Dec. 24, 1946. L. H. HOSBEIN 2,413,183

FURNACE WALL

Filed July 3, 1944 5 Sheets-Sheet 1

FIG. 1

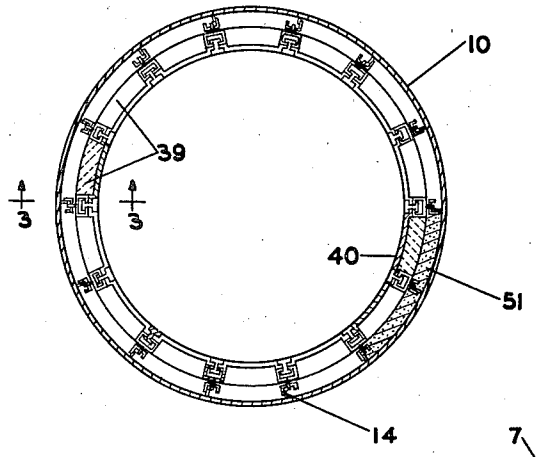

FIG. 2

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FURNACE WALL

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FIG. 3

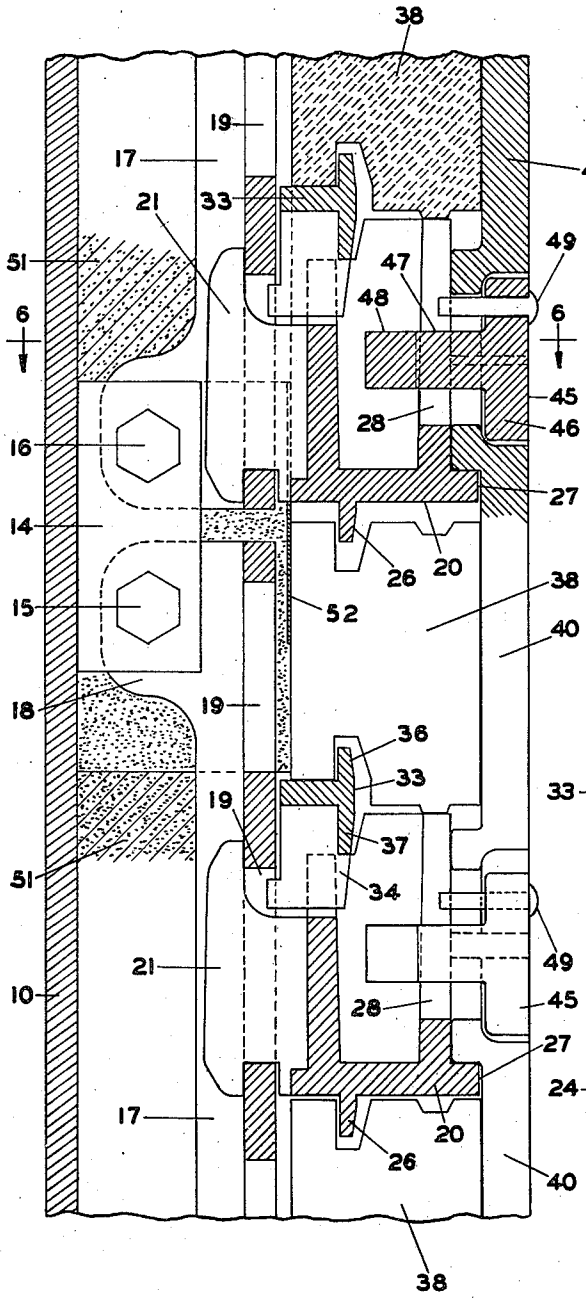


FIG. 4

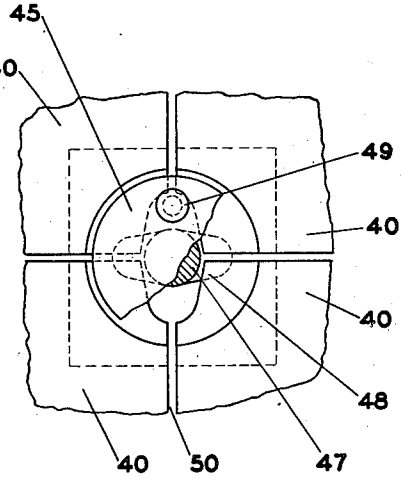
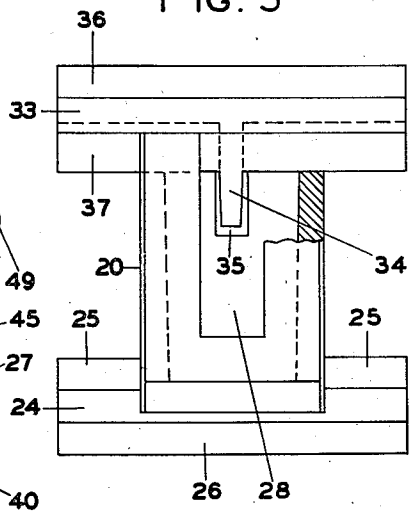


FIG. 5



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FURNACE WALL

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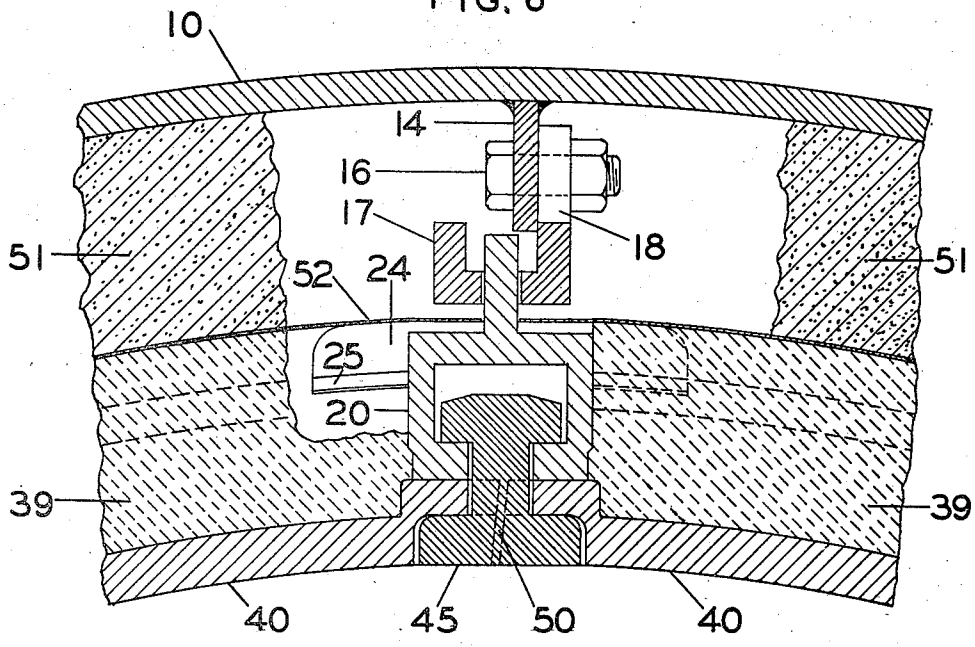
FIG. 6



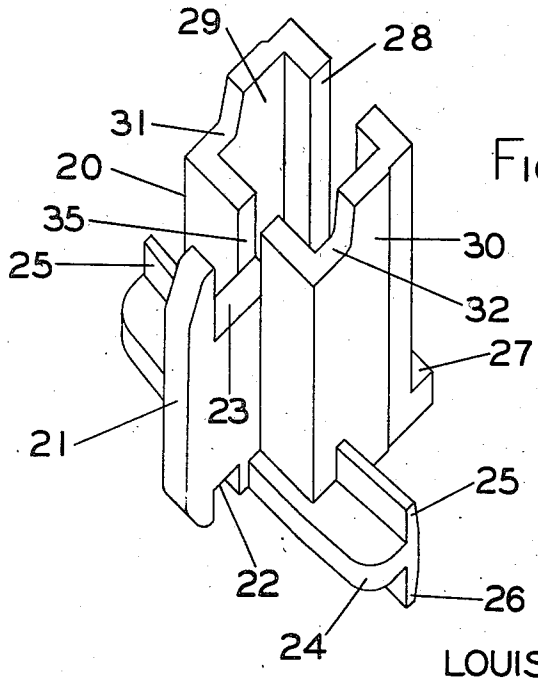


FIG. 7

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FURNACE WALL

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FIG. 8

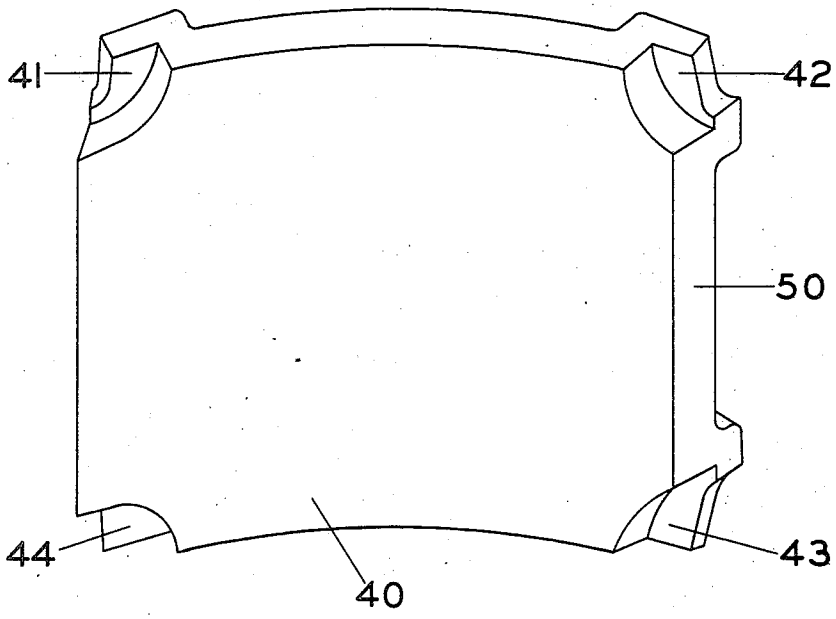
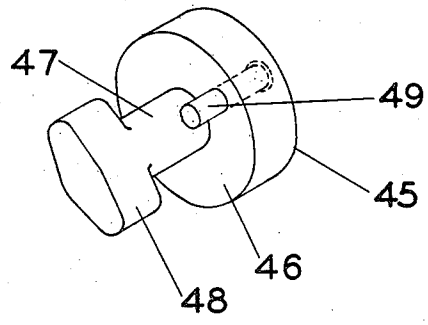


FIG. 9



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FURNACE WALL

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FIG. 10

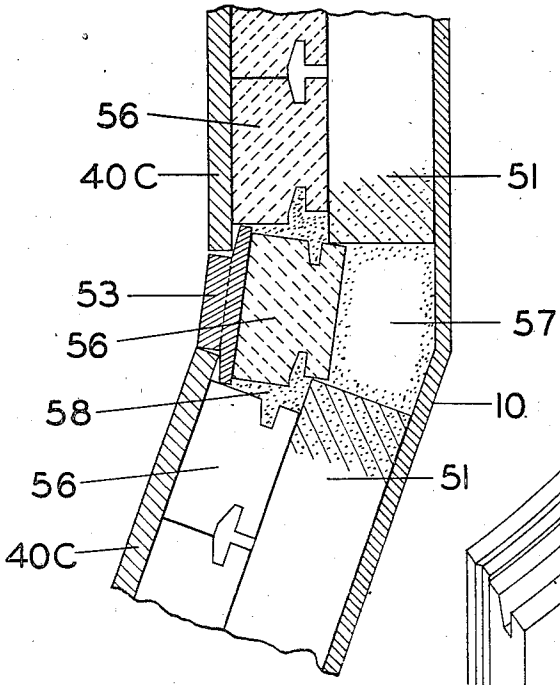


FIG. 11

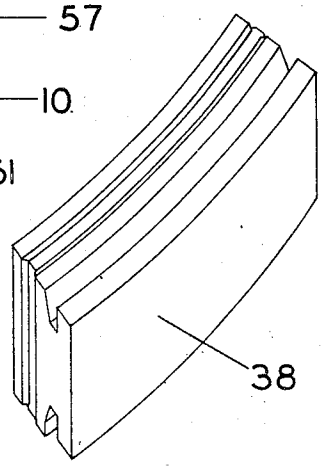
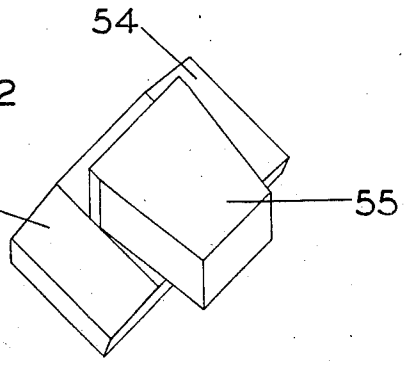


FIG. 12



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Patented Dec. 24, 1946 2,413,183

UNITED STATES PATENT OFFICE

2,413,183

FURNACE WALL

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Application July 3, 1944, Serial No. 543,263

19 Claims. (Cl. 72—101)

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The present invention relates to furnace walls and more particularly to linings for tubular sections of furnaces and the like where it is desired to provide the tubular section with an insulated lining and an inner covering of some such material as cast iron which is capable of withstanding some pressure and of resisting the wear of abrasion materials that are circulated through the tubular section.

It is the principal purpose of this invention to provide a novel lining of the type above referred to wherein the refractory portion of the lining and the inner surface of the lining are carried by the outer shell in sections. The construction is such that sectional supported wall zones are built up with provision for interposition of high temperature insulation between the tubular shell and the combined refractory and inner plate lining.

It is also a purpose of this invention to provide a novel construction whereby a series of lining plates of cast iron or the like may be attached to the inner wall of a tubular duct.

It is a further purpose of the invention to provide a construction of this character wherein changes in direction of the tubular duct may be allowed for and the inner plate construction may be carried across the joints between two adjacent sections at an angle to each other with adequate protection for the tubular shell.

It is also an important purpose of this invention to provide a lining of the character described wherein the sectional supporting of the various parts of the lining is accomplished by means of individual relatively small parts easily placed in position and locked against displacement during operation together with combined sealing and insulating means to effectively prevent circulation of air or gas lengthwise of the tubular section.

While the invention is not limited thereto a preferred form of the invention is illustrated herein in connection with a riser section forming part of a catalyst cracking unit. In the riser section the temperature gets high enough to require refractory lining and insulation, also the pressure varies a good deal in the riser and often the pressure is much higher at one point than at another. The catalyst which is a finely divided solid tends to pack into the lining and push the refractory tile out of place. Air currents tend to set up lengthwise of the riser through the insulation. These currents unless they are blocked soon cut out the insulation and allow

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the hot air in the riser to flow behind the refractory in direct contact with the shell.

The features and advantages of the present invention will appear more fully as the description proceeds, reference being had to the accompanying drawings wherein a preferred form of the invention is shown. It is to be understood however that the description and drawings are illustrative only and are not to be taken as limiting the invention except insofar as it is limited by the claims.

In the drawings:

Fig. 1 is a cross section through a tubular section of a riser such as has been hereinbefore referred to, the riser being lined in accordance with my invention;

Fig. 2 is a longitudinal section through a portion of the riser;

Fig. 3 is an enlarged fragmentary sectional view taken substantially on the line 3—3 of Fig. 1;

Fig. 4 is a fragmentary side elevation of a portion of the construction shown in Fig. 3;

Fig. 5 is a fragmentary side elevation looking at a portion of Fig. 3 from the right with the refractory tile and the liner or wear plates removed;

Fig. 6 is a fragmentary sectional view taken on the line 6—6 of Fig. 3;

Fig. 7 is a perspective view of a box type casting which is utilized in mounting the liner or wear plates and refractory tile;

Fig. 8 is a perspective view of one of the plates;

Fig. 9 is a perspective view of a retaining button which cooperates with the box type casting to secure the plates in position;

Fig. 10 is an enlarged fragmentary sectional view taken on the line 10—10 of Fig. 2;

Fig. 11 is a perspective view of one of the refractory tile used in the lining; and

Fig. 12 is a perspective view of a cast iron filler link shown in position in Fig. 10 between adjacent plates of two sections of the riser meeting at an angle to each other.

Referring now in detail to the drawings, the showing in Figs. 1 and 2 is of a tubular riser section wherein an outer shell 10 is made up of cylindrical sections such as 11, 12 and 13 meeting each other at an angle as the riser changes from a horizontal direction to a vertical direction. Hereinafter the description generally will follow the individual sections which are similar, and it should be understood that the construction is applicable also to various wall sections which are

either vertical or horizontal. It is not limited to tubular sections.

The outer shell 10 is of steel plate and it carries on its inner surface longitudinally spaced rows of connection clips 14. These clips are preferably made of steel and are welded directly to the steel plate shell 10. The connecting clips are extended longitudinally of the shell and as shown by Figs. 3 and 6 they are merely small rectangular pieces of steel plate uniformly spaced about the interior periphery of the shell. Each connection clip is provided with two spaced bolt holes to receive bolts 15 and 16 by which the adjacent ends of two wall supporting bars 17 are mounted. The wall supporting bars 17 are heat resistant castings substantially channel shaped in cross section with one side of the channel having ears 18 at its opposite ends, the ears 18 being apertured to receive the bolts 15 and 16. A suitable material for the castings is that known in the trade as Meehanite. One of the ears has a round aperture to receive its bolt while the ear at the other end of the casting has its opening elongated lengthwise of the casting to allow for minor length variations and for expansion differences between the shell and the casting. The webs of the channel shaped castings are provided with a series of relatively closely spaced rectangular openings 19. The castings 17 are the only wall supporting castings that have bolted connections to the shell 10. In erection these castings should all be mounted in place before the application of the remainder of the lining.

It will be noted from an examination of Fig. 2 that all of the castings 17 are of the same length although on the outer line of the riser the length of the shell sections is greater than it is along the inner line of the riser. The manner in which provision is made for lining the shell between the ends of the castings 17 in two adjacent sections of the shell will be described in detail hereinafter.

Figs. 3 to 7, inclusive, illustrate the construction whereby the castings 17 support sections of refractory tile and inner lining plates. A box type casting 20 has a projecting rib 21 which is cut out at 22 and 23 so that it may be hooked into one of the openings 19 and supported by the castings 17. This casting 20 has a horizontally running rib portion 24 along its lower edge, the rib portion being provided with upper and lower flanges 25 and 26. A shoulder 27 is provided at the lower front edge of the casting 20 and a slot 28 is made in the front face of the casting 20, the slot extending from the top edge of the casting down to a point slightly above the shoulder 27. It will be noted that the casting 20 has its side walls 29 and 30 cut off at the back as indicated at 31 and 32. This is for the purpose of receiving a small horizontally running tile retaining casting 33. This casting has a depending rib 34 that drops into a channel 35 that is directly over the projecting rib 21. Upper and lower flanges 36 and 37 are provided on the casting 33 to cooperate in retaining refractory tile in place.

The box type castings 20 have refractory tile 38 above and below them and in addition between circumferentially adjacent castings 20 there are refractory tile 39. In construction erection should be started at the lower end of the tubular section after the supporting castings 17 are in place. First a row of the box type castings is mounted in place on the bars 17 and refractory tile 39 are inserted to fill the spaces between the adjacent castings. The vertically running joints between the castings and the tile are filled with a suitable plastic refractory insulation; for example, that sold by the M. H. Detrick Company under the trade name of "Monoseal." This same material is also used to fill the interior of the casting 20. Between longitudinal rows of the castings 20 the tile 38 are inserted. These tile are held in place by the flanges 26 on the casting 20 and the flanges 36 on the tile retaining casting 33. It should be noted at this point that the flanges 25 on the castings 20 and the flanges 37 on the castings 33 are utilized in securing the tile 39 in place.

A series of combination liner and wear plates 40 are mounted by means of the castings 20. The plates 40 may be of various sizes and thicknesses and the castings 20 are spaced to provide adequate support for the size of plates used. These plates as shown are offset to provide shoulders 41, 42, 43 and 44 (see Fig. 8). The shoulders preferably are so located that four plates may have one corner of each secured by means of a cast iron button 45 (shown in perspective in Fig. 9). The plates 40 are of course curved to fit the contour of the tubular section 10 so that a series of these plates placed end to end around the inner circumference will provide an adequate lining. The spacing of the plates is such as to permit a minimum of one quarter inch clearance on all four sides to take care of expansion under heat. The clearance is also necessary to permit breathing or adjustment of pressure in the lining as the pressure rises and falls in the duct. This pressure fluctuates rather widely in a catalyst type oil cracking unit.

The button as shown is provided with a head portion 46, a neck portion 47 and a flattened locking portion 48. The dimensions of the portion 48 are such that when it is turned with the long dimension parallel to the slot 28 in the casting 20 it will pass through the slot. Then when it is turned with the long dimension crosswise of the slot it cannot be withdrawn. In erection, after the button is placed in locking position with respect to the slot 28, a pin 49 is driven into an aperture in the button head 46 far enough to extend between the side walls in the slot 28. This is an expansion type pin or rivet which can be locked in the opening in the head 46 so that it will not work out. It can be knocked out when the button has to be removed.

In laying or replacing one of a circumferential row of the plates 40 the difficulty of putting the last plate in position is overcome by beveling the end faces 50 of the plates so that the end faces do not extend radially with respect to the center of curvature of the plate. This is illustrated by the showing, in dotted lines, of the adjacent ends of two plates in Fig. 6 of the drawings. While the normal spacing allowed for expansion might be adequate for the insertion of a plate this additional feature aids in assembling the plates on the castings 20.

In completing a particular wall section I fill in the space between the shell 10 and the refractory tile 38 with a double thickness of blocks of insulating material 51. The space around the bars 17 where the blocks do not fit in is filled with an insulating cement after the castings 20 are mounted in place. Owing to the sectional construction the expansion joints that run horizontally occur at the ends of the bars 17. I may provide a filler of a suitable type for these joints. In the courses having the continuous rings of the tile 38 I may provide expansion joints be-

tween the vertical faces of the tile wherever necessary. This is in accordance with good practice of providing expansion joints in constructions of this character. The horizontal joints between the tile 38 and 39 are laid with a fire clay joint. In back of the horizontal expansion joints and around the ends of the supporting castings 17 I provide a belt of a dense tough plastic insulation such as the Monoseal hereinbefore referred to. This material is mixed on the spot and rammed in place as the erection is carried forward. It then hardens in place and prevents transfer of gas across the belt. These Monoseal belts serve to seal off the areas between them into zones. They prevent any tendency for gas to travel along the interior of the steel plate from a zone of high pressure to a zone of lower pressure. (The gas if permitted to so travel would soon cut out the insulation.) To further insure protection at the expansion joint I provide a metal seal plate 52 in back of each horizontal open expansion joint. This seal plate, which may be desirably constructed of stainless steel, is pressed tightly against the back face of the adjacent tile between the supporting castings 20 and prevents the plastic insulation from being forced into the expansion joint.

In order to take care of the condition brought about by having adjacent sections of the shell 10 disposed angularly with respect to each other I find it necessary to make the plates 40 in various lengths such as indicated by 40*a*, 40*b* and 40*c* in Fig. 2 of the drawings. These plates, instead of having the shoulders provided at the corner, have one set of shoulders provided intermediate their ends so as to receive the buttons 45 as illustrated in Fig. 2. This however still leaves a gap in the lining where the ends of the plates approach each other. In order to protect the shell at this point and to complete the wear lining I utilize a series of cast iron filler members 53. These little filler members are shown in detail in Figs. 10 and 12 of the drawings. Each filler member comprises a backing section 54 and a wedge section 55. They are made with varying sizes of wedge sections so that it is an easy matter for the erector to select proper sizes to fill the space between the adjacent ends of two plates. As illustrated in the drawings, these little filler members are made in fractions of the width of a plate. The flange section 54 fits behind the plates and locks the filler members in place. In back of the filler links I provide a tile 56 and a plurality of such tile 56 may be used to fill the space from the adjacent box type casting as illustrated in Figs. 2 and 10.

The plastic insulation is shown as utilized at 57 behind the tile 56 and at 58 to fill the irregular open areas between the tile 56 that backs up the filler member 53 and the adjacent tile 56. Thus the entire interior surface of the shell is protected. Yet the lining can be repaired at any particular section without tearing down adjacent sections. In order to replace any part of the lining, the pins 49 are removed from the buttons holding one or more of the plates 40. Then the buttons can be turned and withdrawn, to release the plates. This provides access to the castings 20 and the refractory tile both of which can be removed.

From the foregoing description it is believed that the nature and advantages of the present invention will be readily apparent to those skilled in this art.

Having thus described my invention, what I

claim as new and desire to secure by Letters Patent is:

1. A lining for protecting supporting walls in furnaces, said lining comprising rows of spaced supporting bars, means mounting said bars on the wall, casting supports in said bars, box castings having projections engaging said supports, refractory tile interposed between adjacent castings on a row of bars, liner plates covering the castings and tile and retaining buttons having head portions overlapping the adjacent exposed faces of said liner plates, neck portions projecting from the head portions into said box castings and locking portions in the box castings whereby to hold the liner plates in place.

2. A lining for protecting supporting walls in furnaces, said lining comprising rows of spaced supporting bars, means mounting said bars on the wall, casting supports in said bars, box castings having projections engaging said supports, refractory tile interposed between adjacent castings on a row of bars, liner plates covering the castings and tile, said plates having offset corners, and retaining buttons having head portions overlapping the offset corners of said plates, neck portions projecting from the head portions into said box castings and locking portions in the box castings whereby to hold the plates in place.

3. In a furnace wall construction, a shell, rows of plate supporting castings having slots therein, supporting means for said castings on said shell, liner plates covering said castings, retaining buttons having heads overlying parts of said plates, said buttons having neck portions extending through said slots, and locking portions holding the neck portions in the slots, and a refractory backing for said plates also carried by said castings.

4. In a furnace wall construction, a shell, rows of plate supporting castings having slots therein, supporting means for said castings on said shell, liner plates covering said castings, retaining buttons having heads overlying parts of said plates, said buttons having neck portions extending through said slots, and locking portions holding the neck portions in the slots, and a refractory backing for said plates also carried by said castings, said refractory backing comprising grooved tile and the castings having flanges for engaging the tile.

5. An inner sectional lining for metallic walls of upright ducts and chambers in furnaces, said lining comprising vertically spaced rows of vertical connecting members on the inner face of the metallic wall, supporting bars fastened to said connecting members, said bars extending along the walls from one row of connecting members to another, removable refractory tile supports carried by said bars, and refractory tile mounted on said supports.

6. An inner sectional lining for metallic walls of upright ducts and chambers in furnaces, said lining comprising vertically spaced rows of connecting members on the inner face of the wall, supporting bars fastened to said connecting members, said bars extending along the walls from one row of connecting members to another, box castings having projecting ribs and said bars having longitudinally spaced openings receiving said ribs and removably mounting the castings on the bars, refractory tile supported by said castings, and interposed between adjacent castings, metallic plates covering the castings and refractory tile, and means removably mounting the plates on said castings.

7. Means to provide a wear resistant and reenforcing covering for refractory and insulated furnace linings comprising spaced supporting members in said lining, a plurality of relatively thin metal plates resting against the lining and providing a substantially unbroken covering for the lining and headed securing members extending through the plate covering and interlocked with said supporting members.

8. A lining for tubular ducts in furnace construction, said lining comprising an insulating lining, a refractory lining inside the insulating lining, sectionally arranged frameworks carrying said linings and including members having slotted portions at the inner face of the refractory lining, metallic liner plates covering the refractory linings and means securing the plates to the slotted portions of said members.

9. A lining for tubular ducts in furnace construction, said lining comprising an insulating lining, a refractory lining inside the insulating lining, sectionally arranged frameworks carrying said linings and including slotted members at the inner face of the refractory lining, liner plates covering the refractory linings and buttons securing the plates to the slotted members, said buttons having enlarged ends connected by a neck portion, one of said ends having one dimension transverse to the axis of the button less than the width of the slots in said members and its other dimension greater than the width of said slots, so that the button end may be inserted in one of said slots and rotated to secure the button to one of said members.

10. A lining for tubular ducts in furnace construction, said lining comprising an insulating lining, a refractory lining inside the insulating lining, sectionally arranged frameworks carrying said linings and including slotted members at the inner face of the refractory lining, liner plates covering the refractory linings and buttons securing the plates to the slotted members, said buttons having enlarged ends connected by a neck portion, one of said ends having one dimension transverse to the axis of the button less than the width of the slots in said members and its other dimension greater than the width of said slots, so that the button end may be inserted in one of said slots and rotated to secure the button to one of said members, the other end of the button having an aperture therein and a locking pin in said opening extending into the slot of the member to which the button is secured whereby to prevent rotation of the button after it is secured.

11. Means providing a continuous wear resistant lining for tubular ducts of furnaces where the ducts are in sections meeting at an angle, said means comprising spaced supporting members mounted in each section, a refractory lining around said members and carried thereby, rectangular cast iron liner plates covering the members and refractory lining, means securing said plates to the supporting members, and cast iron filler members having wedge-shaped lugs fitting between the ends of the plates of adjacent duct sections and having flanges overlapping the back sides of said plates.

12. Means providing a continuous wear resistant lining for tubular ducts of furnaces where the ducts are in sections meeting at an angle, said means comprising spaced supporting members mounted in each section, a refractory lining around said members and carried thereby, rectangular cast iron liner plates covering the members and refractory lining, means securing said plates to the supporting members, and cast iron filler members having wedge-shaped lugs fitting between the ends of the plates of adjacent duct sections and having flanges overlapping the back sides of said plates, the refractory lining including refractory tile members resting against the back surfaces of said filler members to hold them in position.

13. A lining for tubular ducts in furnace construction, said lining comprising an insulating lining, a refractory lining inside the insulating lining, sectionally arranged frameworks carrying said linings and including slotted members at the inner face of the refractory lining, liner plates covering the refractory linings and buttons securing the plates to the slotted members, the refractory lining having expansion joints extending circumferentially between adjacent sections, a thin sealing strip encircling the refractory lining at each of said expansion joints, the insulating lining being packed against the outer surfaces of said sealing strips.

14. A lining for tubular ducts in furnace construction, said lining comprising an insulating lining, a refractory lining inside the insulating lining, sectionally arranged adjacent frameworks carrying said linings and including slotted members at the inner face of the refractory lining, liner plates covering the refractory linings and means securing the plates to the slotted members, the insulating lining including annular air tight portions between adjacent ends of said frameworks for avoiding gas flow through the insulation from section to section of the lining.

15. A lining for tubular ducts in furnace construction, said lining comprising an insulating lining, a refractory lining inside the insulating lining, sectionally arranged frameworks carrying said linings and including supporting members at the inner face of the refractory lining, liner plates covering the refractory linings and means securing the plates to the supporting members, the refractory lining having expansion joints extending circumferentially between adjacent sections, a thin sealing strip encircling the refractory lining at each of said expansion joints, the insulating lining being packed against the outer surfaces of said sealing strips.

16. A lining for tubular ducts in furnace construction, said lining comprising an insulating lining, a refractory lining inside the insulating lining, sectionally arranged frameworks carrying said linings and including supporting members at the inner face of the refractory lining, liner plates covering the refractory linings and means securing the plates to the supporting members, the refractory lining having expansion joints extending circumferentially between adjacent sections, a thin sealing strip encircling the refractory lining at each of said expansion joints, and the insulating lining including a substantially air tight ring between the sealing strips and the duct wall for preventing gas flow from section to section through the insulating lining.

17. A sectional lining for the metallic wall of a duct, comprising connecting members projecting inwardly from said wall, a refractory lining spaced from said wall, sectional supporting means for said lining detachably connecting said lining with said connecting members, an insulating lining between said refractory lining and said metallic wall, and a plurality of thin plates of wear resisting material on the inner face of said

refractory lining detachably connected with said supporting means.

18. A lining for tubular ducts in furnace construction, said lining comprising an insulating lining, a refractory lining inside the insulating lining, sectionally arranged frameworks carrying said linings and including supporting members at the inner face of the refractory lining, metallic liner plates covering the refractory linings and means securing the plates to the supporting members.

19. A lining for tubular ducts in furnace construction, said lining comprising an insulating

lining, a refractory lining inside the insulating lining, sectionally arranged adjacent frameworks carrying said linings and including members having slotted portions at the inner face of the refractory lining, metallic liner plates covering the refractory linings and means securing the plates to the slotted portions of said members, the insulating lining including annular air tight portions between adjacent ends of said frameworks for avoiding gas flow through the insulation from section to section of the lining.

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