PLAINTIFF'S
EXHIBIT
59

EXHIBIT A

BIGELOW-LIPTAK

AS0000012

INDUSTRIAL FURNACE

WALL and ARCH CONSTRUCTION

"right in the heat of things . . ."



equals

long life,

low overall cost

Retaining and directing heat for industry's processes is Bigelow-Liptak's job. Heat is used for power—it's used for refining petroleum and chemical products—it's used for drying wet materials—it's used for metal-working—it's used in the making of sugar and glass and cement and a host of other products. In all of these industries you will find installations of Bigelow-Liptak furnaces; they are, in fact, "right in the heat of things."

This booklet is designed to illustrate the different types of construction which Bigelow-Liptak Corporation considers as standard for industrial furnaces. Properly balanced in an installation—that is the use of the right design of wall and arch—means a furnace which will provide long, dependable service. This book is designed only to give you a "thumbnail" outline of what B-L does. Naturally, further information is available.

Probably the most important factor that governs design is "on line" service. There is plenty of proof that low initial cost is false economy when the furnace fails to give the service that is expected of it. As the furnace enclosure is the area most subject to wear, its length of satisfactory service governs the satisfactory operation of the entire unit.

Therefore, maintenance is a vital consideration. Costs must be weighed; not only of repairs, but of the inconvenience and loss of production as well.

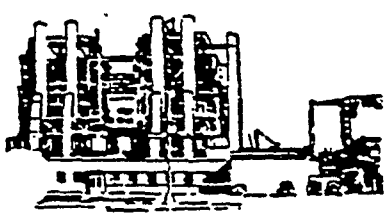
Bigelow-Liptak enclosures are completely engineered. Designs are the result of thorough investigation into the thermo-dynamics and mechanics involved in the unit.

In developing any furnace—large or small—consideration is placed upon long life and low cost. When repairs are needed, they can be made quickly and easily with conventional B-L tile and castings.

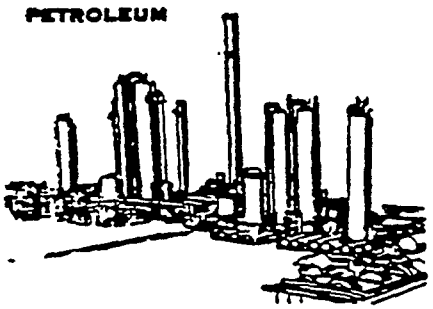
As there is no standard solution to the problem, each furnace becomes an individual problem with B-L engineers. Correct engineering is the one vital factor which assures the long life of the unit.

Because B-L furnace installations are designed to individual specifications this book is intended to show work standards only. The eventual design of any new furnace is decided by B-L engineers only after they have analyzed the work it is to do and have designed a unit that will meet specific requirements perfectly.

POWER



PETROLEUM



SUGAR

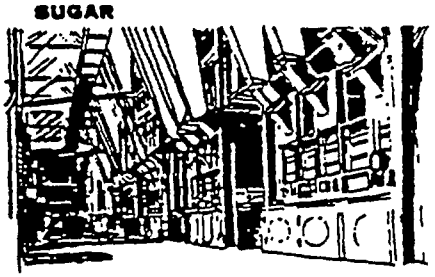
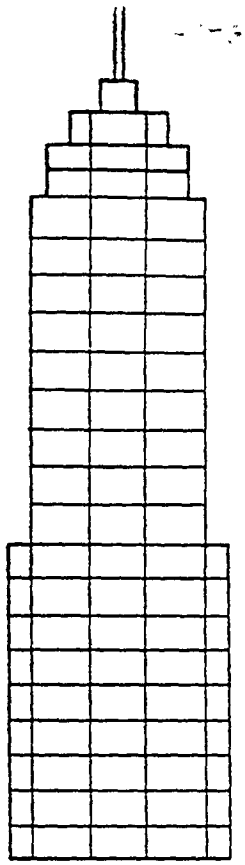


EXHIBIT A AS0000013

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Unit-Suspended Construction for Walls and Arches



Perhaps the most simple comparison of this type of construction is with a skyscraper. In erecting tall buildings, contractors first put up a steel framework. From this are hung masonry slabs. Result: elimination of cumulative loading on the bottom masonry. Often such buildings during construction are built with complete enclosures missing at one or more floor levels. This illustrates unit-suspension construction. Bigelow-Liptak pioneered unit-suspended construction for industrial furnaces which like a skyscraper results in no individual tile bearing more than its own weight. Like a skyscraper, too, courses of tile can be left out without disturbing courses above or below. This is a big advantage during repairs.

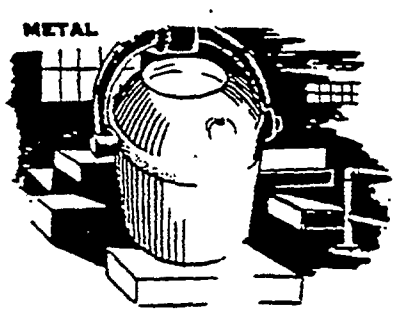
The furnace enclosure construction usually starts off with a structural steel framework surrounding the heat machine. From the steel is hung heat resistant castings. Refractories are placed on the castings just like books are placed on shelves. As each refractory tile is a unit in itself, all of the expansions and strains caused by temperature fluctuations are confined to the individual tile. This means that the walls literally breathe and that large cumulative movements caused by thermal change (and resulting wall cracking) cannot take place.

This is the secret of B-L unit suspension. Like a skyscraper, there are no limits as to contours and heights. Unit suspension is completely flexible. It promotes air tightness, negligible heat loss, and easy maintenance. When repairs are necessary, only worn tile need be replaced.

Castable Construction

For petroleum refining furnaces and in some cement applications, Bigelow-Liptak has developed a smooth monolithic wall of refractory castable. This wall is designed to do two things: contain heat and resist the extraordinary abrasion prevalent in these installations.

In this field, B-L alone provides complete engineering, proven materials, plus erection service.





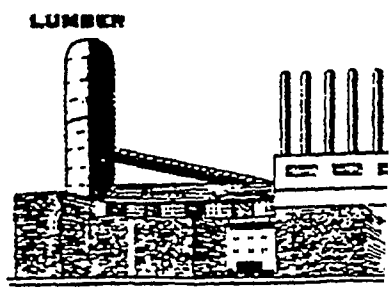
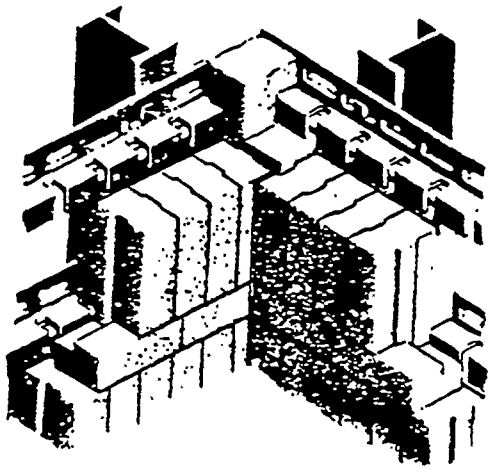


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The Bigelow 7-Inch Single Wall



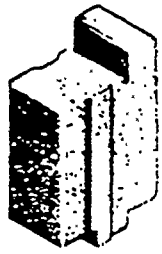
Front view—showing the completed wall.

Side view—showing the refractory thickness. Note the husky supporting castings.

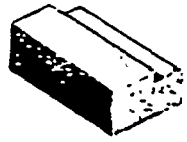


This wall is designed for rugged duty where space does not permit the use of thicker materials. It can be air cooled to contain high temperatures. Where moderate temperatures are to be met, the wall can be insulated to reduce radiation losses.

It is completely unit-suspended. Refractories are set like books on shelves and filler tile are placed between the rows. All joints are completely and effectively offset and cumulative loading and expansion is eliminated. Thin joints of special plastic fire clay seal each tile individually in place and allow for expansion and contraction.



Service tile



Filler tile

Refractory support
Cast iron bracket support

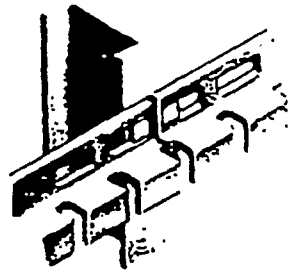
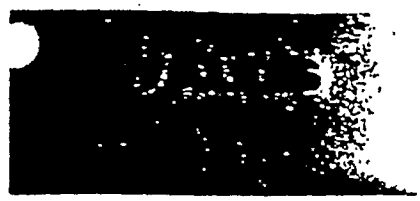


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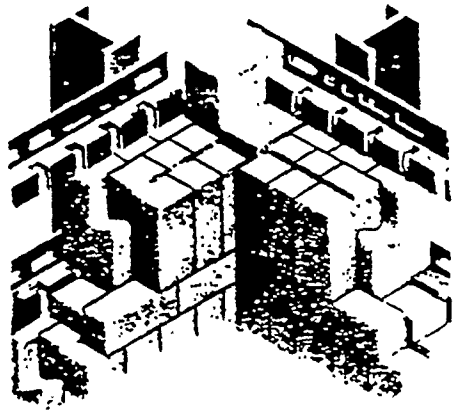
The Bigelow 9-inch Double Wall



This wall is designed for heavy duty work. Its unique design incorporates a super duty facing tile and a holding tile of first quality fire brick. As a result, there is nine inches of refractory—40% of which is designed for high heat service.

The facing tile is exposed to deleterious gases and flame impingement and is further designed to stand up under erosion and spalling conditions.

When extremely high temperatures are encountered the wall is air cooled; however, when medium to high temperatures are met, the wall is insulated with special B-L insulating materials. Tile offsets effectively seal against air leakage. The wall is also available in an 11-inch thickness.



Front view—showing complete wall.

Side view—showing the refractory thickness. Note the unique design of wall tile.



Service tile



Holding tile



Filler tile

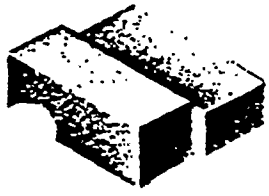
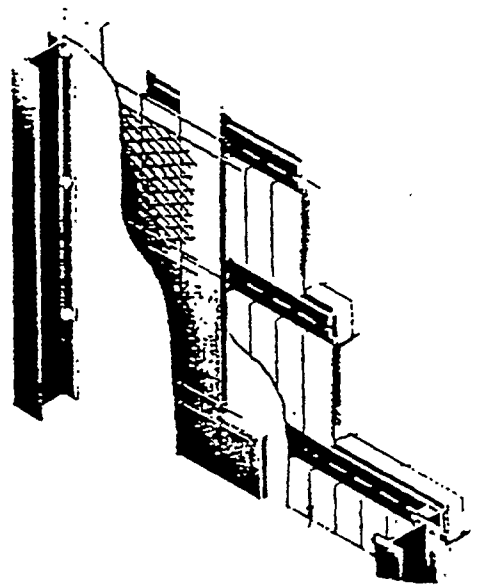


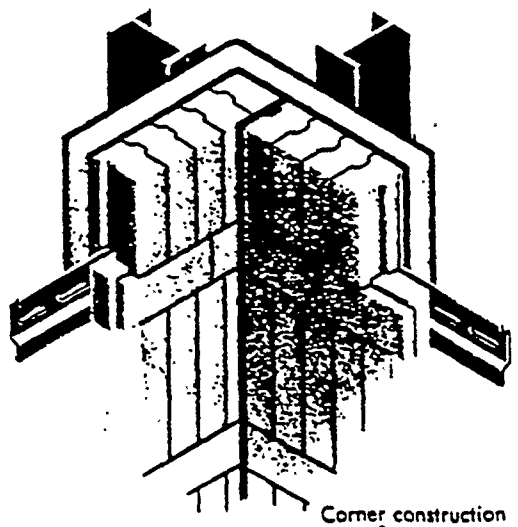
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The Bigelow 4½-inch, 3-inch Single Wall



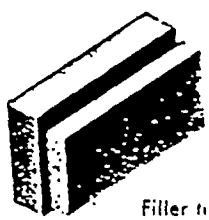
Exterior view—showing the cutaway of the wall and illustrating the plastic-block-plastic insulation seals.



Corner construction

The Bigelow-Liptak thin wall is designed for moderate and low temperature applications and where operating conditions are not too severe. The thinner (4½ or 3 inch) refractories are backed by a three-ply insulation seal to cut radiation and conduction losses and to block air infiltration.

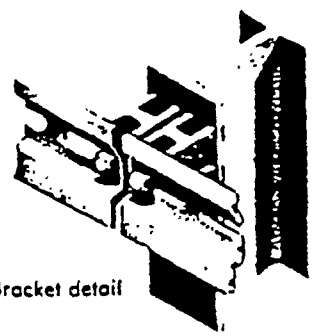
Like all B-L wall designs, the thin wall can be curved or sloped and eliminates any possibility of cumulative loading or expansion thrusts.



Filler tile



Main tile



Bracket detail

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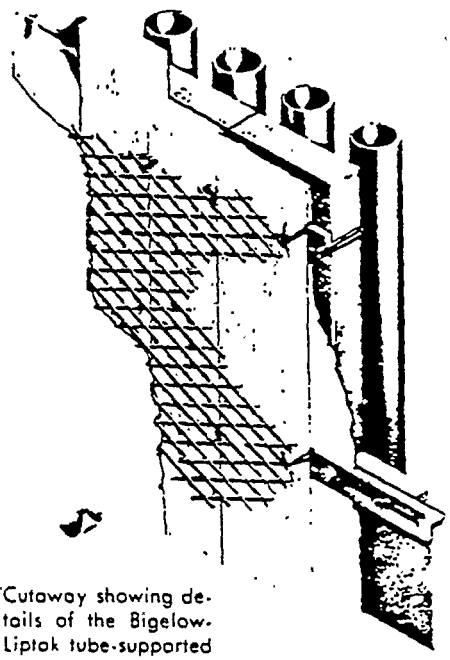
The Bigelow Tube-Supported Wall



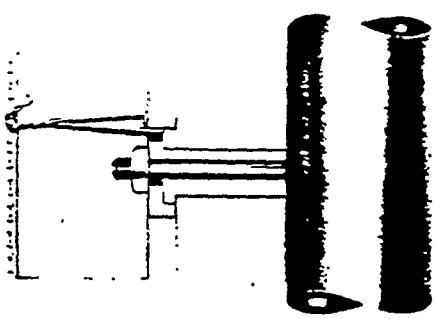
The Bigelow-Liptak tube-supported wall answers the trend toward closely-spaced water tubes and the elimination of special structural supports in industrial boilers. This design eliminates furnace enclosure structural steel. Instead, retainers are welded, or otherwise fastened to the tubes after the boiler skeleton has been erected. Refractory supporting castings are fastened to the retainers. After the refractories are in place, three layers of insulation—plastic, block and plastic—complete the job.

Steel casings are eliminated in this type of construction. Instead Texad* (see page 14) is used to finish off the enclosure which assures complete air tightness. Result: a saving of steel, both structural and plate.

*REGISTERED U. S. PATENT OFFICE



Cutaway showing details of the Bigelow-Liptak tube-supported wall.

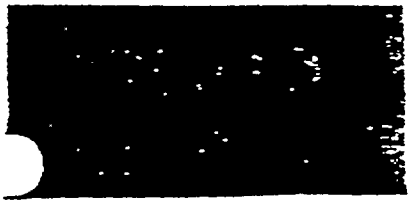


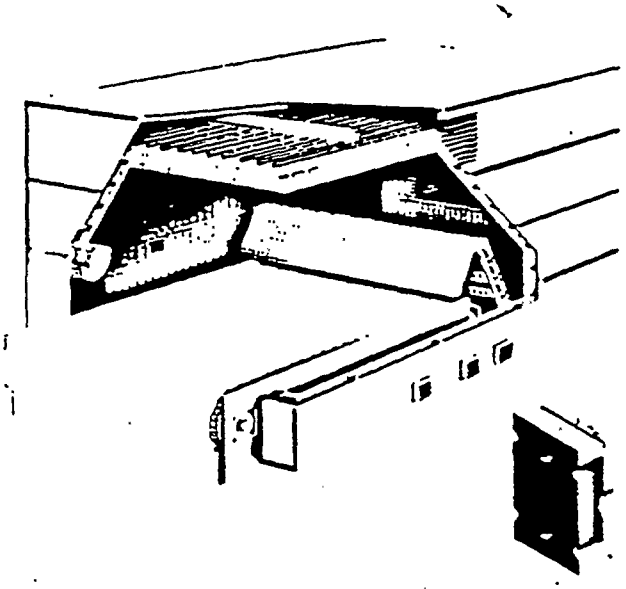
Detail showing how the studs are welded to the boiler tubes.



Note the thin refractories used in the easy-to-erect enclosure.

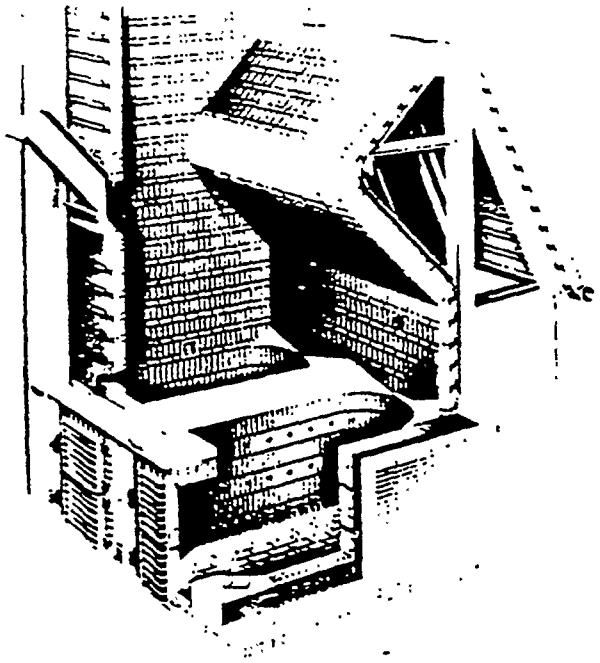
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Dryer Furnaces

Bigelow-Liptak dryer furnaces supply heat for drying coal, lumber, chemicals, foods, or any other product which has a high moisture content. Actually, the design of this enclosure is a modification of the standard B-L thin wall. Tempering air enters the exterior furnace casing through louvers and cools the backs of the refractories. As the air passes through its channel, it is preheated and drawn into the furnace through special air inlet tile. As a result, the gases are brought below the refractory survival point and are gradually reduced to the right outlet temperature. This method tends to mix the air with hot furnace gases reducing them to required temperatures with practically no stratification.



Moist Fuel Cells

Another application of B-L designed unit-suspended walls and arches is found in furnaces where material with a high moisture content is to be burned.

Although designed originally for use in cane sugar countries for the burning of bagasse—spent raw sugar cane—these furnaces proved so successful that their use has spread to other fields such as the burning of bark and wet wood refuse.

The patented B-L moist fuel design incorporates special interlocking type tuyere tile and special base castings. Pre-heated air is forced through the tuyeres to promote rapid combustion of the wet fuel.

Through the years many B-L moist fuel cell furnaces have been installed in various parts of the world. It is significant that their records show that remarkably little maintenance has been required to keep them in operation.

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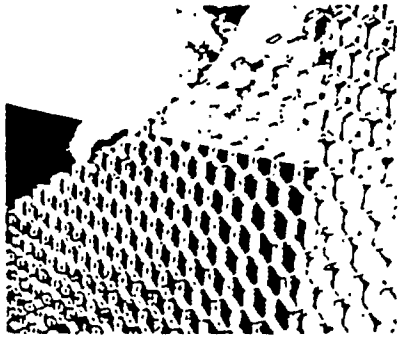


Bigelow-Liptak has two construction methods particularly suited for refining and petrochemical installations.



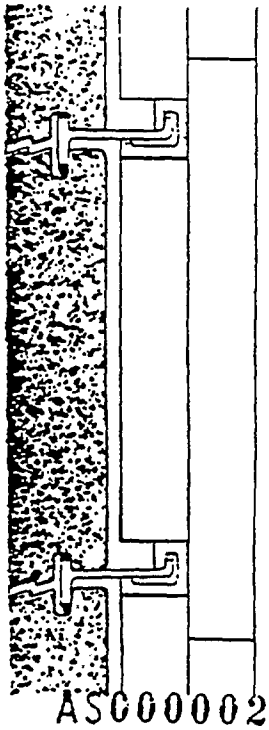
Castable Construction for Refineries

The latest development incorporates two castable refractories which have insulating and abrasion-resistant qualities. Together, they form a smooth monolithic wall adaptable to any furnace or vessel contour. Application is simple when properly supervised. Studs are welded to the inside of a steel shell, and after a layer of insulating refractory has been air-gunned onto the shell, a retaining mesh is welded to the studs. The abrasion-resistant refractory fills the mesh and finishes off the job. Installations of this type are particularly adaptable to catalytic regenerators, catalytic reactors, cyclones, stacks and similar refinery equipment where castable can be applied.



Suspended Construction for Refineries

The old proven stand-by for refinery installations, however, is suspended construction. As with installations in other fields, each tile is individually hung from a supporting casting, and can be removed without disturbing adjacent areas. Suspended enclosures offer the inherent features of low maintenance and high efficiency plus easy replaceability of small damaged areas without disturbing adjacent sections. Parts can be pre-fabricated leading to minimized erection costs. Frequently, both castable and suspended construction are combined in the same furnace for maximum efficiency and economy.



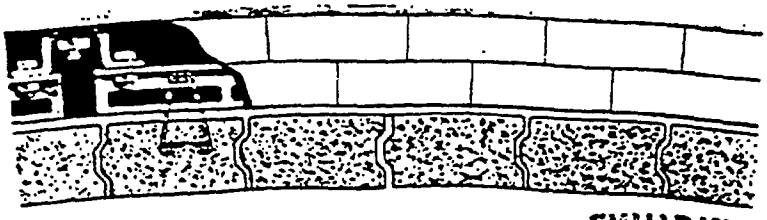
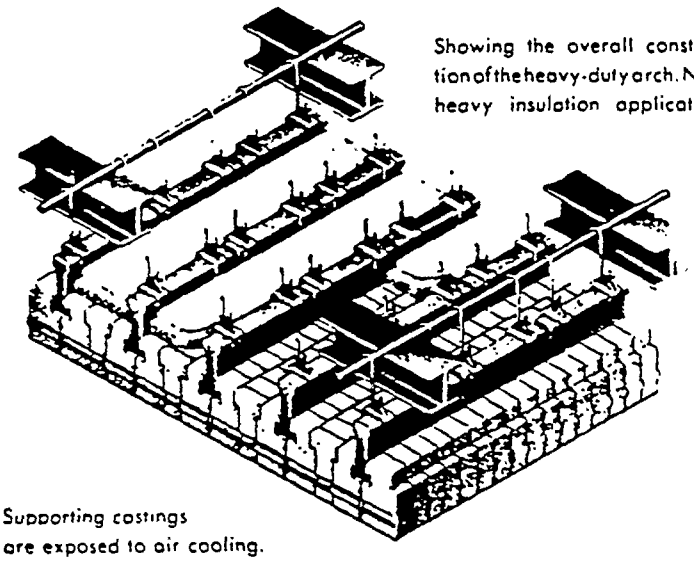


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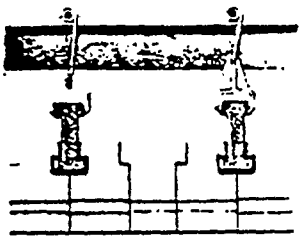
The BIGELOW Double Arch

The Bigelow double suspended arch is used for high temperature applications requiring heavy insulation. The exposed tile is usually made in the quality best suited for the furnace conditions encountered. It is supported by a husky beam tile of first quality refractory which is held by castings and rods. In order to provide for easy service and repair, filler "T" tile are spaced between the service tile units. After a row of the filler tile is removed there is easy access to the service tile.

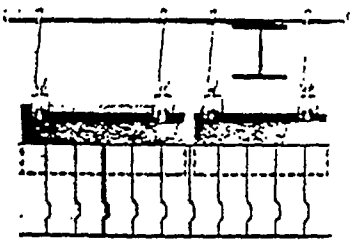


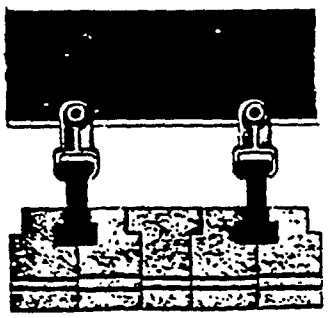
Showing the overall construction of the heavy-duty arch. Note heavy insulation application.

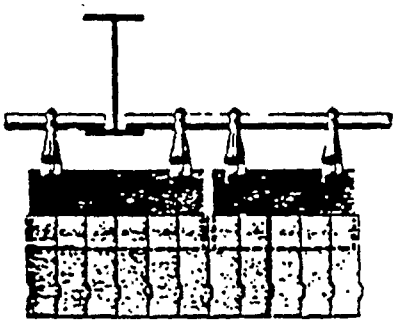
Supporting castings are exposed to air cooling.



Close up views of the supporting devices





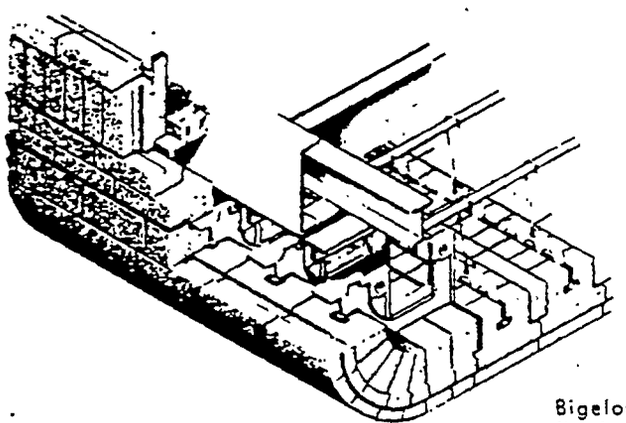


Alternate designs for use where head room is limited.

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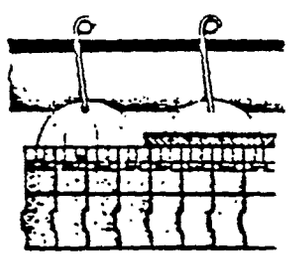
The BIGELOW Single Arch

The Bigelow single arch features a pendulum-type suspension which permits the tile to swing freely in all directions. Each group of tile is suspended by means of a cast iron hanger. Hangers are engaged by a steel hook carried on a pipe over the roof supports. This arch design can be horizontal or sloped. The nose castings permit movement of the complete radial unit.

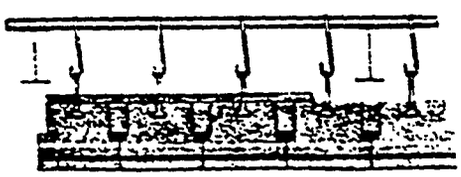


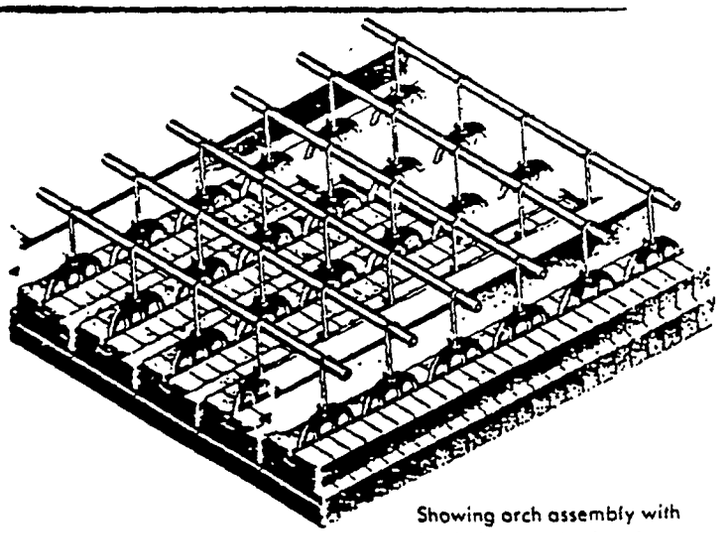


Bigelow-Liptak's free-floating arch nose design.



Close up views of the supporting methods.





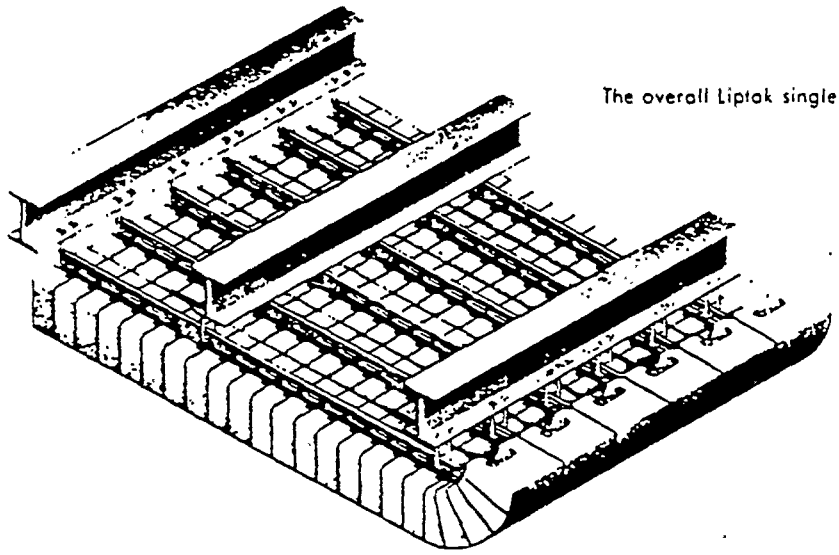
Showing arch assembly with insulation partly in place.

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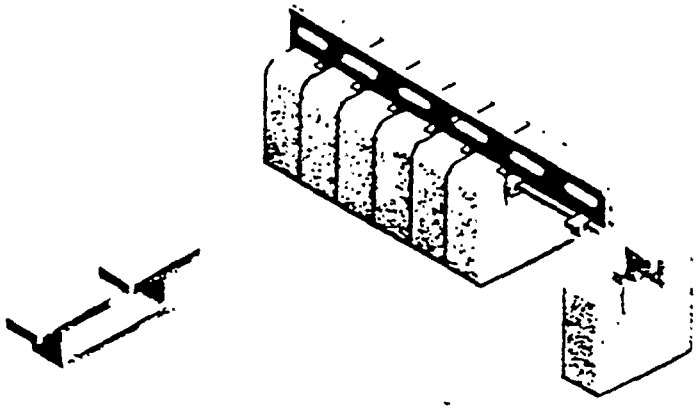
The LIPTAK Single Arch

The Liptak single suspended arch is ideally suited for arch designs where slopes and drop noses are required.

The holding lugs of the arch tile are designed so that a sliding casting can be inserted in each tile from above or below, when erecting or repairing the arch. Since the tile faces are not grooved, repairs can be made easily without completely cooling down the furnace. Arch design provides for a minimum amount of head room.



The overall Liptak single arch design

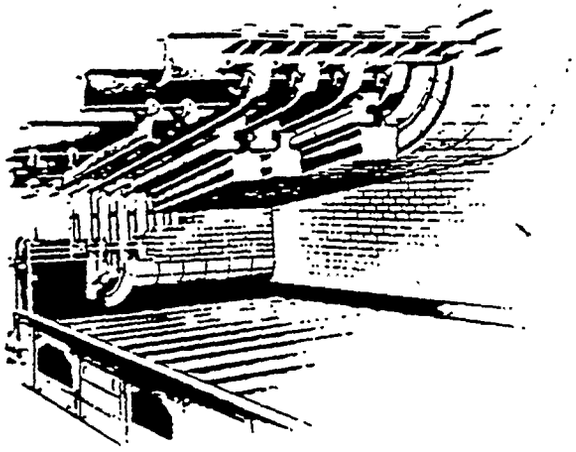




Tile is supported on individual clips which slide on the rail castings and permit individual repairs. Note how any one may be removed without disturbing other tile

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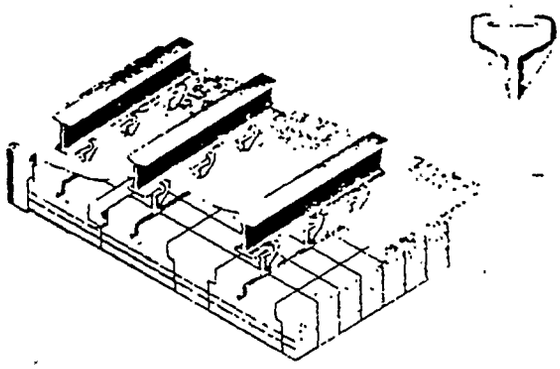
The LIPTAK Double Arch

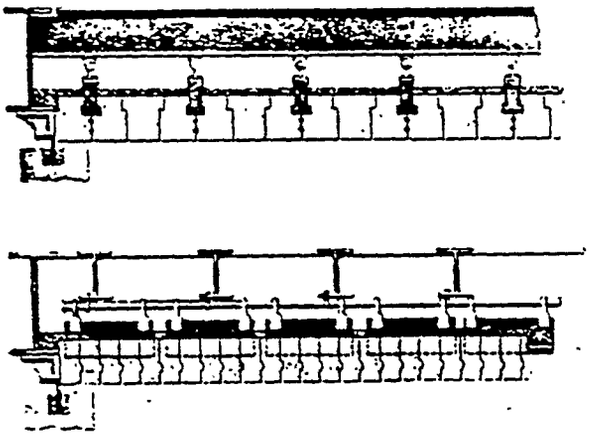


The Liptak double arch consists of a service tile supported by a holding tile which is in turn supported by rail castings. All tile joints are offset to minimize air leakage.

Incinerator Arch

The incinerator arch is designed for rugged service and uses a husky casting support that permits maximum insulation of the top of the arch. Special filler "T" tile are used to facilitate repairs whenever required. The free floating nose construction (see page 11) is used around fuel chutes. Details of this construction have been adapted from other B-L designs but are particularly applicable to large incinerators.





Soaking Pit Cover

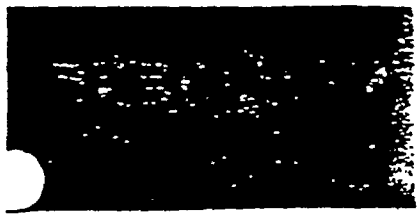
The Bigelow double suspended arch is ideally suited for the severe service encountered in soaking pit roofs.

The husky beam type holding tile supports the service tile.

Insulation can be applied reasonably heavy over the service tile because the holding tile are made of refractories too. Supporting castings are located above the insulation and are not subject to excess heat. It will be noted that this type construction, like many B-L designs, has individual hanger castings which do not span the joints between tile. This eliminates burnouts caused by hot escaping gases from furnaces under plus pressure. Special short units of base castings are framed around the arch. Base castings also hold the special angle seal castings. All tile are small to resist thermal and mechanical spalling.

EXHIBIT A

ASC000024



TEXAD* Casing

TEXAD* was developed by Bigelow-Liptak to answer a definite need for an easy to apply, weatherproof finish for boilers and other industrial furnaces. It is a woven textile of canvas, asbestos, fiber glass, or other synthetic non-flammable material, impregnated with a heat-resistant plastic synthetic resin emulsion. Texad is water and weather-proof—can be painted any color or left white. It cuts costs, eliminating expensive steel plate. It helps make settings air tight—something that non-flexible steel plate cannot do.

How it is applied



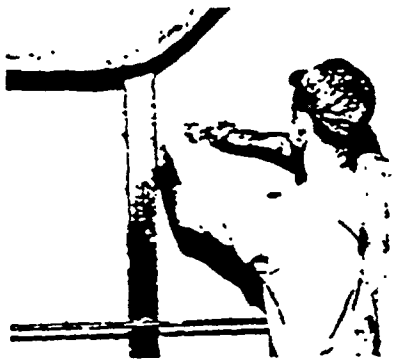
The insulator is coating one side of 40-inch wide strip of textile with the special B-L adhesive—a plasticized synthetic emulsion.



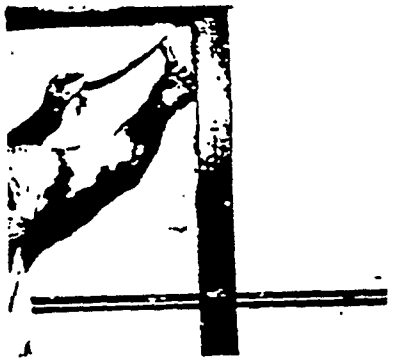
As the insulator brush-coats the textile, he folds the material into 12-inch pleats—a convenient size for application to the furnace wall.



The textile is stapled temporarily to the enclosure top. It drops loosely in place and the insulator lines up the canvas before trimming.



Wrinkles are smoothed out with a trowel. The application is noticeably similar to hanging wallpaper.



The textile is trimmed approximately one-quarter of an inch beyond the edges of the flanges of the supporting columns. The edges then are tucked under the steel.



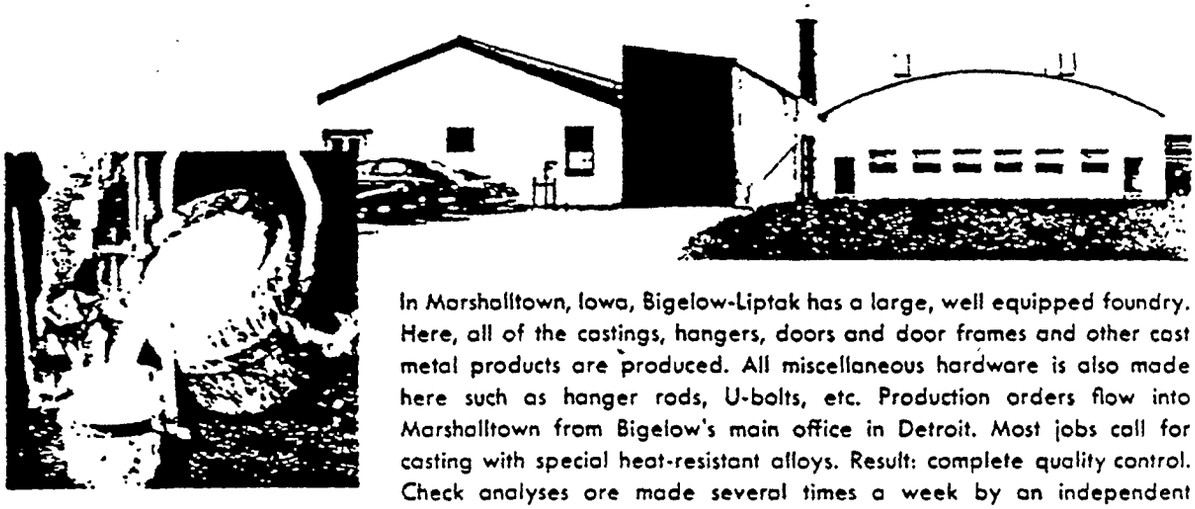
This is the last stage where the insulator gives the textile a final brush coat of adhesive. The job can be painted if desired.

EXHIBIT A

ASC000025

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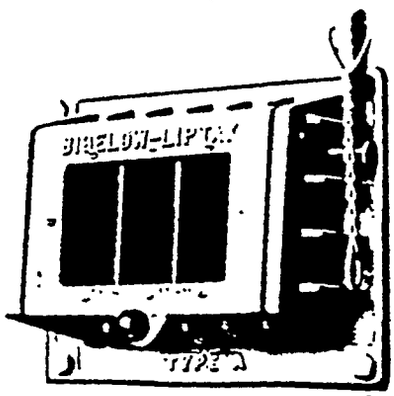




In Marshalltown, Iowa, Bigelow-Liptak has a large, well equipped foundry. Here, all of the castings, hangers, doors and door frames and other cast metal products are produced. All miscellaneous hardware is also made here such as hanger rods, U-bolts, etc. Production orders flow into Marshalltown from Bigelow's main office in Detroit. Most jobs call for casting with special heat-resistant alloys. Result: complete quality control. Check analyses are made several times a week by an independent laboratory. B-L's warehouse carries a large stock of standard castings for emergency order.

DOORS—Observation

The Bigelow-Liptak observation door has been designed for rugged, heavy duty work. Its husky, cast frame has a special rib design for strength and to help radiate heat. The actual opening, measuring 4" x 6", is covered with blue heat-resistant glass for safety and visibility. A shutter on the hot side of the furnace guards against explosion hazards and "puffs".



DOORS—Access

Furnaces are designed with a door to be used when the furnace is shut down for repair or cleaning. Bigelow-Liptak has produced a refractory-lined access door with sufficient space to offer easy entrance to the furnace. The door casing is of heavy heat-resistant cast iron—ribbed for strength, rigidity, and air cooling. A strong wheel-type lock keeps the door secure during furnace operation.

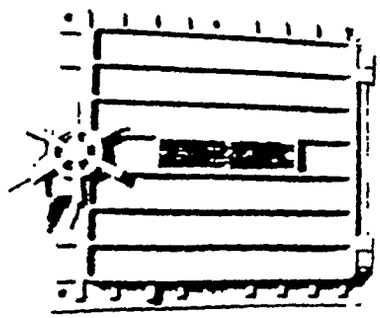


EXHIBIT A ASC0000026



Block Insulation
BL-19

an all-purpose mineral wool material for temperatures to 1900°F.

BL-19 is a block insulation manufactured from a high-grade mineral wool material. It is recommended for temperatures to 1900°F. and remains completely stable within that limit. Complete insulation is made possible by small, interlocking fibers sealing millions of tiny air cells. Thermal conductivity is very low. Block is tough enough to withstand normal handling and usage, yet is extremely light and easy to cut. Hard surface available on special order.

Insulating Cement
C-18

an all-purpose mineral wool plastic for temperatures to 1800°F.

C-18 is an insulating cement composed of mineral wool, long-fiber asbestos, and an adhesive binder. While it does not trowel to a hard finish, many installations are in service where C-18 comprises the sole exterior coat. It has a low thermal conductivity rating and is easy to work.

Finishing Cement
C-10

a hard white finish coating for temperatures to 1000° F.

C-10 is a finishing cement composed of asbestos, clay and white Portland cement. It provides a smooth, dense, white finish coat for all types of insulation. It is effective within a range of 70° F. to 1000° F. and is non-reclaimable.

Insulating-
Finishing Cement
FC-11

a smooth-finish insulation for temperatures to 1000°F.

FC-11 is a smooth-finish insulating and finishing cement which is applied to BL-19 or BL-20. It combines the insulating qualities of C-18, yet trowels as smooth as C-10 finishing cement. As a result only a one layer application is needed for a complete installation.

Insulating Wool
W-12

a mineral wool insulating material for temperatures to 1200° F.

W-12 is a high-temperature mineral wool insulation available in both fibrous and granulated forms. It is used wherever a loose "fill" type insulation is needed.

Insulating Cement
RC-23

a semi-refractory plastic insulation for temperatures to 2300° F.

RC-23 insulating cement is a plastic-type material with the ability to withstand a full range of continuous temperatures to 2300° F. It is made of fire clay, asbestos, mineral wool, and diatomaceous earth. May be applied where surface temperatures are too high for BL-19 or C-18, in the thickness required to permit a junction temperature suitable for BL-19 or C-18. It can be exposed to flame if protected by a wash coat of Lumnite cement.

EXHIBIT A

ASC0000627

	BL-19	C-18	C-10	FC-11	W-12	RC-23
Temperature Limit	1900° F	1800° F	1000° F	1000° F	1200° F	2300° F
Conductivity	0.90 at 1000°F; 1.46 at 1200°F	0.77 at 500°F; 0.81 at 700°F	Higher than C-18—But is only finish coat	0.62 at 300°F; 0.96 at 700°F	0.45 at 400°F; 0.61 at 600°F	2.38 at 800°F; 2.795 at 1200°F
Shrinkage	.03% at 1200°F; .084% at 1740°F	15% in thickness only	7% in thickness only	Nil		10% in thickness only
Water Absorption	Enough to aid drying finish		Absorbs but does not disintegrate	Can be washed down	Nil	
Density lbs/Bd ft	1.67	1.82	3.8	2.91	0.6 loose	4.45
Corrosion	Nil	Nil	Nil	None for steel; not used for non-ferrous metals	Nil	Nil
Adhesive		Complete bond	Adheres well	Adheres well		to refractory

EXHIBIT A ASC000028



Bigelow-Liptak Research

Bigelow-Liptak research covers both familiar and out-of-the ordinary applications. Frequently supervisors, engineers, sales personnel and draftsmen are brought into special schools for discussion of unusual problems. One school recently taught Bigelow-Liptak personnel erection techniques for applications in the refining field. Trained technicians explained and demonstrated every aspect of job construction. Errors were made on purpose so that the supervisors would know what to look for as potential "hot spots" and trouble areas in a finished furnace. Parallels were drawn to indicate standard Bigelow-Liptak practice in the field.

Actual laboratories in Detroit, Michigan; Marshalltown, Iowa; and Mexico, Missouri thoroughly explore new ideas before they are tested in the field. That's why Bigelow quality control is so high.

Custom Engineering

Every Bigelow-Liptak job is custom engineered. Each is considered as a separate problem and the resulting enclosure is designed to produce long-lasting dependability and economy. B-L design engineers and draftsmen are men who have had years of training in thermodynamics and refractory application.

In addition to intelligent engineering, B-L supplies all the material necessary to complete the job. Tile are made to Bigelow's specifications in leading refractory plants throughout the world. Castings are produced in Bigelow's modern foundry. All of the insulation and Texad® casing materials are supplied from the company's line of high temperature products.

In many cases, B-L engineers actually supervise construction right in the field. You will find them scattered throughout the world. Sometimes they are in Bahrein Islands in the Persian Gulf putting in a refinery installation. At other times they may be in West Virginia, in the United States, installing a coal dryer furnace. They could be in the Pacific Northwest working in lumber mills, or in lower California on big boiler jobs. You will find them in South America, the Philippines, Denmark—anywhere in the world.

Remember: if you are building any kind of a boiler, refinery heater or furnace, *insist* upon a separate enclosure. Bigelow-Liptak wants very much to work with you.

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EXHIBIT A ASC0000029



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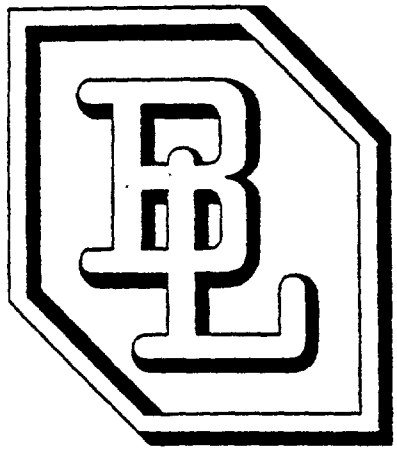
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EXHIBIT A ASC000031