Dec. 6, 1966 M. F. ADAMS ETAL 3,289,372

REFRACTORY SUPPORT

Filed Oct. 2, 1963 3 Sheets-Sheet 1

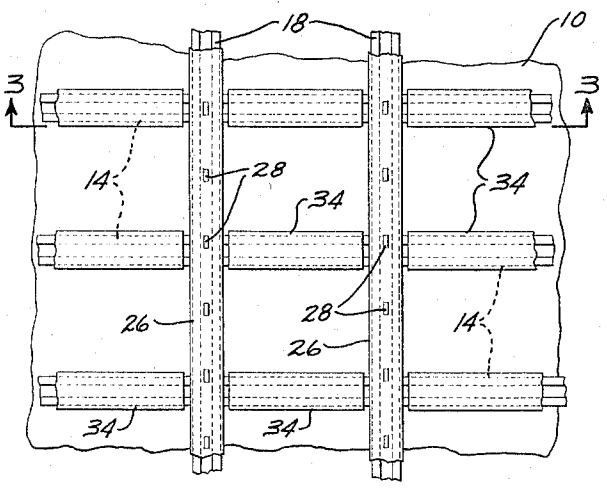


FIG. 1

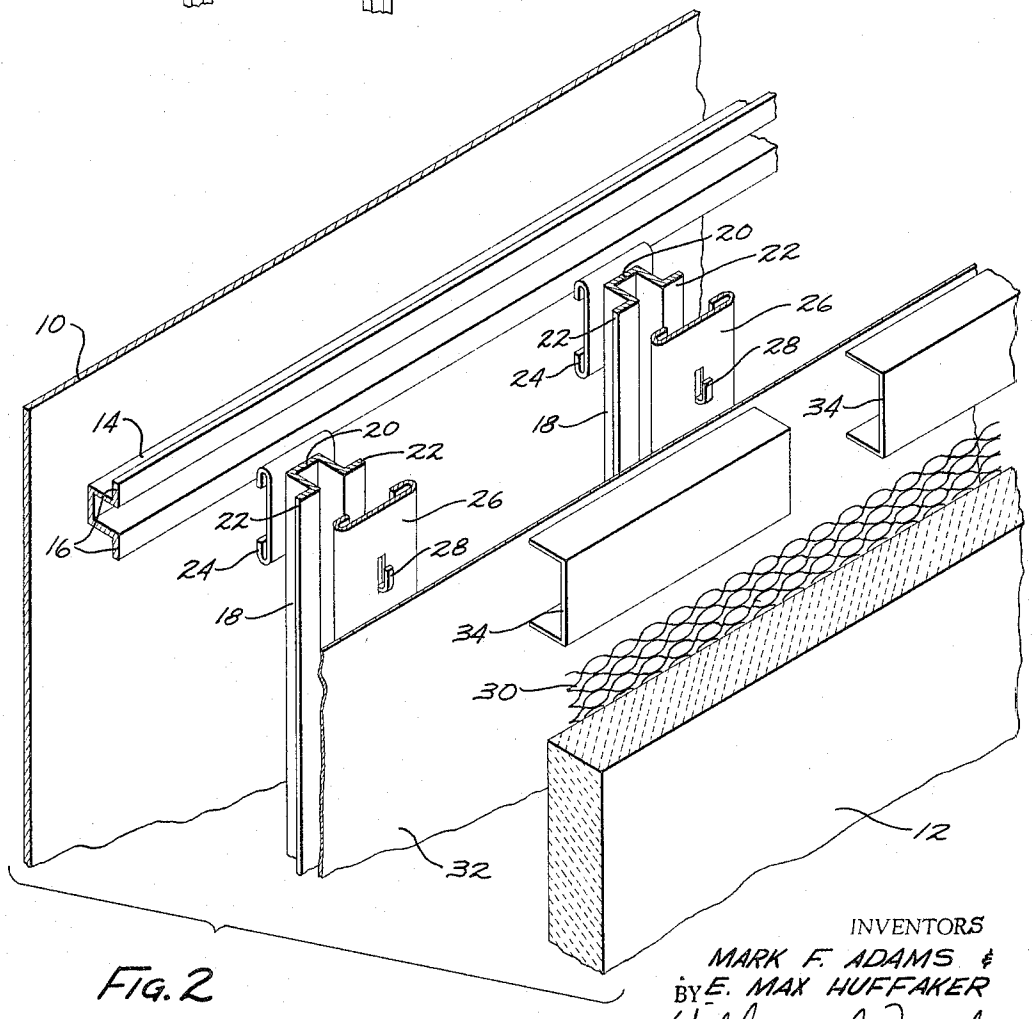


FIG. 2

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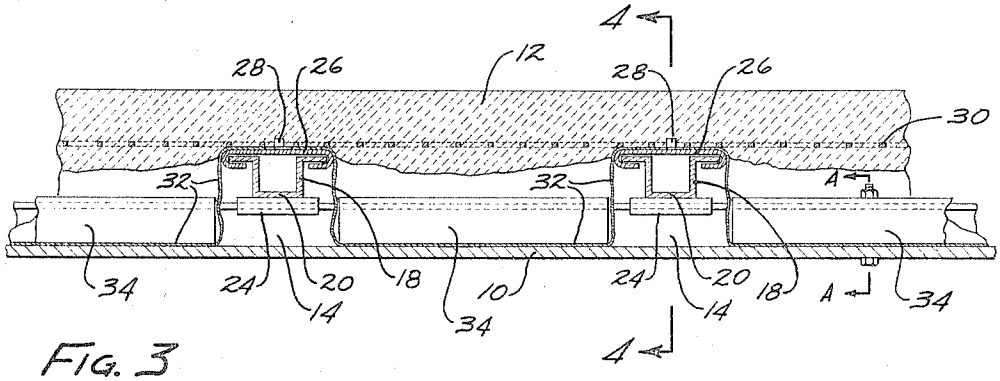


FIG. 3

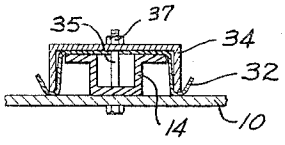


FIG. 3A

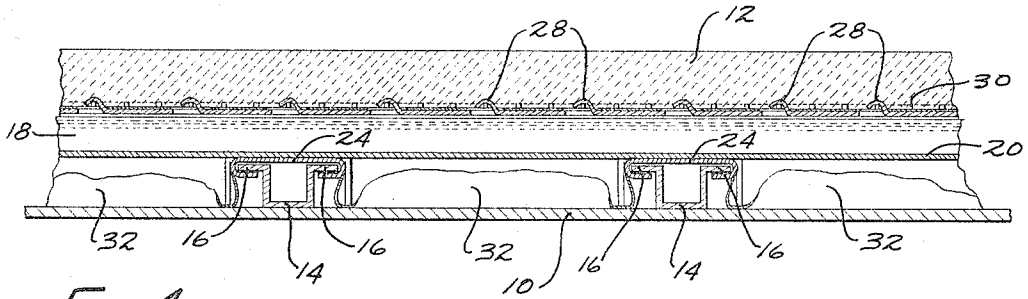


FIG. 4

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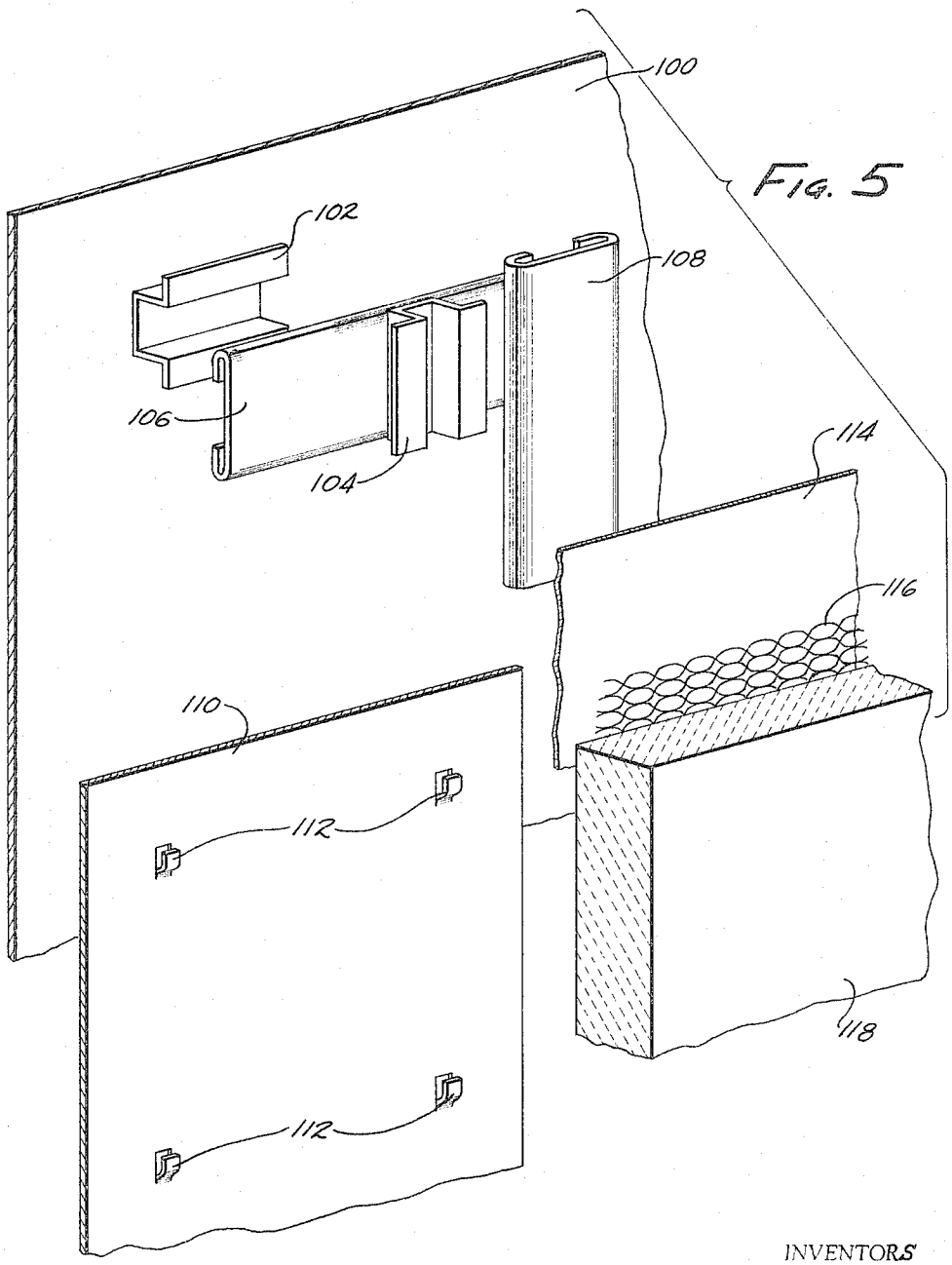


FIG. 5

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3,289,372
REFRACTORY SUPPORT

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6 Claims. (Cl. 52—346)

This invention relates to refractory supports and, more particularly, it concerns apparatus for supporting a monolithic refractory lining on a supporting wall structure of metal or other structural material having a different coefficient of expansion than the refractory.

The conventional technique employed to support monolithic refractory linings in furnaces, for example, to a structural steel framework, has been to employ refractory hangers suitably shaped to effect a mechanical interlock with the monolithic material. The refractory hanger is, in turn, engaged by a metal anchor designed to be secured to the steel support. Because of the difference in coefficients of thermal expansion between the refractory material and the steel support, the connection of the monolithic refractory and the metal support has usually involved provision for some degree of relative movement between the refractory and the metal. In some applications, the refractory hanger extends throughout the monolithic lining, whereas the metal anchor extends out of the refractory and slidably engages the steel support. In other situations, the anchor is embedded completely in the monolithic refractory and designed so that the relative movement between the refractory and the support is accommodated by flexibility of the metal anchor. While such anchoring techniques have been satisfactory for monolithic linings of several inches in thickness (e.g., 9″), where the refractory lining itself develops adequate strength to overcome resistance of the anchorage means to relative movements between the lining and the metal support, they are not as effective for thin monolithic refractory linings of the order of 2″ or less. Where such thin linings or coatings are used, the refractory material must be provided with substantially complete reinforcement and support so that conventional anchorage techniques become ineffective from a practical standpoint. Moreover, because of the inherent structural weakness of refractory material in thin layers, it is important that stresses therein as a result of differential expansion between the refractory and the support, be kept to an absolute minimum. Although conventional refractory supporting techniques afford some measure of such relative movement, they do not approach complete elimination of stresses in the refractory.

Accordingly, an object of this invention is to provide an improved refractory support, by which the problems previously incurred in supporting a monolithic refractory lining on a metal wall are effectively and substantially overcome.

Another object of this invention is to provide a monolithic refractory support which is inexpensively formed, and which affords full relative expansive movement between the refractory and a metal backup plate having different thermal expansion characteristics, without stressing the refractory material.

A further object of this invention is to provide a refractory support of the type referred to, by which a monolithic refractory lining may be expeditiously applied to a metal supporting plate without danger of fouling the track system by which substantially complete movement, due to relative expansion between the refractory and the metal plate, is permitted.

Still other objects and further scope of applicability

of the present invention will become apparent from the detailed description given hereinafter, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a fragmentary elevation showing the track system forming a part of the present invention;

FIG. 2 is an enlarged fragmentary perspective view exploded to show the components of the supporting apparatus of this invention;

FIG. 3 is an enlarged fragmentary cross section taken on line **3—3** of FIG. 3, with the addition of the refractory material in place;

FIG. 3A is a fragmentary cross section taken on line A—A of FIG. 3;

FIG. 4 is a fragmentary cross section taken on line **4—4** of FIG. 3; and

FIG. 5 is an enlarged fragmentary exploded perspective view of a modified version of the supporting apparatus of the invention.

According to the present invention, a relatively thin refractory lining or coating is supportable on a metal wall having a different coefficient of thermal expansion than the refractory, by applying the refractory to a grillework such as metal lath, which is, in turn, anchored to a track system capable of affording expansive movement in all directions. The track system is completely and effectively separated from the refractory so that substantially complete relative movement between the refractory and the metal sheet, due to different rates of expansion upon heating, is afforded, without in any way stressing the refractory. The system involves a series of primary tracks fixable to the metal support wall, and a series of secondary tracks supported on the primary tracks, to afford expansive movement in one component of direction; while the secondary tracks support slide elements to accommodate expansive movement in another component of direction, thereby permitting universal movement in a plane parallel to both the refractory and the support wall. The slide elements, in turn, are connected to the metal lath ultimately embedded in the refractory coating applied by troweling or gunniting, as desired.

Referring now to the drawings, a metal backup or support wall is designated by the reference numeral **10**. The apparatus by which a monolithic refractory lining **12** is adapted to be connected to the metal wall **10**, in a manner so as to compensate for differences of coefficients of thermal expansion between the metal and the refractory lining, is shown to include a plurality of primary tracks **14** welded, bolted, or otherwise suitably fixed to the metal support **10**, so as to extend in generally parallel directions. Preferably, the primary tracks **14** extend horizontally where the support wall **10** is vertically disposed; and each is of generally T-shaped cross-section, to define a pair of laterally projecting flanges **16** spaced from the backup plate **10** to which the primary tracks are fixed. A plurality of similarly parallel secondary tracks **18** are arranged to overlie the primary tracks **14**, and extend in a direction to intersect directions in which the primary tracks extend. Hence, in the application of the connecting means of the present invention to a vertical wall, the secondary tracks **18** would extend generally perpendicularly to the tracks **14** or along generally vertical paths. The cross-sectional configuration of the secondary tracks **18** is substantially identical to that of the primary tracks **14**, or T-shaped to define a base **20** and a pair of laterally projecting flanges **22**. The secondary tracks are supported on the primary tracks for thermally expansive sliding movement along the length thereof by slide elements **24** of generally C-shaped cross-sectional configuration. The backs of the elements **24** are welded or otherwise suitably secured to the bases **20** of the secondary tracks; whereas, the forward faces thereof, each

generally complementing the shape presented by the flanges **16** on the primary tracks **14**, make sliding engagement with the primary tracks, as shown most clearly in FIG. 4 of the drawings. Thus, it will be seen that the secondary tracks are anchored against movement in substantially all directions, except along the length of the primary tracks **14**.

A second component of movement, relative to the primary tracks **14** and, thus, the metal backup wall **10**, is afforded by slide elements **26**. The slide elements are, also, of generally C-shaped cross-sectional configuration, so as to partially envelop and, thus, become secured to the flanges **22** on the secondary tracks **18**. Thus, the slide elements, though anchored against movement outwardly and transversely of the second tracks **22**, will be free to expansively slide along the lengths of the secondary tracks **18**. Projecting from the backs of the slide elements **26**, at spaced intervals, are a plurality of integral or stamped-out clips **28**, for engagement of an open grillework or metal lath **30** to which the refractory lining **12** is applied in a manner to be described more fully hereinafter. While the grillework **30** is shown to be a continuous piece, it should be understood that small individual sections may be substituted therefor. Also, other keying means may be employed.

To isolate, effectively, the refractory layer **12** from the primary and secondary tracks **14** and **18**, respectively, a fluid impervious film **32** is positioned between the metal lath **30** and the remainder of the track assembly including the slide elements **26**. As a further measure of protection of insurance against fouling of the tracks, a plurality of channel-shaped track guards **34** are arranged to be placed over the primary tracks **14** and the plastic film **32**. As shown in FIG. 3, the track guards are of a length somewhat less than the intended distance between the secondary tracks **18**, and envelop that portion of the primary tracks **14** between the points at which the secondary tracks are attached by the slide elements **24**. Also, the guards **34** are of a width somewhat greater than the projection of flanges **16**, to allow expansive movement in the vertical direction. This is more clearly illustrated in FIG. 3A. Further, if the wall **10** is to be employed in a ceiling construction, it is desirable to loosely secure the guard **34** in place without detracting from the components of expansive movement of slide elements **24** and **26**. Referring to FIG. 3A, the guard **34** may be loosely secured in place by means of bolt **35** and nut **37**. Grooves (not shown) may be provided in guard **34**, where the bolt **35** passes therethrough, to allow expansive movement in any direction. Other means may be employed of securing guard **34** until the monolithic material is applied, such as, for example, hooks, clips, wire, and crimping.

In use, the primary tracks are first fixed to the metal backup plate, in the manner described above, and the secondary tracks **18** assembled thereto by sliding the elements **24** over the ends of the primary tracks **14**. In some instances, it may be desirable to assemble the secondary tracks to the primary tracks before the primary tracks are fixed to the metal backup, so that proper spacing of the primary tracks on the metal backup wall **10** is assured. After the slide elements **26** have been engaged over the flanges **22** of the secondary tracks **20**, impervious plastic film **32** is laid over the entire track assembly in a loose condition, so that it may be adapted to the somewhat irregular contour of the tracks. Then, the track guard channels **34** are placed against the metal wall over the plastic film to the position shown in FIGS. 3 and 4 of the drawings. As the plastic film **32** is applied, it will be understood that the clips **28** on the slide elements **26** will pierce and project through the plastic film. Such rupturing of the plastic film will be of no harmful effect, since the shape of the slide elements themselves affords a measure of protection at the points of rupture. After the metal lath **30** is placed over the assembly and secured by the clips **28**, the refractory lining **12** is applied to the metal lath. While various types of refractory material may be employed, and while various techniques of applying the refractory material may be used, it is preferred that the refractory material be of the monolithic ramming or castable type well known to those skilled in the refractory art, so that it may be gunnited or troweled into the metal lath **30**. Also, while the thickness of the refractory will vary in different applications and may be applied in thicknesses of up to one or two inches without exceeding practical limits, the connecting system of the present invention has been found extremely satisfactory where three-quarter inches of castable refractory were gunnited onto the metal lath, and hand troweled to polish and seal any possible open pores as a result of the gunniting operation. Such thin layers of monolithic refractory are possible with the connecting apparatus of the present invention, because the refractory is afforded structural support throughout by the metal lath **30**, yet is free to move, by thermal expansion, in all directions relative to the metal wall **10** by virtue of the perpendicular components of direction afforded by the mounting of the secondary tracks on the primary tracks and the slide elements **26** on the secondary tracks. In other words, one component of direction is afforded by sliding movement of the secondary tracks **18** along the length of the primary tracks **14**; whereas, another component of direction is afforded by movement of the slide elements **26** along the length of the secondary tracks **18**. In this manner, it will be seen that a point on the slide elements (e.g., any one of the clips **28**), is capable of movement in all directions parallel to the backup metal plate **10**. Examples of commercial refractory materials which can be applied or gunned on the support structure of this invention is described in "Modern Refractory Practice," copyright 1961 by Harbison-Walker Refractories Company, pages 161 through 166.

With reference to FIG. 5, there is shown an alternate design for the refractory support. The support includes a support wall **100**, to which is secured relatively short primary tracks **102**. Secondary tracks **104** of similar size and shape as the primary tracks **100** are arranged to overlie the primary tracks, as in FIG. 2. The secondary tracks **104** are supported on the primary tracks **102**, for thermally expansive sliding movement along said tracks by C-shaped slide elements **106** of a length greater than the primary tracks, to afford secondary protection for the tracks **102**. The backs of the slide elements **106** are secured to the secondary tracks, as was stated previously with respect to the original design. C-shaped slide elements **108** are also provided for slidable engagement with secondary tracks **104**, as in FIG. 2. The slide elements **108** are, preferably, of the same length as slide elements **106**, and are of greater length than the secondary tracks **104**.

Rigidly attached to side elements **108** are cover plates **110** containing clips **112**, with dimensions preferably equal to the length of slide elements **106** and **108**. The cover plates afford primary protection for the tracks **102** and **104**, to insure expansive movement in all directions. Fluid impervious films **114** are disposed on plates **110**, so that the clips **112** perforate the films. The films **114** effectively prevent the monolithic material from flowing under plates **110**, to obstruct the expansive motion of the wall support and further prevent the monolithic material from becoming rigidly attached to wall **100**. Metal laths **116** are attached to plates **110**, and are secured thereto by clips **112**. The monolithic wall **118** is then applied in any desired manner; such as, gunning and troweling.

This modified design of the wall support will obviate the necessity for the track guards **34**, shown in FIG. 2. The lengths of slide elements **106** and **108** will be governed by the maximum anticipated expansion of the metal wall **100**, with reference to the monolithic wall **118**.

Another modification of the design to facilitate expansive movement in all directions would be to suitably deploy wheels, rollers, or bearings, in the same relative cooperating sequence as the tracks and slide elements.

It is recognized that a problem exists when a ceiling section meets a wall section or when two walls meet at an angle since it is anticipated that the main supporting wall, being a metal wall, will expand when exposed to heat. The monolithic wall is difficult to attach to the corners. It is suggested that heavy woven asbestos cloth, or glass cloth or the like, could be used to make the corner transitions. If gas pressures are such that the flue gasses would be forced through the woven fabric to come in contact with the metal walls, it is suggested that a back pressure of fresh air could be employed in the annular space between the monolithic wall and the metal wall, that would equalize the pressure of the hot gases in the chamber. In this manner, passage of the flue gases into the annular space to corrode the metal wall would be prevented.

Thus, it will be seen that by this invention there is provided an extremely effective apparatus, by which a monolithic coating or lining may be attached to a metal support without danger of damage to the refractory, due to differences in coefficients of thermal expansion between the refractory and metal backup plate. Moreover, various modifications and adaptations of the connecting apparatus of this invention may be employed, without departing from the true spirit and scope of this invention. Accordingly, it is to be distinctly understood that the above description is illustrative only, not limiting, and that the true scope of the present invention is to be determined by reference to the accompanying claims.

We claim:

1. Apparatus for connecting a monolithic refractory lining to a support wall having a different coefficient of thermal expansion comprising: a plurality of generally parallel primary tracks mountable on said support wall, a plurality of generally parallel secondary tracks overlying said primary tracks and extending in directions to intersect the directions of said primary tracks, means supporting said secondary tracks on said primary tracks for expansive sliding movement in the direction of said primary tracks, track guard elements overlying said primary tracks and extending between said secondary tracks to separate the primary tracks from the refractory lining, and means engaging the refractory lining, said last mentioned means including elements slidably engaging said secondary tracks to be expansively movable along the length thereof.

2. The apparatus recited in claim 1 including further, a cover plate overlying said primary and secondary tracks to protect the tracks from the refractory lining.

3. The apparatus recited in claim 1 wherein said last-

mentioned means includes further, an open grille adapted to be embedded in the refractory lining and fixedly secured to said slide elements.

4. The apparatus recited in claim 3 including a fluid impervious film between said tracks and said grillework.

5. Apparatus for supporting a monolithic coating of refractory material on a metal support wall comprising a plurality of primary tracks secured to the metal wall and extending in generally parallel directions, a plurality of generally parallel secondary tracks overlying said primary tracks and extending in a direction substantially perpendicular to said primary tracks, said secondary tracks being of generally T-shaped cross-section to present a pair of laterally projecting flanges spaced from said primary tracks, slide element means supporting said secondary tracks on said primary tracks for expansive sliding movement in the direction of said primary tracks, slide elements of generally C-shaped cross-section slidably engaging said secondary tracks, each of the slide elements substantially covering the outer faces of the primary and secondary tracks presented in the direction of the refractory coating, cover plates rigidly secured to said last mentioned slide elements, a grillework of metal lath adapted to be embedded in the refractory coating, means on said cover plates for engaging said metal lath and a sheet of fluid impervious material overlying said cover plates and said tracks.

6. Apparatus for supporting a monolithic coating of refractory material on a metal support wall comprising a plurality of generally parallel primary tracks secured to the metal wall, a plurality of generally parallel secondary tracks overlying said primary tracks and extending in a direction substantially perpendicular to said primary tracks, said secondary tracks being of generally T-shaped cross-section to present a pair of laterally projecting flanges spaced from said primary tracks, slide element means supporting said secondary tracks on said primary tracks for expansive sliding movement in the direction of said primary tracks, slide elements of generally C-shaped cross-section slidably engaging said secondary tracks, each of the slide elements substantially covering the outer faces of the primary and secondary tracks presented in the direction of the refractory coating.

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