United States Patent

Smith

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[54] APPARATUS FOR USE IN LINING VESSELS

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[52] **U.S. Cl.** .....**214/1 H,** 52/747, 52/749, 212/74, 214/16 B

[51] **Int. Cl.** **B66c 19/00**

[58] **Field of Search** .....52/747, 749; 264/30; 214/1 H, 214/15 R, 15 C, 1 R; 212/15, 19, 74

[56] **References Cited**

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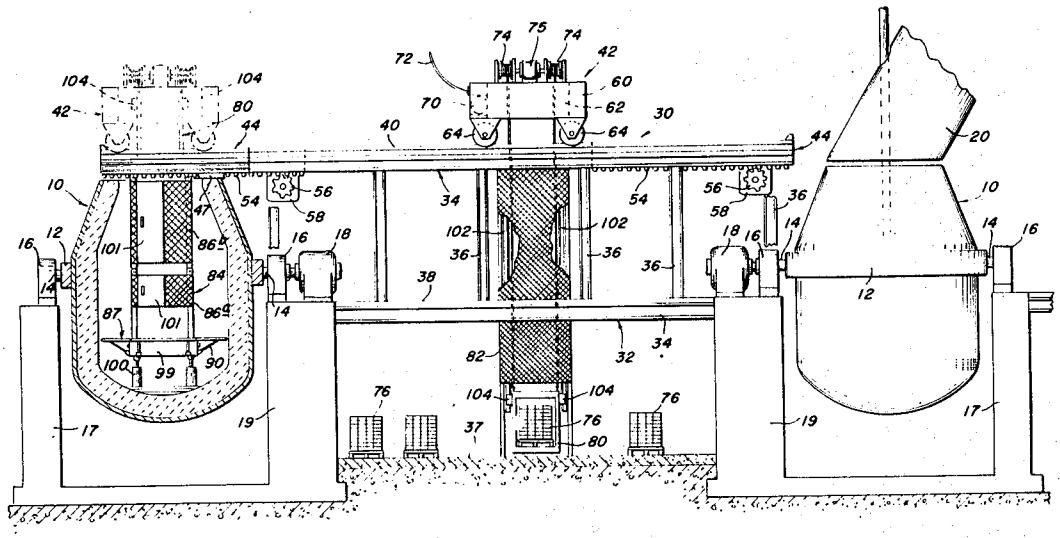
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Assistant Examiner—Frank E. Werner
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[57] **ABSTRACT**

Apparatus for use in lining ground supported open-mouth metallurgical processing vessels arranged oppositely one another is disclosed. The apparatus includes an elongated support structure arranged between the vessels and upon which is disposed a transportation bed, such as parallel rails. The transportation bed includes selectively movable end sections arranged to be moved between a position outside of the vessels and a position over the mouth of each vessel. A self propelled vehicle having a compartment for storing refractory bricks is provided for travelling on the transportation bed between the vessels. Delivery means are provided in the form of an elevator cage and hoist for lowering refractory brick into a vessel where workers on a portable scaffold may receive the brick and place it in position to form the refractory wall of the vessel.

9 Claims, 5 Drawing Figures



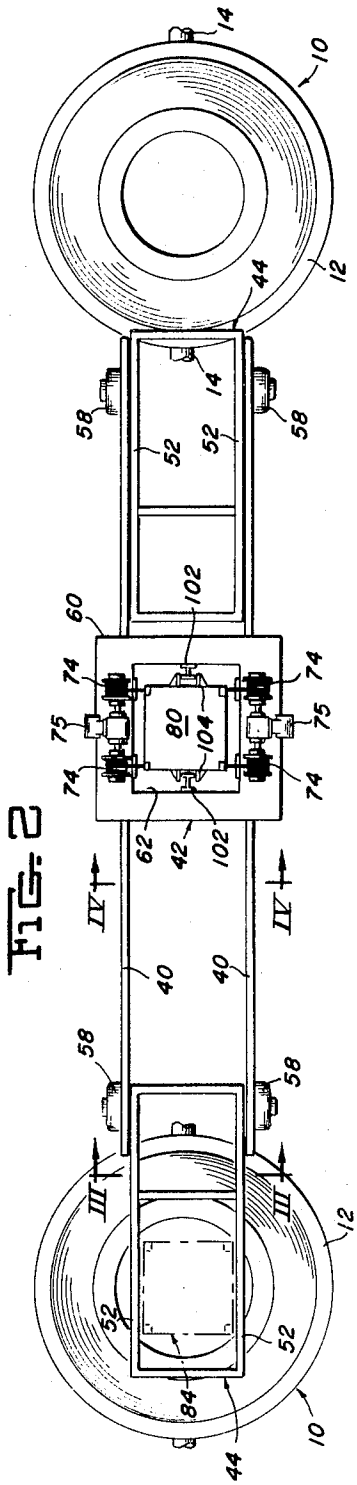


FIG. 2

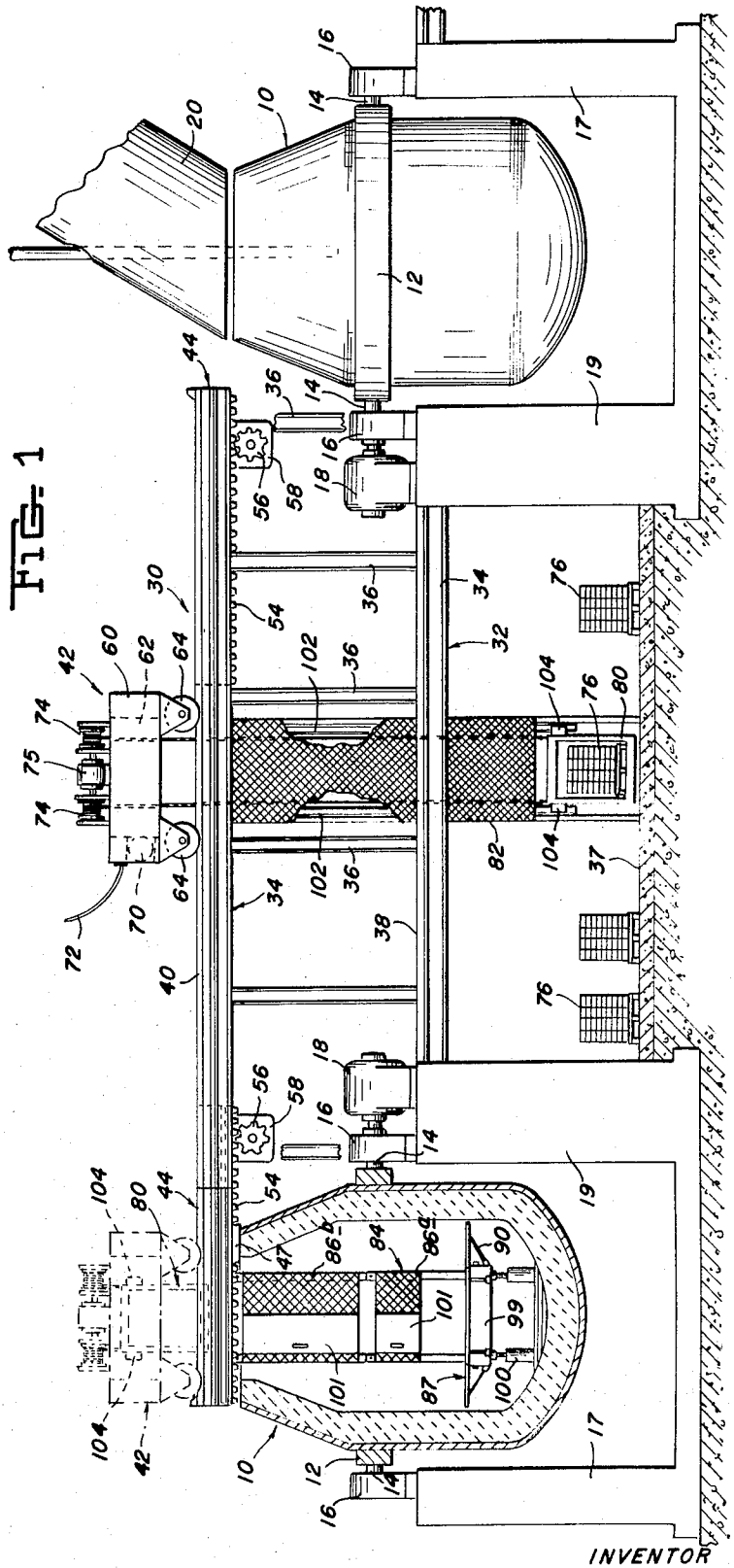


FIG. 1

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FIG. 3

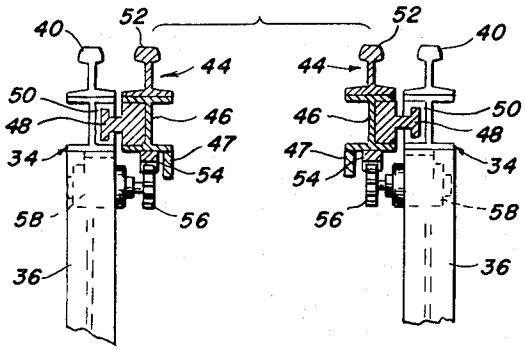


FIG. 4

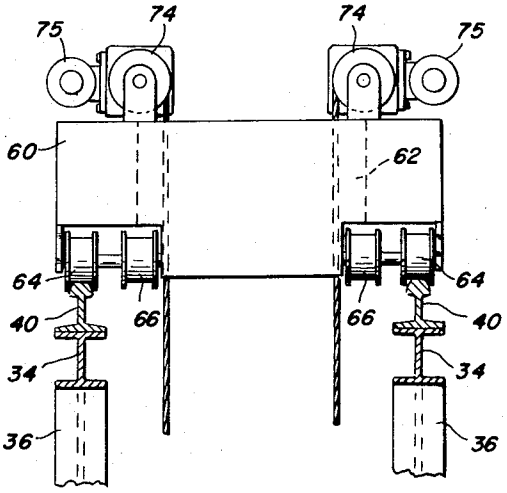
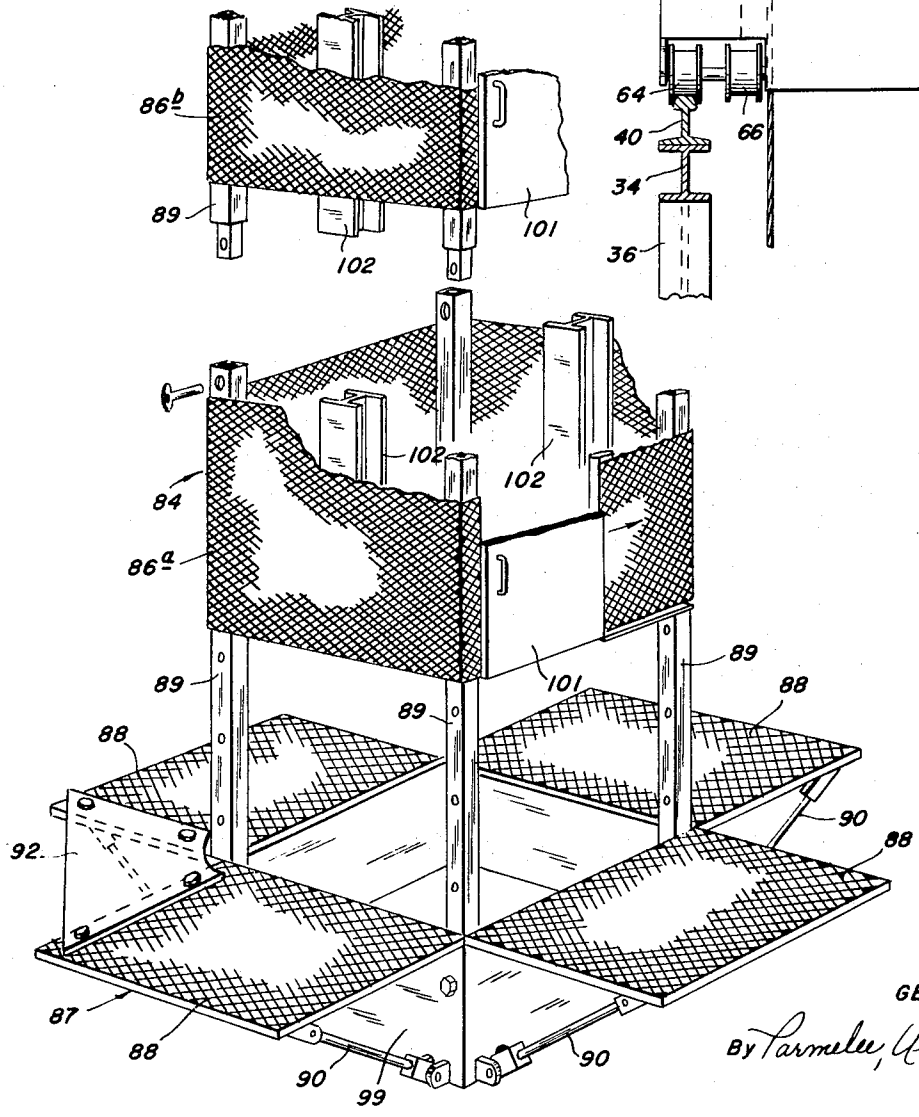


FIG. 5



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APPARATUS FOR USE IN LINING VESSELS

This invention relates to apparatus for use in lining ground supported metallurgical processing vessels arranged oppositely one another, as for example open-mouthed basic oxygen furnaces.

Basic oxygen steelmaking furnaces include open-mouthed vessels having a refractory brick lining. The lining must be replaced regularly, usually after only a few days service. The usual manner in relining the vessels is for workers to install the bricks with the vessel in the upright position. The workers stand on platforms forming part of a tower which includes a collapsible scaffold platform. The tower also is provided with an elevator shaft for transporting the refractory bricks to the platform level. The tower is usually a very tall structure, extending vertically from the vessel through the furnace hood to an upper floor of the shop building where the brick is stored. Such a system requires a tall building for support of a special overhead crane to handle the tower and for provision of the high level floor for the storage of the brick. A freight elevator is also necessary for transporting the brick from ground level to the storage floor.

Since the existing building structures for basic oxygen furnace shops are high, having been designed for accommodating flux storage bins at a high level, the use of the tall towers and upper level brick storage facilities is quite acceptable. However, in new basic oxygen shop designs equipment and building structure costs may be reduced by providing for a low building structure where the flux bins and other equipment usually installed at the higher levels may be installed at ground level. Such a low level building concept of basic oxygen refining may be applied to existing open hearth buildings without resorting to extensive structural modifications.

Applying the low level building concept to basic oxygen refining shops, however, would necessitate vessel relining apparatus which would not require the heretofore used tall elevator tower. This invention provides for such an apparatus which additionally eliminates the need for the high refractory brick storage area and a freight elevator for transporting brick to the high level. More particularly, the present invention provides apparatus for use in lining ground supported, open-mouth metallurgical processing vessels arranged oppositely one another, preferably comprising: elongated support structure arranged between the vessels with the ends thereof disposed adjacent the inner portions of the mouths of the vessels; a transportation bed, such as spaced rails, arranged on the support structure and including selectively movable end sections arranged to be moved between a position outside the vessel to a position over the mouths of the vessels; a self propelled vehicle adapted for travelling on the transportation bed, including the end sections thereof, and having a storage compartment for receiving and storing refractory brick; and delivery means for lowering the refractory bricks into a vessel whereby workers on a scaffold platform supported in the vessel may take the bricks and form the refractory lining. Preferably the end sections of the transportation bed are selectively retractable and extendible with respect to the remainder of the bed and are movable between a retracted position within the ends of the stationary portion of the bed and an extended position over the mouths of the vessels. The end sections are preferably rail sections, and the vehicle is preferably a rail car having inner and outer sets of wheels engageable with the end section rails and the stationary section rails, respectively. Also, the vehicle preferably includes a storage compartment accessible from the underneath portion thereof with the delivery means being integral with the vehicle assembly and including a hoist whereby an elevator cage for supporting refractory brick or a portable scaffold may be grasped by the hoist and selectively lifted to and from the storage compartment and placed in or taken out of a vessel. With the apparatus of this invention the refractory brick may be stored below the transportation bed which could include an opening over the brick storage area, whereby a elevator cage for the brick may be selectively lowered and lifted to and from the storage area. By making the rail vehicle self propelled with its own hoist, the special overhead crane needed for transporting the heretofore tall elevator tower to and from the vessels could also be eliminated in the low building refining shop.

Other details and advantages of this invention will become apparent as the following description of a present preferred embodiment thereof proceeds.

In the accompanying drawings I have shown a present preferred embodiment of the present invention in which:

FIG. 1 is a front elevation view showing two upright ground supported open mouthed tiltable metallurgical processing vessels such as would be used in basic oxygen refining of steel and apparatus for use in lining those vessels embodying the present invention;

FIG. 2 is a top plan view of the apparatus and vessels of FIG. 1;

FIG. 3 is a view taken along the line III—III of FIG. 2;

FIG. 4 is a view taken along the line IV—IV of FIG. 2; and

FIG. 5 is a partial perspective view of a portable collapsible scaffold for use within a vessel during lining operations.

Referring now to the drawings, there is shown in FIGS. 1 and 2 a pair of oppositely arranged identical generally cylindrical or pear shaped metallurgical processing furnaces or vessels **10** such as would be used in the basic oxygen refining of steel. Each vessel **10** is illustrated as being supported for tilting about a transverse axis thereof by a trunnion ring **12** to which is fixed diametrically opposed trunnions **14**. Both trunnions **14** are arranged in ground supported bearings **16** mounted on concrete pedestals **17** and **19** with one trunnion being coupled with a drive motor **18** and the other trunnion serving as an idler trunnion. In FIG. **1**, with reference to the left side vessel **10**, the right or inside trunnion **14** is the drive trunnion with the other trunnion, left or outside trunnion, being the idler trunnion. The same relationship (i.e. outside trunnion-idler and inside trunnion-drive) holds for the vessel **10** on the right in FIG. **1**. The vessels **10** are supported so that their respective mouth portions lie in a common horizontal plane. Also, the usual exhaust hood **20**, shown partially in FIG. **1**, is provided and is removable from the vessels or partially dismantable so that lining of the vessels may be carried out without interference by the hood. The hood **20** would be in place over the mouth of the vessel being used to refine steel. The reason for the two vessels is that while one vessel is in service refining steel, the other vessel could be in the process of being relined.

The apparatus for use in lining the vessels **10** is generally designated by the numeral **30** and is shown arranged between the vessels. The lining apparatus **30** includes a support structure **32** formed of interconnected horizontally and vertically arranged channel members **34** and **36**, respectively. The support structure is fixed to the inside pedestals **19** and is thus suspended above ground level **37**. The space between the upper and lower horizontal channels **34** serves as a storage area for equipment such as a portable scaffold, with a floor surface **38** provided between the lower horizontal channels for supporting the equipment.

Rails **40** are anchored to the upper horizontal channels **34** and serve as a transportation bed for rail car **42**. Arranged between rails **40** and at the opposite end sections thereof, are retractable and extendible end sections **44**. Each end section **44** includes a support frame comprising a pair of channel members **46**, shown clearly in FIG. **3**, slidably coupled to the upper horizontal channels **34** by T-bars **48** fixed to channels **46** with the heads of the T-bars being mated with complementary shaped brackets **50**. A pair of rails **52** is fixed to the upper surface of the channels **46**, while gear racks **54** are fixed to the lower surface of the channels. The racks **54** operatively engage pinion gears **56** which are operatively connected to drive motors **58** mounted to the upper horizontal channels **34**. The elements comprising the end sections **44** are so sized, shaped, and arranged, that the upper surfaces of rails **52** are coplanar with the upper surfaces of rails **40** and the entire assembly is disposed within the ends of rails **40** when the end sections **44** are fully retracted and is disposed over the entire mouth of a vessel **10**, as shown in FIG. **1**, when end sections are fully ex-

tended. Flat bar sections **47** are secured to the lower surfaces of channels **46** and are sized to engage the top surface of the vessel **10** when the end sections **44** are extended whereby the vessel will provide support for the cantilevered end section. Additional or even sole support of the end sections **44** may be provided by removable legs extending from the channels **46** to the trunnion ring **12** of the vessel assembly.

The rail car **42** includes an open top and bottom main body **60** defining an interior storage compartment **62** accessible from the underneath portion of the body. Outside wheels **64** are rotatably fixed to the lower portion of body **60** and are sized and spaced to engage the outer rails **40**. Inside wheels **66**, shown clearly in FIG. **4**, are rotatably fixed to the body **60** and are sized and spaced to engage the rails **52** of the end sections **44**. The wheels **64** and **66** are operatively coupled to a drive motor **70** which is supplied electric power through a trailing cable **72** connected to a source of power, not shown. The rail car **42** is thus self-propelled being controlled by an operator who travels with the car.

The rail car **42** is also provided with drum type hoists **74** driven by electric motors **75** supplied by electric power through trailing cable **72**. Hoists **74** are used for lifting and lowering loads to and from the storage compartment **62**. Refractory bricks **76** stored at ground level **37** are lifted into storage compartment **62** by loading the bricks **76** onto an elevator cage **80** and lifting the cage through a permanent elevator shaft **82** extending downwardly from the upper plane of rails **40**. The hoists **74** may also be used to lift into storage compartment **62** the sections of a portable collapsible scaffold assembly **84** stored on the floor **38** between the upper and lower horizontal channels **34**. The rail car **42** would then transport the sections of the scaffold assembly **84** to a vessel to be lined and lower the sections into the vessel.

The scaffold assembly **84** is shown clearly in FIGS. **1** and **5** and is of any well known sectional shaft type design. The scaffold assembly **84** is provided with a pair of elevator cage sections **86***a* and **86***b* to which may be attached a work platform section **87** having four grating platform sections **88** secured to the hinged brackets **90** shown pinned to a box-shaped support structure **99**. Corner plates **92**, one shown in FIG. **5**, are bolted between adjacent platform sections **88** to provide a continuous platform area. The lower shaft section **86***a* is lowered into the vessel **10** and when that section is positioned in the vessel the work platform section **87** is installed around the shaft section and locked in place in a suitable fashion as by bolting the support structure **99** to the framework of the section **86***a*. The work platform section **87** is sized and shaped to slide up and down with respect to the cage sections **86***a* and **86***b*. Both cage sections **86***a* and **86***b* are also provided with doors **101** at spaced locations through which the interior of the cage sections would be reached from the work platform section **87**.

The lower cage section **86***a* is supported on the bottom of the vessel by means of adjustable screw jacks **100**. The screw jacks **100** are supported on planking resting on refractory bricks which would have been installed before the emplacement of the scaffold assembly **84** within the vessel. After the lower cage section **86***a* is positioned, the upper cage section **86***b* is lowered by hoists **74** into the vessel. The cage sections **86***a* and **86***b* are provided with tubular sleeves **89** at the four corners thereof, which sleeves are sized so that the cage sections may be mated with each other. The sleeves **89** are provided with registering openings through which pins may be inserted for securing together the cage sections **86***a* and **86***b*. The cage sections are provided with oppositely disposed longitudinally extending guide rails **102** which are sized to receive rails **104** fixed to the sizes of elevator cage **80**.

After old burned lining is removed from a vessel and the vessel is ready for relining, it is placed in its upright position as shown in FIG. **1** and the hood **20** is removed. The end section **44** adjacent the vessel to be lined is then extended over the mouth of the vessel, and in this embodiment rests on the top surface of the vessel. The rail car **42** is positioned over the section of scaffold assembly **84** stored between the channel members **34** and **36** and lower cage section **86***a* is then hoisted into the storage compartment **62** of the rail car. The rail car **42** is then driven onto the end section **44**, positioned centrally of the vessel, and the lower cage section **86***a* lowered into the vessel where it is fixed in position on screw jacks **100** and the work platform section **87** installed. The upper cage section **86***b* is similarly installed within the vessel. The assembled scaffold assembly **84** is provided with stabilizing support by inserting bracing members (not shown) between the upper surface of the upper cage section **86***a* and the inner face of channel members **46**. The rail car **42** is then driven to the central elevator shaft **82** where the hoists **74** are lowered to engage the elevator cage **80** having a pallet load of refractory bricks thereon. The cage **80** is lifting into storage compartment **62**, the rail car **42** is then driven to the vessel and the cage **80** lowered through elevator shaft and cage sections **86***a* and *b* to the work platform area. The rail car **42** is returned to the central elevator shaft **82** for refractory brick until the relining operation is completed, at which time the sections of the scaffold assembly **84** are removed from the vessel and returned to the storage area between the upper and lower horizontal channels **34**. The end section **44** is retracted, the hood **20** replaced, and the vessel is then ready for operation.

It should be readily recognized that the apparatus of this invention as just described is simple and compact in construction, and provides an efficient means for transporting refractory bricks to the vessel being relined. Also, the present apparatus eliminates the need for a tall building structure, as has been previously required for basic oxygen steel processing shops. Since brick storage may be at ground level using this invention, the need for a freight elevator to lift the brick to a high storage area is no longer required. In addition, there is no need for a special high level crane to handle the scaffolding and elevator shaft when using the apparatus of this invention.

While I have shown and described a present preferred embodiment of this invention, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied within the scope of the following claims.

I claim:

1. Apparatus for use in lining ground supported, open-mouth metallurgical processing vessels arranged oppositely one another, comprising:

elongated support structure arranged between the vessels with the ends thereof disposed adjacent the inner portions of the mouths of the vessels;

transportation bed means arranged on said support structure and defining a pathway on which a vehicle may travel, said bed means including selectively movable end sections at the end portions thereof and including means for moving the sections between a position outside the vessels and a position over the mouths of the vessels;

self propelled vehicle means adapted for travelling on said bed means and including a storage compartment for receiving and storing refractory brick; and

delivery means for lowering the refractory bricks from said vehicle means into a vessel, whereby workers on a scaffold platform supported in the vessel may take the bricks and form the refractory lining.

2. Apparatus as set forth in claim **1** wherein the plane of said transportation bed means is horizontally disposed above and in close spaced relationship to the horizontal planes of the mouths of the vessels.

3. Apparatus as set forth in claim **1** wherein said end sections are retractable and extendible with respect to the remainder of said bed means and are movable between a retracted position within the ends of the bed means and a position over the mouths of the vessels.

4. Apparatus as set forth in claim **1** wherein said delivery means is integral with said vehicle means.

5. Apparatus as set forth in claim **1** wherein said storage compartment of said vehicle means is accessible from the underneath of the vehicle; said delivery means is integral with

said vehicle and includes hoist means for selectively lifting and lowering equipment, refractory brick and the like to and from said storage compartment.

6. Apparatus as set forth in claim 5 including a refractory brick storage area arranged below said transportation bed means; and wherein said bed means includes an opening over said storage area whereby an elevator cage may be selectively lowered and lifted by said hoist means to and from the storage area.

7. Apparatus as set forth in claim 1 wherein said transportation bed means includes first tracks for supporting a rail car; said end sections of said bed means includes second tracks arranged within the spacing of the first tracks; and said vehicle means includes a rail car having a first set of wheels engageable with said first tracks and a second set of wheels engageable with said second rails.

8. Apparatus for use in lining ground supported, open-mouth metallurgical processing vessels arranged oppositely one another, comprising:

elongated support structure arranged between the vessels with the ends thereof disposed adjacent the mouth portions of the vessels;

generally horizontally disposed rail means arranged on the upper plane of said support structure and extending longitudinally thereof, said rail means including selectively retractable and extendible rail sections at each of the end portions thereof and including means for moving the rail sections from a retracted position outside the vessels to an extended position over the mouths of the vessels; and

a rail car assembly transportable on said rail means and said rail sections and including an interior storage compartment accessible from the underneath of the car, said rail car assembly also including refractory brick delivery means comprising hoist means for selectively lifting and lowering equipment, refractory bricks, and the like to and from said storage compartment, whereby said rail car assembly may be transported on said rail means and said rail sections to lower bricks into a vessel to workers on a portable scaffold supported in the vessel after raising a load of bricks from a storage area disposed below said rail means.

9. The apparatus as set forth in claim 8 including a refractory brick storage area arranged below said rail means; and wherein said rail means includes an opening over said rail storage area whereby an elevator cage may be selectively lowered and lifted by said hoist means to and from the storage area.

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