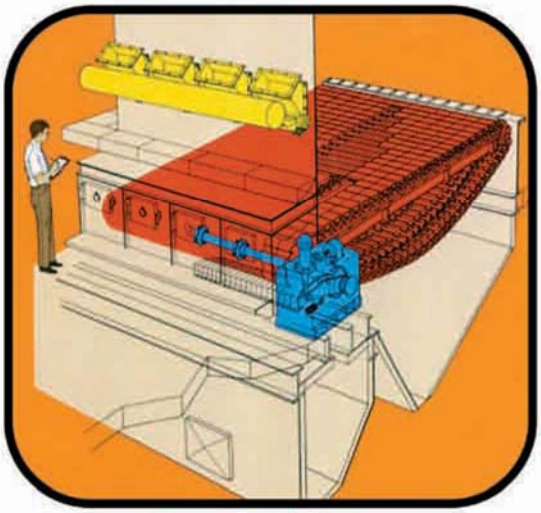
Both the ***Travagrate***$^{\theta}$ front ash discharge traveling spreader stoker and the water cooled stationary grate spreader stoker have been utilized to produce steaming rates from 25,000 pounds of steam per hour up to 500,000 pounds of steam per hour.

Depending on the type of stoker, the fuels able to be fired include;

- Coal and Lignite
- Wood and Bark
- Bagasse
- Demolition Wood
- Tires (Shredded)
- RDF (Processed Urban Garbage)
- Agricultural Wastes (Stalks, Shells, Fronds, Etc.)

One of the older technologies developed for firing solid fuels, spreader stokers still provide a vital means of producing steam using an efficient and reasonably priced machine.

Stokers can be designed in a multitude of widths and lengths, able to custom-fit the shape and other physical constraints of any steam generator.



Travagrate$^{\theta}$ **Stoker**

In addition to the traditional coal or lignite fired applications, both the **IKE** traveling grate and stationary grate stokers have been supplied to fire the less common biomass fuels found throughout the world.

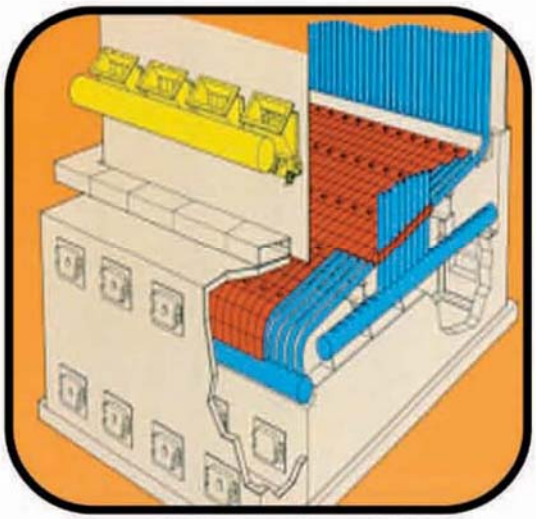
A brief list of international projects includes;

• Columbia	Bagasse
• Canada	Wood
• Ethiopia	Bagasse
• Denmark	Wood
• Philippines	Bagasse
• India	Bagasse and Lignite
• U.S.A.	Wood, Tires, RDF
• Ireland	Wood

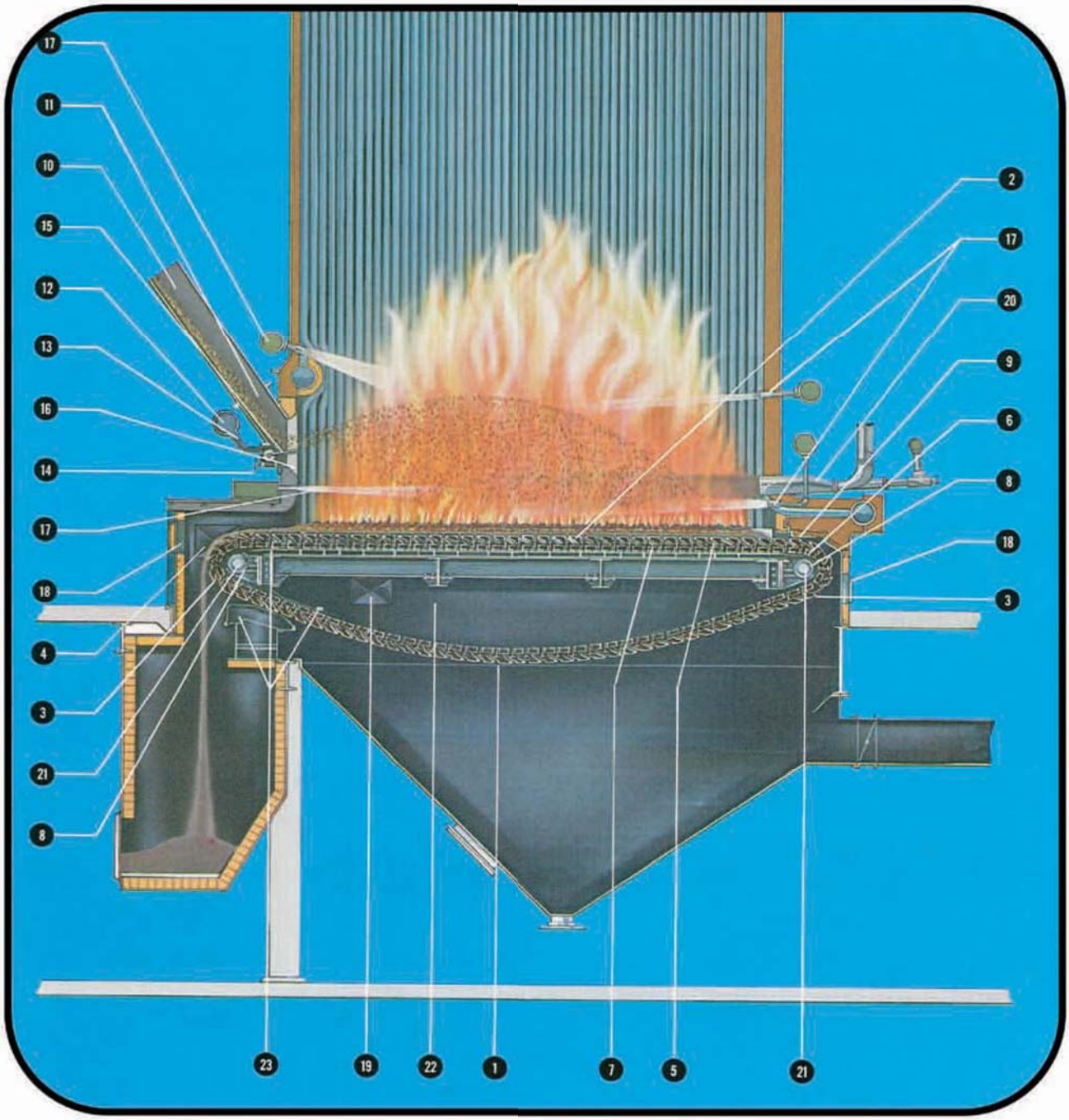
Along with the ability to produce a variety of stoker equipment specifically designed for each installation, **IKE** has the staff and skills needed to provide equipment properly documented and transported anywhere in the world.

Offering on-line availabilities greater than 98% and reinjection systems able to reduce combustible losses below 2%, a spreader stoker can provide decades of dependable service with a minimum of maintenance.

Traveling or stationary grate stokers provide ease of maintenance and problem free operation.

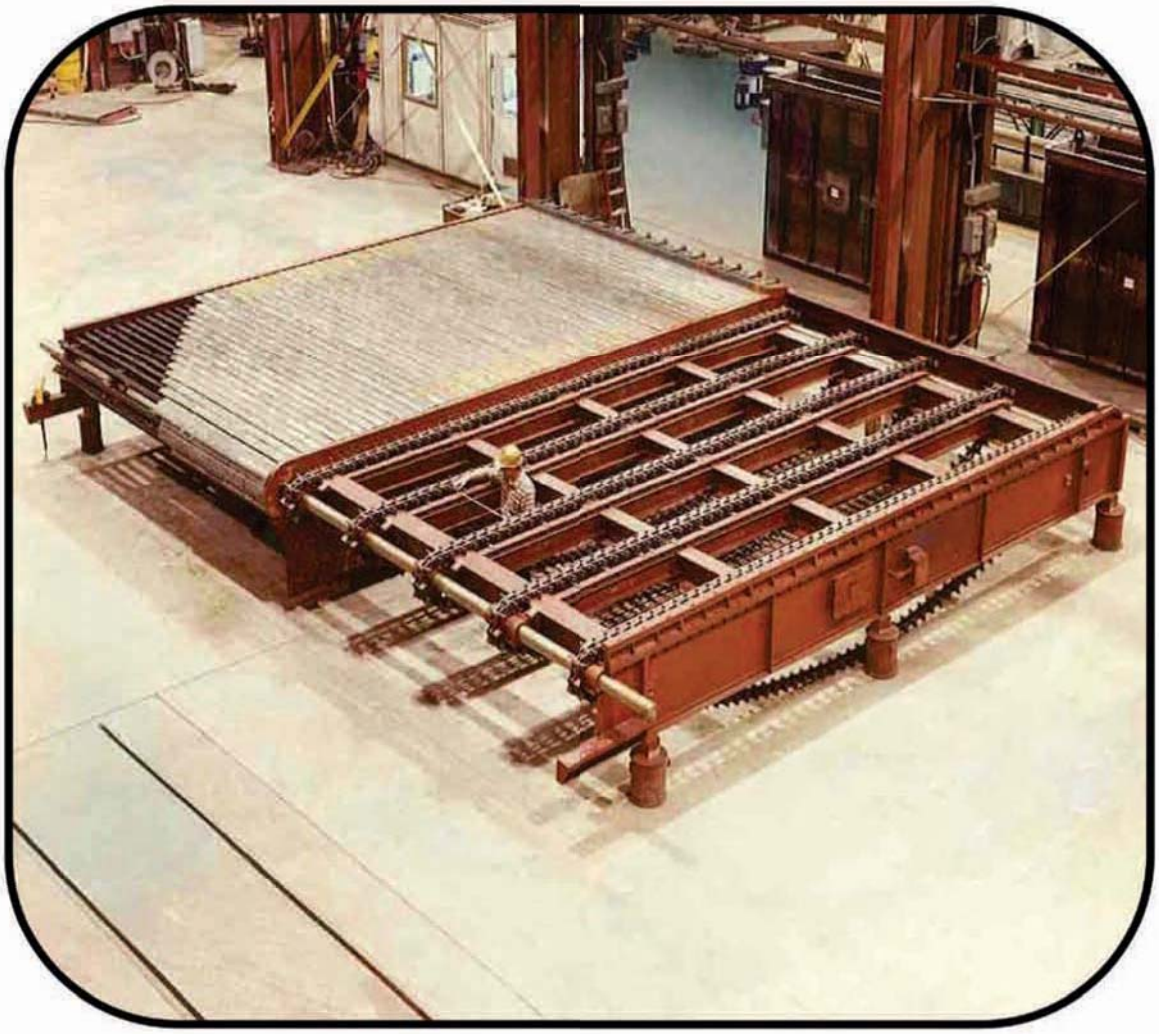


Stationary Grate Stoker



Cross Section Through The IKE Travagrate® Stoker

1 Free Hanging Catenary
2 Alloyed Metal Grate Surface
3 Closed Grate Curvature Design
4 Side Door Grate Removal
5 Chain Design
6 Case Hardened Chain Pins
7 Full Grate Support Castings
8 Split Sleeve Bearings
9 Self-Adjusting Rear Seals
10 Individual Fuel Chutes
11 Pneumatic Fuel Distributors
12 Fuel Air Supply Ducts
13 Metering Fuel Air Dampers
14 Fuel Trajectory Controls
15 Distributor Deflector Plate
16 Fuel Distributor Plate
17 Overfire Air System
18 Front and Rear Access Doors
19 Undergrate Access Doors
20 Char Recovery System
21 Front and Rear Grate Shafts
22 Air Pressure Chamber
23 Front Undergrate Air Seals



▶ The stoker grate frame assembly is always pre-assembled in the factory to assure that all components fit properly, are aligned, and correctly bolted in place.

Pre-fitting the grate frame structural components, castings, doors, bearings, shafts, and sprockets, eliminates time consuming field fit-up. Any corrections, if necessary, are made at the factory.

After fit-up, final paint and match-marking, the stoker parts and components are crated and properly tagged to allow rapid re-assembly at the site.

▶ When the structural components of the grate frame assembly are viewed in detail, you can see that the frame is constructed of perpendicularly interlaced beams. providing strength and alignment. Due to this type construction, the weight of the moving portion of the grate is supported along its full length and width.

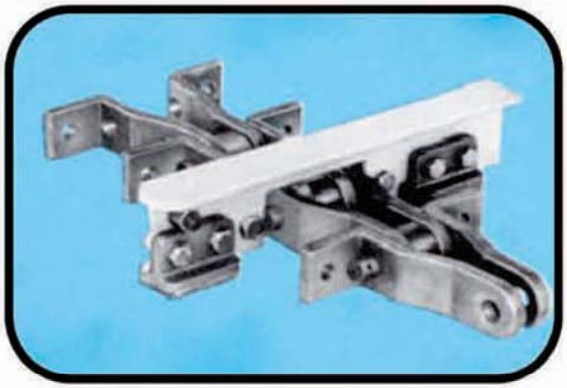
Using more than an adquate number of grate chain assembles reduces the loadings to each sprocket and distributes the loading more evenly across the main shafts.

Since each grate casting is supported by a steel grate carrier bar, the grate only supports its own weight and a small amount of ash or fuel.

▶ A variety of main shaft sleeve bearings are offered depending on the application. The sleeves can be provided in graphite impregnated bronze, for totally dry operation, or in graphite grooved or plugged bronze, designed to be flushed with a cleansing lubricant.

Depending on the loads carried by the front and rear main shafts (provided in high alloy 4340 steel), the bearings are located to uniformly support the load along the shaft's full length.

▶ The components used to produce the stoker chains are made from forged steel chain links and case hardened steel pins and rollers. When attached to the steel grate carrier bars, the complete assembly produces a strong and resilient means of uniformly moving the grate system forward. To support the assembly, each chain link is straddled by case hardened skid castings which move along case hardened rails.



▶ The key components used to move the grate assembly forward are the high strength case hardened ductile iron sprockets. The sprockets are designed to be easily replaced when needed.

▶ The most important component of the grate assembly system is the grate casting. **IKE** offers the "Travagrate" grate casting in a variety of alloys and sizes. Besides the standard 12 and 15-inch widths, the grate shape is also offered in 1-inch and 1½-inch "Finger" widths for selected applications.

All sizes of grate castings are now offered in either high silica ductile iron or "HH" grade stainless steel. The alloy selected is based on the fuel characteristics and the application.

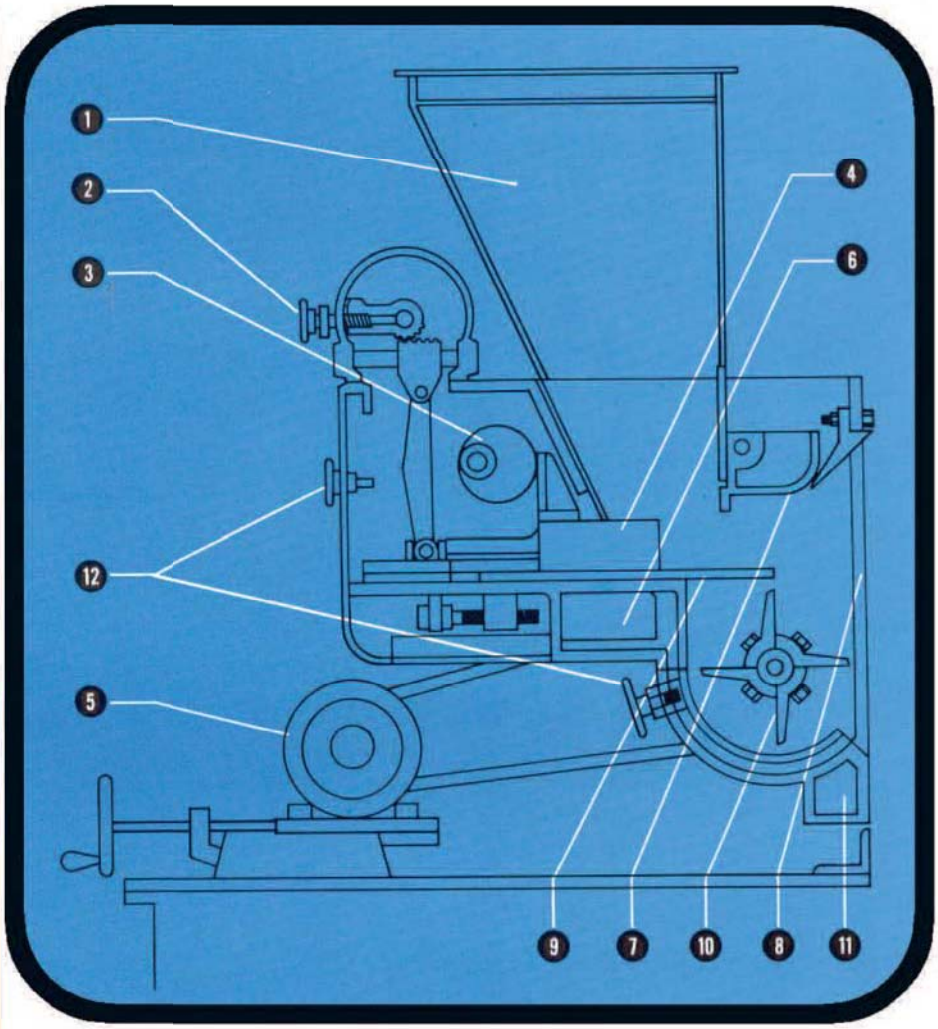
INDEPENDENT MECHANICAL FEEDERS ASSURE UNIFORM AND CONTINUOUS FUEL SUPPLY

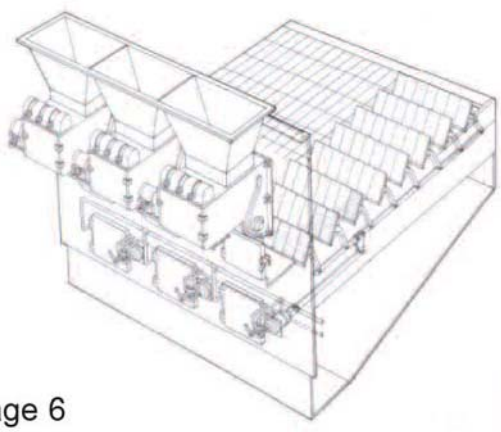
IKE designs, engineers and constructs a series of mechanical feeders ideally suited for dump-grate and other smaller capacity spreader stokers.

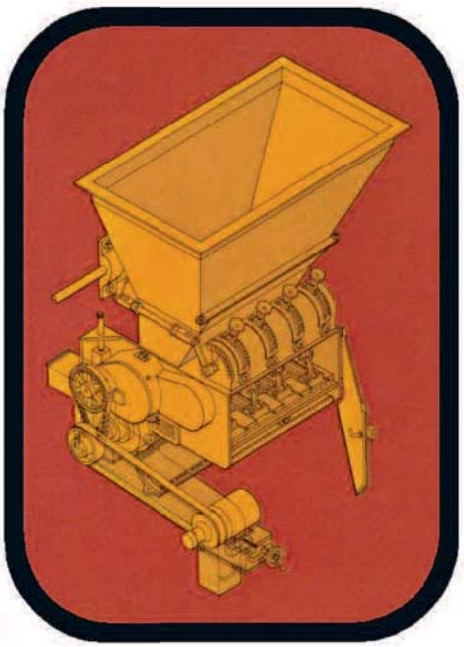
Coal feeders are the reciprocating type, mounted in the stoker front plate, each complete with a coal receiving hopper and independent feeder drive assembly.

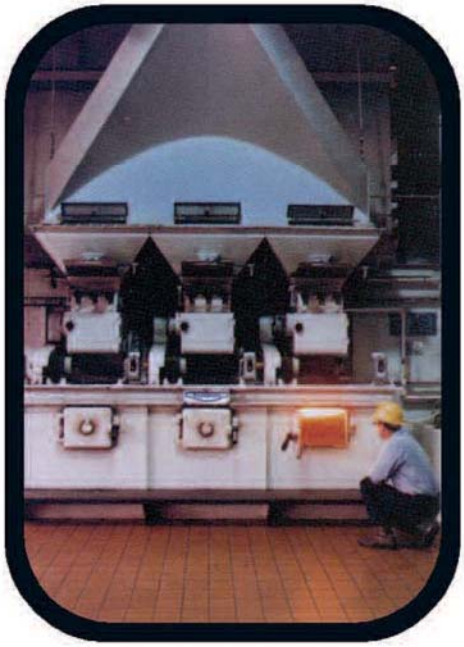
The design is such to permit operation of one feeder independently of the others, or all feeders simultaneously. Each feeder is provided with three cam-actuated coal pusher blocks where one of the three coal pusher blocks is always feeding coal to the rotor. The triple cam-actuated pusher block system incorporates numerous distinct advantages including:

- **Uninterrupted flow** of coal to the furnace.
- **Complete agitation** in the coal hopper — a major advantage, especially when handling wet coals.
- **Full control** of the volume of coal flowing to any part of the grate with any one of the three blocks.
- **Compensation for segregation** of coal within the feeder.
- **Cuts out** any portion of the feeder with simple operator wrist action.
- **Can modulate** as little as one-third of the feeder's capacity over the entire control range — especially desirable during light-load periods of operation.









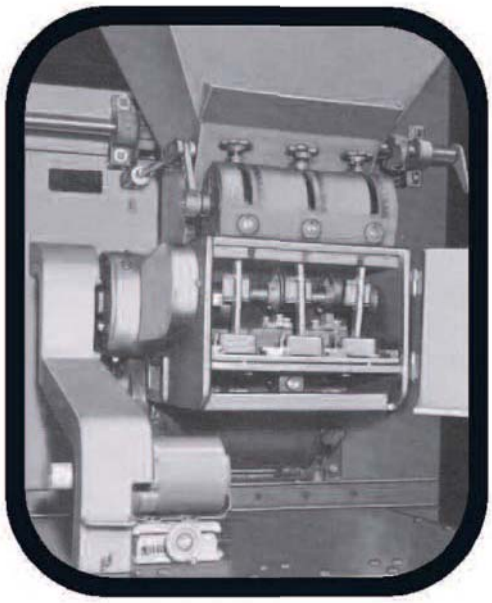
FEATURES

IKE reciprocating feeders, completely factory-assembled, efficiently feed a large range of different grades of coal and are carefully constructed for easy operation, low maintenance and long life. Uniform distribution of fuel and rate of feed are assured by design features which include:

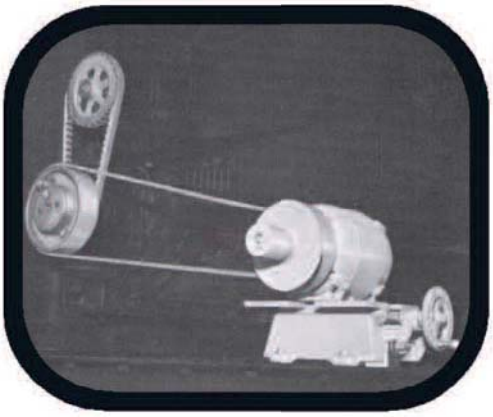
1. **Large coal-receiving hoppers** with sufficient coal capacity.
2. **Individual feeder controls** allow for fine regulation of the fuel bed through three separate pusher blocks.
3. **Pusher block eccentrics** move each pusher block back and forth over a 2-inch maximum stroke.
4. **Pusher feed blocks** are individually controlled.
5. **Individual feeder drives** provide for independent control of each feeder.
6. **Air ducting** continually dissipates heat from vital feeder mechanisms.
7. **A swivel gate** immediately opens, allowing large obstacles to pass, thus protecting vital feeder parts.
8. **The fuel distributor opening** includes a completely air- and water-cooled casting.
9. **The trajectory plate** is adjustable for maximum efficiency.
10. **Fuel distributor rotor blades,** revolving at 250-1000 rpm are specially designed for uniform lateral and longitudinal fuel distribution.
11. **Water-cooled ducting** protects the vital feeder mechanism from excess furnace heat.
12. **Access** is provided to both the feeder and distributor sections.

(Far left) Overall view of IKE reciprocating feeder with belt guard removed.

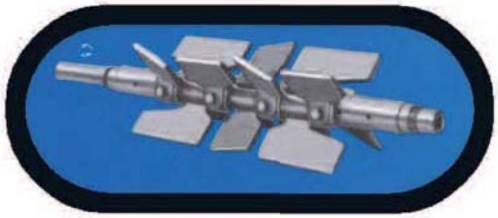
(Near left) IKE reciprocating feeders, installed on this 90,000 lbs/hr boiler with TRAVAGRATE stoker, are usually specified for steam generators ranging from 10,000 to 100,000 lbs/hr.



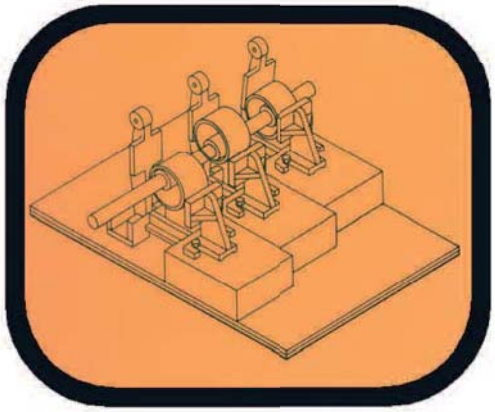
The feeder assembly is shown with the door of the housing open to reveal the three cam-actuated coal pusher blocks. Directly above this housing are located the individual controls for each block. These controls can be made fully automatic simply by engaging the shaft of the automatic control lever mounted at the left of the housing.



Individual feeder drive provides for independent control of each feeder and avoids high maintenance on line shafts, clutches and universal joints, associated with other designs. Each feeder drive assembly consists of a TEFC motor complete with a Reeves vari-speed pulley with belt drive to a shearing pulley on the rotor shaft, and in turn, through a reduction unit, to the cam shaft which actuates the pusher blocks.



Fuel distributor blades can be easily and safely replaced or adjusted. The motor is stopped, access door unbolted and adjustment is made. Line shaft designs call for clutch holding while adjustment is made to the rotor blades.



Detailed illustration of the unique triple pusher blocks, each cam-activated and adjustable to provide constant coal feeding to the feeder rotor assembly.

SPREADER STOKERS: A RESOURCEFUL ENERGY ALTERNATIVE

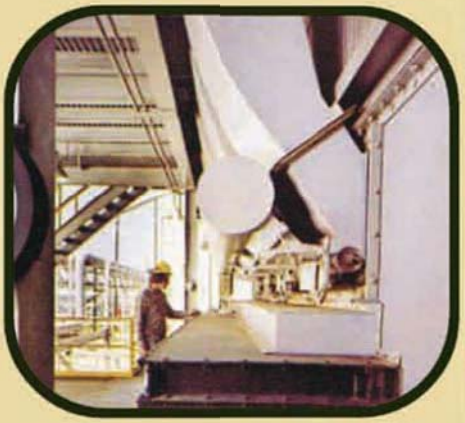
Renewable energy resources such as wood, refuse and other biomass wastes are receiving greater consideration as primary energy sources by industry and utilities.

In the early 1900's, wood was the major source of energy in the United States. Today, wood, agricultural wastes and other biomass supply almost 2% (1.5 *Quads/year) of U.S. energy, 7% of industrial energy. Government analysts estimate bioenergy resources could supply 15 to 20% (12-17 Quads/yr.) of U.S. energy by the year 2000. The combustible portion of municipal solid waste, now generated at 135 million tons/year has the potential of providing another 2%.

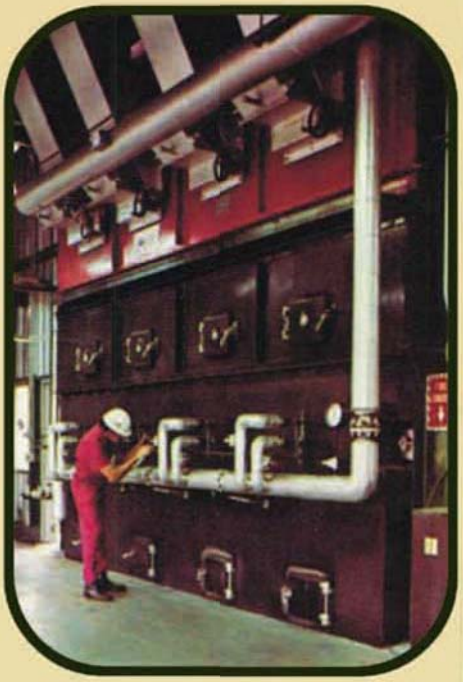
Higher costs for basic fossil fuels coupled with favorable legislation have greatly increased the financial viability of using alternate fuels. Stoker-fired systems are an excellent way to capitalize on these valuable energy resources.

IKE Inc. designs, engineers, manufactures and installs spreader stokers for burning a wide variety of wood, refuse and biomass fuels in boilers produced by us or by any other boiler manufacturer.

*A Quad equals 1 quadrillion (10^{15}) Btu. It equals the energy of approximately 464,000 bbl/d of oil for 1 year, 50 million tons of coal, or the typical annual energy output of eighteen 1,000 Mw power plants. Energy consumption in the U.S. totalled 70.45 Quads in 1983.



TRAVAGRATE spreader stoker provides continuous-ash-discharge for a 140,000 lb/hr wood-fired unit in a Texas forest-products producing plant. System was designed for future lignite firing and future cogeneration.



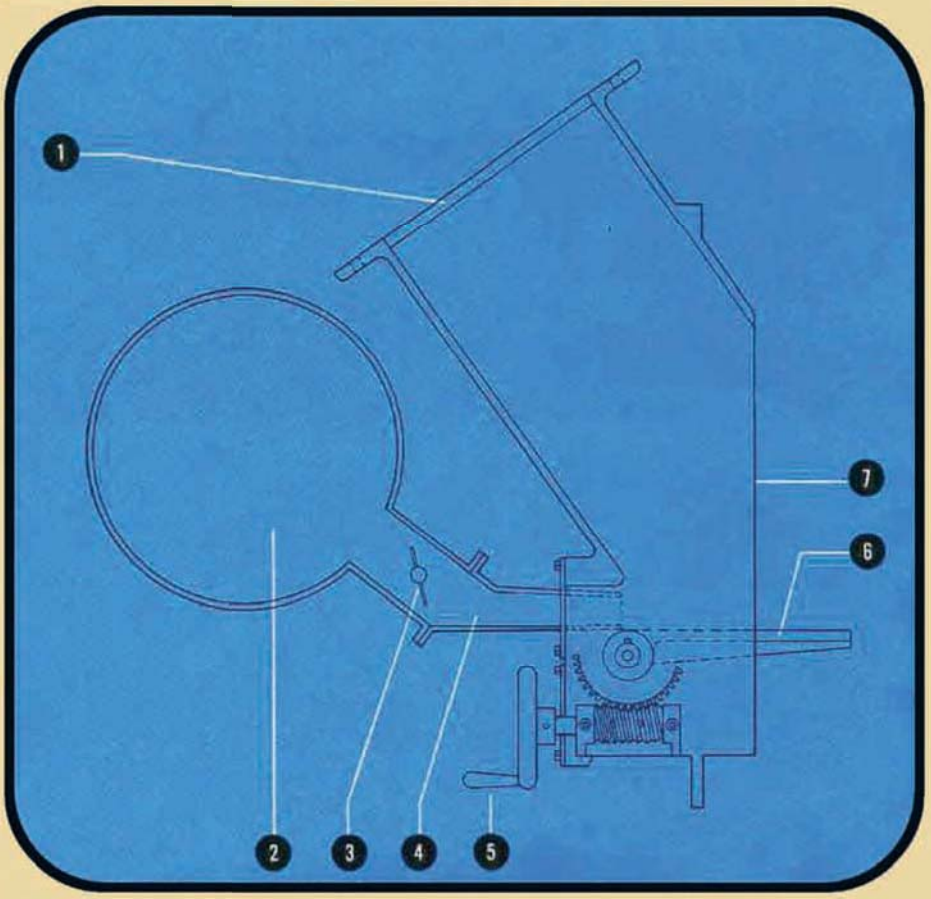
Our stationary water-cooled-grate spreader stoker allows intermittent zoned cleaning of grates in a 120,000 lbs/hr unit at a Georgia paper plant.

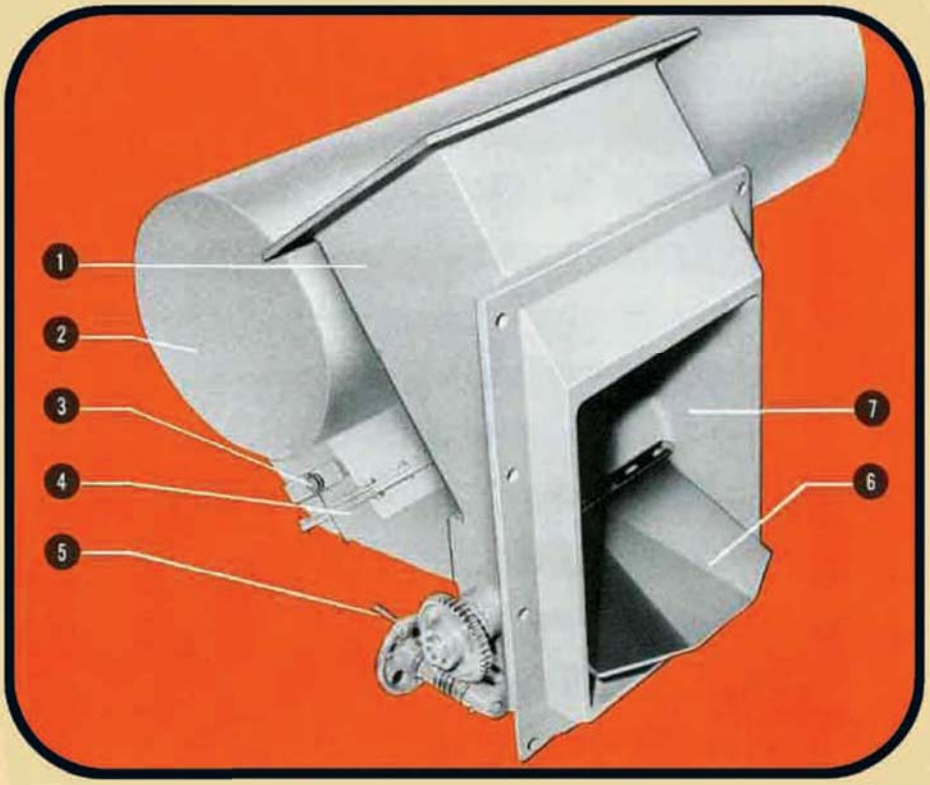
Our pneumatic fuel distributor assembly, TRAVAGRATE spreader stoker and hydraulic grate drives were pre-assembled at our fabrication facility to assure component fit and alignment. System is installed and providing 480,000 lbs/hr steam to produce electricity for a 50 Mw wood-fired municipal power plant.

PNEUMATIC FUEL DISTRIBUTORS DELIVER FUEL EFFICIENTLY FOR OPTIMUM BOILER PERFORMANCE

Pneumatic fuel distributors were developed to provide wide-range fuel flexibility for most spreader stoker designs. Each fuel distributor is a self-contained unit that can be adjusted differently and operated independently of the other units. Features of the IKE fuel distributor include:

1. **The fuel feeding chute** is designed and constructed for large capacity, continuous flow.
2. **A high pressure air duct** supplies air to move fuel into the furnace.
3. **An air-metering damper** allows adjustment of air flow for proper front-to-rear fuel distribution.
4. **An air distributor duct** provides full-width air sweeping of fuel.
5. **A setting device** determines the position of the distributor deflector plate.
6. **The distributor trajectory plate** allows for lateral and longitudinal fuel distribution into the furnace.
7. **The fuel distributor opening** is designed for large or small volume feeding and is completely air cooled.





IKE manufactures fuel feed systems designed to fire either fossil fuels or biomass fuels. Fossil fuels (coals-lignites) are fired with overthrow mechanical feeders. Biomass fuels (wood-RDF) are fired using pneumatic feeders. Both type feed devices are provided with adjustments to accommodate variations in furnace depth and fuel sizing as well as boiler load.

Each feed device is individually adjustable and is able to correct for differences in fuel sizing across the width of a stoker. Both fuel devices provide turndown ratios from three to six to one depending on the stoker grate release rates.

IKE utilizes a self-contained hydraulic drive to activate the Travagrate stoker system. The drive converts the power produced by a 1½ horsepower motor into 48,000 ft.lbs. of rotary torque. Through the control provided by a hydraulic flow control valve, the drive output speed can be infinitely adjusted from a maximum of six revolutions per hour down to fractions of an inch per hour.

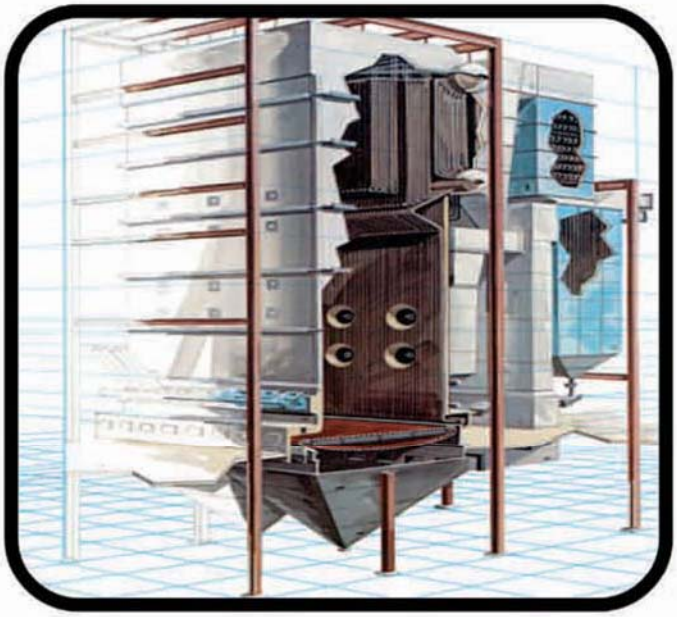
Because the hydraulic drive is self-contained, no external tubing and plumbing is needed to make the drive operational. In addition, the danger of leaking external tubing connections is eliminated.

BOILER DESIGN: As essential as the proper design of the stoker is to the successful performance of a boiler, many factors involved with the design of the boiler itself must be considered.

The boiler furnace must contain the needed depth and width to provide an adequately sized burning surface for the fuel. A properly sized furnace floor area (grate surface) insures fuel will not overload the furnace and produce excessively high upward air and combustion gas velocities.

Quantity of ash in the fuel and the required grate width are considered to allow for proper ash discharge thickness without the need for excessive grate speeds.

A further consideration, in addition to the area of the furnace, is the furnace height. To allow the fuel particles to burn-out before exiting the furnace, the furnace must be tall enough to provide a sufficient time of residence before exiting into the boiler generating tube banks.

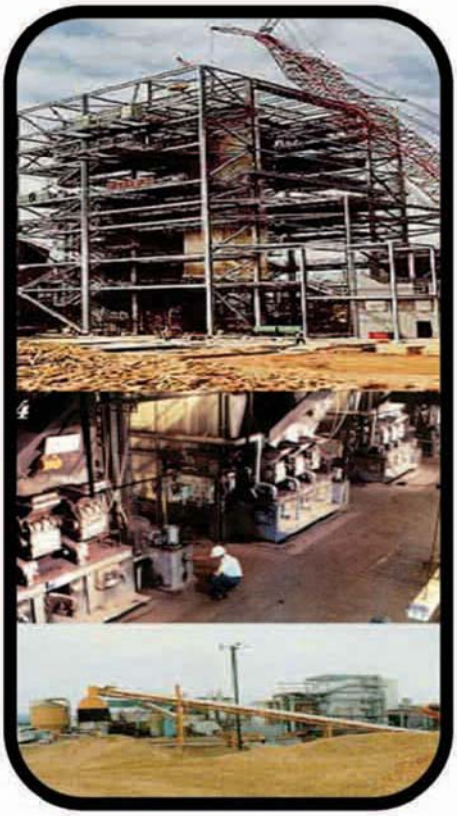


IKE can help you evaluate and design a stoker properly sized for your needs. We will utilize our extensive boiler and stoker knowledge to help you determine what the optimum firing equipment should be and how to best integrate it into your boiler design and operational needs.

Contact us directly or IKE Sales Representative located throughout North America and in strategic areas around the world.

Besides offering new stoker systems, **IKE** provides service, repair, and upgrades of existing stokers of ours as well as other manufacturer's.

Contact **IKE** for your stoker and boiler needs.



A LIST OF TYPICAL INSTALLATIONS

Customer	Fuel	Steam Capacity
Burlington Electric Co.	Wood	500,000 lb/hr
Roquette America	Coal	150,000 lb/hr
Ridge Generating	Wood-Tires	345,000 lb/hr
Montenay Power	RDF	180,000 lb/hr
Cognis, Inc.	Coal	30,000 lb/hr

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