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Johns-Manville Service

to the

Iron and Steel Industry

JOHNS-MANVILLE
JM
PRODUCTS

MANUALS OF J-M SERVICE TO INDUSTRY—NO. 101

DEFENDANT'S
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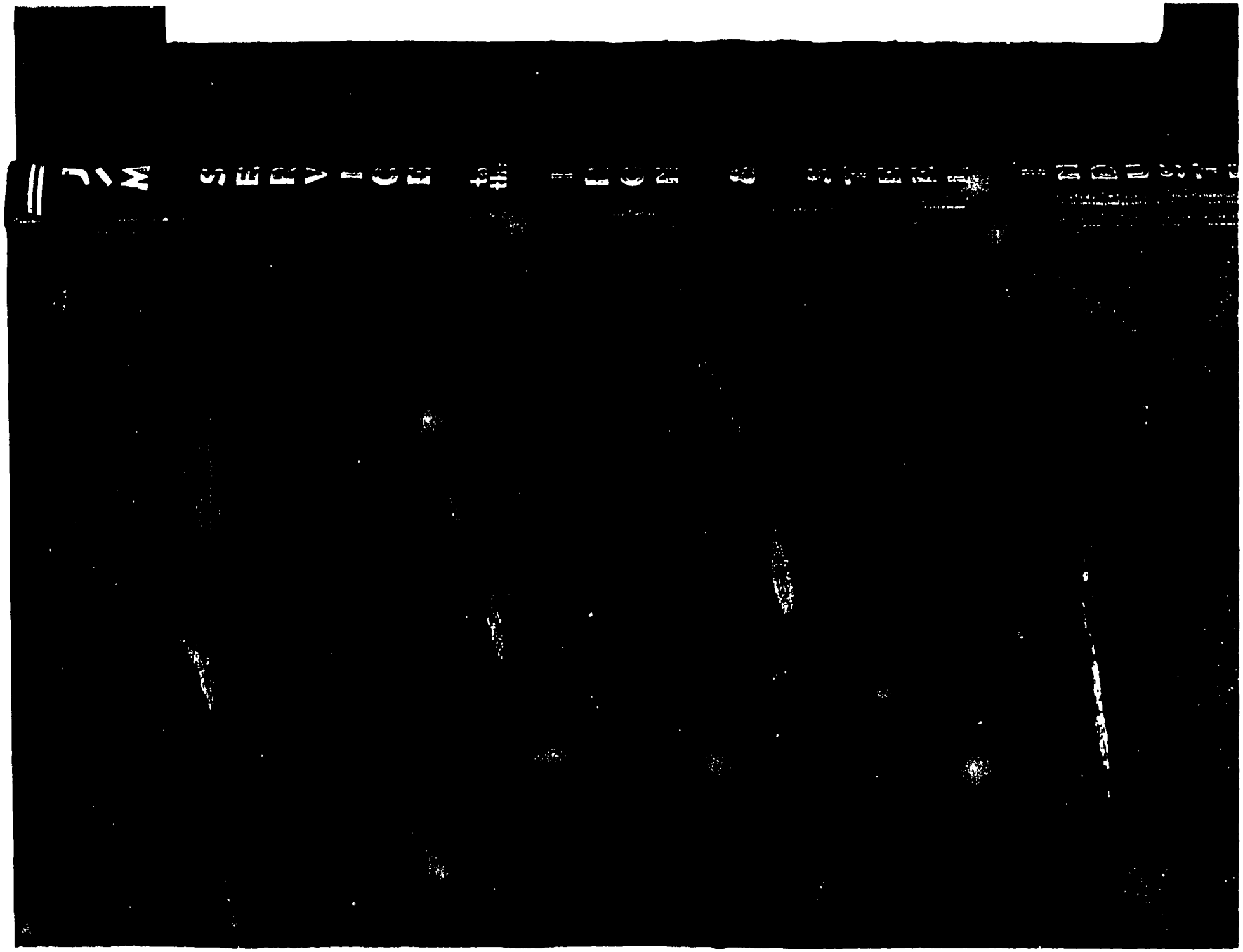
OE-34



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Issued 1930

INTRODUCTORY

THE purpose of this book is to present, as completely and yet as concisely as possible, the service Johns-Manville offers in improving the operating efficiencies of Iron and Steel manufacturing processes.

The blast furnace plant, the open hearth plant, the mill furnaces and the power plant have been given special attention in describing the application of insulation and refractory cements. Whether pig or wrought iron, open hearth or Bessemer steel, J-M products will decrease the cost of production.

Blast furnace stacks, hot blast stoves, mains and bustle pipes function much more economically when properly insulated, as does also every furnace, regenerator, metal mixer, and waste heat boiler.

In the by-product coke plant the utility of J-M materials is apparent at every turn: Insulation on the ovens, preheaters, and stills; packings on the gas, air and water apparatus; Transite for the quenching station in the yard; and built-up roofs on the buildings.

In the rolling mills, sheet mills, tin plate mills, wire mills and pipe mills, J-M insulations, packings, refractory cements, brake blocks and roofings—economical, durable and efficient—point the way to reduced operating costs by conserving heat, lessening deterioration, and maintaining production.

For motive equipment—locomotives, shovels, drag lines and buckets, hoists, transfer bridges and loaders—Johns-Manville

furnishes brake blocks and clutch facings, packings, insulations, and housings of weather-proof and corrosion-resisting Transite.

For all concrete construction—shafts, man-ways, portals, foundations and walls—Celite for Concrete adds to the workability and insures permanence and water-tightness.

For buildings, J-M roofings—built-up, insulated, ready-to-lay—afford the maximum of protection and durability with the least maintenance in any climate. J-M shingles provide a roof, the appearance of which meets every architectural requirement.

Transite roofing and siding used on steel frame construction is not only durable under the most adverse atmospheric conditions, but requires no painting or other maintenance.

For the power plant — boilers, pipe lines, pumps, compressors—there are J-M insulations for all operating temperatures; refractory cements; packings for steam, air, surface or mine waters, and oil; Asbestos Ebony for panel control boards; Orangeburg Fibre Conduit and other electrical specialties.

The number and variety of J-M products and the magnitude of the Iron and Steel Industry preclude complete discussion of every application in a book of this size. Detailed specifications for the use of any J-M material, as well as drawings and other engineering data based on long and specialized experience, are available on request.

JOHNS-MANVILLE

The Blast Furnace Plant

THE proper use of Johns-Manville insulation and refractory materials for the blast furnace stack and hot blast stoves, mains and bustle pipes is a great factor in the present-day economical production of pig iron. In the following pages will be found descriptive recommendations based on applications which have been found successful in blast furnace plant operation.

Blast Furnace Stack

An important application of insulation, which is now being employed satisfactorily by a number of plants, is the insulation of the blast furnace stack. Sil-O-Cel Coarse Grade is used, packed between the inwalls and the shell of the stack, above the mantel, as shown in Fig. 1.

Sil-O-Cel acts as a cushion between the refractory and shell, preventing the rivet shearing action encountered when densely packed loam or granulated slag is used. Sil-O-Cel is inert chemically and cannot react upon the brick or shell as might be the case with loam, due to lime content. The effect of the Sil-O-Cel insulation is to give a more uniform heat gradient through the lining with more uniform expansion and a lessened possibility of cracks forming. The shell is also protected against excessive temperatures.

A number of plants are insulating stacks because of the above advantages as well as to minimize the building-up action of the refractory lining due to condensation and chilling of zinc vapors or other impurities in the ore. Because a more uniform heat is maintained through the refractory, the vapors are carried through into the Sil-O-Cel, where condensation takes place. By virtue of its great porosity, Sil-O-Cel will absorb condensed vapors equal to 80 per cent of its volume.

Sil-O-Cel Insulation Recommendations

The J-M recommendation for the insulation of blast furnace stacks consists of from 2½ in. to 4 in. of Sil-O-Cel Coarse Grade extending from the mantel to the bottom of wearing plates (see Fig. 1).

The Sil-O-Cel Coarse Grade should be packed in the space between the brick lining and the steel shell to a density of 22 lb. per cubic foot. This is best accomplished by carrying up the brickwork approximately 3 ft. at a time, then filling in and tamping the Sil-O-Cel Coarse Grade in place.

Refractory Cement Recommendations

To prevent the heat from entering the inwalls through cracks, thereby softening the brickwork at some distance from its surface, and also to reduce spalling, the brick in the blast furnace is set up with refractory cement, as indicated by zones in Fig. 2. J-M No. 30 Refractory Cement is used in laying

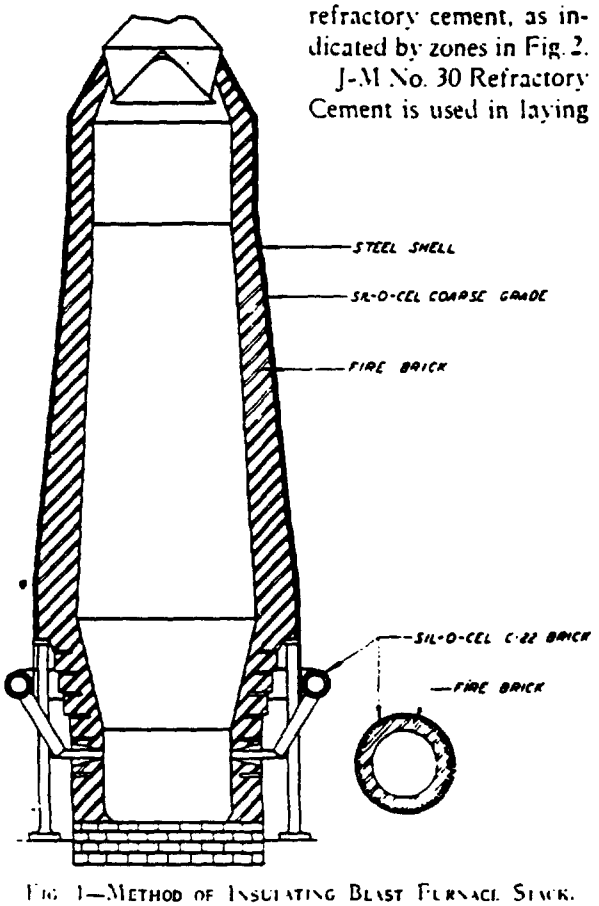

FIG. 1—METHOD OF INSULATING BLAST FURNACE STACK, MAIN AND BUSTLE PIPE

the bottom blocks, the hearth, bosh, and lower inwall brick. J-M No. 20 Plastic Refractory Cement is employed in the middle inwall and the top.

J-M No. 30 Refractory Cement is particularly resistive to the action of blast furnace slag and the erosive action of materials passing through the furnace in the blast. In the bottom blocks, it prevents metal penetration and cuts down labor costs, because by using No. 30 it is not necessary to chip off the blocks to level each course. J-M No. 20 Refractory Cement strongly bonds the metal wearing plates to the brick and resists the cutting action of the ore, limestone and coke fed into the furnace at the top.

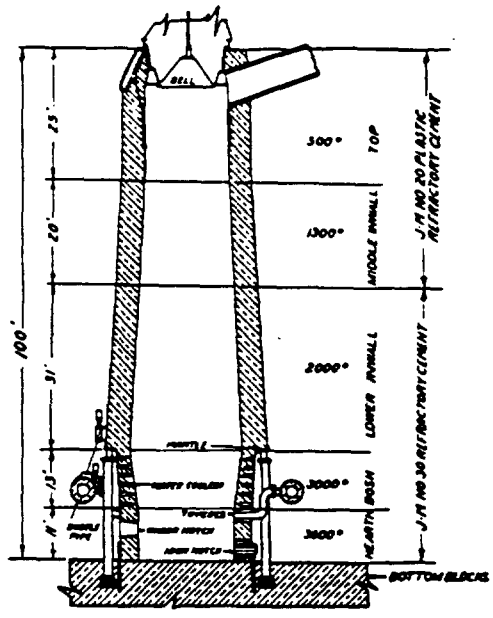

FIG. 2—REFRACTORY CEMENT RECOMMENDATIONS FOR TYPICAL BLAST FURNACE

Hot Blast Stoves

The problem of sufficient hot blast stove capacity to enable the operator to supply high hot blast temperatures becomes more pronounced with modern demands for greater uniformity in iron composition. Another element is the increased use of blast furnace gas for metallurgical operations, which renders desirable further fuel economies in the stoves. Adequate insulation of the hot blast stoves offers an obvious means of meeting each of these requirements.

The approved insulation for stoves consists of 2½ in. of Superex Blocks next to the shell, with 4½ in. of the fire brick lining immediately inside the Superex replaced by 4½ in. of Sil-O-Cel C-22 Brick. The older practice made use of Superex only, but the method which replaces 4½ in. of fire brick with Sil-O-Cel C-22 Brick has proved highly advantageous and well justified by the excellent return secured on the additional investment. The following table shows the per cent return on insulation investment for the two types of construction, figured for a stove of recent design. Definite recommendations appear on succeeding pages.

	Value heat loss per year at 30¢ per million B.t.u.	Value heat saved over uninsulated stove	Est net cost of insulation installed	Per cent yearly gross return
Stove uninsulated	$8,430			
Stove Insulated with 2½ in. Superex Blocks on shell and dome and 6 in. Sil-O-Cel C-3 Concrete under base	4,110	$4,320	$3,770	115%
Stove Insulated with 2½ in. Superex Blocks and 4½ in. Sil-O-Cel C-22 Brick on shell and dome and 6 in. Sil-O-Cel C-3 Concrete under base	3,240	5,190	6,490	84%

Cement and finished off flush with the top of the rivet heads. Superex Insulation of proper thickness is then placed over the cement fill so that the face of this material will be flush with the face of the adjoining insulation.

In constructing the brick lining immediately next to the Superex, Sil-O-Cel C-22 Brick 4½ in. thick is laid to form the outer course of the brick wall. No bond is used between the fire brick and the Sil-O-Cel C-22 Brick.

Sil-O-Cel C-3 Concrete, instead of Superex, is used in the same thickness as adjacent Superex around the hot blast outlet for 2 linear feet in each direction. This C-3 Concrete is prepared by mixing Sil-O-Cel C-3 and portland cement in the proportion of four parts of C-3 to one part of portland by volume, and adding sufficient water to make a plastic mixture.

Walls, Recommendation "B"—Where the steel shell is built with shingle lap joints (see Fig. 6), Superex Insulation and Sil-O-Cel C-22 Brick are applied as above, except that Superex is used in special cut sizes to fit each section, tapering from 2¼ in. thick at the top of each steel section to 2¾ in. thick at the bottom. A drawing should be furnished, giving all dimensions and the details of joints and reinforcing plates.

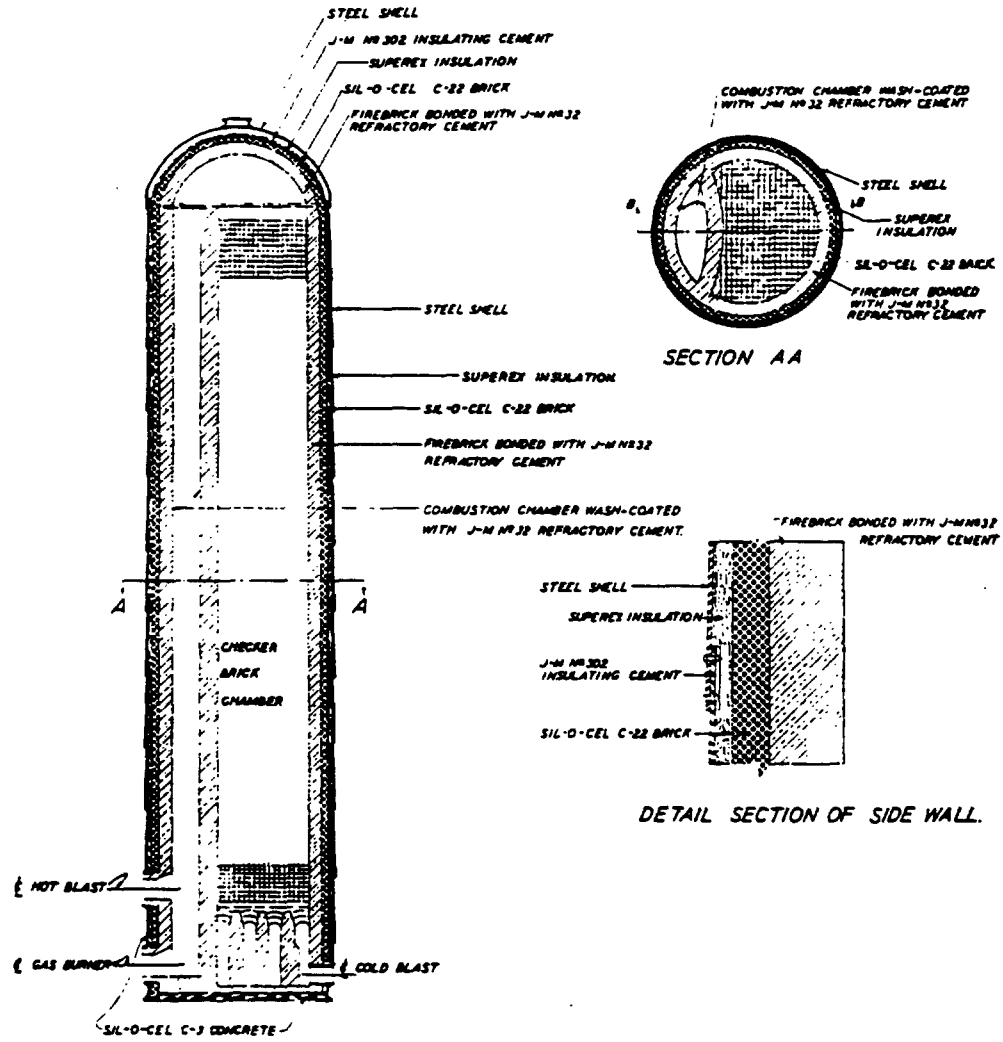

FIG. 6—SIL-O-CEL C-22 BRICK AND SUPEREX BLOCKS IN SIDE COMBUSTION STOVE

Dome (For Recommendations "A" and "B")—This recommendation applies to the dome of a two- or three-pass stove, where a steel shell forms a housing over the insulation.

As the dome is erected, Sil-O-Cel C-22 Brick, 4½ in. thick, is laid over the fire brick, and followed by 6 in. x 12 in. x 2 in. thick Superex Blocks with all joints closely butted. All Sil-O-Cel C-22 Brick should be laid with a thin rubbed joint of Sil-O-Cel Mortar. Over the insulation a ½ in. thickness of J-M No. 302 Cement is troweled to a smooth finish (see Figs. 5 and 6). The edges of the insulation around the relief plug in the dome are coated with J-M No. 20 Plastic Refractory Cement.

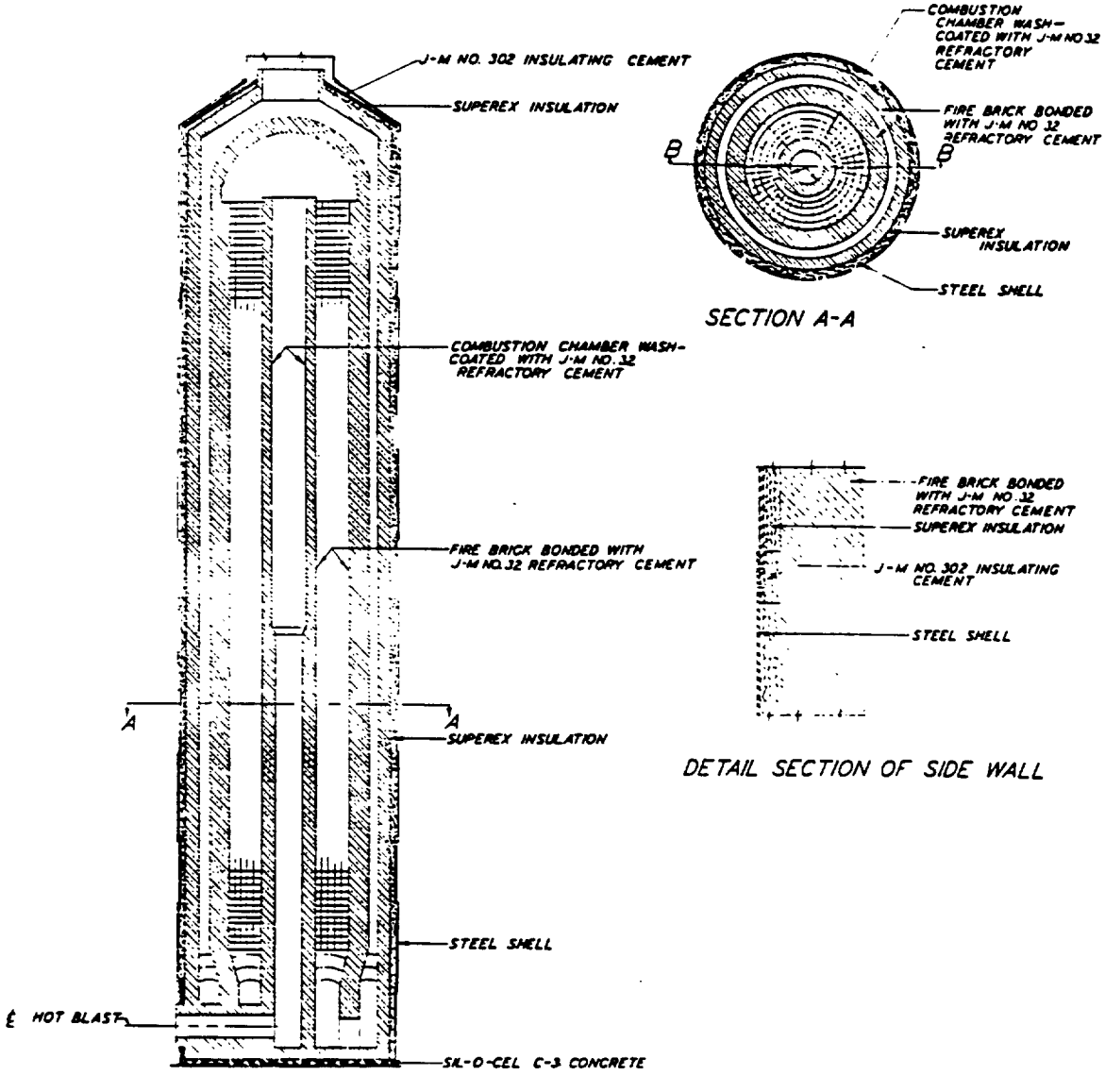

FIG. 7—SUPEREX BLOCK INSULATION IN THREE-PASS STOVE

Superex Insulation

Walls, Recommendation "C"—This recommendation is intended for stoves built so that the alternate sections have both edges lapping inside of the adjacent ones, to form an "in and out" lapping (see Fig. 7). The steel shell is assumed to be ½ in. thick.

The insulation consists of Superex placed between the fire brick and the steel shell as the work progresses. The insulation between the inner rings and the brickwork is 2¼ in. thick, and between the outer rings and the brickwork is 2¾ in. thick.

All joints are closely butted and pointed up with J-M No. 302 Cement. The space between the rivet heads is filled in with J-M No. 302 Cement and finished off flush with the top of the rivet heads. Superex Insulation of proper thickness is placed over the cement fill so that the face of the insulation at this point will be flush with the face of the adjoining insulation.

Sil-O-Cel C-3 Concrete, instead of Superex, is used in the same thickness as adjacent Superex around the hot blast outlet for 2 linear feet in each direction.

Walls, Recommendation "D"—Where the steel shell is built with shingle lap joints, Superex Insulation is applied as above, except that it is in special cut sizes to fit each section, tapering from 2¼ in. thick at the top of each steel section to 2¾ in. thick at the bottom. A drawing should be furnished, giving all dimensions and the details of joints and reinforcing plates.

Dome (For Recommendations "C" and "D")—This recommendation applies to the dome of a two-pass or three-pass stove, where a steel shell forms a housing over the insulation.

Superex Insulation, 2 in. thick and furnished in flat blocks 6 x 12 in., is applied over the fire brick as the dome is erected, with all joints closely butted (see Fig. 7). Over the insulation a ½ in. thickness of J-M No. 302 Cement is troweled to a smooth finish.

The edges of the insulation around the relief plug in the dome are coated with J-M No. 20 Plastic Refractory Cement.

Sil-O-Cel C-3 Concrete

Base—The base of the hot blast stove is insulated with a minimum thickness of 4 in. of Sil-O-Cel C-3 Concrete, protected by two 2½ in. courses of fire brick laid with broken joints (Fig. 8).

Sil-O-Cel C-3 Concrete is made by mixing C-3 and portland cement in the proportion of four parts of C-3 to one part of portland by volume. Care should be taken to avoid an excess of water. After thorough mixing, the C-3 Concrete is tamped into place.

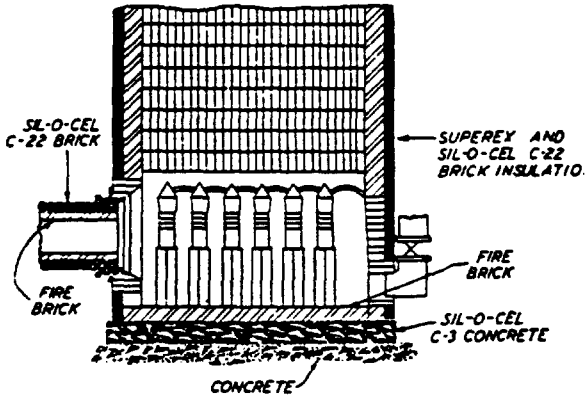

FIG. 8—METHOD OF INSULATING BASE OF HOT BLAST STOVE

Doors—J-M Special Braided Asbestos Rope i supplied as a groove packing on hot blast stov clean-out doors as the best material to withstan successfully this severe service.

Insulation of Flues on Diehl Stoves

In Fig. 9 is shown the method of insulating the flues used in conjunction with Diehl stoves. Flues are insulated with Superex Blocks. The stoves are insulated in accordance with J-M standard recommendations.

Refractory Cement Recommendation for Hot Blast Stoves

Walls, Dome and Bottom—All fire brick in th walls of the combustion chamber is bonded wit J-M No. 32 Refractory Cement, and the expose brick inside of the combustion chamber is wash coated with J-M No. 32 Refractory Cement. F patching, J-M No. 20 Plastic Refractory Cement most satisfactory.

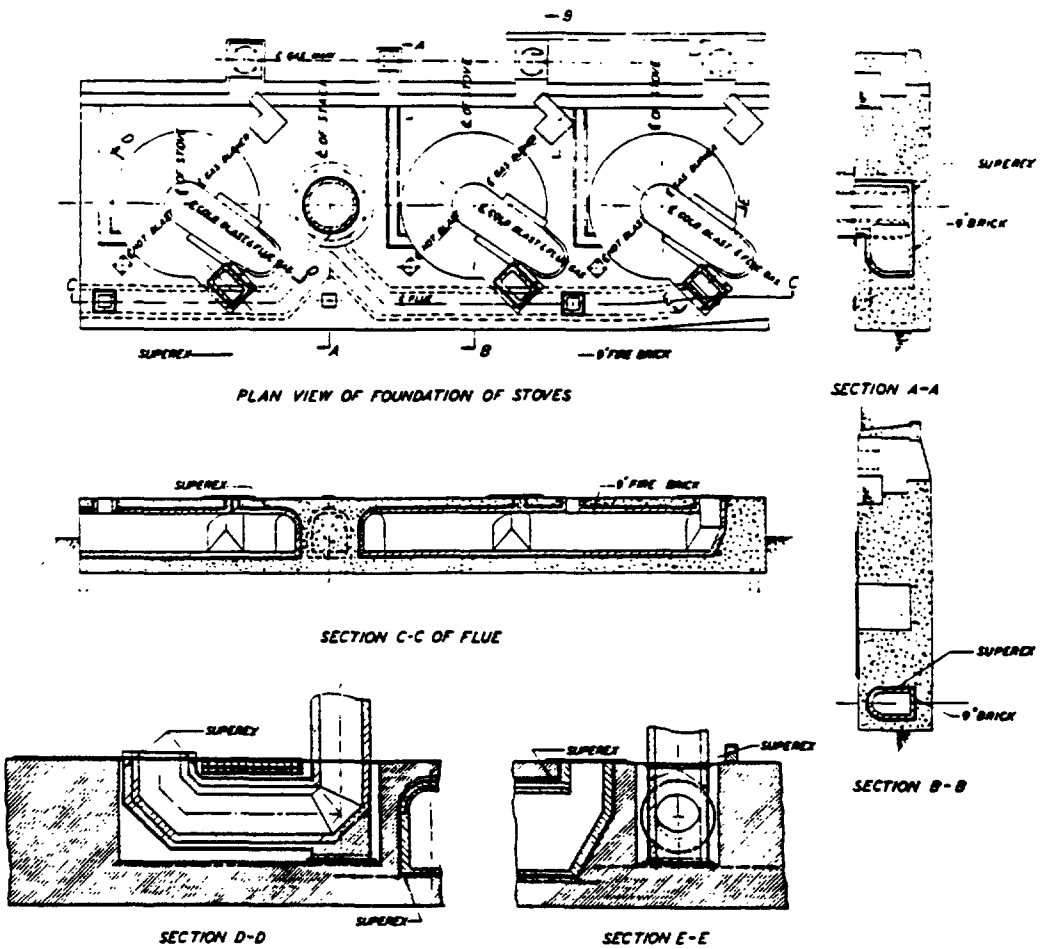

FIG. 9—INSULATION OF DIEHL HOT BLAST STOVE FLUE TO STACK

Hot Blast Mains and Bustle Pipes

In the matter of delivering high temperature blast at the tuyeres, the insulation of mains and bustle pipes is as essential as the insulation of the stoves. There can be no question of the desirability of this practice if reference is made to the numerous successful installations of suitable insulation between the steel shell and the fire brick lining of mains, which have been in extended use.

A lining failure in hot blast main or bustle pipe is, of course, an affair of no mean consequence. The cost of labor and materials incidental to repair is a factor without importance compared to interruption of production and furnace difficulties. The superintendent is well justified, therefore, who eyes with suspicion the use of any but well-tried methods and materials. Linings are subject to enormous stresses from fire brick expansion and general severe operating conditions, all of which demand the use of a high quality, mechanically strong insulation, capable of enduring high temperatures without harmful effect upon its physical properties.

These specifications may seem hard to meet, but developments in this field have been rapid in the last few years, and the insulation of hot blast mains and bustle pipes now presents no problem. The cost of insulation is returned in full during the first few months' operation by virtue of heat saving alone, to say nothing of longer life of refractories through heat equalization and improved furnace performance.

Uninsulated mains and bustle pipes lose large quantities of heat due to the comparatively thin linings employed. The method recommended for insu-

Coke Oven Insulation Recommendations

A great many coke oven plants now employ insulation to insure maximum economy of operation. The method of insulating is shown in Fig. 14.

Bases are insulated with Sil-O-Cel C-3 Concrete over the portland cement concrete foundation. Sil-O-Cel Natural Brick is used between fire brick and red brick in the regenerator walls, or Superex Blocks with a Transite or steel casing is employed. The doors of the coking chambers and the flash plates are insulated with Sil-O-Cel C-3 Concrete or Superex Blocks behind the silica brick. Tops are most effectively insulated with Sil-O-Cel C-3 Concrete over the silica blocks. A paver course is then laid over the C-3 Concrete.

J-M Insulating Materials are also used for insulating piping and other apparatus in the by-product plant, such as oil separators, reheaters, superheaters, stills and tanks.

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-Sections Below Ground

mendation 30

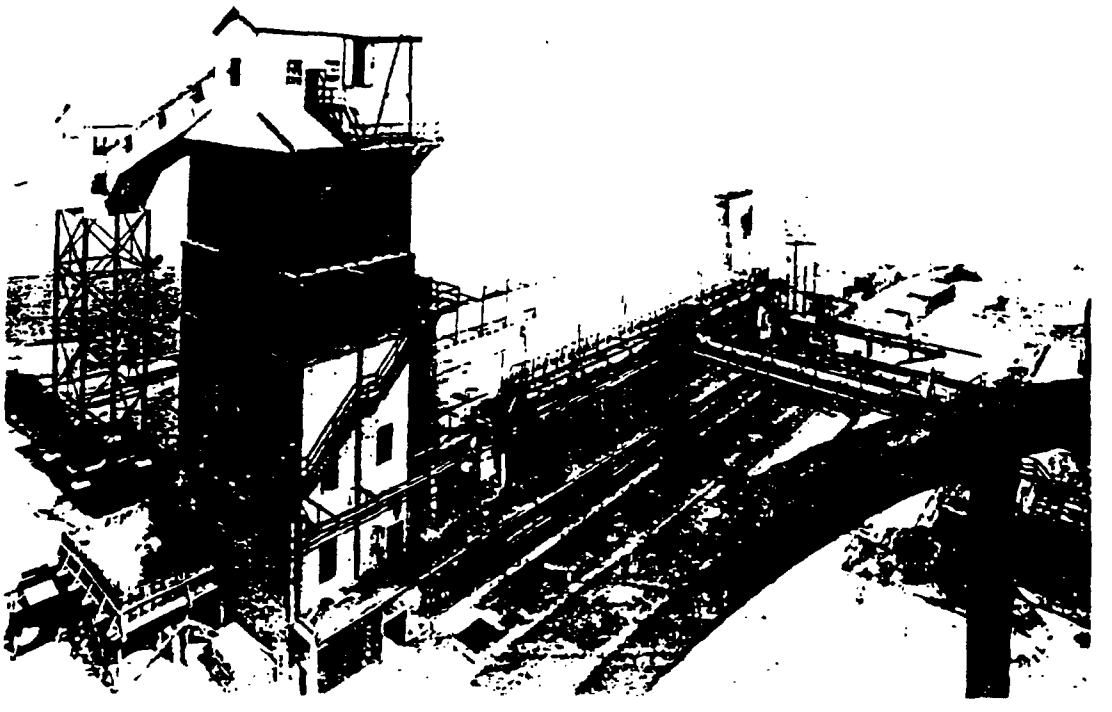

Fig. 15—Coke Oven Plant of the Weirton Steel Co., Weirton, W. Va., Insulated with Sil-O-Cel

II—THE OPEN HEARTH PLANT

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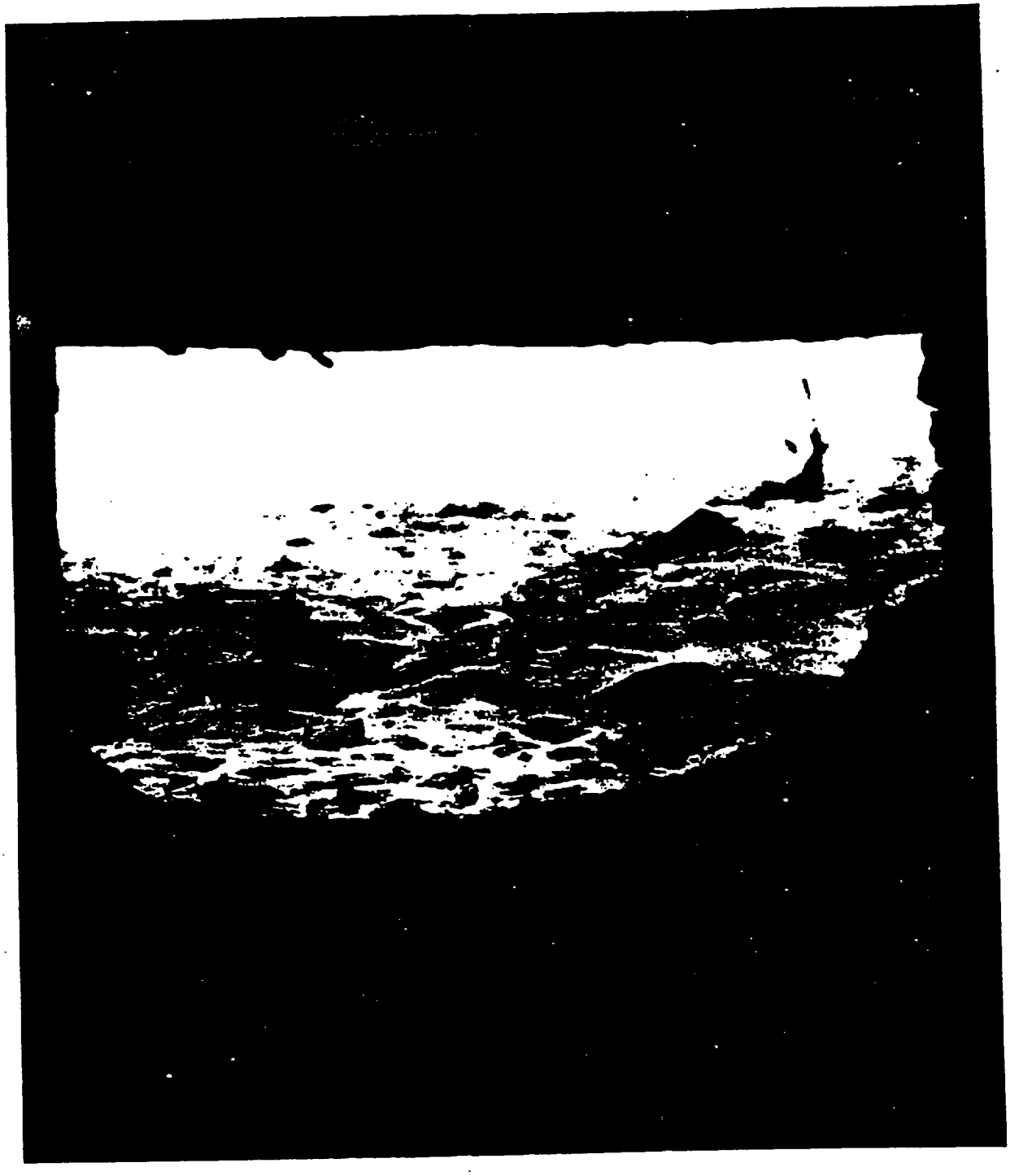
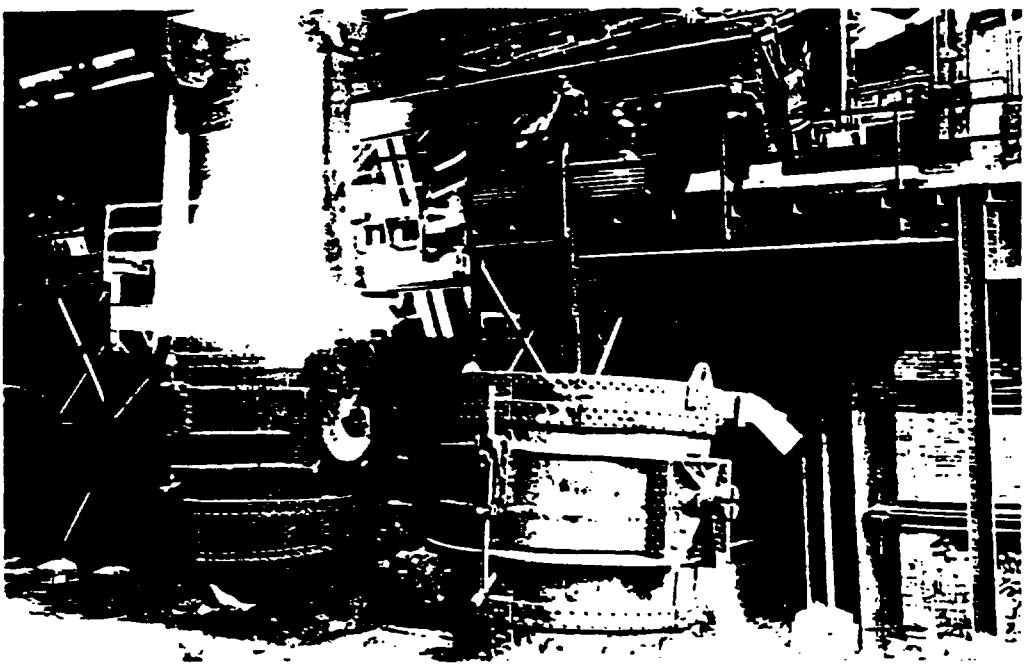


An Open-Hearth Bat[illegible] Stage Looking Through One of the Charging Doors

The Open Hearth Plant

THE insulation of regenerators, slag pockets, fan-tails and flues is recognized as an effective method of increasing the efficiency of the open hearth process, and very substantial results on numerous installations are now being attained by this means. The regenerators of every important open hearth installation made in the United States during recent years have been insulated.



TILTING TYPE OPEN HEARTH WITH COMPLETELY INSULATED REGENERATIVE SYSTEM

Insulation in the Open Hearth Plant

The application of insulation to the open hearth furnace itself has been regarded as precluded by the fact that furnace operating temperatures so nearly approach the limiting temperatures of refractories ordinarily used in open hearth construction. A number of furnaces have been insulated under the hearths (in the pan) and also on the sloping back walls with very satisfactory results. The use of insulation in these locations is of great interest because of the enormous savings which are effected and because the structural members supporting the furnace are prevented from buckling.

In open hearth regenerators, which are invariably insulated, the actual economies of operation are much greater than would be indicated by calculations based on increase in temperature of preheated gas and air, because suitable insulation, properly applied, also minimizes leakage through regenerator walls. New and old chambers are insulated according to slightly different specifications because of constructional features involved, but the general effect is the same in either case because the additional heat saving which results from the better construction that may be used on new regenerators is matched by decreased leakage through cracked walls of old regenerators.

Decreased fuel cost per ton of steel, increased speed of heats, diminished air leakage, increased flue temperature to waste heat boilers, and more satisfactory service in general, result from the proper

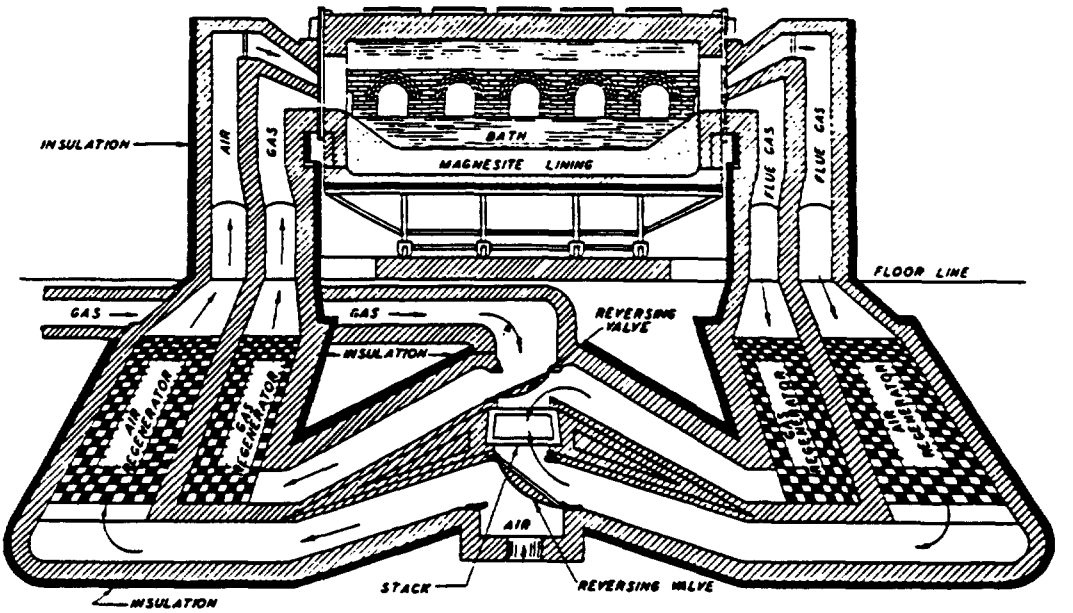


FIG. 1—PERSPECTIVE CROSS-SECTION OF THE OPEN HEARTH REGENERATIVE SYSTEM, SHOWING, IN HEAVY LINES, THE LOCATION OF INSULATION

use of insulation on open hearth regenerators. Some or all of these benefits are secured to a highly profitable degree in every case, and the many successful installations have conclusively shown that earlier fears as to possible ill effects on refractories were unfounded.

Soaking pit furnaces and regenerators benefit by insulation in much the same manner as the open hearth, except that the lower furnace temperatures permit the application of insulation to all parts of the pits. This results in a more uniform soaking temperature in all portions of the furnace; assists in the elimination of rolling difficulties that result from uneven heating; and, by conserving the heat of previous charges, soaking time for all stock except cold, high-carbon ingots may be reduced without forcing the burners and without danger of burning the steel.

The efficiency of the soaking pit is usually less than 10 per cent. This efficiency can be materially improved by insulation and actual cost of upkeep reduced by minimizing temperature variation within the refractories. A suitable insulation and casing applied to the soaking pit and to the regenerator walls, with the elimination of some common brick, raises air temperature and reduces leakage, increases production, and cuts operating costs.

Insulation of New Open Hearth Regenerators

SECTIONS ABOVE GROUND

Superex Block Recommendation

Regenerator Walls—On new steel-encased regenerators built with solid fire brick walls not less than 13½ in. thick, all exterior brickwork above the ground is insulated with 4 in. of Superex Blocks (see Fig. 2). Furnaces of this type are built from the outside in; that is, the buckstays and steel casing are first erected, then the brickwork run up inside. The Superex, furnished in blocks 6 in. x 36 in. x 2 in., is placed between the shell and the brickwork as the brickwork progresses. It is applied in two 2 in. thick layers, using broken joint construction and with all joints closely butted and pointed up with J-M No. 302 Cement. The thrust of arches

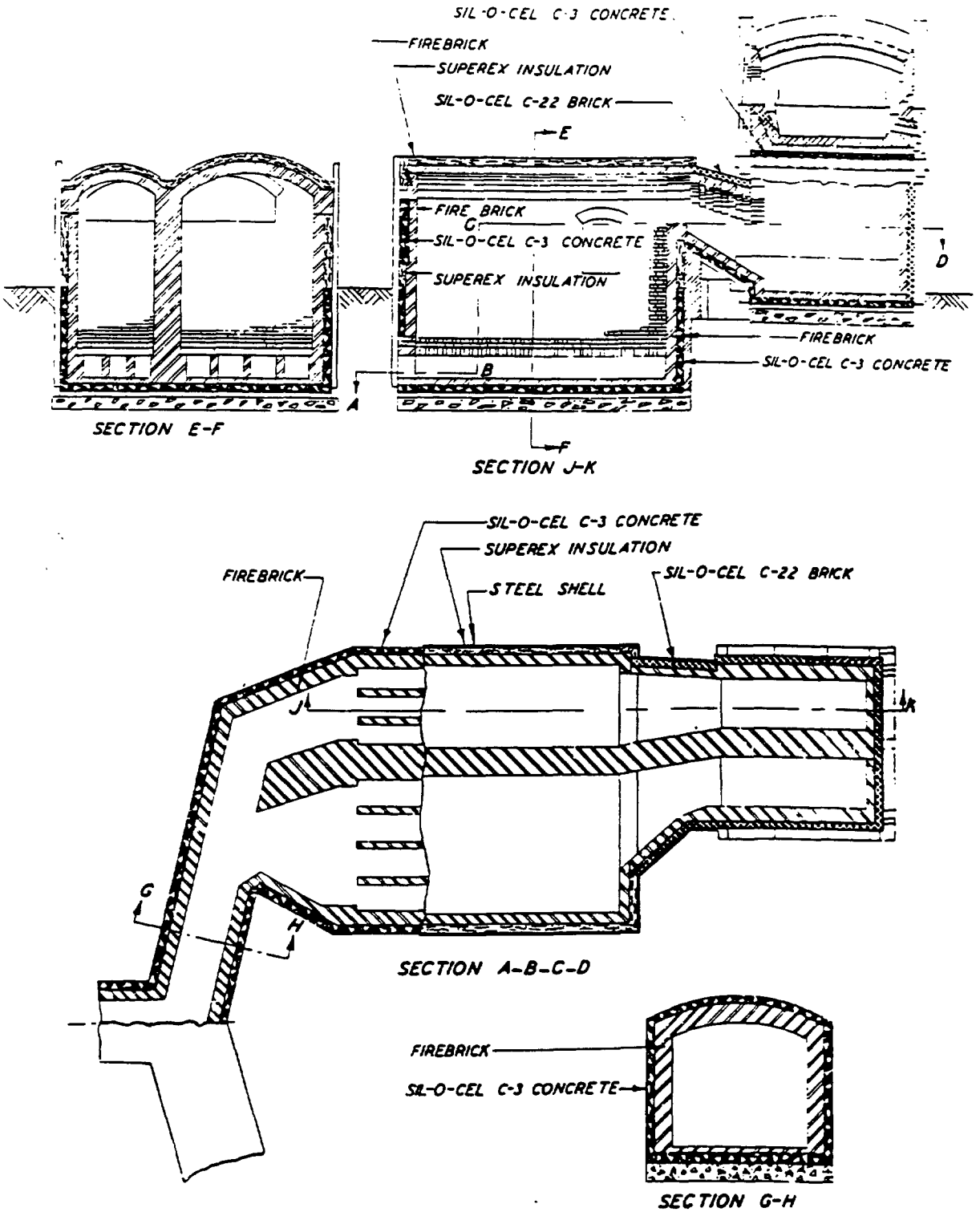


FIG. 2—SUPEREX BLOCK RECOMMENDATION FOR SECTIONS ABOVE GROUND ON OPEN HEARTH REGENERATOR. SIL-O-CEL C-3 CONCRETE ON SECTIONS BELOW GROUND AND UNDER HEARTH OF FURNACE PROPER. SIL-O-CEL C-22 BRICK ON FAN-TAIL AND SLAG POCKET

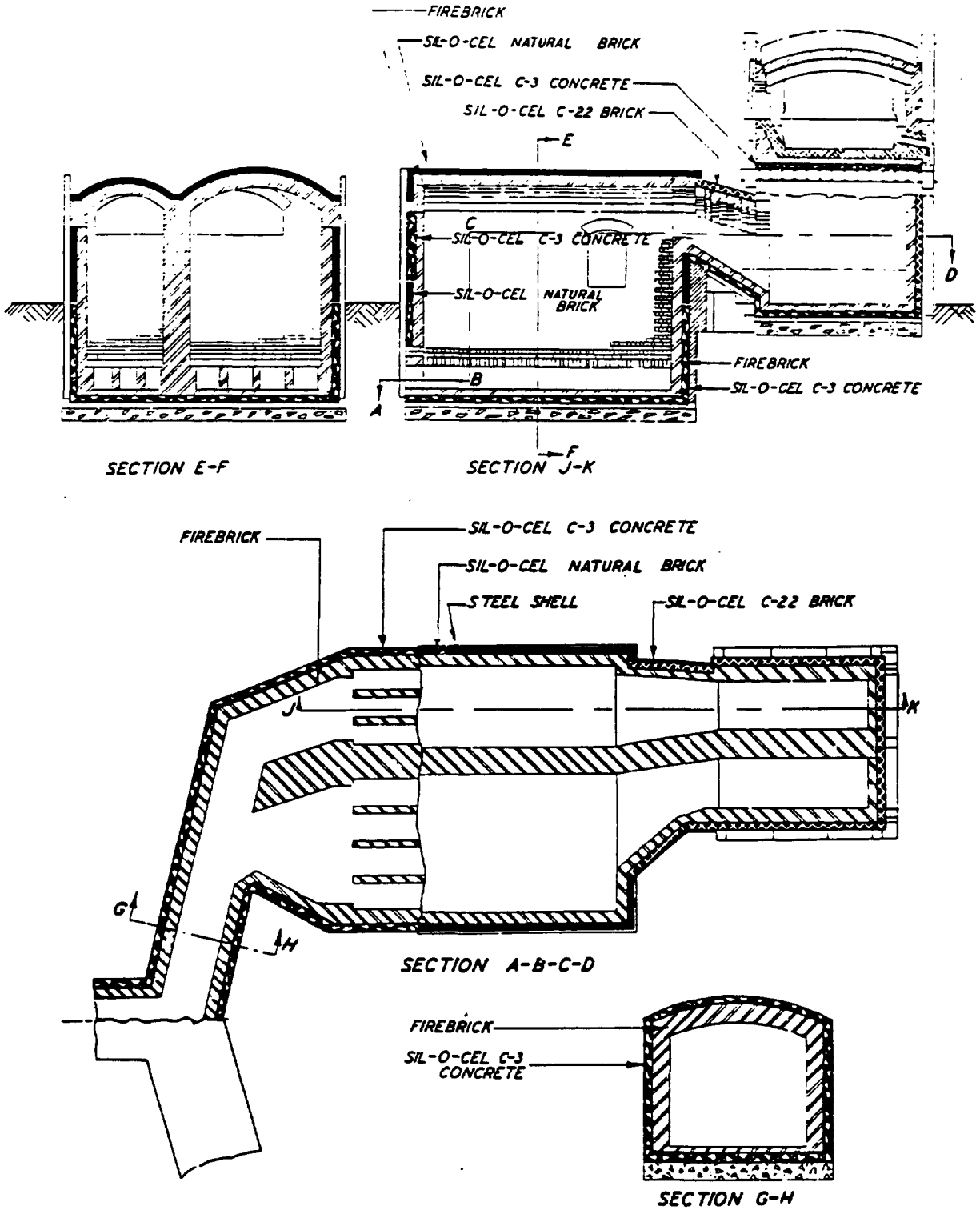
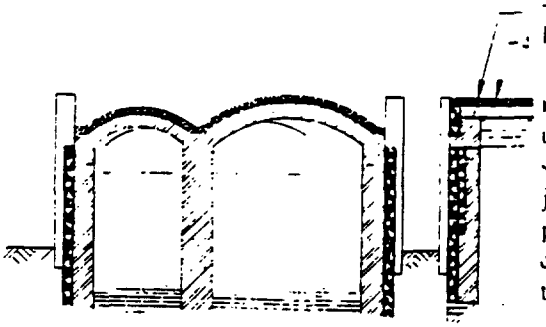


FIG 3—SIL-O-CEL BRICK RECOMMENDATION FOR SECTIONS ABOVE GROUND ON OPEN HEARTH REGENERATOR. SIL-O-CEL C-3 CONCRETE ON SECTIONS BELOW GROUND AND UNDER HEARTH OF FURNACE PROPER SIL-O-CEL C-22 BRICK ON FAN-TAIL AND SLAG POCKET

should not be carried on insulation and the fire brick should be run solid to the arch-thrust channel.

Regenerator Roofs—This recommendation is intended for solid fire brick roofs at least 9 in. thick. The roof is insulated with 2 in. thick Superex Insulation, applied in approximately 1½ in. thick layers, allowing from 6 to 24 hours between application of succeeding layers.

Form Method of Application—Reinforcing rod and mesh are first erected as described above. The



lation, applied in a single layer, with all joints tightly butted. Then a 1½ in. hexagonal mesh galvanized wire netting is stretched over the insulation and fastened securely at the edges by means of expansion bolts or staples driven in the brickwork. After the netting is in place two ½ in. coats of J-M No. 502 Cement are troweled over the surface. The first coat is left to dry with a rough surface before the application of the second coat. The second coat is troweled to a smooth finish.

Sil-O-Cel Brick Recommendation

Regenerator Walls—When all exterior brickwork above the ground is insulated with 4½ in. of Sil-O-Cel Natural Brick instead of Superex, the insulation, furnished in standard fire brick size, 9 in. x 4½ in. x 2½ in., is placed between the shell and the brickwork as the work progresses (Fig. 3).

In order to construct a monolithic wall of equal insulating value at every point, it is necessary to lay up the Sil-O-Cel Natural Brick in a mortar of the same material, with the thinnest possible rubbed joints. This mortar is furnished at the rate of 80 lb. per thousand brick. At the arches, the fire brick is carried through to the steel, as previously noted in the Superex recommendation.

Regenerator Roofs—When the roof is insulated with 2½ in. of Sil-O-Cel Natural Brick instead of Superex, the Sil-O-Cel is laid over the surface in a single layer, with the bricks tightly butted together and finished with a slurry of Sil-O-Cel Mortar.

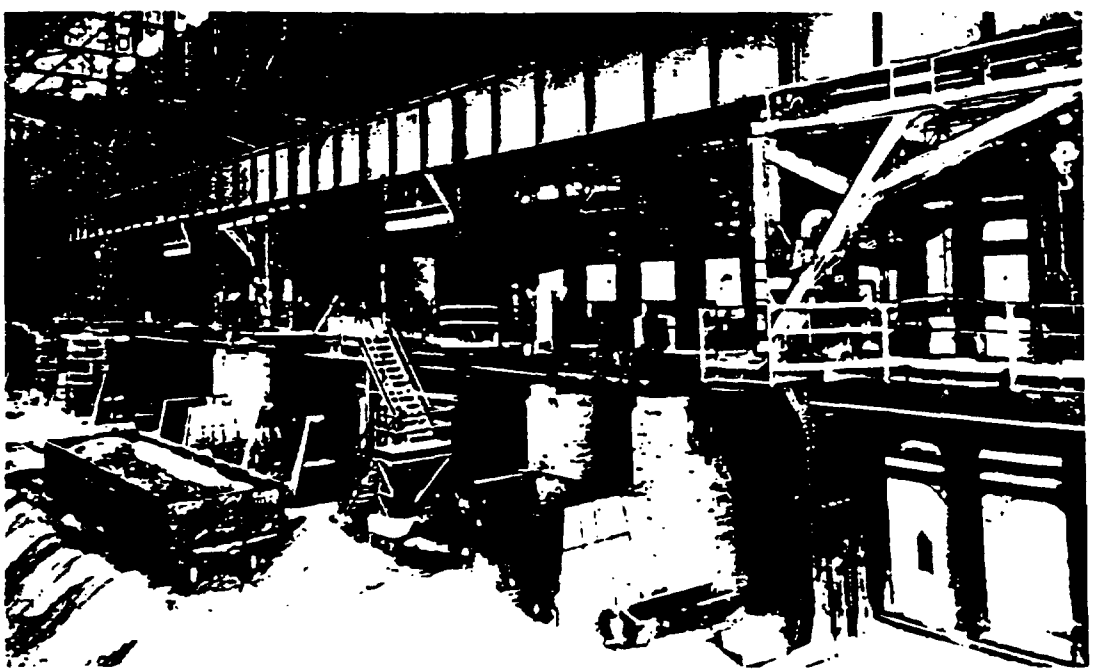


Fig. 5—The Regenerators and Flues of These Furnaces Are Insulated with Sil-O-Cel

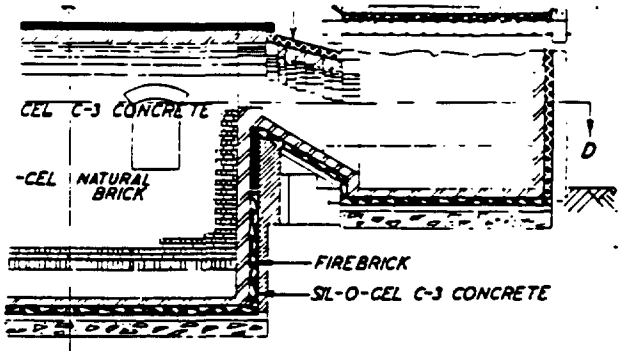
Insulation of New Open Hearth Regenerators

SECTIONS BELOW GROUND

Sil-O-Cel C-3 Concrete Recommendation

Regenerator Bases — The entire base of the regenerator chambers is insulated with a minimum of 4 in. of Sil-O-Cel C-3 Concrete, covered with two 2½ in. layers of fire brick.

Sil-O-Cel C-3 Concrete is made by mixing Sil-O-Cel C-3 and portland cement, either by hand or in a mechanical mixer, in the proportion of four parts of C-3 to one part of portland, by volume. An excess of water should be avoided. After thorough mixing, the C-3 Concrete is tamped into place.



Insulation of Existing Open Hearth Regenerators

SECTIONS ABC

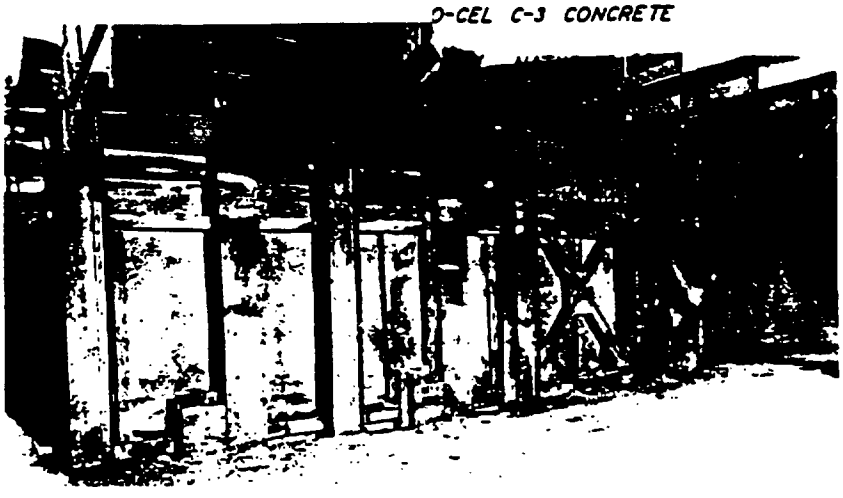


FIG. 6—SIL-O-CEL C-3 CONCRETE ON OPEN HEARTH REGENERATIVE CHAMBERS. THE INSULATING CONCRETE IS APPLIED TO THE WALLS BY MEANS OF A CEMENT GUN

Sil-O-Cel C-3 Concrete Recommendation

Regenerator Walls — On old regenerator chambers constructed either of solid fire brick or a combination of fire brick and red brick, the insulation consists of a minimum of 4 in. of Sil-O-Cel C-3 Concrete (see Figs. 6 and 7).

Cement Gun Method of Application —Before any application of C-3 Concrete is started, the entire regenerator wall and steel work should be given a wet sand-blast with the cement gun, to wash off thoroughly all loose mortar and dust from the brickwork and remove loose scale, rust and paint from the steel work.

After this sand-blasting, ½ in. reinforcing rods are placed through holes provided in the buckstays on approximately 3 ft. vertical centers, so that the rods will be as near as possible to 2 in. from the face of the brick surface, thus placing the reinforcement in the center of the C-3 Concrete. To these rods, a 4 in. x 4 in. mesh of not lighter than No. 12 wire is securely fastened.

Sil-O-Cel C-3 Concrete is made by mixing Sil-O-Cel C-3 and portland cement in the proportions of four parts of C-3 to one part portland, by volume. An excess of water should be avoided.

The C-3 Concrete is then shot on the wall in approximately 1½ in. thick layers, allowing from 6 to 24 hours between application of succeeding layers.

Form Method of Application.—Reinforcing rods and mesh are first erected as described above. The forms, either of wood or sheet metal, are then erected so that the required thickness of Sil-O-Cel C-3 Concrete may be placed. After thorough mixing, the mixture is tamped into the forms. Forms should be left in place for approximately 48 hours.

Regenerator Roofs — On old regenerators with solid fire brick roofs at least 9 in. thick, the roof is insulated with Sil-O-Cel C-3 (granular), spread out over the roof surface to an even thickness of 2½ in. (see Fig. 7).

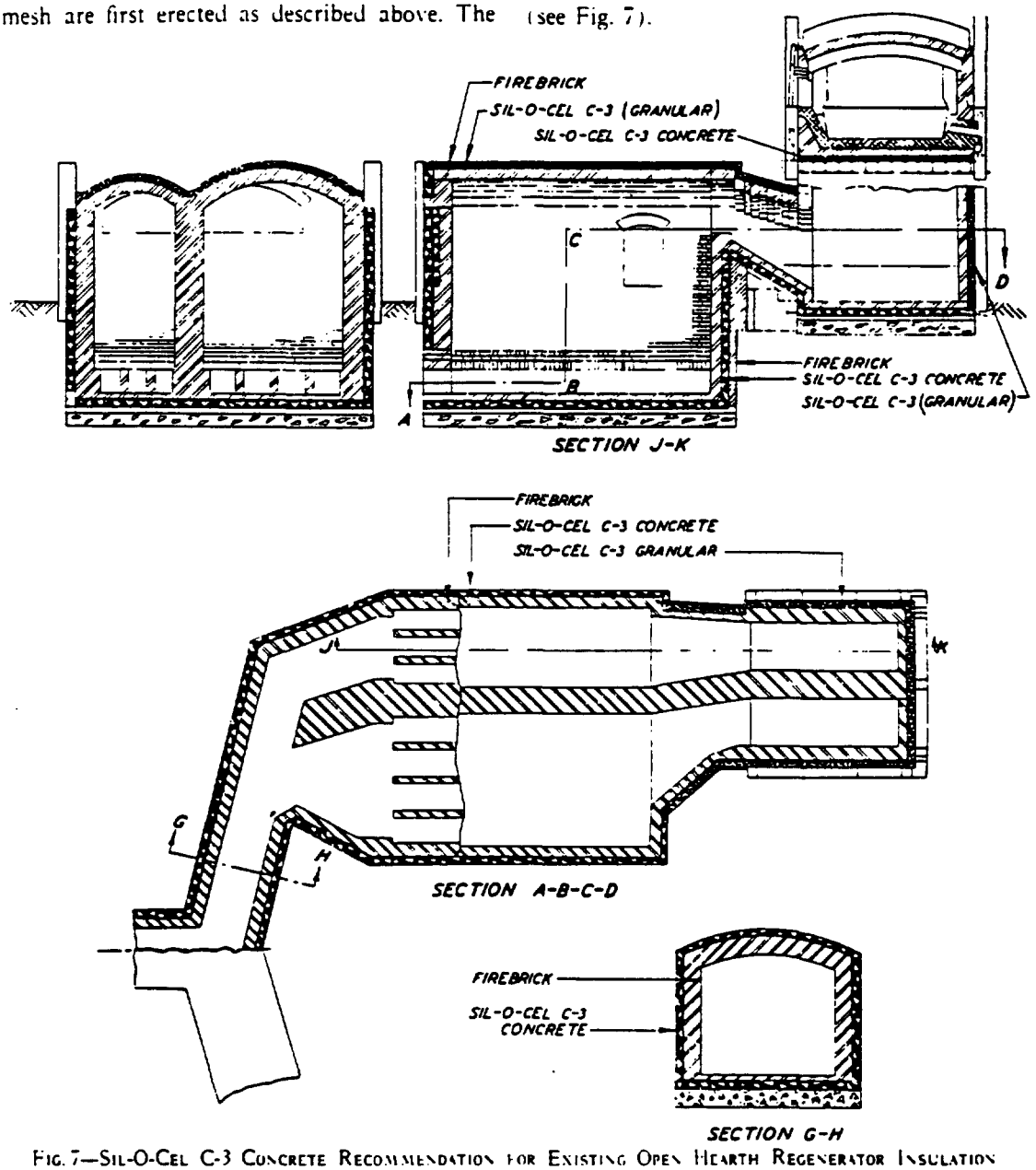


FIG. 7—SIL-O-CEL C-3 CONCRETE RECOMMENDATION FOR EXISTING OPEN HEARTH REGENERATOR INSULATION



FIG. 8—OPEN HEARTH REGENERATORS INSULATED WITH SIL-O-CEL

Insulation of Open Hearth Fan-Tails and Slag Pockets

Bases— The entire base of both the fan-tail and slag pocket is insulated with a minimum of 4 in. of Sil-O-Cel C-3 Concrete, mixed according to directions and tamped into place.

Walls — The walls are insulated with Sil-O-Cel C-22 Brick or C-3 (granular) 4½ in. thick. The brick insulation, furnished in standard fire brick size, 9 in. x 4½ in. x 2½ in., is placed between the shell and the brickwork as the brickwork progresses.

In order to construct a monolithic wall of equal insulating value at every point, it is necessary to lay up the Sil-O-Cel C-22 Brick in a mortar of the same material, with the thinnest possible rubbed joints. This mortar is furnished at the rate of 80 lb. per thousand brick.

The thrust of arches should not be carried on the insulation, and the fire brick should be run solid to the arch thrust channel.

If Sil-O-Cel C-3 (granular) is used, it is packed in the space between the brick lining and the steel shell to a density of 31 lb. per cubic foot. This is best accomplished by carrying up the brickwork approximately 3 ft. at a time, then filling in and tamping the C-3 (granular) in place.

Fan-Tail Roofs — The fan-tail roof is insulated with Sil-O-Cel C-22 Brick or C-3 (granular) 2½ in. thick. The Sil-O-Cel C-22 Brick is laid over the surface of the roof in a single layer and finished with a slurry of Sil-O-Cel Mortar. If Sil-O-Cel C-3 (granular) is used, it is spread out over the roof surface to an even thickness of 2½ inches.

Insulation of Open Hearth Furnace Hearths

The entire hearth and sloping back wall of the open hearth furnace is insulated with 5 in. of Sil-O-Cel C-3 Concrete, making proper provision for expansion. Immediately above the supporting steel work in the pan of the hearth, the C-3 Concrete is placed in monolithic construction (see Figs. 2, 3 and 7). Sil-O-Cel C-3 Concrete is made in the usual way and tamped into place after thorough mixing. The usual brick hearth construction proceeds after the C-3 Concrete has set. In certain instances it may be preferable to use 5 in. of Sil-O-Cel C-22 or Super Brick instead of the Sil-O-Cel C-3 Concrete



FIG. 9—OPEN HEARTH FURNACE DESIGNED BY FREYN ENGINEERING CO. FOR THE FALK CORPORATION, MILWAUKEE, WIS. HEARTH INSULATED WITH SIL-O-CEL SUPER BRICK. SLAG POCKETS, REGENERATORS AND FLUES ALSO INSULATED WITH J-M MATERIALS

Insulation of Open Hearth Flues

Open hearth flues are completely insulated in base, sides, and over the top with at least 4 in. of Sil-O-Cel C-3 Concrete, outside the fire brick lining.

Base —After thorough mixing, the C-3 Concrete is rammed into place, 4 in. thick, over the concrete flue base.

Walls — After the base insulation is thoroughly dry, the brick flue, including bottom, side walls, and roof, is constructed. Wooden or sheet metal forms are then erected so that 4 in. of Sil-O-Cel C-3 Concrete may be placed between the forms and the brickwork. The C-3 Concrete is made as previously described and, after thorough mixing, tamped into place. The forms are left in place for approximately 48 hours after pouring has been completed.

Roof — When applying the side wall insulation the application of Sil-O-Cel C-3 Concrete can be continued up over the roof and the material tamped into place. After thorough drying, the earth backfill may be placed over the flue.

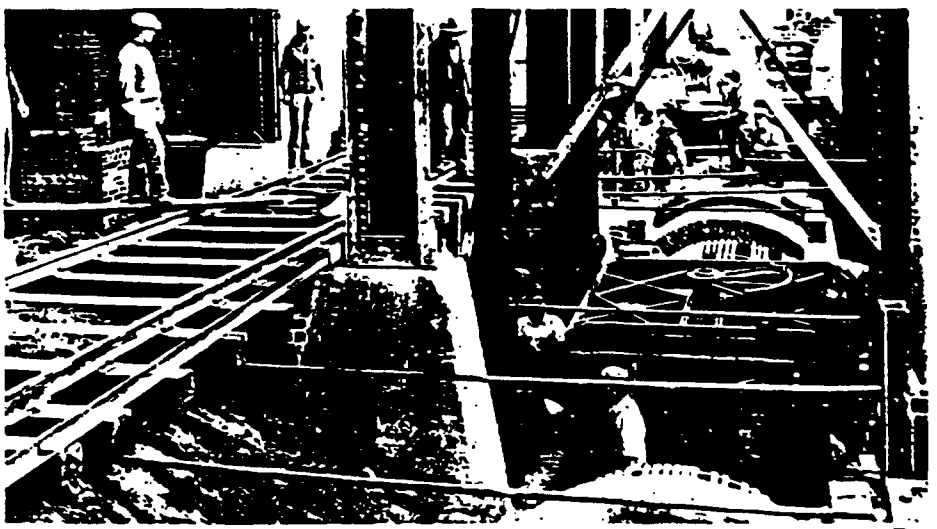


FIG 10—OPEN HEARTH FLUE BEING INSULATED WITH SIL-O-CEL IN BASE, SIDES AND OVER TOP

Insulation of Soaking Pits

Soaking pits are insulated in much the same manner employed for open hearth regenerators. Three approved methods of insulating involve the use of Superex Blocks, Sil-O-Cel Natural Brick, and Sil-O-Cel C-3 Concrete. These methods are illustrated in Figs. 13, 14, and 15.

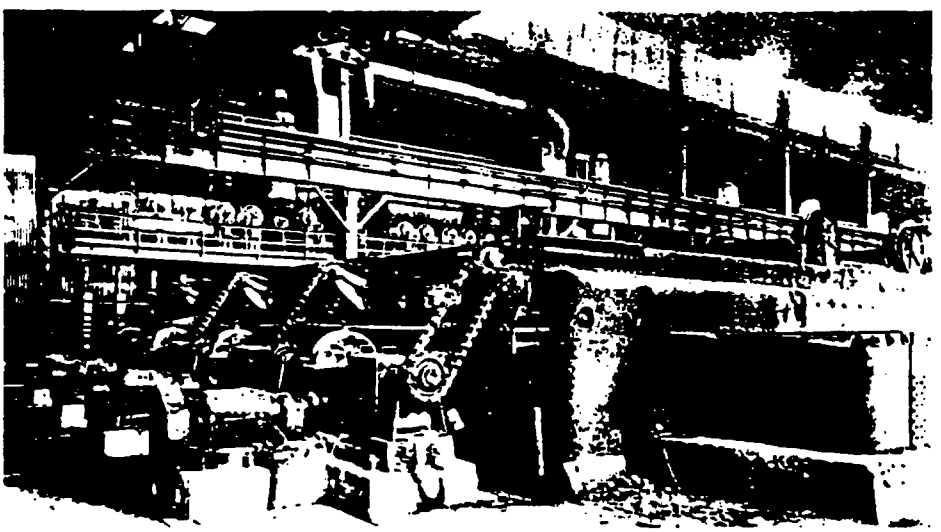


FIG. 11—SOAKING PITS AT THE INLAND STEEL COMPANY, INDIANA HARBOR, IND.

Refractory Cement Recommendations for Open Hearth Regenerators and Soaking Pits

Walls strongly bonded with refractory cement prevent air infiltration and better withstand the destructive action of brick movements, as well as the flame impingement and slagging action. For this service J-M No. 20 Plastic Refractory Cement or No. 2(Refractory Cement is used.

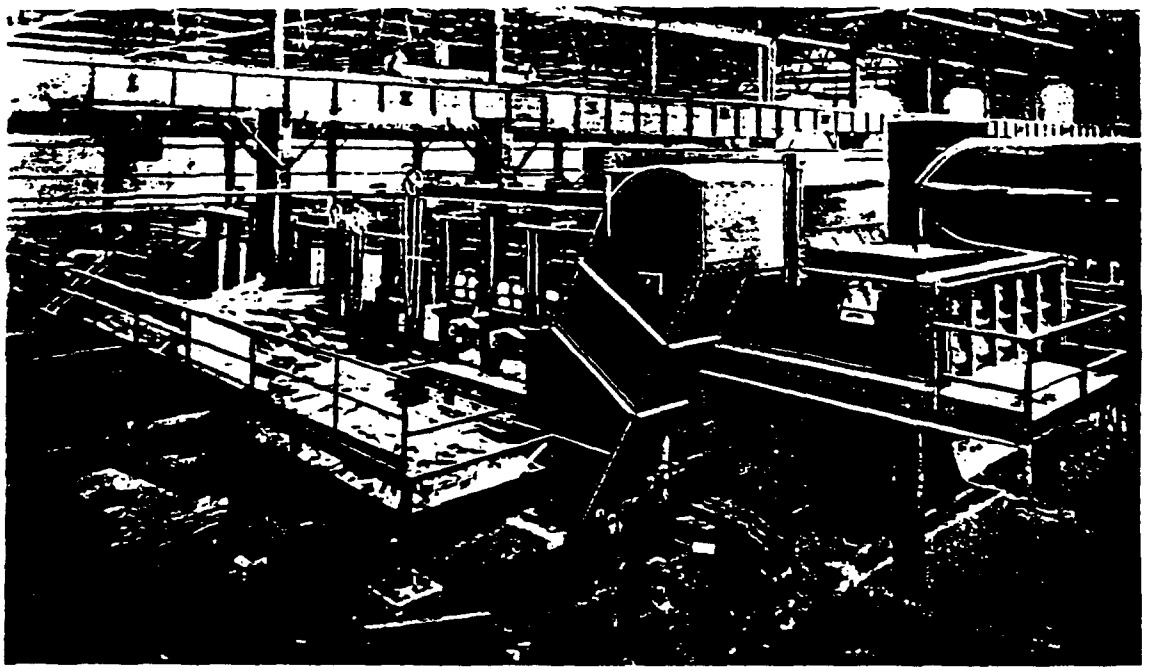


Fig. 3—Chapman-Stein Recuperative Billet Heating Furnace Insulated with Sil-O-Cel

Billet Heating Furnace Insulation Recommendations

These recommendations are based on an operating temperature of 2300 to 2600 deg. F. in the heating chamber.

Furnace Walls

This recommendation is intended for solid fire brick walls not less than 13½ in. thick, or for walls built with a combination of not less than 13½ in. of fire brick and not more than 8 in. of red brick. All exterior brickwork is insulated with 2 in. thick Superex Insulation, furnished in blocks 6 in. x 36 in. and applied in a single layer with all joints closely butted and pointed up with J-M No. 302 Cement. Suitable openings are cut for doors, burners, etc. Around these openings the brickwork is carried through to the outside.

Where the insulation is applied after the brickwork is in place, a cement finish over the insulation is recommended.

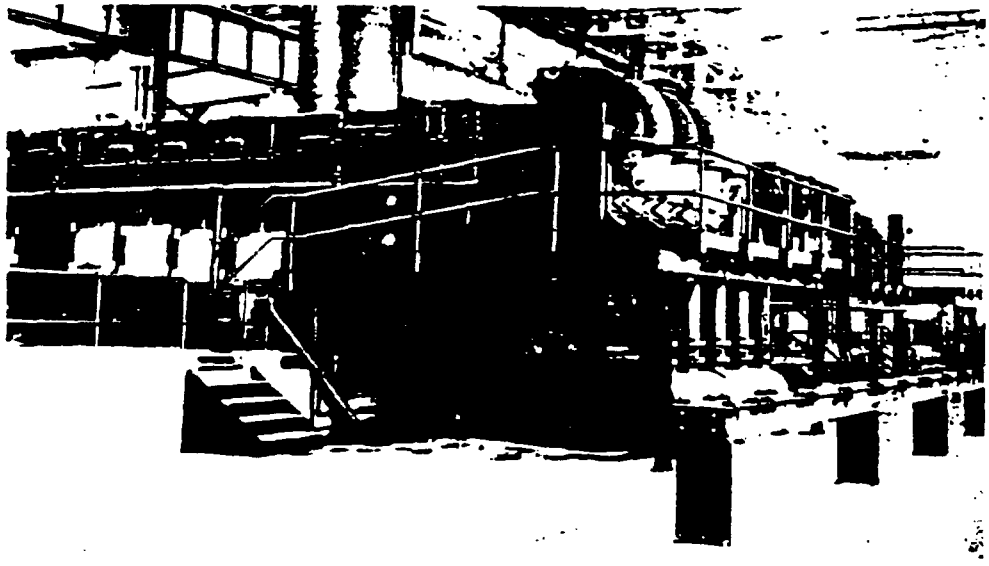
The insulation is secured in place by lacing it with No. 16 soft annealed wire to cables through holes in the buckstays as shown in Figs. 2 and 6. All supporting steel is left sufficiently exposed to prevent its reaching undue temperature. Over the insulation, 1½ in. hexagonal mesh galvanized wire netting is stretched tightly and fastened securely to the cables laced through the holes in the buckstays.

Two ¼ in. coats of J-M No. 302 Cement are applied over the insulation, the first coat being left to dry with a rough surface before the application of the smooth finishing coat. When an exceptionally hard finish is desired, J-M No. 302 Cement may be mixed with portland cement for the second ¼ in. coat, the proportion of portland cement being from ⅓ to ½ by weight, depending on the degree of hardness required.

If a more durable casing is needed, Transite may be applied as shown in the detail of Fig. 2, or steel plate erected as indicated in Fig. 5. Either casing is supported by suitable angles or angle clips, spot-welded or bolted to the buckstays (see Fig. 5). The blocks are temporarily held in place until the casing is applied, by spotting them to the brick surface with J-M Fibrous Adhesive.

New furnaces are frequently steel cased in the original design. Furnaces of this type are usually built from the outside in; buckstays and steel casings are first erected; then insulation and brickwork are

Furnaces, Ovens and Producer Gas Mains



Morgan Continuous Billet Heating Furnace (Oil-fired) with Side Walls Insulated with Superex Blocks

Insulation of Heating Furnaces

IN intermediate furnaces which prepare stock for further rolling, such as billet, bloom, and slab heating furnaces or sheet and pair furnaces, the matter of uniform heating and close temperature control is of even more importance than in the soaking pit. Oxidizing conditions must be avoided in all parts of the furnace, because, with light sections, scaling wastes a very appreciable percentage of the steel and causes other difficulties by cementing the pieces together or by picking up bits of brick and sand which scab the surface of the finished material.

Closer temperature control, more uniform heating and reduced air infiltration through the proper use of insulation in the furnace casing results in improved rolling conditions, less waste, a finer quality of product and better working conditions. Furthermore, the saving in heat radiation from a properly designed job is, by itself, quite sufficient to pay a highly satisfactory return on the insulation investment. There can be no justification, on a dollars and cents basis, for neglecting to provide adequate insulation in the construction of this class of equipment.

For many furnaces in this group, the conditions throughout the industry are so similar that standard insulation specifications have been prepared covering materials and their application to the various designs. The use of such standards should be governed by determining how close the installation under consideration falls within the limits of practice for which the specification was drawn.

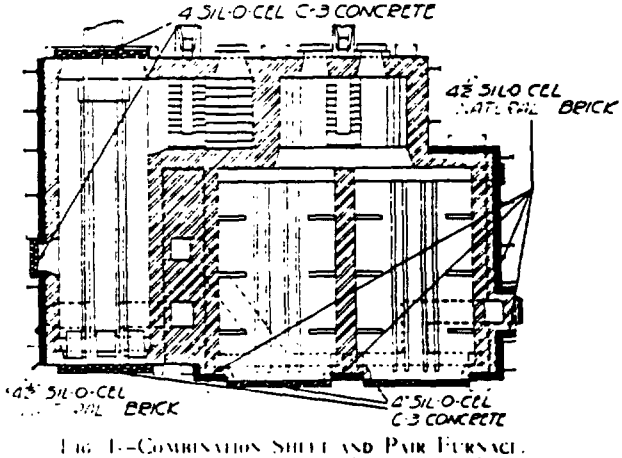


Fig. 1.—Combination Sheet and Pair Furnace, Costello Engineering Co., Pittsburgh, Pa.



FIG. 12—STRIPPING CRANE REMOVING HOT INGOT FROM A SOAKING PIT

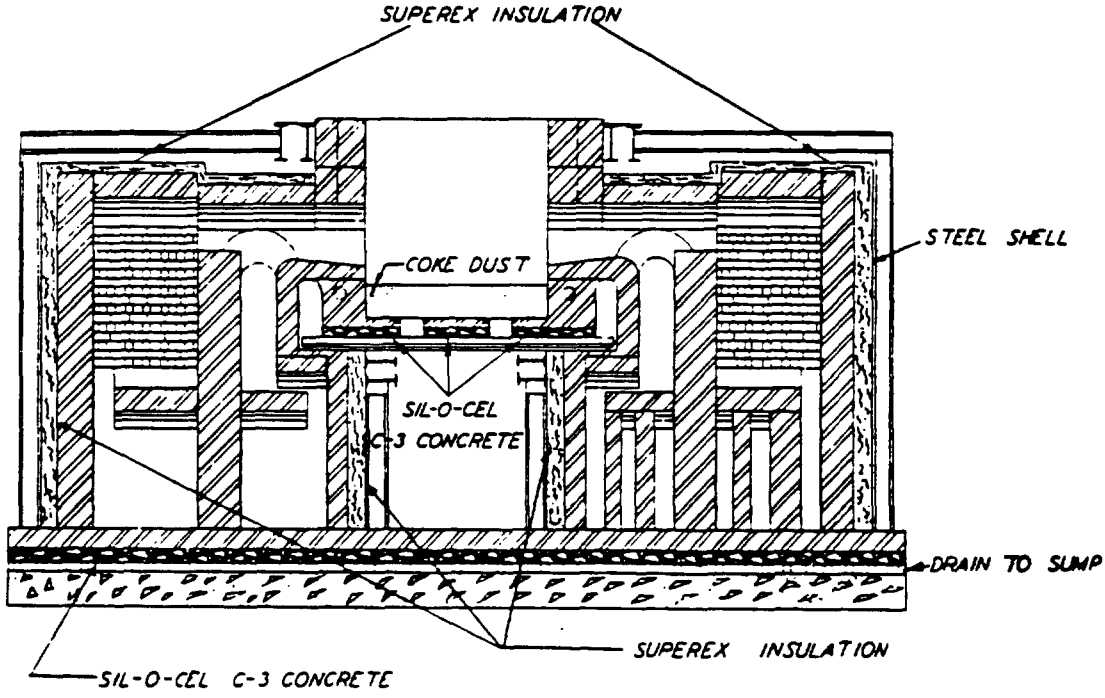


FIG. 13—SOAKING PIT INSULATION (METHOD A)

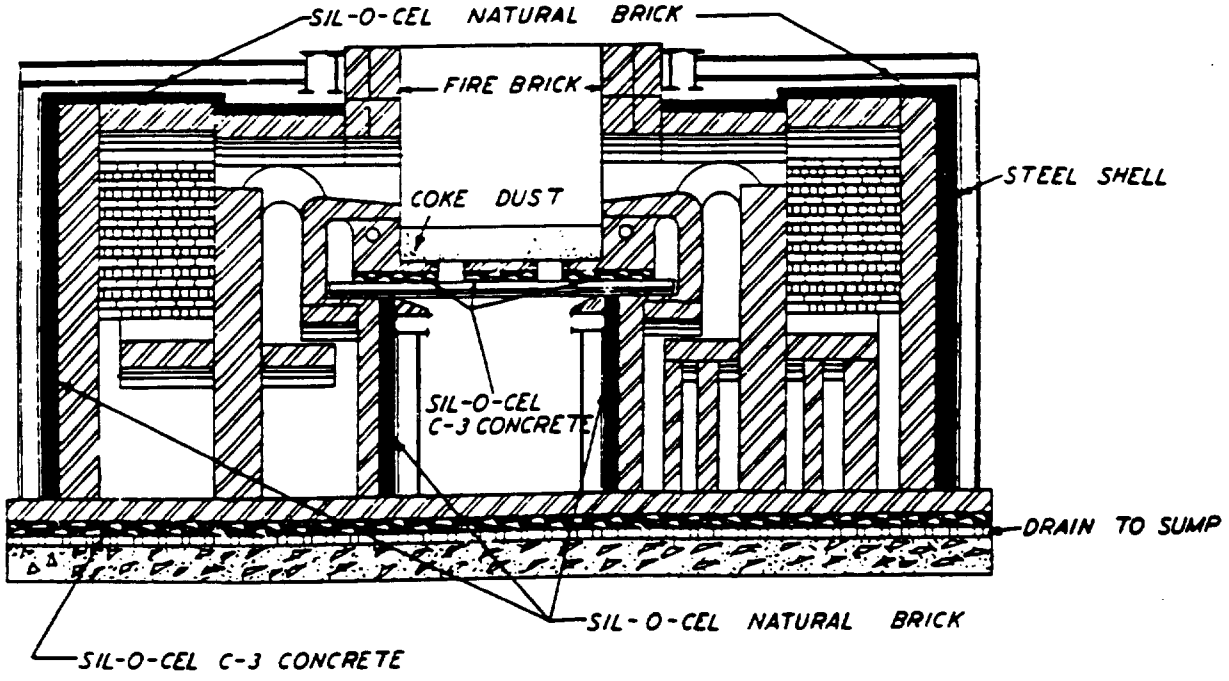


FIG. 14—SOAKING PIT INSULATION (METHOD B)

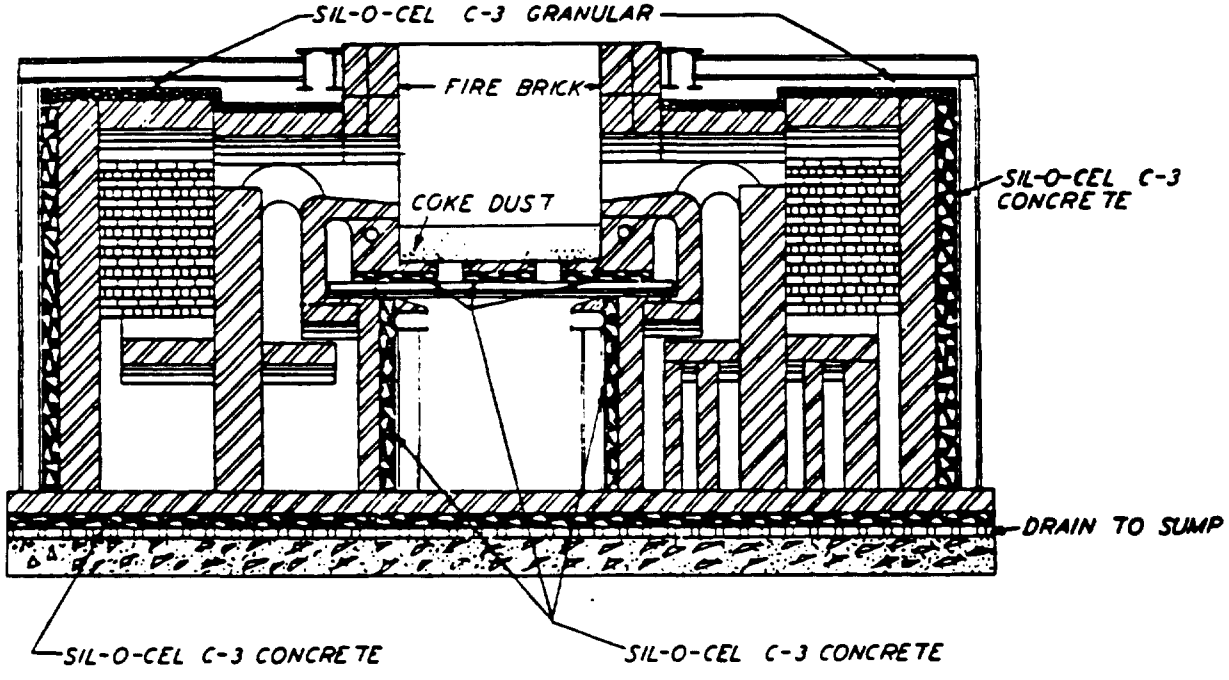


FIG. 15—SOAKING PIT INSULATION (METHOD C)

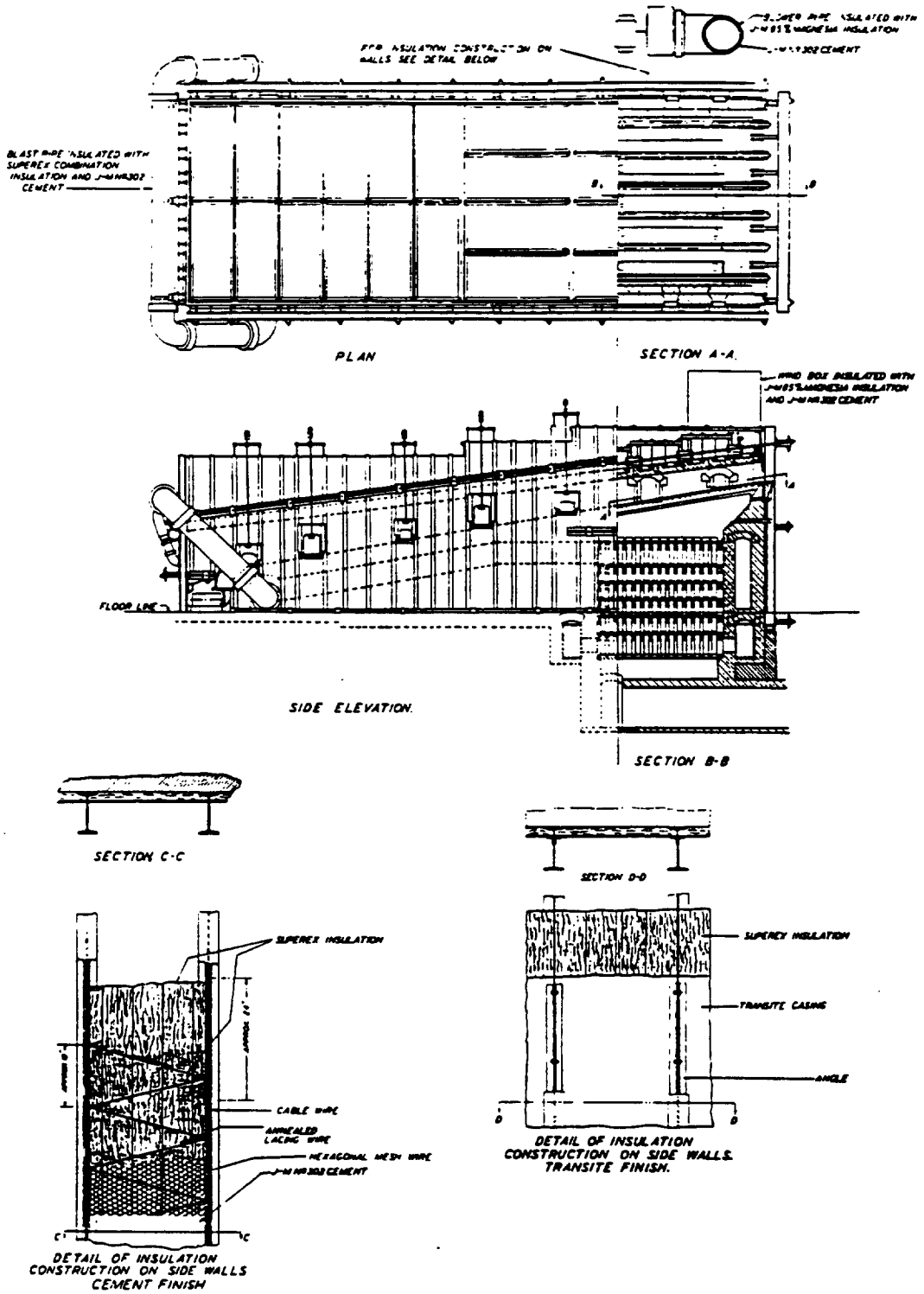
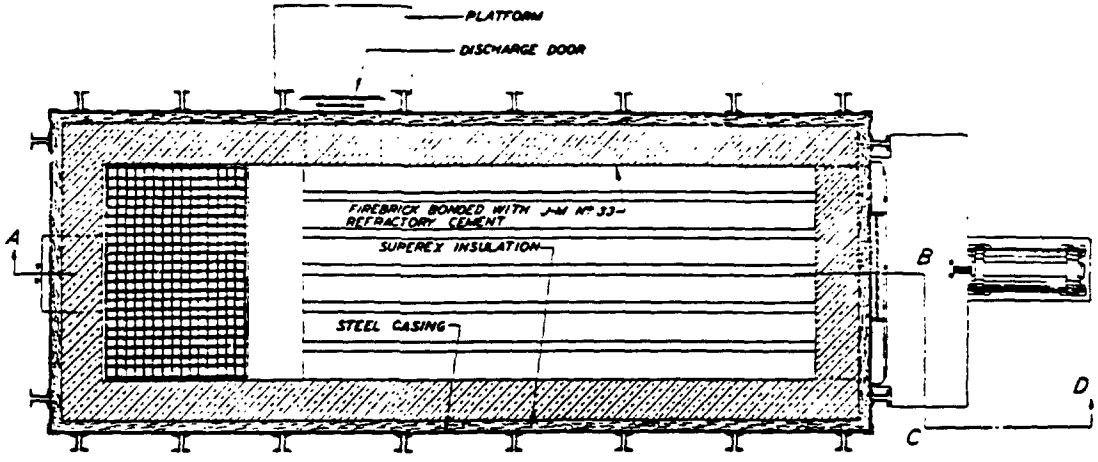


FIG. 2—GAS-FIRED RECUPERATIVE BILLET HEATING FURNACE INSULATION. SUPEREX BLOCKS WITH CEMENT FINISH OR TRANSITE CASING ON EXISTING FURNACES



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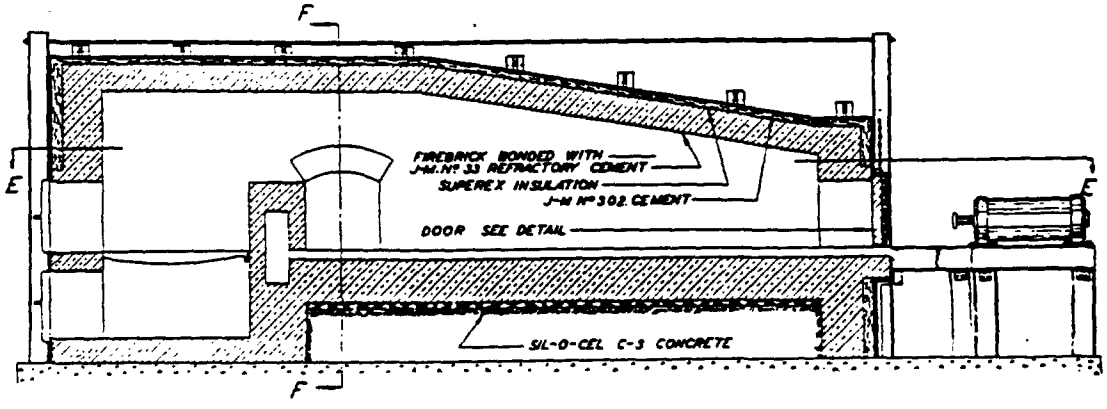

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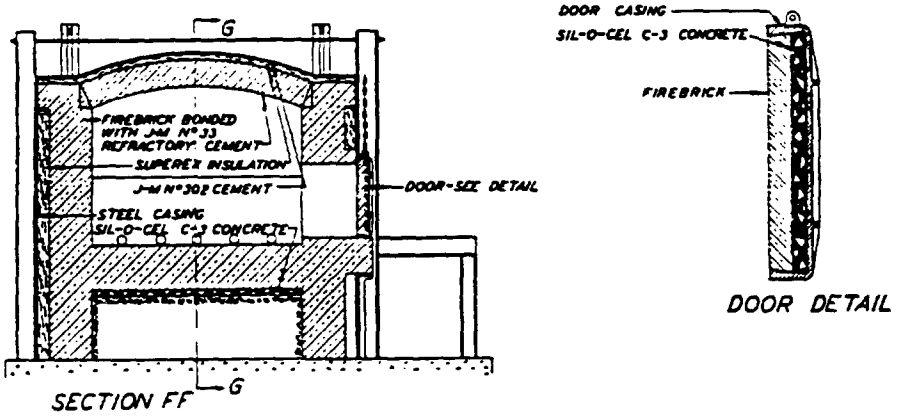
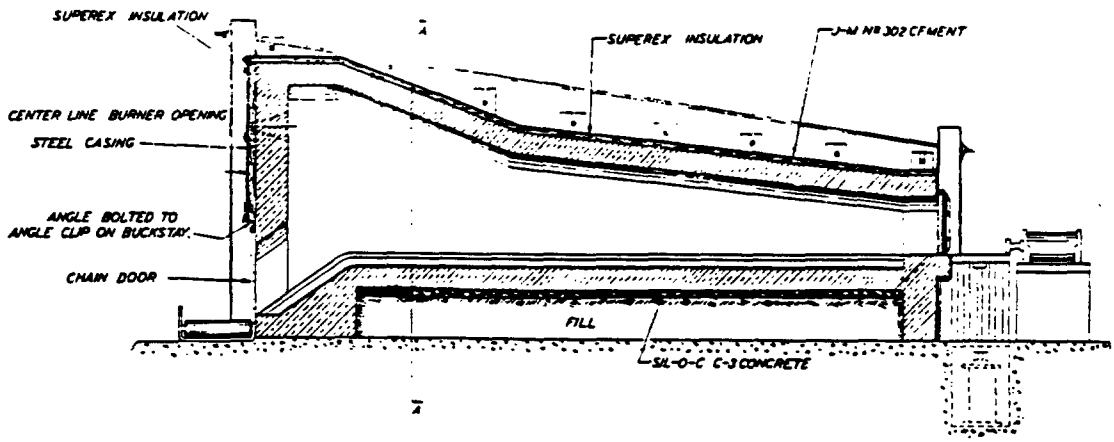


SECTION FF

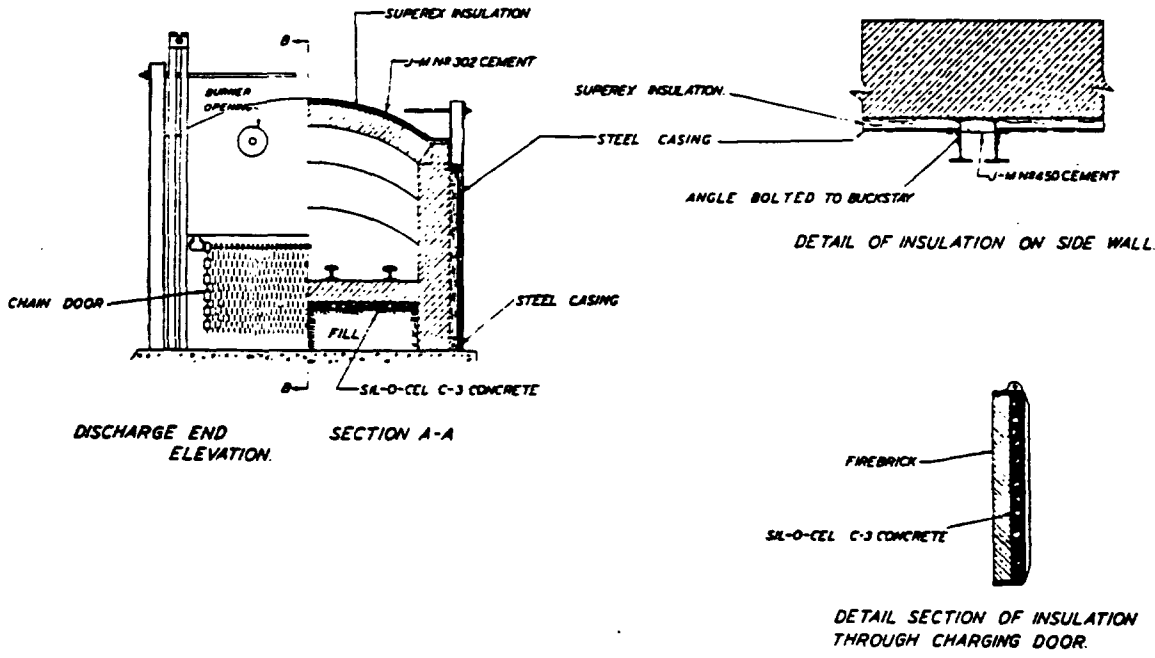
DOOR DETAIL

FIG. 4—COAL-FIRED L-TYPE BAR HEATING FURNACE INSULATION. SUPEREX BLOCKS AND STEEL CASING INCLUDED IN DESIGN ON NEW FURNACE

laid up inside. The steel casing extends from the floor to the furnace top and all joints between the sheets occur behind the buckstays. The corners of the casing are ordinarily secured by steel angles bolted to the outside of the plate. In places where arch thrust or other exceptional stress is transmitted to the buckstays, the insulation is omitted and the fire brick is carried through to the steel work (see Fig. 4).



LONGITUDINAL SECTION B-B THROUGH CENTER LINE OF FURNACE



DISCHARGE END ELEVATION.

SECTION A-A

DETAIL OF INSULATION ON SIDE WALL.

DETAIL SECTION OF INSULATION THROUGH CHARGING DOOR.

FIG. 5—OIL OR GAS-FIRED STRAIGHT LINE BILLET HEATING FURNACE INSULATION. SUPEREX BLOCKS WITH STEEL CASING ON EXISTING FURNACE

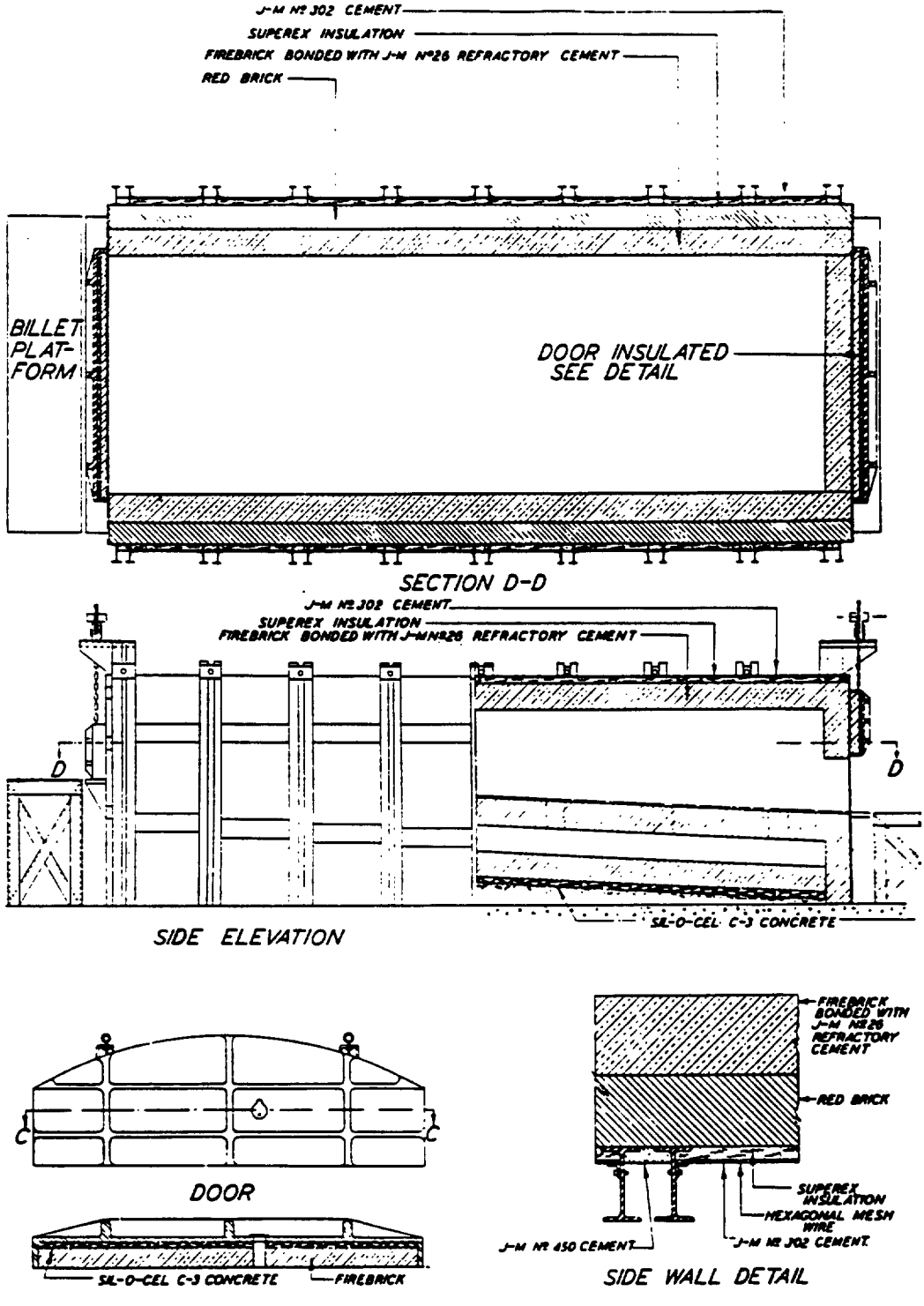


FIG. 6—OIL OR GAS-FIRED STRAIGHT LINE BILLET HEATING FURNACE. SUPEREX BRICKS AND CEMENT FINISH ON EXISTING FURNACES

Billet Furnace Hearths

This recommendation is intended for 5 in. or more of solid fire brick hearths resting on a fill, or for 5 in. or more of solid fire brick floors of flues underneath hearths. These portions are insulated with Sil-O-Cel C-3 Concrete at least 4 in. thick, made by mixing Sil-O-Cel C-3 and portland cement in the proportion of four parts of C-3 to one part of portland cement by volume. An excess of water should be avoided. After thorough mixing, the Sil-O-Cel C-3 Concrete is tamped into place (see Figs. 4, 5 and 6).

Billet Furnace Roofs

Due to varying conditions, it is advisable to consult the nearest Johns-Manville office for definite recommendations for insulating billet heating furnace roofs.

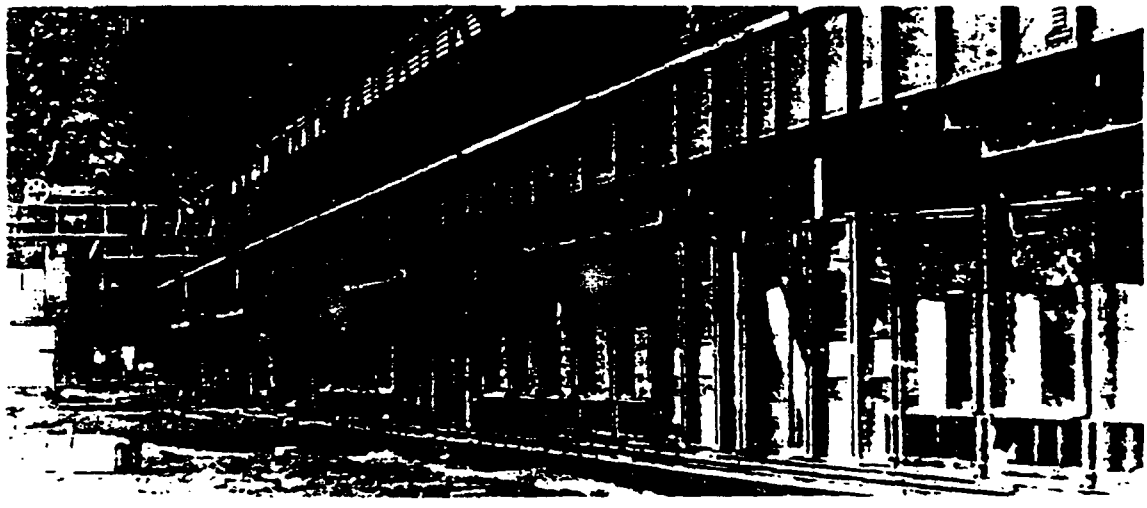


Fig. 7—Plate Mill Heating Furnaces Offer an Excellent Opportunity for Heat Saving by Insulation

Annealing and Heat-Treating Furnace Insulation

Wastage incidental to annealing and normalizing operations has been greatly curtailed in recent years by improvements in furnace design and methods of handling the work. Not least among the factors that are responsible for decreased rejections are the realization of the importance which insulation plays in evenly heating all parts of the furnace and its charge, and the attempt to abide by logical principles of design in preventing the flow of heat from those portions which tend to remain at lower than mean temperature. Here again are conditions where heat loss alone does not begin to explain the benefits that result from the proper use of suitable high-temperature insulation materials.

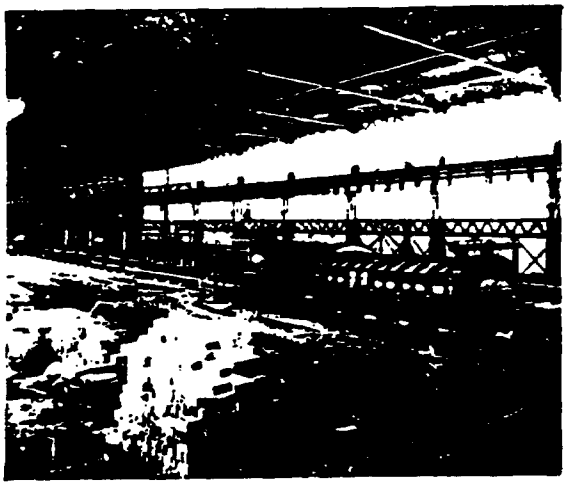
A typical example might be selected in the field of horizontal sheet normalizers so generally used in present-day practice. Designers of well-known continuous sheet normalizers, after numerous trials decided upon the use of Superex, to be applied where possible, in two layers of thickness specified in accordance with results of experiments. The excellent



Fig. 8—These Malleable Annealing Ovens Are Insulated with Sil-O-Cel Brick. Doors Made of Sil-O-Cel C-3 Concrete 9 in. Thick

insulating qualities of the Superex permitted the use of relatively thin wall sections which decreased bulkiness; and the staggered double layer construction made possible the avoidance of through joints, with corresponding reduction in heat loss.

The results, which the designers ascribe in no small measure to the proper use of insulation, include superlative deep drawing qualities, fuel costs well below general practice because of heat conservation, increased speed, better texture by saving the bottom heat, thorough normalizing through uniformity of temperature, and standard quality of product. Scratching and the necessity for roller leveling are reduced to a minimum, and there is a marked decrease in the number of seconds, even when operating without waster sheets.



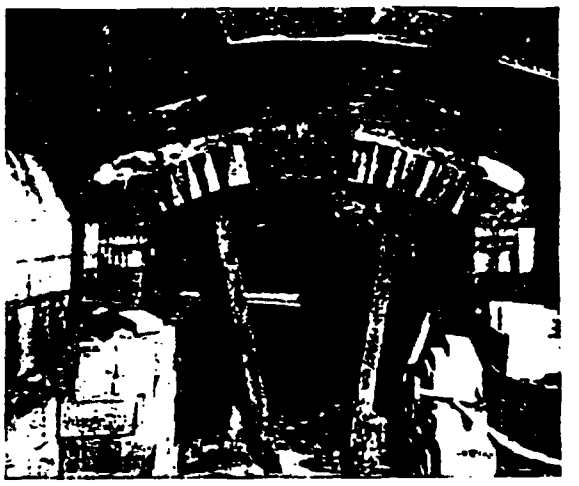


FIG. 9—KATHNER SHEET NORMALIZING FURNACE INSULATED WITH SUPEREX. ALSO SEE FIG. 19

ANNEALING AND HEAT-TREATING FURNACE INSULATION RECOMMENDATIONS

These recommendations, for either brick or block insulation, are based on operating temperatures of 1500 to 2300 deg. F. in the heating chamber.

Furnace Walls

All exterior brickwork is insulated with Superex block or Sil-O-Cel brick. The thickness of Superex and the thickness and type of Sil-O-Cel brick used will vary with the temperature, type of heating employed, and degree of temperature control required. The minimum advisable thickness of insulation is 4 in. of Superex or 4½ in. of Sil-O-Cel brick. For electrically heated equipment, much heavier insulation is always necessary to insure economical operation. Where operating temperatures are not more than 1800 deg. F., either Superex or Sil-O-Cel Natural Brick are used; at higher temperatures Sil-O-Cel C-22 Brick or Sil-O-Cel Super Brick should be used.

Superex Blocks are furnished 6 in. x 36 in. and are applied in two or more layers, using broken joint construction, with all joints closely butted and pointed up with J-M No. 302 Cement.

Sil-O-Cel brick are furnished in standard fire brick size, 9 in. x 4½ in. x 2½ in., and are laid in a mortar of the same material as the brick, with the thinnest possible rubbed joints.

Suitable openings are provided through the insulation for doors, burners, etc. Around these openings the brickwork should be carried through to the outside.

Where insulation is applied over the brickwork after the brickwork is in place, a cement finish over Superex Blocks or Sil-O-Cel brick is recommended (see Figs. 10, 11 and 12).

The insulation is secured in position by lacing it with soft annealed iron wire to cables run through holes in the buckstays, or laced to drilled angle clips spot-welded or bolted to the buckstays. All support-

ing steel work is left sufficiently exposed to prevent its reaching undue temperatures.

Over the insulation, 1½ in. hexagonal mesh galvanized wire netting is stretched tightly and fastened securely to the cables. Two ¼ in. coats of J-M No. 302 Cement are applied over the insulation, the first coat being left to dry with a rough surface before the application of the smooth finishing coat. When an exceptionally hard finish is desired, J-M No. 302 Cement may be mixed with portland cement for the second ¼ in. coat, the proportion of portland cement being from ⅓ to ½ by weight, depending on the degree of hardness required.

If a more durable casing is desired, steel plate or Transite, instead of a cement finish, is applied over the insulation and held in place by suitable angles or angle clips, spot-welded or bolted to the buckstays.

New furnaces are generally provided with a steel casing in the original design. Furnaces of this type are usually built from the outside in: buckstays and steel casings are first erected; then Superex Blocks or Sil-O-Cel Brick are laid up inside between the fire brick and the casing (see Figs. 13 and 14). In places where arch thrust or other exceptional stress is transmitted to the buckstays, the insulation is omitted and the brickwork carried through to the steel work.

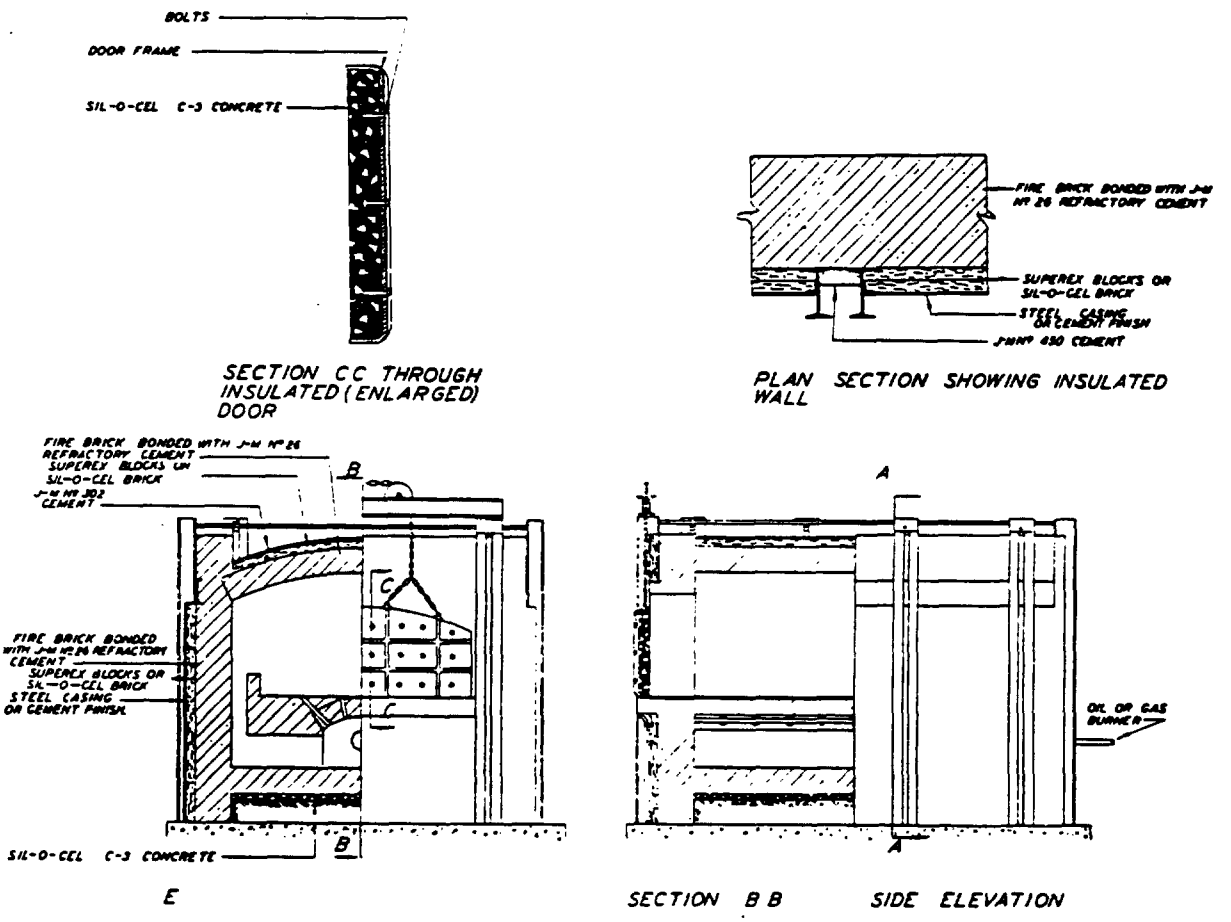


FIG. 10—OIL OR GAS UNDERFIRED ANNEALING FURNACE INSULATION
SUPEREX BLOCKS ON EXISTING FURNACE

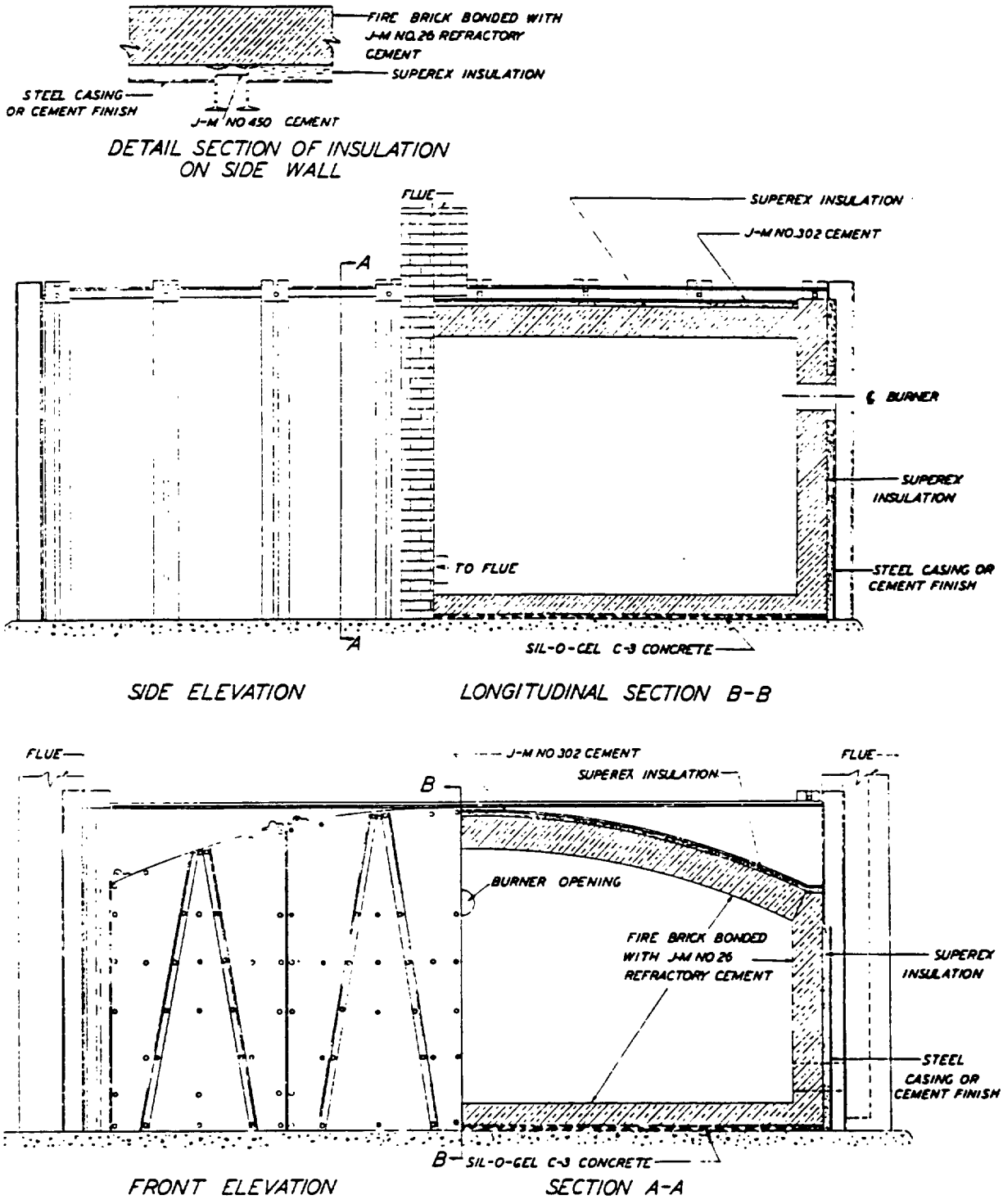


FIG. 11—POWDERED COAL-FIRED MALLEABLE ANNEALING OVEN INSULATION. MALLEABLE ANNEALING OVEN DOORS ARE ALMOST INVARIABLY MADE OF SIL-O-CEL C-3 CONCRETE

Annealing Furnace Roofs

The roof is insulated over the refractory with Superex Blocks or Sil-O-Cel Brick, the thickness and type of insulation used being governed by the temperature, method of heating employed and degree of temperature control required. Insulation should not be less than 4 in. of Superex Blocks, or 5 in. of Sil-O-Cel Brick.

The Superex Blocks are applied in one or more layers with all joints closely butted. Over the insulation is stretched 1½ in. hexagonal mesh galvanized wire netting, fastened securely at the edges by means of expansion bolts or staples driven in the brickwork. For a finish, two ½ in. coats of J-M No. 302 Cement are then applied, the first coat being left to dry with a rough surface before the application of the second; the second coat troweled to a smooth finish (see Figs. 10, 11, 12 and 14).

Where Sil-O-Cel Brick is used, it is laid over the surface of the roof with the bricks tightly butted together. The finish consists of a slurry of Sil-O-Cel Mortar (see Fig. 13).

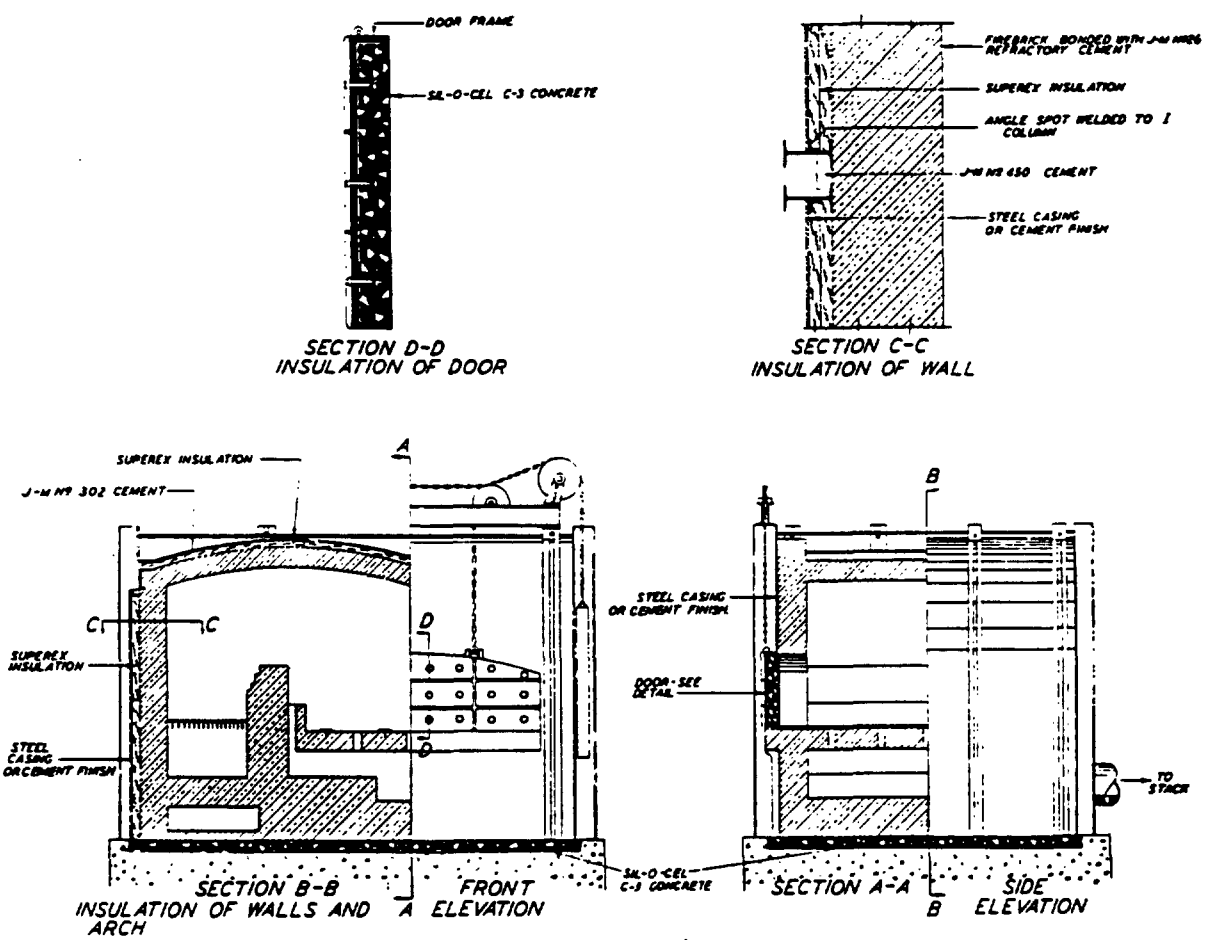


FIG 12—COAL-FIRED ANNEALING FURNACE INSULATION: SUPEREX BLOCKS ON EXISTING FURNACE

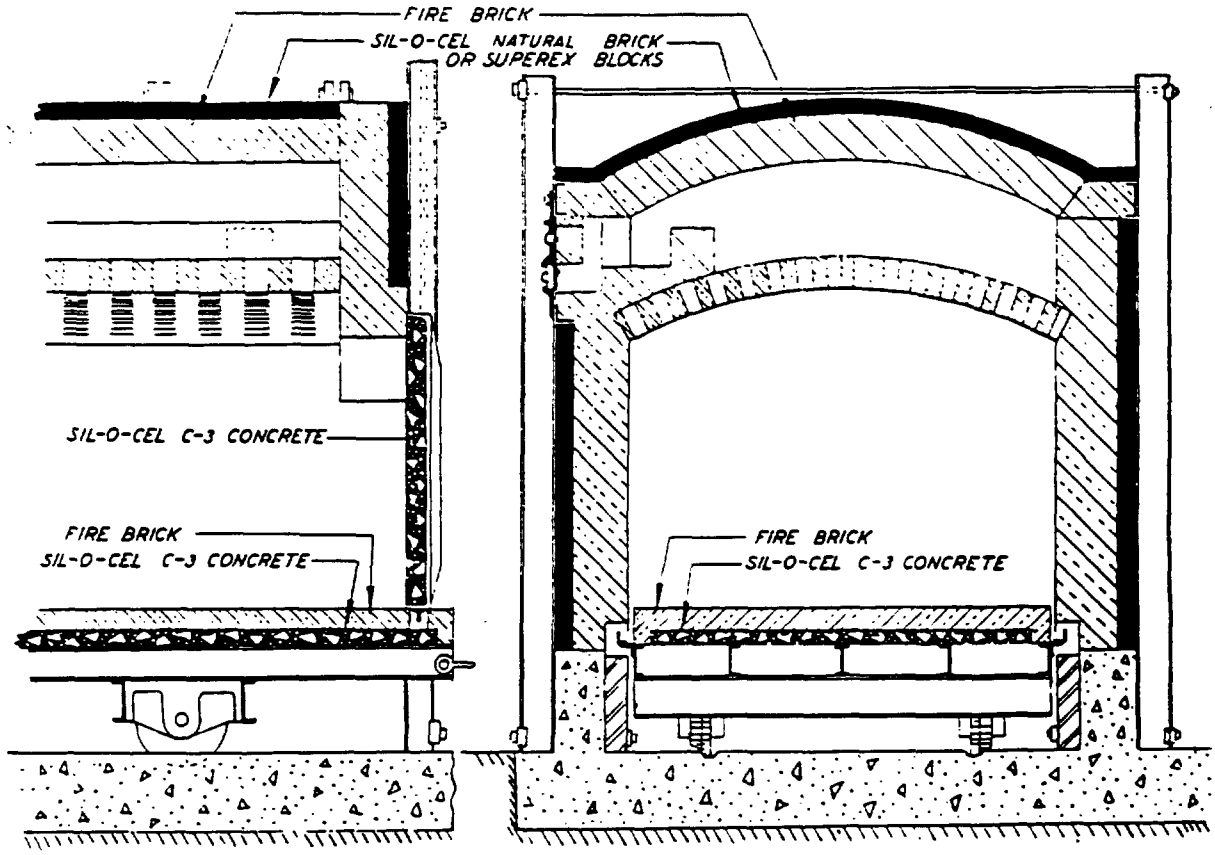


FIG. 13—INSULATION RECOMMENDATION FOR CAR-TYPE ANNEALING FURNACE. SIL-O-CEL BRICK OR SUPEREX BLOCKS IN WALLS AND OVER ARCH, SIL-O-CEL C-3 CONCRETE IN DOOR AND CAR, INCORPORATED IN DESIGN

Annealing Furnace Hearths

This recommendation is intended for use with 5 in. or more of solid fire brick in hearths, 5 in. or more of solid fire brick in floors of flues and for floors of combustion chambers of under-fired furnaces where the floor consists of 5 in. or more of solid fire brick resting on a fill or concrete base.

These portions are insulated with Sil-O-Cel C-3 Concrete at least 4 in. thick, made by mixing Sil-O-Cel C-3 and portland cement in the proportion of four parts of C-3 to one part of portland cement by volume (see Figs. 10, 11, 12 and 14). An excess of water should be avoided. After thorough mixing, the Sil-O-Cel C-3 Concrete is tamped into place.

Annealing Furnace Car Floors

This recommendation is intended for car floors with 5 in. or more of solid fire brick on top of the insulation. Car-floor insulation should consist of 4 in. or more of Sil-O-Cel C-3 Concrete, mixed and applied as described under "Hearths." (See Fig. 13).

Furnace Door Linings

The insulation recommended for doors of industrial furnaces with a maximum operating temperature of 1800 deg. F. consists of Sil-O-Cel C-3 Concrete not less than 4 in. thick. The exact thickness depends on the operating temperature, the method of heating employed and the degree of temperature control required. Sil-O-Cel C-3 Concrete door lining are usually from 6 to 9 in. thick. For detail of door lined with Sil-O-Cel C-3 Concrete, see Figs. 10, 12 14, 15 and 16.

Where operating temperatures are higher than 1800 deg. F., the Sil-O-Cel C-3 Concrete of th

required thickness for proper insulation should be faced with fire brick. For detail of doors insulated with Sil-O-Cel C-3 Concrete and faced with fire brick, see Figs. 4, 5 and 6.

Method of Lining—In doors of a greater area than four square feet, reinforcement should be provided. This is best accomplished in cast iron doors by installing rods or long bolts projecting from the

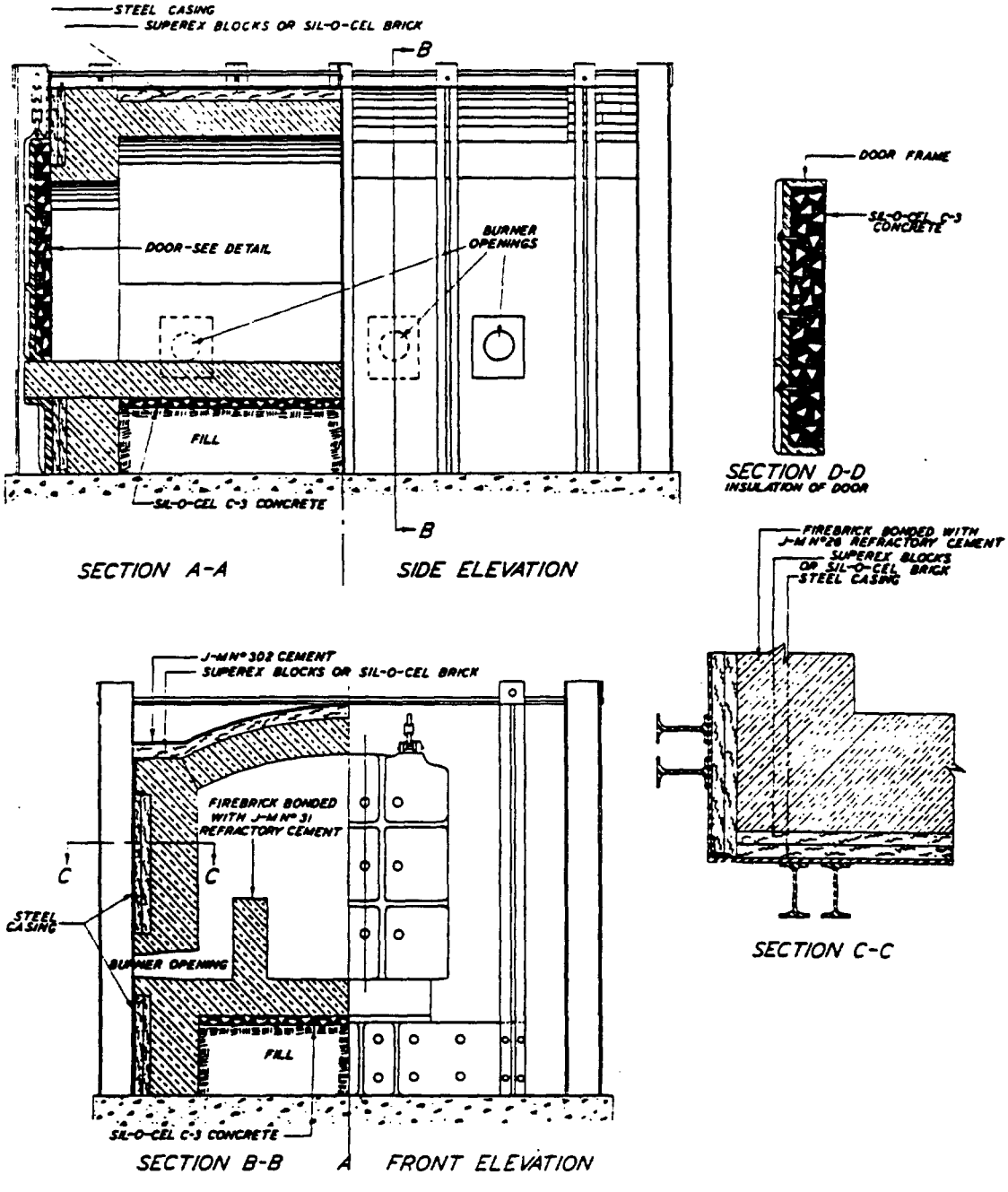


FIG. 14—OIL OR GAS-FIRED, IN-AND-OUT TYPE ANNEALING FURNACE INSULATION. SUPEREX BLOCK ON WALLS AND ROOF, SIL-O-CEL C-3 CONCRETE IN DOOR AND BASE, PROVIDED IN THE ORIGINAL DESIGN

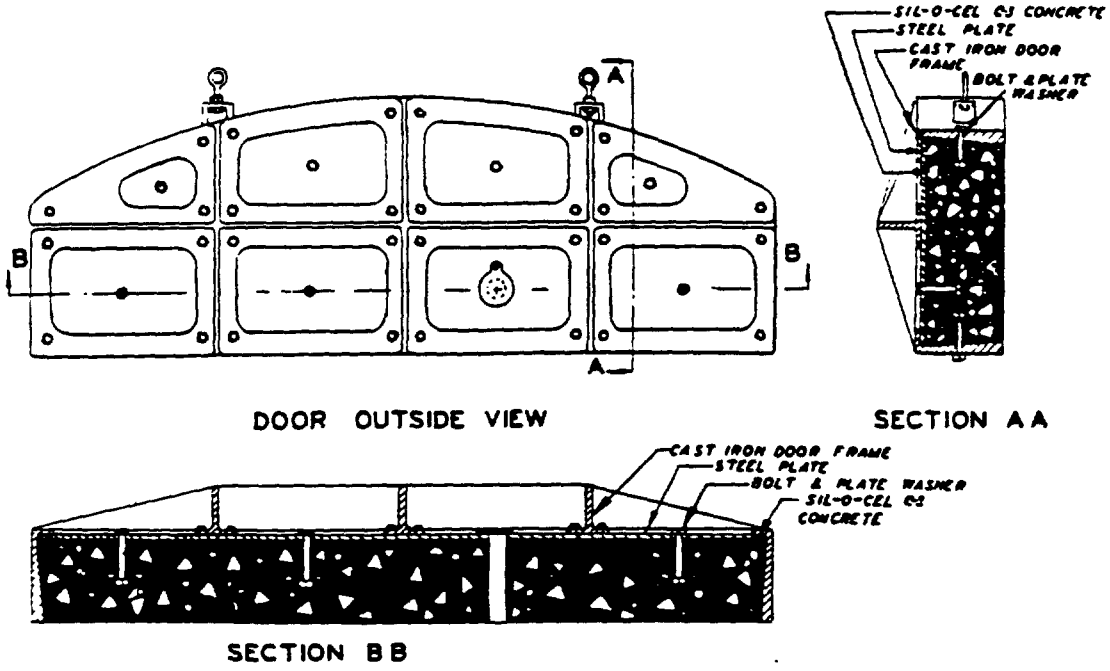


FIG. 15—INDUSTRIAL FURNACE DOOR (MAX TEMP. 1800 DEG. F.) INSULATED WITH SIL-O-CEL C-3 CONCRETE

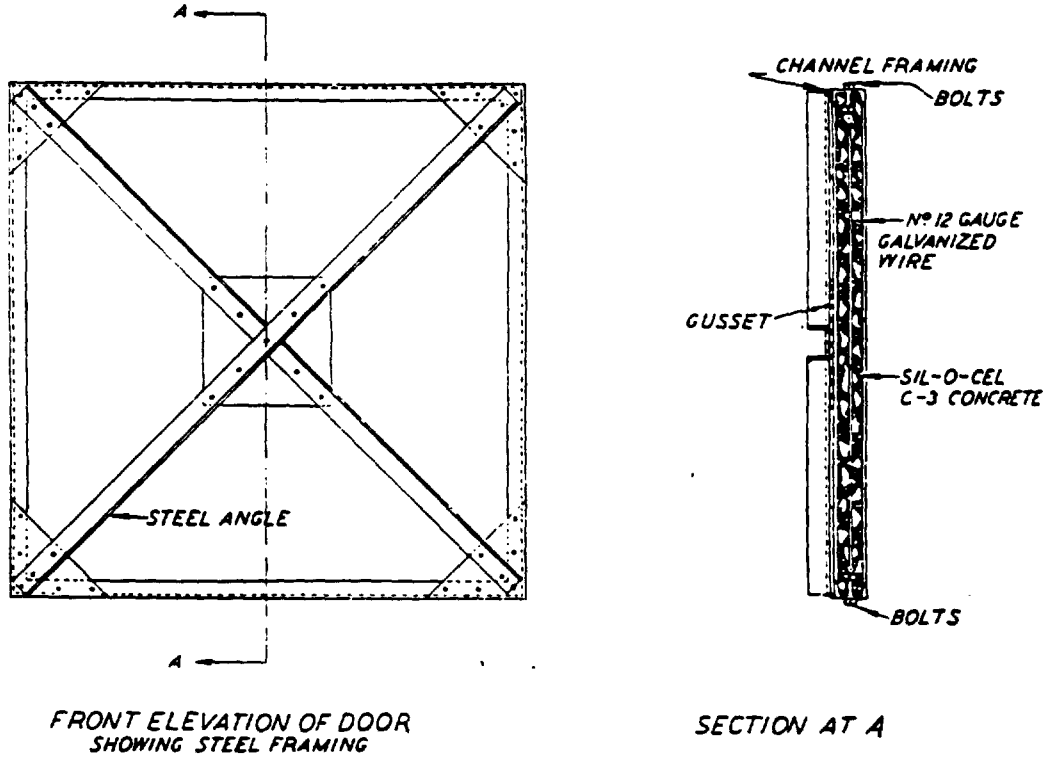


FIG 16—CHANNEL-FRAME FURNACE DOOR (MAX TEMP 1800 DEG. F.) INSULATED WITH SIL-O-CEL C-3 CONCRETE

sides and door face into the C-3 Concrete. Lugs should extend only part way through the lining, as shown in Fig. 15.

In channel iron frame doors, reinforcement is accomplished by installing rods or bolts projecting into the lining from the sides, top and bottom of the metal door frame placed midway between the inner and outer surface of the door. In this type door additional reinforcement may be provided by tying together the ends of the projecting rods or bolts by means of suitable wire. (See Fig. 16.)

In the case of either type of door, the application of Sil-O-Cel C-3 Concrete is the same. This C-3 Concrete is made by mixing C-3 and portland cement in the proportion of four parts of C-3 to one part of portland cement by volume. The C-3 is first saturated with water and allowed to stand overnight. Portland cement is then added and mixed thoroughly with the C-3. If necessary, additional water is added and well mixed, care being taken to avoid an excess of water.

The door is laid horizontally upon a flat surface and the C-3 Concrete, after thorough mixing,

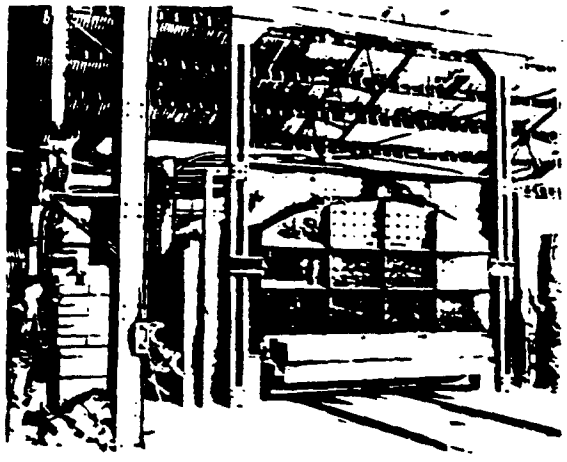


Fig. 17—Door Lined with Sil-O-Cel C-3 Concrete

rammed into place with a heavy metal tamper. The top surface is then finished smooth and covered with a damp cloth, which should be kept wet for approximately 48 hours.

On doors of furnaces operating at temperatures higher than 1800 deg. F., fire brick are tightly bonded and wedged in place over the C-3 Concrete.

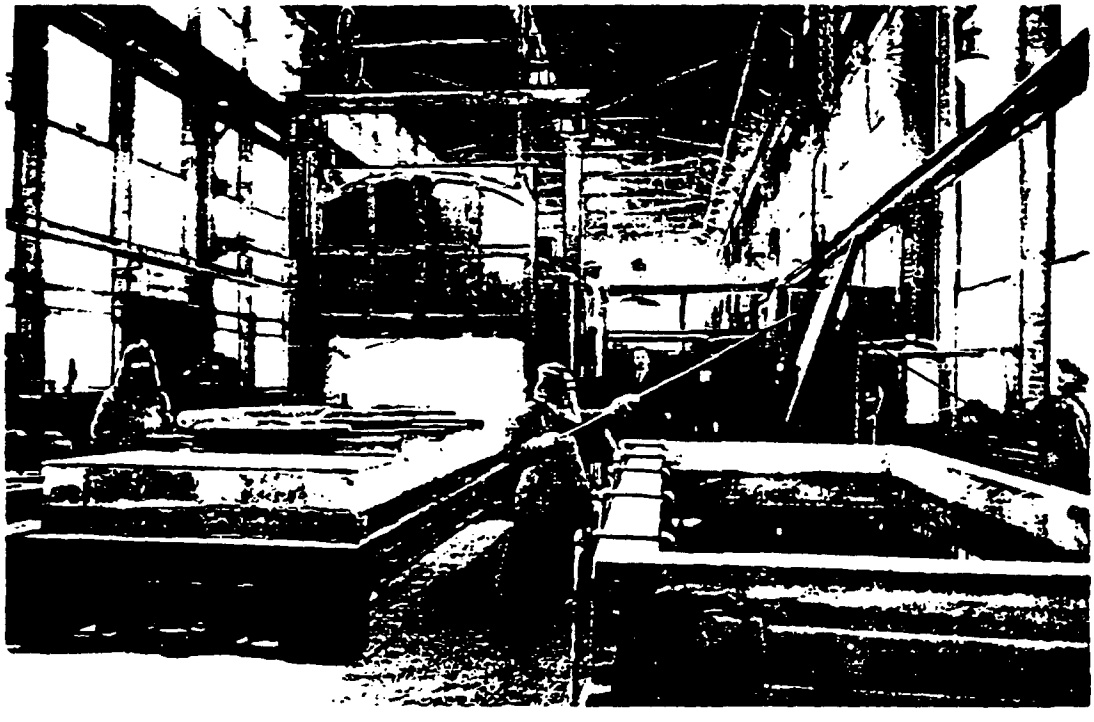


Fig. 18—G-E Electric Annealing Furnace Insulated with Sil-O-Cel Asbestos Ceiling Protects Workmen from Hot Steel

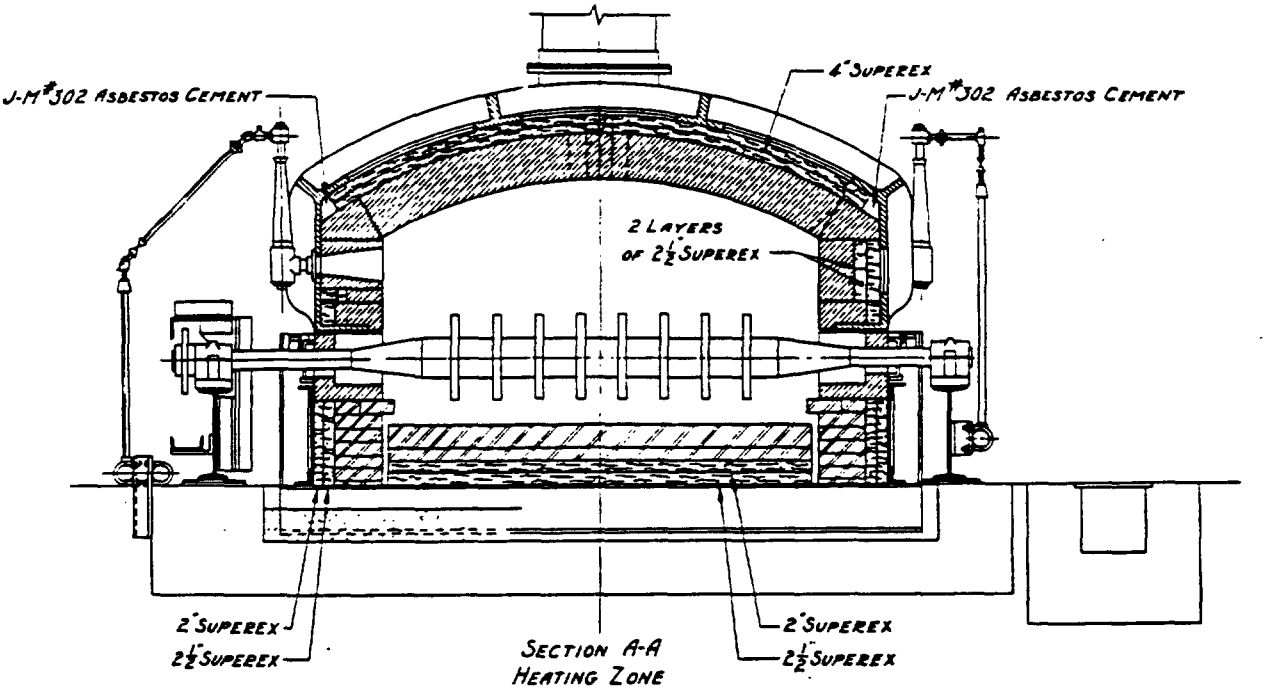


FIG 19—KATHNER NORMALIZING FURNACE INSULATION

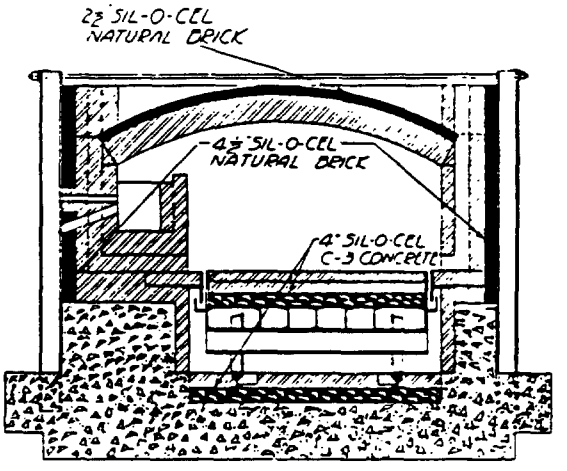


FIG 20—SINGLE CAR TYPE ANNEALING FURNACE
COSTELLO ENGINEERING CO., PITTSBURGH, PA

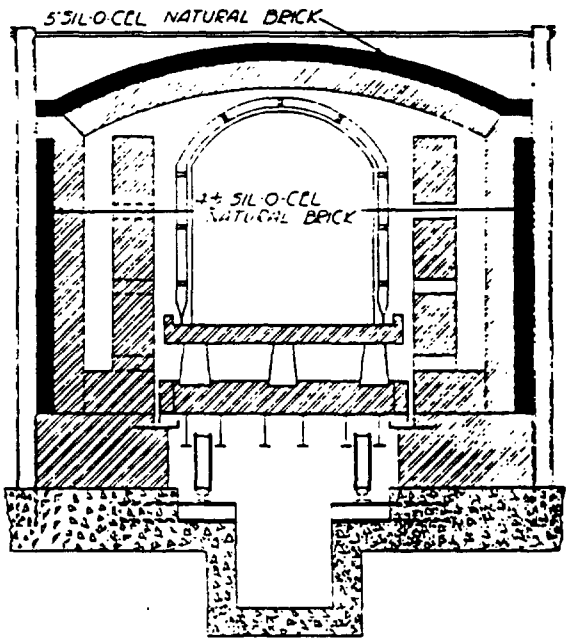


FIG 21—CONTINUOUS BOX ANNEALING FURNACE
GEORGE J. HAGAN CO., PITTSBURGH, PA

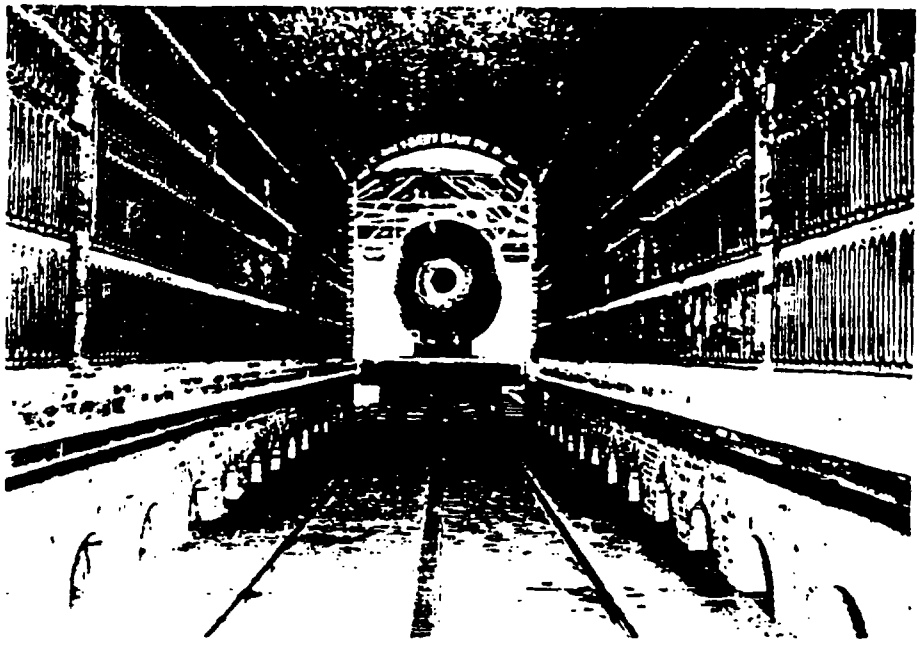


FIG. 22—LARGE ELECTRIC ANNEALING FURNACE. POWERED WITH 3000 KW. HEATING CAPACITY, 15 TONS PER HOUR. BUILT BY THE ELECTRIC FURNACE CO., SALEM, OHIO.
FOR INSULATION USED, SEE PAGE 57

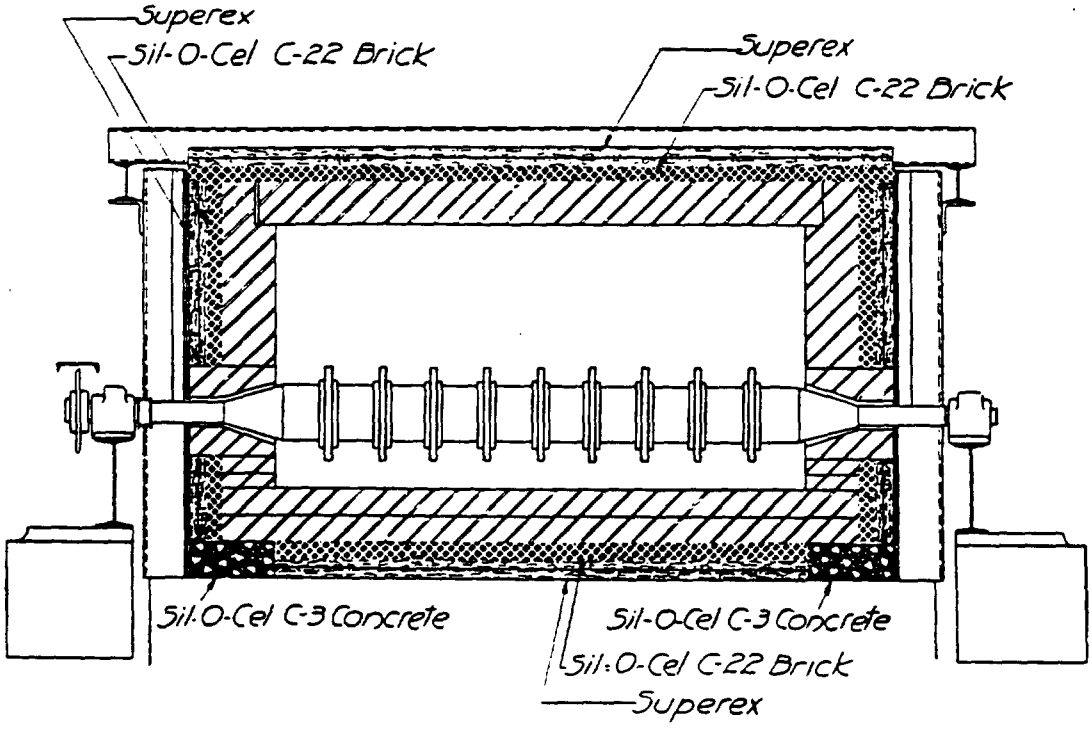
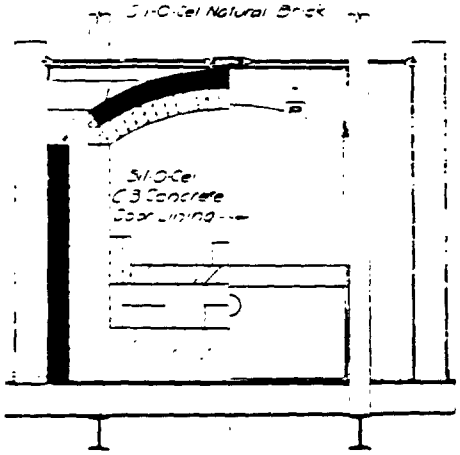
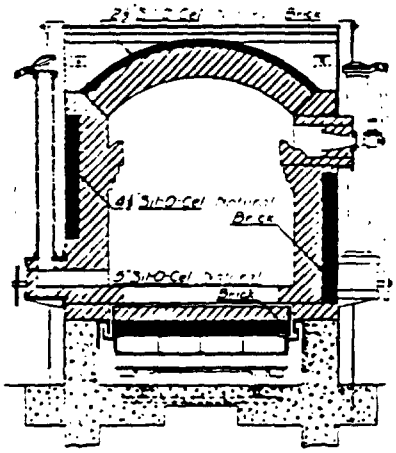


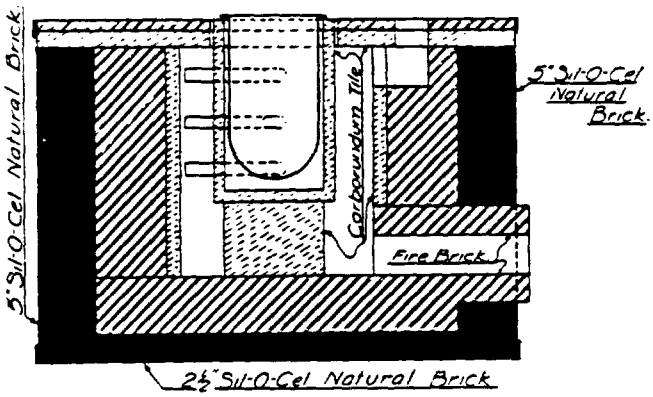
FIG. 23—SWINDELL NORMALIZING FURNACE INSULATION



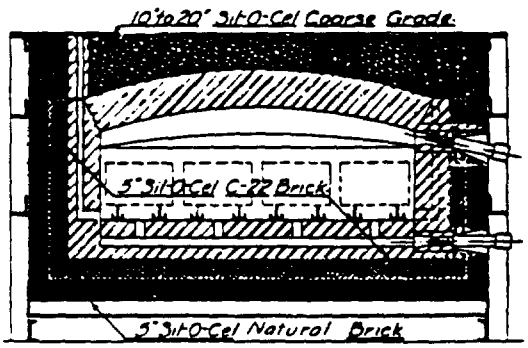
Heavy duty furnace, designed and built by Chicago Flexible Shaft Co., Chicago, Ill.



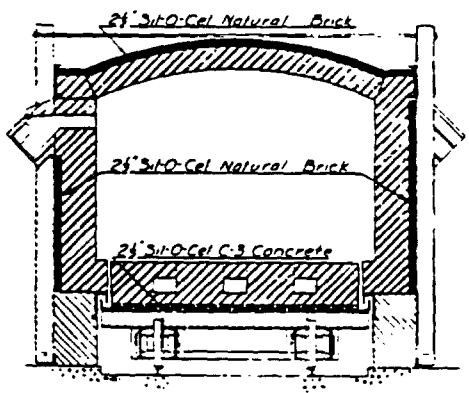
Direct over fired recuperative car type furnace, designed and built by Denver Fire Clay Co., Denver.



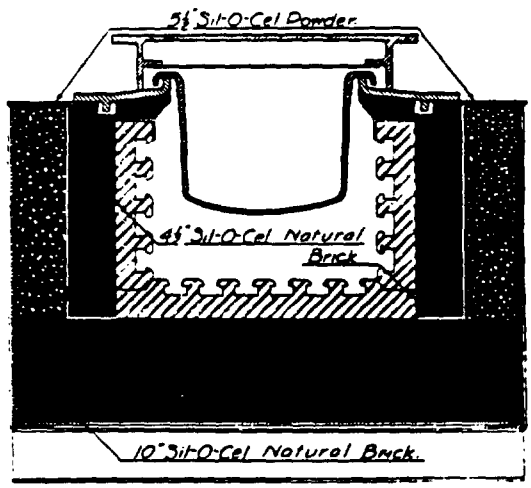
"Lavite" gas fired furnace. Method of insulating used by Bellis Heat Treating Co., Bramford, Conn., furnace designers and builders.



Gas carbonizing furnace, Holcroft & Co., Detroit, designers and builders.

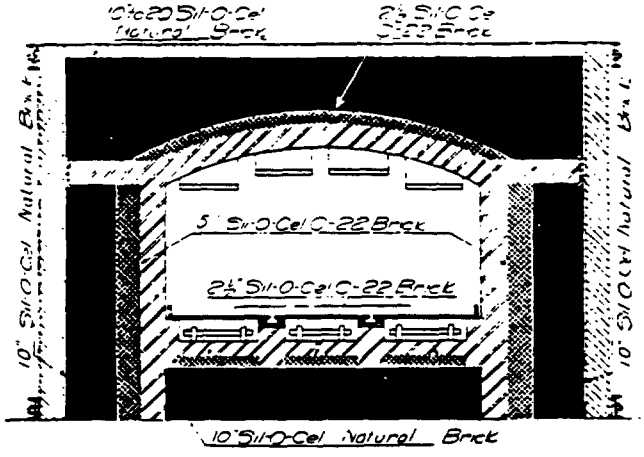


Car type annealing furnace designed and built by Mahr Mfg. Co., Minneapolis, showing their method of insulating.

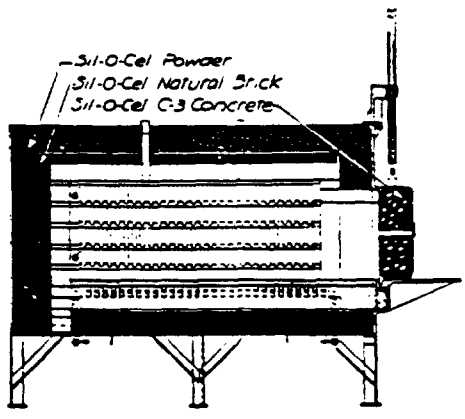


Lead pot designed and built by Hoskins Manufacturing Co., Detroit.

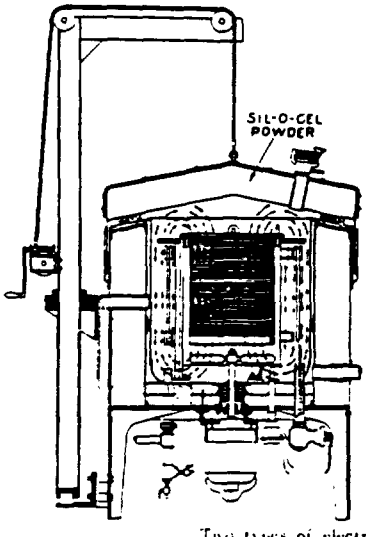
FIG. 24—HEAT-TREATING FURNACES INSULATED WITH J-M MATERIALS

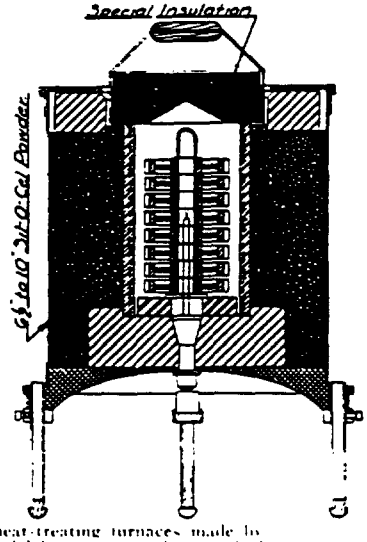


Thorough insulation recommended by General Electric Co. in this electric box type heat-treating furnace.

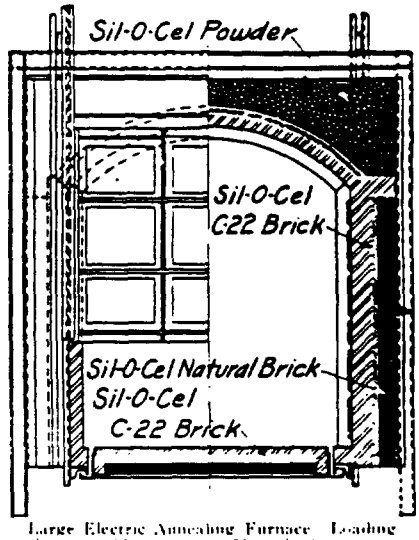


Electric box-type furnace. Designed and built by American Electric Furnace Company, Boston, Mass.

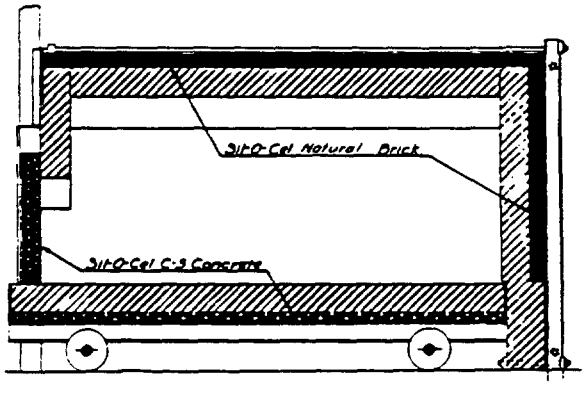




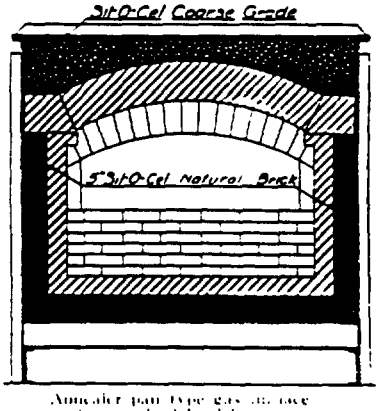
Two types of electric heat-treating furnaces made by Leeds & Northrup, Philadelphia, showing their method of insulating



Large Electric Annealing Furnace. Loading clearance 12 ft. wide x 12 ft. high x 68 ft. deep. Built by Pyc Electric Furnace Co., Salem, Ohio. (See Fig. 22).

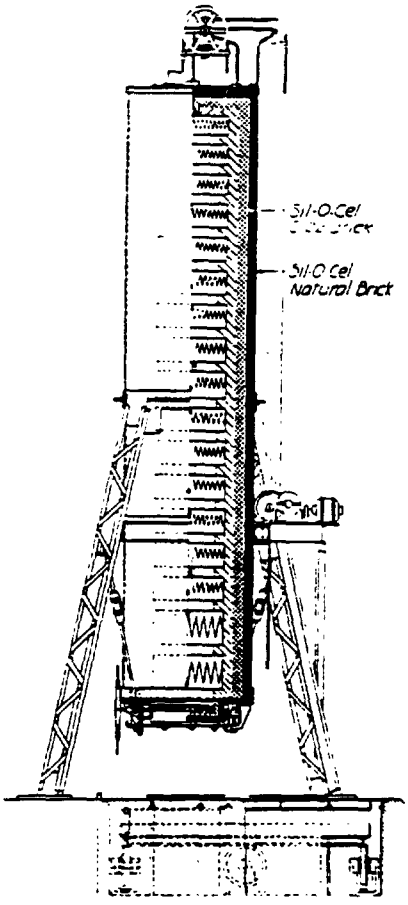


Ferguson car bottom annealing furnace. Method of insulating recommended by Railway Materials Corp., Toledo, builders

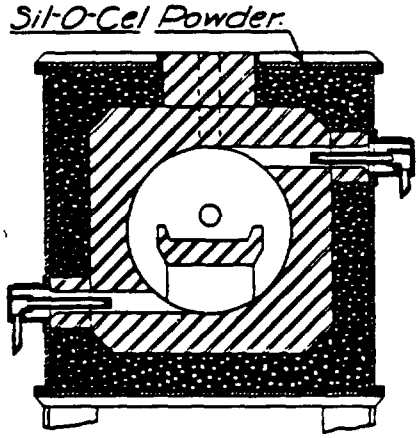


Annealer pan type gas furnace of the Standard Fuel Engineering Co., Detroit.

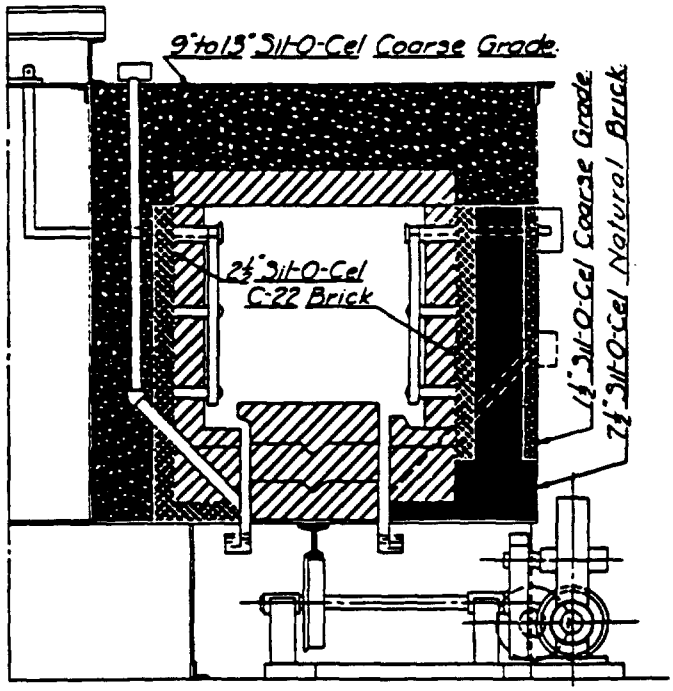
Fig 25.—Heat-treating Furnaces Insulated with J-M Materials



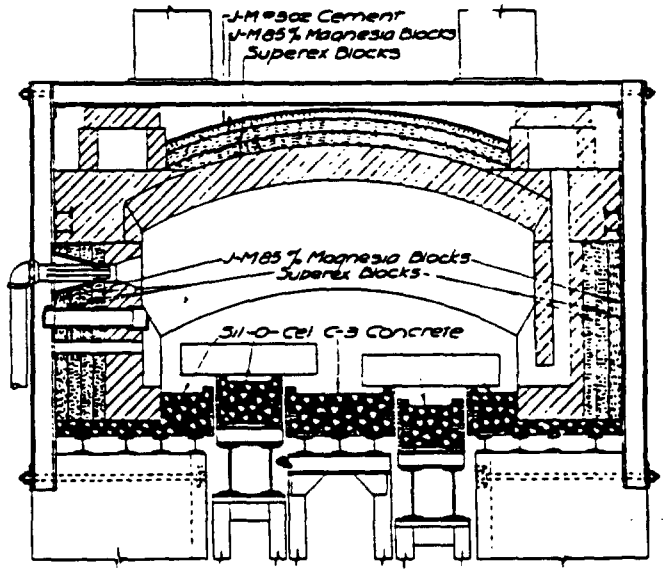
Duralumin heat-treating furnace, designed and built by Strong, Carlisle & Hammond Co., Cleveland, Ohio.



High speed steel furnace designed by Industrial Heating Equipment Co., Detroit.

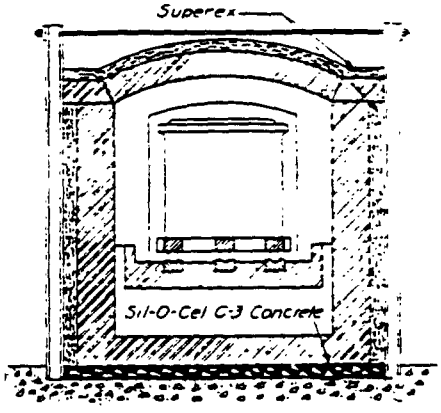


Method of insulating Westinghouse Electric & Manufacturing Co. rotary hearth electric furnace.

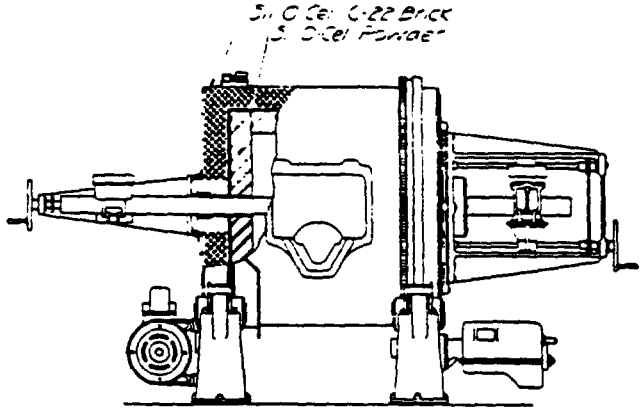


Walking beam furnace, designed and built by Ryan, Scully & Co., Philadelphia, Pa.

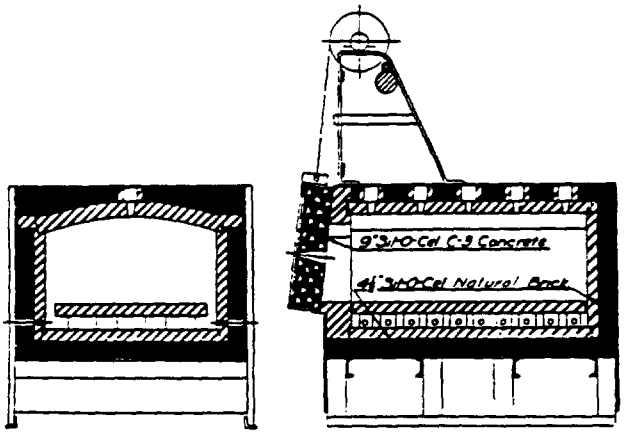
FIG. 26—HEAT-TREATING FURNACES INSULATED WITH J-M MATERIALS



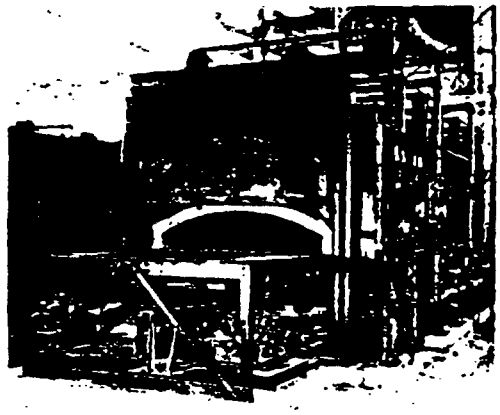
Car and roll furnace. W. S. Rockwell Company, designers and builders, New York City



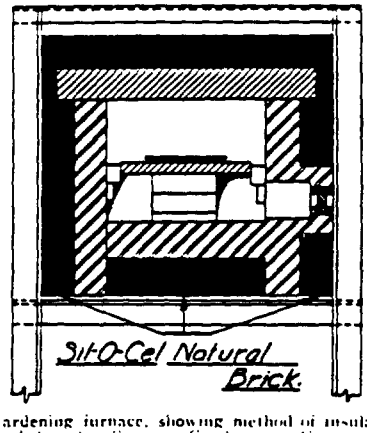
Rotary electric furnace, designed and built by Detroit Electric Furnace Co., Detroit.



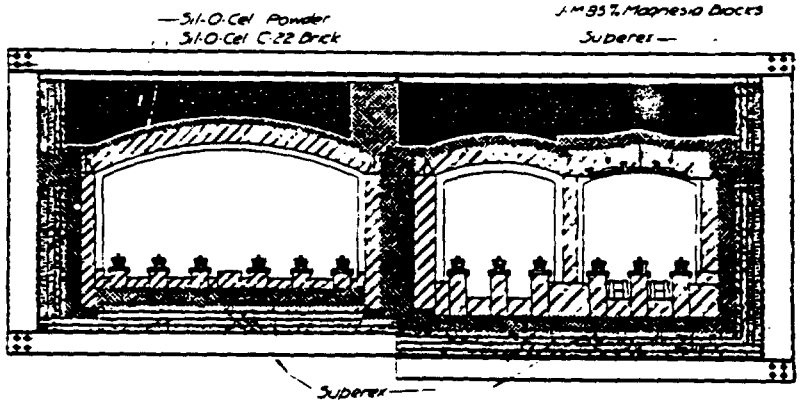
Method of insulating oven furnace as designed by American Gas Furnace Co., Elizabeth, N. J.



Conveyor hearth furnace, designed and built by McCann-Harrison Corporation, Cleveland, Ohio. Insulated with Sil-O-Cel C-22 Brick, Superex Blocks, and 85% Magnesia Blocks.

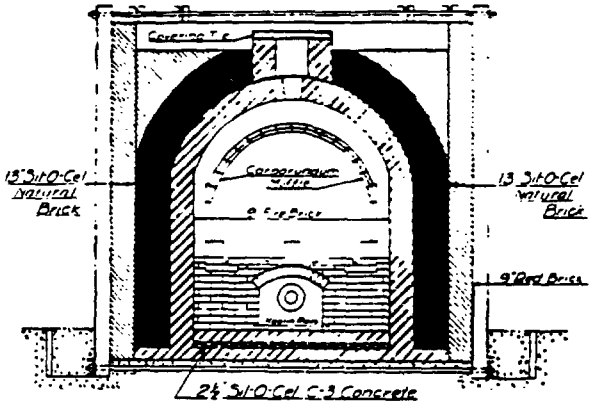


Hardening furnace, showing method of insulating used by the Surface Combustion Co., furnace designers and builders, at Toledo, Ohio

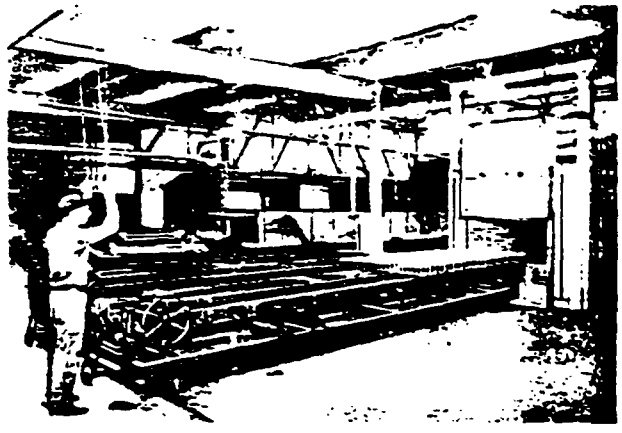


Furnace designed and built by Hevi Duty Electric Co., Milwaukee, Wis.

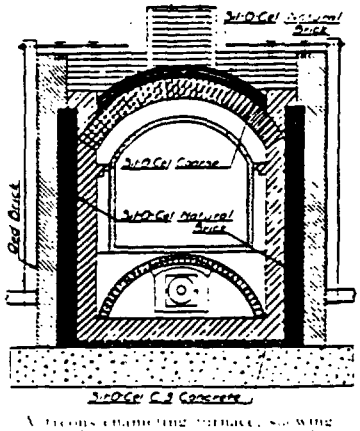
FIG. 27—HEAT-TREATING FURNACES INSULATED WITH J-M MATERIALS



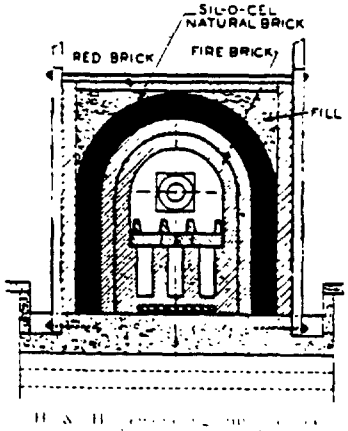
Method of insulating oil fired enameling furnace recommended by Porcelain Enamel & Manufacturing Co., Baltimore, Md.



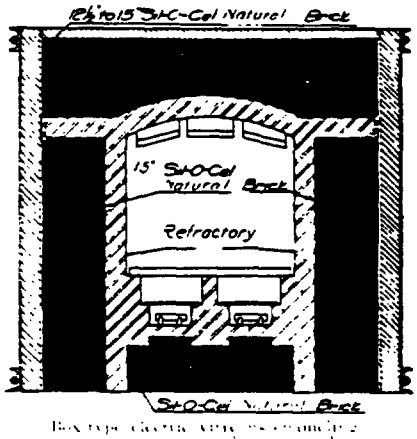
Vitreous enameling furnace built by Ferro Enamel Supply Co., Cleveland, at Louisville Enameled Products Co., Louisville, Ky. Insulated with 13½ in. Sil-O-Cel Natural Brick.



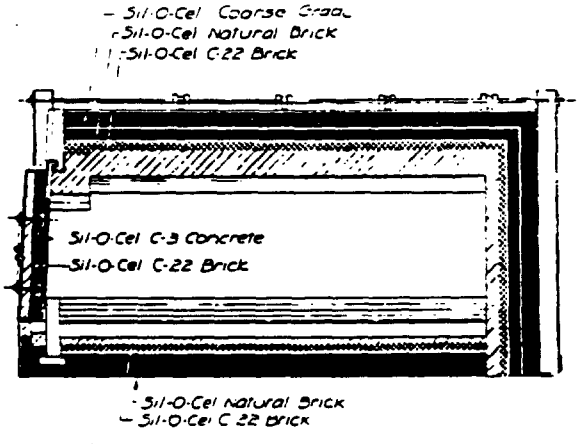
Vitreous enameling furnace, showing method of insulating, recommended by designer and builder, Albert J. Boland, St. Louis, Mo.



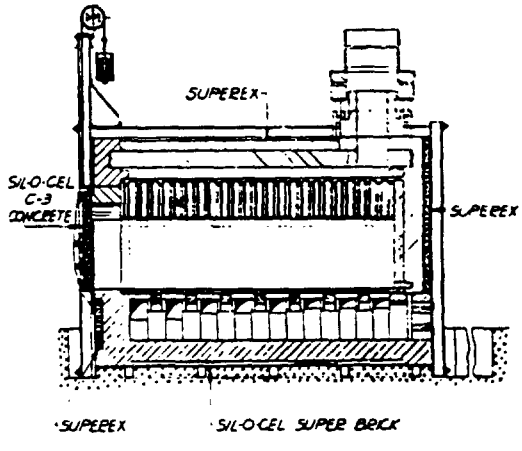
H. & H. [illegible] A. H. [illegible] & Co., Peoria, Ill.



Box-type electric vitreous enameling furnace showing method of insulating recommended by General Electric Company.



Electric enameling furnace designed and built by Gas Equipment Engineering Corporation, Philadelphia, Pa.



Muffle furnace for vitreous enameling designed and built by the Cavernodium Co.

FIG. 28—VITREOUS ENAMELING FURNACES INSULATED WITH J-M MATERIALS

Sil-O-Cel as a Combination Insulating and Refractory Material

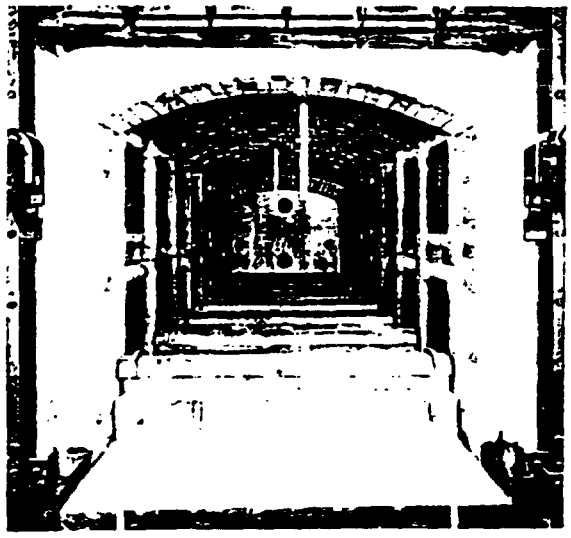


Fig. 29—Electrically Heated Furnace. Designed by Ryan, Scully & Company, Philadelphia. Sil-O-Cel C-22 Brick, 4½ in. Thick, Is Used As Inner Lining in Walls, Car Top, and Arch, Backed Up with 9 in. Sil-O-Cel Natural Brick. The Only Fire-clay Refractory Is That Supporting the Ribbon Elements

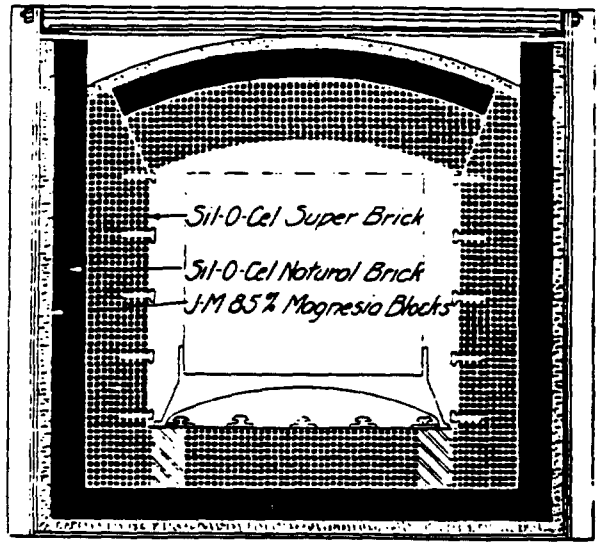


Fig. 30—Electric Heat-treating Furnace (Up to 2000 deg. F.) Utilizing Sil-O-Cel Materials As Combination Refractory and Insulation. Designed and Built by Falls Electric Furnace Corp., Buffalo, N. Y.

While in most cases Sil-O-Cel is used as an insulating material behind fire brick linings, its use as a combination refractory and insulating material in certain types of equipment has been attended with great success.

Sil-O-Cel C-22 Brick and Sil-O-Cel Super Brick, because they have been calcined at high temperatures, are semi-refractory and serve very well without fire brick protection when not subjected to erosion and abrasion. The great advantage of such construction lies not only in excellent insulating qualities but also in marked reduction in heat stored in the furnace lining and time required to reach operating temperature.

Sil-O-Cel C-3 Concrete for Monolithic Furnaces and Ovens

Core ovens and furnaces operated at moderate temperatures are in many cases now being constructed entirely of Sil-O-Cel C-3 Concrete without fire brick linings.

The walls and tops of the core ovens in Fig. 31 are composed of 12 in. of Sil-O-Cel C-3 Concrete and the doors are Sil-O-Cel C-3 Concrete, 9 in. thick. (see Fig. 32 also). Ovens of this type can be constructed and operated at very great savings over the ordinary type of masonry construction. Due to the insulating properties of Sil-O-Cel C-3 Concrete and the fact that all masonry joints are eliminated, fuel consumption is surprisingly low. This construction



Fig. 31—Battery of Four Monolithic Gas-fired Core Ovens, Built Entirely of Sil-O-Cel C-3 Concrete, 12 in. Thick in Walls and Tops. Doors of Sil-O-Cel C-3 Concrete, 9 in. Thick

can be satisfactorily employed for many types of equipment.

Detailed recommendations and specifications for this construction on any specific type of equipment will be gladly supplied by an experienced J-M engineer upon request.



FIG. 32—JAPANNING OVENS AT THE DURAND STEEL LOCKER CO., CHICAGO HEIGHTS, ILLINOIS. BUILT ENTIRELY OF SIL-O-CEL C-3 CONCRETE. 9 IN. THICK IN WALLS AND TOPS. SIZE OF OVENS 9 FT. WIDE, 22 FT. HIGH, 50 FT. LONG

Core Oven Insulation

TEMPERATURES TO 600 DEG. F.

On brick core ovens operating at temperatures up to 600 deg. F. the side walls, roof and door are insulated with 2½ in. thick J-M 85% Magnesia Insulation (for temperatures below 400 deg. F. use 2 in. thick 85% Magnesia).

Side Walls—The Magnesia blocks, 6 in. x 36 in. x 2½ in. thick, are firmly attached to ¼ in. thick Transite sheets by J-M Fibrous Adhesive, forming panels. The blocks are tightly butted and all joints pointed up with J-M No. 302 Cement. These panels are securely fastened to the interior of the side walls by means of suitable expansion bolts in the brick wall, as shown in Fig. 34.

Roof—No. 6 gauge wire fabric, with 6 in. square mesh, is fastened to the lower flange of the roof I-beams by large, square washers and bolts tapped in on approximately 2 ft. centers along the beams. The Magnesia blocks are laced under, and wired to this fabric. All joints are tightly butted and pointed up with J-M No. 302 Cement.

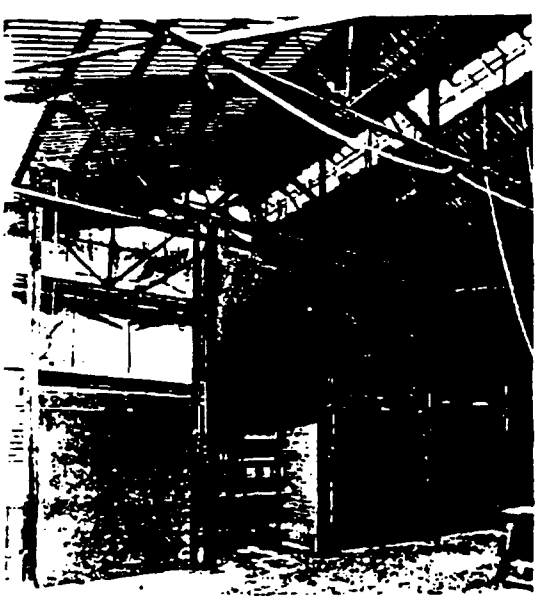


FIG. 33—CORRUGATED TRANSITE ROOF OVER J-M INSULATED CORE OVENS

Over the insulation, 1½ in. hexagonal mesh galvanized wire netting is stretched and wired to the lacing wires. Two ¼ in. coats of J-M No. 302 Cement are then applied. The first coat is allowed to dry with a rough surface before the application of the second coat.

Door—The door insulation is applied between steel plates, bolted together through the insulation, as shown in Fig. 34. Angles, suitably fastened, protect the insulation at the edges.

The blocks are tightly butted and pointed up with J-M No. 302 Cement. Light angles, riveted to the outside plate, give the door added stiffness.

Combustion Chamber—Side walls of the combustion chamber are insulated with 2 in. of Superex Insulation applied in one layer over the exterior with all joints tightly butted and pointed up with J-M No. 302 Cement.

The insulation is protected with at least 9 in. of fire brick.

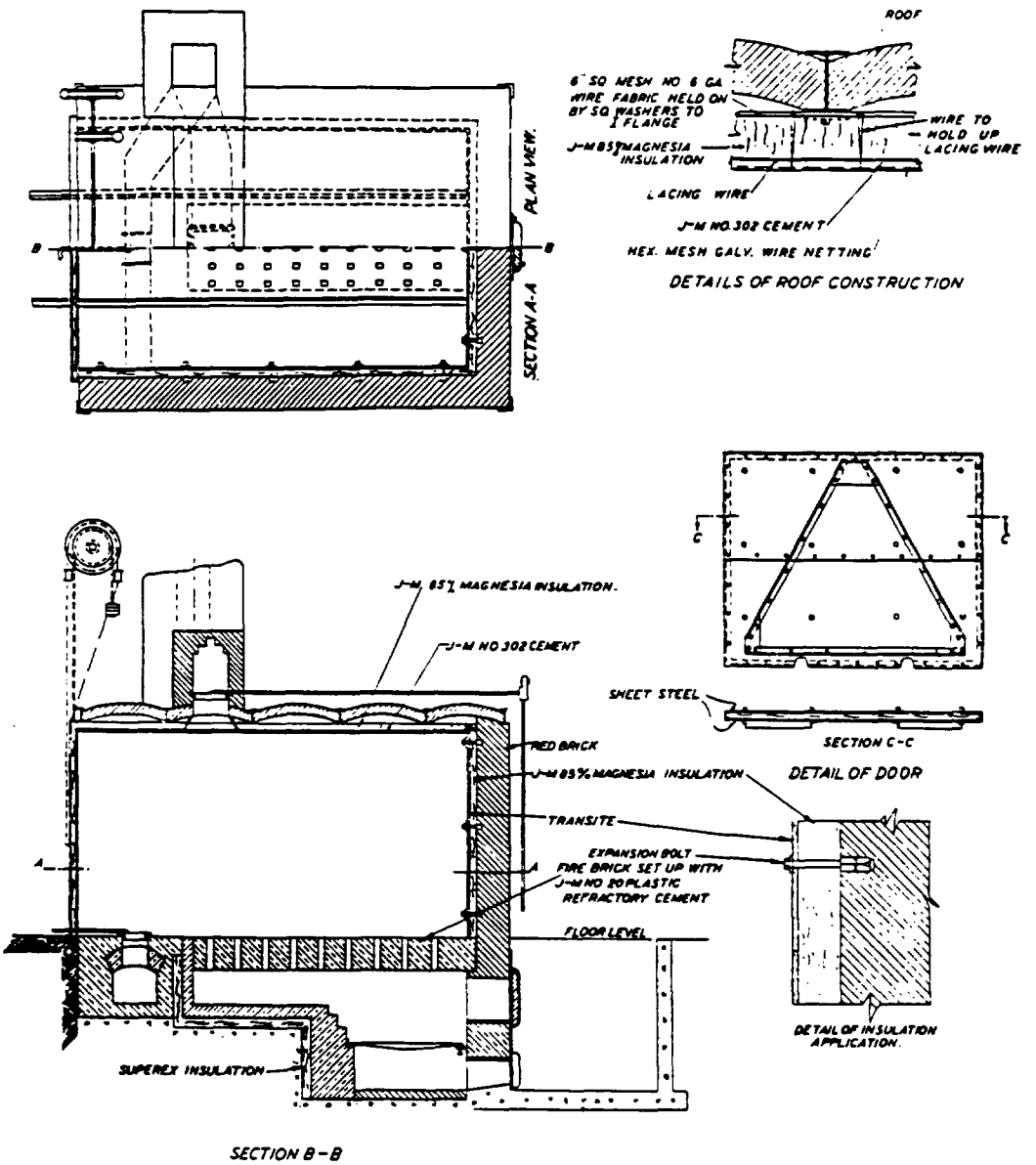


FIG. 34—TYPICAL COKE OVEN INSULATION FOR TEMPERATURES TO 600 DEG. F. COAL-FIRED IN-AND-OUT TYPE

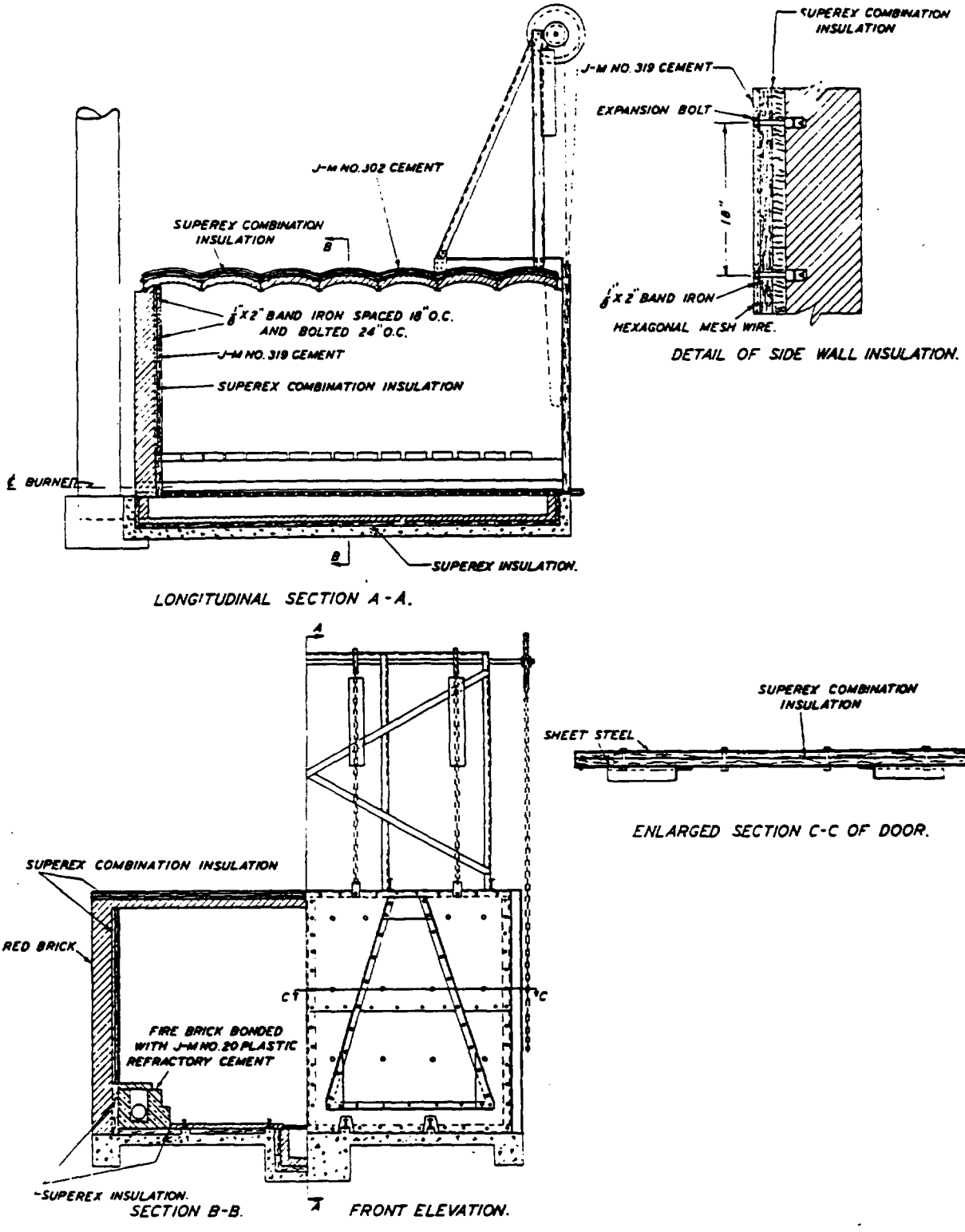


FIG. 35—TYPICAL CORE OVEN INSULATION FOR TEMPERATURES TO 800 DEG F. OIL-FIRED CAR-TYPE

Core Oven Insulation

TEMPERATURES TO 800 DEG. F.

On brick core ovens operating at temperatures up to 800 deg. F., the side walls, roof and door are insulated with 3 in. thick Superex Combination Insulation.

Side Walls—The Superex Combination Insulation, 3 in. thick, consists of 1½ in. J-M 85% Magnesia Insulation, applied to the inside of the wall next to the brickwork, and 1½ in. of Superex Insulation applied over the Magnesia. All joints are broken, tightly butted, and pointed up with J-M No. 319 Cement. The blocks, 6 in. x 36 in., are applied vertically and held in place by ⅝ in. x 2 in. horizontal band iron on 18 in. centers, bolted through the insulation to the brickwork by expansion bolts on 24 in. centers (see Fig. 35).

Over the insulation a 1½ in. hexagonal mesh galvanized wire netting is stretched and fastened securely to the band iron. Then two coats of J-M No. 319 Cement are applied to a total thickness of ½ in. The first coat should be thoroughly dry before application of the second coat.

Roof.—On the top of the roof 1½ in. of Superex Insulation, then 1½ in. of J-M 85% Magnesia are applied, using broken joint construction, with all joints tightly butted and pointed up with J-M No. 302 Cement. Then two ¼ in. coats of J-M No. 302 Cement are applied. The first coat is left to dry with a rough surface before the application of the second coat.

Door—The door insulation is applied between sheet steel, bolted together through the insulation, as shown in Fig. 35. Angles, suitably fastened, protect the insulation at the edges.

Against the outside plate, 1½ in. of J-M 85% Magnesia, then 1½ in. of Superex Insulation are applied, using broken joint construction. All joints are tightly butted and pointed up with J-M No. 319 Cement. Light angles riveted to the outside plate give the door added stiffness.

Combustion Chamber and Oven Floor—Side walls of combustion chambers and the floor of the oven are insulated, as shown in Fig. 35, with 2½ in. of Superex Insulation applied in one layer, with all joints tightly butted and pointed up with J-M No. 319 Cement.

The insulation on the combustion chambers should be protected by at least 9 in. of fire brick. The insulation on the floor should be protected by at least one layer of red brick or paving brick.

Insulation in Producer Gas Mains

Insulated linings in producer gas mains effect operating economies entirely apart from savings in sensible heat. By maintaining a high temperature in the gas, the insulation inhibits the condensation of tarry vapors resulting from the breaking down of unstable hydrocarbons, which subsequently deposit on the fire brick lining. These vapors, by remaining in suspension, increase the calorific value of the gas at the furnaces, and, as a corollary effect, the length of time between shut-downs for burnout is materially increased.

The remarkable economies through heat conservation incidental to the proper use of insulation appear in producer mains as elsewhere. Heat loss through an uninsulated main lined with 4½ in. of fire brick with a gas temperature of 1400 deg. F., approximates 1250 Btu. per square foot per hour. Insulated in accordance with a much-used J-M standard specification, this loss is reduced to 325 Btu. On the basis

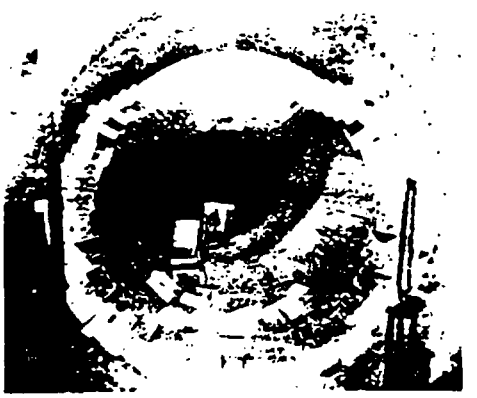


Fig. 36—Main Being Installed with Sil-O-Cel Natural Brick

of heat worth 25 cents per million Btu. and continuous operation, the saving corresponds to $2.00 per square foot per year on an outlay of less than 35 cents per square foot for insulating materials.

The take-offs from the producers, the soot catcher, and the mains should always be insulated. Fig. 38 shows typical cross-sections through this class of equipment. Producer gas mains are insulated either when old mains are being re-lined with fire brick or when new mains are being installed.



FIG. 37—MAIN BEING INSULATED WITH SUPEREX BLOCKS

Insulation Recommendations

Producer gas mains should be insulated with a minimum of 2½ in. of Superex Block or Sil-O-Cel Natural Brick.

Block Insulation—Superex Blocks, 2½ in. to 4 in. thick, depending on requirements, are applied in a single layer on the inside of the main next to the steel shell. Superex is furnished in blocks 6 in. x 36 in. or 3 in. x 18 in., curved to fit if necessary, and is applied with all joints tightly butted and pointed up with J-M No. 302 Cement (see Figs. 37 and 38). If desired, the blocks may be stuck to the shell with J-M Fibrous Adhesive.

The fire brick lining is applied over the insulation.

Brick Insulation—The brick insulation, depending on requirements, consists of Sil-O-Cel Nat-

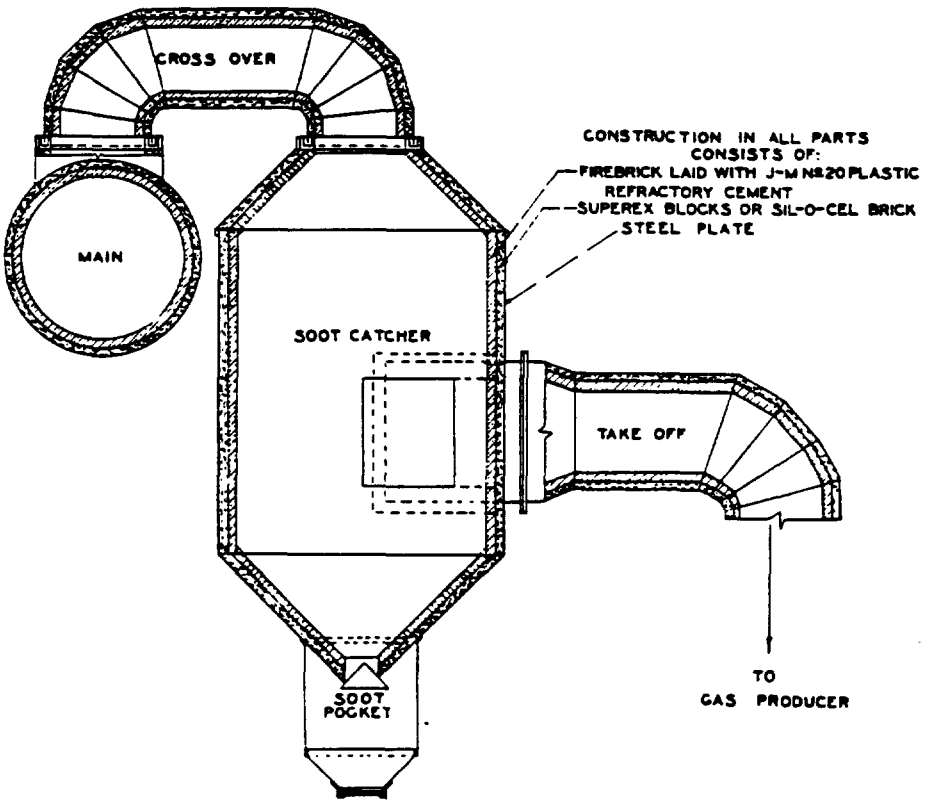


FIG. 38—CROSS-SECTION OF TAKE-OFF, SOOT-CATCHER AND MAIN INSULATION

ural Brick, 2½ in. or 4½ in. thick, furnished in standard fire brick size, 9 x 4½ x 2½ in. The fire brick and insulation are simultaneously applied to the inside of the shell. To insure a monolithic construction of equal insulating value at every point, Sil-O-Cel Natural Brick are laid with Sil-O-Cel Insulating Mortar, using the thinnest possible ruibed joints. This mortar is furnished with the insulating brick at the rate of 80 lb. per thousand brick (see Figs. 36 and 38).

Refractory Cement Recommendations

Heating and Forging Furnaces

The brick in walls and roof of heating furnaces are bonded with J-M No. 31, 32 or 20 Refractory Cement. No. 31 is a dry cement used in making a bond joint; No. 32 is a dry cement unexcelled for brick to brick joints; No. 20 is a plastic cement suitable for either kind of joint. These cements pay for themselves several times over in reduced spalling and slag action. J-M Plastic Fire Brick Material is well adapted for patching.

J-M No. 20 Plastic Refractory Cement is used for bonding brick in the flues, where it goes a long way in checking erosion. For those who prefer a dry cement, J-M No. 26 is equally efficient in making a bond joint.

Annealing and Heat-Treating Furnaces

The brick walls and arches of these furnaces are bonded with No. 31, No. 29 or No. 26. The No. 29 is a plastic cement for bond or brick to brick joints. For electric annealing furnaces No. 20 or No. 29 are generally recommended. Both No. 20 and No. 29 are sulphur free and therefore will not affect resistor elements.

Hearths and walls of old furnaces are made to last much longer by a ½ in. plaster-coating of J-M No. 33 Super-Refractory Cement. This cement is extremely resistant to the cutting action of flames and slag. Before application, incrustations must be removed and glazed or smooth surfaces chipped away and well scarified.

The brick in flues are bonded with No. 26 or No. 20.

Producer Gas Mains

In this class of equipment, the use of a suitable refractory cement is very essential. Unless the fire brick lining of a main is laid up with a joint that will prevent the seepage of tar and other condensible matter, the insulation will be rendered very inefficient, due to its impregnation by these substances. All fire brick in the take-offs, mains and dust catchers is bonded with J-M No. 20 Plastic Refractory Cement. The brick are laid in a thin mortar and tapped into place.

The exposed brickwork inside the take-offs, mains and dust catchers is protected with a wash coat of J-M No. 20 Plastic Refractory Cement.



Fig. 39—A Plate Mill Furnace of the Inland Steel Co. Set Up with J-M Refractory Cement

IV—THE POWER PLANT

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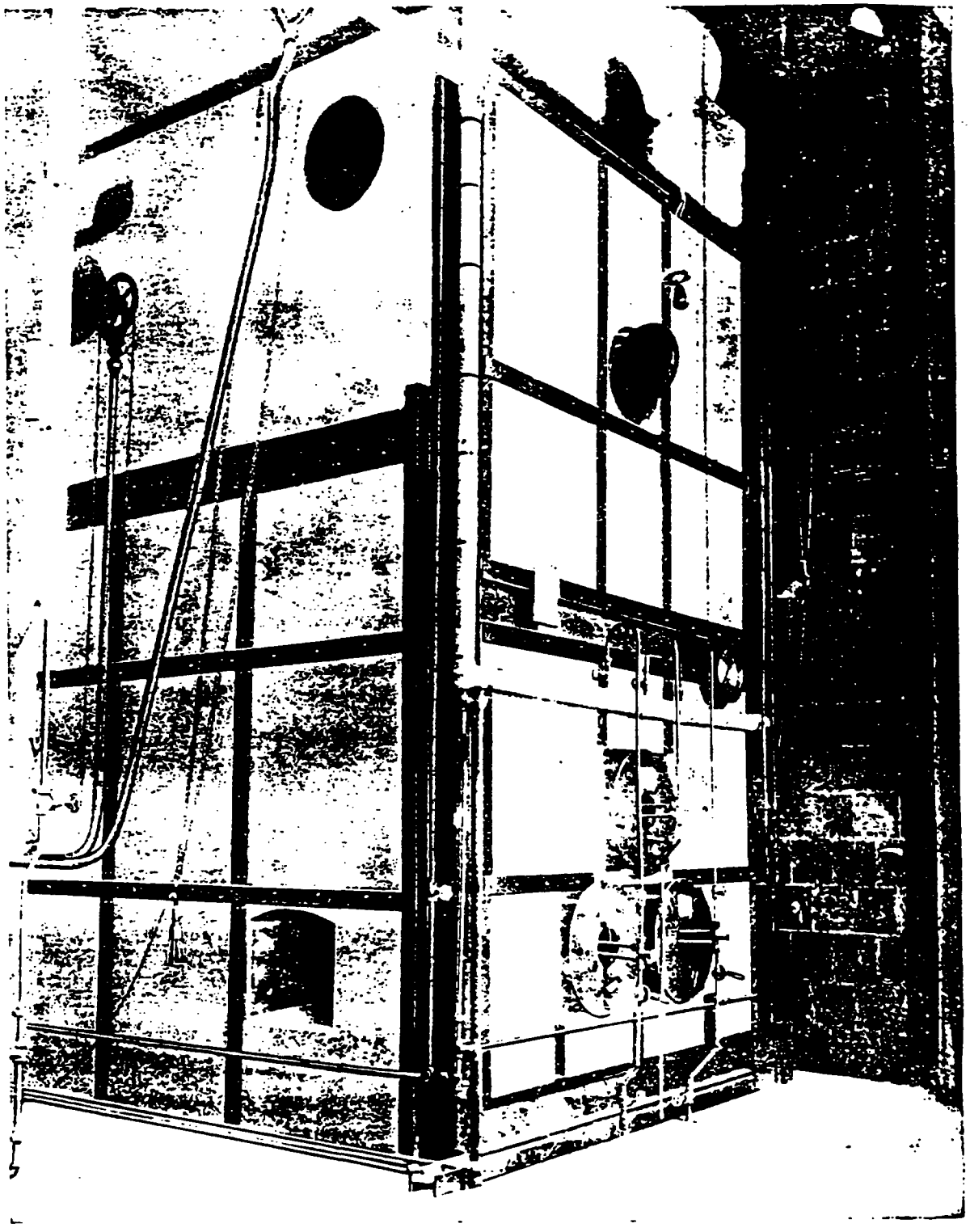


Boiler Insulated with Sil-o-cel Blocks and Cased with Transite

The Power Plant

JOHNS-MANVILLE furnishes a wide variety of power plant materials for improving performance, increasing capacity and reducing operating costs. Insulation is particularly important in insuring economical operation of power plant equipment. Fuel cost is one of the principal items of expense wherever heat is generated, and the problem of fuel conservation is a matter of major consequence. A complete line of insulating materials in all forms is available to save heat otherwise dissipated from boiler settings and drums, economizers, breechings and stacks, turbines, pumps, feed-water heaters, and piping.

J-M Refractory Cements lengthen the life of boiler furnaces and lessen maintenance costs by reducing spalling, by preventing the entrance of flame at the joints, and by decreasing the destructive action of low-fusion ash. The tight sealing of the joints, particularly when wash-coating is also employed, inhibits the infiltration of air or the extrusion of furnace gases. Old settings which are not effectively sealed may be made air-tight by the application of J-M Aertite Boiler Wall Coating over the exterior surface.

For expansion joints Johns-Manville furnishes resilient, high-temperature materials especially developed for packing these joints in boiler furnaces. J-M No. 4200 Asbestos Rope, Jelly-Rolls, Roll Fire-Felt, RX Fibre, and No. 352 Cement are used extensively in this class of work.

The use of flat Transite sheets as a casing material outside the insulation on boiler settings has been attended with great success. Transite furnishes excellent protection for the insulation, resists mechanical abrasion, and is not subject to deterioration. It lends attractiveness to the boiler-room, lasts indefinitely, and requires no painting.

Transite is also furnished in corrugated sheets for use as roofing and siding. These sheets are adaptable for the construction of housings over coal and ash handling equipment and for similar purposes.

J-M Asbestos Ebony is a durable, attractive material of high dielectric strength, used for switchboards, controller plates, switch bases, bus-bar supports and similar applications. Thick sheets of flat Transite also serve as bus-bar barriers, disconnect switch housings, cell structures, etc.

A complete line of packings and gaskets for all purposes in and around the power plant is set forth and described in the J-M Packing Catalogue. This catalogue may be had by applying to any Johns-Manville office.

Among other Johns-Manville materials for the power plant are included Industrial Brake Blocks and Linings; Orangeburg Fibre Conduit for cableways; Celite for improving workability of concrete mixes; Asbestos Membranes and Asphaltic Materials for waterproofing and damp-proofing; Asphaltic Concrete Flooring to provide resiliency and to resist wear; and a full line of Asbestos and Asphalt Roofings and Shingles.

Insulation of Brick Settings for Boilers

The development of insulation suitable for use on boiler furnaces has been coincident with that of the refractories in connection with which it is used. The furnace setting is simply a container for the combustion of the fuel, and the more thermally efficient the container, the greater will be the capacity of the furnace and the lower the fuel consumption. The necessity for materials designed to retard heat flow arose as a corollary to the use of thinner walls of better grade brick, as well as increasing demands for higher efficiencies.

Raw fuel has been steadily increasing in price during recent years, and modern construction has eliminated the great thickness of brick that formerly tended to cut down heat losses. Both of these factors point directly toward the use of an efficient material to block the flow of heat from combustion chamber and hot gas passes. When it is considered that heat loss from one square foot of bare surface often amounts to a matter of several dollars per year, the proper emphasis begins to be laid on insulation which will save a major portion of this loss.

As an example, if the heat from an uninsulated 2400 deg. F. furnace with 18 in. fire brick walls is worth 40 cents per million Btu., the dollar equivalent of the heat loss amounts to $2.67 per square foot per year. If the walls are insulated with 3 in. of Superex Blocks, this loss is reduced to $1.21, saving $1.46 per square foot per year. In such a case the investment represented by the cost of the insulation is repaid by the savings in operating cost long before the end of the first year.

Aside from heat conservation, the insulation reduces the temperature gradient through the refractories, lowering the temperature differential between the two faces of the fire brick, and thereby lessening internal strains and spalling. The more uniform temperature throughout the fire brick wall reduces cracking due to expansion and contraction.

Insulation itself, if properly applied over the exterior of the brick, tends to seal cracks in the wall, thereby operating to prevent the infiltration of air. This feature is often of even more importance than the saving of heat and reduction in fuel cost.

The capacity and efficiency of a boiler are usually directly dependent upon the operating temperature. With the recent improvements in refractories and the protection against internal stresses afforded to the brickwork by insulation, the effort is continually to carry on at higher and higher temperatures in spite of limitations imposed by the heat-resisting properties of refractories.

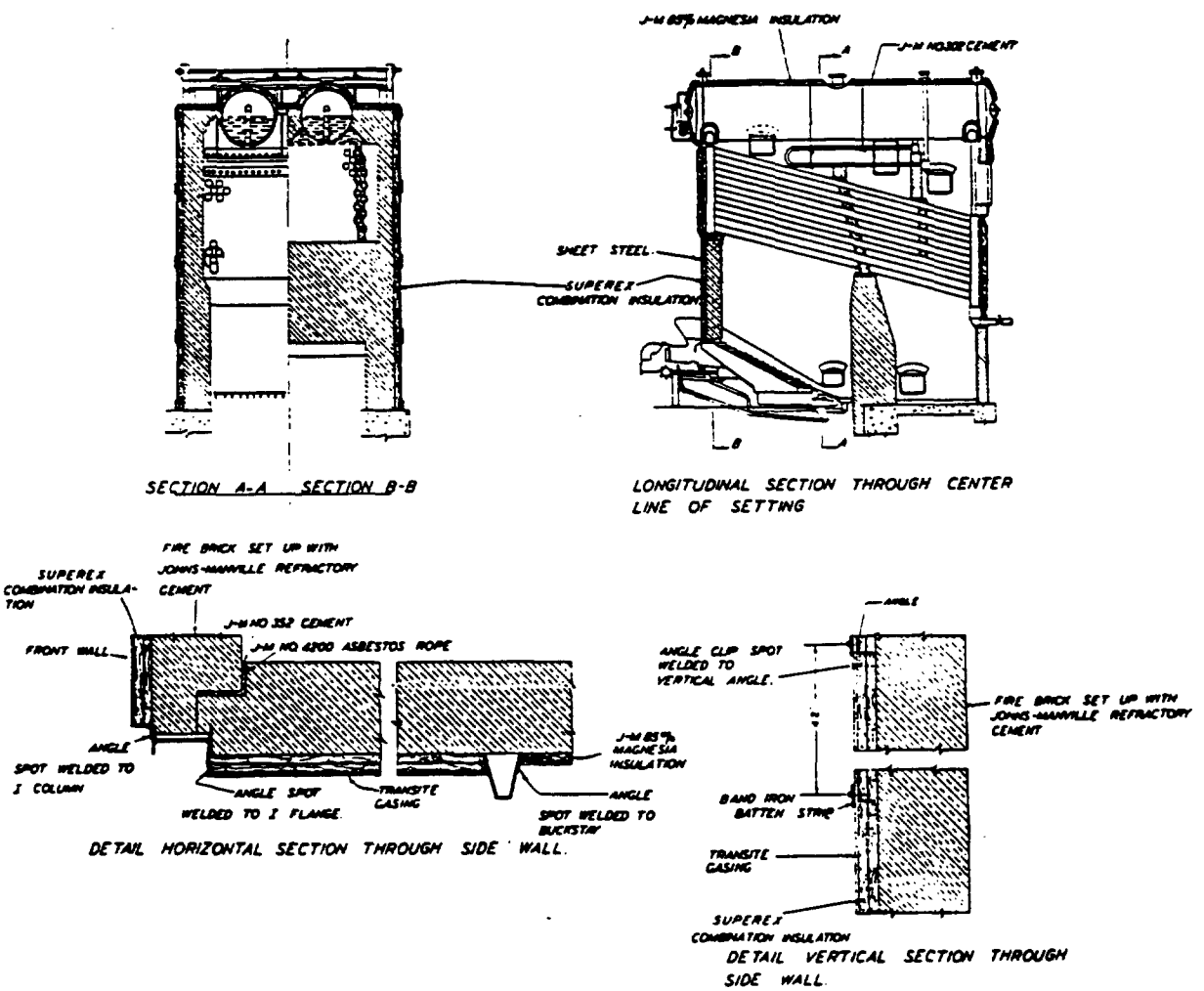


FIG. 1—BLOCK INSULATION RECOMMENDATION FOR B. & W. TYPE BOILER SETTING

However, increased steam production per unit of heat does not wait upon the use of increased temperatures. The saving of the heat, the side flow of heat to the back passes, and the elimination of air infiltration which may be obtained through insulation, have resulted in a very material improvement in economy of boiler operation. There is also the important human advantage of cooler boiler-rooms.

Insulation for B. & W. Type Boiler Setting Block Recommendation

Furnace and Side Walls—All exterior brickwork on the furnace and side walls is insulated with 3 in. thick Superex Combination Insulation, as shown in Fig. 1. The fire brick in the furnace section is assumed to be at least 18 in. thick and in the first pass at least 13½ in. thick.

Rear Wall —The exposed brick section in the rear of a B. & W. boiler is seldom in the path of gases containing useful heat and, in these cases, is not insulated.

Application of the Insulation — Superex Combination Insulation 3 in. thick consists of 1½ in. thick Superex Insulation to be applied next to the brickwork and 1½ in. thick J-M 85% Magnesia to be applied over the Superex. These materials are furnished in blocks 6 in. x 36 in. and are applied in broken joint construction, all joints being closely butted and pointed up with J-M No. 302 Cement. The blocks are applied between the buckstays and horizontal steel work. It is to be noted that all steel work is left sufficiently exposed to prevent its reaching undue temperatures.

Vertical supporting angles are spot-welded to the corner columns and buckstays, as shown in Fig. 1. Light horizontal angles are used where insulation terminates at top and bottom of walls, at exposed horizontal steel members and where distance between horizontal supporting members exceeds 42 in. The vertical legs are punched with ½ in. holes on approximately 12 in. centers, the first hole starting at a point 6 in. from the end of the angle. These angles are spaced on not greater than 42 in. centers. The insulation is secured by lacing it to the angles with 16-gauge annealed iron wire.

Transite Finish —Transite sheets ⅛ in. thick are applied over the insulation. These are clamped in place with steel battens fastened to the angles by means of ⅜ in. x 1¼ in. round-head stove bolts, so that the bolt heads bear on the inside face of the angle. Washers are used under all bolt heads and nuts. After the nuts are set up tight, bolt ends are cut flush with the top of the nut. All vertical joints are tightly butted and battened with 3 in. wide, ¼ in. thick batten strips of flat steel. All horizontal joints are battened similarly with 2½ in. wide, ¼ in. thick steel strips.

Cement Finish (Alternate) —Over the insulation is stretched 1½ in. hexagonal mesh galvanized wire netting, fastened securely to the angles and wires. Two ¼ in. coats of J-M No. 302 Cement are then applied, the first coat being left to dry with a rough surface before the application of the smooth finishing coat. Where an exceptionally hard finish is desired, J-M No. 302 Cement may be mixed with portland cement for the second ¼ in. coat, the proportion of portland cement being from ⅓ to ½ by weight, depending on the degree of hardness required.

Suitable openings are cut for doors, burners, etc., as required. The edges of the insulation at these openings are coated with J-M No. 20 Plastic Refractory Cement.

Boiler Tops —The boiler tops are insulated over the fire brick with 2½ in. thick J-M 85% Magnesia Insulation, which is furnished in blocks 6 in. x 36 in. and applied in a single layer with all joints closely butted and pointed up with J-M No. 302 Cement. Over the insulation is stretched 1½ in. hexagonal mesh galvanized wire netting, which is fastened securely by means of expansion bolts or staples in the brickwork. The cement is applied as described in the foregoing paragraphs.

Recommendations for insulating boiler drums and tube doors will be found on subsequent pages.

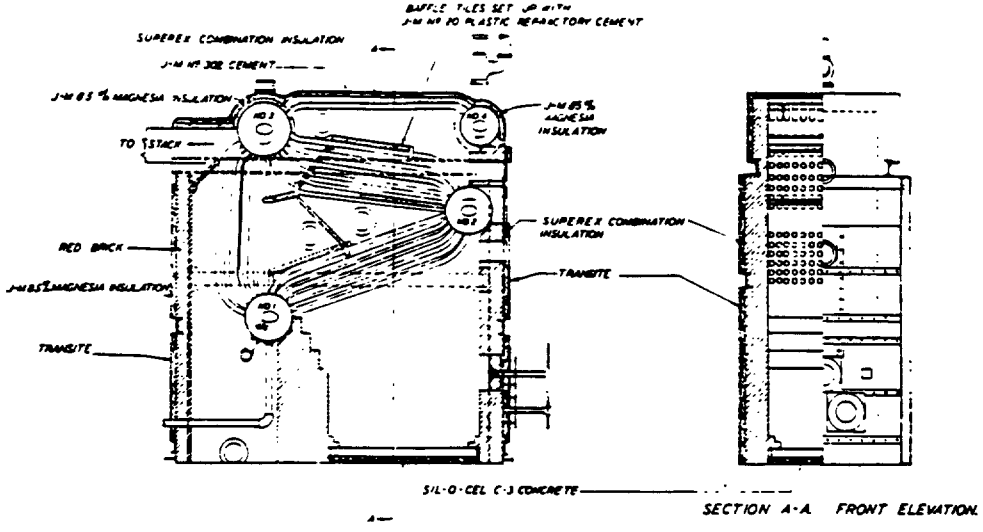
Insulation for Stirling Type Boiler Setting Block Recommendation

Furnace and Side Walls —All exterior brickwork on the furnace and side walls of Stirling type boilers, with the exception of that portion to the rear of the bridge wall, is insulated with 3 in. thick Superex Combination Insulation, as shown in Fig. 2. The balance of the side walls, extending from the floor to the top of the boiler in the section to the

rear of the bridge wall, is insulated with 3 in. thick J-M 85% Magnesia (see Fig. 2). On the furnace proper the fire brick walls are assumed to be at least 18 in. thick. On the other portions where Superex Combination Insulation is used, the fire brick walls are assumed to be 13½ in. thick.

Rear Walls —All exterior brickwork in this section of the boiler is insulated with 1½ in. thick J-M 85% Magnesia Insulation.

Application of the Insulation —All insulation 3 in. thick or over is applied in two or more layers, broken joint construction, with all joints



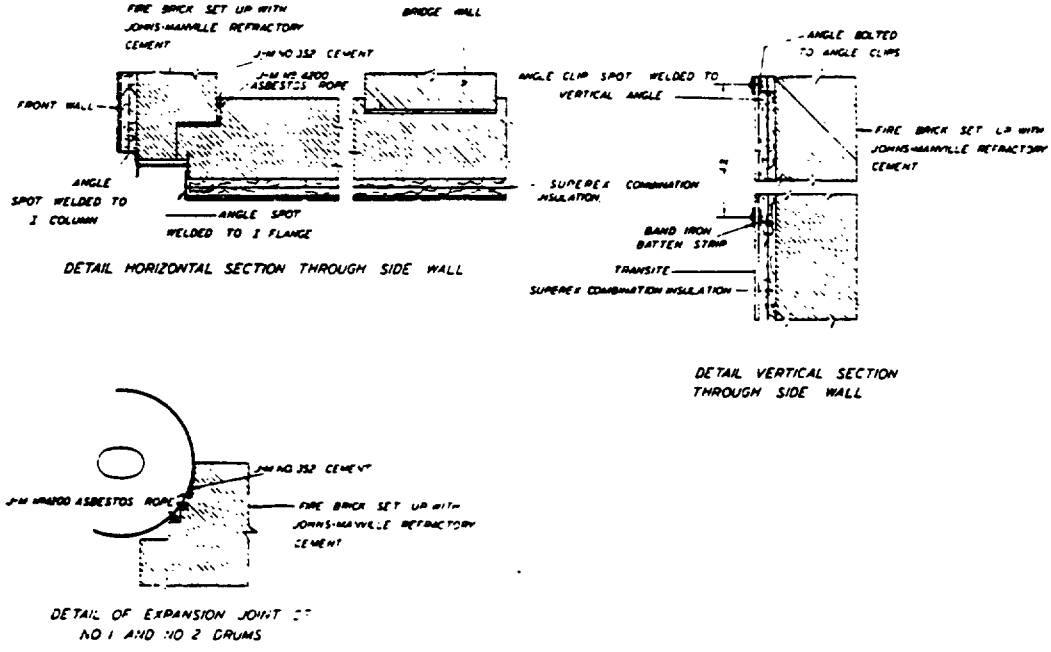


FIG. 2—BLOCK INSULATION RECOMMENDATION FOR STIRLING TYPE BOILER SETTING

closely butted and pointed up with J-M No. 302 Cement. Insulation less than 3 in. thick is similarly applied, but in only one layer. The method of supporting the insulation in place is the same as that described in the corresponding paragraph for B. & W. boiler settings.

Finish —As a finish over the insulation, either a Transite casing or J-M No. 302 Cement may be used, as outlined for B. & W. boilers.

Boiler Tops —Boiler tops are insulated over the fire tile with 3 in. thick Superex Combination Insulation which consists of 1½ in. thick Superex, followed by 1½ in. thick J-M 85% Magnesia with all joints broken, closely butted and pointed up with J-M No. 302 Cement. The insulation and cement finish are applied as described previously.

Recommendations for insulating boiler drums and accessory equipment will be found on subsequent pages.

Insulation for Springfield Type Boiler Setting Block Recommendation

Side Walls and Rear Walls—On boilers of the Springfield type, where there is no bridge wall, all exterior brickwork on the furnace, side walls and rear wall is insulated with 3 in. thick Superex Insulation (see Fig. 3). The fire brick walls are assumed to be 22½ in. thick.

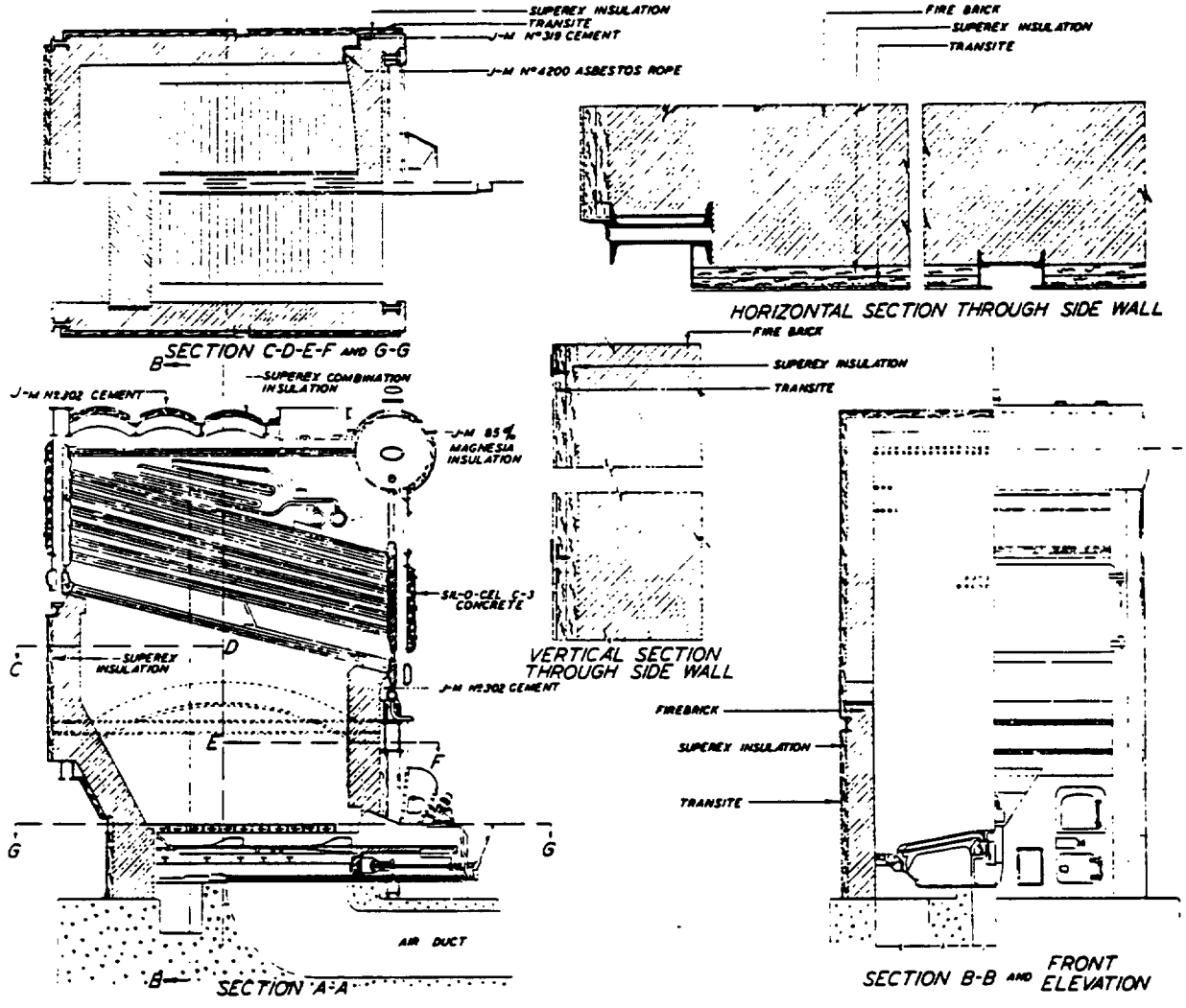


FIG. 3—BLOCK INSULATION RECOMMENDATION FOR SPRINGFIELD TYPE BOILER SETTING

The Superex Blocks are applied in two 1½ in. thick layers, broken joint construction, with all joints closely butted and pointed up with J-M No. 302 Cement. The insulation is secured in place as described in the recommendation for B. & W. type boilers. A Transite casing is applied over the Superex, or a cement finish is used, as previously described.

Boiler Top—The boiler top is insulated over the refractory with 3 in. thick Superex Combination Insulation, employing broken joint construction with all joints closely butted and pointed up with J-M No. 302 Cement. A cement finish over wire netting is applied in the usual manner.

Recommendations for insulating boiler drums and tube doors will be found in subsequent pages.

Insulating Brick Veneer Recommendation

Insulating brick can be used as a veneer insulation on the outside of either new or existing settings. The methods employed are described below, it being assumed that at least 18 in. of fire brick are used in the furnace and first pass.

New Settings—On new settings, the outer course of brick consists of 4½ in. of Sil-O-Cel C-22 Brick, as shown in Fig. 4. The insulating brick are laid up with the fire brick. In the combustion zone the C-22

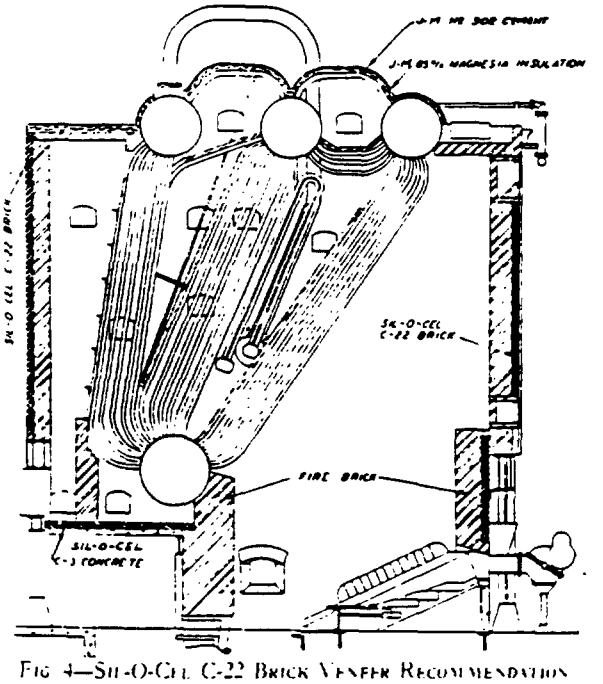


FIG. 4—SIL-O-CEL C-22 BRICK VENEER RECOMMENDATION FOR NEW BOILER SETTING



FIG. 5—SIL-O-CEL NATURAL BRICK VENEER ON EXISTING WATER TUBE BOILER WALL

Brick are bonded to the fire brick by means of a course of C-22 Brick laid as headers every fifth course vertically. In the balance of the setting the bond consists of C-22 Brick headers every fifth course, but with three stretcher brick between bonds, horizontally, instead of a solid row of headers.

Over Sil-O-Cel C-22 Brick no finish is necessary, as the brick themselves offer an attractive and durable surface. If a positive air seal is desired, however, the surface is primed with J-M Insulkote Primer and then coated with a ¼ in. to ⅜ in. thickness of Insulkote. This presents a dark brown surface which may be left unpainted, or, if desired, aluminum paint may be applied.

Existing Settings—Existing settings are insulated with 4½ in. of Sil-O-Cel Natural Brick (Fig. 5). Spikes or expansion bolts with wires attached to their heads, located on 2 ft. centers driven into the mortar joints of the brickwork, provide reinforcement. The Sil-O-Cel Natural Brick are then laid up tightly against the brickwork and 1 in. hexagonal mesh galvanized wire netting is applied

over the insulated surface and fastened by the projecting tie wires.

Two ¼ in. coats of J-M No. 302 Cement are then applied over the insulation, the first coat being left to dry with a rough surface before the application of the smooth finishing coat. J-M No. 302 Cement may be mixed with portland cement for the second ¼ in. coat, the proportion of portland cement being from ⅓ to ½ by weight, depending on the degree of hardness required. Where an additional air seal is desired, Aertite may be applied over the cement finish or, as an alternate, Insulkote may be substituted for the second coat of No. 302 Cement.

Note—For veneer constructions, the mortar furnished with Sil-O-Cel C-22 Brick and Sil-O-Cel Natural Brick should not be used. For this purpose, J-M No. 20 Plastic Refractory Cement should be thinned down to a creamy consistency and the brick dipped to provide a thin rubbed joint. Where Sil-O-Cel C-22 Brick are used and no additional finish is desired, the excess cement may be washed off with water before the cement sets.

Core Wall Insulation

In core wall insulation construction, insulating brick are built in as a "core" between the fire brick and an outer wall of red brick. The J-M recommendation for core wall insulation is restricted to water tube boilers of 500 hp. or less, and to return tubular boiler settings. Core wall construction is also employed very successfully on such equipment as heat-treating furnaces, malleable annealing ovens, ceramic kilns, etc.

For water tube boilers, Sil-O-Cel C-22 Brick are used 4½ in. thick in the furnace and first pass behind at least 13½ in. of fire brick. On the remainder of the setting Sil-O-Cel Natural Brick are used 4½ in. thick behind at least 9 in. of fire brick. (Figs. 6, 7 and 8).

In the furnace and first pass the bond consists of a solid course of fire brick headers and a solid course of red brick headers joined through the insulation course. This bond is formed every fifth course vertically. In other parts of the setting the bond consists

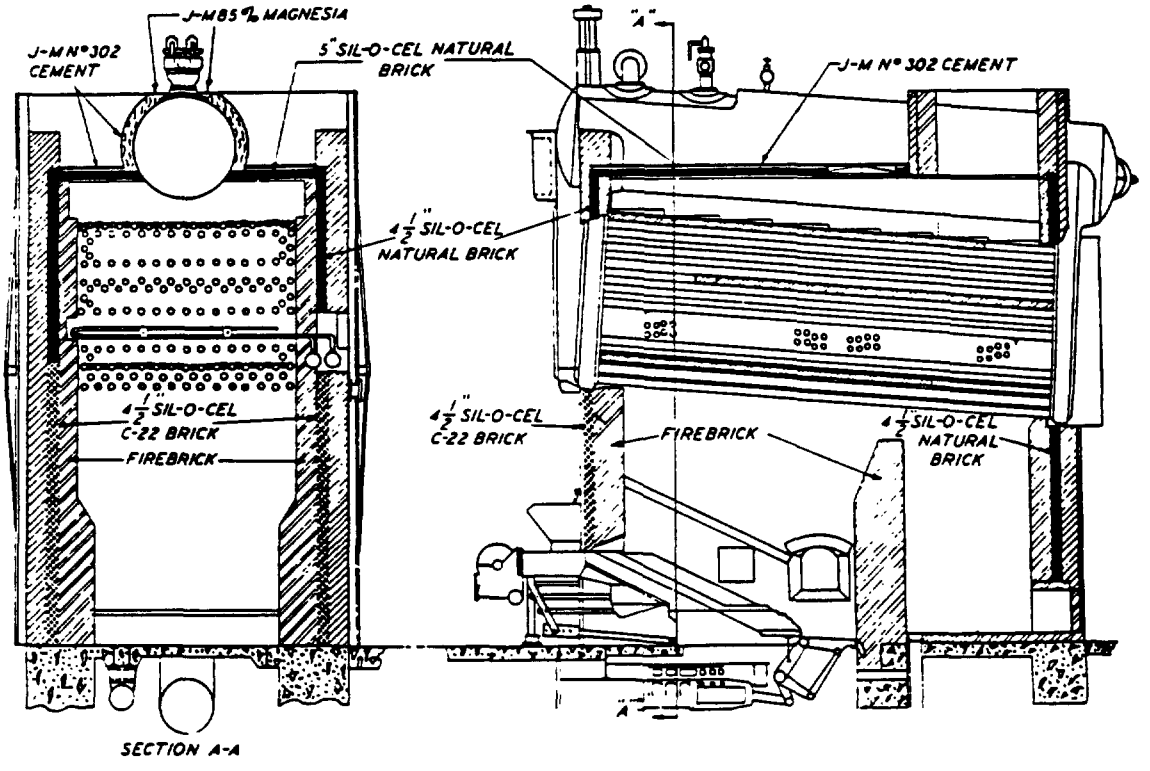


FIG. 6—HEINE BOILER SETTING INSULATED WITH SIL-O-CEL BRICK IN CORE WALL CONSTRUCTION

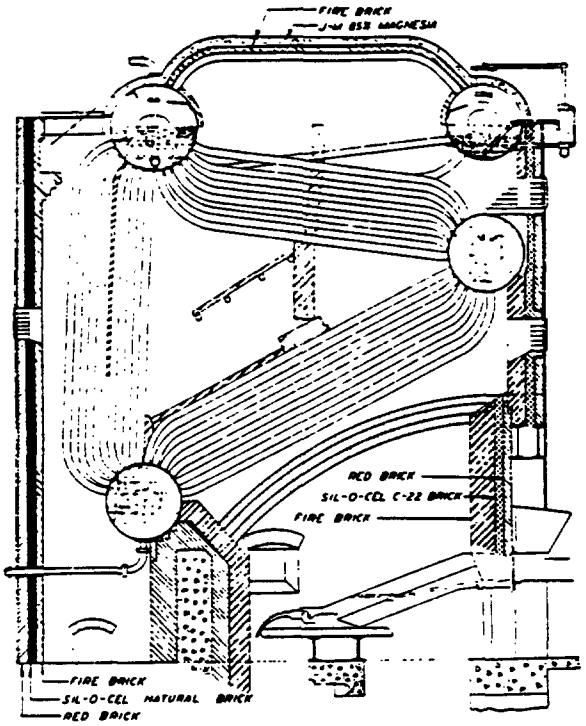


FIG 7—CORE WALL INSULATION RECOMMENDATION FOR BOILER SETTING (500 HP. OR LESS)

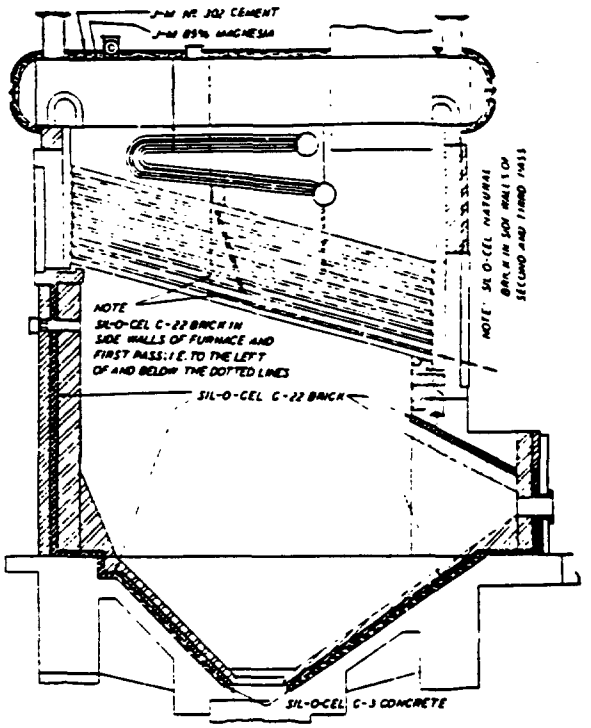


FIG. 8—CORE WALL INSULATION CONSTRUCTION IN BOILER FURNACE FIRED WITH BLAST FURNACE GAS

of two adjacent fire brick headers and two adjacent red brick headers joined through the insulation course. This bond is formed every fifth course vertically, with three insulating brick as stretchers between the bonds, horizontally. (Note: In core wall construction, insulating brick should not be used as bonds.)

To eliminate any possibility of heat leakage through joints, the Sil-O-Cel Brick should be laid up in Sil-O-Cel Mortar with the thinnest possible rubbed joints. This mortar is furnished at the rate of 80 lb. per thousand brick.

The insulating brick are backed up with an 8 in. wall of red brick laid in portland cement mortar.

Water-Cooled Boiler Wall Insulation and Casing

Johns-Manville engineers have developed methods of insulating and casing water walls which offer maximum efficiency, durability and ease of application. Complete specifications and drawings have been worked out in co-operation with the designers of the walls.

Bailey furnace walls, for instance, are insulated with: First, a filler coat of J-M No. 450 Cement applied over the metal work to provide a level surface for the application of the insulating blocks; then two layers of insulation, either J-M 85% Magnesia, or Superex and Magnesia (if the temperatures are above 600 deg. F.) are applied. The insulation is then encased with removable and replaceable panels of Transite, 3/8 in. thick (see Fig. 9). This construction permits the changing of a few blocks, or one or two tubes, without disturbing the insulation anywhere on the wall except that portion which covers the parts to be changed. It has proved eminently satisfactory on every installation of Bailey furnace walls.

Detailed specifications and drawings for the insulation and casing of other types of boiler water walls are also available and may be had on application to any Johns-Manville office. The usual con-

struction consists of Superex Confirmation Insulation one layer of Superex and one layer of J-M 85% Magnesia applied over the water walls in broken joint construction. A removable and replaceable panel type casing of Transite ¼ in. thick, is applied over the insulation (Fig. 10).

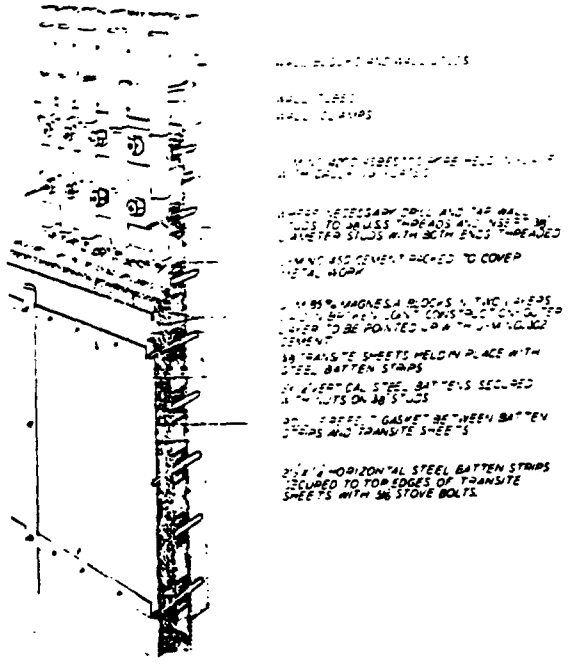


Fig. 9—Bailey Water-wall Insulation Recommendation

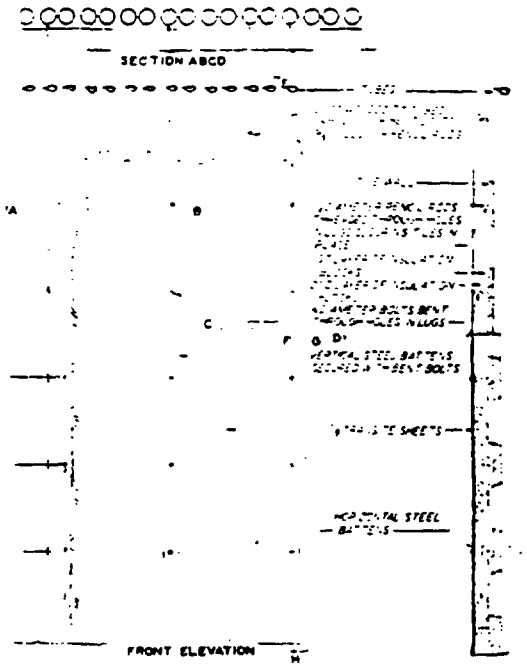


Fig. 10—Tile-faced Water-wall Insulation

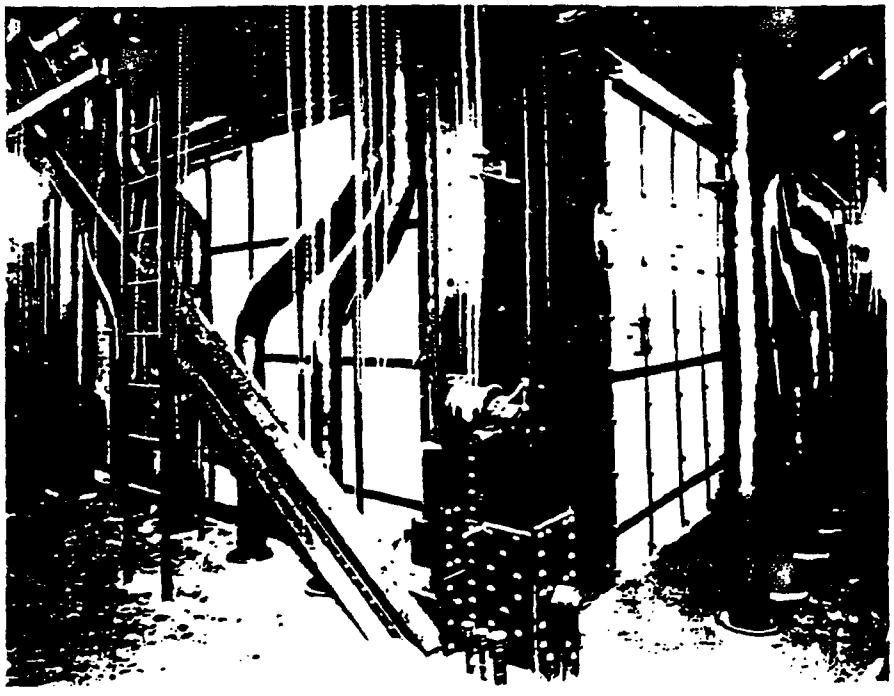


Fig. 11—Bailey Water-wall Insulation with Transite Casing

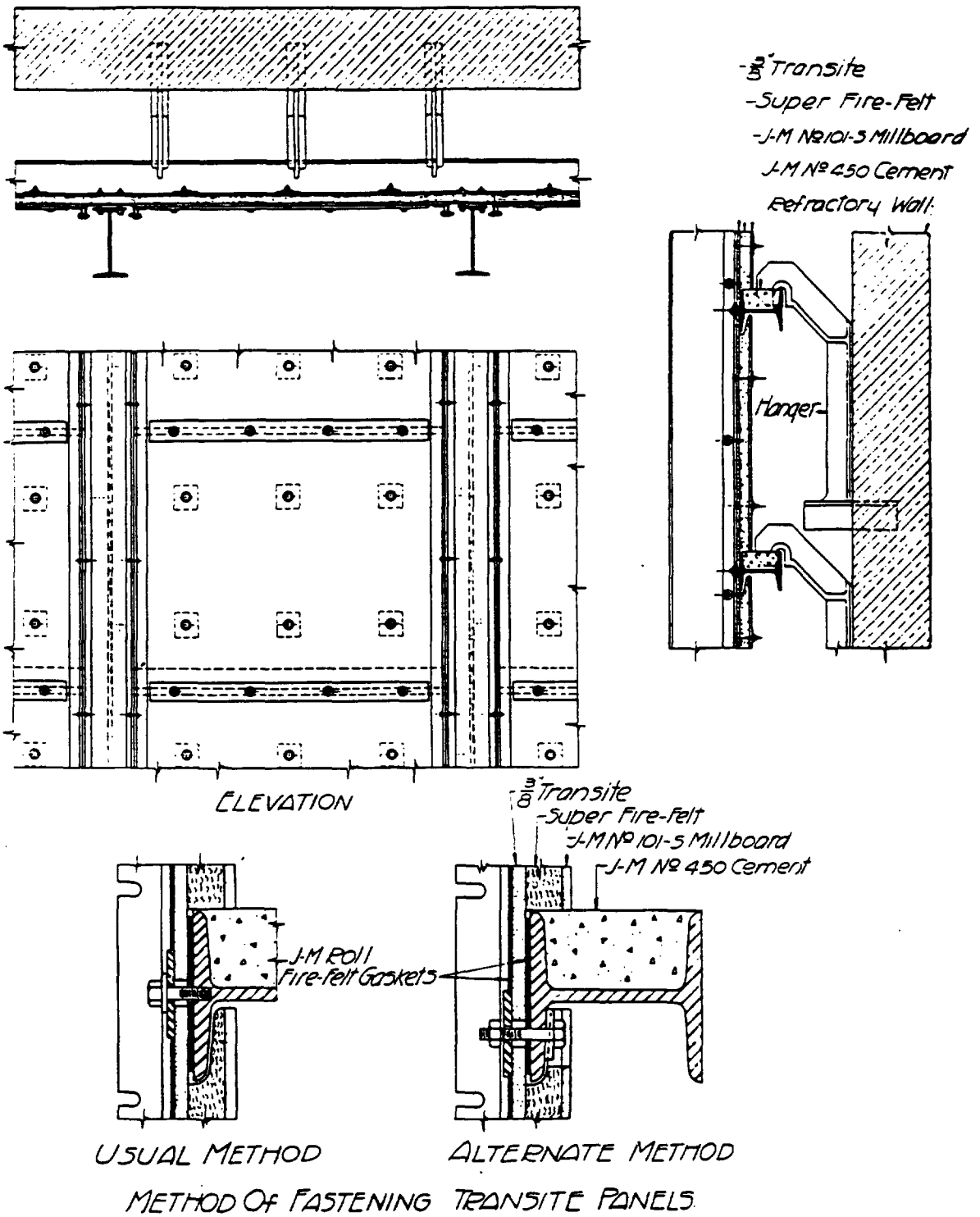


FIG. 12—INSULATION RECOMMENDATION FOR AIR-COOLED FURNACE WALLS

Air-Cooled Boiler Wall Insulation and Casing

Whatever kind of air passages are provided over the surface of ventilated boiler walls, their function is to retain the heat recovered by the air, furnish a suitable clearance for air travel so that adequate scrubbing action is combined with the elimination of undue friction loss and resist the infiltration of air which would interrupt the flow over surfaces to be cooled. Furthermore, the construction should be fireproof and able successfully to withstand abrasion, ordinary mechanical impact and high temperature.

As in the case of water walls, definite specifications have been developed by Johns-Manville for the insulation and casing of various types of air-cooled walls. The construction most generally used consists of removable and replaceable panels composed of outside sheets of Transite, $\frac{3}{8}$ in. thick, inside sheets of J-M No. 101-S Millboard, $\frac{1}{4}$ in. thick, and an intermediate layer of J-M Super Fire-Felt Sheets 1 in. thick (Fig. 12). These panels are fabricated as a unit by means of $\frac{3}{8}$ in. x $2\frac{1}{2}$ in. round head stove bolts with standard bolt washers outside and with nuts on the inside bearing against $\frac{1}{8}$ in. x 3 in. x 3 in. square iron washers laid against the furnace surface of the Millboard.

Behind each vertical buckstay, Super Fire-Felt Blocks 1 in. thick, and of a width equal to that of the back of the buckstay, are erected with an inside protective layer of $\frac{1}{4}$ in. thick No. 101-S Millboard and held in place by means of $\frac{3}{8}$ in. bolts passing through bevel washers to the backing channel of the buckstay and terminating inside with nuts bearing upon $\frac{1}{8}$ in. x 3 in. x 3 in. square iron washers laid against the furnace side of the Millboard.

Previous to the erection of the fabricated panels, all horizontal H-beams over the air-cooled portion of the wall are filled with J-M No. 450 Cement from the web to a point level with the top of the flange.

Application of insulation and casing is ordinarily completed prior to the erection of brick furnace walls (Fig. 13).

Casing panels are erected in place over the walls after fabrication is complete, and maintained in

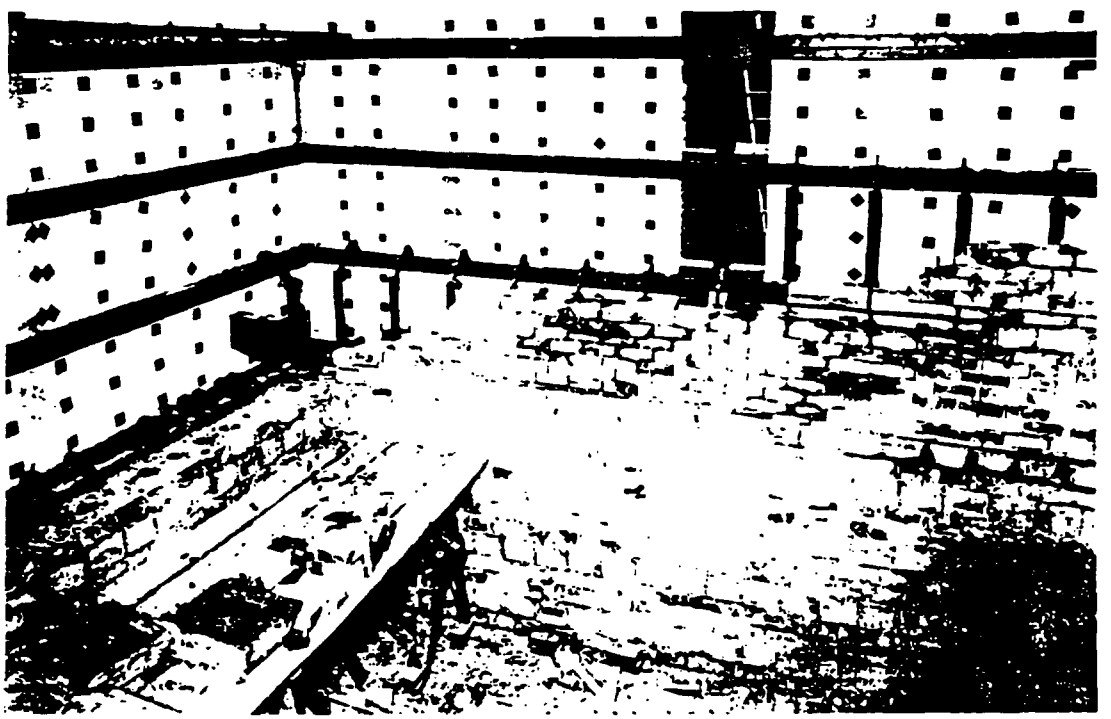


Fig. 13—Interior of Insulated Transite Casing Erected Outside Air-cooled Furnace Walls. Brickwork Is Laid After the Casing Is Completed

position by 2½ in. x ¼ in. horizontal steel battens bolted to the horizontal H-beams by means of ⅝ in. x 1¼ in. cap screws with washers. Vertical joints between casing panels and buckstays are sealed by means of 1½ in. x 1½ in. x ⅛ in. angles with slotted holes for ⅝ in. bolts, on approximately 18 in. vertical centers. These angles are bolted securely to the channel backing of the buckstays and pressed firmly against the Transite panels as the final operation. All joints between supporting steel work and casing which may be subject to air leakage should be gasketed, during erection, with Roll Fire-Felt, ⅛ in. in thickness.

This construction combines adequate insulation with high heat resistance, impermeability, durability and a permanently attractive exterior surface. The removable and replaceable panels offer the further distinct advantage of maximum accessibility. This specification meets every requirement demanded of the ideal casing for air-cooled boiler walls.

Waste Heat Boiler Insulation

When the gases from open hearths and similar equipment are used in waste heat boilers, heat conservation is particularly important. In such cases not only should the furnaces and regenerators be insulated and sealed against air infiltration, but the entire flue system and the waste heat boilers themselves must be thoroughly blanketed against heat loss if the system is to operate economically. A difference of 100 degrees in the temperature of gases delivered to the waste heat boilers may determine whether the boilers operate at a loss or pay a worthwhile return on the investment. Complete insulation, therefore, is an absolute necessity wherever so-called "waste heat" is utilized. The methods of insulating waste heat boilers are usually the same as those employed in direct-fired boilers.

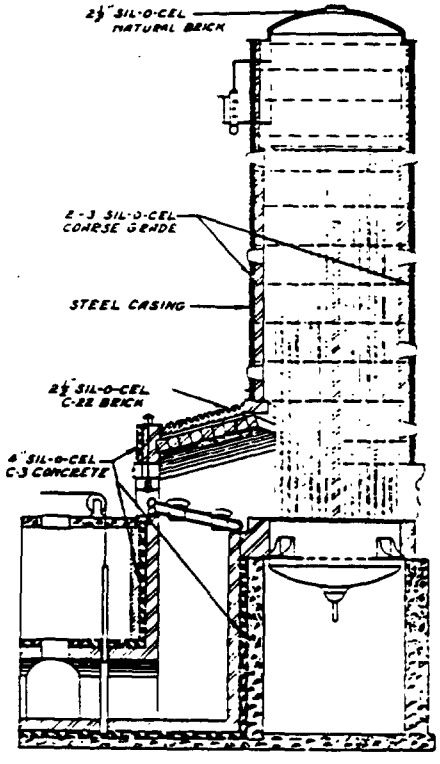


FIG. 14—METHOD OF INSULATING WICKES VERTICAL OPEN-HEARTH WASTE HEAT BOILER



FIG. 15—SUPEREX COMBINATION INSULATION (2 IN. SUPEREX, 1½ IN. MAGNESIA) BEING INSTALLED IN WASTE HEAT BOILER

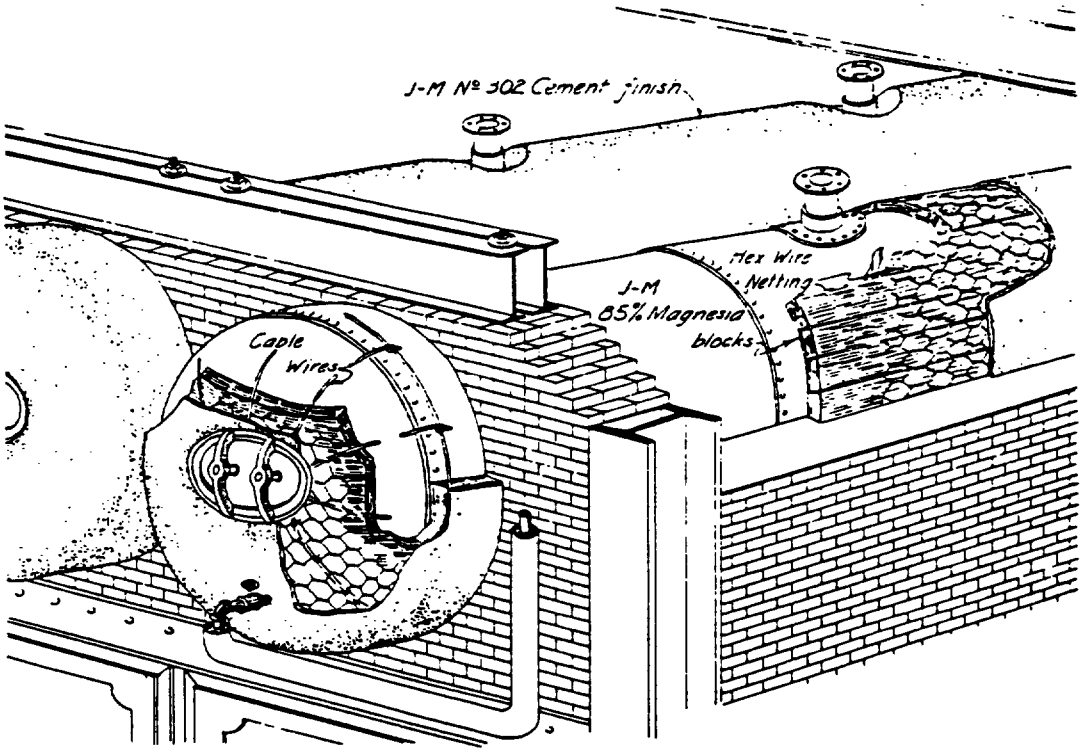


FIG. 16—METHOD OF INSULATING DRUMS AND DRUM-HEADS

Drum and Drum-Head Insulation

Exposed drums and drum-heads are insulated with J-M 85% Magnesia Insulation, which is furnished in blocks 6 in. x 36 in. and applied in one layer with all joints closely butted and pointed up with J-M No. 302 Cement. The insulation is 1½ in. thick for steam pressures of 25 to 100 lb.; 2 in. thick for pressures of 100 to 200 lb.; and 2½ in. thick for pressures of 200 lb. and over. On the drum-heads the insulation is held in place by suitable cables and lacing wire (see Fig. 16). Over the insulation, 1½ in. hexagonal mesh galvanized wire netting is stretched and fastened. Two ¼ in. coats of J-M No. 302 Cement are then applied over the insulation, the first coat being left to dry with a rough surface before the application of the smooth finishing coat. Where an exceptionally hard finish is desired, J-M No. 302 Cement may be mixed with portland cement for the second ¼ in. coat, the proportion of portland cement being from ⅓ to ½ by weight, depending on the degree of hardness required.

Boiler Tube Door Lining

Sil-O-Cel C-3 Concrete Lining

Where boiler tube doors have not yet been hung and can be laid horizontally so that the material can be tamped in place, the insulation consists of Sil-O-Cel C-3 Concrete of such thickness as to completely fill the inner portion of the door. The C-3 Concrete is reinforced by installing bolts projecting from the door face so as to extend part way through the lining (Fig. 17).

Sil-O-Cel C-3 Concrete is made by mixing Sil-O-Cel C-3 and portland cement in the proportion of four parts of C-3 to one part of portland cement by

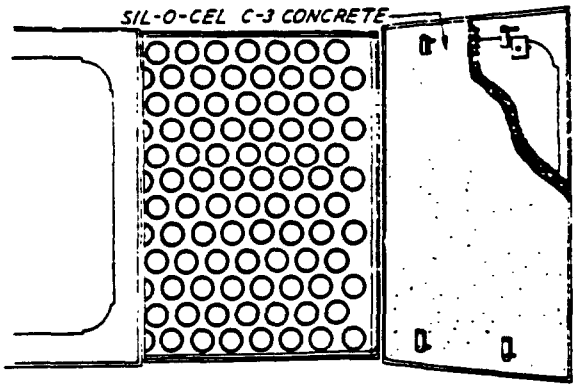


FIG. 17—METHOD OF INSULATING TUBE DOORS WITH SIL-O-CEL C-3 CONCRETE

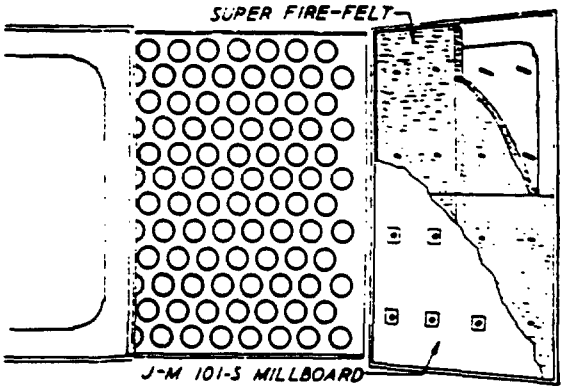


FIG. 18—METHOD OF INSULATING TUBE DOORS WITH SUPER FIRE-FELT

volume. An excess of moisture should be avoided. After thorough mixing, the Sil-O-Cel C-3 Concrete is rammed in place in the door with a heavy tamper. The top surface should be kept damp for approximately 48 hours.

Super Fire-Felt Lining

When the use of Sil-O-Cel C-3 Concrete is not practical, the tube doors are lined with Super Fire-Felt Sheets, 2 in. thick, secured in place by means of ⅜ in. x 3 in. x 3 in. plate washers which are fastened to the door by bolts running through the insulation and the door (Fig. 18). All joints between sheets and around the edges of outside sheets are sealed with J-M No. 319 Cement.

The exposed surface of the insulation is covered with ¼ in. J-M No. 101-S Millboard, held in place by means of the plate washer construction described above. Bolts and washers should be provided on approximately 12 x 12 in. centers.

Insulation of Fire-Box Type and Cast-Iron Sectional Boilers

All exposed metal surfaces of fire-box type boilers and cast-iron sectional boilers are insulated with J-M 85% Magnesia Insulation of the proper thickness, depending upon steam pressures (see Figs. 19 and 20). For steam pressures up to 25 lb., 1 in. thick Magnesia should be used, for pressures from 25 to 100 lb. 1½ in., and for pressures of 100 to 200 lb., 2 in. The finish consists of ⅛ in. No. 302 Cement, applied in two layers, as previously described for drum insulation on page 83.

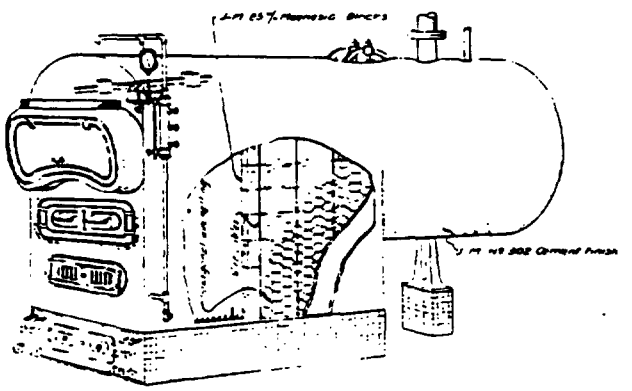


FIG. 19—METHOD OF INSULATING FIRE-BOX TYPE BOILERS

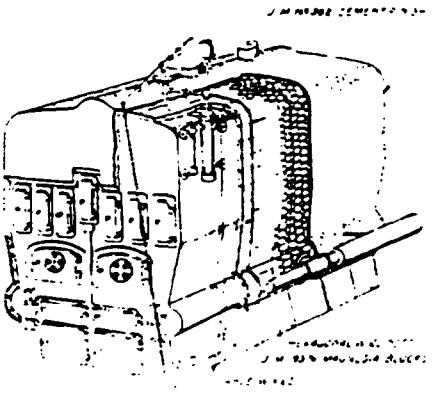


FIG. 20—METHOD OF INSULATING CAST-IRON SECTIONAL BOILERS

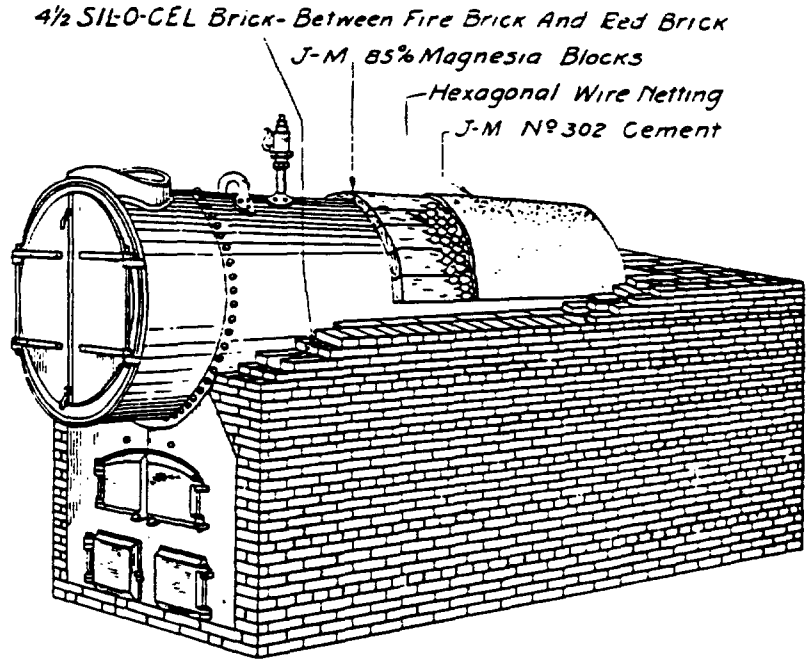


Fig. 21—Method of Insulating H.R.T. Boiler

Insulation of H.R.T. Boilers and Settings

The settings of H.R.T. boilers are ordinarily insulated in core wall construction with a 4½ in. course of Sil-O-Cel Natural Brick (Fig. 21) between the fire brick and red brick as described on page 77. As alternate constructions, insulating block or brick may be applied on the outside of the brickwork.

The exposed surfaces of the boiler shell are insulated with J-M 85% Magnesia Blocks of the following thickness: For steam pressures up to 25 lb., 1 in. thick; for pressures of 25 to 100 lb., 1½ in., and for pressures of 100 to 200 lb., 2 in. Over the insulation 1½ in. hexagonal mesh galvanized wire netting is stretched and two ¼ in. coats of insulating cement applied, as described under drum insulation.

Steam Turbine Insulation

Steam Temperature—600 deg. F. and Over

The iron surfaces of the upper and lower halves of the high pressure turbine shell, including inlet pipe, bodies of the controlling and throttle valves, flanges between throttle and controlling valves and between the controlling valves and the turbine shell, are insulated with 1½ in. thick Superex Insulation and 1½ in. thick J-M 85% Magnesia, together with a ½ in. J-M No. 302 Cement finish—a total thickness of 3½ in.

In applying the insulation, all irregularities are first filled with J-M No. 302 Cement. Then each layer of insulating blocks is securely wired in place on the surface of the shell, using broken joint construction, closely butting all blocks, and pointing up joints with J-M No. 302 Cement. A cement finish is then applied over the wire netting in two ¼ in. coats, as previously described.

Steam Temperature—400 to 600 deg. F.

The casings of turbines supplied with steam at these temperatures are insulated with 3 inches of

J-M 85% Magnesia Blocks, preferably applied in two layers with all joints closely butted and sealed with J-M No. 302 Cement and securely wired in place. A cement finish is then applied over wire netting in two ½ in. coats in the usual manner.

Steam Temperature—400 deg. F. and Under

The casings of turbines supplied with steam at temperatures from 300 to 400 deg. F. are insulated with 2 in. thick J-M 85% Magnesia Blocks. For temperatures below 300 deg. F., 1½ in. thick J-M 85% Magnesia Blocks are applied as previously described, and finished with cement in two ¼ in. coats.

Asbestos Blanket Insulation for Turbines

The demand for removable insulation construction which would provide quick accessibility to bolt heads of turbine flanges, fitting flanges and valve bonnets, and which would be durable, clean and not damage the surrounding insulation when it was removed, has been responsible for the development of a highly efficient asbestos blanket insulation.

The following parts of the turbines are insulated with J-M Asbestos Blankets of the same thickness as the adjacent block insulation:

Horizontal flanges between the upper and lower halves of the turbine shells.
Throttle valve top bonnets.
Throttle valve bottom bonnets.
Controlling valve top bonnets.
Controlling valve bottom bonnets.
Controlling valve strainer bonnets.

J-M Asbestos Blankets are made of pure asbestos cloth in envelope form, filled with brown asbestos fibre and tufted with copper wire at close intervals. The edges and seams are sewed with asbestos cord, using sewed-on monel metal hooks or rings in lieu of holes through the cloth. The blankets are made to suit each individual case.

Blankets are applied in two layers of equal thickness, except when the space allowed for insulation by the design of the sheet metal cover is less than 3 in., in which case the blanket is made and applied in a single layer.

Insulation of Feed-Water Heaters, Pump Cylinders and Chests

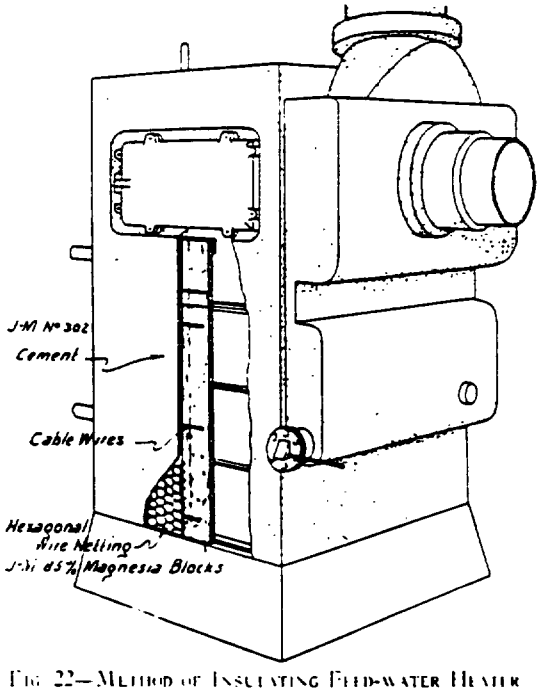


FIG. 22—METHOD OF INSULATING FEED-WATER HEATER

Feed-Water Heaters

The entire exposed surface of the feed-water heater is insulated with J-M 85% Magnesia Blocks, 1½ in. thick, secured in place with suitable cables and wiring, all joints being closely butted and sealed with J-M No. 302 Cement.

Over the insulation is applied wire netting and two coats of cement, as previously described. (See Fig. 22).

Pump Cylinders and Chests

The steam and hot water cylinders and chests of all pumps are lagged with J-M 85% Magnesia Blocks, 2 in. thick, with all joints tightly butted and sealed with J-M No. 302 Cement. Over the insulation, an iron jacket is applied.

The insulation on the chests and cylinder heads should be applied in such a manner that it, together with the iron jacket, may be readily removed and replaced.

Insulation of Breechings and Ducts

No one doubts the advisability of insulating smoke flues, breechings and ducts in order to maintain the sensible heat of the gas being conveyed. Steel ducts are protected from corrosion, draft is improved, excessive room temperatures are avoided, and workmen are shielded from burns on the hot metal. When economizers or air preheaters are used the sustained temperature head increases the effectiveness of heat recovery. In the following paragraphs are set forth several insulation methods, which may be adapted to meet any requirements.

Internal Insulation—Superex Block Temperatures to 1000 deg. F.

Breechings and ducts are lined with 2 in. thick Superex Blocks laid longitudinally and bonded to the steel with J-M Fibrous Adhesive. The insulation blocks are held in place by means of two 14-gauge iron tie wires laced over each block and fastened to the inside of the flue as described below:

Suitable anchors for the tie wires, such as angle clips with a hole punched in the outstanding leg, small washers or nuts set on edge, are welded to the inside surface of the flue. These anchors are placed on 12 x 18 in. centers on ceiling and 12 x 24 in. centers on side walls and have the tie wires fastened through them. An additional set of 14-gauge annealed iron tie wires for fastening the wire mesh to the surface of the block are fastened through the anchor clips.

Over the blocks, 16-gauge 1 in. hexagonal mesh galvanized wire netting is stretched and secured to the clips by means of the tie wires. Over this netting J-M No. 319 Cement is applied in two coats to a total thickness of 1½ in. The first coat is worked well into the wire mesh, left rough and allowed to dry thoroughly before the succeeding coat is applied. The finishing coat is troweled to a smooth, uniform surface.

Internal Insulation—Sil-O-Cel Brick Temperatures to 1000 deg. F.

Breechings and ducts are lined on the inside with 2½ in. Sil-O-Cel Natural Brick, bonded to the steel with J-M Fibrous Adhesive and further held in place by lacing wires as described below:

Anchors for the tie wires (which may be angle clips with a hole punched in outstanding leg, or square washers or nuts on edge) are spot-welded to the inside breeching surface, spaced on 12 x 18 in. centers on the top and 12 x 24 in. centers on the sides. No clips are necessary on the bottom. As the brick are applied, they are secured in place by wires, laced through the anchor clips. (See Fig. 25.)

Over the surface of the brick is stretched 16-gauge 1 in. hexagonal mesh galvanized wire netting, securely fastened to the lacing wires.

A finish of ½ in. J-M No. 319 Cement is then applied in the same manner as described previously for the Superex lining.

External Insulation—Magnesia or Superex Blocks Applied Over Air Space

For temperatures up to 600 deg. F., breechings and ducts are insulated on the outside with 2 in. thick J-M 85% Magnesia Blocks applied over an air space formed by projecting stiffeners.

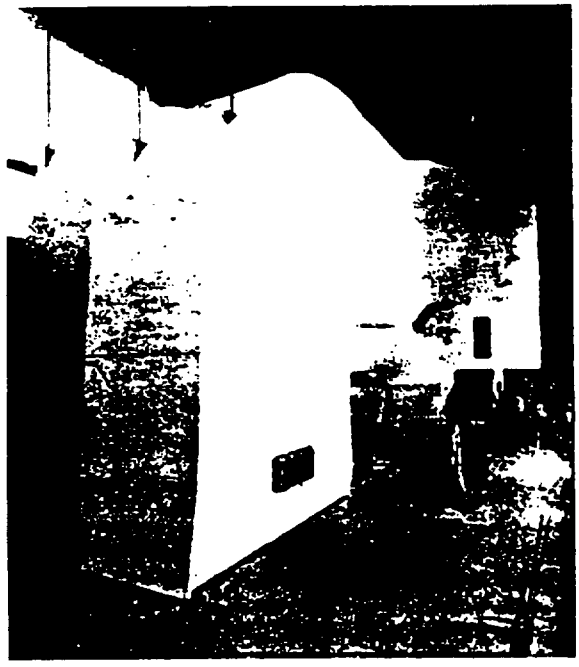


Fig. 23—Chimney Flue Insulated with Superex Blocks with Cement Finish



Fig. 24—Boiler Breeching Being Lined on Inside with 2½ in. Sil-O-Cel Natural Brick and Facing of Semi-refractory Cement

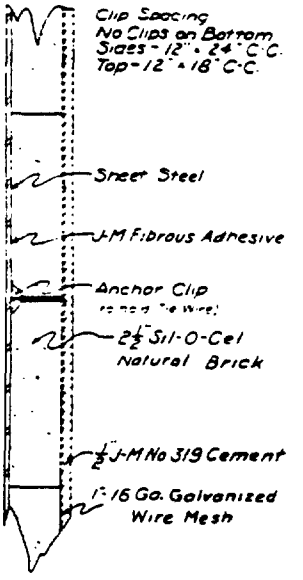


Fig. 25—Breeching Lining with Sil-O-Cel Brick

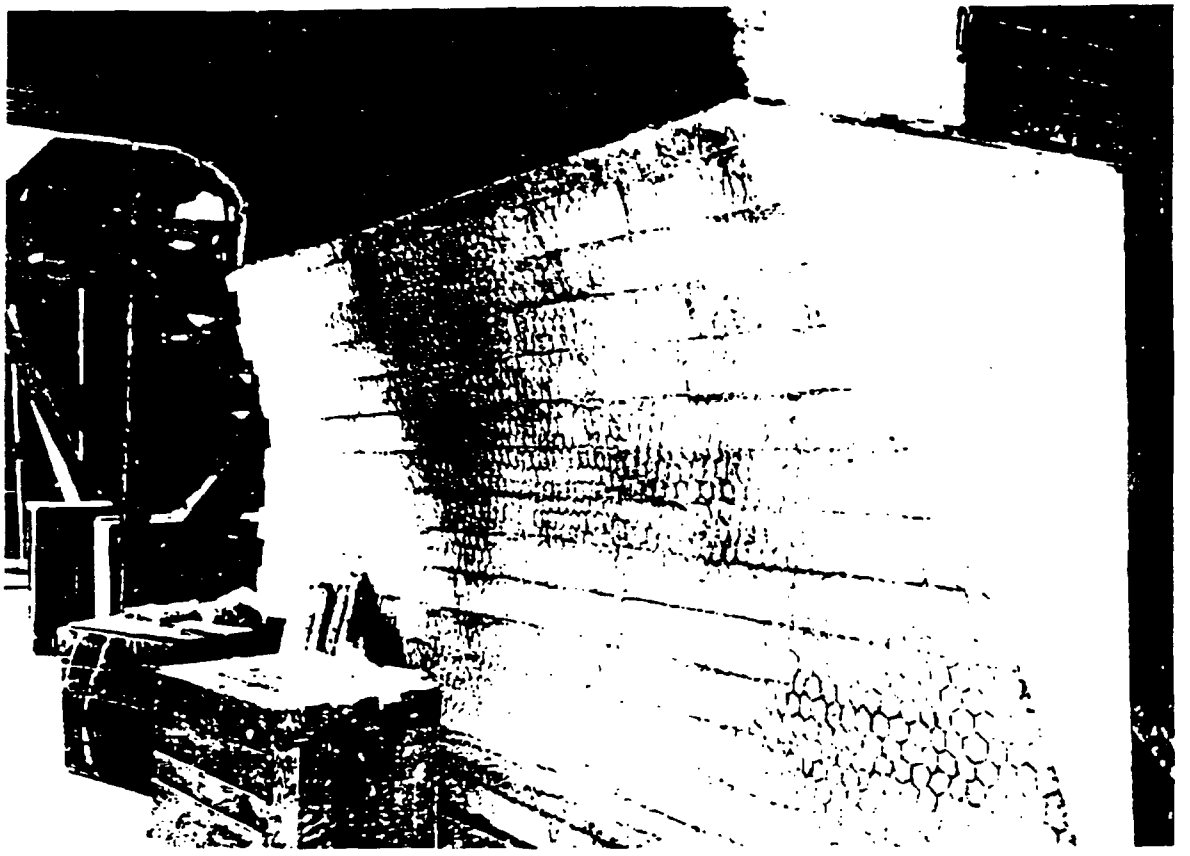


Fig. 26—Block Insulation Applied to a Breeching

For temperatures over 600 deg. F., breechings and ducts are insulated over an air space with 2 in. thick Superex Blocks instead of Magnesia Blocks.

The air space is formed by applying 6 in. square mesh 6-gauge wire fabric over the stiffening members (Fig. 27). On Connery flues the fabric is spot-welded to the V-ribs at suitable intervals. On other flues the fabric is securely laced to stiffening angles.

On up-takes or surfaces not provided with projecting stiffeners, the air space is not less than 1 in. in depth, and formed with V-rib metal lath securely wired in place.

The insulating blocks are secured over the fabric with suitable cable fastenings. Over the blocks, 1½ in. hexagonal mesh galvanized wire netting is stretched tightly and fastened to the cables and lacing wires. Two ¼ in. coats of J-M No. 302 Cement are applied over the insulation, the first coat being left to dry with a rough surface before the application of the smooth finishing coat. Where an exceptionally hard finish is desired, J-M No. 302 Cement may be mixed with portland cement for the second ¼ in. coat, the proportion of portland cement being from ⅓ to ½ by weight, depending on the degree of hardness required.

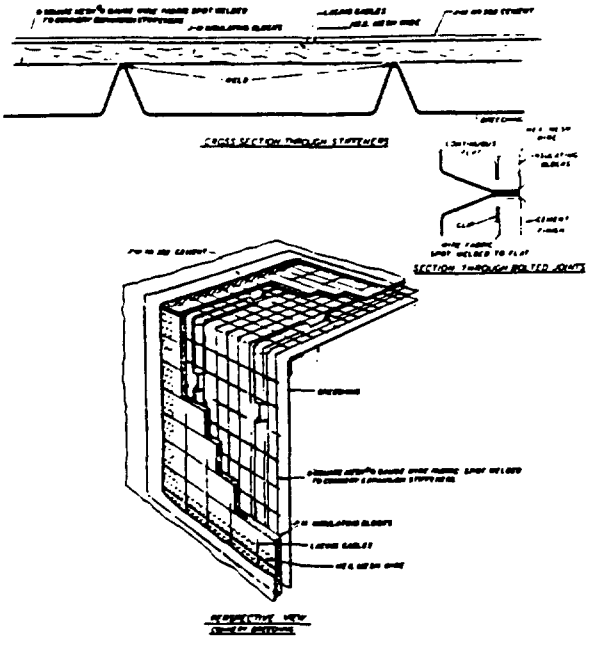


FIG. 27—EXTERNAL INSULATION OF CONNERY FLUE, APPLIED OVER AIR SPACE

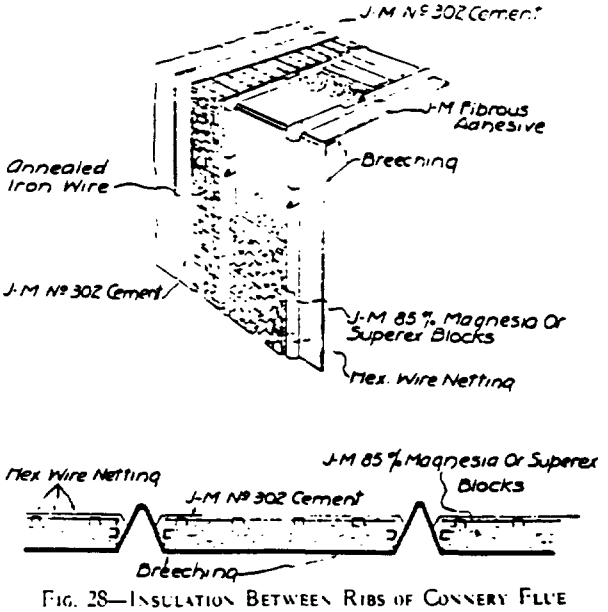


FIG. 28—INSULATION BETWEEN RIBS OF CONNERY FLUE

External Insulation—Magnesia or Superex Blocks Without Air Space

For temperatures up to 600 deg. F., breechings and ducts are insulated with 2 in. thick J-M 85% Magnesia Blocks laced directly to the outside surface of the flues.

For temperatures over 600 deg. F., breechings and ducts are insulated with 2 in. Superex Blocks in place of 85% Magnesia Blocks, and similarly applied.

Over the insulation, 1½ in. hexagonal mesh galvanized wire netting is stretched and fastened to the cables and lacing wire. A cement finish is then applied in two ¼ in. coats, as previously described.

Note—On Connery flues the insulation blocks are applied only between the V-ribs and secured with J-M Fibrous Adhesive. The V-ribs are left exposed, as shown in Fig. 28.

Magnesia or Superex Blocks Over Air Space Where Stiffening Angles Are More than 4 Feet Between Centers

For temperatures up to 600 deg. F., breechings and ducts are insulated on the outside with 2 in. thick J-M 85% Magnesia Blocks, applied over an air space formed by V-rib lath, with 1 in. ribs.

For temperatures over 600 deg. F., breechings and

ducts are insulated on the outside with 2 in. thick Superex Blocks, applied over the air space formed by V-rib lath with 1 in. ribs. The V-rib lath is securely wired in place on the surface of the flue, and the block insulation is then securely wired to the lath. All joints are closely butted and sealed with J-M No. 302 Cement. A cement finish is then applied in the usual manner (see Fig. 29).

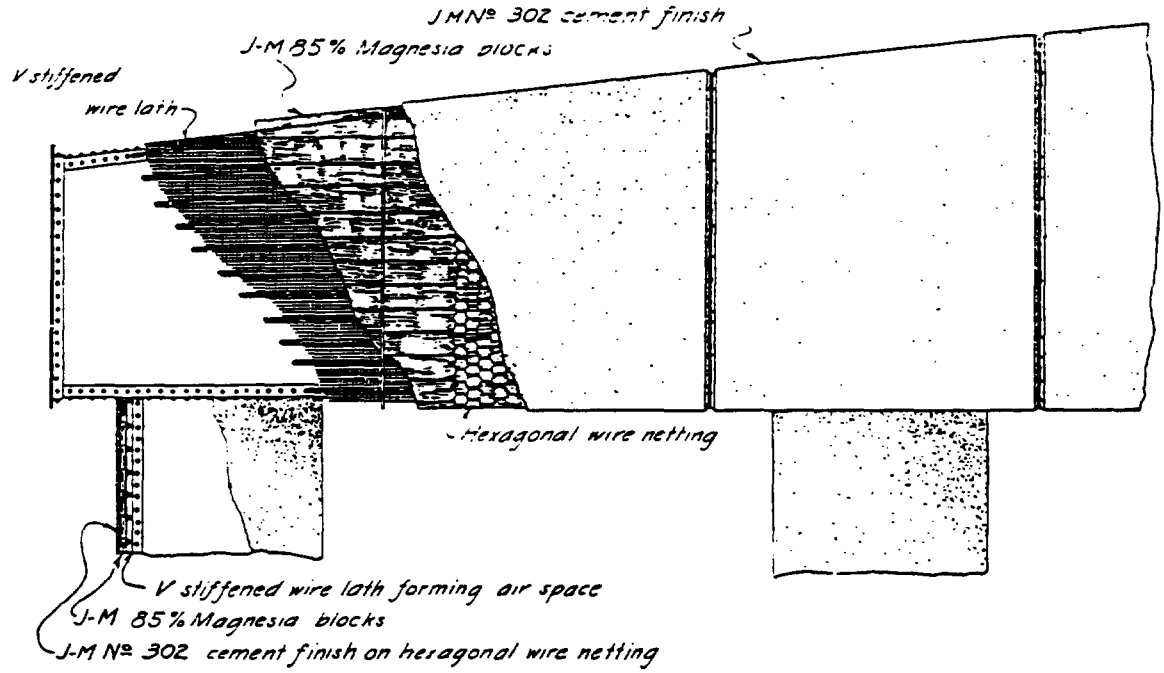


FIG. 29—SMOKE FLUE AND UP-TAKE INSULATION WITH STIFFENERS MORE THAN 4 FT. APART

Stack Lining

Sil-O-Cel Brick Lining

During recent years many steel stacks have been lined with Sil-O-Cel Brick with very satisfactory results. In industrial plants stacks are lined to prevent corrosion of the steel, increase draft and improve the operation of the equipment. In office buildings and hotels they are lined for the additional purposes of reducing fire hazard and keeping rooms adjacent to the stack shaft from becoming too warm.

Stacks are usually lined with 2½ in. of Sil-O-Cel Natural Brick, although in some cases Sil-O-Cel C-22 Brick has been used, as shown in Fig. 31. Prior to application of the insulation, circumferential angles, 2 in. x 2 in. x ⅛ in., are placed in the stack on 37 in. vertical centers, the outstanding leg punched with ¼ in. holes on 12 in. centers. After the inside surface of the stack is cleaned of all paint or other foreign material, the Sil-O-Cel Brick are applied, securely cemented to the stack with J-M



FIG. 30—SIL-O-CEL NATURAL BRICK STACK LINING

fibrous Adhesive and further held in place by vertical lacing wires, laced through the ¼ in. holes in the circumferential angles.

Over the surface of the brick is stretched 1 in. hexagonal mesh galvanized wire netting, securely fastened to the lacing wires. Two coats of J-M No. 319 Cement are then applied to a total thickness of ½ in., the first ¼ in. coat being left to dry with a rough surface before the application of the smooth finishing coat (see Fig. 32).

Vitribestos Lining

Vitribestos Sheets, 2 in. thick, are adaptable for lining stacks at temperatures up to 700 deg. F.

The Vitribestos Sheets are furnished 24 in. x 30 in., curved to fit the radius of the stack. They are supported in the stack at 30 in. intervals on 1 in. x 1 in. x ⅛ in. angle rings riveted or bolted to the stack. These angle rings are punched on the outstanding leg with ⅝ in. holes at 12 in. intervals, and the sheets are held in place by 2 in. x 4 in. 12-gauge washers and ⅝ in. rivet bolts through the holes in the rings (see Fig. 33). All joints are sealed with J-M No. 319 Cement, and the angle rings and all exposed washers and bolts are covered and protected with J-M No. 319 Cement.

At the top of the stack, the Vitribestos should be sealed against the entrance of moisture by an angle ring continuously welded to the steel stack, or by suitable sheet lead flashing, securely fastened in place.

An alternate method of attaching the Vitribestos sheets is shown in Fig. 34.

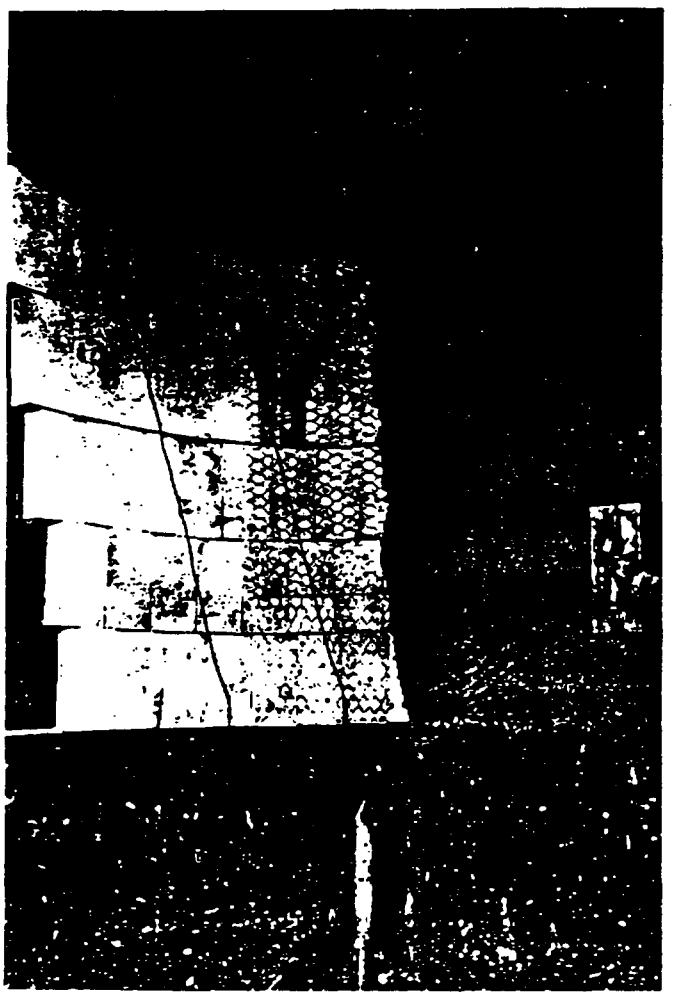


Fig. 31—Sil-O-Cel C-22 Brick Stack Lining.

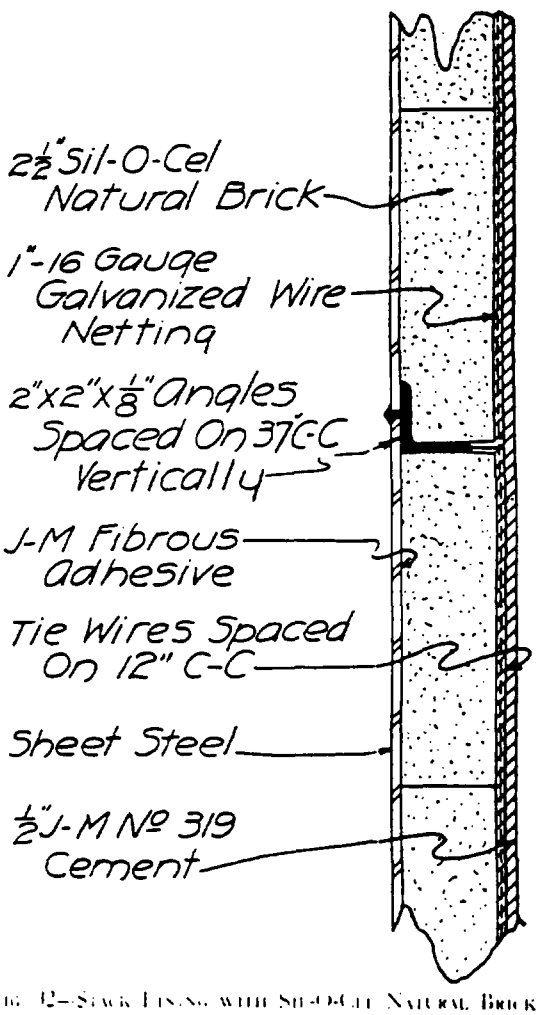


Fig. 32—Stack Lining with Sil-O-Cel Natural Brick.

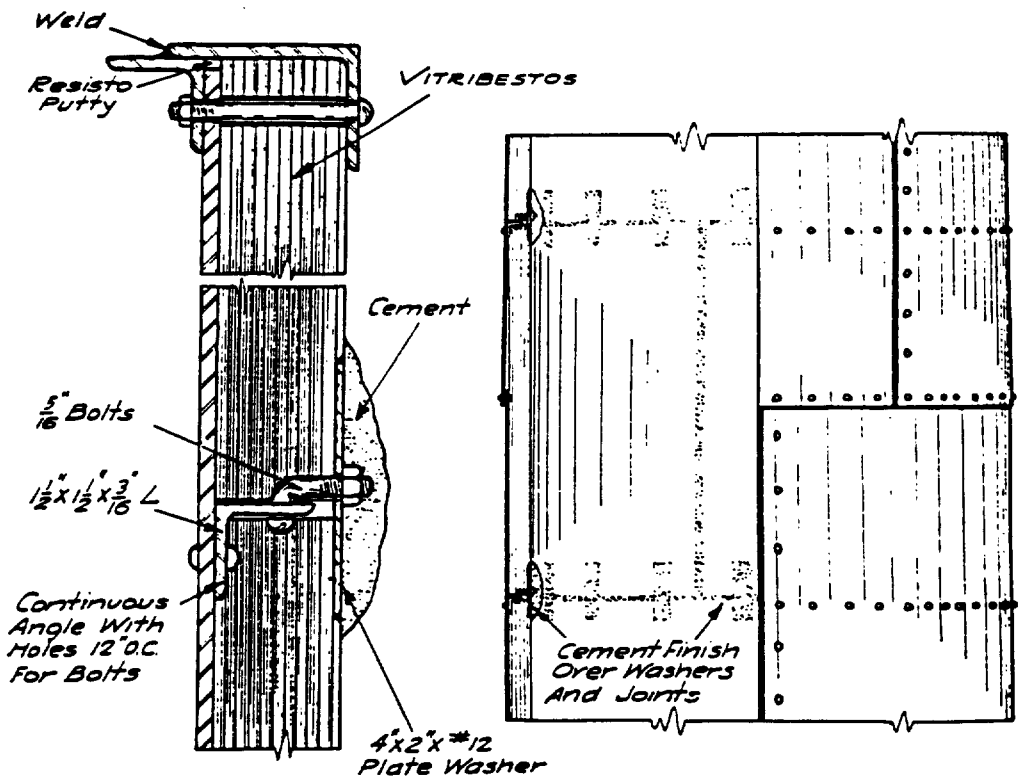


FIG. 33—VITRIBESTOS STACK LINING DETAILS

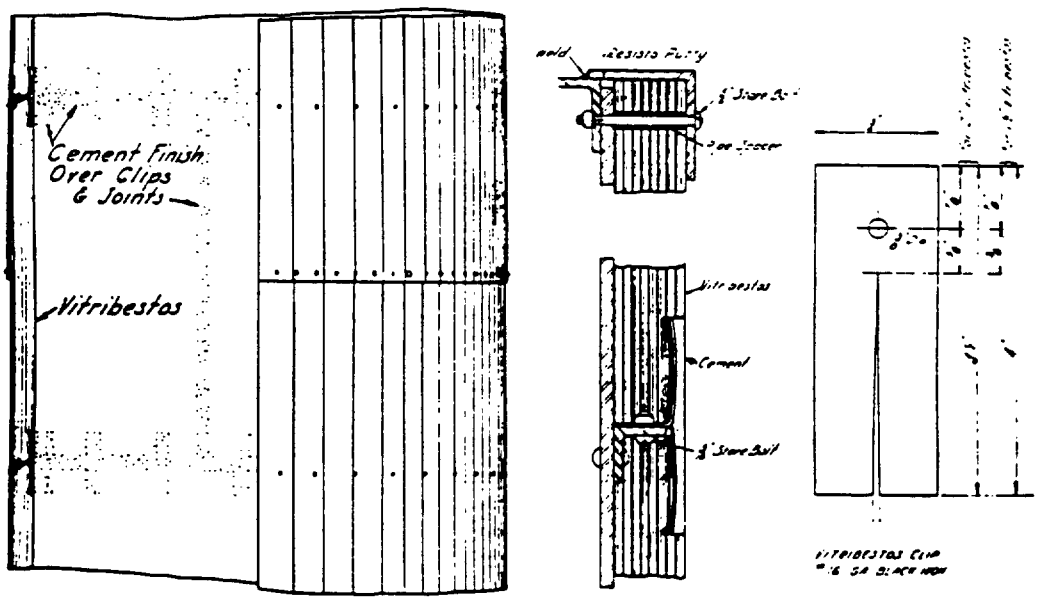


FIG. 34—VITRIBESTOS STACK LINING DETAILS (ALTERNATE METHOD)

Pipe Insulation

Johns-Manville furnishes the following kinds of insulation in a form suitable for insulating pipes conveying heated fluids:

Asbesto-Sponge Felted
85% Magnesia
Superex
Superex Combination
Asbestos Fire-Felt
Banroc
Improved Asbestocel
Wool Felt
Asbestos Combination Spiral
Asbestos Pipe Blankets
Asbestocel in roll form

Insulating materials especially suited for use in cold work are also available.

The proper sort of insulation for exposed pipes is determined by the character of the demand. Pipes subject to foot traffic may not be treated in the same way as those not exposed to this sort of service. Thicknesses which should be used are computed so the heat which is lost through the insulation is only that portion which may not economically be saved. Standard usages have been evolved which are generally applicable, except where there is some special condition such as necessity for minimizing temperature drop or conserving unusually expensive heat.

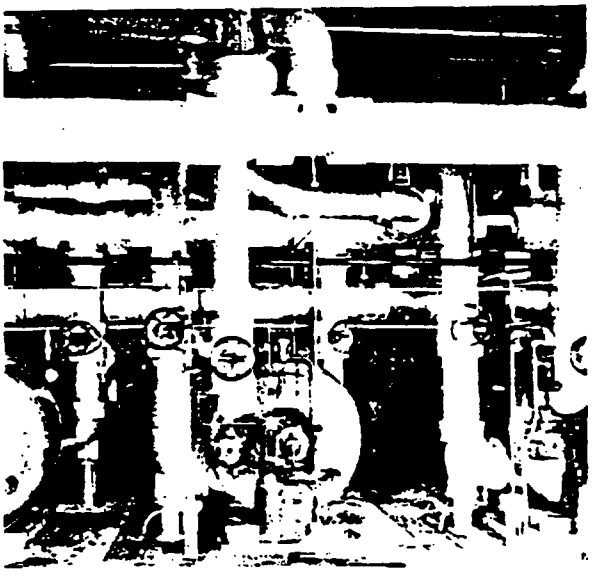
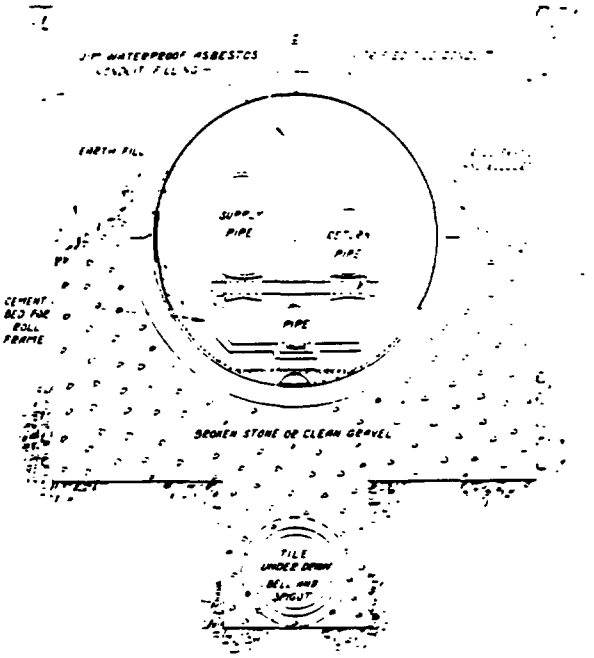


Fig. 35—Power Plant Piping Insulated with J-M Materials



TYPICAL CROSS-SECTION OF J-M SYSTEM OF UNDERGROUND INSULATION

Fig. 36—The J-M System of Insulated Underground Conduit Provides a Permanent, Efficient and Economical Means for Sub-surface Conveyance of Steam and Hot Water

Molded pipe sections of Magnesia bonded with asbestos fibre have become closely identified with best insulation practice in the temperature range which has its upper limit at 600 deg. F. Where the insulation is to be subjected to rough usage, sections of high grade laminated asbestos felts containing embedded particles of spongy resilient material have been found to be much more durable and slightly better in insulating efficiency. This kind of insulation may be used for temperatures to 700 deg. F., and is known as Asbesto-Sponge Felted.

In the range of temperatures so high that 85% Magnesia or Asbesto-Sponge Felted should not be used, molded pipe sections of specially treated diatomaceous silica bonded with asbestos fibre have proved very successful. This insulation is known as Superex. Sometimes Asbesto-Sponge Felted is used outside of these sections of Superex for mechanical protection of the Superex and to increase insulating

efficiency. Magnesia is also often used as an outside layer where the insulation is not subject to abrasion, because it is a little more economical in first cost and is a slightly better insulator than Superex. These combinations of Superex and Asbesto-Sponge Felted or 85% Magnesia are known as Superex Combination Insulation.

Generally speaking, 85% Magnesia, Asbesto-Sponge Felted, or Superex, will solve any insulation problem on heated pipes which ordinarily arises, but other materials are available and frequently may be used to advantage. Complete information on the application of these materials is available at any Johns-Manville office.

Pipe Insulation Recommendations

FOR TEMPERATURES TO 600 DEG. F.

All pipes, fittings and flanges at temperatures below 600 deg. F., except small screwed fittings which are insulated with J-M No. 302 Cement, should be insulated with J-M 85% Magnesia, or, if subjected to excessive vibration or abuse, with Asbesto-Sponge Felted sectional pipe insulation, to the thicknesses given in the tables below.

Asbesto-Sponge Felted pipe insulation may be used, where service conditions warrant, up to 700 deg. F.

J-M 85% Magnesia Insulation

Steam pressure or condition	Temperature	Thickness of insulation		
		Pipes larger than 4"	Pipes 2" to 4"	Pipes smaller than 2"
Hot Water		Std.	Std.	Std.
0 to 25 lbs.	212° to 267° F.	Std.	Std.	Std.
25 to 100 lb.	267° to 338° F.	1½"	Std.	Std.
100 to 200 lb.	338° to 388° F.	2"	1½"	Std.
Low Superheat	388° to 500° F.	Dbl. Std.	2"	1½"
Superheat	500° to 600° F.	3"	Dbl. Std.	2"

Asbesto-Sponge Felted Insulation

Steam pressure or condition	Temperature	Thickness of insulation		
		Pipes larger than 4"	Pipes 2" to 4"	Pipes smaller than 2"
Hot Water		1"	1"	1"
0 to 25 lb.	212 to 267°F	1"	1"	1"
25 to 100 lb.	267 to 338°F	1½"	1"	1"
100 to 200 lb.	338 to 388°F	2"	1½"	1"
Low Superheat	388 to 500°F	2½"	2"	1½"
Superheat	500 to 600°F.	3"	2½	2"
High Superheat	600 to 700 F	3½"	3"	2"

FOR TEMPERATURES ABOVE 600 DEG. F.

All pipes and flanges 1¼ in. and smaller, at temperatures above 600 deg. F., are insulated with a single layer of Superex sectional pipe insulation 2 in. thick. Screwed fittings are insulated with J-M No. 302 Cement. For pipe sizes larger than 1¼ in., at temperatures above 600 deg. F., Superex Combination Insulation is used. This consists of one layer of Superex next the pipe, over which is applied a second layer of either J-M 85% Magnesia or Asbesto-Sponge Felted, as conditions require.

The proper thickness of each layer for the various pipe sizes is given below.

Temperatures	600°–700°F		700°–800°F		800°–1000°F	
Pipe size, inches	Thickness of Superex, inches	Thickness of Asbesto-Sponge Felted, or 85% Magnesia inches	Thickness of Superex, inches	Thickness of Asbesto-Sponge Felted, or 85% Magnesia inches	Thickness of Superex, inches	Thickness of Asbesto-Sponge Felted, or 85% Magnesia inches
1¼ and smaller	2		2		2	
2, 2½, 3½	1½	1½	1½	2	2	1½
3, 4	1½	1½	1½	2	2	1½
4½	1½	2	1½	2½	2	2
5 and larger	1½	2	1½	2½	2	2

Pipe Insulation Recommendations

METHOD OF APPLICATION

The insulation is applied to the pipe with joints tightly butted, and wired to the pipe with 16-gauge annealed iron wire.

All Asbesto-Sponge Felted insulation 2 in. and greater in thickness, 85% Magnesia 3 in. and greater in thickness, and Superex Combination Insulation should be applied in two layers with both circumferential and horizontal joints staggered, and each layer securely wired in place.

The insulation on bends should be given a thin finishing coat of J-M No. 302 Cement to present a smooth, even surface. Insulation over flanges is surfaced with ½ in. J-M No. 302 Cement applied in two layers, the first coat being left to dry with a rough surface before the application of the smooth finishing coat.

All insulation on piping indoors should be finished with a jacket of 8-oz. canvas, sewed on and, if desired, painted with two coats of lead and oil paint. All insulation on piping outdoors, or exposed to the weather, should be protected with a waterproof jacket.

J-M can furnish various types of waterproof insulation jackets, of which full details and specifications will be gladly furnished on request.

Piping located close to the ground or where there is possibility of mechanical injury should be protected with a metal jacket.

Boiler Wall Expansion Joints

The recommendations given below cover the packing of expansion joints used in various types of boilers as a means of preventing failure of boiler setting structures.

The major types of expansion joints are shown in Figs. 37 and 38. These are applicable, in a general way, to almost all boiler settings. Expansion joints not shown on these drawings and found in practice lend themselves to the same class and manner of packing as those shown. The location of expansion joints and the class of boiler settings in which they are found are outlined as follows:

Water-tube Boilers (Stirling, Heine, Casey Hedges, Connolly, Badenhausen, Kidwell, Ladd, Erie City, etc.)

Location of Expansion Joint	*Drawing Reference*
1. Furnace roof and side walls	Fig. 37 Detail A
2. Rear wall and side walls	Fig. 37 Detail H
3. Side walls (vertical joints)	Fig. 37 Detail C
4. Side and end wall	Fig. 37 Detail B
5. Relieving arch	Fig. 37 Detail G
6. Bridge wall	Fig. 38
7. Combustion arch, side and end walls	Fig. 38
8. Steam drum and brick setting	Fig. 38

Water-tube Boilers (B & W, Springfield, Edge Moor, Wickes, Erie City, Walsh and Weidner, etc.)

1. Furnace roof and side walls	Fig. 37 Detail A
2. Rear wall and side walls	Fig. 37 Detail H
3. Side walls (vertical joints)	Fig. 37 Detail C
4. Side and end wall	Fig. 37 Detail B
5. Relieving arch	Fig. 37 Detail G

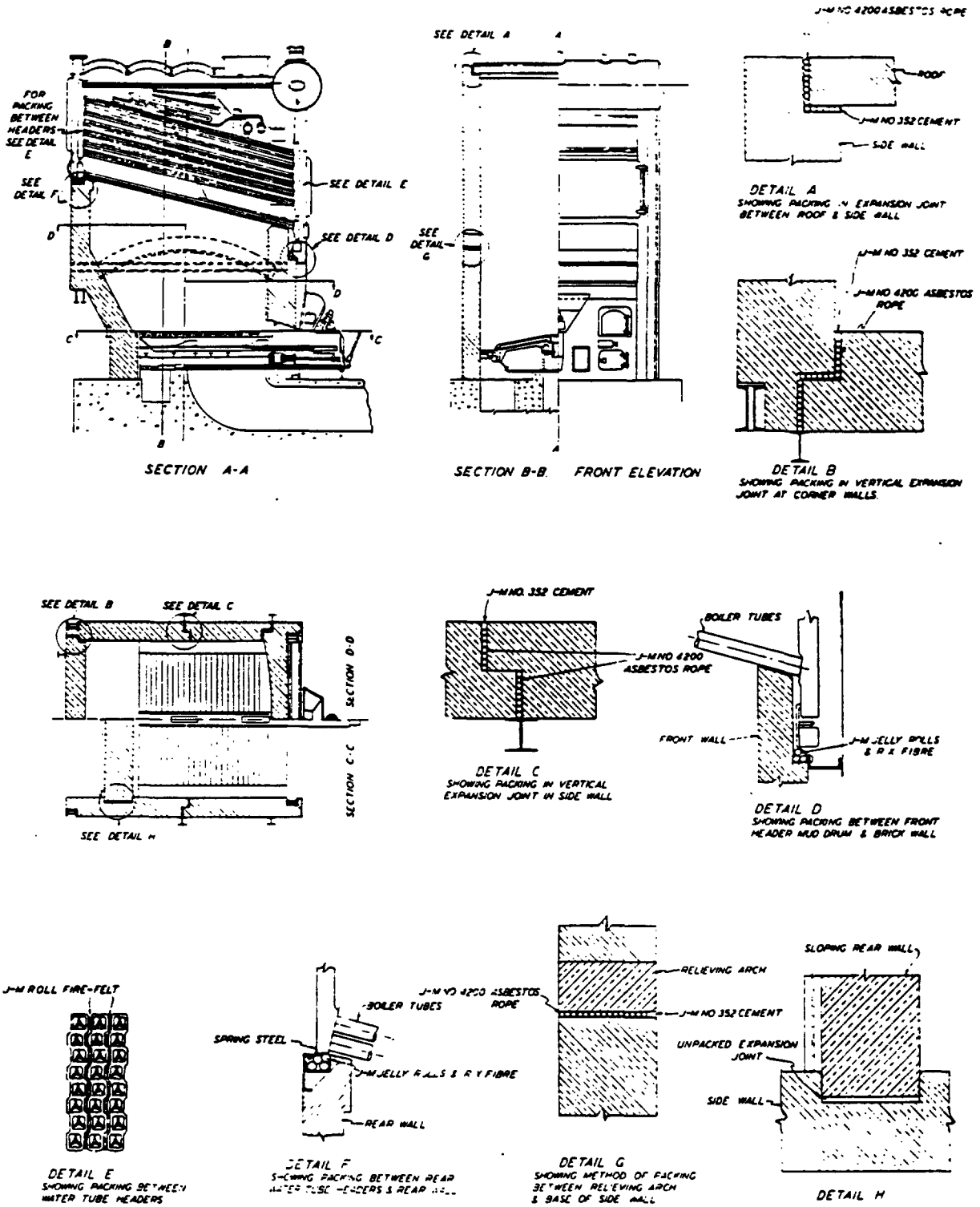


FIG. 37—BOILER WALL EXPANSION JOINT LOCATIONS AND DETAILS

6. Water-tube header ..... Fig. 37 Detail E
7. Front water-tube header and setting ..... Fig. 37 Detail D
8. Rear water-tube header and setting ..... Fig. 37 Detail F
9. Bridge wall ..... Fig. 38
10. Combustion arch, side and end walls ..... Fig. 38
11. Steam drum and brick setting ..... Fig. 38

Fire-tube Boilers

1. Boiler shell and brick settings ..... Fig. 38
2. Side walls (vertical joints) ..... Fig. 37 Detail C
3. Union of side and end walls ..... Fig. 37 Detail B
4. Combustion or deflection arch and side walls ..... Fig. 38
5. Deflection arch and end walls ..... Fig. 38
6. Bridge wall ..... Fig. 38

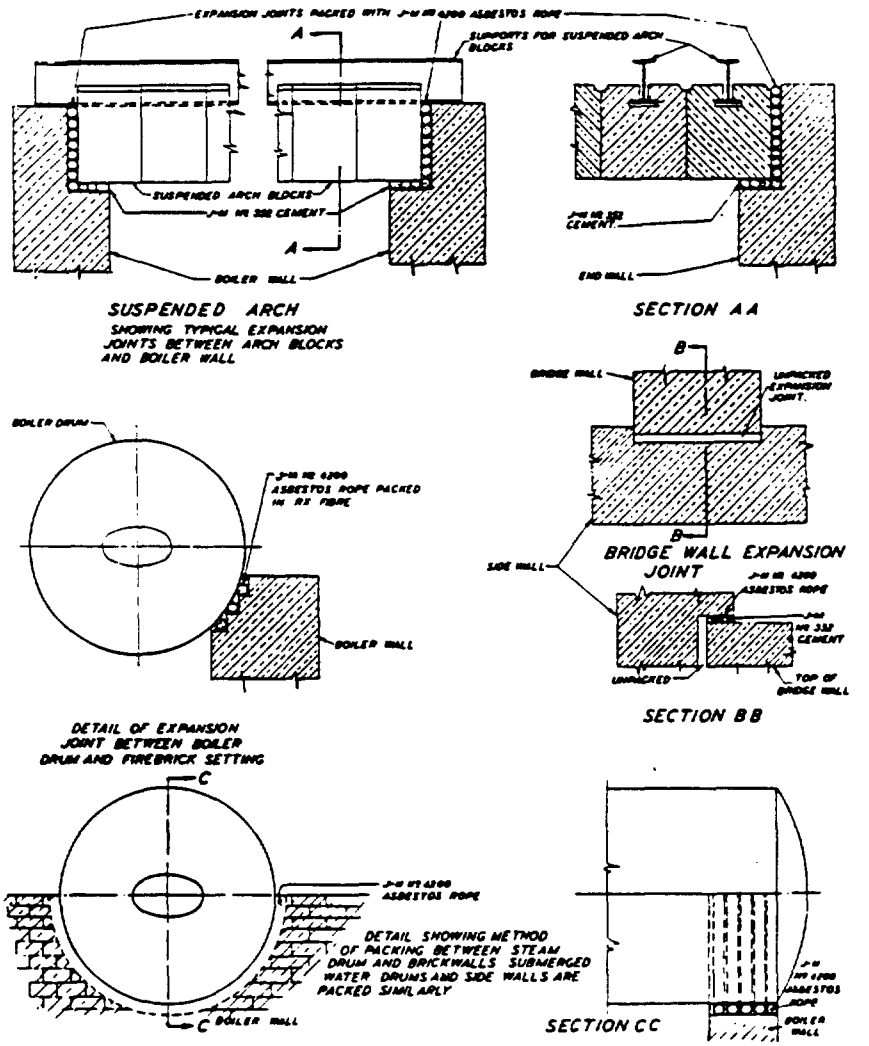


FIG 38—EXPANSION JOINTS AT SUSPENDED ARCH, BRIDGE WALL AND STEAM DRUM

All expansion joints in the boiler setting proper or between parts of the boiler and setting should be made so that the joint is twice as great as the maximum amount of expansion taking place between the adjacent expanding members.

Expansion joint materials are installed when the boiler setting is being constructed, except in cases where joints are accessible and can be conveniently packed when the setting is complete. All material is firmly packed into the joint so that there are no voids.

Expansion Joint Materials

All expansion joints in the boiler setting proper or between parts of the boiler and the setting are packed with either J-M No. 4200 Asbestos Rope or J-M Asbestos Jelly-Rolls. The size of the expansion joint is the determining factor in choosing between the No. 4200 Asbestos Rope and Jelly-Rolls. J-M No. 4200 Asbestos Rope is used for joints up to 1 in. in width. When larger diameter packing is required, it should be the standard Asbestos Jelly-Rolls.

J-M No. 4200 Asbestos Rope is made in sizes from ¼ in. to 1 in. increasing by increments of ¼ in. but can be furnished when necessary as large as 2 in. J-M Asbestos Jelly-Rolls are made in standard sizes of 1 in., 1¼ in., 1½ in., 1¾ in., 2 in., 2½ in., 3 in., 3½ in., and 4 in. diameter.

In expansion joints such as Details D and F, Fig. 37, and the boiler drum-setting expansion joint shown in Fig. 38, the Asbestos Jelly-Rolls are packed in J-M RX Asbestos Fibre. This fibre is used to fill the interstices between the Jelly-Rolls with a resilient material. The water-tube headers, as shown in Fig. 37, Detail E, can be advantageously packed with strips of J-M Asbestos Roll Fire-Felt.

Wall expansion joints should have the opening facing into the combustion chamber sealed with J-M No. 352 Asbestos Cement after the packing is in place. If there is no J-M No. 352 Cement on the job, either J-M No. 302 or No. 400 Asbestos Cement can be used satisfactorily.

Where movement of the expanding members is liable to work the packing out of the joint, the expansion joint material is held in place by a sprung steel plate or by other suitable means.

Refractory Cement Recommendations for Boilers and Stacks

J-M Refractory Cements lessen maintenance costs in the operation of boiler furnaces and considerably lengthen the life of the setting. The tight sealing of the joints, particularly when wash-coating is also employed, prevents infiltration of air or extrusion of furnace gases. By preventing the entrance of flame at the joints, spalling is greatly retarded, and the destructive effects of low-fusion ash are minimized. High quality refractory cements, used properly, pay a high return on the investment in reduced maintenance expense, in longer runs without shut-down for furnace repairs, and in a generally improved performance of the furnace.

Direct-fired Boilers

For bonding fire brick in fire-tube boilers or in furnace walls, bridge walls, or arches of water-tube boilers, J-M No. 31, No. 32, or No. 20 Refractory Cements may be used with excellent results. No. 31 is used where a dry cement is wanted for a bond joint; No. 32 where a dry cement is desired for a brick to brick, or rubbed, joint; or No. 20 where a plastic cement is wanted for a brick to brick, or rubbed, joint.



FIG. 30—BOILER FURNACE SET UP WITH J-M NO. 31 AND WASH-COATED WITH J-M NO. 32 REFRACTORY CEMENTS

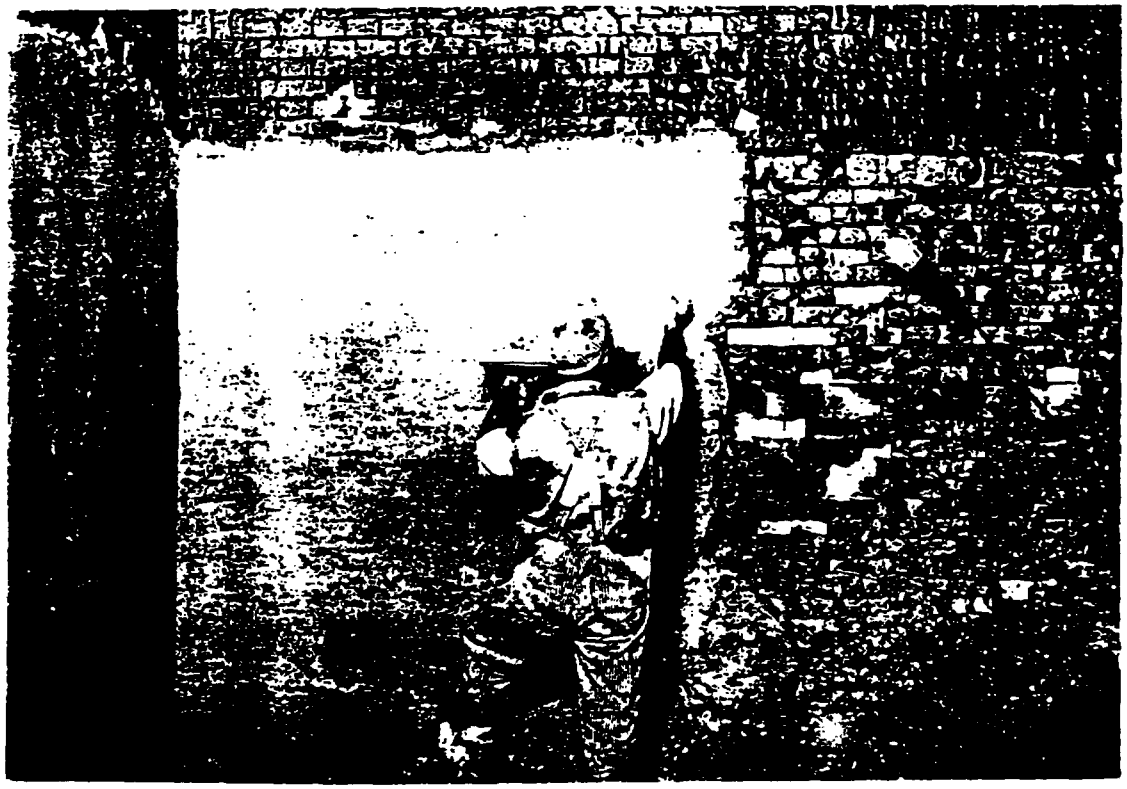


FIG. 40—OLD WALL BEING PLASTERED WITH J-M NO. 33 SUPER REFRACTORY CEMENT

The exposed surfaces of the brick in furnace walls, bridge walls and arches should be wash-coated with J-M No. 32 Refractory Cement, thinned and worked into the cracks and pores of the brick. Where a plaster coating is desired on the furnace walls, No. 33 Super Refractory Cement will be most satisfactory.

An excellent patching job can be accomplished on the furnace walls with J-M Plastic Fire Brick Material.

J-M No. 26 Refractory Cement is especially adapted to the coating of vertical baffles.

Waste Heat Boilers

J-M No. 20 Plastic Refractory Cement used for bonding and wash-coating the entire setting of waste heat boilers will prevent or greatly retard erosion of the brickwork.

Stacks

Where stacks are lined with fire brick, the fire brick should be bonded and wash-coated with J-M No. 20 Plastic Refractory Cement. This material is particularly suited to such applications because of its high resistance to acid fumes.

J-M Aertite Boiler Wall Coating

Aertite Boiler Wall Coating is a tough, rubbery asphaltic-asbestos coating in plastic form for covering the outside of boiler walls to prevent the infiltration of cold air into the combustion chamber.

Suction in the boiler, caused either by induced or natural stack draft, draws the cold outside air through the cracks. This air leakage impairs combustion and also reduces the temperature of gases which are used for generating steam.

J-M Aertite Boiler Wall Coating, applied to the outside of the boiler wall, eliminates air infiltration by providing a coating over the entire boiler setting which remains air-tight because of its adhesive and ductile qualities.

Johns-Manville Insulating Materials

JOHNS-MANVILLE Insulation Service provides materials for use throughout the entire range of temperatures used in industrial processes, from the extreme sub-zero temperatures used in the treatment of oils, chemicals, etc., to those of 3000 deg. F. and more used in many modern industrial plants.

From the four basic mineral materials—asbestos, magnesium carbonate, diatomaceous silica (Celite), and rock wool made from argillaceous limestone—Johns-Manville furnishes insulation in the forms of sectional pipe covering, insulating sheets, blocks, bricks and blankets; insulating cements, fillers and finishes; insulating paper and felts; as well as a light weight aggregate used with portland cement for making insulating concrete.

In the following pages these materials are briefly described. Complete information is available on all of these products as well as detailed recommendations covering their application.

The temperature limits given for the various materials refer to the actual temperature to which the material is subjected. Sil-O-Cel Super Brick for instance, suitable for temperatures of 2500 deg. F., can be used behind refractories in furnaces operating well over 3000 deg. F.

There is a J-M product for every heat-insulating purpose. Fifty years' experience and the engineering knowledge of the largest insulation organization in the world form the background for every Johns-Manville recommendation.

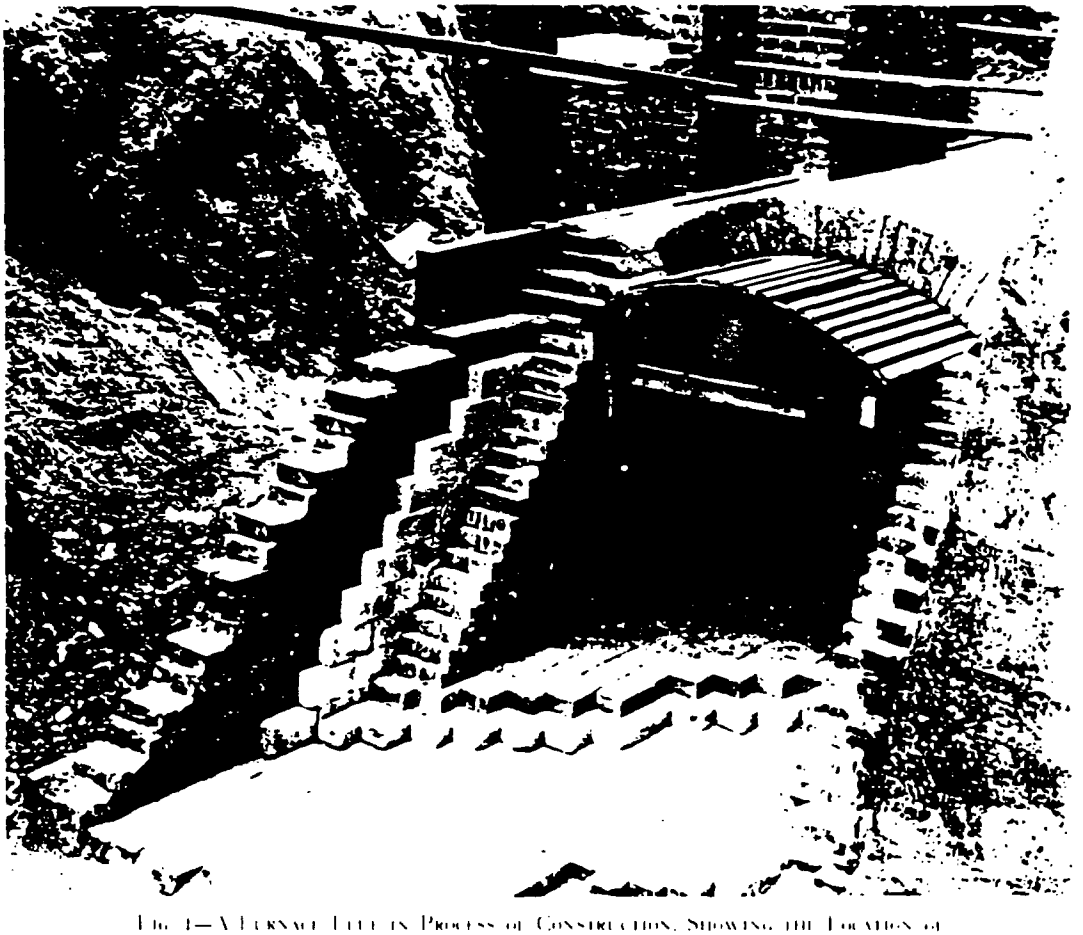


FIG. 1—A FURNACE CELL IN PROCESS OF CONSTRUCTION, SHOWING THE LOCATION OF INSULATION IN BASE AND WALL

Bricks, Blocks, Sheets, Blankets, Etc.

Sil-O-Cel Super Brick

Temperatures to 2500 deg. F.



Sil-O-Cel Super Brick is a calcined semi-refractory type of diatomaceous silica insulating brick designed for exceptionally severe service. They may be used when the insulating brick is subjected to temperatures behind the refractory as high as 2500 deg. F. They are also used without fire brick protection for lining electrically heated or muffle type furnaces.

Furnished in standard fire brick size, 9 in. x 4½ in. x 2½ in., and as No. 1 and No. 2 arch brick. Weight approximately 2¼ lb. each. Packed in fibre cartons containing twenty-five 9 in. straight brick, or an equivalent volume of other sizes. Special mortar furnished for laying.

Sil-O-Cel C-22 Brick

Temperatures to 2000 deg. F.



Sil-O-Cel C-22 Brick is a calcined semi-refractory type of diatomaceous silica insulating brick for use where the insulation will be subjected to temperatures behind the refractory as high as 2000 deg. F. Sil-O-Cel C-22 Brick are used for insulation in furnaces of all types. They are also used without fire brick protection as an inner lining in high temperature flues and in electrically heated and muffle type furnaces.

Furnished in standard fire brick size, 9 in. x 4½ in. x 2½ in., and as No. 1 and No. 2 arch brick. Weight approximately 2¼ lb. each. Packed in fibre cartons containing twenty-five 9 in. straight brick, or an equivalent volume of other sizes. Special mortar furnished for laying.

Sil-O-Cel Natural Brick

Temperatures to 1600 deg. F.

Sil-O-Cel Natural Brick are cut from the pure mineral, diatomaceous silica (Celite). They are used where they will be subjected to temperatures as high



as 1600 deg. F. This type of Sil-O-Cel Brick is the most efficient insulating brick obtainable and is used for the insulation of furnaces and other heated equipment in preference to other types of Sil-O-Cel Brick except where severe temperatures are encountered.

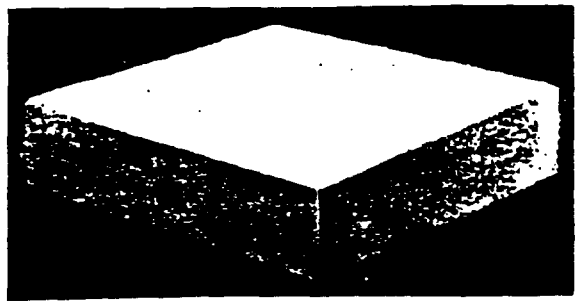
Furnished in standard fire brick size, 9 in. x 4½ in. x 2½ in., and 9 in. x 4½ in. x 1¼ in., 9 in. x 4½ in. x 2 in., 9 in. x 4½ in. x 3 in., as well as No. 1 and No. 2 arch brick. Weight approximately 1¾ lb. each. Packed in fibre cartons containing twenty-five 9 in. straight brick, or an equivalent volume of other sizes. Special mortar furnished for laying.

Superex Blocks

Temperatures to 1600 deg. F.

Superex Insulation is a most adaptable and highly efficient material for insulating boilers, furnaces, etc., where the insulation must resist temperatures between 600 deg. F. and 1600 deg. F. It is essentially

a combination of diatomaceous silica and asbestos fibre, bonded together.



Furnished in standard sizes 3 in. x 18 in. and 6 in. x 36 in., flat and curved, in thicknesses 1 in. to 4 in. Other sizes furnished on special order. Weight approximately 2 lb. per sq. ft., 1 in. thick. Also furnished in sectional form for pipe insulation.

Superex Combination Block Insulation

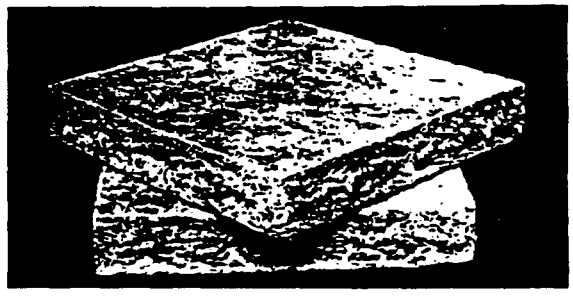
Temperatures to 1600 deg. F.

For maximum insulating efficiency, 85% Magnesia or Asbesto-Sponge Felted blocks are often used in combination with Superex. In this construction Superex is used next to the heated surface as a protection for the other insulation.

Super Fire-Felt Sheets and Blocks

Temperatures to 700 deg. F.

Super Fire-Felt is composed of asbestos fibre, felted and formed into blocks, sheets and special shapes, to provide a light weight, efficient insulation. It is used where an especially resilient material in relatively large sheets is desirable. Since it is easy



to mould Super Fire-Felt into irregular shapes, it is particularly recommended where this character of insulation is required.

Furnished standard in sheets 24 in. x 36 in. and blocks 6 in. x 36 in., from ½ in. to 4 in. in thickness; also in special sizes and shapes. Weight for 1 in. thickness approximately 1.7 lb. per sq. ft.

Asbestos Fire-Felt Sheets and Blocks

Temperatures to 1000 deg. F.

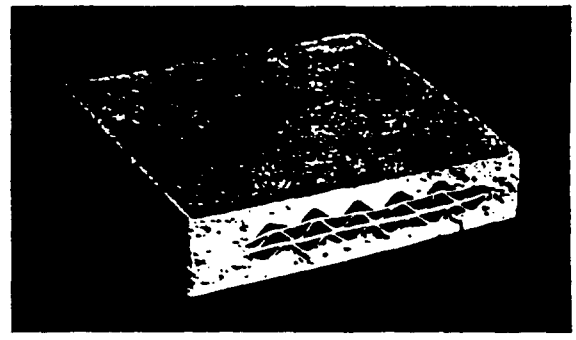
Asbestos Fire-Felt is similar to Super Fire-Felt, except that it is heavier and has greater mechanical strength. It is used where insulation is desired which will not fracture or crumble when applied to surfaces that move or vibrate.



Furnished in same sizes as Super Fire-Felt. Weight for 1 in. thickness approximately 3.3 lb. per sq. ft. Also furnished in sectional form for pipe insulation.

Thermo Fire-Felt Sheets

Temperatures to 1000 deg. F.



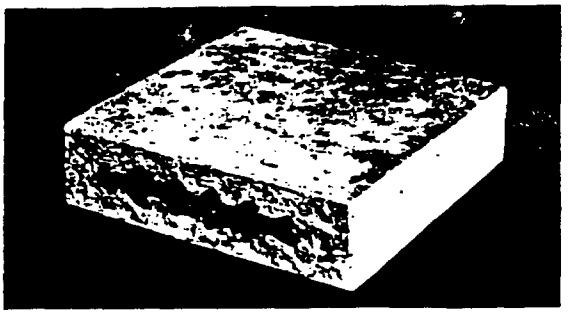
Thermo Fire-Felt is similar to Asbestos Fire-Felt except that it has a cellular asbestos structure completely enclosed in the center of the sheet, giving it increased efficiency and resiliency.

Furnished in standard sheets 24 in. x 36 in., in thicknesses from 1½ in. to. 3 in. Also furnished in curved sheets or sheets of special size. Weight approximately 3½ lb. per sq. ft. for the 1½ in. thickness.

Vitro Fire-Felt Sheets

Temperatures to 1000 deg. F.

Vitro Fire-Felt is similar in construction to Thermo Fire-Felt with the exception that the embedded cellular asbestos structure is vitrified and therefore produces a more rigid sheet.



Vitro Fire-Felt is furnished in the same sizes as Thermo Fire-Felt. Weight approximately 5 lb. per sq. ft. for the 1½ in. thickness.

Asbestos Blankets

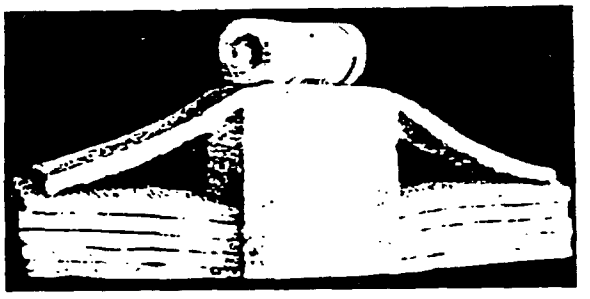
Temperatures to 800 deg. F.

J-M Asbestos Blankets are made of asbestos cloth filled with asbestos fibre, and quilted. They are particularly adapted for use where frequent removal of the insulation is necessary, as on steam turbines, flanges, etc.

Asbestos Blankets are furnished on special order for single or double layer construction. Also furnished for pipe insulation.

Banroc Blanket Insulation

Temperatures to 1000 deg. F.



Banroc Blanket Insulation is a flexible insulating material composed of rock wool felted between metal fabrics. The fabrics used are 1 in. galvanized wire netting, heavy copper bearing metal lath, ⅜ in. rib lath, and ¾ in. rib lath, the type of fabric depending upon the use to which the material is to be put. It is used for the insulation of ovens, oil refinery equipment and for similar purposes.

Furnished in standard sizes 24 in. x 96 in. and 24 in. x 48 in., in thicknesses of 1 in. to 6 in. Can be made in special sizes not over 24 in. x 96 in.

Asbesto-Sponge Felted Sheets and Blocks

Temperatures to 700 deg. F.

Asbesto-Sponge Felted is the most efficient insulating material obtainable in sheet and block form for temperatures up to 700 deg. F. It is built up of laminated asbestos felts, in which are embedded small particles of a spongy cellular material. Asbesto-Sponge Felted sheets and blocks withstand rough

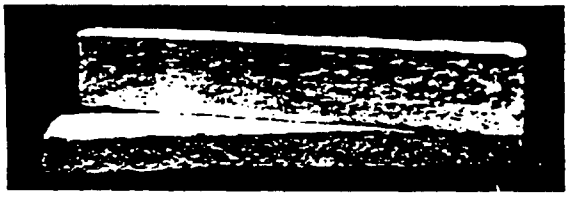


usage and can be removed and replaced without injury. They are flexible and can be made to conform to curved surfaces.

Furnished in sheets 24 in. x 36 in., and blocks 6 in. x 36 in., from ½ in. to 4 in. in thickness. Weight approximately 3½ lb. per sq. ft. per inch of thickness. Also furnished in sectional form for pipe insulation.

85% Magnesia Blocks

Temperatures to 600 deg. F.



J-M 85% Magnesia Insulation is well known as one of the most efficient commercial insulations.

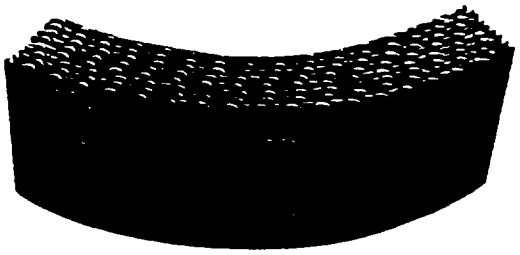
Furnished in standard sizes 3 in. x 18 in. and 6 in. x 36 in., flat and curved, from ½ in. to 4 in. in thickness. Other sizes furnished on special order. Weight approximately 14 lb. per sq. ft., per inch of thickness. Also furnished in sectional form for pipe insulation.

Vitribestos Sheets

Temperatures to 700 deg. F.

Vitribestos sheets are made up of vitrified asbestos felts previously corrugated to form a cellular structure. Used for lining stacks, building theatre curtains, etc.

Furnished in standard size flat sheets 36 in. x 36 in. and 36 in. x 72 in., and curved sheets 24 in. x

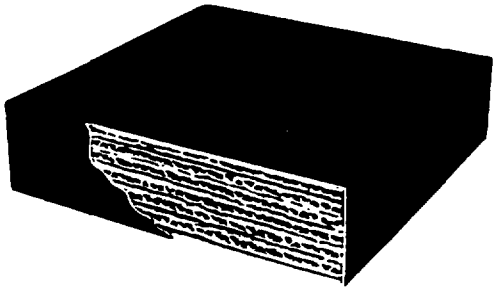


36 in., in thicknesses from ½ in. to 3 in. Other sizes can be furnished on special order. Weight approximately 1.8 lb. per sq. ft., 1 in. thick.

Pan-O-Cel Sheets

Type A—Temperatures to 500 deg. F. Type B—(moisture resistant)—Temperatures to 250 deg. F.

Pan-O-Cel sheets are made up of finely corrugated asbestos felts sealed within sheets of asbestos felt, coated with a refractory solution. Pan-O-Cel



sheets were developed to provide a readily assembled and self-supporting insulating wall construction for low temperature ovens.

Furnished in sheets 36 in. x 36 in., 36 in. x 72 in. and 36 in. x 84 in., and in special sizes. Thicknesses 1 in. to 4 in.

Standard Hair Felt

J-M Standard Hair Felt is made from selected cattle hair. Used for refrigerator car insulation, and to prevent freezing in cold water pipes.

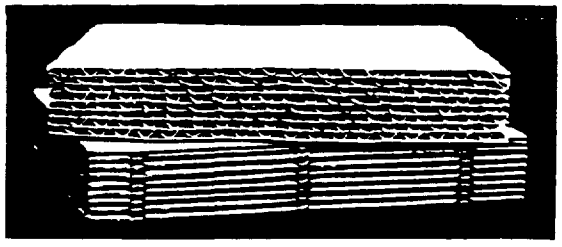
Furnished in 3-foot and 6-foot wide rolls in various standard lengths and in thicknesses from ¼ in. to 2 in.

Tankinsul

Tankinsul is a hair felt insulation with a layer of building paper on each side firmly stitched in place. It is furnished ½ in. or ¾ in. thick, from 3 ft. to 9 ft. wide, in bales containing 50 linear feet.

Improved Asbestocel Sheets and Blocks

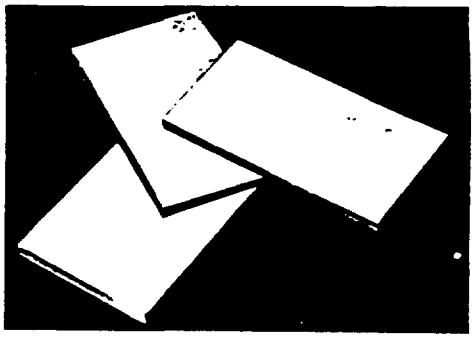
Temperatures to 500 deg. F.



Improved Asbestocel is made of plain and corrugated asbestos felts, with cross-corrugations at regular intervals, built up to the required thickness. Well adapted for low temperature oven insulation when protected from mechanical injury.

Furnished standard in 4 plies per inch. Sizes 36 in. x 36 in. and 6 in. x 36 in. from ½ in. to 4 in. thick. Weight approximately 1 lb. per sq. ft., 1 in. thick. Can be furnished 6 plies to the inch, known as Fine Corrugated Improved Asbestocel. Weight approximately 1.3 lb. per sq. ft., 1 in. thick. Also furnished in sectional form for pipe insulation.

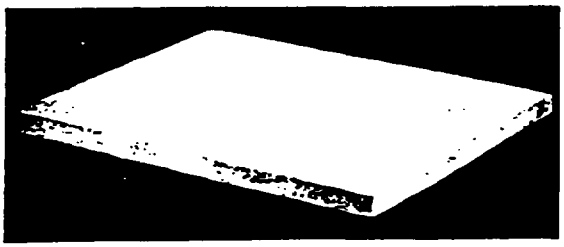
Asbestos Sheet Millboard



J-M Asbestos Sheet Millboard is recommended for industrial use requiring sheet or board for protection against fire, heat, and acid fumes, and is used as a fireproof lining for floors, partitions, ceilings, and elevator shafts. It is also used in ranges, stoves, gas-grate backs, etc. Made in a number of grades of varying densities and fire-resisting properties.

Furnished in standard sheets 42 in. x 48 in. in thicknesses from 1/32 in. to 1/2 in.

Insulating Board



J-M Insulating Board is made from felted wood fibres, damp-proofed, and pressed and moulded to insure uniformity of thickness, density and structure. Extensively used as a low-temperature industrial insulating board where large size sheets may be erected to advantage. Also used as a wall-board, plaster lath and sheathing.

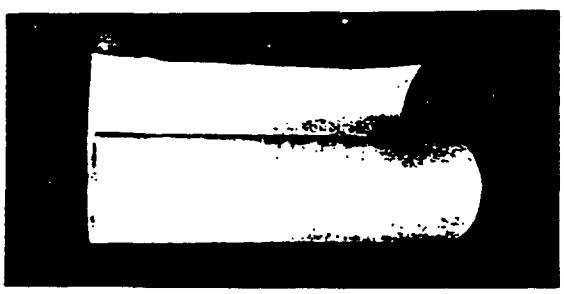
Furnished ½ in. and 1 in. thick, 4 ft. wide and in lengths from 6 to 12 feet. Also available in ½ in., 1 in. and 1½ in. thicknesses in 3-foot widths, and lengths from 6 to 12 ft. Plaster lath is furnished 18 in. x 48 in., ½ in. and 1 in. thick, with ship-lap edges. Thicknesses greater than ½ in. are made by stapling ½ in. boards together.

Rigid Roofinsul

Rigid Roofinsul is a strong, rigid insulating board, made of felted waterproofed wood fibres. An ideal insulation for any type of roof deck. It is usually overlaid with a J-M Built-Up Roof.

Furnished in sheets ½ in. x 2 ft. x 4 ft. Where more than ½ in. of insulation is desired, it can be furnished in two or more boards stapled together.

Asbestos Paper and Roll Board



J-M Asbestos Paper and Roll Board are used when a material of minimum thickness is required, principally as a protection against heat or as a fire-retardant.

Asbestos Paper is furnished in thicknesses from 0.015 in. to 1/16 in. Roll Board is furnished in thicknesses of 3/32 in. and 1/8 in. Both are supplied in standard rolls 18 in., 24 in. and 36 in. wide and in special widths to order.

Asbestos Roll Fire-Felt



Asbestos Roll Fire-Felt is a soft felt of asbestos fibre that may be folded, bent or wrapped around pipes and heated surfaces. Especially adapted for uses demanding heat resistance and great flexibility.

Furnished in thicknesses of 3/32 in., 1/8 in., 3/16 in. and 1/4 in. in rolls 3 feet wide, containing approximately 100 sq. ft.

Ceilinite



Ceilinite is made from Asbestos Roll Fire-Felt, reinforced on one side with asbestos cloth. Used as an inter-lining in steel cars, and for fireproofing electrical apparatus, etc.

Furnished in rolls 36 in. wide x 100 ft. long, in 3/32 in., 1/8 in., 3/16 in. and 1/4 in. thicknesses.

Rock Cork Sheets and Lagging

Temperatures Below 100 deg. F.



J-M Rock Cork is an efficient insulating material for cold storage construction and refrigerating equipment. Manufactured from rock wool combined with

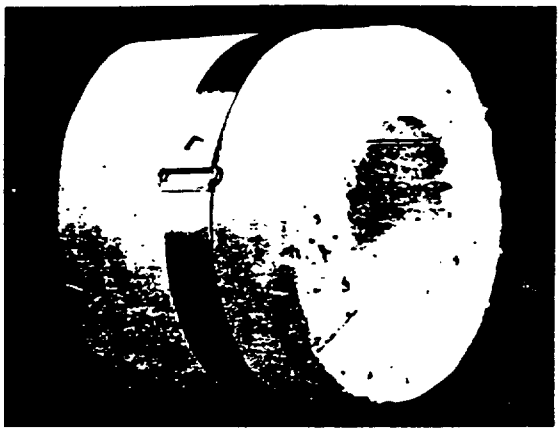
a waterproof binding ingredient moulded into sheets. Furnished in sheets 18 in. x 36 in., in thicknesses from 1½ in. to 4 in., and in 18 in. x 18 in. sheets 1 in. thick. Special sizes including lagging can also be furnished. Weight approximately 1.25 lbs. per sq. ft. per inch thick.

J-M Pipe Insulation Materials

Superex Pipe Insulation

Temperatures to 1000 deg. F.

Superex Pipe Insulation is manufactured from the same material as Superex Blocks. See page 104. Superex has been used for insulation at high temperatures in many of the largest power plants built in recent years where every precaution was taken to insure maximum economy.



Furnished in standard sections, 3 ft. long, in thicknesses from 1 in. to 3 in., for pipe sizes ½ in. to 10 in., inclusive. For pipe sizes larger than 10 in., it is furnished in segments.

Superex Combination Pipe Insulation

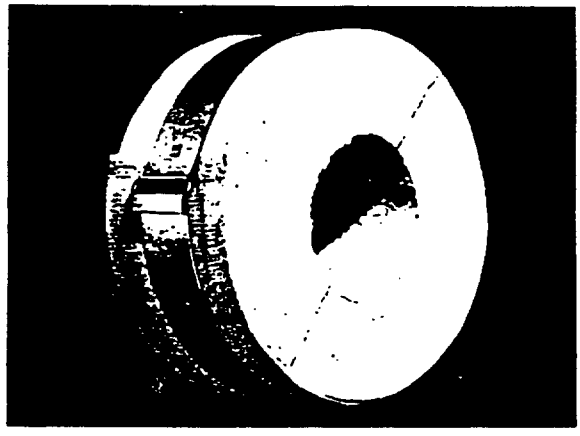
Temperatures to 1000 deg. F.

For maximum efficiency, Superex is often used as a first layer against the heated surface and covered with an outer layer of Asbesto-Sponge Felted or 85% Magnesia. Materials are furnished in standard sizes for this purpose. Detailed information is available on the required thicknesses of each material for various conditions. See page 94.

Asbesto-Sponge Felted Pipe Insulation

Temperatures to 700 deg. F.

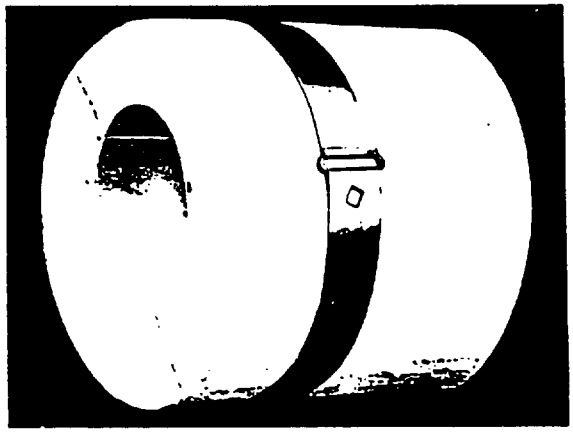
Asbesto-Sponge Felted Pipe Insulation is manufactured in the same manner as Asbesto-Sponge Felted Sheets. For description, see page 100. It has unusual mechanical strength and is used where the insulation may be subjected to severe usage or vibration.



Furnished in 3-foot sections in thicknesses from the standard, which is approximately 1 in., to 3 in., to fit any commercial size of pipe.

85% Magnesia Pipe Insulation

Temperatures to 600 deg. F.

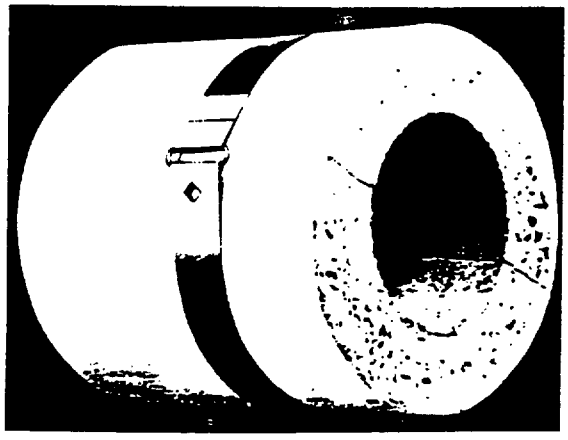


J-M 85% Magnesia Pipe Insulation has become definitely established as the best insulating material for general use within its temperature range.

Furnished in 3-foot sections in the following thicknesses—Standard, 1½ in., 2 in., 2½ in., Double Standard, and 3 in., to fit pipe sizes up to 10 in. For sizes larger than 10 in., segments are supplied.

Asbestos Fire-Felt Pipe Insulation

Temperatures to 1000 deg. F.

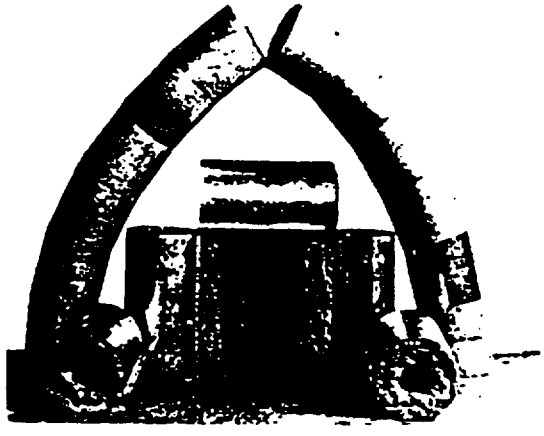


Asbestos Fire-Felt Pipe Insulation is composed of asbestos fibre, felted and moulded into sections. The material is unusually strong and particularly adapted for use where there is considerable vibration.

Furnished in 3-foot sections in thicknesses from 1 in. to 3 in. to fit standard pipe sizes.

Banroc Pipe Insulation

Temperatures to 1000 deg. F.



Banroc Pipe Insulation is made from rock wool in two standard forms, as follows:

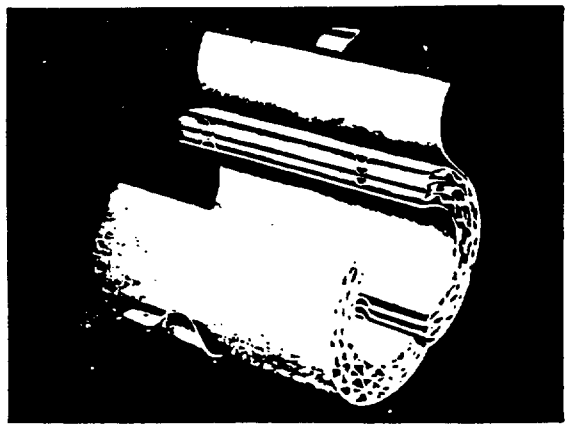
Style No. 25 is manufactured with wire netting inside and metal lath outside, and is used where a cement finish is desired. Furnished in sections 2 ft. long in thicknesses of 1 in. to 4 in. for pipe sizes of 2 in. and larger.

Style No. 65 is made with a 24-gauge galvanized iron outer casing to provide a waterproof and fireproof jacket. Especially adapted for use where insulation must be frequently removed. Furnished in 2-foot sections in thicknesses of 1½ in. to 4 in. for pipe sizes 2 in. in diameter and larger. Special shapes can be furnished for insulating flanges and pipe bends.

Improved Asbestocel Pipe Insulation

Temperatures to 500 deg. F.

Improved Asbestocel Pipe Insulation is made of plain and corrugated asbestos felts, with cross-corrugations at regular intervals, built up to the required thickness. Used principally on domestic steam and hot water systems.



Furnished in thicknesses of 2, 3 and 4 plies, each ply approximately ¼ in. thick. Made in 3-foot sections to fit standard pipe sizes.

Asbestos Combination Spiral Pipe Insulation

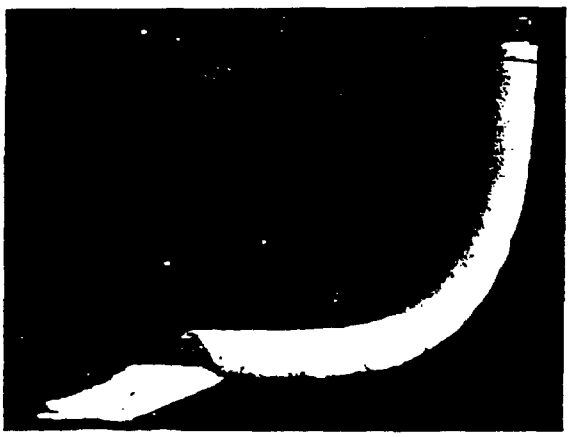
Temperatures to 1000 deg. F.

J-M Combination Spiral Pipe Insulation consists of a layer of Ceilmite 2½ in. wide by ¼ in. thick, over which is wrapped a layer of J-M No. 1091 Asbestos Listing.

Spiral Pipe Insulation is particularly adapted to use on irregular runs of pipe and where considerable vibration is encountered, as on automobile exhaust pipes and on locomotives.

Engineers' Insulating Tape

Temperatures to 1000 deg. F.



J-M Engineers' Insulating Tape consists of 2 in. wide Ceilinite and asbestos listing, stitched together down the center with a ¼ in. marginal extension of the listing for the purpose of sealing the joints. Used for the same purposes as Spiral Pipe Insulation. The thickness is a full ¼ in. Furnished in 25-foot rolls.

Asbestos Pipe Blankets

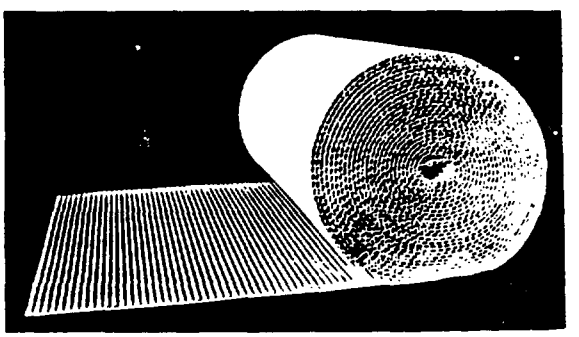
Temperatures to 800 deg. F.

J-M Asbestos Pipe Blankets are made of asbestos cloth filled with asbestos fibre, and quilted. Particularly adapted for use on lines where frequent removal of the insulation is necessary.

Furnished on special order in thicknesses of 1½ in. to 3 in. and in single or double layer construction. Furnished also in special shapes for ells, crosses, tees and valves.

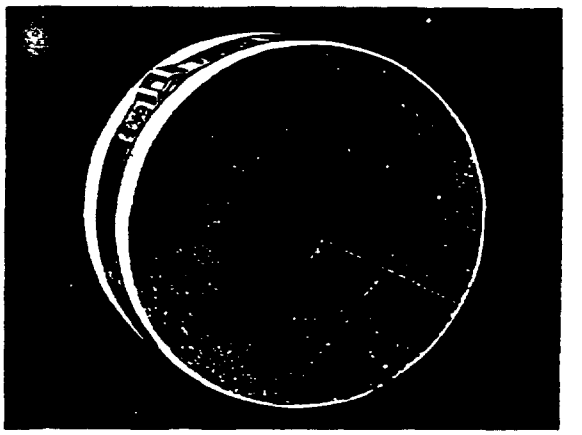
Asbestocel (Roll Form)

Temperatures to 300 deg. F.



Asbestocel in flexible roll form is made by fastening together a plain and a corrugated asbestos felt into a single sheet. Particularly adapted to insulating hot air heater pipes. Furnished in rolls 37½ in. wide, containing approximately 250 sq. ft.

Wool Felt Pipe Insulation



J-M Wool Felt is used for insulating hot or cold water pipes where a low-priced material is required. Several different types are supplied for various conditions. Furnished in 3-foot sections in thicknesses of ½ in., ¾ in. and 1 in.

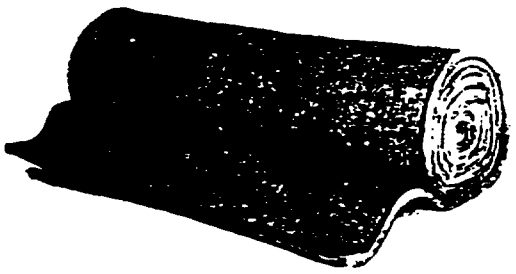
Built-Up Brine and Ammonia Insulation



J-M Built-up Brine and Ammonia Insulation consists of a varying number of layers of hair felt carefully applied around the pipes and thoroughly sealed with a waterproof membrane to give a highly efficient insulation for lines conveying cold fluids.

Standard Hair Felt

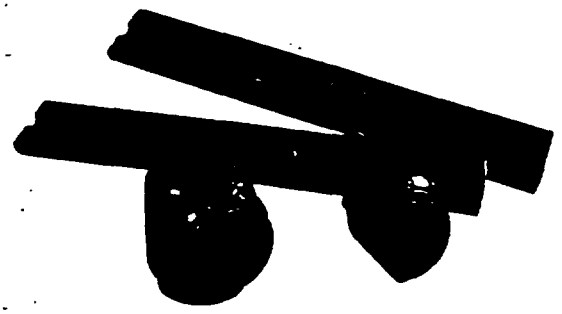
J-M Standard Hair Felt is made from selected cattle hair. Used for refrigerator car insulation and to prevent freezing in cold water pipes. Standard



Hair Felt is furnished in 3-foot and 6-foot wide rolls of various standard lengths in thicknesses from ¼ in. to 2 in.

Cork Pipe Covering

J-M Cork Pipe Covering is manufactured from pure granulated cork, moulded, compressed and baked. Used on pipes conveying cold fluids.

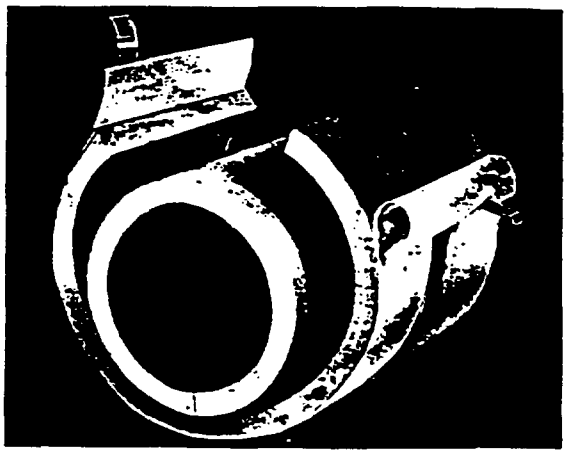


Furnished in all standard thicknesses of sections and segments for various pipe sizes.

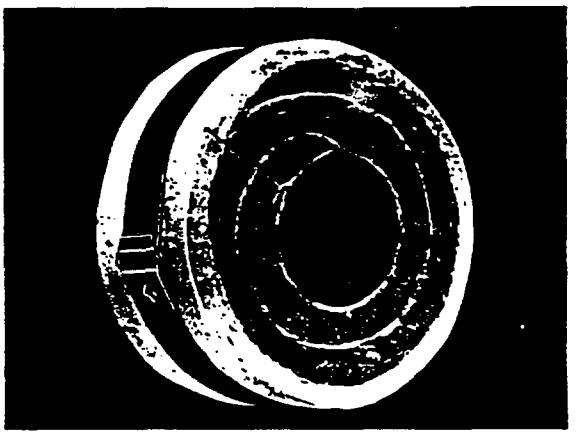
Anti-Sweat Pipe Insulation

Anti-Sweat Insulation is built up of layers of insulating and waterproofing felts. Used to insulate cold water pipes and to prevent condensation.

Furnished in 3-foot sections, in thicknesses of ½ in. and ¾ in. solid construction and in 1 in., 1½ in. and 2 in. broken joint construction, to fit standard pipe sizes.



Zero Pipe Insulation



Zero Pipe Insulation is composed of layers of hair felt and wool felt protected inside and outside. Largely used on cold water pipes to prevent freezing.

Furnished approximately 1¼ in. thick, in 3-foot sections for pipe sizes from ½ in. up.

Insulating Cements, Concrete, Fillers and Finishes

Sil-O-Cel C-3

Temperatures to 2000 deg. F.

Sil-O-Cel C-3 is a coarse granular form of calcined diatomaceous silica. Used as supplied for insulating tops and for filling walls of heated equipment operating at unusually high temperatures. Also used in making Sil-O-Cel C-3 Insulating Concrete.

Weight loose, 28 lb. per cu. ft.; packed, 31 lb. per cu. ft. Furnished in 100 lb. bags.

Sil-O-Cel C-3 Insulating Concrete

Temperatures to 1800 deg. F.

Sil-O-Cel C-3 Insulating Concrete is made on the job by mixing four parts of Sil-O-Cel C-3 and one



SIL-O-CEL C-3 CONCRETE DOORS ON MALLEABLE ANNEALING OVENS

part portland cement, by volume, with sufficient water to form a plastic mixture. C-3 Concrete is over three times as effective as fire brick in preventing heat loss. Used for insulating furnace bases and as a direct refractory in furnace doors, baffles, dampers, etc. Also used for the monolithic construction of ovens and furnaces operated at moderate temperatures, as well as for fireproofing structural steel.

The concrete weighs approximately 60 lb. per cu. ft. Crushing strength about 1000 lb. per sq. in.

Fibro-Cel

Temperatures to 1800 deg. F.

Fibro-Cel is a mixture of diatomaceous silica and long fibre asbestos. Since it does not settle under vibration or sift through cracks, it is well adapted for use as a filling material on gas generator sets and similar equipment.

Furnished in 80 lb. bags. Usually packed to a density of 18 lb. per cu. ft.

Sil-O-Cel Powder and Coarse Grade

Temperatures to 1600 deg. F.

These materials are pure diatomaceous silica (Celite), milled to different degrees of fineness. Their insulating value is exceptionally high. Used as a filling material where block or brick insulation is not adapted. Coarse Grade is preferred where easy packing is desirable.

Furnished in 100 lb. bags. Weight, tamped in place, 15 to 17 lb. per cu. ft. for Sil-O-Cel Powder and 22 lb. per cu. ft. for Sil-O-Cel Coarse Grade.

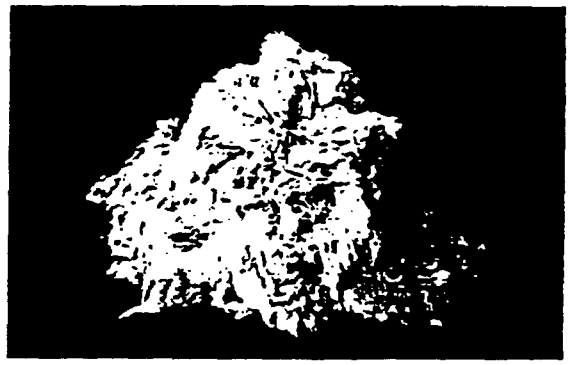
Fil-Insul

Temperatures to 1000 deg. F.

Fil-Insul is an asbestos filling material used where a resilient, non-settling insulation is desired. Because of its fibrous nature, it will not sift through cracks. Weight approximately 17 lb. per cu. ft. packed in place to proper density.

Banroc

Temperatures to 1000 deg. F.



Banroc (rock wool) is an effective insulating material made of pure rock fibre. Used as an insulating filler in ovens, fireless cookers, electric ranges, etc.

Furnished in bags of approximately 50 lb. Packed on job to various densities; usually 12 lb. per cu. ft. is sufficient.

Insulating Cements

J-M Insulating Cements are well known for their excellent coverage, good finish and insulating properties. There is a cement for every purpose.

Asbestos insulating cements are used as a finish over insulation and to seal joints. J-M No. 302 Cement being the one generally employed. Certain types are used for insulating irregular surfaces. J-M No. 450 Cement is usually recommended for this purpose.

J-M No. 319 Cement is semi-refractory and serves as a protection over insulation exposed to the erosive action of hot gases.

Aertite Boiler Wall Coating

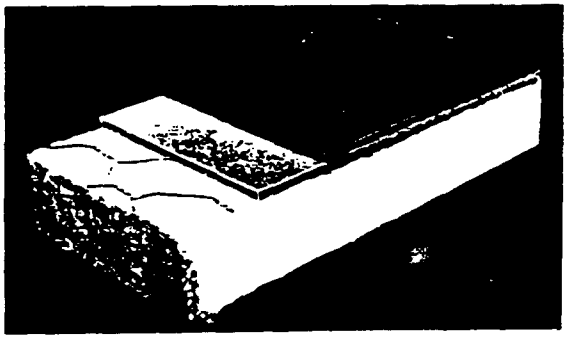
Temperatures to 250 deg. F.

Aertite is a tough, rubbery asphaltic-asbestos coating in plastic form for covering the outside of boiler and furnace walls to prevent air infiltration. Sometimes used as a weatherproof coating over insulation.

For a 1/16 in. coating, 24 to 40 lb. will be required per 100 sq. ft., depending upon the nature of

the surface. Furnished in 25, 50, 150, 300 and 500 lb. containers.

Insulkote



Insulkote is a durable, easily applied, weatherproof coating for insulated surfaces. Applied in one coat ¼ in. thick, it will cover approximately 45 sq. ft. per 100 lb. Furnished in 50-lb. pails, and in 150, 300 and 500 pound drums.

Fibrous Adhesive

J-M Fibrous Adhesive is used for the adhesion of sheet, block or brick insulation to flat or curved surfaces. For sticking insulation to metal surfaces approximately 50 lb. are required per 100 sq. ft., for sticking to brick, concrete, etc., 75 lb. per 100 sq. ft. Furnished ready to use in 80, 180, 365 and 600 lb. containers.

J-M Insulation for Homes

As a result of Johns-Manville experience in the application of industrial insulations, some of the most successful materials for the insulation of homes have been developed. Complete information on request.

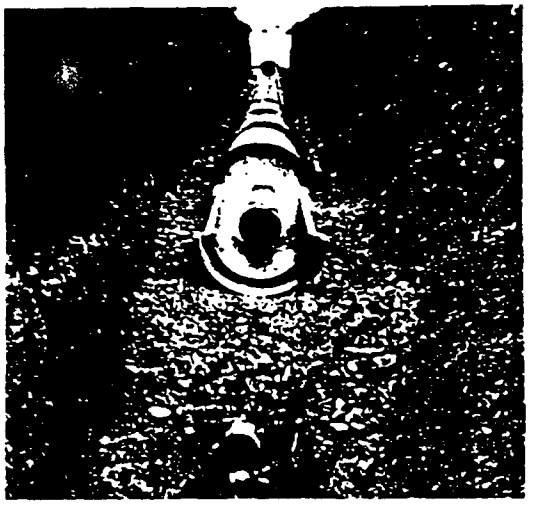
J-M System of Underground Pipe Insulation

The J-M System of Underground Insulation provides a stable, effective and economical means of insulating underground pipes carrying steam or hot water. The efficiency of the Johns-Manville System is at least 90 per cent, which is maintained for an indefinite period.

The insulation used is J-M Waterproof Asbestos Filling which remains unchanged by the temperatures encountered and is immune to moisture, rot and rust. When packed around the pipes, it completely fills the space inside of the protective tile with an elastic porous mass of interlacing fibres.

The J-M System of Underground Insulation provides insulation and supports for the pipes, enclosure for the insulation, and complete drainage by means of drain-tile and broken stone around the conduit.

Detailed recommendations to meet particular conditions will be gladly furnished by any J-M office.



In the J-M System the Conduit Is Completely Filled with Asbestos Fibre and Adequate Drainage Provided by Bell and Spigot Pipe in Broken Stone

J-M Methods of Fireproofing Structural Steel

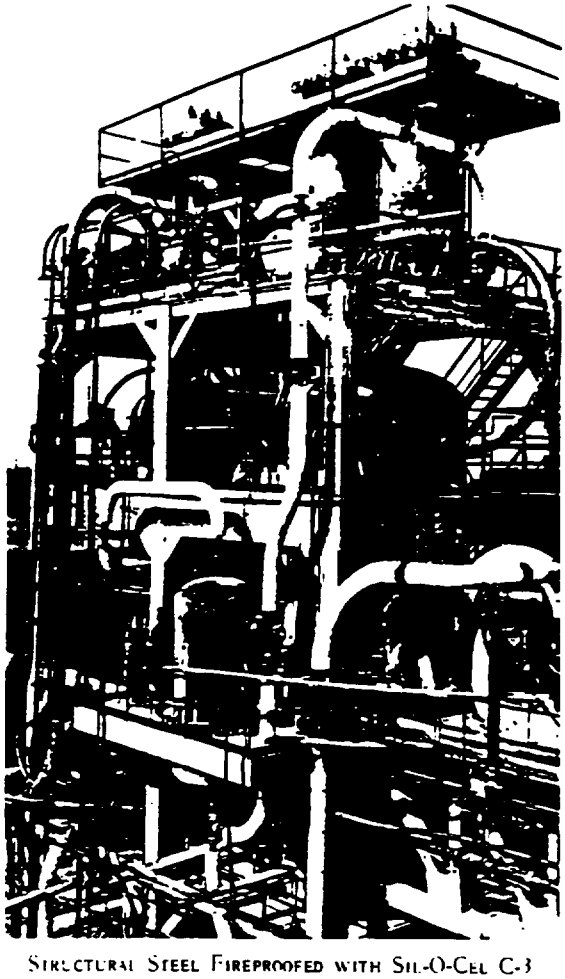
For fireproofing structural steel, Johns-Manville furnishes insulating materials which are designed to meet fire conditions and give superior protection to all members. The insulation prevents the protected steel work from reaching dangerous temperatures for a sufficient length of time so that fire may be extinguished before major damage has been suffered by the supporting structure.

Mild steel becomes materially weakened between 800 and 1000 deg. F., which temperatures are far

below those frequently encountered in plant fires. For this reason it has been proved highly advisable to protect supporting steel work, where failure of any member might cause disastrous results.

Sil-O-Cel C-3 Concrete Fireproofing is recommended to give protection for 6 to 10 hours. A 2 in. thickness is designed for 6-hour protection and a 3 in. thickness for 10-hour protection. Superex Combination Fireproofing (Superex and Magnesia block insulation) of a thickness approximating 3½ in., including cement finish, is designed to provide protection for from 4 to 6 hours. Superex, 1½ in. thick with a ¾ in. cement finish, is used for protection up to 2½ hours.

Detailed information regarding methods of fire protection are available at any Johns-Manville office.



STRUCTURAL STEEL FIREPROOFED WITH SIL-O-CEL C-3 CONCRETE



STRUCTURAL STEEL FIREPROOFED WITH SUPEREX COMBINATION INSULATION

VI — OTHER JOHNS-MANVILLE MATERIALS

(Building and Construction Materials—Packings—Refractory Cements—Electrical Materials—Friction Materials)

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- FLOORING MATERIALS
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  - TILE FLOORING, TYPE "A" 130
- ROOFING AND SHINGLES 125
- TRANSITE ASBESTOS PRODUCTS
  - CORRUGATED TRANSITE SHEETS 127
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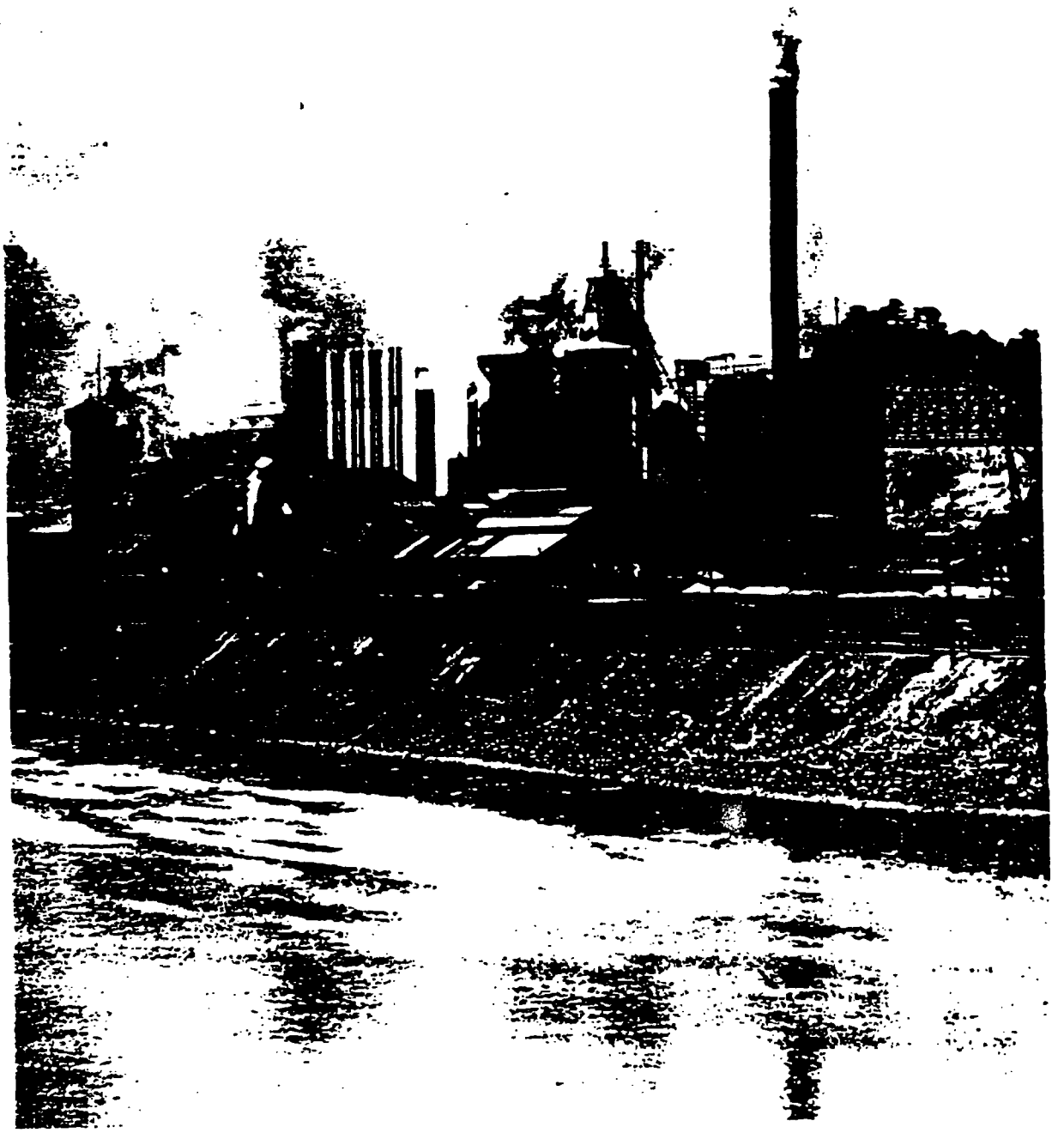


A Familiar Scene Along the Allegheny

Other Johns-Manville Materials

(Building and Construction Materials—Packings—Refractory Cements—Electrical Materials—Friction Materials)

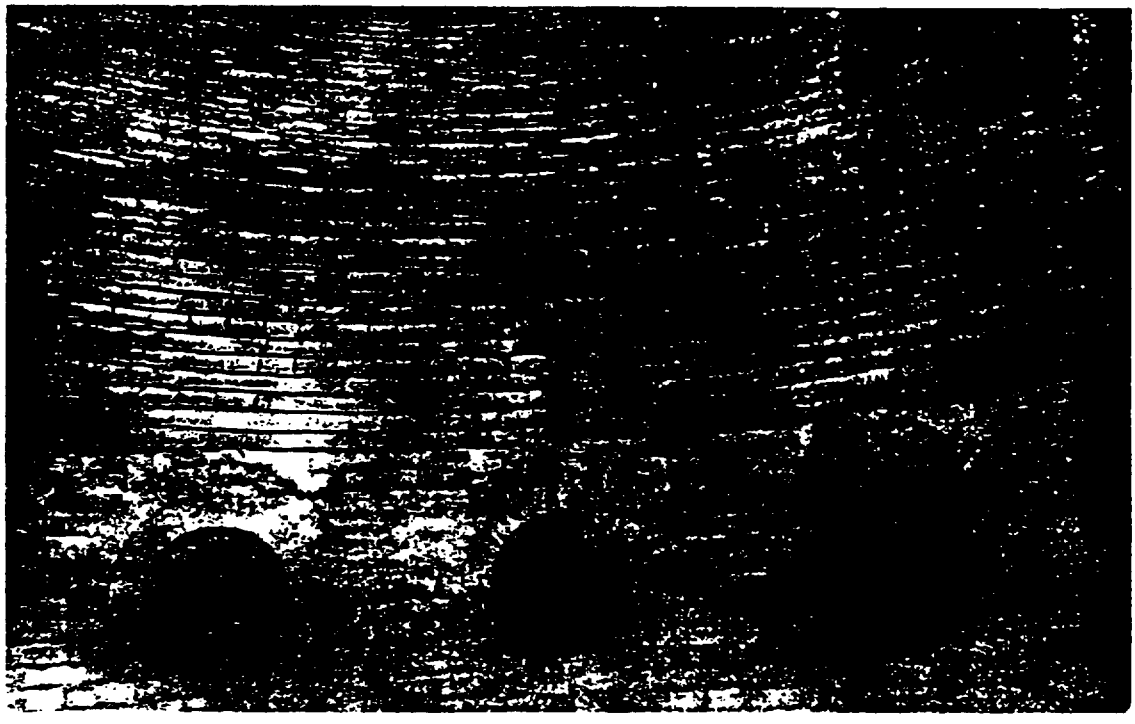


FIG. 1—INTERIOR OF A BLAST FURNACE, SET UP WITH J-M NO. 30 REFRACTORY CEMENT

Refractory Cements

IN best furnace practice, refractory cements are used to bond bricks as well as to provide for irregularities of shape. By bonding with the proper refractory cement, heat losses are cut down by eliminating open joints, the insulation is protected from furnace vapors, and infiltrating air is excluded. By preventing heat penetration at brick joints, a suitable refractory cement causes reduction in spalling and makes furnace walls resist higher temperatures. The refractory cement also retards deterioration from slags.

Wash-coated interiors resist erosive action and prevent brick disintegration. Repairs made with plastic fire brick material are effective and economical.

From a complete line of refractory cements, developed to serve specialized purposes, Johns-Manville recommends three cements for general work:

For a brick-to-brick, or dipped, joint:

J-M No. 32 Refractory Cement where a dry cement is wanted;

J-M No. 20 Plastic Refractory (thinned) where a plastic cement is wanted.

For a bond joint (1/8 in. to 3/16 in.):

J-M No. 31 Refractory Cement where a dry cement is wanted;

J-M No. 20 Plastic Refractory where a plastic cement is wanted.

In meeting conditions where the refractory cement is to come in contact with molten metal, or there are other special problems, the advice of J-M engineers is available on request.

Data on Johns-Manville Refractory Cements

Character or base	No. 20 Plastic Refractory — Silica	No. 26 Aluminum Silicate	No. 29 Plastic Refractory — Aluminum Silicate	No. 30 Silicon Carbide	No. 31 Aluminum Silicate	No. 32 Aluminum Silicate	No. 33 Processed Kaolin — Aluminum Silicate	No. 34 Chrome	No. 35 Processed Alumina	PFBM (Plastic Fire Brick Material) — Aluminum Silicate
Lowest working temperature, or low point vitrification, deg. F.	*	† 900	† 900	1850	1450	1250	1000	1000	1200	1500
Highest working temperature, deg. F.	2700	2600	2900	3000	3100	3100	3300	3400	3500	3000
Specific gravity	1.95	1.68	1.89	1.85	1.76	1.77	1.65	2.4	1.6	2
Approx. capacity; lb. req'd for setting 1,000 brick with ⅛"–3/16" bond joint	500–600	600–700	600–700	800–900	600–700	‡ **	†† 750–850		750–850	‡‡
Approx. capacity; lb. req'd for setting 1,000 brick with brick-to-brick joint	400–500	....	400–500	....	....	400–500	....	600–700	....	....
Form in which furnished	Plastic	Dry	Plastic	Dry	Dry	Dry	Dry	Dry	Dry	Plastic
Containers	5, 10, 25, 50 100, 250 500, 850 lb. cans or drums	100 lb. bags	100, 250 485, 800 lb. drums	100 lb. bags	100 lb. bags	100 lb. bags	100 lb. bags	100 lb. bags	100 lb. bags	250 and 500 lb. drums

*Sets hard when air dried.
†Medium air set.
**Use only in brick-to-brick joint—not bond joint.
‡Quantity of No. 32 cement required for coating varies a great deal depending upon the porosity of the brick. Based on average conditions, and when cement and water are used in equal quantities, i. e., 100 lb. cement and 100 lb. water, 90 lb. of cement are required per 100 sq. ft. of surface.
††For plaster coating—average ¼" thick, 400 lb. per 100 sq. ft.
‡‡For patching figure approx. 125–130 lb. per cu. ft.

Asbestos Textiles

Crude asbestos rock, crushed, spun into yarn and woven into fabric, forms a soft, flexible textile—a mineral cloth that resists heat and chemicals. The fibrous material can be felted, moulded or compounded into thousands of useful forms. The fibre itself, available in various grades, has a multitude of uses as a finished product.

Asbestos bags are used in collecting dust from hot gases. Asbestos cloth serves as a filtering base in the treatment of chemical solutions. Asbestos clothing for fire-fighting has been welcomed by all who face that menace. Fibre, felt, tape and tubing—all have wide industrial use where the remarkable properties of asbestos may be utilized.

Johns-Manville will be glad to answer inquiries about any of these or allied materials.

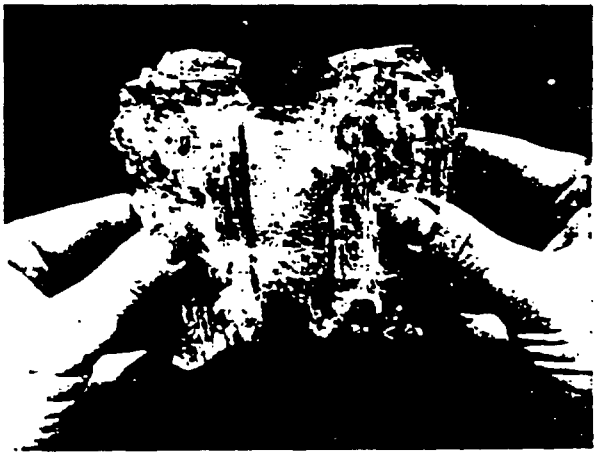


FIG. 2—CRUDE ASBESTOS

Packings

The Johns-Manville line of packings has proved its dependability and economy for all types of industrial service.

Sea Ring, an entirely automatic packing for reciprocating rods, has surprisingly long life under severe service.

Kearsarge Rod packing for steam, Mogul for valve stems, J-M Flax for hydraulic and Centripac for centrifugal service are a few of the well-known standard materials.

Service Sheet for general requirements, Liberty Red Rubber Sheet for service water, Kearsarge Gaskets for boilers, and many others are included.

The J-M line of packings is scientifically designed to satisfy every industrial need.

Rod, plunger, valve stem, piston, sheet packing and gaskets for any service—every requirement is met by some J-M product specially designed to serve the purpose.

All these packings are described in the J-M packing catalogue, sent on request.



FIG. 3—JOHNS-MANVILLE HAS A PACKING FOR EVERY REQUIREMENT

Brake Blocks, Brake Linings and Clutch Facings

Johns-Manville furnishes rigid and flexible asbestos friction materials for brakes and clutches. The rigid class is well known for high strength, uniformity of friction, smooth and quiet operation, and long life on severe low-speed work. The flexible types wear well on light loads with high speeds, have high friction, and are readily adaptable to all sizes of drums.

The rigid type comprises J-M Asbesto-Metallic Friction Blocks, Moulded Asbestos Linings, and Asbestos Friction Facings. The flexible class includes J-M Woven Asbestos Brake Linings and Clutch Facings, and J-M Folded and Compressed Asbestos Brake Linings and Clutch Facings.

Heat endurance, strength and long life are three distinctive qualities built into Johns-Manville Friction Materials. All the needs of every piece of braking equipment yet designed are fulfilled by some J-M product. Recommendations covering any application will gladly be supplied by Johns-Manville.



FIG. 4—A SET OF GIANT J-M BRAKE BLOCKS—DIAMETER 7 FT. 9 IN. AND WEIGHT 1000 LB. SMALL SET IS 1 FT. 6 IN. IN DIAMETER

Expansion Joint Materials

Where through joints are provided in brickwork or between brickwork and steel work in furnaces and boiler settings, it is necessary to install packing which is both resilient and heat resisting. Johns-Manville has developed products specially suited to this purpose, which are adaptable to every requirement.

J-M No. 4200 Asbestos Rope is used in joints up to 1 in. in width. Where larger packing is required, J-M Asbestos Jelly-Rolls are employed. Openings facing combustion chambers are sealed with J-M No. 352 Asbestos Cement after the packing is in place. J-M Roll Fire-Felt is better suited for packing some joints than is rope or Jelly-Rolls. J-M RX Asbestos Fibre is frequently used to fill interstices between and around other packing materials. Details as to best practice will be furnished by Johns-Manville upon application.

Johns-Manville also furnishes expansion joint material for use in building construction and in paving. These materials are designed to provide maximum resiliency and long life. Full information on request.

J-M Electrical Materials

Asbestos Ebony

J-M Asbestos Ebony is an ideal electrical insulator, ebony-like in appearance, which is employed for

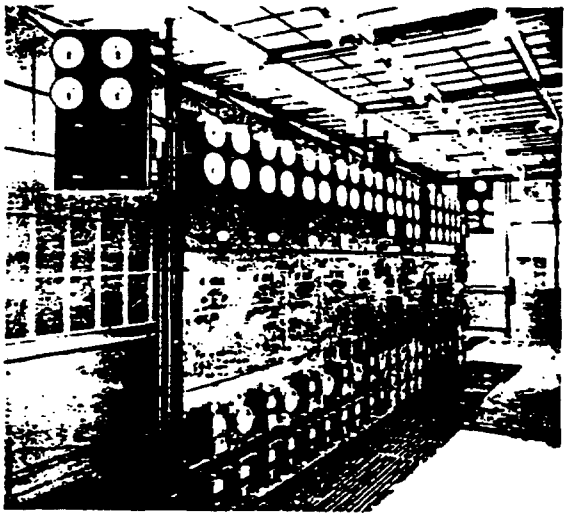


FIG 5—PANELS OF J-M ASBESTOS EBONY IN A WELL-DESIGNED CONTROL ROOM

switchboards, controller plates, switch bases, bus-bar supports, etc. It is purely a mineral product, composed of asbestos fibre and binding cement, bonded under tremendous pressure, impregnated with a special insulating compound, and capable of enduring severe conditions. Because of its structure, it will withstand shock and vibration, is unaffected by rapid temperature changes, will not shrink, crack or buckle, and is uniform in texture throughout.

The specific gravity is 2.05 and the weight 128 lb. per cu. ft. It is furnished in two finishes: "Standard," in thicknesses from 1/8 in. to 3/16 in., is lacquered a deep, lasting black; "Switchboard," in thicknesses from 1/4 in. to 4 in., is lacquered the same as Standard finish, but the surface is smoother than Standard. Sheets are furnished 36 x 48 in. from 1/8 in. to 4 in. thick; 42 x 48 in. from 1/4 in. to 4 in. thick; and 42 x 96 in. from 1/4 in. to 2 in. thick, or finished panels of any size within these limits.

Asbestos Ebony Moulded

Asbestos Ebony Moulded is similar to Asbestos Ebony Sheets, except that it is moulded into special

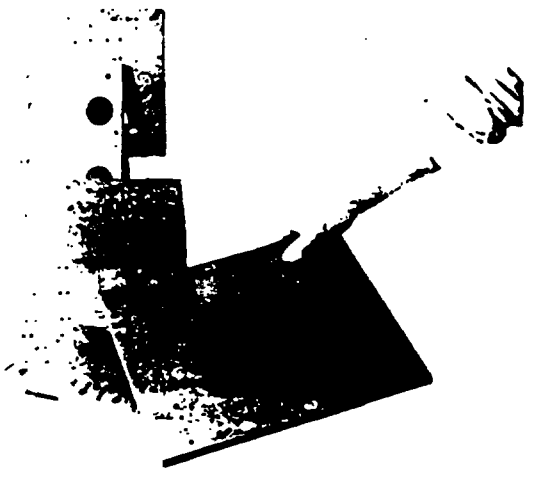


FIG 6—ASBESTOS EBONY MOULDED IS READILY FORMED IN SPECIAL SHAPES

shapes, with holes, counterbores, slots or grooves, as desired. Inserts may be included except in edges of panels. It is used principally where small panels are required for switches, starters, meters, etc. Asbestos Ebony Moulded is strong electrically and mechanically and makes a very presentable appearance. It will not deteriorate with age, will not absorb moisture, and will withstand successfully the action of ordinary laboratory acids.

Furnished in three finishes: No. 101, sanded and lacquered dull black on all surfaces; No. 202, unsanded and lacquered; No. 303, unsanded and unlacquered. Panels can be furnished in thicknesses from ¼ in. to 1½ in. and in sizes up to 20 x 25 in. Tubes and rods can also be furnished in lengths up to 12 in. with wall or diameter from ¼ in. to ½ in.

Transite Sheets

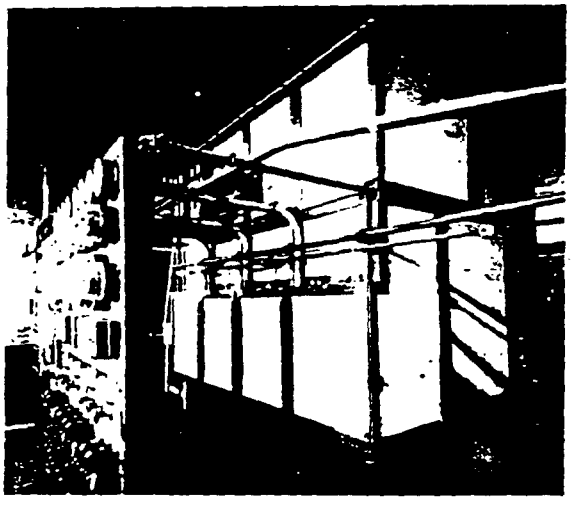


FIG 7—PANELS OF J-M TRANSITE ON FIELD RHEOSTAT ENCLOSURE

Transite, described on page 127, is the leading fireproof material on the market for use where high dielectric strength is not required. Its mechanical strength has caused it to have wide application as a barrier at all points where an electric arc may possibly occur. Long service in the field, severe fire tests, and sudden changes in temperature have proved that it does not become warped, distorted or weakened in service.

Electrobestos

J-M Electrobestos is a heat-resistant moulded material suitable for oven or heater parts, resistance mounts, heater cores, arc deflectors, etc. Standard Electrobestos may be used up to 1200 deg. F. where

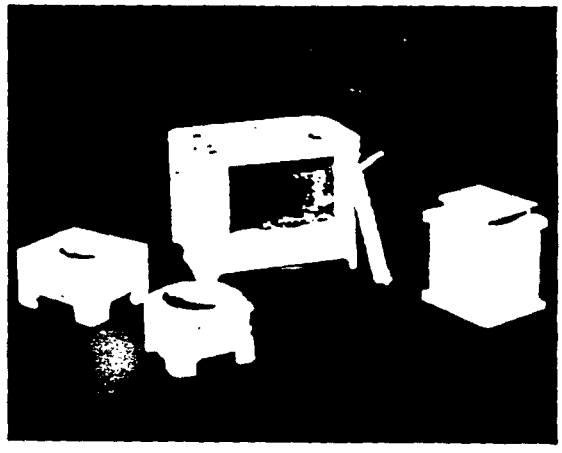


FIG 8—OVENS AND HEATER FOR LABORATORY FLASKS, RETORTS, ETC., MOULDED OF J-M ELECTROBESTOS

conditions involve rapid temperature changes. Electrobestos "X" is harder and stronger and resists temperature changes equally well if below 700 deg. F. It may be used up to 1200 deg. F.

Electrobestos is moulded on order in J-M factories from samples or drawings furnished. When ordering, information should also be given on the allowable tolerances and the conditions under which the material will be used.

Niagrite-Asbestoment Cable Fireproofing

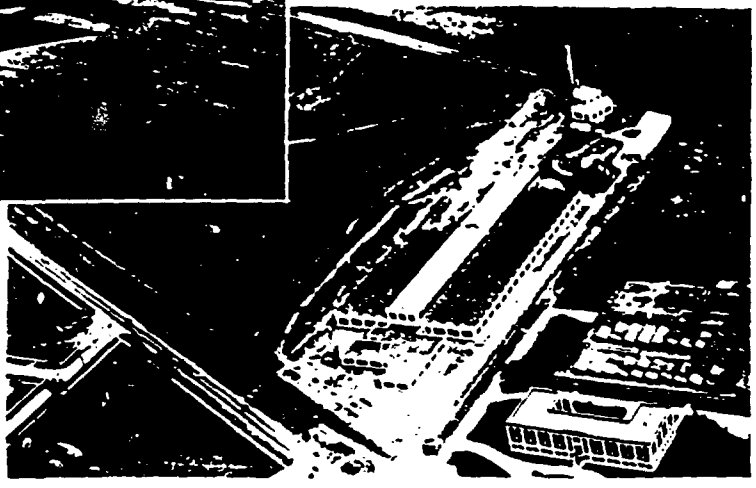
J-M Niagrite-Asbestoment is an inexpensive and easily applied combination of materials used to form a fireproof, arc-proof protection for electric cables. In the event of a breakdown in a cable, adjacent cables covered with Niagrite-Asbestoment are secure from the arc.

J-M Niagrite is commercially pure asbestos felted tape, supplied in widths of 1½ in., 2 in. and 3 in., and in thicknesses of 3/32 in., 1/8 in., 3/16 in., and 1/4 in., and, unless otherwise ordered, in rolls of 15 feet. It is furnished with or without reinforcement of asbestos cloth, asbestos listing or jute cloth.

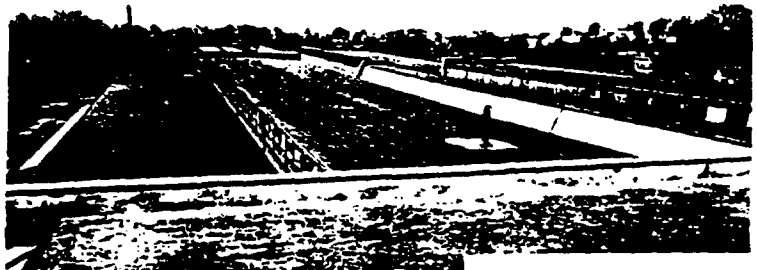
J-M Asbestoment is a chemically neutral powder, packed in 100 lb. bags with complete directions for use. The Niagrite is impregnated with a mixture of Asbestoment and water. The Niagrite is then applied spirally to the cable, after which it is coated with a mortar of Asbestoment.

Application of J-M Corrugated Transite in Saw-Tooth Roof Construction on Large Industrial Plant

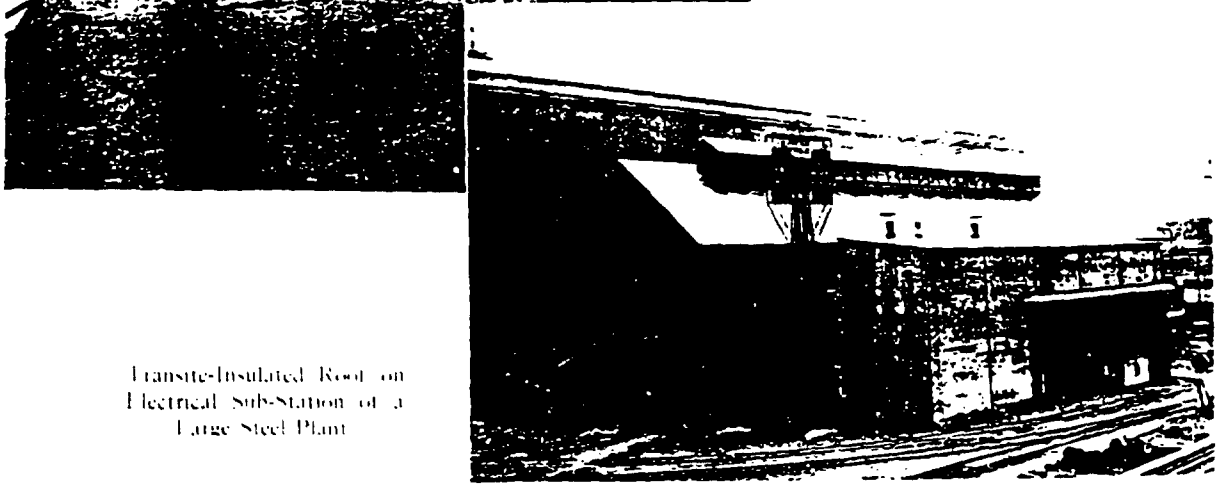




An Airplane View of J-M Built-Up Roofs on Saw-Tooth Roof Construction



Another J-M Built-Up Roof on a Large Industrial Plant



Transite-Insulated Roof on Electrical Sub-Station of a Large Steel Plant

FIG. 9—JOHNS-MANVILLE ROOFING MATERIALS ARE ADAPTABLE TO EVERY ROOFING REQUIREMENT

Orangeburg Fibre Conduit

Orangeburg Fibre Conduit is made of wood fibre, impregnated with an insulating and waterproofing preservative. The ends of the conduit are cut to form a Harrington tapered sleeve joint or a mortise and tenon socket joint.

The conduit is designed for underground distribution of power and telephone cables and signal wires.

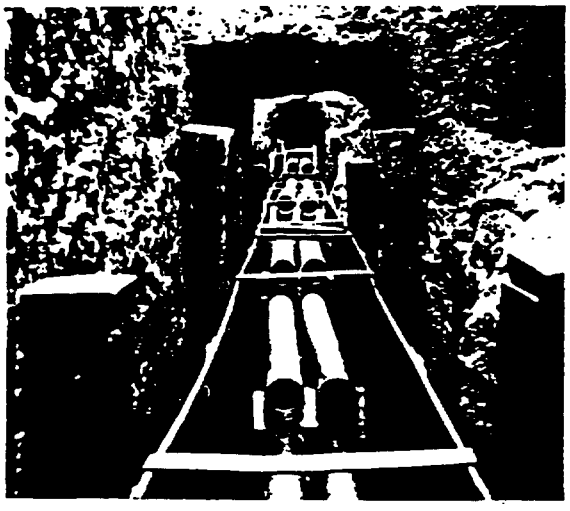


FIG. 10—FIBRE CONDUIT USED IN UNDERGROUND POWER DISTRIBUTION—BROOKLYN EDISON COMPANY

generator leads, transformer leads, bus-bar covers, and ducts in floors and retaining walls. It is particularly suitable for such installations because of its high insulating qualities, lightness, resistance to corrosion, freedom from hysteresis, and ease and speed of installation.

Furnished in five-foot lengths, except in the 1 in size, which is furnished in four-foot lengths. Some short lengths are included in every shipment for convenience. Standard diameters are from 1 in. to 5 in. in ½ in. gradients. Larger sizes on special order. Radial bends, S bends, tees, elbows, crosses and junction boxes, suitable for the most complicated installations, can be obtained. Jointing compound for waterproofing joints is also available at a moderate cost.

Other Electrical Supplies

Johns-Manville supplies Asbestos Listing in various sizes for wrapping electrical wires, Fibroid and Armaturo Asbestos Paper Tape for winding magnet and armature wires, and friction tapes and splicing compounds to fill every need.

Further information on J-M Electrical Materials and their uses is available at any Johns-Manville office.

Roofing and Shingles

To meet any roofing requirement, Johns-Manville supplies Built-Up Roofs, Transite, Asbestos and Asphalt Shingles, Ready-to-Lay Roofing, Insulated and Rot-Proof Roofs, and Roof Insulation, with all necessary accessory materials. The high quality of these materials, their adaptability to serve particular purposes, together with a successful record everywhere, have made the name Johns-Manville pre-eminent wherever roofing is used.

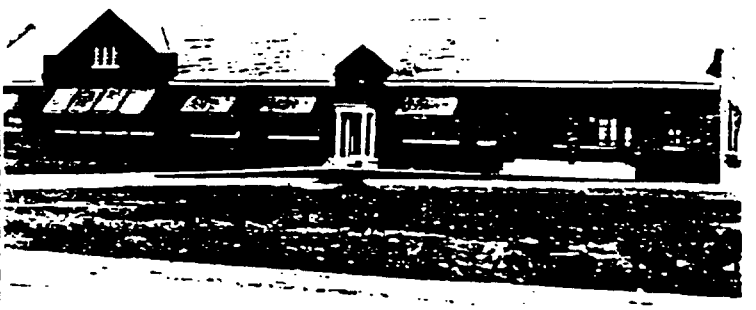
Built-Up Roofs

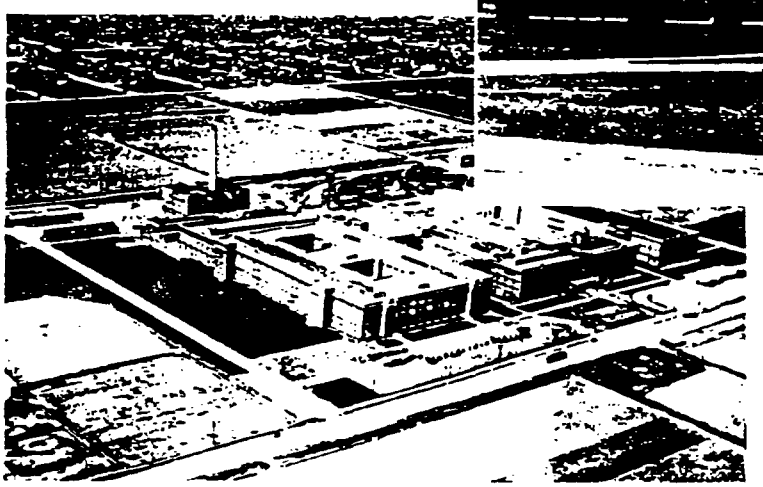
J-M Built-Up Asbestos Roofs are the outcome of several decades of study and experience in producing permanent, fireproof, leakproof, light-weight roofs at moderate cost. They are made of alternating layers of asphalt-impregnated asbestos felt and J-M Roofing Asphalt with a smooth top surface of asphalt. Their resistance to fire and the ravages of weather through years of service without maintenance, amply justifies the guarantee which accompanies each standard roof as a definite assurance of protection to the owner. The number of alternating layers of impregnated asbestos felt and asphalt determines the classification of the roof.

J-M Combination Built-Up Roofs are composed of a rag felt base with asbestos finishing felts. When a top surface of gravel or slag is required, Johns-Manville supplies "Type B" roofs, the felts of which have a rag base. The top surface consists of slag or gravel, embedded in a top coat of J-M Roofing Asphalt. When a colored roof is desired, a top layer of J-M Split-Sheet Slatekote Roofing is used instead of the usual finishing coat of asphalt and slag or gravel.

Proper application is just as important in producing a J-M Built-Up Roof as are the materials themselves. For this reason, in every community J-M Approved Contractors have been selected by Johns-

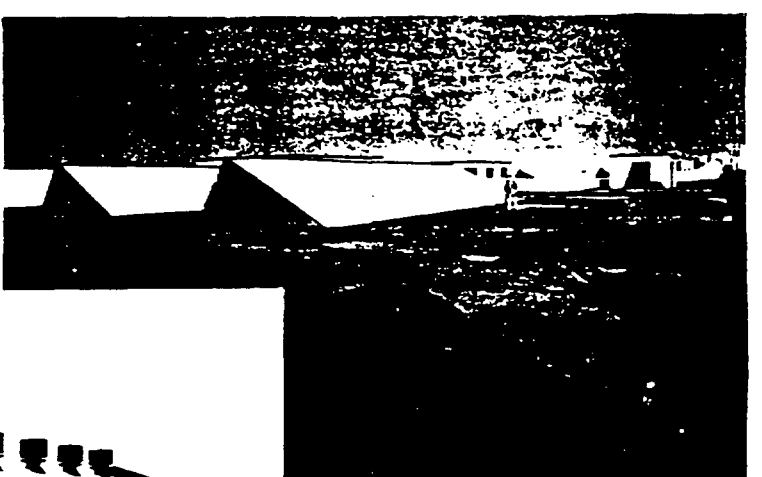
J-M Rigid Asbestos Shingles Provide Lasting and Attractive Roofs

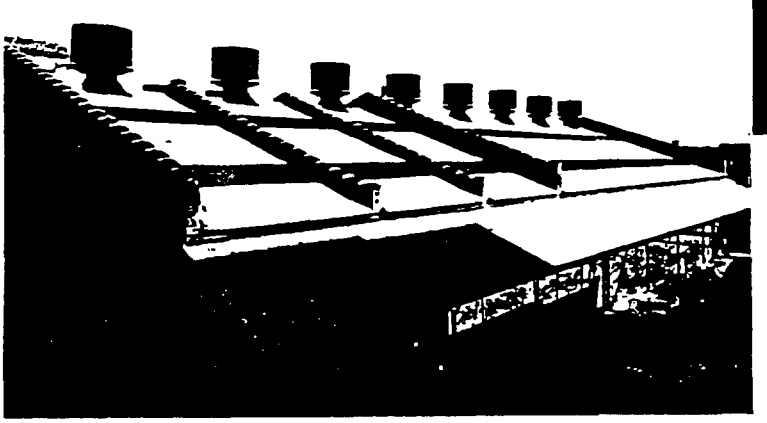




A Total of 432,000 sq. ft. of J-M Built-Up Roofs, As Seen from the Air

Part of the 70,000 sq. ft. of J-M Built-Up Roofing on a Large Building in Ft. Worth Texas





A J-M Corrugated Transite Roof with Insets of Corrugated Glass Skylights

FIG. 11—JOHNS-MANVILLE ROOFING MATERIALS ARE ADAPTABLE TO EVERY ROOFING REQUIREMENT

Manville as qualifying in roofing experience and business integrity to carry the J-M franchise in applying Built-Up Roofs.

Ready-to-Lay Roofings

In Ready-to-Lay Roofings, Johns-Manville supplies both asbestos felts and rag felts with plain or slate-imbedded surfaces. These materials are furnished in a variety of colors and weights. They are inexpensive and well suited for use where roll roofings are adaptable.

Asbestos Shingles

J-M Rigid Asbestos Shingles are made of asbestos fibre and portland cement, moulded under tremendous pressure into rigid, monolithic slabs. They provide a permanent, weatherproof, fireproof roof which can be designed to harmonize with any architectural style and color scheme, because of the great variety of sizes, shapes and colors available.

Asphalt Shingles

J-M Slatekote Shingles, made of asphalt-saturated rag felt and asphalt, are durable, weather-tight, inexpensive and present an attractive appearance. They are made in a wide variety of solid colors and blends.

Transite Roofing

For roofing and siding on skeleton steel frame buildings, corrugated Transite sheets provide a durable, fireproof construction, unaffected by weather and highly resistant to the ordinary acid fumes found in industrial plants. Transite is easily erected and requires no painting or maintenance of any kind. Transite is described below.

Insulated Roofs

J-M Rigid Roofinsul is a strong insulating board made of felted, waterproofed wood fibres. Applied in conjunction with a J-M Built-Up Roof, it is an ideal insulation for any type of roof deck subjected to ordinary conditions.

Where interior humidity is especially high and roof drip must be eliminated, the special patented roof construction known as J-M Insulated Rot-Proof Roof is recommended. In this construction, cork insulation is built-up over W. R. Corrugated Transite and the whole protected by a J-M Built-Up Roof.

Transite Asbestos Products

J-M Transite Products are composed of asbestos fibre and portland cement, combined under tremendous pressure into a homogeneous, dense mass having high strength and great durability. Transite is light grey in color; weighs about 124 lb. per cu. ft.; and can be drilled with twist drills, punched, fastened with nails and screws and sawed with a hand saw, though a portable power saw should be used if much sawing is to be done. Transite is made in a number of different forms for various purposes.

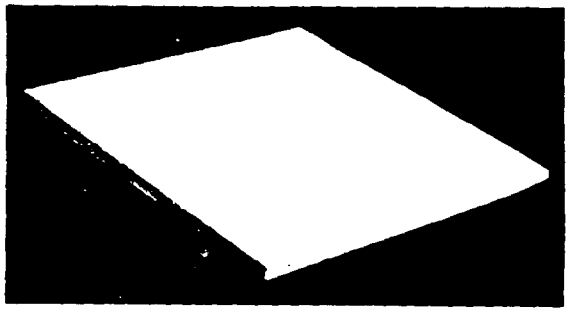


FIG. 12—A SHEET OF FLAT TRANSITE

Flat Transite Sheets

Transite is furnished in flat sheets for use as a casing over insulation on industrial furnaces and boilers; for ceilings, walls, partitions and fire doors in building construction; and as dryer housings, hoods, dampers, baffles, and ducts in various industrial processes. It is also furnished made up into ventilators, forge jacks, smoke jacks, etc.

Transite offers high resistance to acid fumes and atmospheric conditions. It cannot rot or corrode and can safely be used where it will be subjected to temperatures as high as 800 deg. F.

Flat sheets are furnished 36 x 48 in., 42 x 48 in., and 42 x 96 in., and in thicknesses of ⅛ in. to 4 in.

Corrugated Transite Sheets

Corrugated Transite sheets are particularly designed for use as roofing and siding. This material has found wide application in industrial plants due to its high resistance to acid fumes and atmospheric

conditions and because of its strength, permanence and ease of application. As accessories, the material is furnished in the form of ridge rolls, corner rolls, and louvres. Every detail of construction has been thoroughly worked out, and full information may be had on application to any Johns-Manville office.

Corrugated Transite sheets have corrugations with a 4.2 in. pitch and a depth of 1¼ in. They are furnished 42 in. wide and in lengths of 4 ft., 5 ft., 5½ ft., 6 ft., 7 ft., 8 ft., and 8½ ft. The thickness is approximately 7/16 in. at ridge and valley of corrugations, and approximately 5/16 in. on tangent. Weight approximately 4.1 lb. per sq. ft. Curved sheets or special cut sheets within the above size limitations can be furnished on special order.



FIG. 13—LAYING J-M CORRUGATED TRANSITE ROOFING. THE CUT CORNER CONSTRUCTION PERMITS THE NESTING OF CORRUGATIONS, MAKES A TIGHT JOINT, AND RESULTS IN A DURABLE AND ATTRACTIVE ROOF

W. R. Transite

Both Flat and Corrugated Transite sheets are furnished with a special bituminous impregnation to afford maximum impermeability where the material will be subjected to extreme and sustained moisture or acid conditions.

W. R. Flat Transite is furnished in sheets 42 x 48 in. and 42 x 96 in. and in thickness of ¼ in. Smaller sizes can be furnished on special order.

W. R. Corrugated Transite is furnished in the same sizes and thickness as the standard material.

Transite-Encased Insulating Board

This material consists of a core of ½ in. or 1 in. J-M Insulating Board with a ⅛ in. sheet of flat Transite cemented to each side. Used as a combination insulation and casing for low temperature ovens and dryers. Furnished in standard size sheets 42 x 96 in.

Transite Pipe

Transite Pipe is manufactured by a process which insures a highly uniform quality. It has a dense, close-grained structure, is immune to oxidation, tuberculation and electrolysis, and highly resistant to chemical action. Transite Pipe has a very smooth interior surface and a high delivery capacity. It is much lighter in weight than corresponding metal pipes, is readily workable, may be cut or tapped, and does not need exterior or interior protection except for extreme conditions. Furnished in five classes as follows:

Class S (not for pressure conditions) is used as soil pipe as well as vent stacks and flues carrying gases up to 500 deg. F. It is also used for protecting electric cables against fire hazard. Furnished in sizes ranging from 2 in. to 40 in. in diameter.

Classes A, B, C, and D are designed for working pressures of 37½, 75, 150 and 225 lb. per sq. in., respectively, and are used for delivering hot or cold water, gas, brine, and certain process liquors and solutions under pressure. Classes A and B are furnished in sizes from 2 in. to 40 in.; Classes C and D in sizes from 2 in. to 24 in., and larger on special order.

Celite for Concrete, Plaster and Mortar

Celite for Concrete is a light weight mineral powder (diatomaceous silica) used in portland cement concrete for increasing the workability of the mix and for improving uniformity, strength, watertightness and appearance of the final concrete. Used at the rate of 0.2 to 0.6 cu. ft. per bag of cement. For the average 1:2:4 mix, 0.3 cu. ft. will give excellent results.

Extended use over a period of years has shown that Celite is a positive mechanical means of insuring better concrete under average field conditions. Being practically pure silica, SiO_2, it is the most

permanent element in concrete and does not affect the time of setting.

Due to decreased labor costs and to the increase in the yield of concrete when Celite is used, it does not add to the cost of the concrete per unit of volume.

Celite is also used with excellent results in cement and lime plasters and mortars, materially improving the plasticity and working qualities and increasing strength. By holding the water within the mortar, it allows more time for the placing of the brick before the workability of the mortar has been lost. Celite mortars have exceptional spread and "fatness."

Celite is furnished in 100 lb. bags.

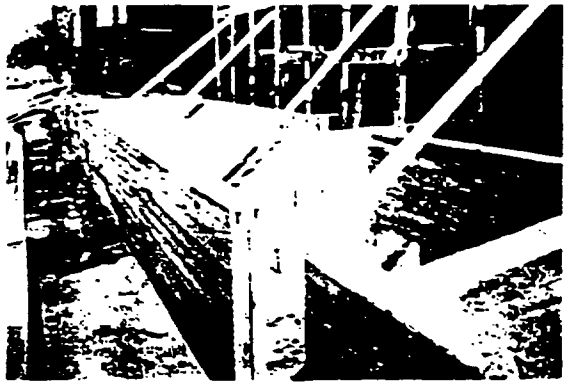


FIG. 14—CELITE FOR CONCRETE WAS USED IN THESE CONDENSER PITS OF THE ST LOUIS COKE & IRON CO., GRANITE CITY, ILLINOIS

J-M Flooring Materials

J-M Industrial Flooring

J-M Industrial Flooring consists of a carefully selected and graded mineral aggregate, bonded with high quality asphalt cement. The materials used are resistant to the action of acids, brines and other alkalies. Extensive experience in the application of industrial flooring is the basis for recommendations designed to meet various service conditions.

This flooring is monolithic, smooth, dry, warm and easy under foot. It will not crack under atmospheric changes or grind out or warp under severe traffic. It can be readily cleaned by flushing. It is non-slip, dustless, sanitary, noiseless, resilient, waterproof, fire-retardant, and practically wearproof.

J-M Industrial Flooring is ideal for laboratories, battery rooms, machine shops, warehouses, etc. It can be laid over any substantial base such as wood, concrete, brick or tile which, in itself, is strong enough to carry the required load.



FIG 15—J-M INDUSTRIAL FLOORING IN A STEEL MILL

Recommendations for the proper type and thickness of flooring required for specific conditions will be furnished on application.

J-M Tile Flooring, Type "A"

J-M Tile Flooring, Type "A," is a decorative flooring, composed of specially prepared asphalt compounds, asbestos fibre, mineral fillers, and pigments, manufactured in flat tile form.

J-M Tile Flooring is sanitary, odorless, and does not originate dust. Under the usual foot traffic to be found in buildings, it is extremely durable. It is comfortable under foot and not slippery. As it will not support combustion, it is considered a fire-resisting floor and has been approved for use in fireproof buildings.

J-M Tile Flooring is furnished in black, red, mahogany, tan, grey, blue, ivy green and olive green, in the following sizes: 6 x 6 in., 9 x 9 in., 12 x 12 in., 9 x 27 in., and 12 x 24 in. The standard thickness of tile is 3/16 in., although 1/8 in. tile can be furnished where traffic is light. The 3/16 in. tile weighs 200 lb. per 100 sq. ft. The 1/8 in. tile weighs 135 lb. per 100 sq. ft.



FIG. 16—J-M TILE FLOORING IN A CONTROL AND SWITCHBOARD ROOM

Underground Pipe Protection

Adequate protection of underground pipe lines is recognized as an economic necessity to eliminate costly shut-downs, replacements and repairs which follow the burial of unprotected pipe.



FIG. 17—APPLYING BITUMEN AND ASBESTOS FELTS TO PIPE LINE

The value of underground pipe protection is determined by its ability to protect the line indefinitely from soil corrosion and electrolysis. Greater success has attended the use of bituminized asbestos felt than has resulted from any other method.

The major feature of the Johns-Manville method of pipe protection involves the use of an asbestos felt combined with a suitable bituminous cementing compound, the felt itself being impregnated with the same material. The method of application provides a durable waterproof envelope which completely encloses the pipe.

Asbestos felt is essential because of its resistance to soil acids, salts and alkalies, electrolysis and decay. In combination with the bitumen it effects a positive safeguard against corrosion and electrical disintegration of the steel.

J-M recommendations are based on long experience in waterproofing underground structures of every description, including over 10,000 miles of pipe. Leading engineers, pipe line operating companies, scientific societies, and associations concerned with the corrosion problem endorse the principles advocated by Johns-Manville.

Engineers in the Johns-Manville organization are available to assist in selecting the most economical materials and methods of application for every specific requirement.

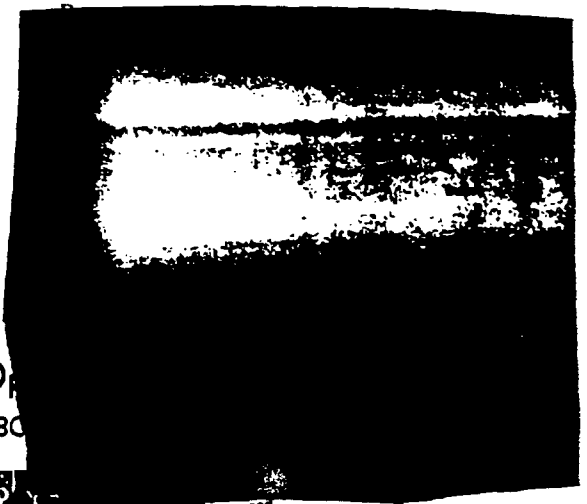
Insulation of New Open Hearth Regenerators

SECTIONS BELOW GROUND

Sil-O-Cel C-3 Concrete Recommendation

Regenerator Bases — The entire base of the regenerator chambers is insulated with a minimum of 4 in. of Sil-O-Cel C-3 Concrete, covered with two 2½ in. layers of fire brick.

Sil-O-Cel C-3 Concrete is made by mixing Sil-O-Cel C-3 and portland cement, either by hand or in a mechanical mixer, in the proportion of four parts of C-3 to one part of portland, by volume. An excess of water should be avoided. After thorough mixing, the C-3 Concrete is tamped



Insulation of Existing O

SECTIONS ABO



FIG 6—SIL-O-CEL C-3 CONCRETE ON OPEN HEARTH REGENERATIVE CHAMBERS. THE INSULATING CONCRETE IS APPLIED TO THE WALLS BY MEANS OF A CEMENT GUN

Sil-O-Cel C-3 Concrete Recommendation

Regenerator Walls — On old regenerator chambers constructed either of solid fire brick or a combination of fire brick and red brick, the insulation consists of a minimum of 4 in. of Sil-O-Cel C-3 Concrete (see Figs. 6 and 7).

Cement Gun Method of Application — Before any application of C-3 Concrete is started, the entire regenerator wall and steel work should be given a wet sand-blast with the cement gun to wash off thoroughly all loose mortar and dust from the brick work and remove loose scale, rust and paint from the steel work.

After this sand-blasting

are placed through holes pre

on approximately 3 ft vertical centers

rods will be as near as possible to 2 in

of the brick surface, thus

in the center of the C-3 Concrete

4 in. x 4 in. mesh of

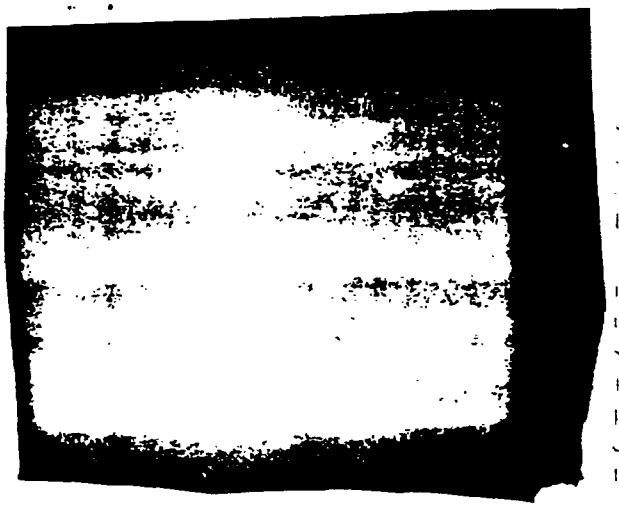
is securely fastened



CONCRETE



Regenerator Roofs



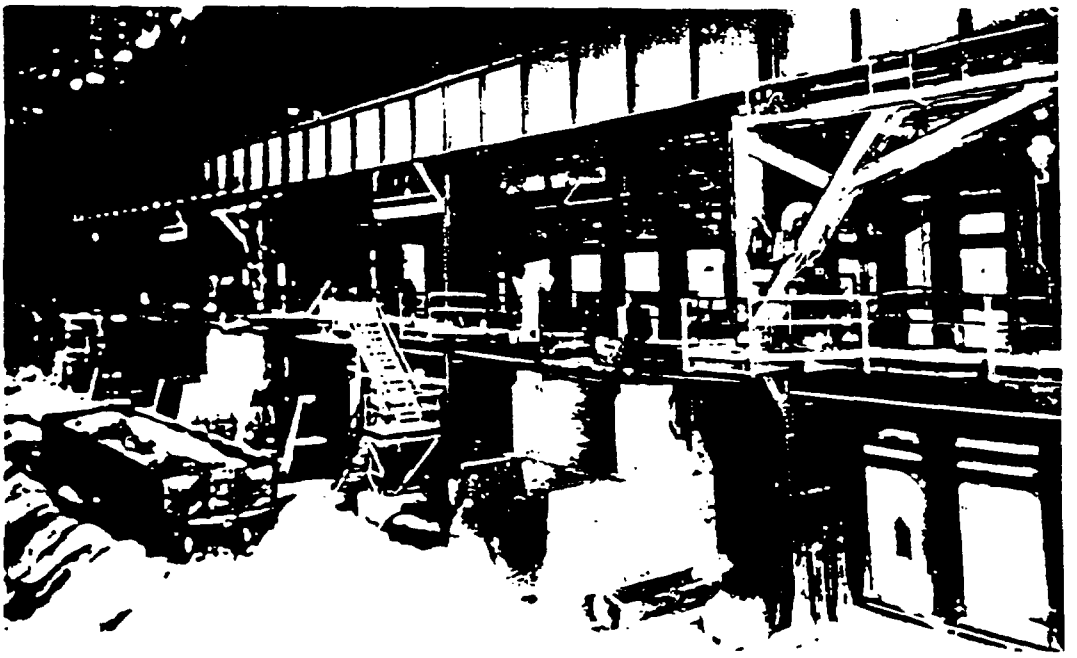
[illegible] butted. [illegible] netting is [illegible] and fastened securely at the edges [illegible] expansion bolts or staples driven in the [illegible]. After the netting is [illegible] 1-M No. 302 [illegible] The first coat is left to [illegible] surface before the application of [illegible] The second coat is troweled to a [illegible]

Sil-O-Cel Brick Recommendation

Regenerator Walls — When all exterior brickwork above the ground is insulated with 4½ in. of Sil-O-Cel Natural Brick instead of Superex, the insulation, furnished in standard fire brick size (9 in. x 4½ in. x 2½ in.), is placed between the shell and the brickwork as the work progresses (Fig. 3).

In order to construct a monolithic wall of equal insulating value at every point, it is necessary to lay up the Sil-O-Cel Natural Brick in a mortar of the same material, with the thinnest possible rubbed joints. This mortar is furnished at the rate of 80 lb. per thousand brick. At the arches, the fire brick is carried through to the steel, as previously noted in the Superex recommendation.

Regenerator Roofs — When the roof is insulated with 2½ in. of Sil-O-Cel Natural Brick instead of Superex, the Sil-O-Cel is laid over the surface in a single layer with the bricks tightly butted together and finished with a slurry of Sil-O-Cel Mortar.



[illegible] Are Insulated with Sil-O-Cel

Request Number
10119

RECORDS CENTER SERVICE REQUEST MC-3390 (3/89)

SERVICE	REQUESTOR INFORMATION			SCHEDULE INFORMATION		
☑ Retrieval ☐ Return ☐ New Intake ☐ Forms _____ ☐ New Boxes _____ ☐ Permanent Out ☐ Other	Requestor			Date Requested	Time	By (Initials)
	Department	Location	Extension	Date Needed	Time	By (Initials)
	Requested For Use Of:			Date Completed	Time	By (Initials)
	BOX NUMBER	BOX LOCATION		FILE/FOLDER INFORMATION		

COMMENTS:

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COPY FORM	INITIALS	DATE
	TRD	

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NOTES