PLIBRICO

Furnace Construction

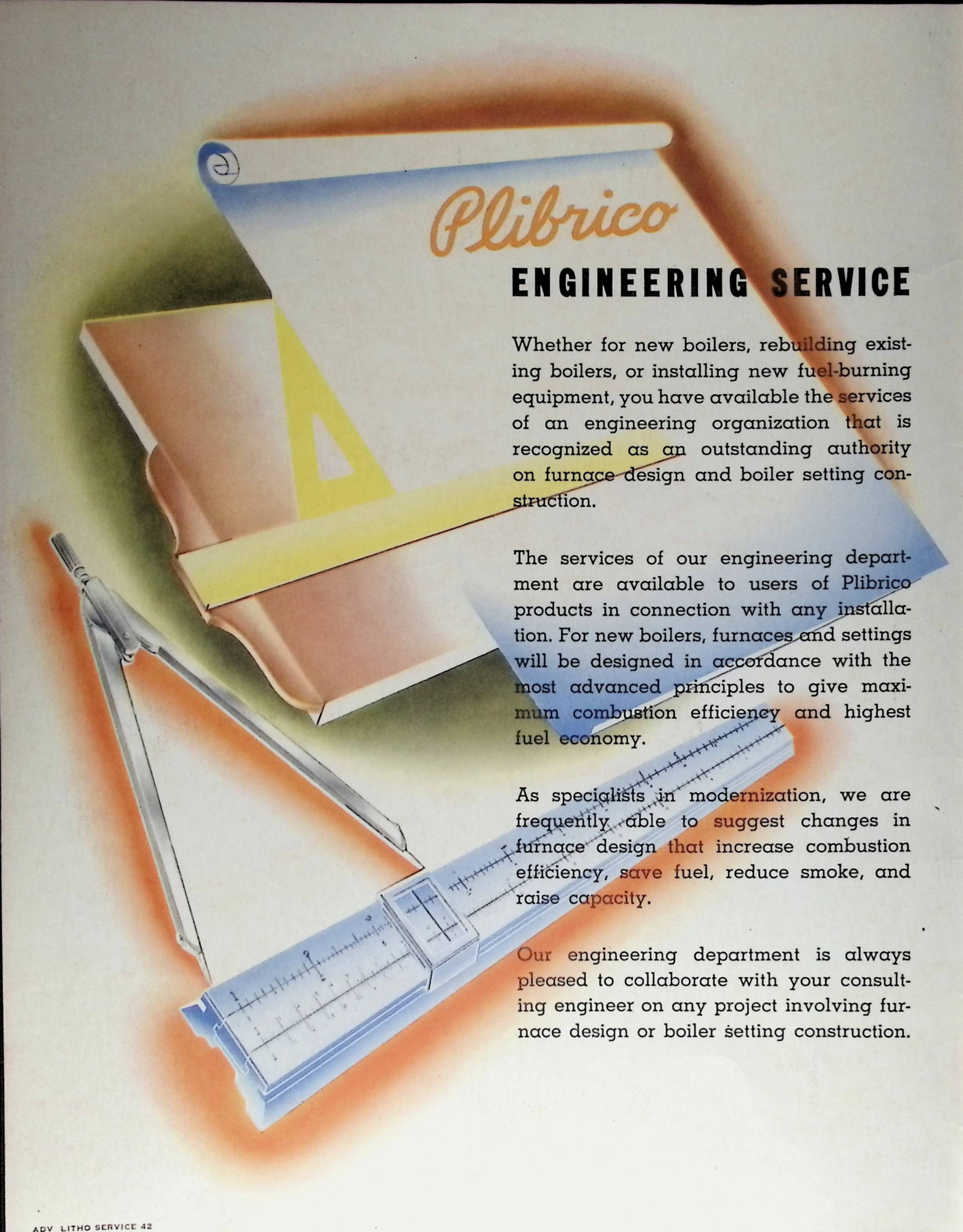


for H.R.T. BOILERS

• AND OTHER TYPES OF FIRE TUBE BOILERS

Rcd. May 1944

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Plibrico

ENGINEERING SERVICE

Whether for new boilers, rebuilding existing boilers, or installing new fuel-burning equipment, you have available the services of an engineering organization that is recognized as an outstanding authority on furnace design and boiler setting construction.

The services of our engineering department are available to users of Plibrico products in connection with any installation. For new boilers, furnaces and settings will be designed in accordance with the most advanced principles to give maximum combustion efficiency and highest fuel economy.

As specialists in modernization, we are frequently able to suggest changes in furnace design that increase combustion efficiency, save fuel, reduce smoke, and raise capacity.

Our engineering department is always pleased to collaborate with your consulting engineer on any project involving furnace design or boiler setting construction.

ADV LITHO SERVICE 42

PLIBRICO

Furnace Construction

THE leadership of the Plibrico organization in the field of boiler setting construction is not due alone to the superiority of Plibrico refractory materials, although Plibrico products are accepted as the standard by which others are judged.

It is not due alone to Plibrico engineering, although our engineering department is an outstanding authority on the subject of furnace design and boiler setting construction.

Because it owns some of the finest deposits of refractory clays in the country, operates its own plants and controls all manufacturing processes, maintains representatives and installation service in all principal industrial centers, and has kept far ahead in furnace design and engineering, Plibrico has earned its position of leadership and remains in a position to furnish you with the most modern developments in refractory materials and boiler setting construction.

for H.R.T. BOILERS

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PLIBRICO JOINTLESS FIREBRICK CO.

★ CHICAGO, ILLINOIS ★ NEW YORK, N. Y. ★

Factories at: CHICAGO, ILLINOIS; TRENTON, NEW JERSEY; FIREBRICK, OHIO

PLIBRICO JOINTLESS FIREBRICK, LIMITED, NEW TORONTO, ONT.

THE JOINTLESS FIREBRICK COMPANY, LTD., LONDON, ENGLAND

Fire finds the weakness!





The destructive force of the fire is constantly working through contraction and expansion to tear down ordinary fire brick walls. It always finds a weakness at the joints.

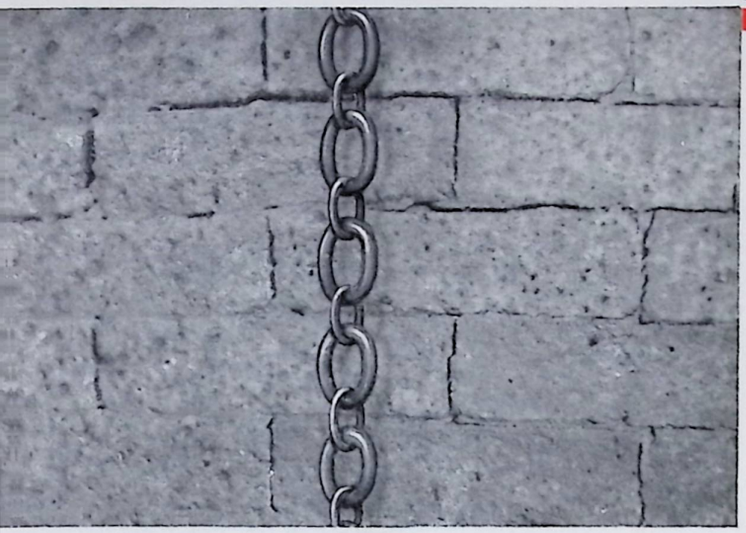
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Every joint is a weak link

A fire brick lining is no stronger than its weakest joint. Like weak links in a chain, the joints in a fire brick lining are the principal cause of failure and collapse.



Sights like this are no novelty to the average fire brick user.



UNDER the terrific onslaught of extreme temperatures, ordinary fire brick linings are doomed to collapse. It is now an accepted fact that the real cause of fire brick failure is the thousands of weak joints found in every fire brick lining.

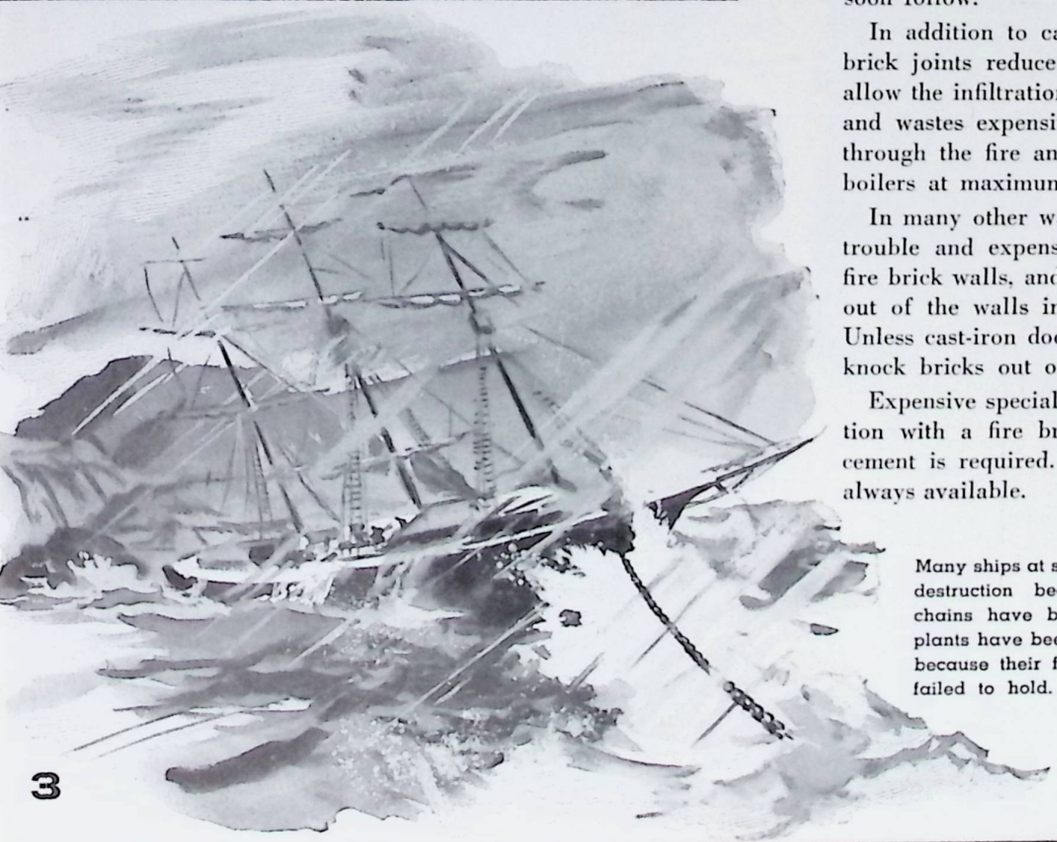
Fire brick walls rarely burn out. Almost without exception, they bulge and collapse while the individual brick are still in serviceable condition.

Contraction and expansion open up the joints between the brick. Corners and edges fuse and spall as they are exposed to the inferno of the fire. Bricks loosen—then the wall bulges as the header courses break away. The collapse of the wall begins; repairs and replacement soon follow.

In addition to causing continual repair expense, fire brick joints reduce combustion efficiency. Leaky joints allow the infiltration of excess air, which retards the fire and wastes expensive fuel. They also reduce the draft through the fire and make it impossible to operate the boilers at maximum capacity.

In many other ways, ordinary fire brick linings cause trouble and expense. Clinkers readily stick to uneven fire brick walls, and firemen often pull individual bricks out of the walls in attempting to remove the clinkers. Unless cast-iron door liners are used, the fireman's tools knock bricks out of the door jambs.

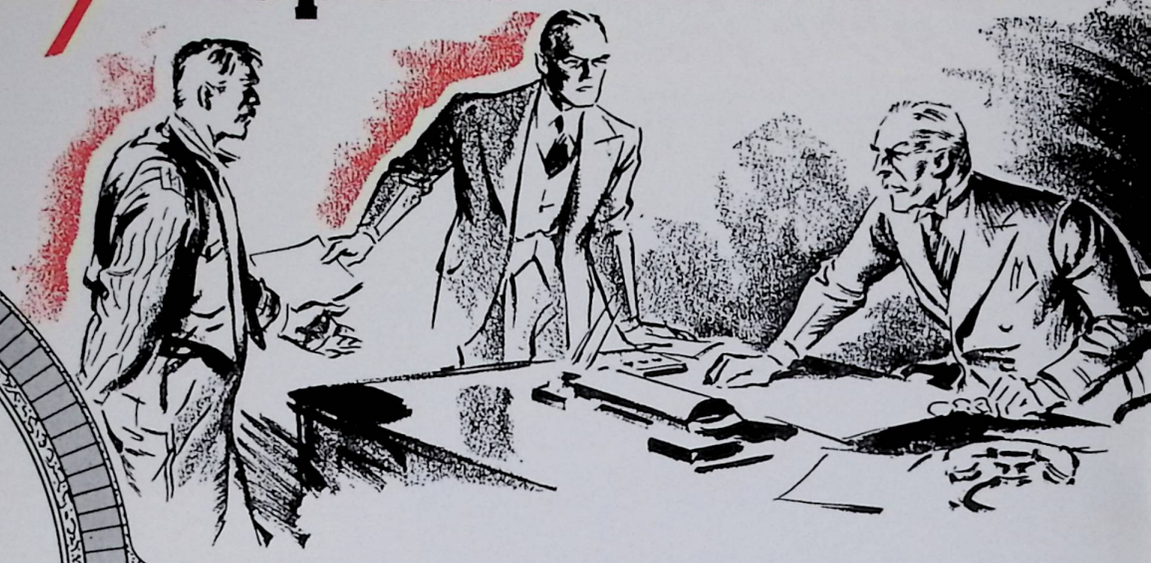
Expensive special shapes are often required in connection with a fire brick lining. Costly high-temperature cement is required. Experienced boiler masons are not always available.

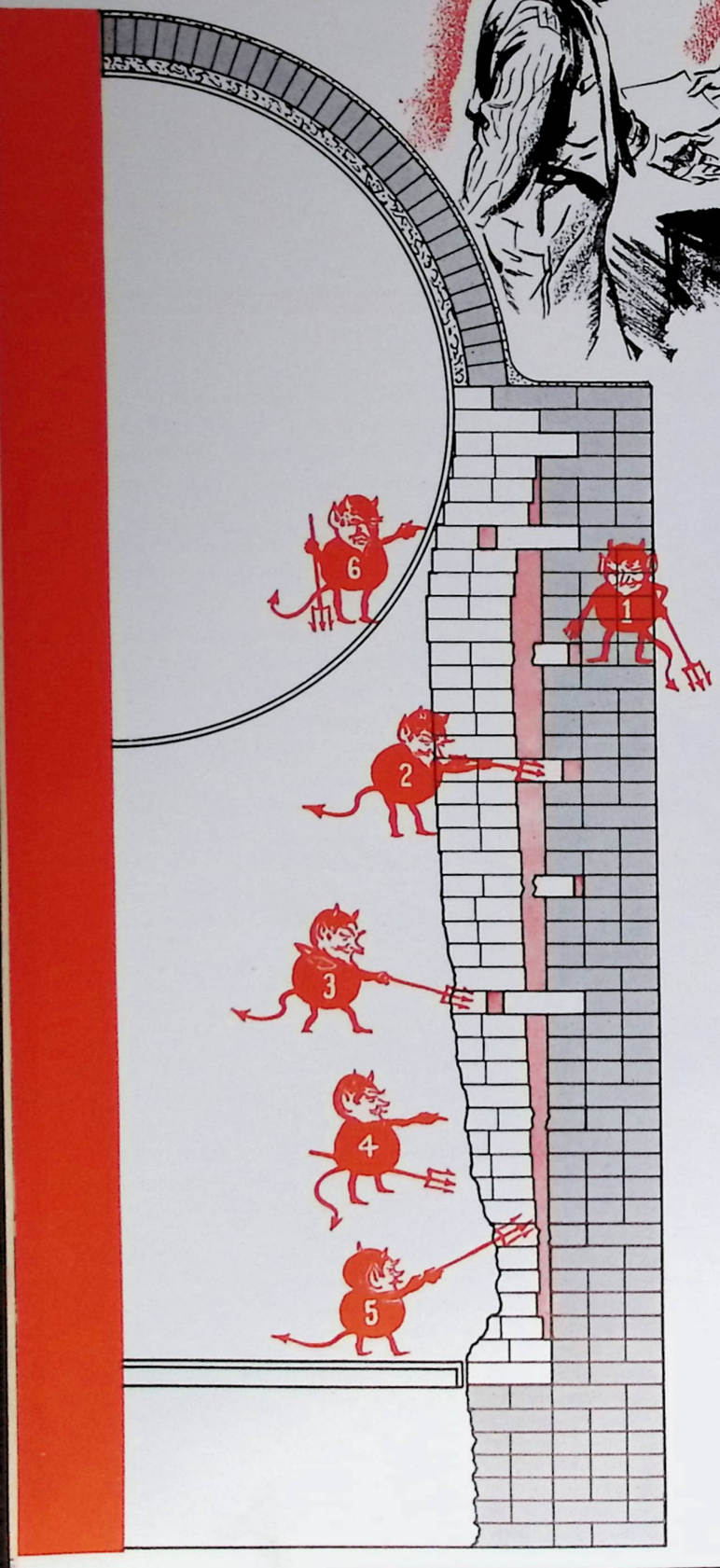


Many ships at sea have gone to their destruction because their anchor chains have broken. Many boiler plants have been visited by disaster because their fire brick joints have failed to hold.

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Costly Repairs - Shutdowns -





Why Fire Brick Bulges

IN SERVICE, the face of a fire brick wall is exposed to a temperature several times greater than the temperature to which the common brick supporting wall is subjected. Expansion of the fire brick is consequently greater than the expansion of the common brick.

The greater movement of the fire brick wall causes it to separate from the common brick wall, permitting the fire brick to bulge and collapse. Here's what happens:

1. Rigid "header" courses are depended upon to tie the fire brick lining to the common brick wall. Under the irresistible forces of expansion, many of these headers snap off as indicated.

2. Some of the headers loosen and pull out of the common brick wall.

3. Where the headers remain fast, the fire brick lining breaks away from the headers. In any case, the tie is broken.

4. As the wall bulges, the exposed edges of overhanging bricks fuse and spall.

5. Fire penetrates the fire brick lining through open joints and attacks the common brick walls, frequently damaging the outer walls to such an extent that they must be rebuilt.

6. The top of the wall leans against the boiler shell, cutting off valuable heating surface.

It is apparent from this print why it is almost always necessary to replace the entire wall when repairing a fire brick lining. When the brick burn out along the grate line, the entire wall collapses, due to the lack of any dependable means of support.

How monolithic Plibrico construction overcomes the fundamental weaknesses of laid-up fire brick construction is shown in the following pages.

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Delay ....

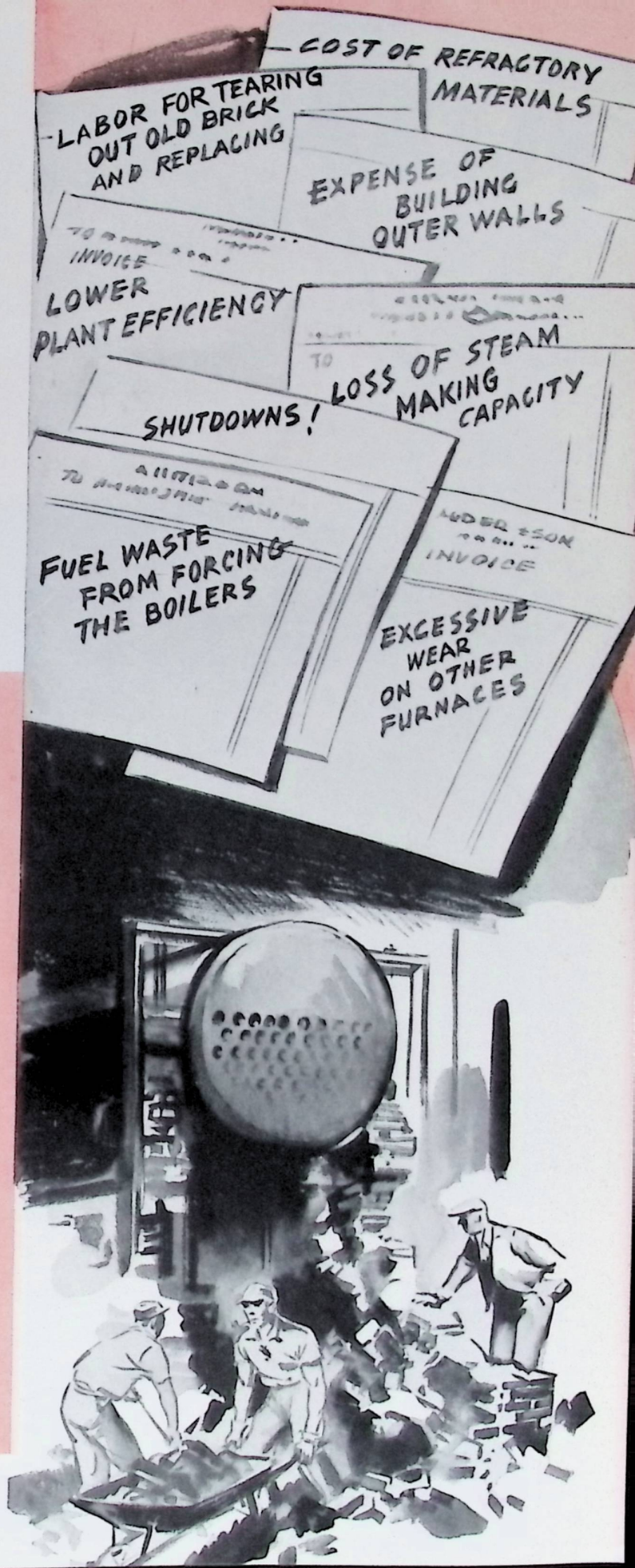
the cost of fire brick failure

THE far-reaching affect of fire brick failure comes not only in the form of direct costs for refractory materials and labor, frequently at overtime rates, but in indirect losses as well. In addition to the cost of lower over-all efficiency of the plant, there is the cost of forcing other boilers to carry the load and the danger that they, too, will be damaged and require costly repairs.

Your boiler room is the heart of your plant. A single shut-down or serious interruption in production would pay the cost of Plibrico protection many times over.



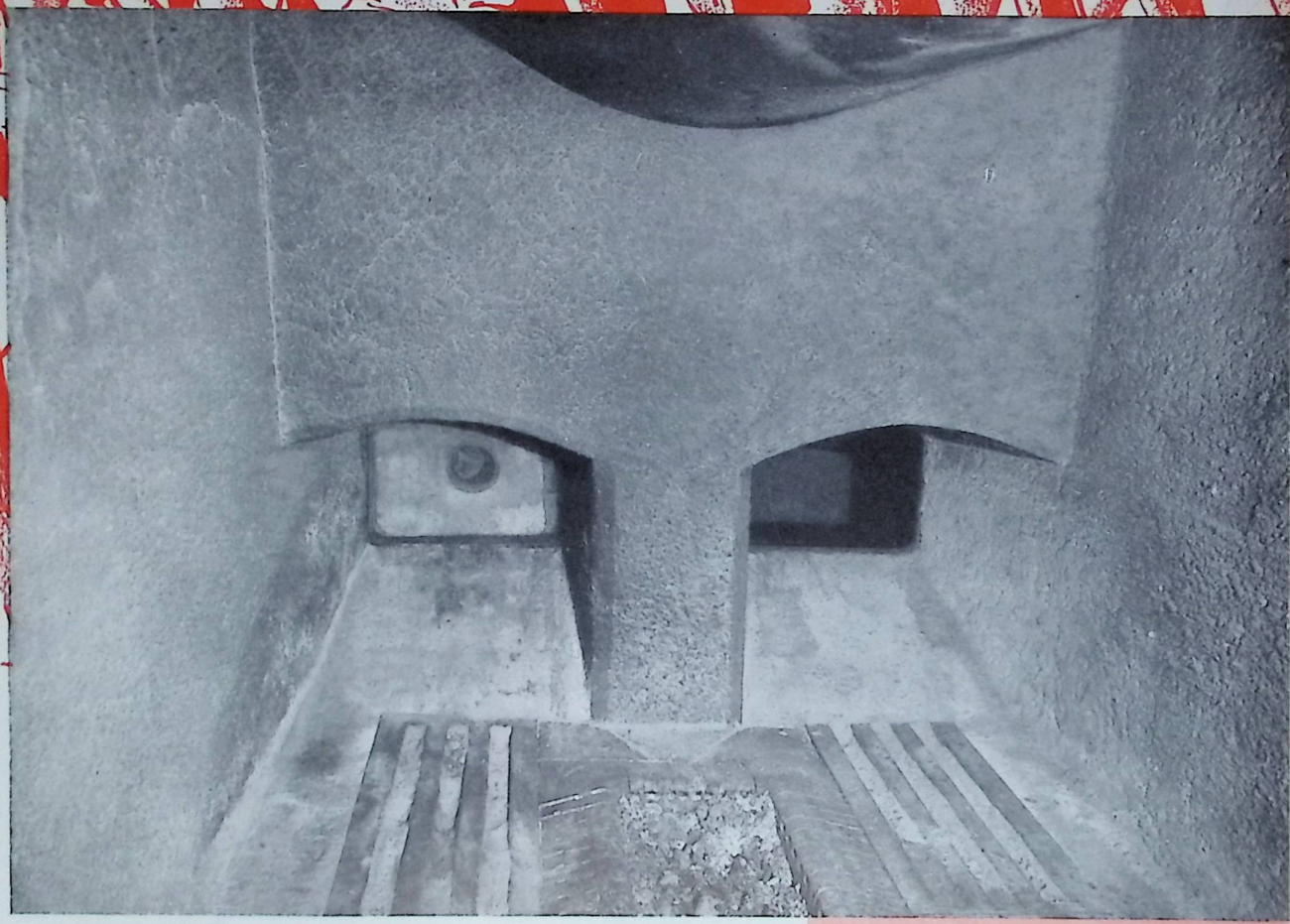
Showing how fire brick bulges, illustrating from actual service the conditions shown in print on opposite page. Note headers pulling out and reduction in boiler heating surface.



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PLIBRICO *Jointless* FIREBRICK



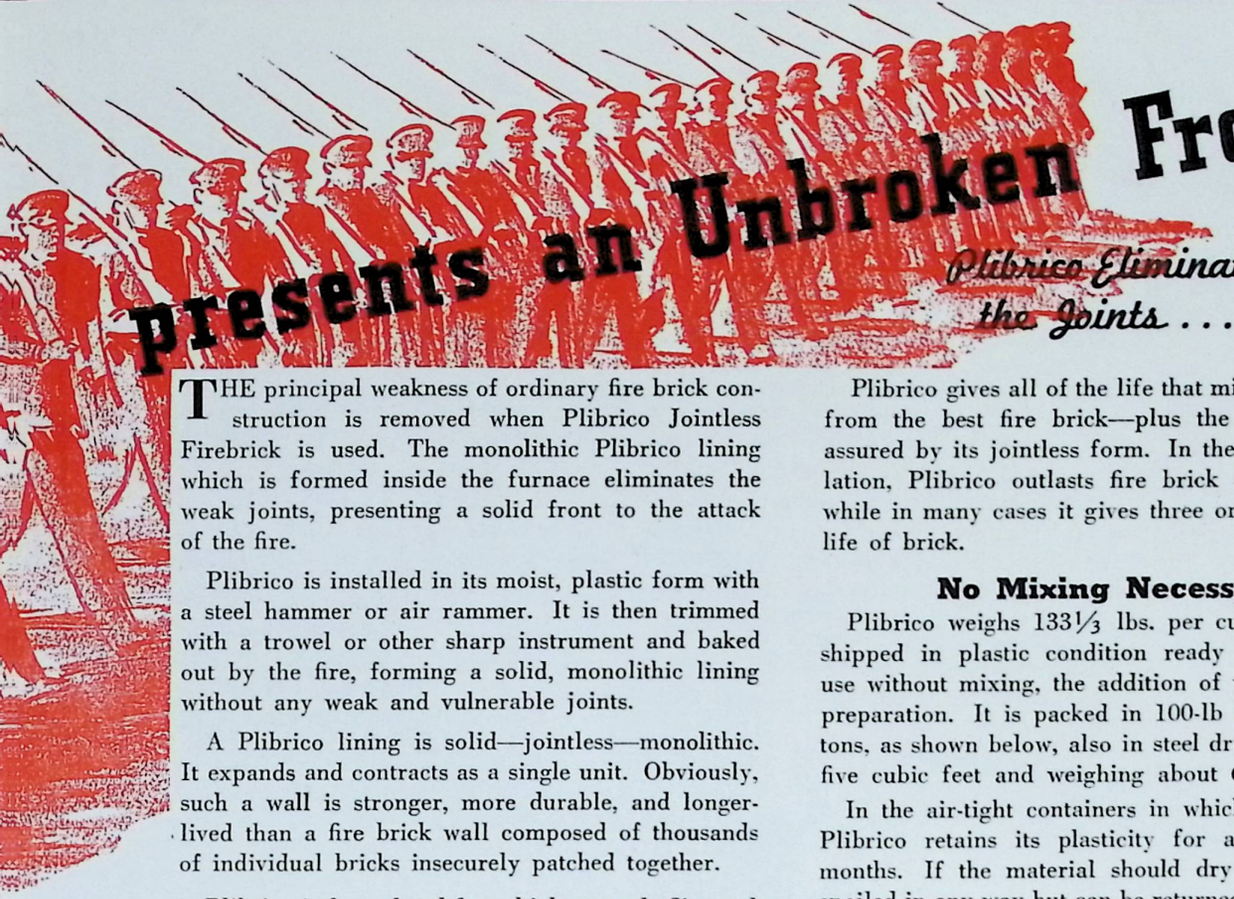


A typical Plibrico lining in connection with stoker-fired H.R.T. boiler. The strength and durability of this Plibrico lining are apparent at first glance.

What is PLIBRICO?

PLIBRICO is a superior refractory material in plastic, semi-baked form, the consistency of stiff putty. It is used in place of ordinary fire brick for lining boiler furnaces, ovens, kilns, etc. It is not installed as a coating or plaster over an old fire brick lining but entirely replaces the old lining, being installed next to the common brick wall after the old fire brick has been removed.

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presents an Unbroken Front !

Plibrico Eliminates the Joints . . . .

THE principal weakness of ordinary fire brick construction is removed when Plibrico Jointless Firebrick is used. The monolithic Plibrico lining which is formed inside the furnace eliminates the weak joints, presenting a solid front to the attack of the fire.

Plibrico is installed in its moist, plastic form with a steel hammer or air rammer. It is then trimmed with a trowel or other sharp instrument and baked out by the fire, forming a solid, monolithic lining without any weak and vulnerable joints.

A Plibrico lining is solid—jointless—monolithic. It expands and contracts as a single unit. Obviously, such a wall is stronger, more durable, and longer-lived than a fire brick wall composed of thousands of individual bricks insecurely patched together.

Plibrico is formulated from highest-grade flint and fire clays mined from our own mines. Its Pyrometric Cone Equivalent (fusion point) is 3100 deg. F., in which respect Plibrico is equal to first-quality fire clay brick.

Plibrico gives all of the life that might be expected from the best fire brick—plus the additional life assured by its jointless form. In the average installation, Plibrico outlasts fire brick at least 100%, while in many cases it gives three or four times the life of brick.

No Mixing Necessary

Plibrico weighs 133⅓ lbs. per cubic foot. It is shipped in plastic condition ready for immediate use without mixing, the addition of water, or other preparation. It is packed in 100-lb fibreboard cartons, as shown below, also in steel drums containing five cubic feet and weighing about 665 lbs.

In the air-tight containers in which it is packed, Plibrico retains its plasticity for as long as six months. If the material should dry out, it is not spoiled in any way but can be returned to its original condition by the addition of a small amount of water.

Genuine Plibrico is not sold in unmarked containers or under any other name. It is packed only under the Plibrico label.

PLIBRICO *Super*

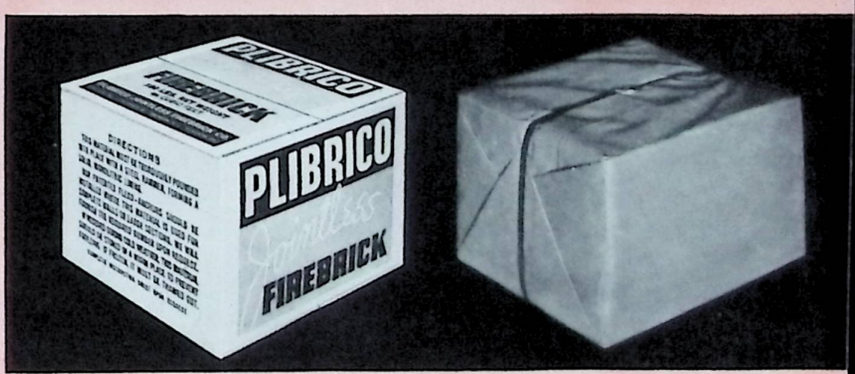
PLIBRICO *Super* is a special grade of Plibrico possessing greater load-bearing strength than standard Plibrico, together with higher resistance to alkaline fluxes and slags.

This special grade of Plibrico is compounded from highest-quality calcined flint clays that have been adequately fired to thoroughly remove all shrinkage and hand-selected from the kiln to assure absolute uniformity.

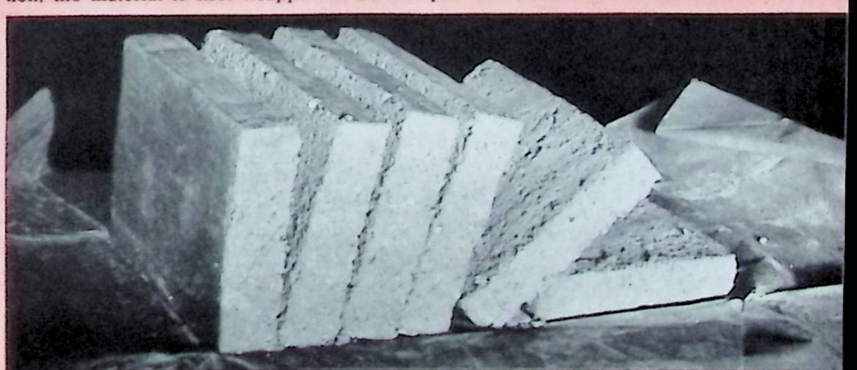
These properties recommend Plibrico *Super* for use under extreme combustion conditions and particularly for applications where the fuel exerts an excessively corrosive action on the refractory material.

Like the regular grade, Plibrico *Super* is packed in 100-lb. cartons similar to those pictured opposite.

FACTORY-SLICED 100-Lb. PACKAGES



Plibrico is packed in convenient 100-lb. cartons containing ¾ cubic feet of material. To preserve its moist, plastic condition, the material is first wrapped in an air-tight wrapper. In these cartons, the material is cut into six slices 2 in. thick and 9x12 in. in size for convenient and rapid installation.



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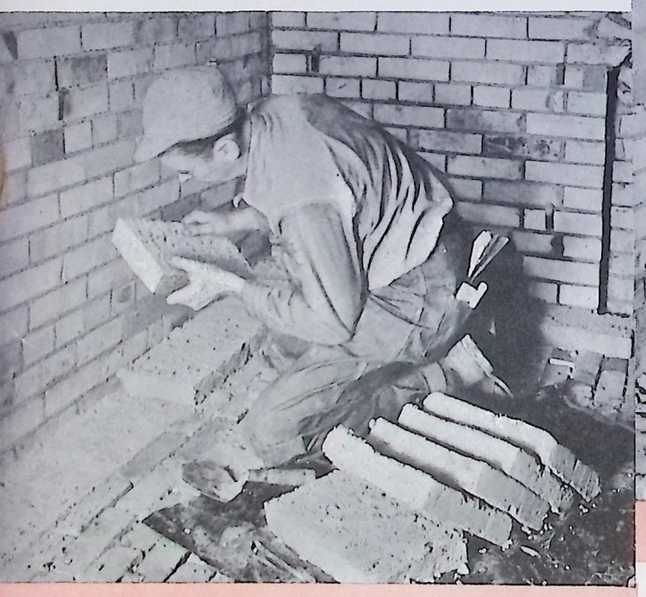
HOW *Plibrico* IS INSTALLED

The convenient factory-sliced form in which Plibrico is packed speeds up installation and cuts labor cost.



THE ease with which a monolithic Plibrico lining is installed is clearly shown in this series of photographs. Plibrico is not installed as a coating over old fire brick but always replaces the old lining. Consequently, the first step is the complete removal of the old lining as shown, after which the Plibrico material is installed, being solidly pounded into place with a steel hammer or air rammer.

Then the Plibrico lining is trimmed down to the desired thickness with a trowel or other sharp instrument, giving a smooth surface. Finally, the completed lining is baked out by the fire.



1 After the old fire brick lining has been removed, the convenient 2 in. Plibrico slabs are laid against the outer brick wall.



2 Then the plastic material is thoroughly pounded into place using a steel hammer or pneumatic rammer.

Detailed instructions for the installation of any Plibrico job gladly furnished on request.

IT is not necessary to allow a Plibrico installation to "set" before it can be fired. Where Plibrico is used for small patches, the boiler may be put back into operation immediately. Where it is used for complete walls or a full lining, a slow fire should be carried for a period of at least twelve hours with the dampers kept nearly closed to give an even temperature throughout the furnace, after which the boiler may be put into normal operation and the baking of the lining will be completed in service.



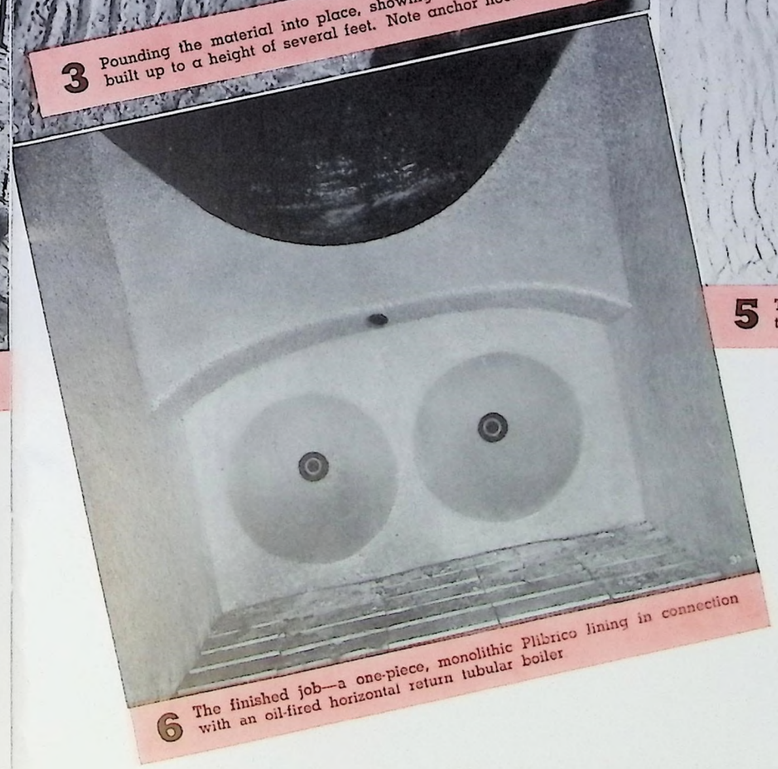
3 Pounding the material into place, showing the Plibrico lining built up to a height of several feet. Note anchor hooks.



4 In this picture the workman is installing the Flexo-Anchors that tie the Plibrico lining to the outer wall and prevent bulging.



5 Trimming the lining down to a smooth surface and the desired thickness. A sharpened spade or trowel is used.



6 The finished job—a one-piece, monolithic Plibrico lining in connection with an oil-fired horizontal return tubular boiler

Installation Service

We maintain a nation-wide boiler setting and installation service capable of handling any job from a small repair to a complete setting. Your local Plibrico representative will gladly call at your plant at any time to make a careful inspection of your linings and to quote on monolithic Plibrico construction for any repairs necessary.

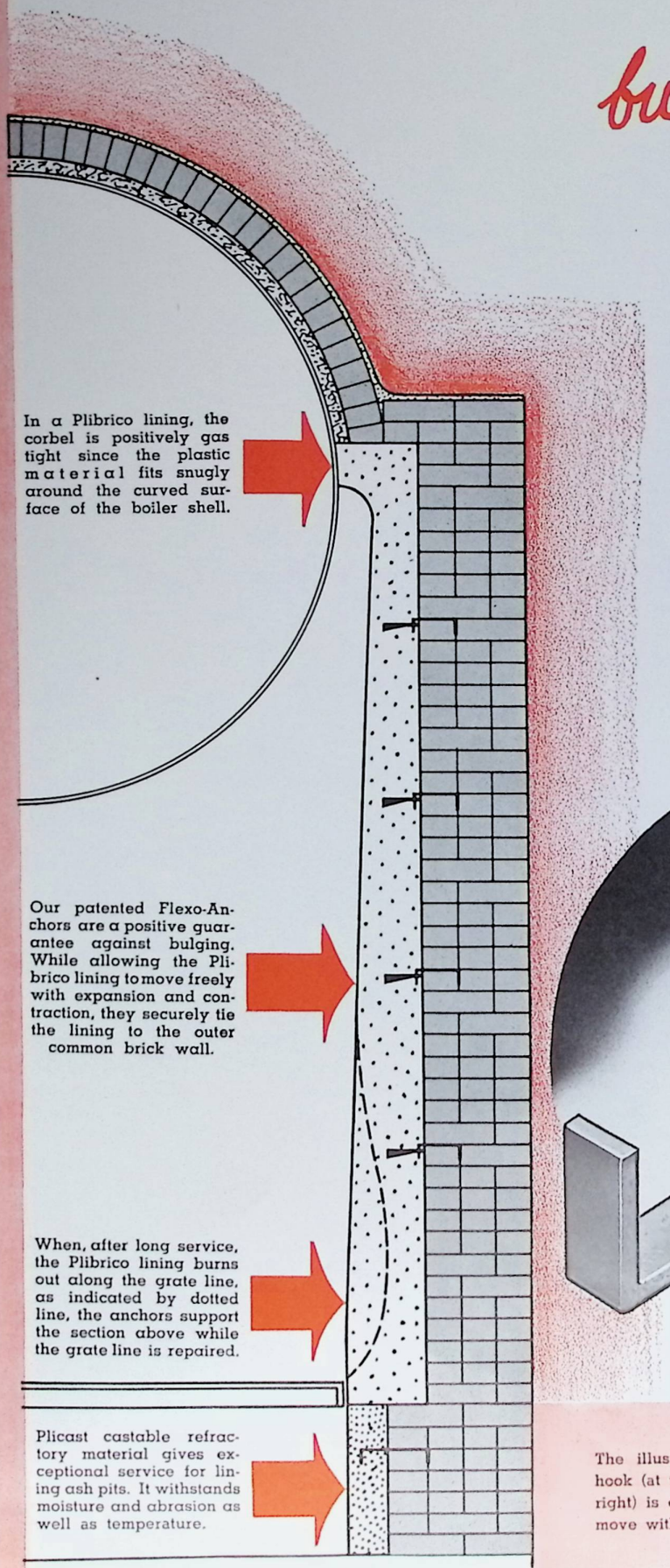
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FLEXO-ANCHORS

but allow free movement!

VERTICAL

LATERAL

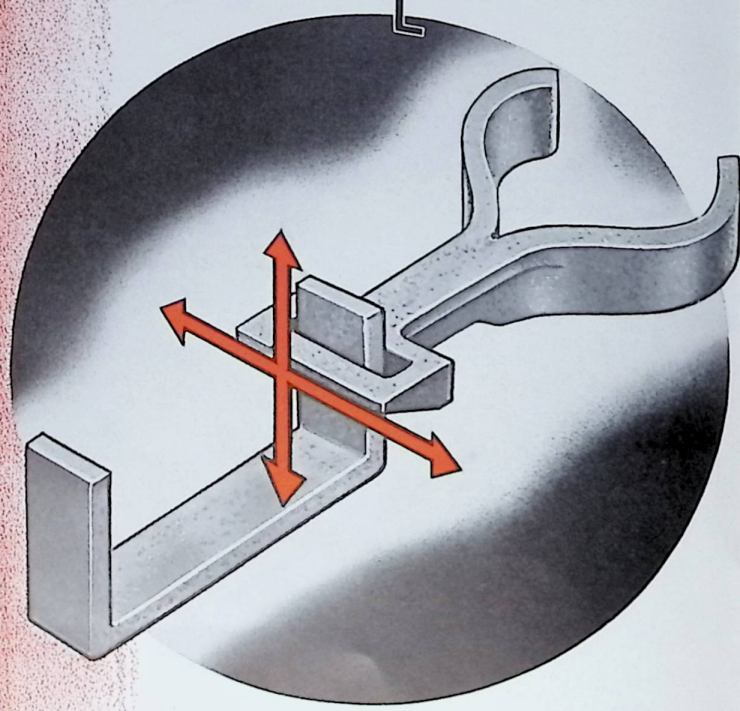


In a Plibrico lining, the corbel is positively gas tight since the plastic material fits snugly around the curved surface of the boiler shell.

Our patented Flexo-Anchors are a positive guarantee against bulging. While allowing the Plibrico lining to move freely with expansion and contraction, they securely tie the lining to the outer common brick wall.

When, after long service, the Plibrico lining burns out along the grate line, as indicated by dotted line, the anchors support the section above while the grate line is repaired.

Plicast castable refractory material gives exceptional service for lining ash pits. It withstands moisture and abrasion as well as temperature.



STANDARD ANCHOR

The illustration above shows our standard Flexo-Anchor. The hook (at the left) is set in the brickwork while the plate (at the right) is embedded in the Plibrico material. The plate is free to move with expansion and contraction.

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PREVENT BULGING

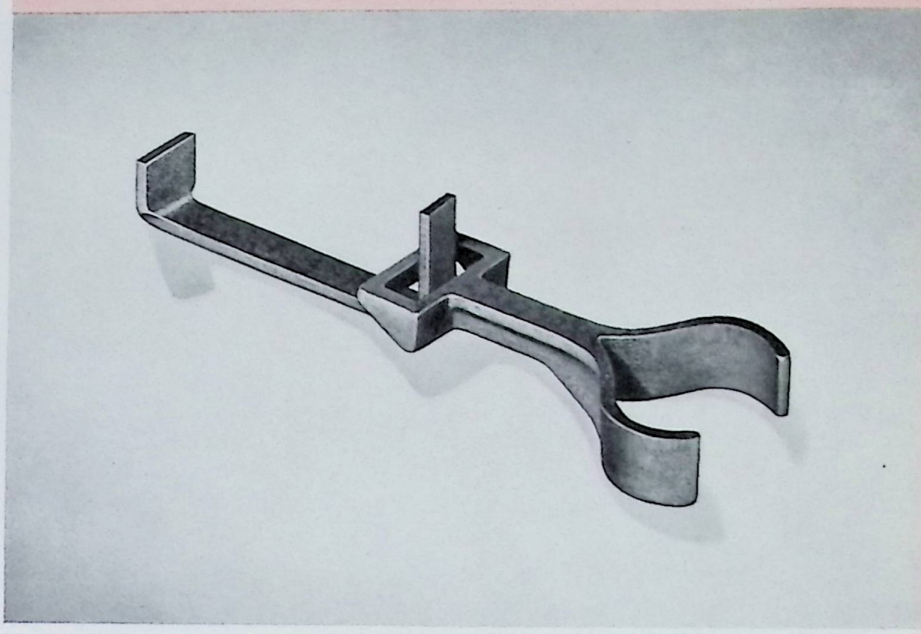
THE great difference between the temperature on the refractory lining compared with that of the outside common brick wall is the direct cause of the failure of fire brick linings. The outside walls remain relatively stationary, but the high temperatures to which the furnace lining is subjected cause the lining to expand and contract.

This constant back-and-forth movement breaks the ties that are depended upon to hold the fire brick lining to the outside walls. The rigid header bricks either loosen or break off, allowing the fire brick walls to bulge and collapse.

Our patented Flexo-Anchors are a positive guarantee against bulging. They allow free movement vertically or laterally with expansion and contraction, but securely tie the Plibrico lining to the outside common brick wall. The anchors act as "shock absorbers" in the heart of the walls, taking up the shocks that ruin fire brick construction.

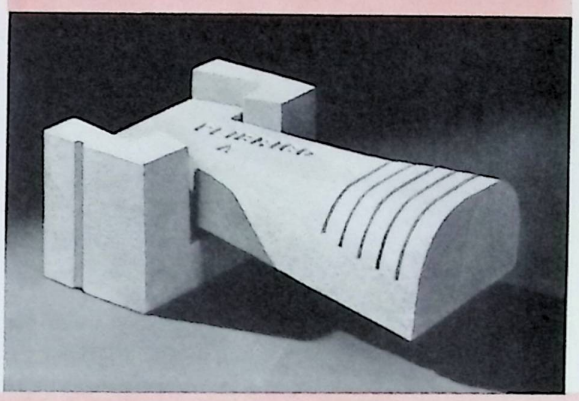
The anchor hook is fastened in the common brick wall, while the other piece is embedded in the Plibrico lining as it is built up. In new settings, the hooks are set into the brick work as the outside walls are laid up. In existing settings, the hooks are easily installed by prying out a common brick, inserting the hook, then replacing the brick with mortar and a wedge.

HIGH-TEMPERATURE ALLOY ANCHOR



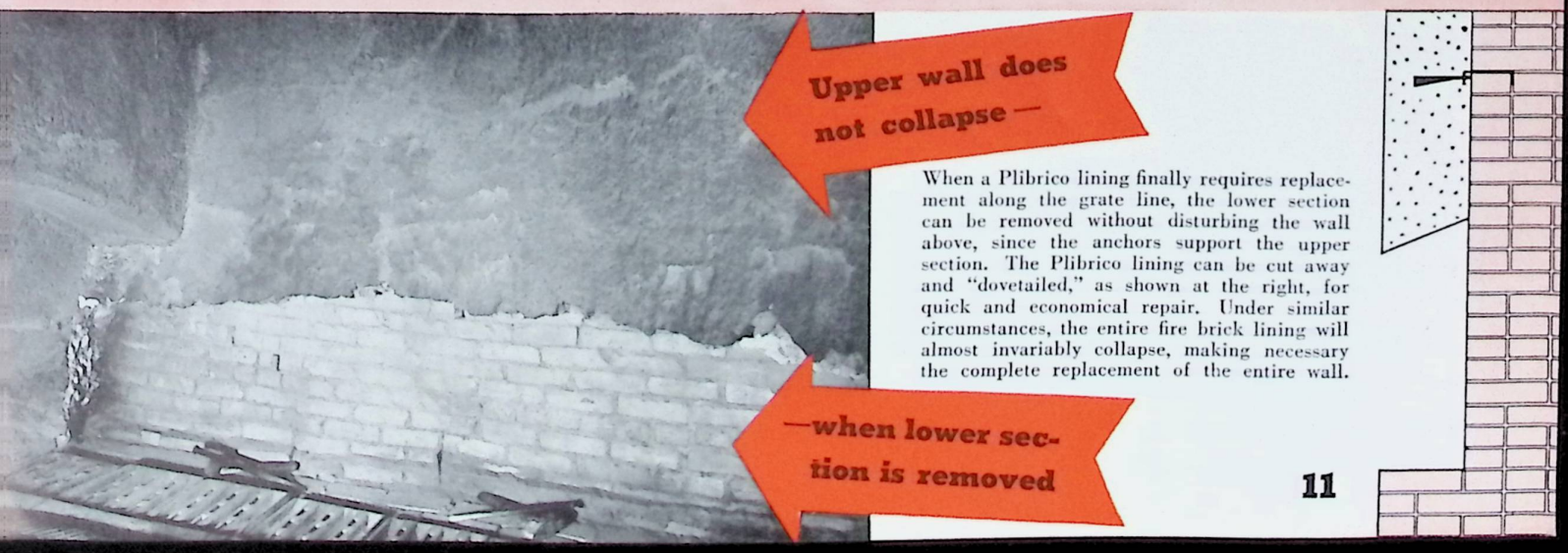
The Flexo-Anchor is also furnished in high-temperature alloy material, as shown above, for severe conditions. In the alloy anchor, both parts are formed of high-temperature refractory alloy material which is practically indestructible as used in connection with a Plibrico lining.

REFRACTORY TILE ANCHOR



We also offer the refractory tile anchor shown opposite. Both parts are highest-grade refractory shapes. The refractory box at the left sets into the brickwork while the anchor at the right is embedded in the Plibrico material where it moves freely with expansion and contraction.

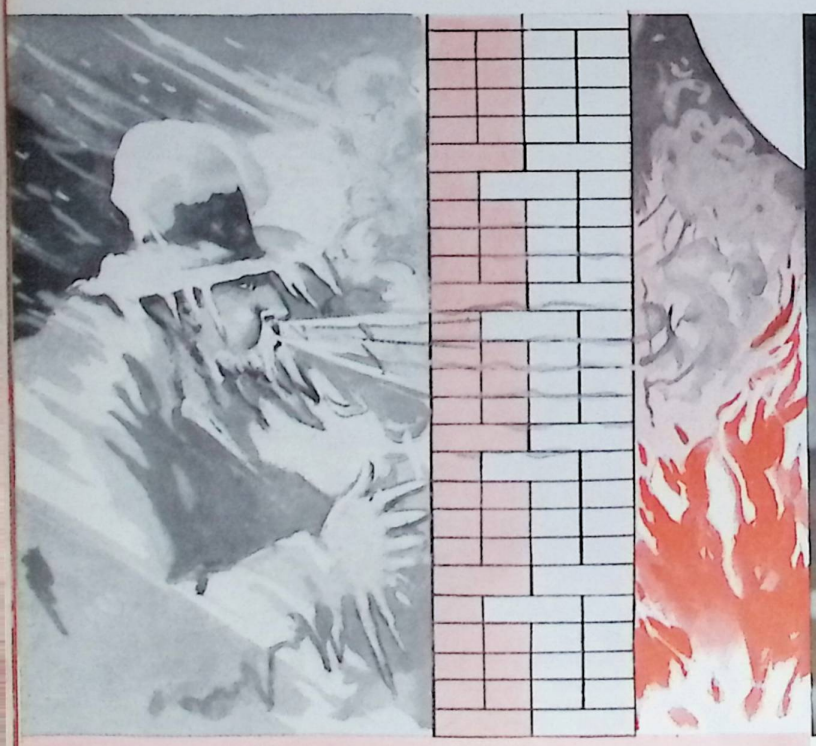
PLIBRICO IS ECONOMICALLY REPAIRED

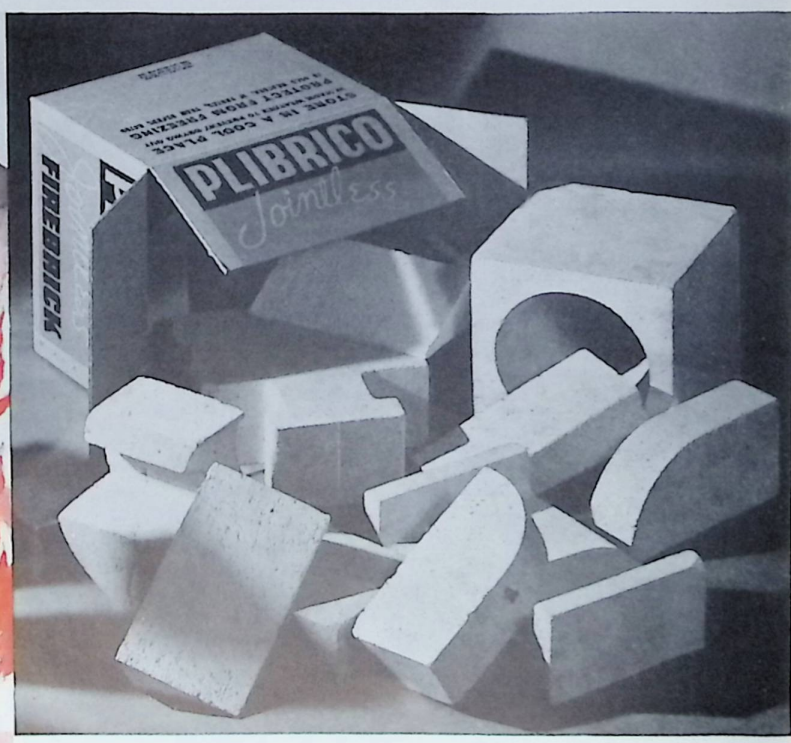


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6 More Reasons for Plibrico

As the preceding pages show, the use of Plibrico for your furnace lining means that weak joints have been eliminated, that the lining cannot bulge, that repairs will be inexpensive, and that you have installed the most economical refractory material available. Here are six more good reasons why Plibrico is the best refractory material for your boiler furnaces.





REDUCES INFILTRATION

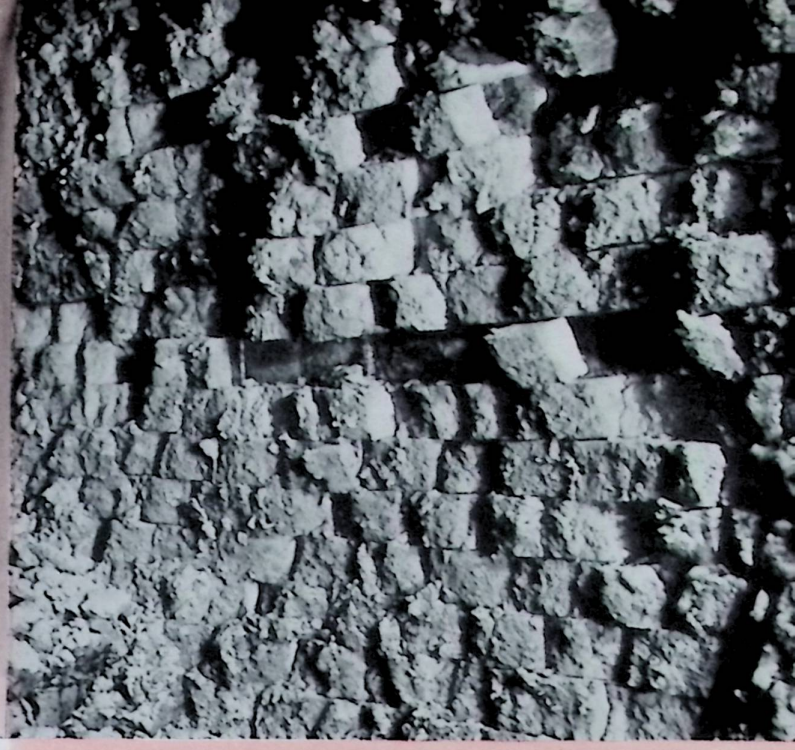
By eliminating leaky joints Plibrico gives you an air and gas-tight furnace, reducing the infiltration of cold excess air, increasing CO_2, and saving fuel.

REPLACES SPECIAL SHAPES

You need no expensive tile shapes when you line your furnace with Plibrico. Any shape that you require can be found in a Plibrico carton!

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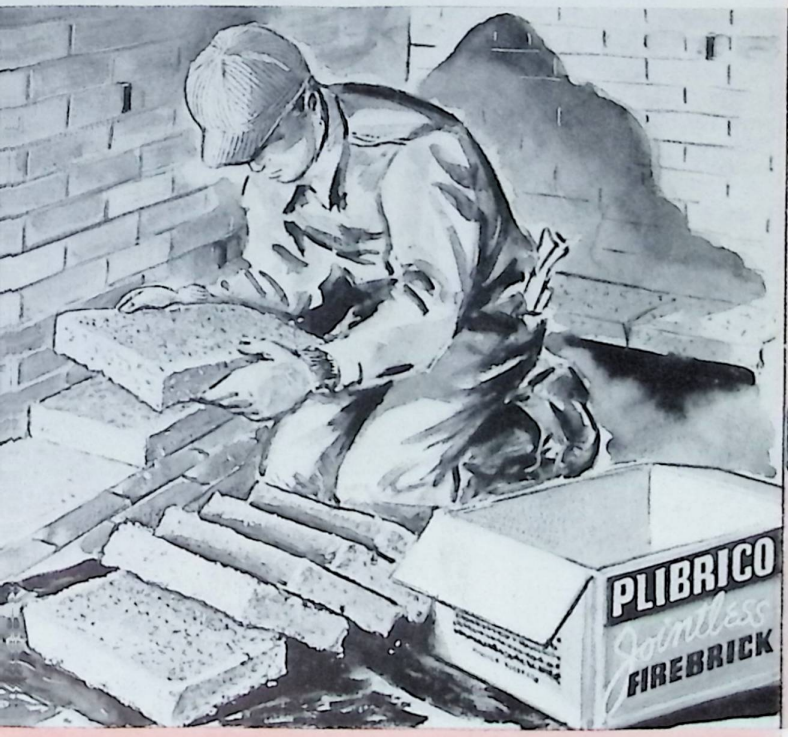


PLIBRICO SAVES FUEL

Radiation losses through the setting are reduced because of Plibrico's greater insulating value. It's like firing a thermos jug.

MINIMIZES SPALLING

In a fire brick lining, corners and edges are exposed to the fire and spalling and cracking result. Plibrico minimizes spalling by eliminating the joints.





DECREASES LABOR COST

The simple method followed in the installation of Plibrico with either steel hammers or air rammers cuts down installation time and reduces labor cost.

NO REFRACTORY CEMENT

You don't need to buy any expensive high-temperature cement when you use Plibrico. Don't overlook this saving when comparing costs.

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FRONT DOOR ARCHES

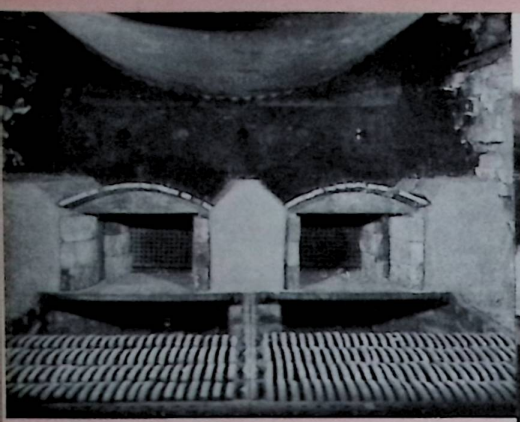
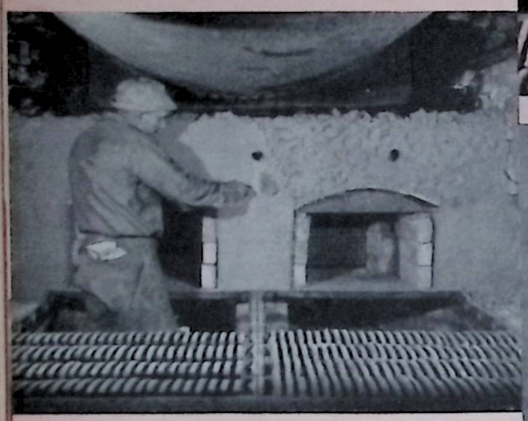


Photo above shows completed door jambs and center pier with temporary wooden forms in place to support the door arches.

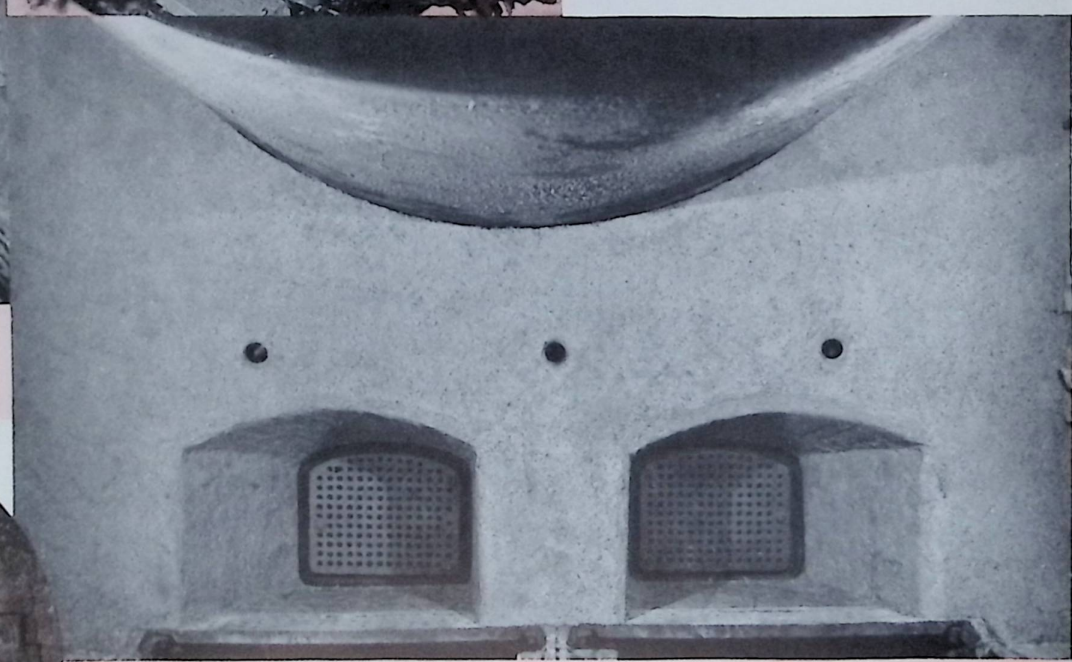


MONOLITHIC Plibrico construction is particularly suitable for front walls where door arches or burner openings must be constructed.

When built of ordinary fire brick, such openings are extremely weak and the danger of premature collapse is always present. When constructed of large and expensive special shapes, excessive spalling is experienced. When formed of Plibrico, openings of any kind are as strong as the strongest part of the lining, and involve no extra cost for construction.



Picture above shows workman trimming the lining with a trowel. Note ease with which the material is moulded around steam jets.



The completed installation—a one-piece, monolithic lining without any weak joints, ready for a long life of trouble-free service. The temporary wooden forms supporting the door arches may be removed as soon as the installation has been finished.



In this picture, note the impossibility of fitting fire brick around the curved shell of an H.R.T. boiler.

Plibrico "Fits" Boiler Shell

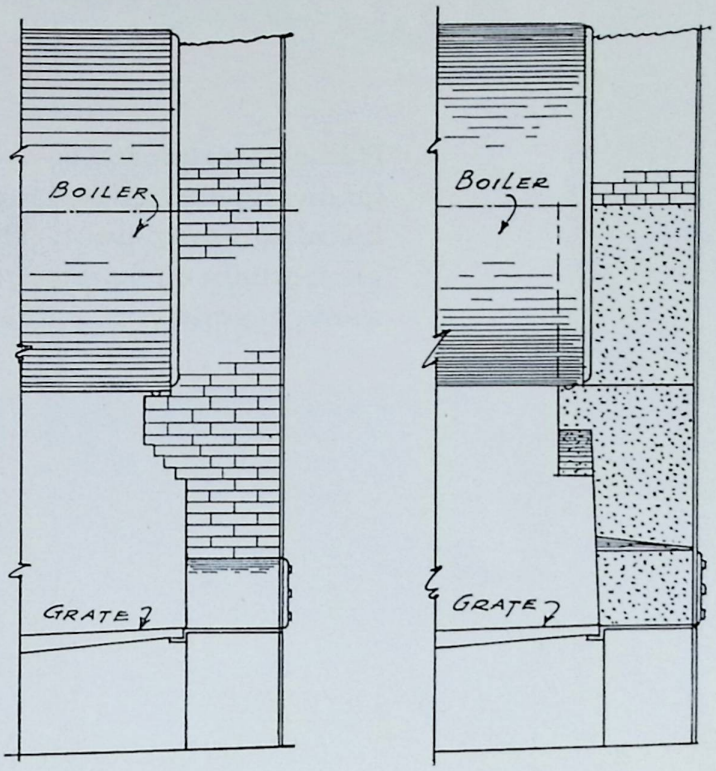
Plibrico fits snugly around the boiler shell, completely protecting the boiler rivets. In the picture opposite, note the excessive amount of cutting and chipping employed in an attempt to fit fire brick around the boiler shell. Also note how brickwork has sagged and chips have fallen out, exposing the rivets and allowing the gases to short-circuit into the smoke box.

Eliminates Door Pockets

Door pocket castings are ordinarily used with fire brick construction to support the door arches and protect the door jambs from the firing tools. Such castings are costly and soon burn out or warp. No such castings are necessary in connection with a monolithic Plibrico front since there are no bricks to be knocked out by the fireman's shovel or slice bar.

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that stand up

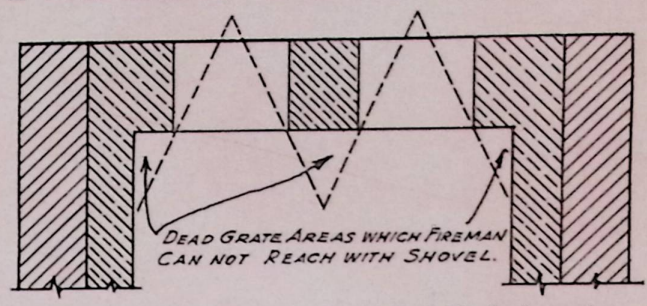


Extension Arch to Protect Rivets

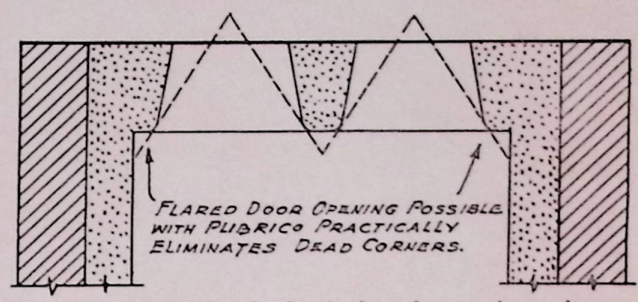
Where the extension arch is built of fire brick, the brick must be stepped out or "corbelled" as shown above. This construction exposes the corners of the brick at one of the hottest spots in the fire.

Where the extension arch is constructed of Plibrico, a single surface is exposed to the fire. The Plibrico arch spans the furnace high above the grates. Better protection for the boiler rivets is assured.

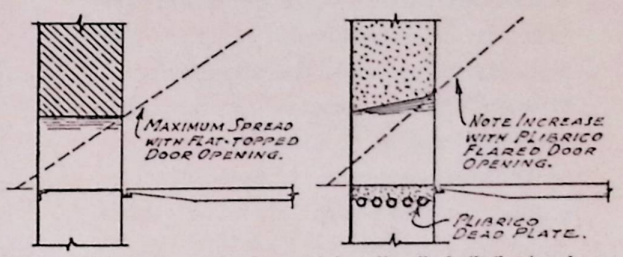
FLARED DOOR JAMBS



It is difficult to build flared door jambs with fire brick. As shown above, with straight jambs the fireman cannot reach the entire grate surface, and it is impossible to carry a good fire over the entire grate area.



With Plibrico construction, the door jambs and center pier can be properly flared, as shown above, eliminating dead corners and making it possible for the fireman to cover the entire grate surface without difficulty. That's why Plibrico fronts are popular with the firemen.



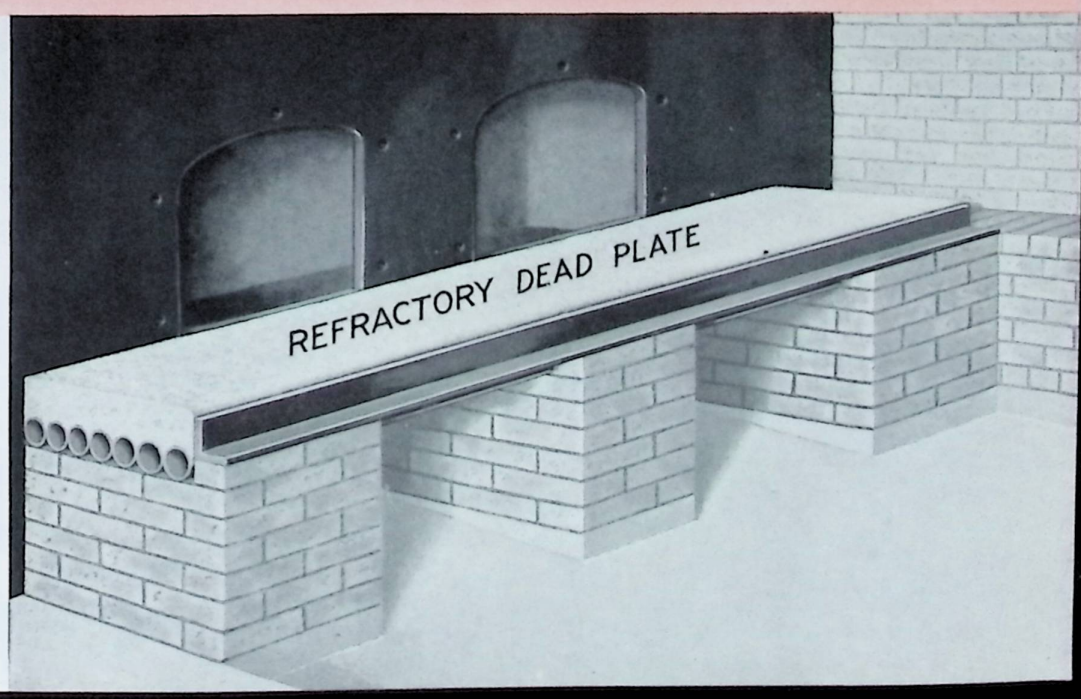
With fire brick, the top of the door arch is ordinarily built flat (as shown left) making it difficult for the fireman to spread his coal without hitting the arch. With Plibrico, the door arch is flared upwards (as shown right).

RENEWABLE REFRACTORY DEAD PLATE

WHEN ordinary cast-iron dead plates warp, crack, and burn out, they cannot be replaced without rebuilding the entire front. The illustration opposite shows a renewable dead plate that can easily be built of Plibrico or Plicast. (See page 32.)

This type of dead plate can be easily constructed out of old pipe with a simple cast-iron angle to serve as a grate rest. The refractory material can readily be replaced when necessary without disturbing the Plibrico front.

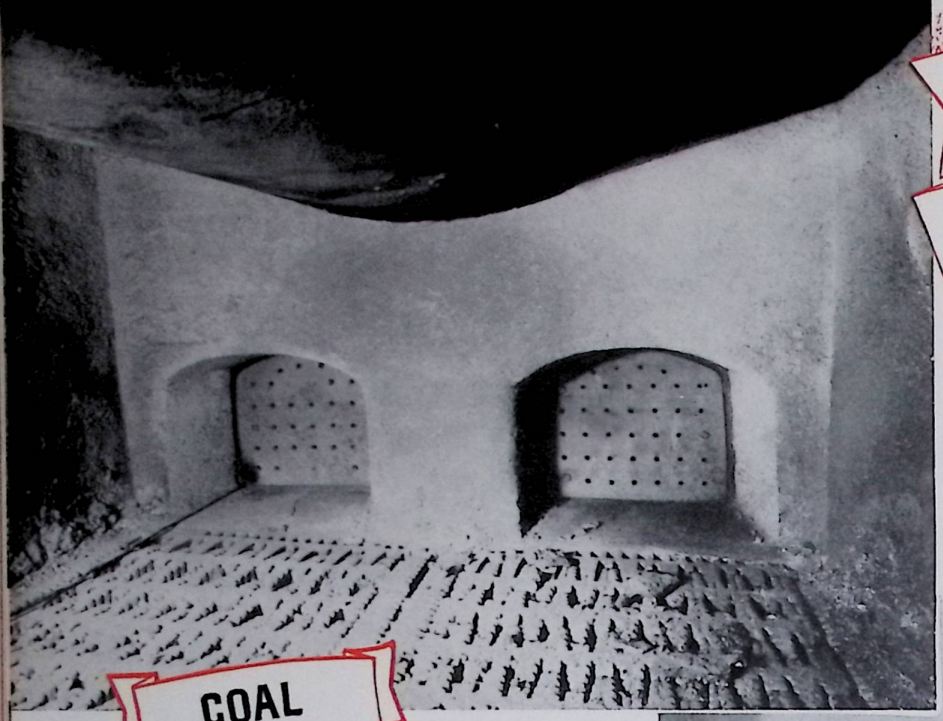
Your local Plibrico representative will be pleased to give you any further information that you require and to quote on installation.



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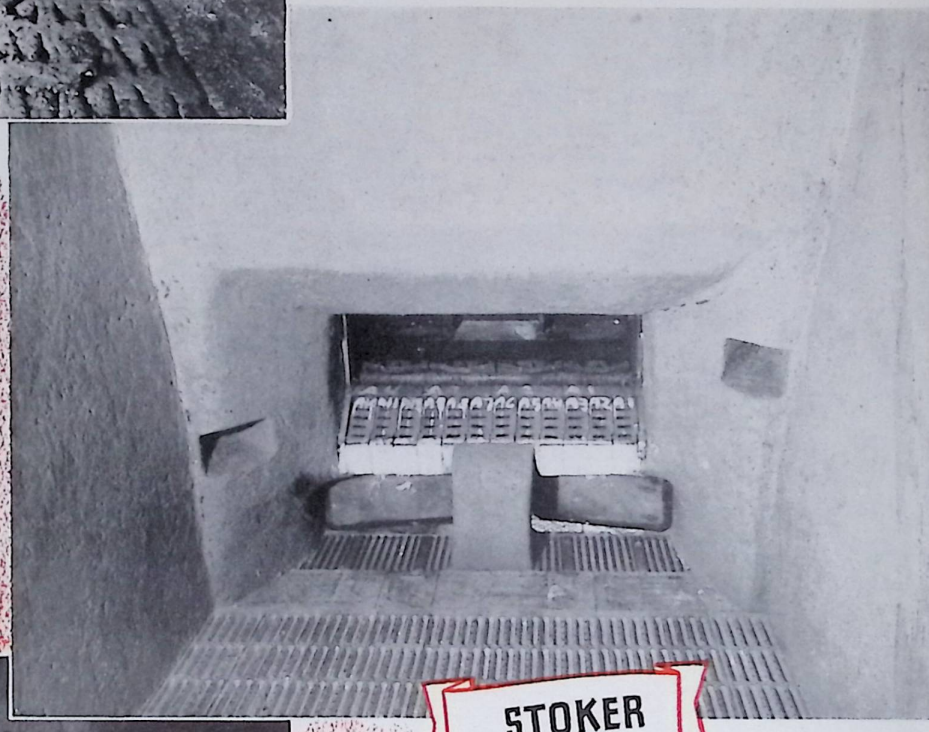
FOR ALL KINDS

Plibrico construction is ideal for any type of fuel and fuel-burning equipment. The photographs on these pages show a variety of Plibrico



COAL

Here is another picture of a Plibrico lining in connection with a hand-fired boiler burning coal. The superiority of Plibrico for this type of setting has been demonstrated in thousands of installations throughout the country. This installation photographed after three years of hard service.



STOKER

Plibrico gives long, economical service in connection with stoker-fired boilers. Here our suspended arch construction has been employed for the ignition arch over a spreader stoker. (See page 21.)



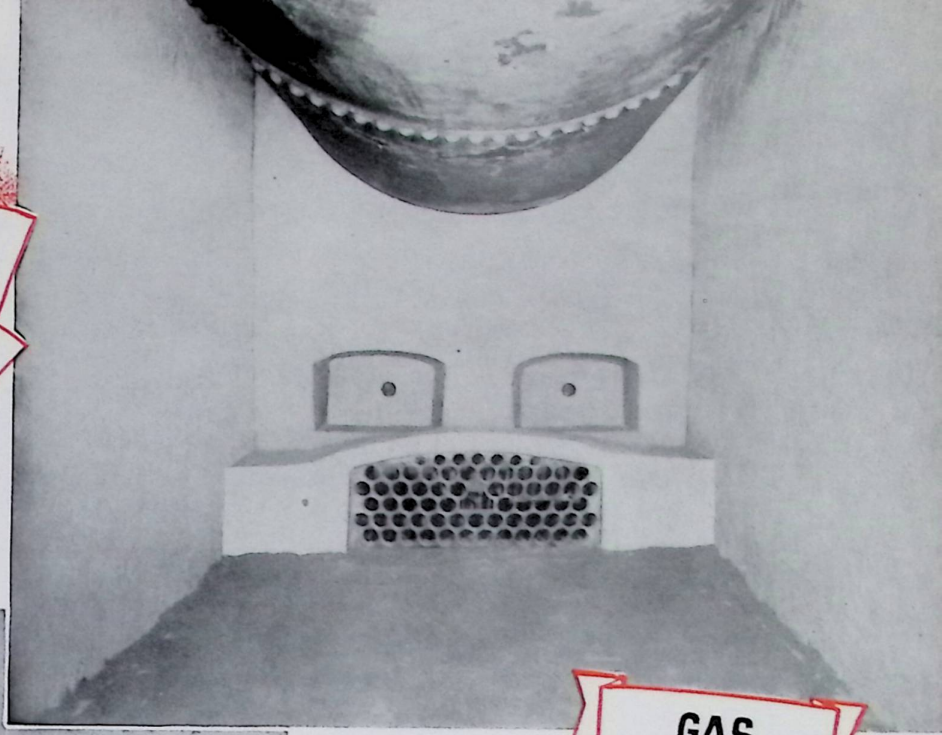
The more severe the service, the more apparent is the economy of Plibrico. Photo at right shows Plibrico lining in connection with H.R.T. boiler fired by pulverized coal after operating at high rating for two full seasons.

PULVERIZED COAL

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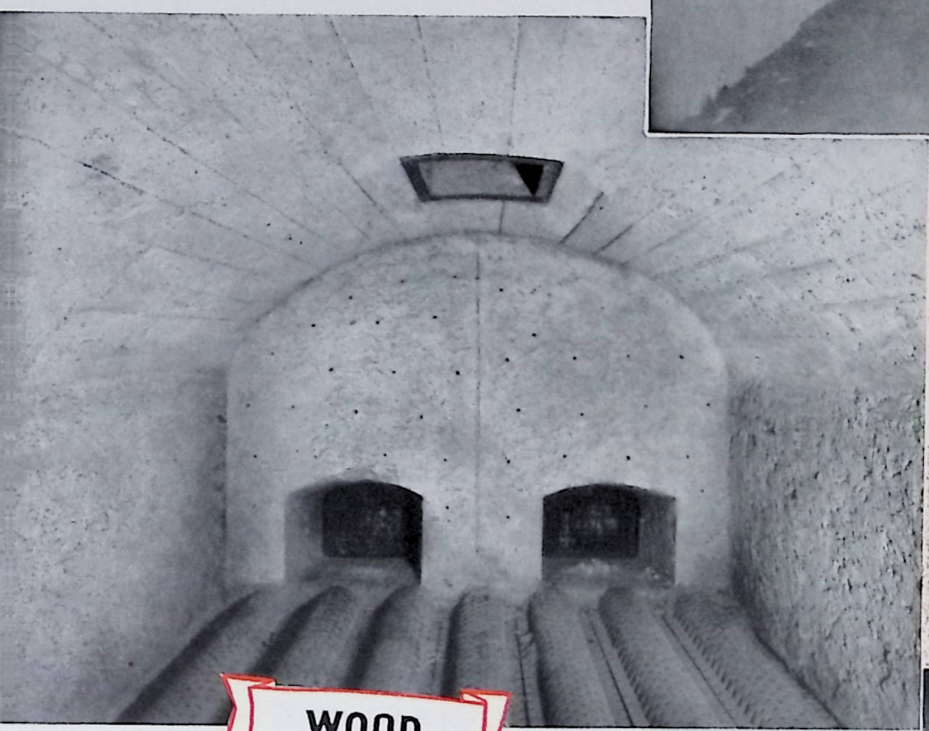
OF FUEL . .

installations, illustrating the ready adaptability of monolithic Plibrico construction to conform to any type of fuel-burning equipment.



GAS

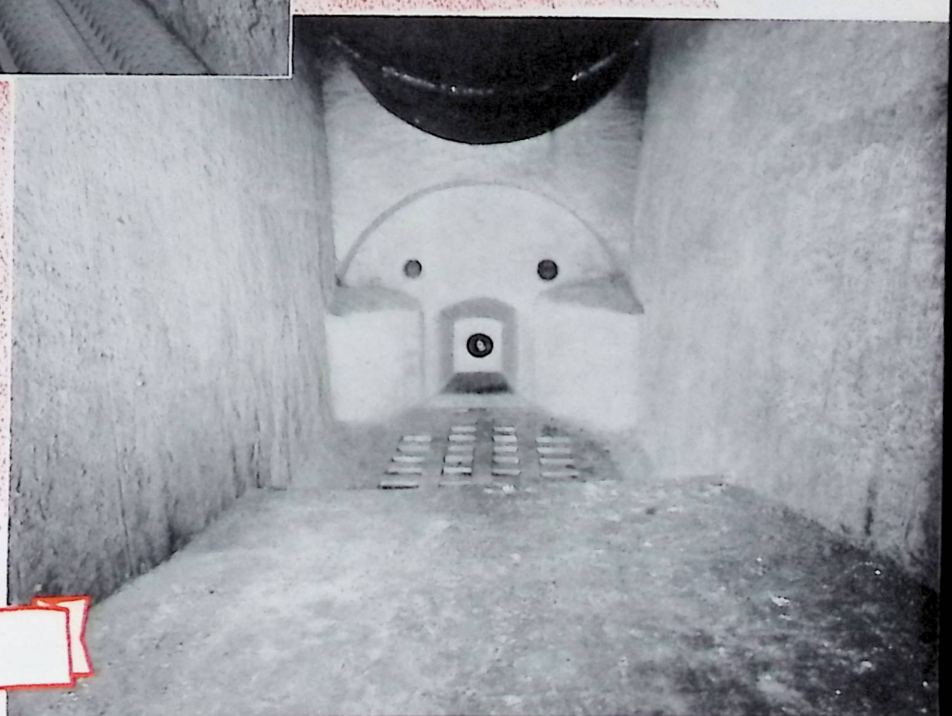
Plibrico linings have demonstrated their superiority in connection with hundreds of gas-fired boilers. In this service, they not only reduce repair costs but also reduce gas bills by eliminating the leaky joints found in fire brick linings.



WOOD

Dutch ovens for burning wood give long service when built of Plibrico. Plibrico arches far outlast sprung arches built of fire brick. In above picture, note Plicast lining around feed chute.

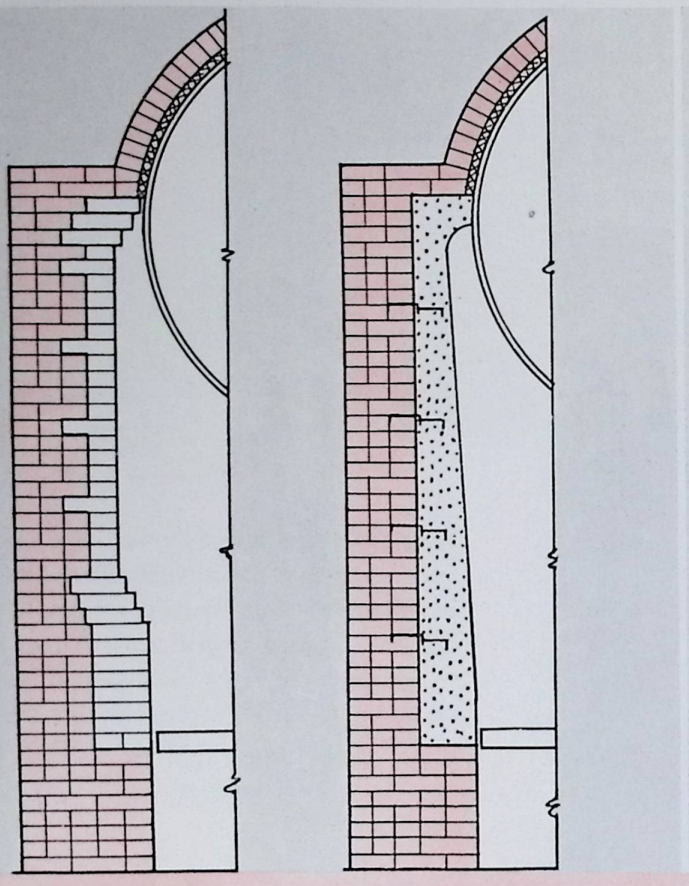
In territories where oil is commonly burned, the superiority of Plibrico construction for oil-fired settings is generally recognized. Burner openings are easily moulded with plastic Plibrico.



OIL

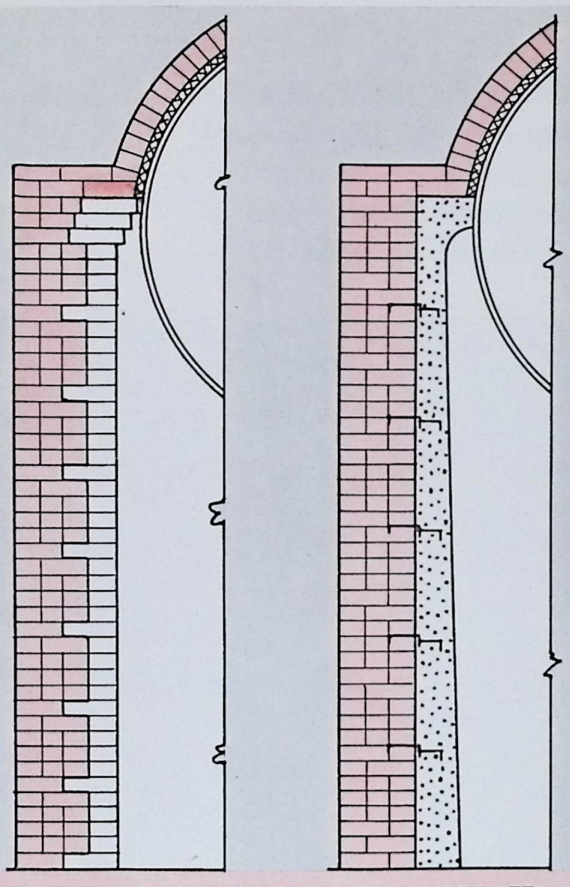
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Extra thickness with *Plibrico* construction



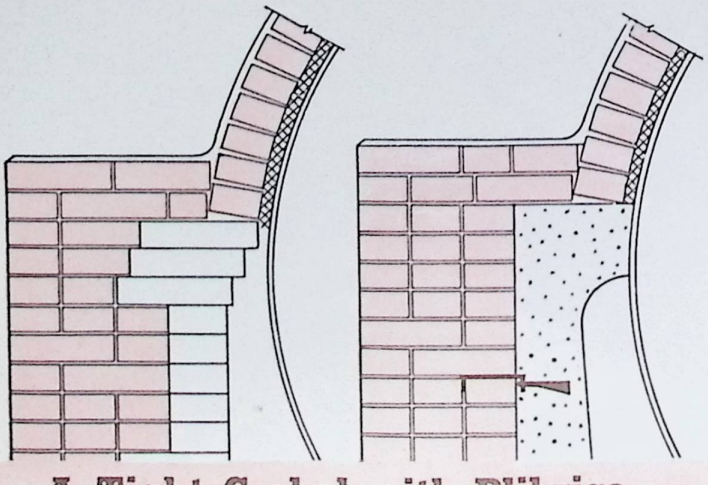
Firebox Side Walls

The print at the left shows usual fire brick construction for firebox side walls with only one course of fire brick (4½ in.) a short distance above the grate line. The print at the right shows standard Plibrico construction, the lining being 9 in. thick at the base battered to 5 in. thick at the corbel. (Average 7 in.)



Combustion Chamber Walls

With fire brick construction, combustion chamber side walls and rear walls are ordinarily built only one course (4½ in.) thick, as shown in the print at the left. Plibrico combustion chamber walls are built 7 in. thick at the base battered to 5 in. at the corbel. (Average 6 in.) This is 33⅓ per cent more refractory material.



A Tight Corbel with Plibrico

Plibrico gives you a tight corbel, as shown at the right. The plastic material hugs the boiler shell. A fire brick corbel (left) does not remain air and gas tight.

IN constructing side walls for H.R.T. boilers with monolithic Plibrico, you not only get the advantage of jointless, monolithic construction but Plibrico walls give you greater refractory thickness which lengthens furnace life, affords better insulation, and reduces infiltration. The prints above show the extra refractory thickness secured with Plibrico. Always check the refractory thickness when comparing the cost of an ordinary fire brick lining with a Plibrico job.

Plibrico corbel construction, as shown opposite, is positively air and gas tight. This is another reason for the recognized superiority of Plibrico for side walls in connection with H.R.T. boilers.

For SIDE WALLS

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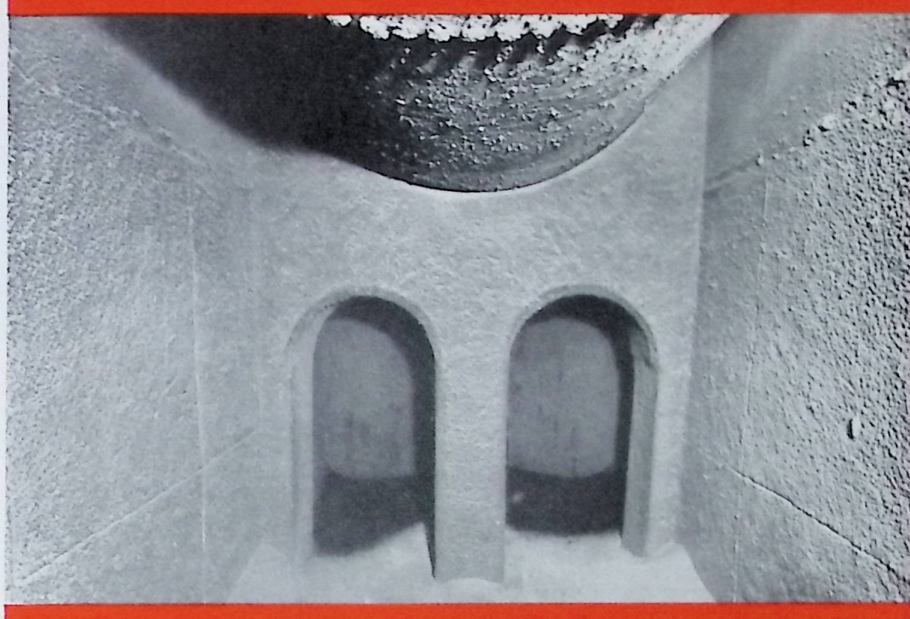
Bridge Wall and Blow-off Pier

THE photograph opposite shows the rear end of an oil-fired H.R.T. boiler with complete Plibrico furnace lining. The V-shaped pier protecting the blow-off pipe is seen behind the bridge wall. Such piers are easily constructed with Plibrico and far outlast fire brick piers. Plibrico bridge walls stand up under the severe punishment to which bridge walls are subjected.



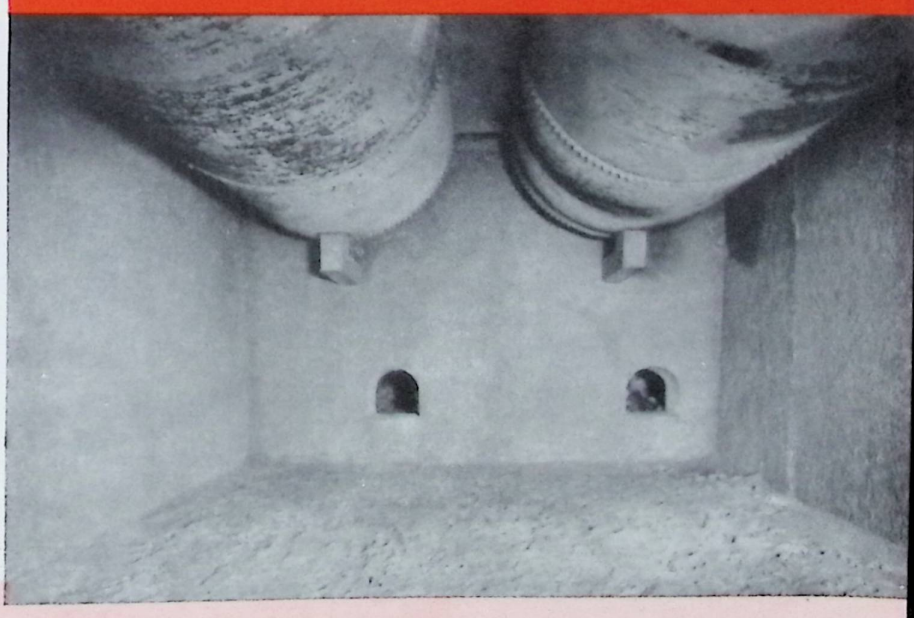
Deflecting Arch

DEFLECTING arches increase combustion efficiency by increasing the turbulence of the fire and lengthening flame travel. They bring about more complete combustion, save fuel, and abate smoke. This deflecting arch, located immediately in front of the blow-off pipe, also serves as a blow-off protector.



Double Furnace

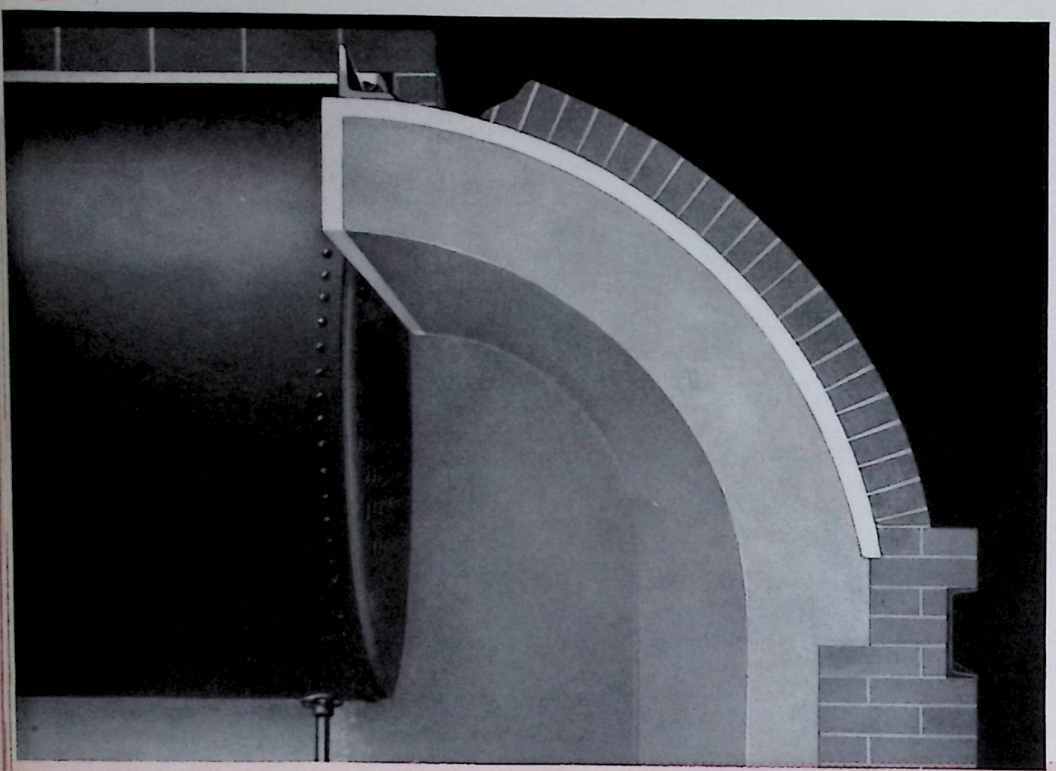
AN INTERESTING Plibrico installation in connection with two 84″ x 20′ H.R.T. boilers with a twin setting, one double furnace serving both boilers. Wood refuse is used for fuel, this picture showing the rear end of the furnace. Monolithic Plibrico construction is unequalled for large furnace walls like those required for this double furnace.



REAR WALLS · BLOW-OFF PROTECTORS

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Plibrico Circular Rear Arch

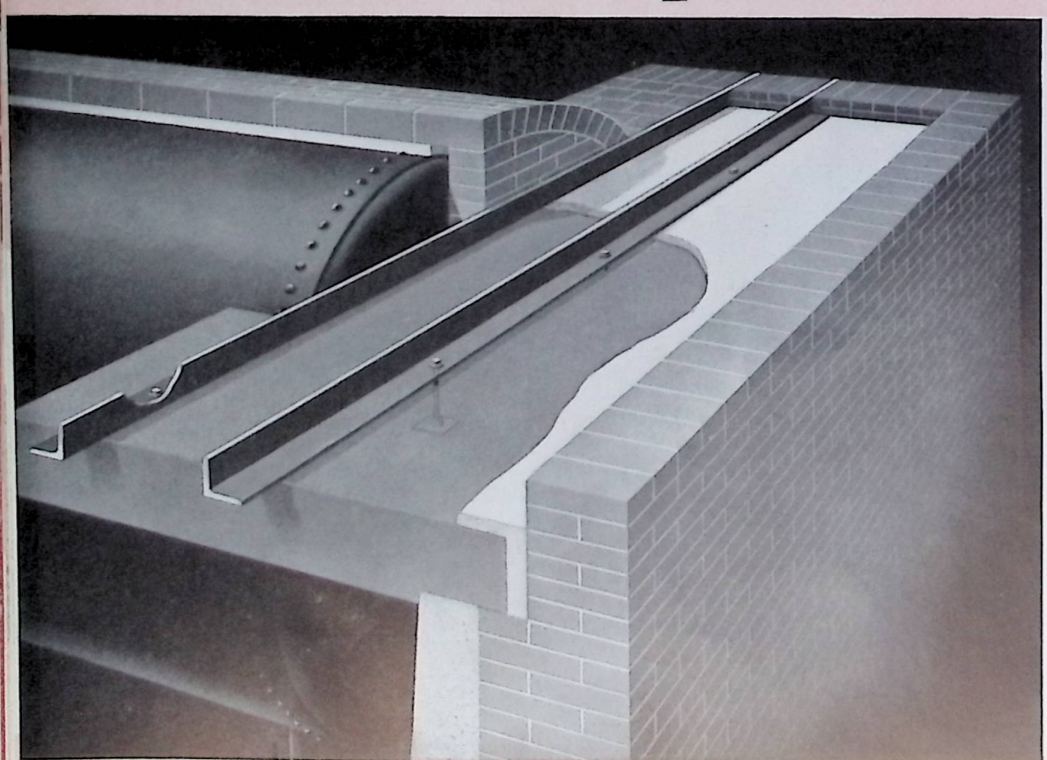


THE Plibrico circular rear arch has been popular for over twenty years. Hundreds of arches of this type have been installed; many of them have been in service for ten years or more and are still in excellent condition.

This type of arch is built of Plibrico Jointless Firebrick. The plastic material is pounded into place over simple wooden forms which are easily constructed. The arch is then baked out by the fire which also burns out the forms, leaving a solid, monolithic arch that will last indefinitely without necessity for repairs.

This type of arch, like the Plicast arch shown below, can be installed in connection with any H.R.T. boiler without any delay awaiting special tile, castings, or other fittings. Any Plibrico or Plicast arch can be installed in a single day.

Plicast Suspended Rear Arch



The light-colored covering over both arches illustrated above is insulating material. In both types, insulating material is also employed as an expansion joint to allow for the expansion of the boiler, avoiding any disturbance of the rear wall.

THE Plicast suspended rear arch is rapidly being recognized as an advanced step in the construction of rear arches, and is ideal where a flat arch is preferred. This type of arch is constructed of Plicast castable refractory material.

The Plicast arch is supported from inexpensive angles with simple hangers as illustrated. The Plicast material (see page 32) is poured upon a wooden form, then sets to concrete-like hardness without application of heat. The hangers become embedded in the arch, holding the flat Plicast slab in position.

Your local Plibrico representative will gladly explain the relative merits of the two types of arches shown here. Whichever type you prefer can readily be adapted to your boilers.

Let us quote on your rear arches the next time they require rebuilding. We furnish complete installation service where desired.

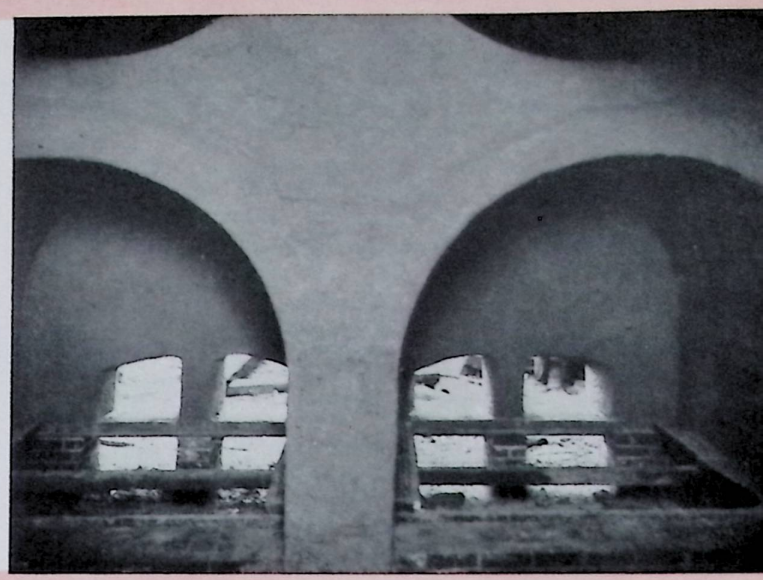
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DUTCH OVEN ARCHES

MONOLITHIC Plibrico construction is unequalled for Dutch oven arches of all types. Wherever wood refuse is burned, it will be found that the arches required for the proper ignition and combustion of this type of fuel can most readily be constructed of plastic Plibrico.

In building Dutch oven arches with Plibrico, any shape or contour that is required to give the best reflection and radiation of the heat to the fuel bed can be secured since Plibrico can be formed into any shape desired. Plibrico is not limited to the shapes that can be constructed with brick or tile.

In the Dutch oven photograph on page 17, attention is called to the elliptical shape of the arch which effects rapid ignition of the fuel.

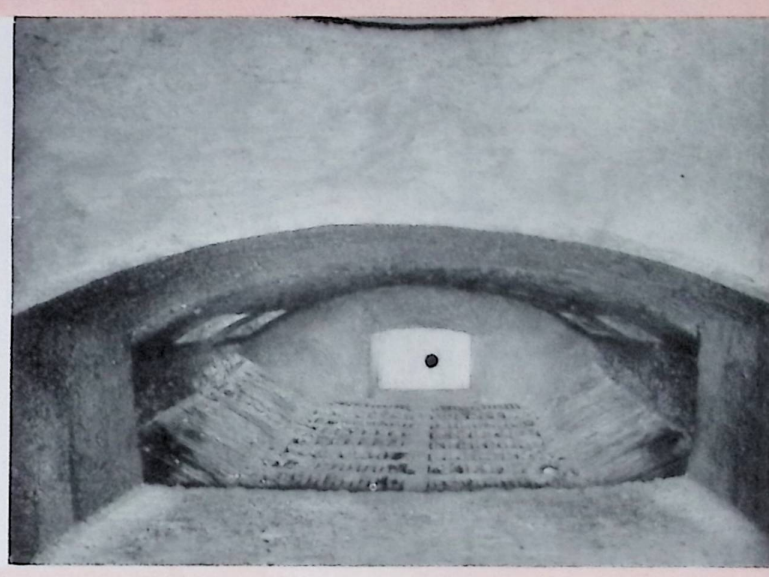


"Smokeless Furnace" ARCHES

THE photograph opposite shows a Plibrico arch in connection with a "smokeless furnace." It will be noted that the front, throat, and curtain wall, in addition to the arch itself, are all built of monolithic Plibrico.

This service is a severe test for any refractory material on account of the restricted firebox, but Plibrico can be relied upon to distinguish itself under severe conditions. In the installation pictured, the average life of arch and lining was increased from one year with fire brick to three years with Plibrico. (Name of customer on request.)

In this type of furnace, Plibrico arches eliminate expensive special shapes and shipping delays. Any type of arch can be built with plastic Plibrico.



FLAT SUSPENDED ARCHES

OPPOSITE is shown a Plibrico flat suspended arch in connection with the same two 84″ x 20′ H.R.T. boilers shown on page 19. This arch is 17′6″ wide by 9′3″ deep and is built throughout of Plibrico, including the drop nose. The arch is suspended by means of Plibrico Arch Hangers embedded in the Plibrico material.

Plibrico flat arches can be suspended from existing hangers or from simple steel work. They outlast other types of construction, minimize spalling, accelerate ignition, and increase combustion efficiency.

Plibrico Flat Suspended Arches are described in detail in a special bulletin which will be gladly furnished on request.



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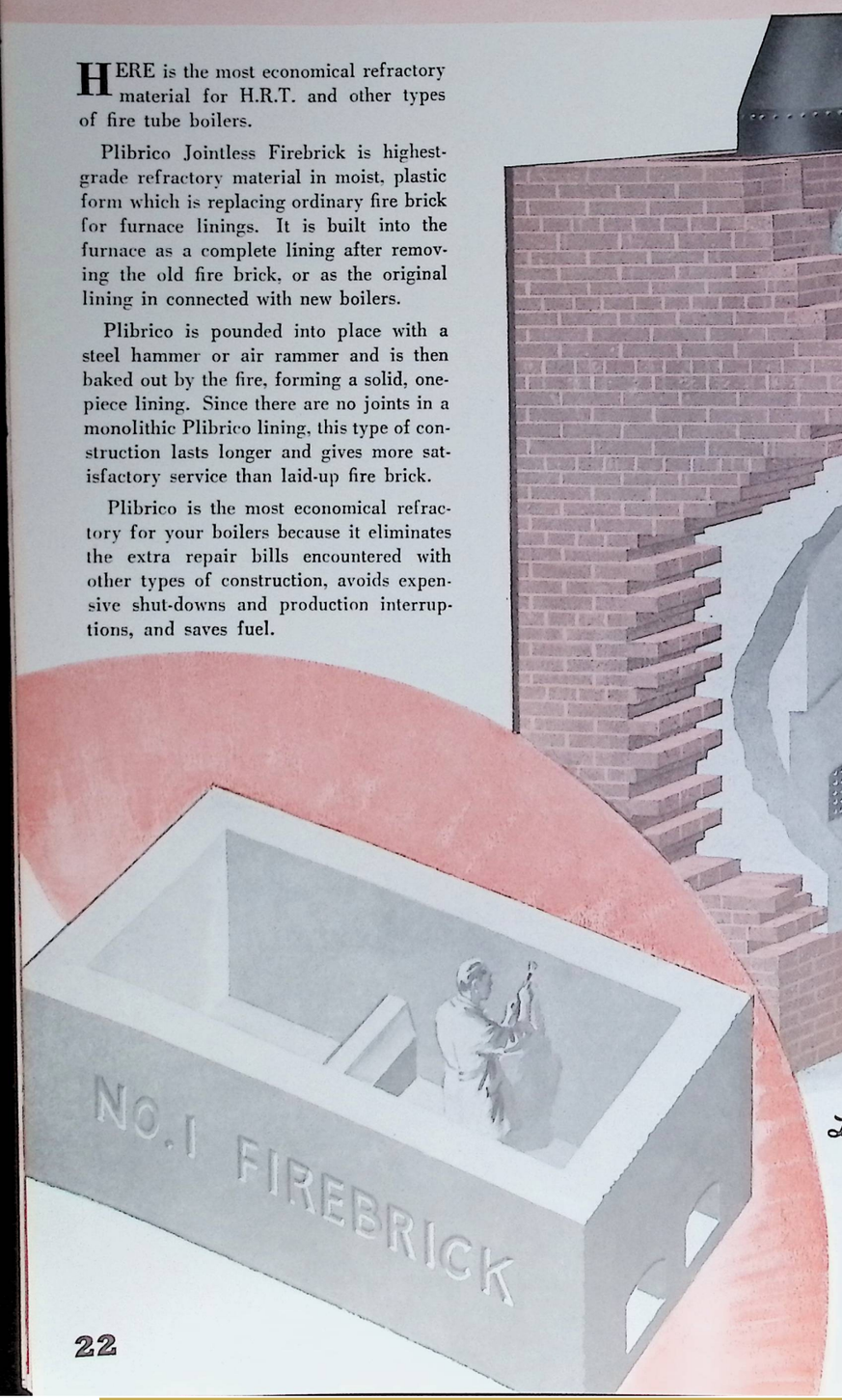
A One-Piece Lining that CAN TAKE IT!

HERE is the most economical refractory material for H.R.T. and other types of fire tube boilers.

Plibrico Jointless Firebrick is highest-grade refractory material in moist, plastic form which is replacing ordinary fire brick for furnace linings. It is built into the furnace as a complete lining after removing the old fire brick, or as the original lining in connected with new boilers.

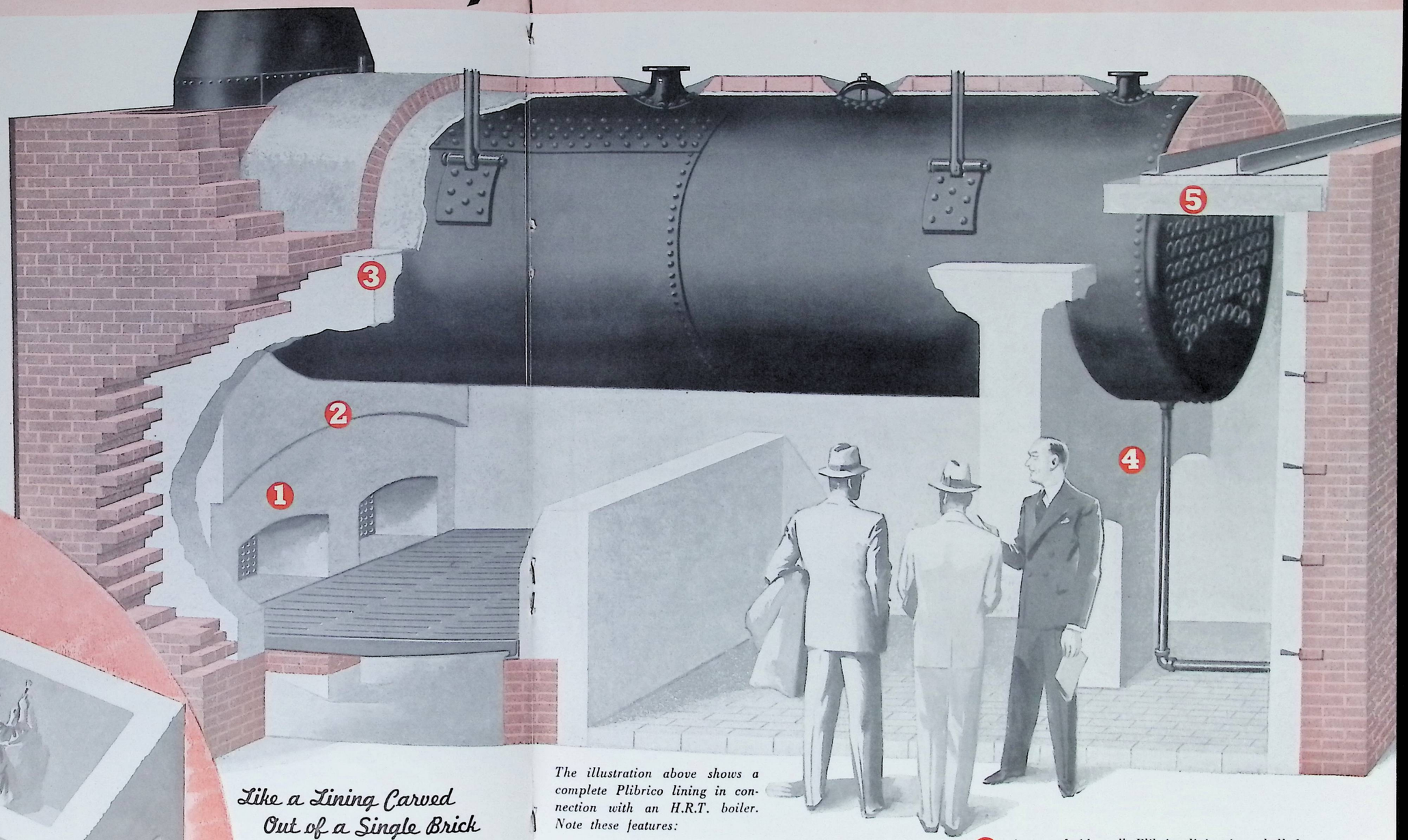
Plibrico is pounded into place with a steel hammer or air rammer and is then baked out by the fire, forming a solid, one-piece lining. Since there are no joints in a monolithic Plibrico lining, this type of construction lasts longer and gives more satisfactory service than laid-up fire brick.

Plibrico is the most economical refractory for your boilers because it eliminates the extra repair bills encountered with other types of construction, avoids expensive shut-downs and production interruptions, and saves fuel.



Like a Lining Carved Out of a Single Brick

A monolithic Plibrico lining is all one piece—as though it were carved out of one huge fire brick to fit your boiler furnace. There are no joints to open up—no individual bricks to loosen and bulge.



The illustration above shows a complete Plibrico lining in connection with an H.R.T. boiler. Note these features:

1. Solid, monolithic construction, entirely free of all weakening joints. No individual brick to cause collapse of front door arches. Note how door openings are flared for easy firing.
2. Extension arch to protect boiler rivets is easily constructed. Strong and substantial.
3. At top of side wall, Plibrico lining is corbelled over to give tight seal against boiler shell.
4. Deflecting arch protects blow-off pipe and improves combustion.
5. Suspended rear arch constructed of Plicast castable refractory material. (See page 20.)

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SPECIFICATIONS

THE prints opposite show standard Plibrico construction for typical H.R.T. settings, and the specifications following give the proper thicknesses for the installation of Plibrico linings in connection with H.R.T. boilers. Engineers and architects can write their specifications from the following information with confidence that it represents the most advanced practice in monolithic furnace construction.

The furnace should be lined with Plibrico Jointless Firebrick in accordance with the following specifications:

Front Wall

For coal—Full thickness of dead plate.

For oil, gas, or pulverized fuel—9 in. thick, or as required to suit fuel-burning equipment.

Where necessary, an extension arch should be built to protect the boiler rivets.

Dead Plate

To be constructed of Plibrico Jointless Firebrick or Plicast No. 27 4 in. thick.

Side Walls

For coal—In firebox, 9 in. thick at grate line battered to 5 in. thick at corbel. In combustion chamber, 7 in. thick at floor line battered to 5 in. thick at corbel.

For oil, gas, or pulverized coal—9 in. thick at floor line battered to 5 in. thick at corbel the entire length of the furnace.

Bridge Wall

To be 18 in. thick above grate line; 6 in. facing below grate line in combustion chamber.

Deflecting Arch

Usually 12 in. thick.

Blow-Off Pier

To be solid 18″ x 18″ up to bend in blow-off pipe; wings above bend in pipe to be 6 in. thick.

Rear Wall

For coal—7 in. thick at floor line battered to 5 in. thick at arch.

For oil, gas, or pulverized fuel—9 in. thick at floor line battered to 5 in. thick at arch.

Rear Arch

7 in. thick if built of Plicast in flat suspended form.
9 in. thick if built of Plibrico in circular form.

Floor

For coal—The floor in the combustion chamber should be constructed of No. 2 fire brick 4½ in. thick.

For oil, gas, or pulverized fuel—To be built as required.

Air-cooled walls are recommended for severe combustion conditions as with oil, pulverized coal, or stoker firing at high ratings. Where air-cooled walls are advisable, they should be constructed as shown on page 26.

We are also including herewith the following materials specifications covering Plibrico which the engineer or architect can incorporate in his general specifications:

Refractory Lining

"The refractory lining is to be constructed of Plibrico Jointless Firebrick installed in accordance with the following thickness specifications: (See above.) The lining is to be anchored to the supporting walls (or steel casings) by means of flexible, two-piece anchors allowing the refractory wall to move independently of the outer wall with expansion and contraction. The anchors are to be installed in accordance with the directions of the manufacturers of the refractory materials. The lining is to be built by workmen skilled and experienced in the installation of plastic fire brick material and the work is to be done under the supervision of the manufacturer."

How to Figure the Amount Required

YOUR local Plibrico representative will gladly call at your plant at any time to inspect your furnaces and figure the amount of Plibrico required for any repairs necessary. If desired, he will quote on labor for installation as well as material.

However, the amount of Plibrico required for any installation can be accurately computed by using the figure of 133⅓ lbs. per cubic foot.

PER SQUARE FOOT

Pounds of Plibrico required per square foot of furnace wall area in various thicknesses:

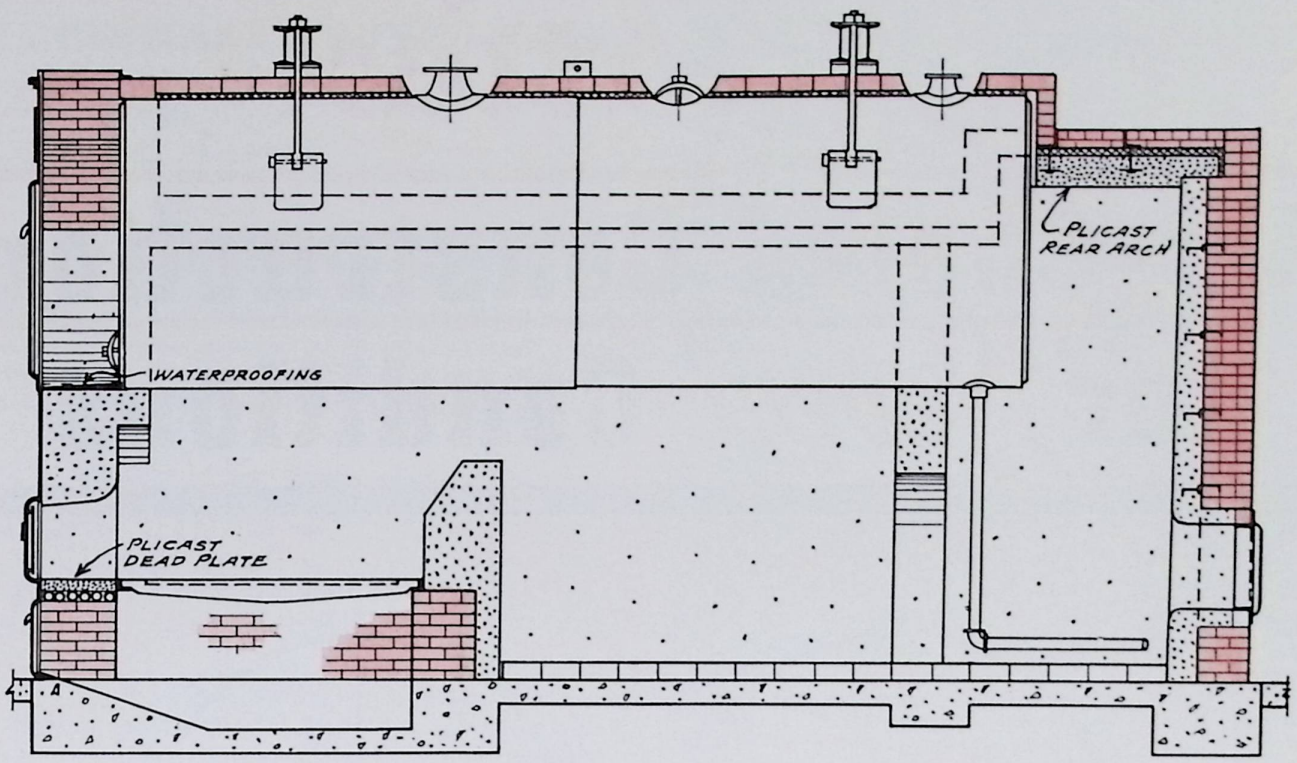
4½ in. walls	50 lbs.
6 in. walls	67 lbs.
7 in. walls	78 lbs.
9 in. walls	100 lbs.
12 in. walls	133⅓ lbs.

Average thickness should be used in figuring battered walls.

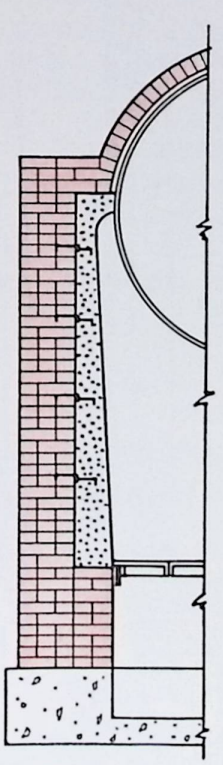
The convenient table opposite gives the amount of Plibrico necessary per square foot of wall area in different thicknesses.

In the case of a battered wall, the average thickness should be used in computing the amount of material necessary. The average thickness of a wall 9 in. thick at the base battered to 5 in. thick at the top is 7 in., while that of a wall 7 in. thick at the base battered to 5 in. thick at the top is 6 in.

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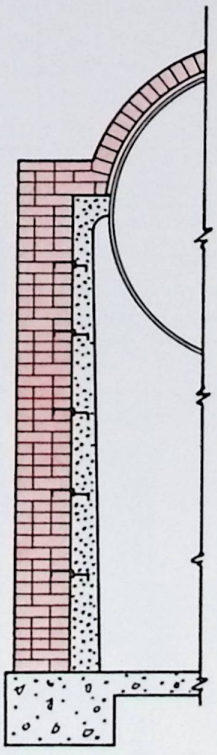


Standard Plibrico setting for typical H.R.T. boiler. Specifications listed on opposite page.



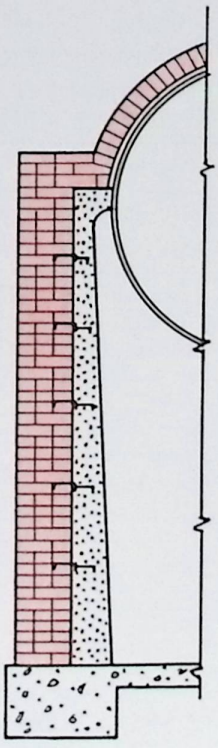
Firebox Side Walls

Section through firebox showing Plibrico side walls 9 in. thick at grate line battered to 5 in. at corbel.



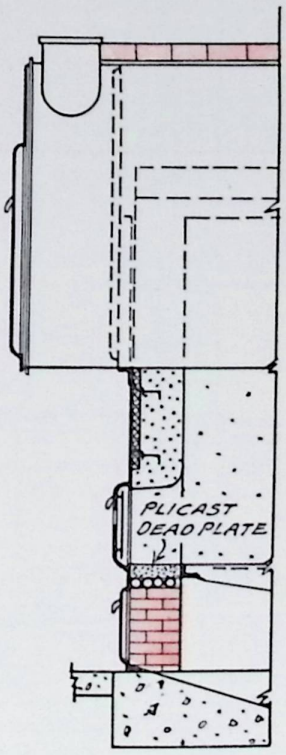
Combustion Chamber Walls

Section through combustion chamber showing Plibrico side walls 7 in. thick at base battered to 5 in. thick at corbel.



Oil, Gas, or Pulverized Coal

Section through furnace showing Plibrico side walls 9 in. thick at floor line battered to 5 in. thick at corbel.



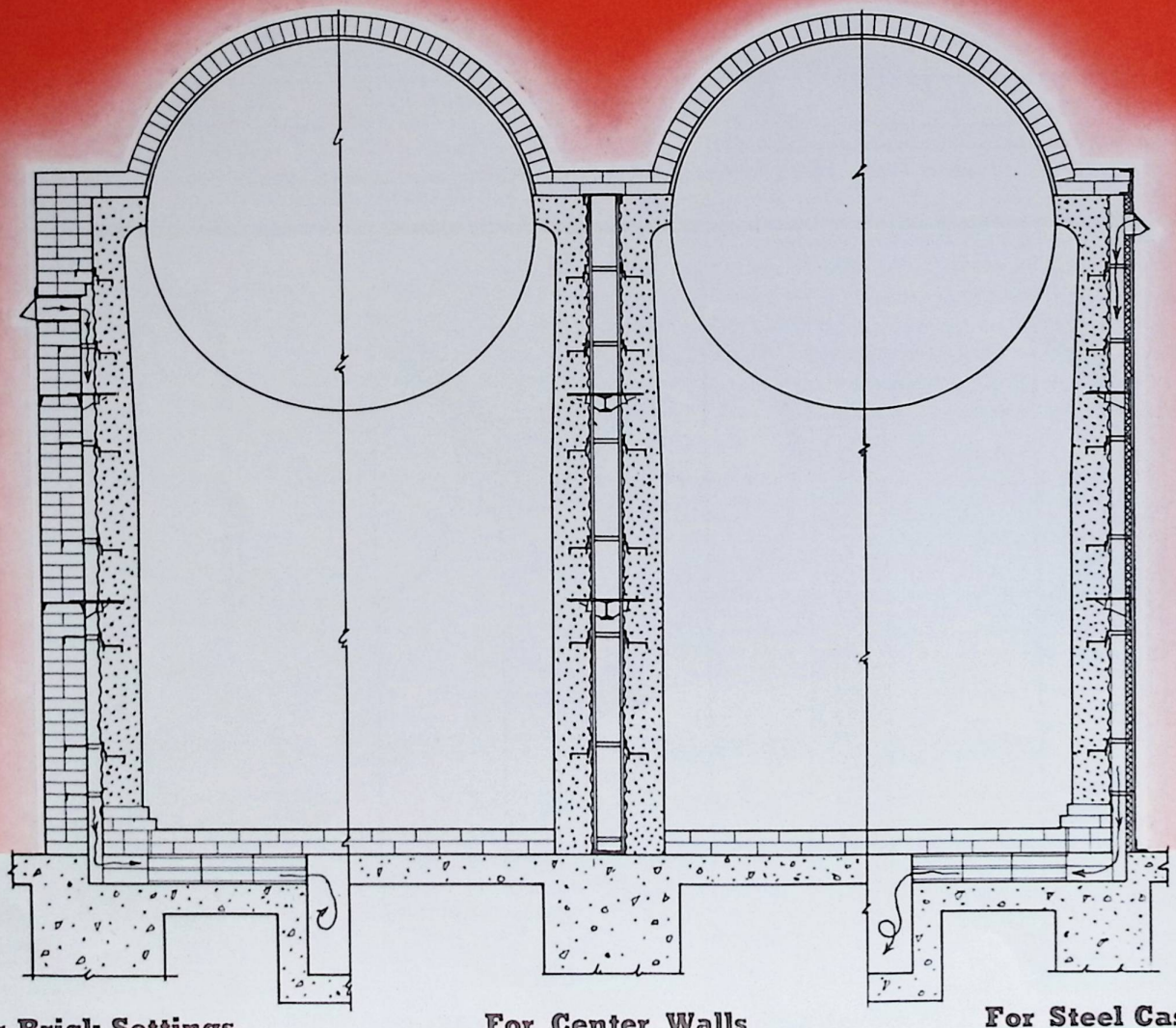
Extension Fronts

In this type of setting, the front wall is ordinarily built 12 in. thick as shown above. Note anchors and insulation.

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Plibrico

Air-Cooled Construction for *Severe* Conditions



For Brick Settings

Left wall of print above shows Plibrico Air-Cooled Wall as erected in connection with standard brick setting. Note how supporting brackets divide wall into sections.

For Center Walls

Center portion of print above shows Plibrico sectionally-supported air-cooled wall construction for center walls. Air may be removed from ends, top, or bottom of wall.

For Steel Casings

Right wall of print shows Plibrico Air-Cooled Wall as erected in connection with steel-cased setting. Special brackets are available for use with steel casings.

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SECTIONALLY-SUPPORTED *built like a* SKYSCRAPER

THE Plibrico Air-Cooled Wall is a simple but effective sectionally-supported construction that can readily and economically be adapted to any H.R.T. or two-pass boiler It is recommended for any setting where combustion conditions are severe.

The modern trend in the operation of boilers is towards higher boiler ratings with consequent higher furnace temperatures. The perfection of automatic stokers, and the burning of fuels in suspension, as with oil and gas burners, spreader stokers, and pulverized coal, has resulted in more severe combustion conditions and increased refractory maintenance cost.

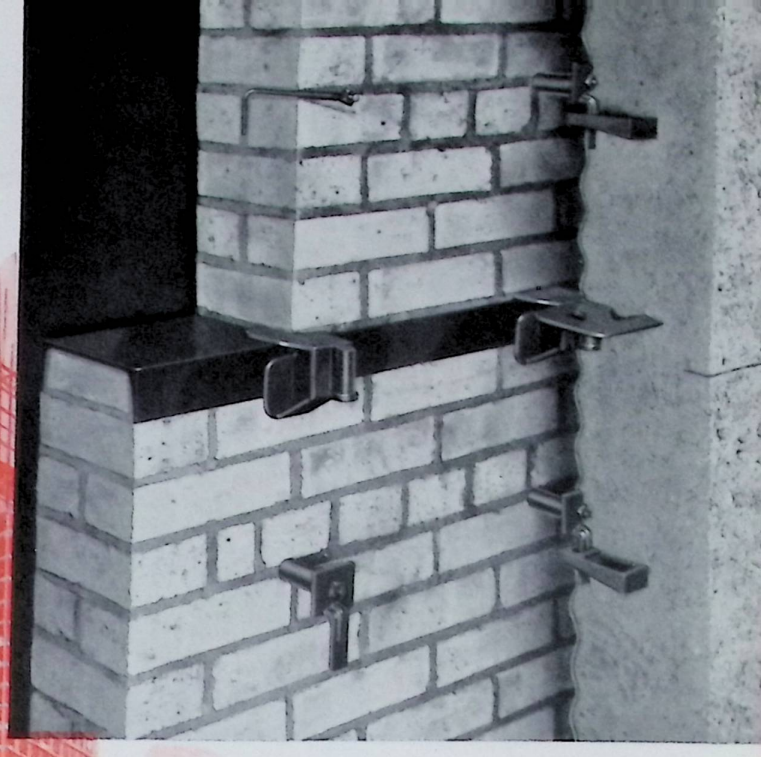
Plibrico air-cooled wall construction is designed to minimize refractory deterioration at high ratings. It reduces the temperature of the refractory below the critical point by means of an air passage between the Plibrico lining and the exterior supporting wall. Air-cooling not only saves the furnace walls from excessive deterioration but also reduces the formation of slag deposits on the refractory material.

The warm air discharged from the walls may be used as preheated air for combustion, or for drying the fuel where the boilers are equipped with pulverized coal burners. Thus the heat ordinarily lost through the setting is reclaimed and used. In cases where it is advisable to allow the air lanes to discharge to atmosphere, the heat loss is negligible as compared with the saving effected in refractory maintenance.

The Plibrico Air-Cooled wall can readily be adapted to any existing boiler. Wherever excessive maintenance cost is encountered, air cooling should be considered.

An oil-fired H.R.T. boiler with Plibrico air-cooled sectionally-supported setting. Air inlets are clearly shown along top of wall.





Details of Plibrico air-cooled wall construction showing air lane behind Plibrico lining. Wall is sectionally supported by means of high-temperature alloy brackets, installed at intervals of about 3 ft., which transfer the load of each section to steelwork in the outer wall. Any section of Plibrico lining may be repaired, when necessary, without disturbing other sections.

Plibrico air-cooled construction is superior in important respects to other types of sectionally-supported air-cooled walls. Compared with other types of construction, Plibrico construction offers the following advantages.

1. *Monolithic refractory lining.* As in all Plibrico construction, the furnace lining is monolithic with the exception of a relatively small number of joints dividing the lining into independent sections. This is particularly important in the case of air-cooled walls because of the considerable amount of air infiltration found to be a weakness of other types of air-cooled construction.

2. *Simplicity and flexibility.* The Plibrico Air-Cooled Wall is supported by simple, inexpensive steel work. Our construction requires less supporting steel work since it does not employ heavy cast-iron hangers. No special tile shapes are used. All materials can be obtained from local sources with the exception of our bracket castings.

3. *Less space required.* Other types of sectionally-supported walls require more space than Plibrico construction. The over-all thickness of the Plibrico Air-Cooled Wall is only 19 in. including all supporting steel columns, which may be set into the walls.

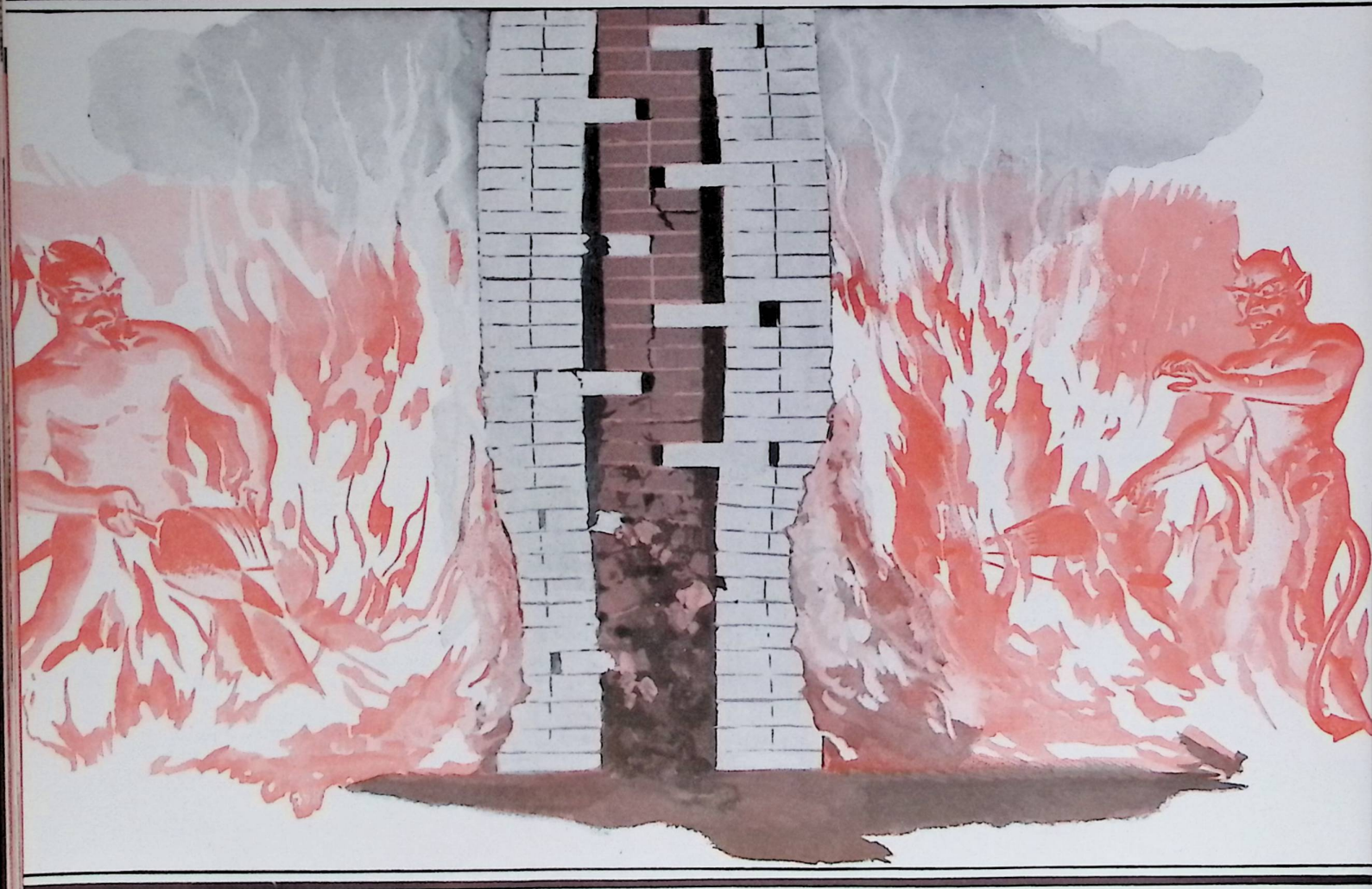
4. *Ideal for resetting work.* Our designs adapt themselves better to resetting existing boilers since no special units are necessary for any installation. Every installation is constructed of standard units without special castings or special tile. Thus delays are not encountered in any variation from standard design.

5. *Air flow in any direction.* With the Plibrico Air-Cooled Wall, the flow of air may be either vertical or horizontal. The direction of flow may be changed at will while the wall is in service since the air passages are not restricted by heavy castings.

Scores of boilers, many of them being large water tube units, have been provided with Plibrico Air-Cooled Walls with uniformly satisfactory results. Our engineering department will gladly prepare blueprints showing the adaptation of the Plibrico sectionally-supported air-cooled wall to any new or existing boiler.

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Plibrico Air-Cooled Center Wall for Battery Settings



BETWEEN TWO FIRES . . .

IN most boiler plants, the maintenance of center walls in connection with battery settings is a source of considerable annoyance and expense.

With both boilers in operation at the same time, there is no opportunity to dissipate the heat which is "soaked up" by the center wall. Gradually the temperature of the center wall builds up higher and higher until the danger point is reached. As shown above, the common brick forming the core of the wall break up and crumble away, allowing the fire brick walls to loosen and collapse as the core fails.

A big disadvantage of solid masonry construction for center walls is the fact that it is frequently impossible to repair one side of the wall without causing the collapse of the entire center wall. This is a major catastrophe where a plant is equipped with only two boilers!

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BANISH
Center Wall Trouble

FOR battery settings, we recommend the Plibrico Air-Cooled Center Wall which can be installed at moderate cost in connection with either new or old boilers.

It is a simple matter to cool a center wall with our air-cooled center wall construction. Excessive deterioration of the refractory lining on either side of the center wall is thus eliminated and the center walls, henceforth, give no more trouble than is experienced with outside side walls.

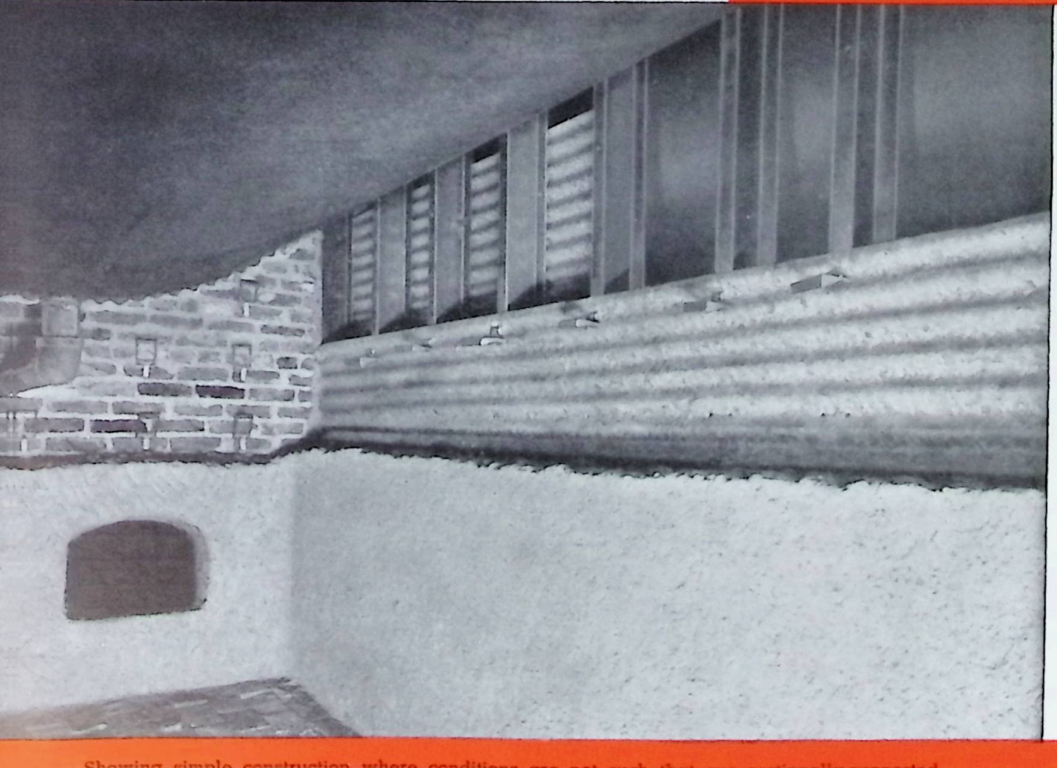
Wherever the Plibrico Air-Cooled Center Wall has been installed, it has proved eminently satisfactory. It is the answer to the problem that has been so bothersome with battery settings.

The Plibrico Air-Cooled Center Wall is built in two types in connection with H.R.T. boilers. For the larger boilers and higher settings, our sectionally-supported air-cooled construction is used as shown opposite. For smaller boilers and lower settings, it is erected with more simple supporting steel work as shown below.

Within its range of application, either type will give full satisfaction and will eliminate the excessive repair cost of solid masonry construction for center walls. Let us quote on equipping your battery settings with Plibrico Air-Cooled Center Walls.



Showing adaptation of our sectionally-supported, air-cooled construction for center walls. Note openings in horizontal channel for removal of heated air.



Showing simple construction where conditions are not such that our sectionally-supported construction is recommended. Here corrugated sheets forming the backing for the lining have been placed in position, and Plibrico lining has been partially built up.

MODERNIZE
Your Settings

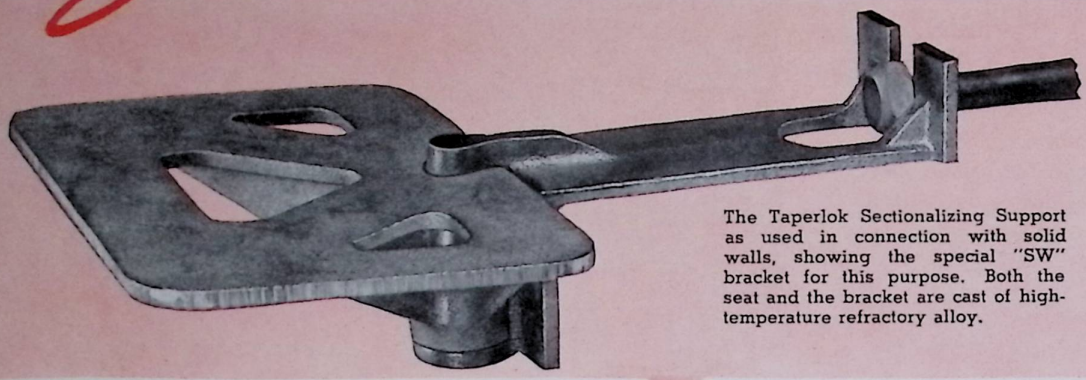
IN many plants, boiler setting construction and furnace design have not kept pace with the development in fuel-burning equipment. In consequence, excessive refractory maintenance costs are encountered while utmost boiler efficiency and capacity are not realized.

Our engineering department will be pleased to give you our recommendations for modernizing your boiler settings through more advanced furnace design and construction, suggesting the installation of the Plibrico Sectionally-Supported Air-Cooled Wall where advisable. Our air-cooled construction can be employed in connection with existing boilers at reasonable cost.

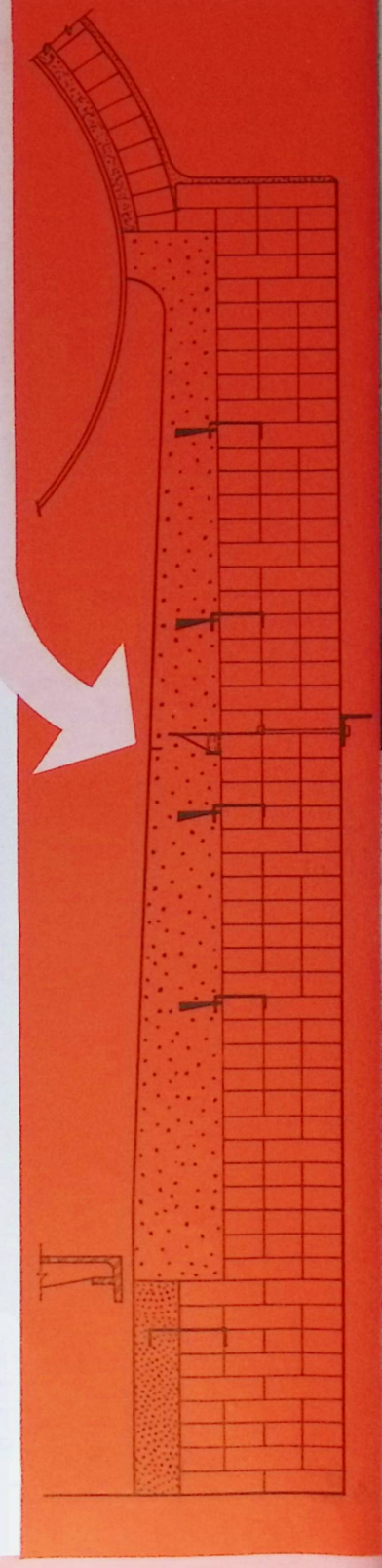
Send us your blueprints if you intend to modernize existing boilers, to set new boilers, or to install stokers, pulverizers, oil or gas burners, or other new firing equipment. We shall gladly prepare drawings showing the application of our construction for your boilers.

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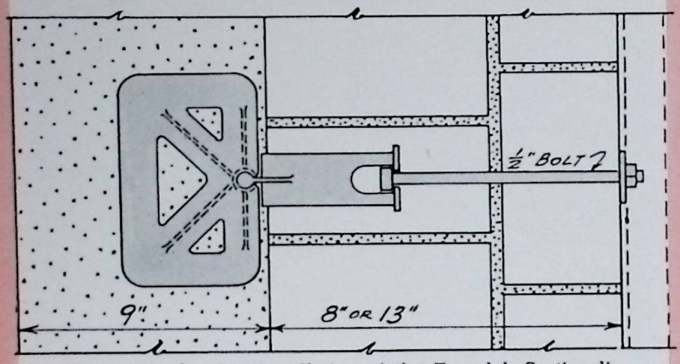
PLIBRICO *Sectionally-Supported Construction* for SOLID WALLS



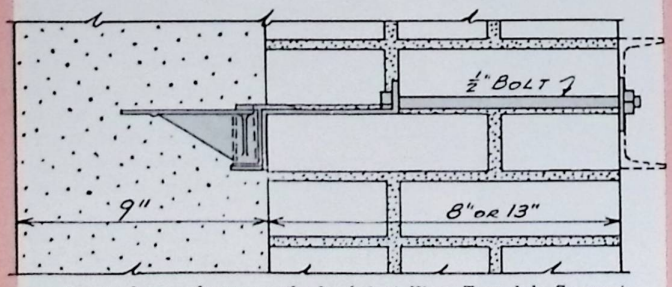
The Taperlok Sectionalizing Support as used in connection with solid walls, showing the special "SW" bracket for this purpose. Both the seat and the bracket are cast of high-temperature refractory alloy.



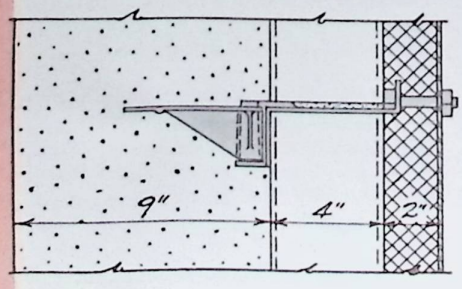
How "SW" Bracket Is Used



Plan view showing installation of the Taperlok Sectionalizing Support. In existing walls, the "SW" bracket can be installed by removing and replacing a single brick as indicated.



Print above shows method of installing Taperlok Support showing ½ in. bolt bolting "SW" bracket to brick work. Steel channel is required only with existing brick walls or with new brick walls less than 12 in. in thickness.



Taperlok Support as installed in connection with Plibrico steel - cased, insulated construction in which hollow tile of the load - bearing type support the "SW" brackets.

THE print at right shows Plibrico Sectionally - Supported Construction for solid walls where air cooling is not desired. As in our air-cooled construction, a row of TAPERLOK Sectionalizing Supports is used to divide the Plibrico lining into individual sections, transferring the load of the refractory lining to the outer brick wall.

The photograph above shows the special bracket used in conjunction with the TAPERLOK Support for solid walls. These brackets are installed in the brick work as shown at the left. In new settings, the brackets are set in place as the brick work is built up. In existing settings, the brackets can readily be installed by removing and replacing a single brick.

In either new or existing settings, the bracket is held in place by a ½ in. bolt extending through the wall. Where the outside wall is old brick work, or new brick less than 12 in. thick, a supporting steel channel or angle is installed across the outside of the wall, as shown, to give the necessary strength to the structure.

This construction increases the life of the refractory lining by reducing the load on each section. A further advantage is the fact that any section can be repaired, when necessary, without disturbing other sections.

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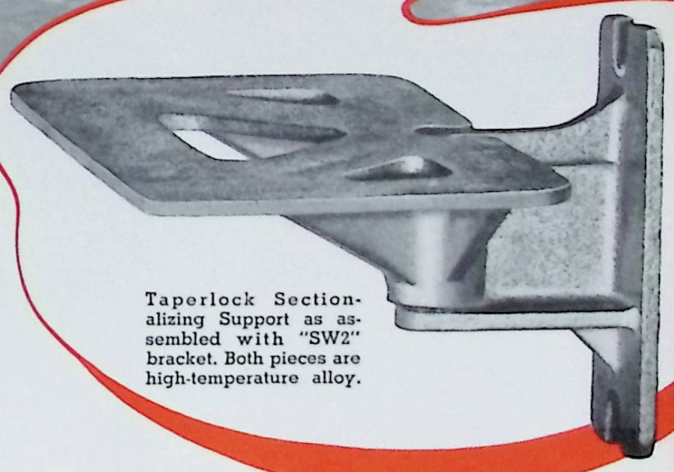
Plibrico battery setting under construction with sectionally-supported, solid side and rear walls and sectionally-supported, air-cooled center wall.

THE photograph above shows a Plibrico Sectionally-Supported Setting under construction in connection with two H.R.T. boilers set in battery. The side and rear walls are Plibrico sectionally-supported, solid wall construction while the center wall between the two furnaces is Plibrico sectionally-supported, air-cooled center wall construction as described on page 29.

This type of setting is recommended for boilers set in battery where combustion conditions are not severe enough to require air cooling of exterior walls but where it is advisable to air cool the center wall to prevent excessive deterioration.

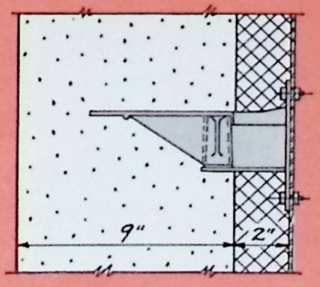
In our sectionally-supported, solid wall construction, the "SW" brackets can easily be installed in connection with either new or existing brickwork as shown on the opposite page. The TAPER-LOK Sectionalizing Supports, fitting over the brackets, support the upper section of the Plibrico lining.

The illustrations at the right show the "SW2" bracket which is used in connection with Plibrico sectionally-supported, solid wall construction where the bracket must be attached to a steel casing or cast-iron plate. This bracket makes provision for an adequate thickness of insulation as shown.



Taperlock Sectionalizing Support as assembled with "SW2" bracket. Both pieces are high-temperature alloy.

THE "SW2" BRACKET



Print showing method of installing "SW2" bracket in connection with steel casing or cast-iron plate.

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PLICAST *Castable*

PLICAST is a self-hardening or "castable" refractory material. As shown below, it is shipped in dry, powdered form. After being mixed with water to the proper consistency, Plicast is poured between forms or into moulds like concrete. It then sets to concrete-like hardness without the application of heat. After installation, the material should be allowed to stand for 24 hours, if possible, before being subjected to heat.

In this material, shrinkage is negligible so that a Plicast installation is free of cracks or "checks." Plicast withstands moisture and abrasion as well as temperature. It is a durable material of great tensile strength which is proving very useful in connection with fire tube boilers for the applications shown on these pages and throughout this catalog.

Plicast is made in various grades: Plicast No. 27 for high temperature applications; Plicast No. 15 for lower temperatures; Plicast Hearth Cement for setting stokers and oil burners; Plicast L-W-I, a lightweight, insulating castable material.

All grades of Plicast, with the exception of L-W-I, weigh 110 lbs. per cubic foot and are packed in 100-lb. bags. Plicast L-W-I weighs only 57 lbs. per cubic foot and is packed in 50-lb. bags.

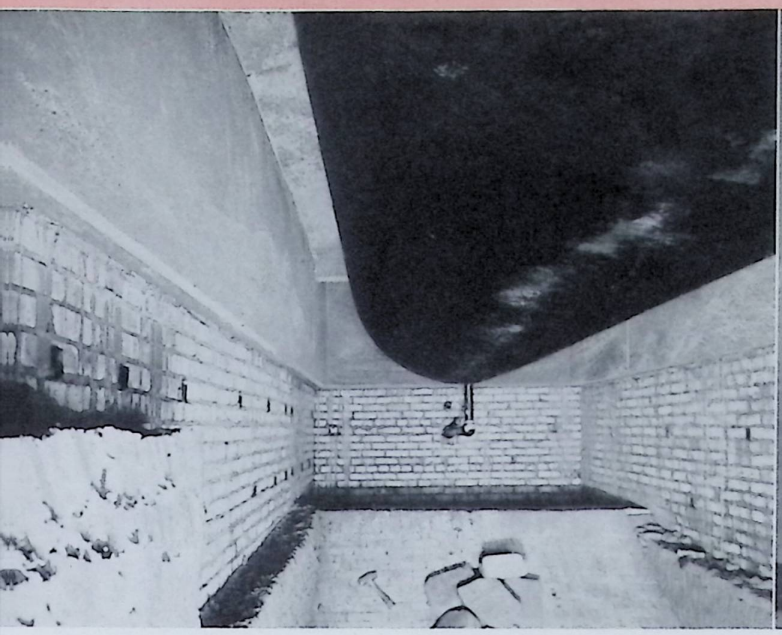


It's easy to line a door with Plicast. After being properly mixed, the material should be shovelled into the door casting, then trowelled smooth. After setting for the required time, the Plicast liner will become as hard as concrete.

In a Plicast liner, there are no individual bricks to jar loose when door is slammed.

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REFRACTORY MATERIAL



Showing Plicast as installed to line upper section of furnace. In this picture, installation of Plibrico Jointless Firebrick to line lower section has been started.

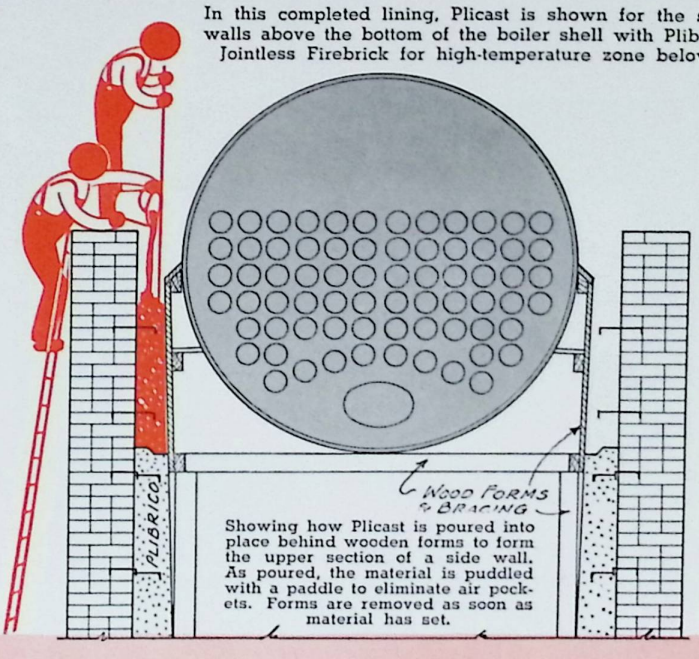


In this completed lining, Plicast is shown for the side walls above the bottom of the boiler shell with Plibrico Jointless Firebrick for high-temperature zone below.

WITH horizontal return tubular boilers, Plicast is used extensively for lining the upper portion of the furnace. In this application, the Plicast lining is not ordinarily extended below the bottom of the boiler shell, Plibrico Jointless Firebrick being used for the high-temperature zone. However, where conditions permit, Plicast may be used for complete side and rear walls in the combustion chamber.

In this application, as shown by the photographs above, Plicast gives a strong, substantial construction of great durability. The Plicast walls are securely anchored to the exterior brickwork so that they are not in any way dependent upon the lower section for support. The material forms a strong corbel which fits closely against the boiler shell, preventing leaks at this point.

As shown by the accompanying diagram, Plicast is installed behind wooden forms like concrete. The forms are removed after the material has set. The material is so easily installed that labor costs are reduced to a minimum.



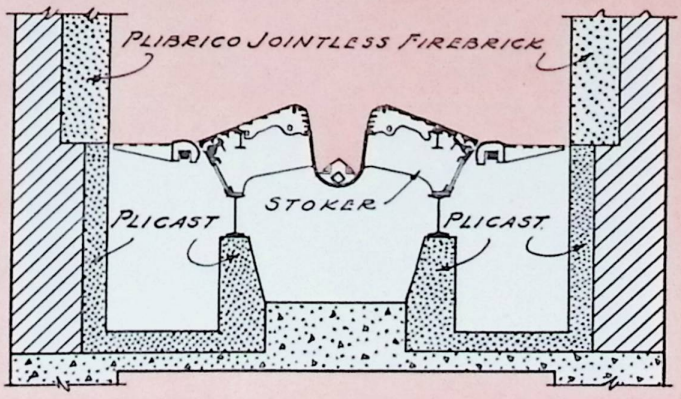
Showing how Plicast is poured into place behind wooden forms to form the upper section of a side wall. As poured, the material is puddled with a paddle to eliminate air pockets. Forms are removed as soon as material has set.



Gas burner block cast of Plicast which is ideal for moulding special shapes.

Special Shapes

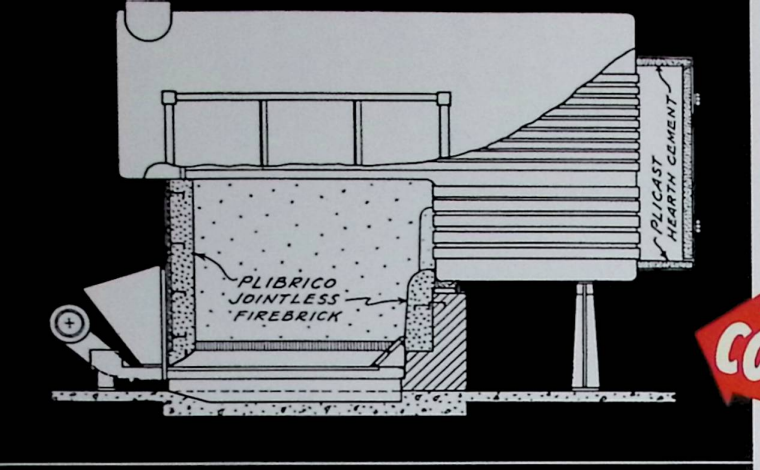
Plicast No. 27 has proved especially useful for making special shapes. The gas burner block shown at the left is typical of a wide variety of complicated special shapes easily and economically cast out of Plicast. Ordinary tile shapes are costly, frequently cannot be secured promptly, and are easily broken in storage, but any special shape desired can be readily cast out of Plicast.



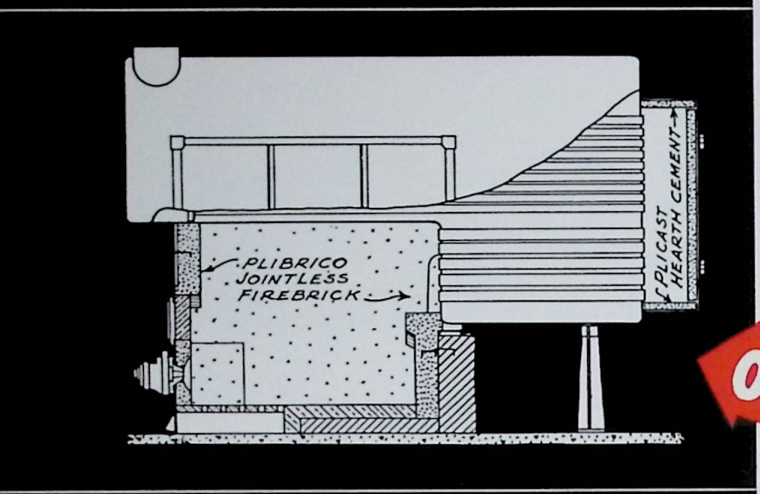
Plicast is ideal for stoker supporting piers and ash pits because it withstands moisture and abrasion as well as temperature.

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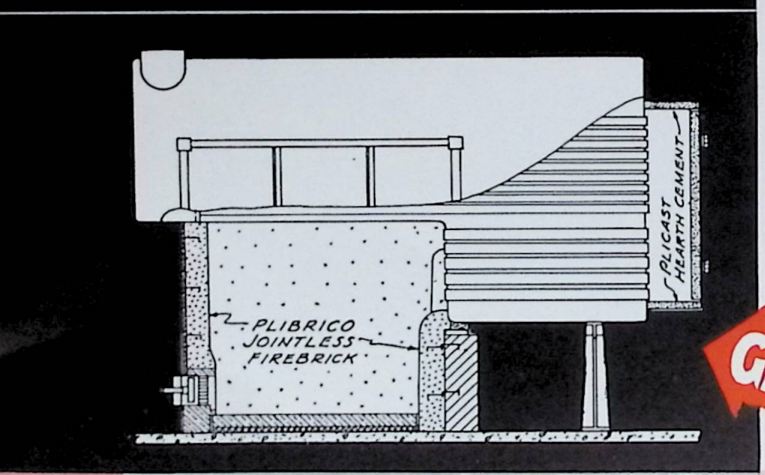
Plibrico



COAL



OIL



GAS

PLIBRICO is especially suitable for lining two-pass boilers. The prints at the left show monolithic Plibrico linings as installed in connection with this type of boiler where fired by coal, oil, and gas.

The print below contrasts Plibrico construction for two-pass boilers with the usual tile lining. Plibrico is especially suitable for lining two-pass boilers for the following reasons:

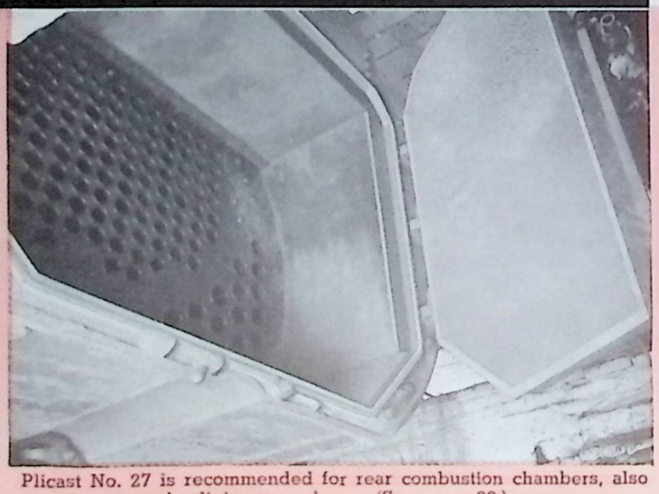
1. It eliminates the special tile ordinarily used for lining this type of boiler. A Plibrico lining can ordinarily be installed at lower cost than a tile lining. Many users of Plibrico in connection with this type of boiler now order such boilers without tile linings, installing Plibrico linings upon delivery of the boilers.

2. Plibrico construction also eliminates the anchor rods. In repair work, this saves the expense of new rods where the rods have been warped or burned away. When Plibrico is used, the anchor rods are removed and our Flexo-Anchors bolted to the casing as shown.

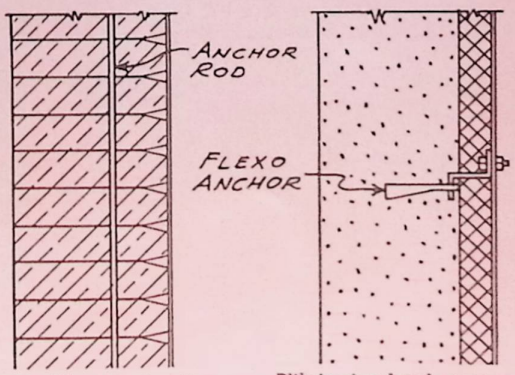
3. It avoids the delay and inconvenience of ordering tile and rods from distant sources. Plibrico can always be secured immediately from our local warehouse.

4. Where the firebox is lined with Plibrico, the casing can be readily insulated, minimizing heat loss by radiation from the casing, saving fuel, and keeping the boiler room cool. We recommend the use of about 2 in. of insulating material for this type of boiler.

5. All of the usual benefits and economies of monolithic Plibrico construction are obtained.



Plicast No. 27 is recommended for rear combustion chambers, also for lining rear doors. (See page 32.)

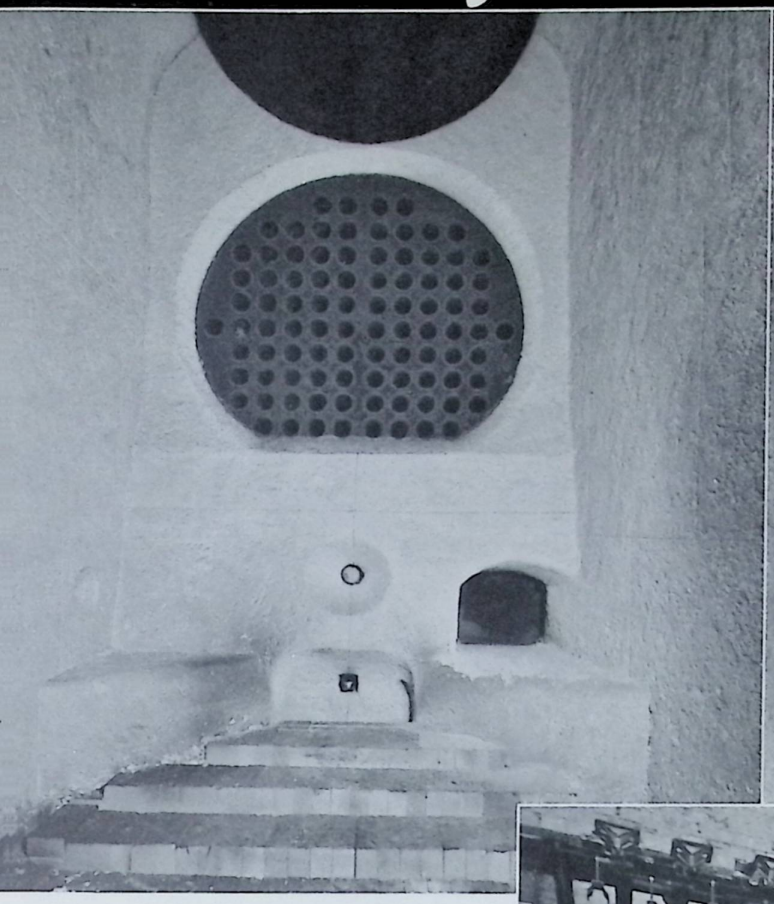


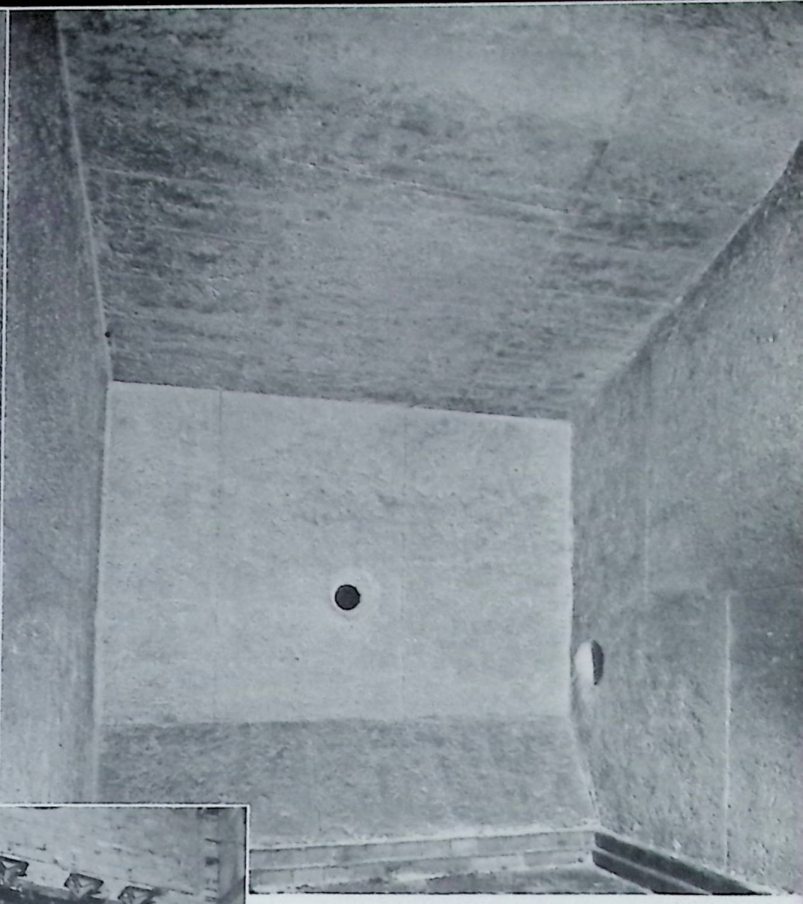
Ordinary tile construction, showing expensive special shapes. Rods warp and burn. No insulation is provided.

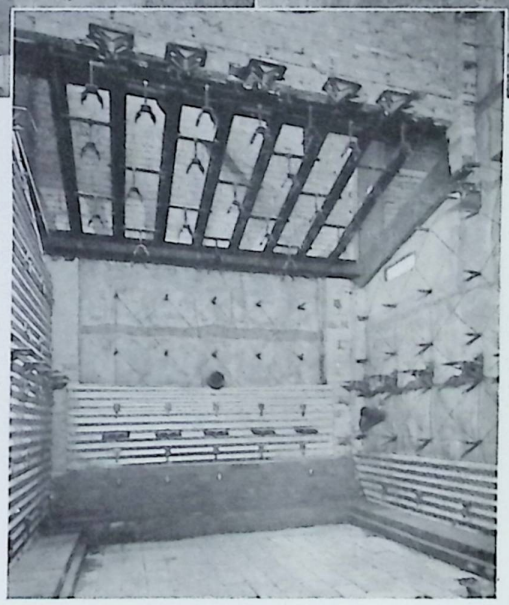
Plibrico insulated construction. Held in place by Flexo-Anchors. No special fittings necessary. Heavily insulated.

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LININGS *for* TWO-PASS BOILERS







Air-Cooled CONSTRUCTION

WHERE two-pass boilers equipped with automatic fuel-burning equipment are operated at high ratings, with severe combustion conditions, Plibrico air-cooled linings are employed to permit carrying heavy loads without excessive refractory deterioration.

In units of normal size, a simple method of air-cooling, which does not involve sectional supporting, can be used. In numerous installations, the air cooling of the rear wall only has been recommended, since the rear wall is subjected to the most severe service.

In larger units, where sectional supporting is advisable, Plibrico sectionally-supported, air-cooled construction can readily be installed.

PLIBRICO AIR-COOLED CONSTRUCTION WILL:

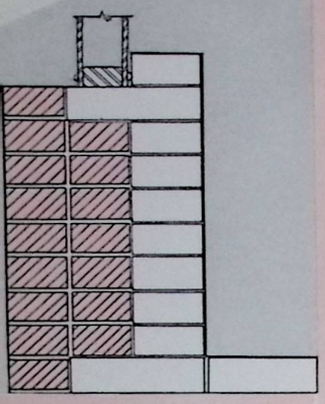
- Prevent excessive refractory deterioration at high ratings.
- Sectionalize lining so that any section can be repaired without disturbing other sections.
- Provide pre-heated air for combustion.

THE three photographs on this page show a Plibrico sectionally-supported, air-cooled lining in connection with a 66 in. two-pass boiler. The boiler is fired by oil, the burner being located at the rear end of the firebox as shown. The cooling air from the walls enters the furnace through the checkerwork shown after passing through a hollow floor.

The smaller photograph of the supporting structure in the center of the page shows the Taperlock supports which sectionalize the Plibrico lining. It also shows the steel work and Plibrico arch hangers which support the Plibrico suspended arch over the Dutch Oven with which this boiler is provided.

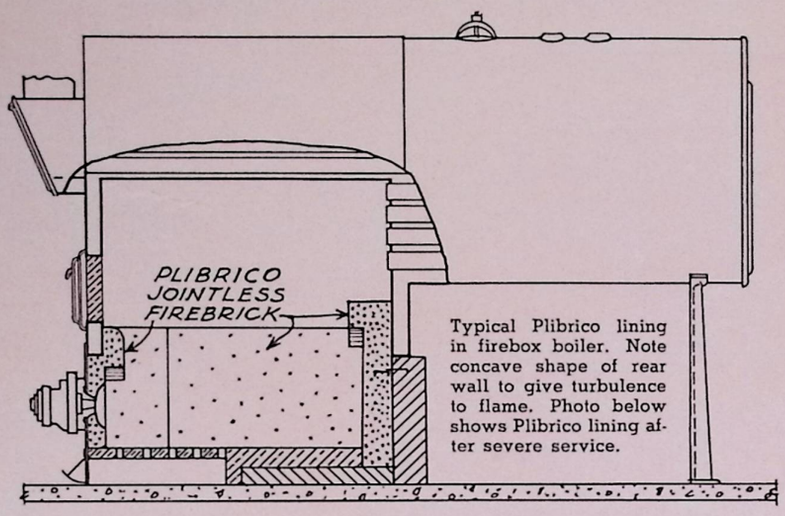
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Plibrico for FIRE-BOX BOILERS



FIREBRICK

Note how boiler rests on fire brick lining. Removal of lining for repair will disturb boiler.



Typical Plibrico lining in firebox boiler. Note concave shape of rear wall to give turbulence to flame. Photo below shows Plibrico lining after severe service.



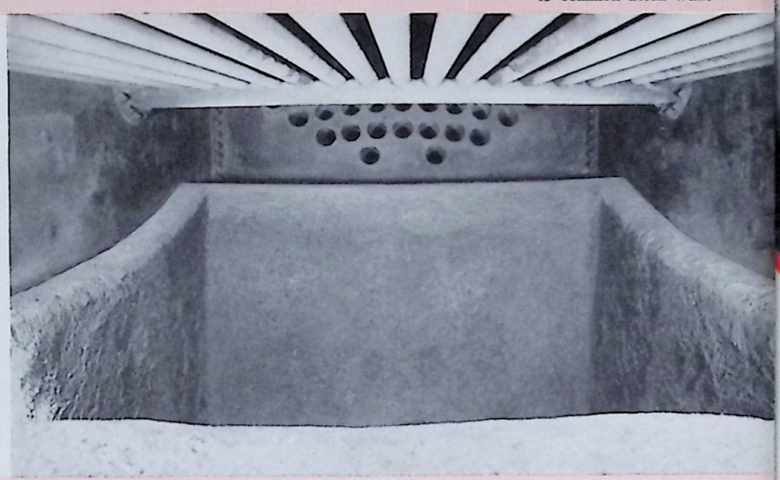
PLIBRICO

Can be repaired without disturbing boiler. Plibrico lining securely tied to common brick wall.

THE superiority of Plibrico for lining firebox boilers is widely recognized. Where oil or gas is burned, or stokers are employed, service is severe and a high-grade refractory lining is required.

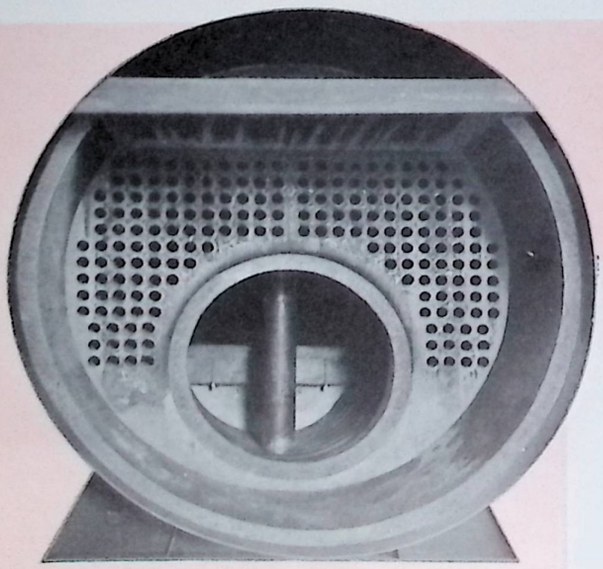
The print at left above shows the difficulty encountered in tying a fire brick lining to the common brick base in this type of boiler. Where only one course of brick is used, the headers must either be omitted or built into the wall supporting the boiler. The latter course makes it difficult to repair the lining without disturbing the boiler.

A Plibrico lining is anchored to the brick base by means of Flexo-Anchors and, consequently, can be built entirely independent of the common brick. The boiler is not disturbed if any repairs become necessary. With Plibrico construction, no such difficulty is encountered, as shown in print at right above.

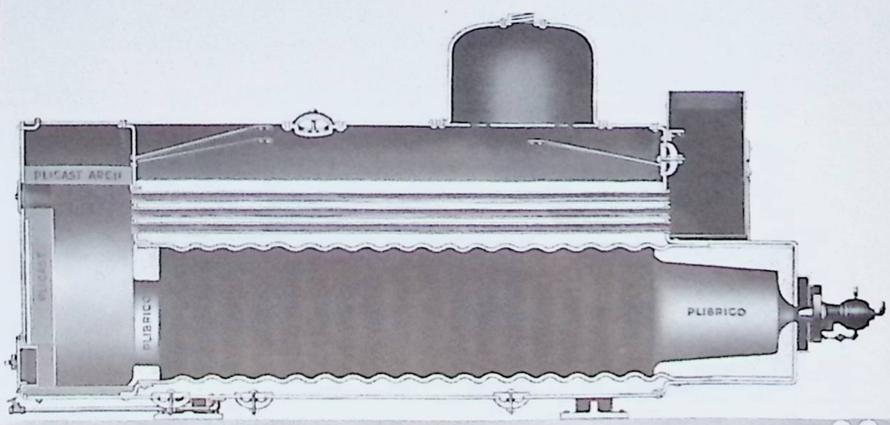


... for SCOTCH MARINE

Plibrico is practically indispensable for Scotch Marine boilers. Since Plibrico is installed in plastic form, it can be moulded to the circular shapes required by this type of boiler.



The illustration at right shows use of Plibrico for lining the extension furnace of an oil-fired Scotch Marine; also for the circular ring at the rear of the corrugated tube to protect the boiler rivets. Plicast No. 27 is recommended for lining the rear combustion chamber and for the rear arch, as shown in both pictures.



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PLIBRICO Is Ideal for Patching AND SMALL REPAIRS





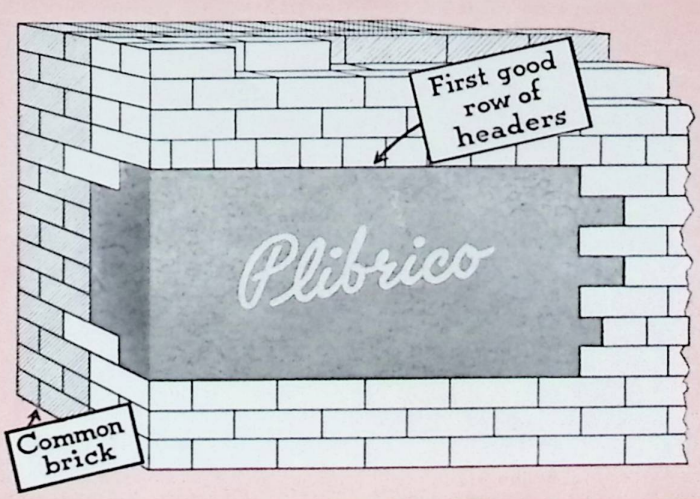
PLIBRICO is valuable for patching burned out sections in fire brick linings. When bad spots begin to develop in a fire brick lining, the damaged brick can be removed and replaced with Plibrico as shown in the two photographs at the left.

When fire brick that has spalled or burned away is removed for patching, a jagged and irregular hole frequently results due to the sagging of the wall around the patch. It would be difficult to fill in an irregularly-shaped hole with fire brick but it's a simple matter with Plibrico.

Only a minimum amount of fire brick must be removed when Plibrico is used for patching. Often a Plibrico patch pounded firmly into place will give strength and support to weakened and loosened brick work that otherwise would need to be replaced.

In the maintenance of fire brick linings, "a stitch in time saves nine." Many boiler plants keep a few cartons of Plibrico always on hand for patching and minor repairs, thus extending the life of their linings as long as possible.

The illustration below shows in diagrammatic form how Plibrico is used to repair a fire brick wall. The burned out brick are removed up to the first solid row of fire brick headers. Then the Plibrico material is pounded into the cavity in the wall. If no row of headers is found that is solid enough to support the upper section of the fire brick wall, it will, of course, be necessary to replace the entire wall.



You can hardly operate a boiler plant without keeping a little Plibrico on hand for patching. Plibrico makes it easy for you to keep your linings in good repair.

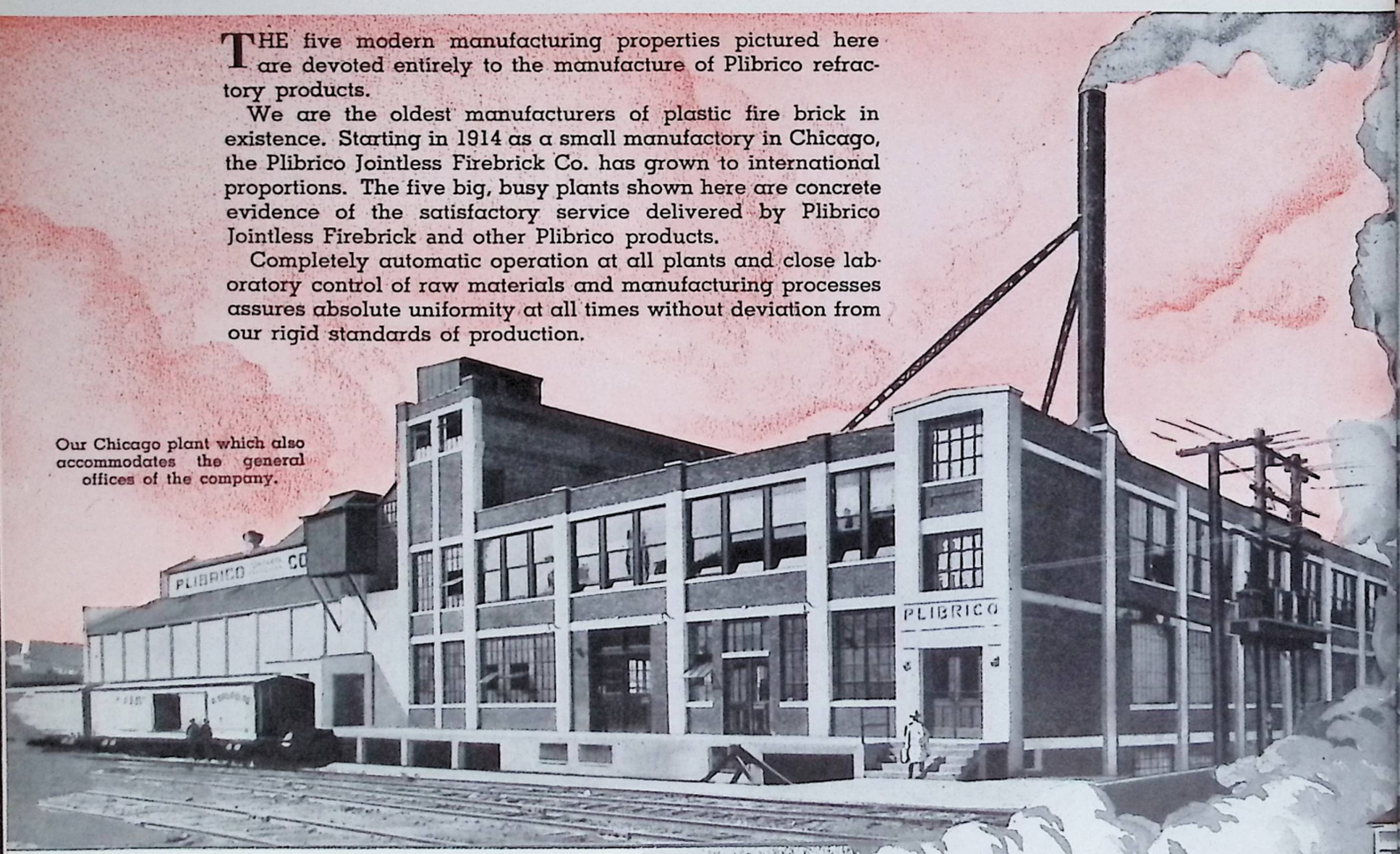
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Unequalled Manufacturing Facilities

THE five modern manufacturing properties pictured here are devoted entirely to the manufacture of Plibrico refractory products.

We are the oldest manufacturers of plastic fire brick in existence. Starting in 1914 as a small manufactory in Chicago, the Plibrico Jointless Firebrick Co. has grown to international proportions. The five big, busy plants shown here are concrete evidence of the satisfactory service delivered by Plibrico Jointless Firebrick and other Plibrico products.

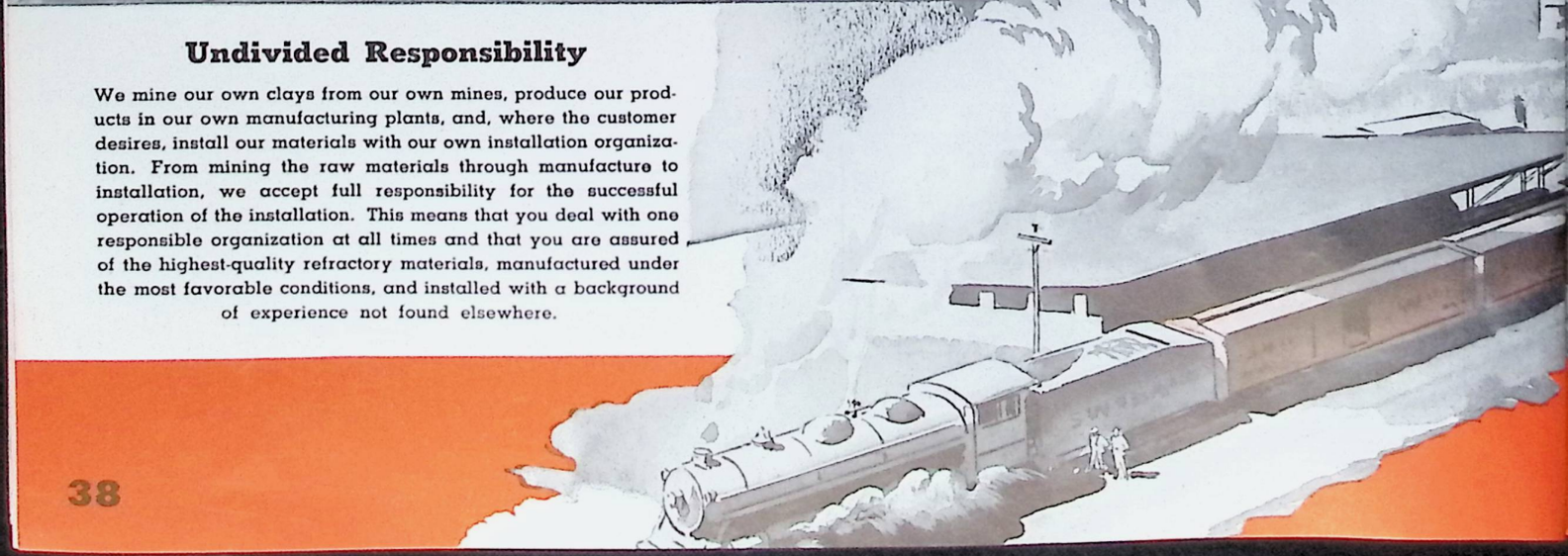
Completely automatic operation at all plants and close laboratory control of raw materials and manufacturing processes assures absolute uniformity at all times without deviation from our rigid standards of production.



Our Chicago plant which also accommodates the general offices of the company.

Undivided Responsibility

We mine our own clays from our own mines, produce our products in our own manufacturing plants, and, where the customer desires, install our materials with our own installation organization. From mining the raw materials through manufacture to installation, we accept full responsibility for the successful operation of the installation. This means that you deal with one responsible organization at all times and that you are assured of the highest-quality refractory materials, manufactured under the most favorable conditions, and installed with a background of experience not found elsewhere.

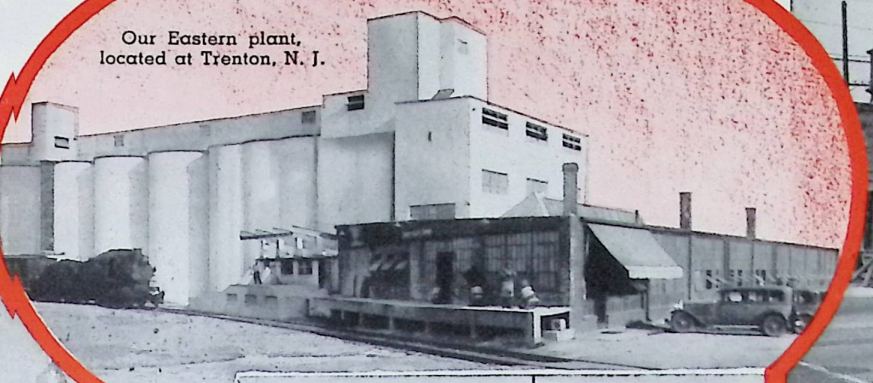


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Our Canadian plant at New Toronto, Ont., operated by our Canadian company, Plibrico Jointless Firebrick, Limited.



Our Eastern plant, located at Trenton, N. J.



British Works of the Jointless Firebrick Co., Ltd., London, England.

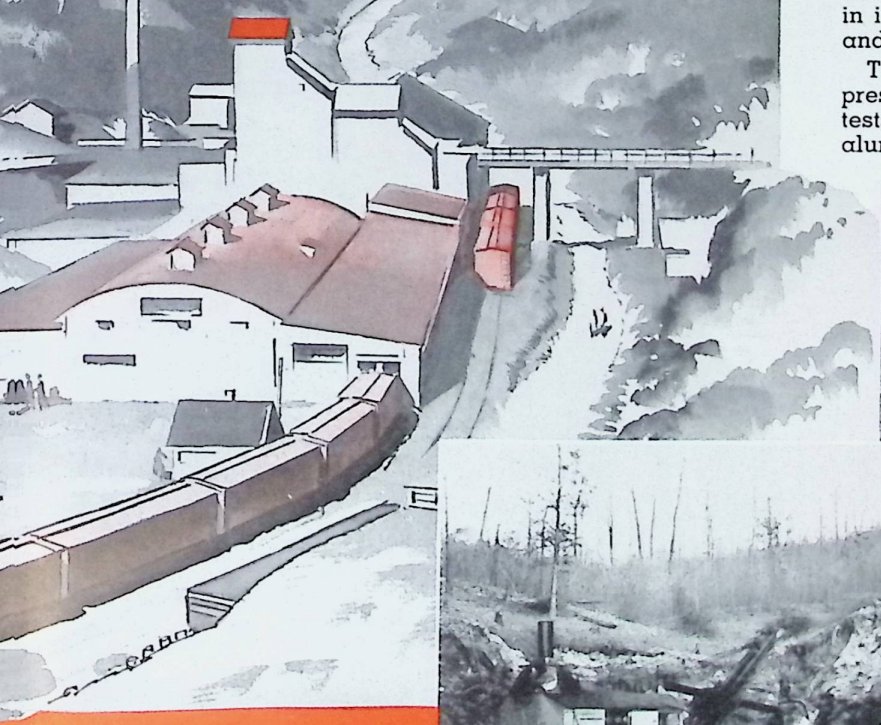


Incomparable Raw Materials

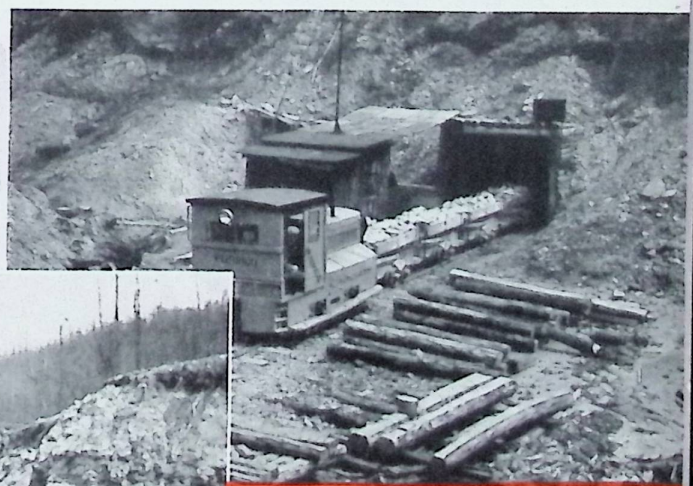
BECAUSE we own the mines from which our clay is produced, every step in the production of Plibrico is under our direct control. The Plibrico clay mines are located at Firebrick, Ohio, where we own 1200 acres of the finest deposits of flint and bonding clays in the world. This acreage is in the center of a district famed for the superb quality of its refractory clays.

The incomparable quality of the bonding clay mined on our property is responsible in no small measure for the superior quality of Plibrico. This clay is unique in its possession of both exceptional bonding strength and high refractoriness.

The calcined clays used in Plibrico are adequately preshrunk, minimizing shrinkage in service. In all tests, Plibrico runs close to the ideal percentage of alumina and shows a negligible flux content.



Clay processing and manufacturing plant located at our mining properties at Firebrick, Ohio.





Scenes at our clay mines showing (above) trainload of clay leaving underground mines, and (left) stripping overburden off of the vein of clay for open-pit mining.

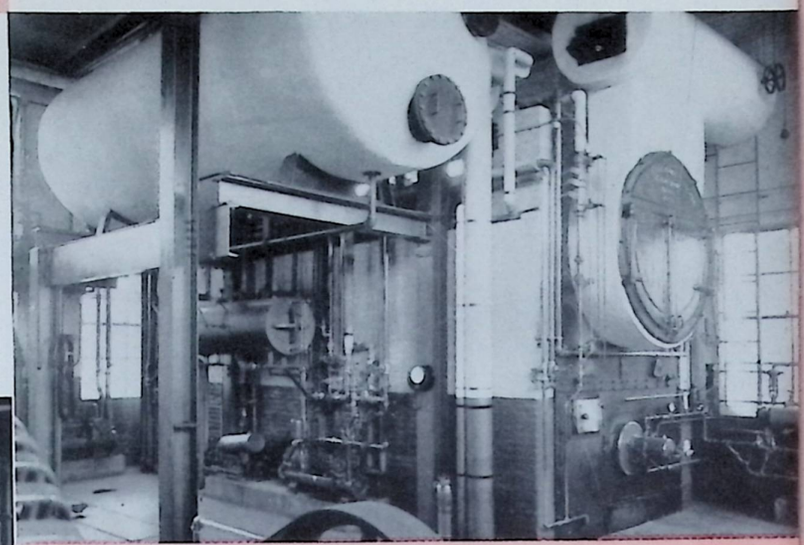
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Plibrico Boiler Setting Service

IN over 100 industrial centers, we maintain complete installation and boiler setting service. Our crews of competent and experienced boiler setters and installation men are ready to serve you at all times.

We handle any type of work, from a small repair job to a complete new boiler setting contract, in an outstanding manner. We are proud of our careful workmanship and you will be pleased with the character of our service.

We operate the most extensive boiler setting organization in the country, which has been built upon the solid foundation of dependable and trustworthy service.

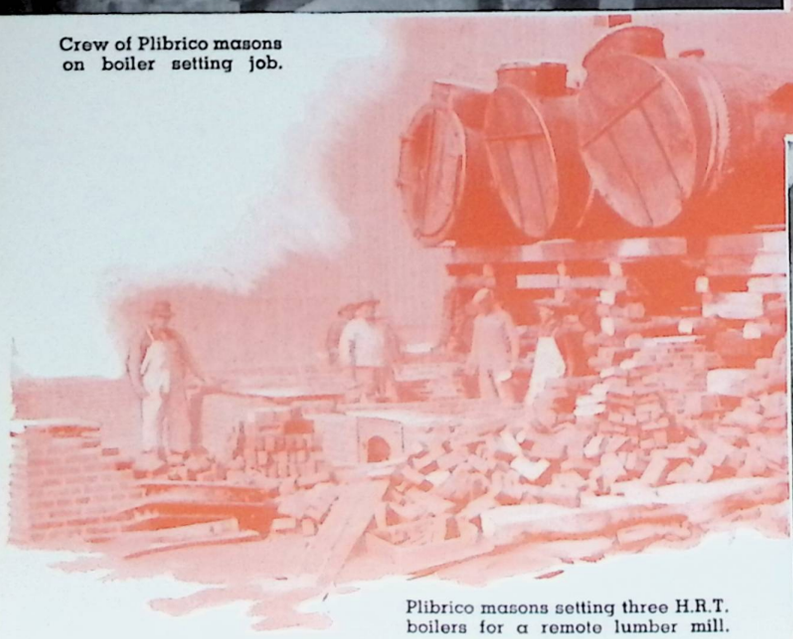


An oil-fired H.R.T. boiler set by the Plibrico organization at a Massachusetts laundry. A handsome example of the boiler setter's art

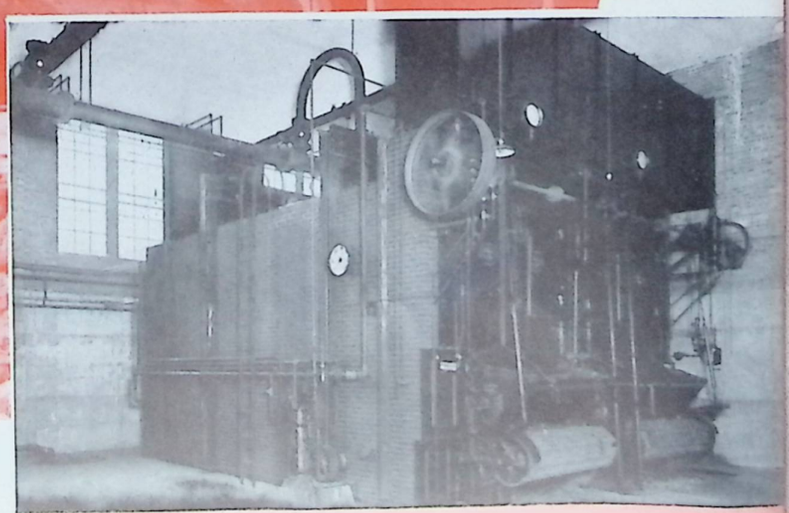


Crew of Plibrico masons on boiler setting job.

Your local Plibrico representative will gladly call at your plant at any time to make a careful inspection of your furnaces and to quote on Plibrico construction for any repairs necessary, including labor for installation if desired. No obligation.



Plibrico masons setting three H.R.T. boilers for a remote lumber mill.



Two H.R.T. boilers with chain grate stokers at an Indiana hospital. Settings erected by our boiler setting organization.

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PLIBRICO STOCKS AND SERVICE

Warehouse stocks of Plibrico Jointless Firebrick and other Plibrico refractory products are maintained in the cities listed below. Plibrico products can be delivered to practically any point in the United States or Canada in no more than 24 hours after receipt of order.

When you receive Plibrico from one of our stocks, you invariably receive fresh material in perfect condition for immediate installation. This is because the demand for Plibrico is so great that stocks are continually renewed by fresh carload shipments from the factory, also because Plibrico retains its original plasticity for months in its air-tight containers.

Your local Plibrico representative will gladly quote you on monolithic Plibrico construction for your repairs, including labor for installation if desired.

ALABAMA
Birmingham
Mobile

ARIZONA
Phoenix

ARKANSAS
Little Rock
Texarkana

CALIFORNIA
Los Angeles
Oakland
San Diego
San Francisco
San Pedro

COLORADO
Denver

CONNECTICUT
Bridgeport
Hartford

FLORIDA
Jacksonville
Miami
Tampa
Winter Haven

GEORGIA
Atlanta
Columbus

ILLINOIS
CHICAGO
Decatur
Peoria
Rockford

INDIANA
Fort Wayne
Indianapolis
Evansville
Terre Haute

IOWA
Davenport
Des Moines
Dubuque

KANSAS
Wichita

KENTUCKY
Louisville
Paducah

LOUISIANA
New Orleans
Shreveport

MAINE
Portland

MARYLAND
Baltimore

MASSACHUSETTS
Boston
Springfield

MICHIGAN
Detroit
Flint
Grand Rapids
Kalamazoo
Saginaw

MINNESOTA
Duluth
Minneapolis
St. Paul

MISSOURI
Kansas City
St. Joseph
St. Louis
Springfield

NEBRASKA
Omaha

NEW JERSEY
Camden
Newark
TRENTON

NEW YORK
Binghamton
Brooklyn
Buffalo
Elmira
New York City
Syracuse
Troy
Rochester
Utica

NORTH CAROLINA
Asheville
Charlotte
High Point
Raleigh

OHIO
Akron
Canton
Cincinnati
Cleveland
Columbus
Dayton
FIREBRICK
Toledo

OKLAHOMA
Oklahoma City

OREGON
Portland

PENNSYLVANIA
Erie
Harrisburg
Philadelphia
Pittsburgh

RHODE ISLAND
Providence

SOUTH CAROLINA
Charleston
Columbia
Greenville

TENNESSEE
Chattanooga
Knoxville
Memphis
Nashville

TEXAS
Houston
Lubbock
Texarkana

UTAH
Salt Lake City

VIRGINIA
Richmond
Roanoke

WASHINGTON
Seattle
Spokane
Tacoma

WEST VIRGINIA
Charleston

WISCONSIN
Madison
Menasha
Milwaukee
Wausau

CANADA
Brantford, Ont.
Calgary, Alta.
Edmonton, Alta.
Halifax, N. S.
Kirkland Lake, Ont.
Montreal, Que.
NEW TORONTO, Ont.
Port Arthur, Ont.
Quebec, Que.
Regina, Sask.
St. John, N. B.
Saskatoon, Sask.
Vancouver, B. C.
Winnipeg, Man.

GREAT BRITAIN
Birmingham
Bristol
Cardiff
Glasgow
Leeds
Liverpool
LONDON
Manchester
Newcastle
Swansea

ARGENTINA
Buenos Aires

AUSTRALIA
Melbourne
Sydney

BRITISH WEST INDIES
Barbados
Trinidad

CHILE
Valparaiso

CUBA
Havana

ECUADOR
Guayaquil

HAWAII
Honolulu

MEXICO
Mexico City

NEW ZEALAND
Wellington

PHILIPPINES
Manila

PORTO RICO
San Juan

SOUTH AFRICA
Johannesburg

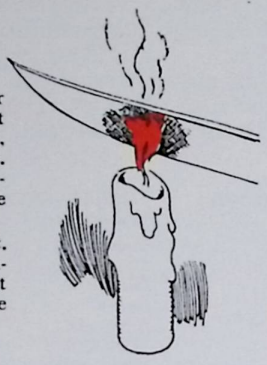


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Adequate Volume

Required for Maximum Combustion Efficiency

Make This Test Yourself



You can prove to yourself that your boiler should not be set too close to the fire. Light a candle and watch it burn with a clean, smokeless flame. Then take a cold knife. Imagine that the knife represents the relatively cold shell of your boiler. Hold the knife in the flame. What happens?

The knife *practically puts the flame out.* The flame turns to heavy smoke. Soot accumulates on the knife because the cooling effect of the cold metal stops combustion on the spot.

ADEQUATE furnace volume is essential for fuel economy. The old idea was to set the boiler "close to the fire to absorb as much heat as possible." Today engineers know that this practice is wrong. Enough space must be allowed so that complete combustion of the gases can take place before they strike the relatively cool boiler shell. The candle test shows what happens if the boiler is set too low.

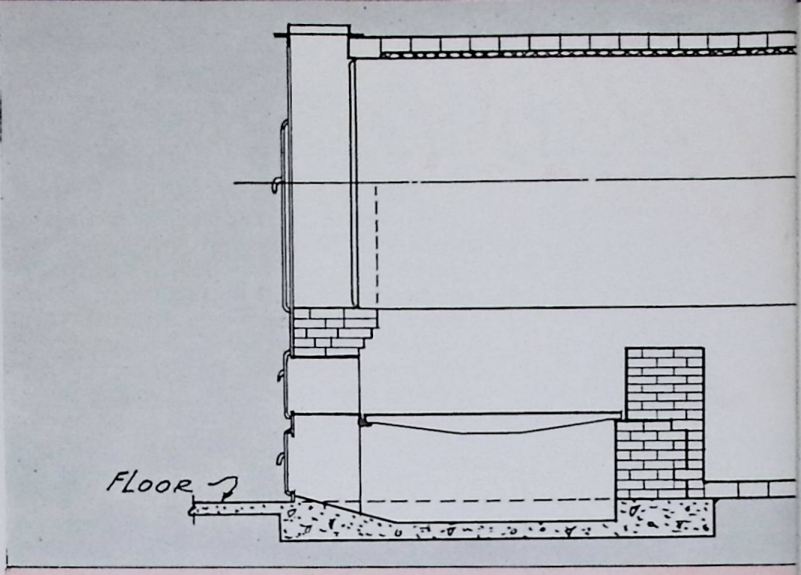
Time, temperature, mixture, and air are the four basic requirements for complete combustion and smokeless operation, since these are the four requirements for the intimate mixing of the gases and oxygen which results in complete combustion. It is the function of furnace design to provide the necessary time and mixture.

Adequate furnace volume is important since it provides more time and space for the mixing of oxygen and gases—for ignition and combustion to take place. Without adequate volume, complete combustion cannot be realized. The gases will strike the boiler shell too soon, and will be cooled down by the rapid transfer of their heat to the water in the boiler. The high temperature necessary for complete combustion, maximum fuel economy, and smokeless operation will never be attained in the furnace.

While adequate furnace volume is essential for efficient combustion, it should not be so great that the radiant heat of the refractory walls is lost. Proper proportioning of the furnace must take into consideration the fuel to be burned and the type of fuel-burning equipment to be employed. It is a fine art at which, we must modestly admit, our engineering department has enjoyed a high degree of success.

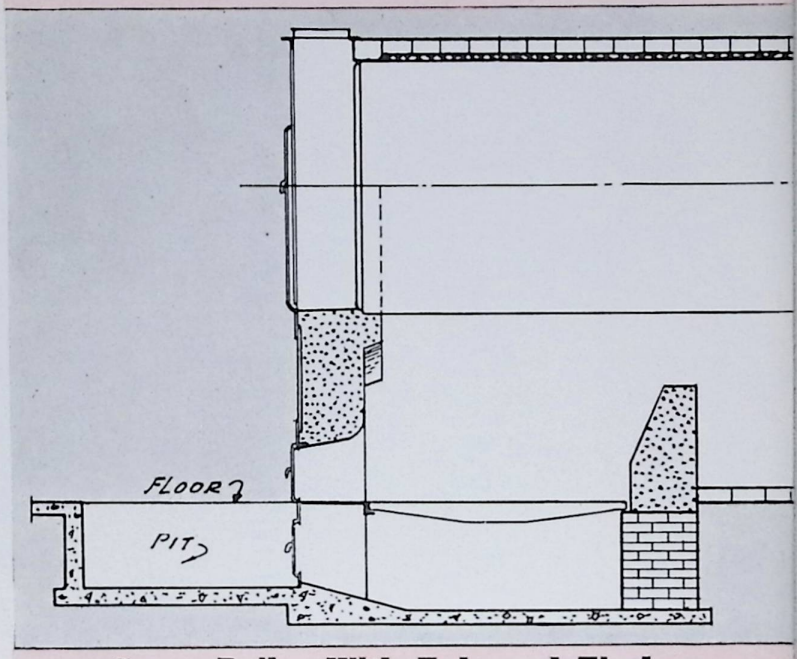
Where furnace volume is inadequate, fuel waste, smoke, and reduced capacity result. These troubles can all be overcome by resetting the boiler, increasing the setting height to the necessary distance to provide adequate volume. Where boilers cannot be raised on account of low head room or other conditions, the expedients shown at the right will prove effective.

The services of our engineering department will be freely placed at your disposal if you wish to give consideration to the matter of adequate furnace volume for your boilers. We shall be pleased to give you our recommendations for correcting the design of your settings.



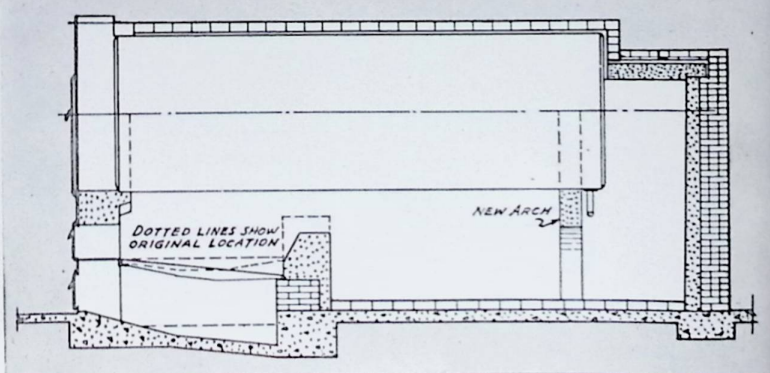
H. R. T. Boiler Before Modernization

Boiler too close to grates. Not enough furnace volume for complete combustion. A boiler that wastes fuel, smokes, and will not steam properly. This boiler wastes money every day it operates.



Same Boiler With Enlarged Firebox

Furnace volume increased at minimum expense by excavating pit below floor level. Combustion efficiency and boiler capacity increased, smoke abated. Work soon paid for in fuel savings.



Increasing Efficiency Without Excavation

Where it is impossible to excavate, combustion efficiency can be increased by lowering grates and bridge wall and installing deflecting arch (to increase turbulence) at rear end of combustion chamber.

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Plibrico Steel Cased Setting

IN the Plibrico Steel-Cased Setting, as illustrated here and on the title page, boiler setting construction for H.R.T. boilers has been developed to the peak of perfection. This type of setting is continually growing in popularity.

The Plibrico Steel-Cased Setting possesses the following advantages as compared with conventional brick settings:

1. The Plibrico Steel-Cased Setting is much neater in appearance and cleaner than a brick setting. It has no joints to collect dust and soot. It requires only an occasional coat of paint to renew its beauty. This is a big advantage in hospitals, dairies, laundries, and other plants where a clean boiler room is demanded.

2. The steel-cased setting requires no maintenance other than painting. Even under the most favorable conditions, deterioration is encountered with a brick setting and rebuilding may be eventually required.

3. This type of setting is adequately insulated against heat loss, and will remain so as long as the refractory lining is properly maintained. This is not true of a brick setting which is in a continual state of deterioration.

4. One of the biggest advantages of our steel-cased construction is the fact that it entirely eliminates the infiltration of excess air. This means increased CO_2 and an appreciable fuel saving.

5. The steel-cased setting requires less floor space than brick settings since it is narrower in width and shorter in length. This is a big advantage in boiler rooms where space is limited.

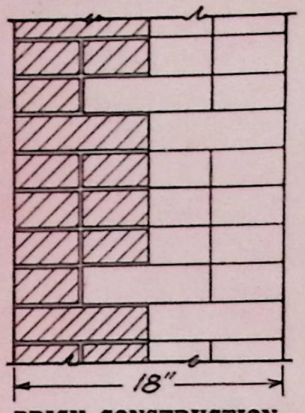
6. With our steel-cased setting, the foundation carries only about one-third the load of a brick setting. This means that the size and cost of the foundation can be reduced. The reduced load is a big advantage with poor soil conditions.

7. The steel casing has 100% salvage value if it becomes necessary to change the location of the boiler. A brick setting must be completely dismantled under similar circumstances.

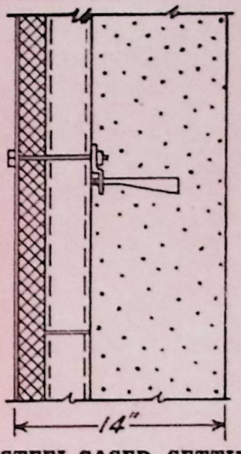
8. As shown in the lower print opposite, the monolithic Plibrico lining is securely anchored to the steel casing by means of our Flexo-Anchors. These anchors, which tie lining, insulation, and casing together, and without which our steel-cased construction would not be practicable, are the secret of our construction.

This type of setting can be erected anywhere in the country by our boiler setting organization at small additional cost. If you contemplate the installation of new boilers, let us quote you on our steel-cased construction which can also be readily adapted to existing boilers. Where air-cooling is desirable, the Plibrico Steel-Cased Setting can be easily air-cooled.

FLOOR SPACE REDUCED



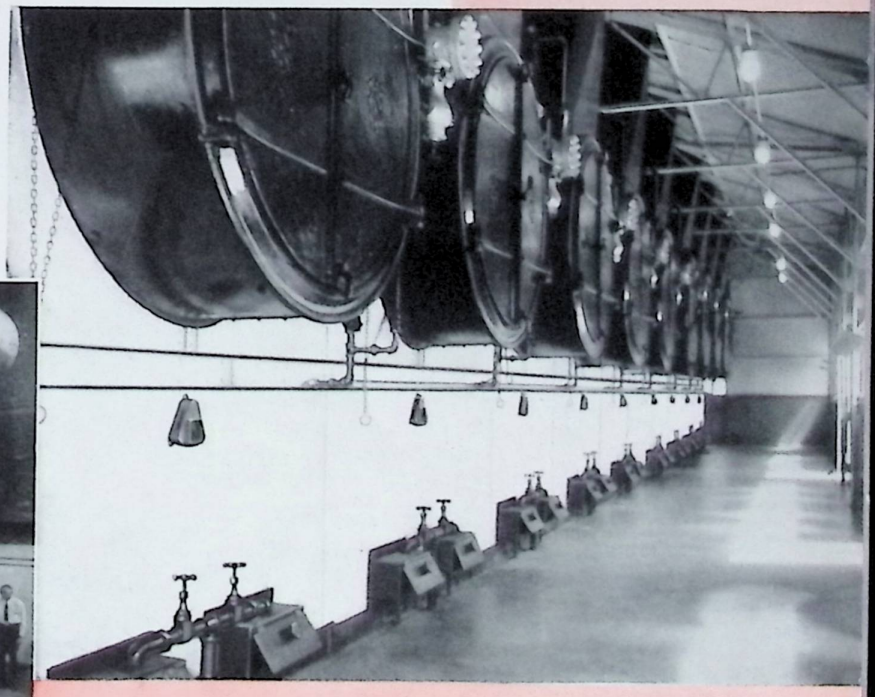
BRICK CONSTRUCTION
Minimum thickness for masonry furnace walls is 18 in., while 22 in. is customary.



STEEL-CASED SETTING
Requires only 14 in. over-all, with 2 in. of insulating material and 3 in. devoted to air-cooling or dead-air insulating space. Space occupied can be further reduced where necessary.

IT'S MODERN . . .

With its gleaming exterior, the Plibrico Steel-Cased Setting is clean and handsome, and keeps its attractive appearance with no more maintenance than an occasional coat of paint. In this modern age when the fact has been proved that good appearance and good performance usually go hand in hand, the superiority of our steel-cased construction has been widely recognized. A modern setting for modern plants.



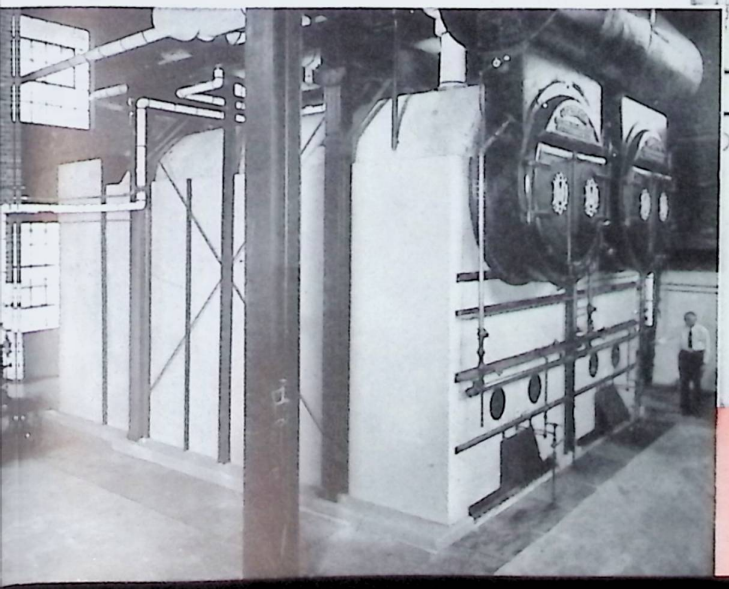


Photo above shows nine 72"x18' H.R.T. boilers set in battery with Plibrico Steel-Cased Settings at a Louisiana gasoline plant. All boilers are provided with Plibrico air-cooled center walls.

Photo at left shows Plibrico Steel-Cased Settings in connection with two 84 in. H.R.T. boilers at a Vermont machinery factory.

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ENGINEERING DATA

Boiler Horse Power

In general, the commercial horsepower rating of H.R.T. boilers is based on 10 square feet of heating surface (surface in contact with the fire or hot gases) per horsepower. In other words a 150 hp. boiler has 1500 square feet of heating surface.

At the present time, as the capacity of modern boilers is being increased by improved operating methods, engineers are inclined to abandon the above formula for rating boilers in terms of horsepower, and boilers are being rated on their ability to produce steam.

In general, the accepted meaning of one boiler horsepower is the evaporation of 34.5 lbs. of water from and at 212 deg. F. into dry saturated steam, at the same temperature, per hour. This requires 33478.8 B.T.U. of heat.

Commercial Ratings of H.R.T. Boilers

In general, H.R.T. boilers are rated in accordance with the following table. It must be remembered, however, that if the number or size of tubes is increased or decreased for a boiler of any size, the horsepower is changed accordingly.

Diameter of Shell	*Length of Tubes*	*No. of Tubes and Horsepower* 4" Tubes No.	HP.	3½" Tubes No.	HP.	3" Tubes No.	HP.
36 in.	12 ft.	...	...	...	...	26	29
42 in.	14 ft.	...	...	...	...	34	43
48 in.	12 ft.	28	45	38	51	50	53
48 in.	13 ft.	28	47	38	54	50	57
48 in.	14 ft.	28	50	38	57	50	61
48 in.	15 ft.	28	53	38	60	50	65
54 in.	14 ft.	36	68	52	74	62	75
54 in.	16 ft.	36	78	52	84	62	85
60 in.	16 ft.	44	80	54	89	72	98
60 in.	18 ft.	44	90	54	99	72	111
66 in.	16 ft.	52	106	74	117	98	130
66 in.	18 ft.	52	119	74	132	98	147
72 in.	16 ft.	78	147	96	149	124	162
72 in.	18 ft.	78	156	96	168	124	183
72 in.	20 ft.	78	165	96	185	124	204
78 in.	18 ft.	96	190	114	197	144	210
78 in.	20 ft.	96	210	114	218	144	233
84 in.	18 ft.	114	224	142	242	180	258
84 in.	20 ft.	114	249	142	269	180	286
90 in.	18 ft.	140	210	168	290	210	301
90 in.	20 ft.	140	300	168	322	210	334

Grate Area

In general, the grate area of the ordinary hand-fired, natural-draft furnace is proportioned to burn 24 pounds of soft coal per square foot of grate area per hour. This means the development of about 5 hp. per square foot of grate area when the overall efficiency of the boiler and furnace is about 60%. This is the common practice on which boiler manufacturers proportion grate area.

CO_2 and Color of Fire

The accompanying table shows approximate furnace temperatures as indicated by the color of the fire. It also shows the approximate CO_2 corresponding to color and temperature.

Color of Fire	*Approx. Temp. in Deg. F.*	*Color of Fire*	*Approx. Temp. in Deg. F.*
Dark red	900	Light Orange	1750
Dull red	1000	White	2200
Dull cherry	1150	Bright white	2600
Bright cherry	1400		

Coal Ash Fusion Points

in Degrees Fahrenheit

Type of Coal	*Fusion*
Illinois (av. 50 tests)	2003-2474
Kentucky (av. 24 tests)	1955-2806
Ohio (av. 7 tests)	1974-2784
Tennessee (single test)	2575
Virginia (av. 5 tests)	2257-2695
West Virginia (av. 34 tests)	2095-2891

Clinkers increase with decreasing ash fusion on coals from same bed.

Clinkers increase with increasing ash content on coals from same bed.

Screening of coal from same bed alters fusion of ash over a considerable range.

Weights of Materials

Pounds per Cubic Foot

Plibrico Jointless Firebricks	133⅓
Plicast Castable Material	110
Plicast L-W-I (Insulating)	60
Common or red brick	110-120
Pressed brick	140
Insulating brick	30
Insulating fire brick	38-75
Concrete	140-150
Cinder concrete	80-90
Earth, dry, loose	76
Earth, dry, packed	95
Earth, mud, packed	115
Sand or gravel, dry, loose	90-105
Sand or gravel, dry, packed	100-120
Coal, anthracite	97
Coal, bituminous	84
Coke	75
Ashes or cinders	40-45
Petroleum	54
Gasoline	45
Kerosene	50
Tar, bituminous	75
Water (29.2 deg. F.)	62.4
Ice	56
Snow	8

Decimals of One Foot

for Calculating Plibrico Quantities

Inches	*Feet*	*Inches*	*Feet*	*Inches*	*Feet*
½	.0416	4½	.375	8½	.708
1	.0833	5	.416	9	.750
1½	.125	5½	.457	9½	.792
2	.166	6	.500	10	.832
2½	.207	6½	.542	10½	.875
3	.250	7	.583	11	.916
3½	.291	7½	.625	11½	.958
4	.3333	8	.666	12	1.000

Useful Formulae

for Calculating Plibrico Quantities

Circumference of circle=
Diameter x 3.1416

Area of circle=
Square of diameter x .7854

Area of circular ring=
Square of outside diameter minus
square of diameter of opening x .7854

Area of triangle=
½ of base x height (altitude)

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Form 2-42MP

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The *Plibrico* OBSERVATION PORT



An inexpensive but efficient window for observing furnace conditions in boilers and other types of furnaces. Shutters close automatically when handle is released. Blue Pyrex glass protects the eyes of the operator when port is open (clear Pyrex can be furnished when specified). Actual flame condition can be observed which will permit adjustment, especially of oil, gas, or pulverized fuel burners. The progress of the heating process in industrial heating furnaces may be watched without admitting cold air. Several of these inexpensive ports can be installed for the price of a single port of other types.

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HYRATE REFRACTORY CEMENT

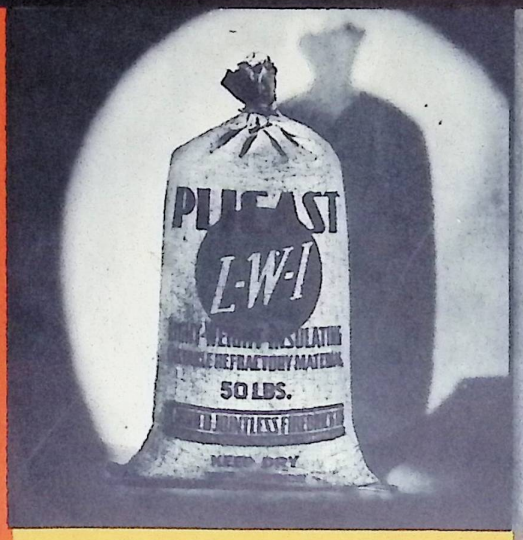
A heat-setting cement in dry, powdered form that is recommended for extreme combustion conditions. Mixes readily and spreads easily as a result of its fine, even texture. Packed in 100-lb. moisture-proof bags.



DEMON *Air-Set* REFRACTORY CEMENT

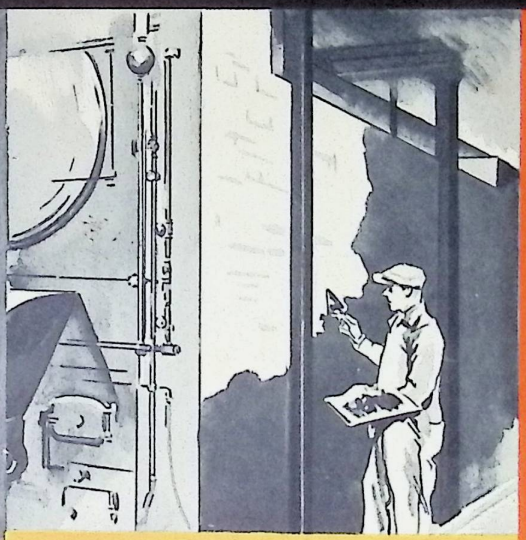
A popular high-temperature cement in moist, plastic form that sets cold upon exposure, forming an exceptionally strong bond. Withstands high temperatures without swelling or bloating. Packed in 50, 100, 200 and 500-lb. drums.

OTHER *Plibrico* PRODUCTS



PLICAST L-W-I (INSULATING)

This castable refractory material combines insulation with light weight and high refractory value. Particularly valuable for industrial furnaces where it reduces heat loss. For services to 2250 deg. F. Packed in 50 lb. bags.



PLISEAL BOILER-WALL COATING

A pliable, elastic material for coating exterior of boiler settings. Saves fuel by sealing brickwork, preventing infiltration of excess air. Provides an "overcoat" for your boiler settings. Will not crack, peel or blister.

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