May 8, 1962 E. V. ABAROTIN ETAL 3,033,389

APPARATUS FOR USE IN LINING VESSELS

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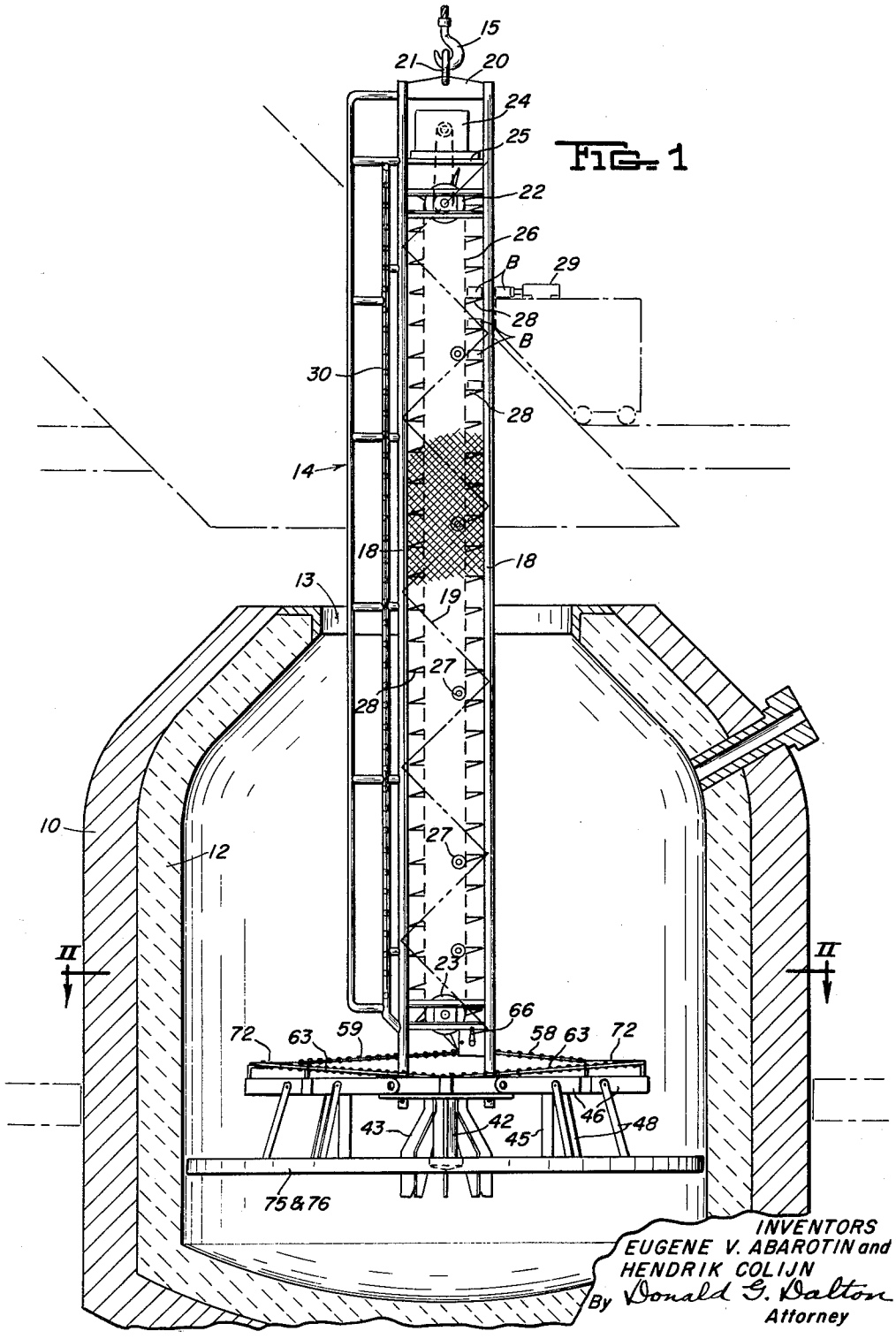


FIG. 1

INVENTORS
EUGENE V. ABAROTIN and
HENDRIK COLIJN
By Donald G. Dalton
Attorney

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FIG. 2

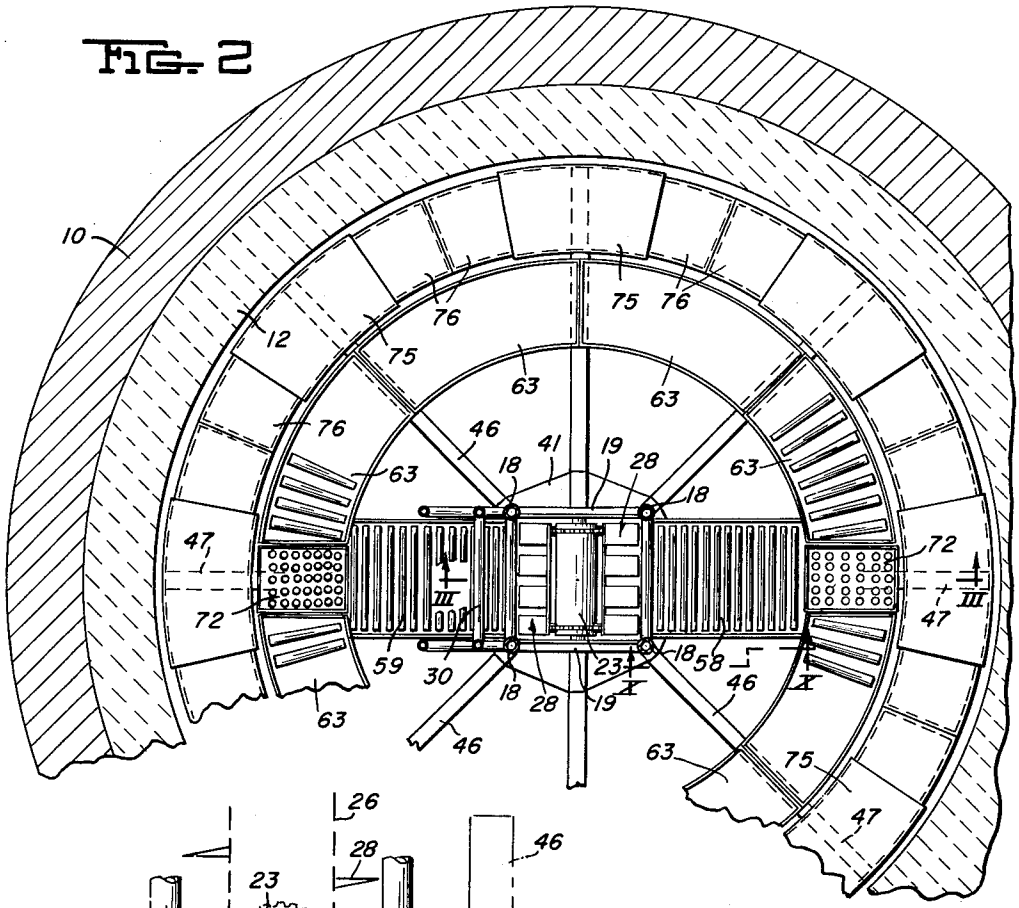
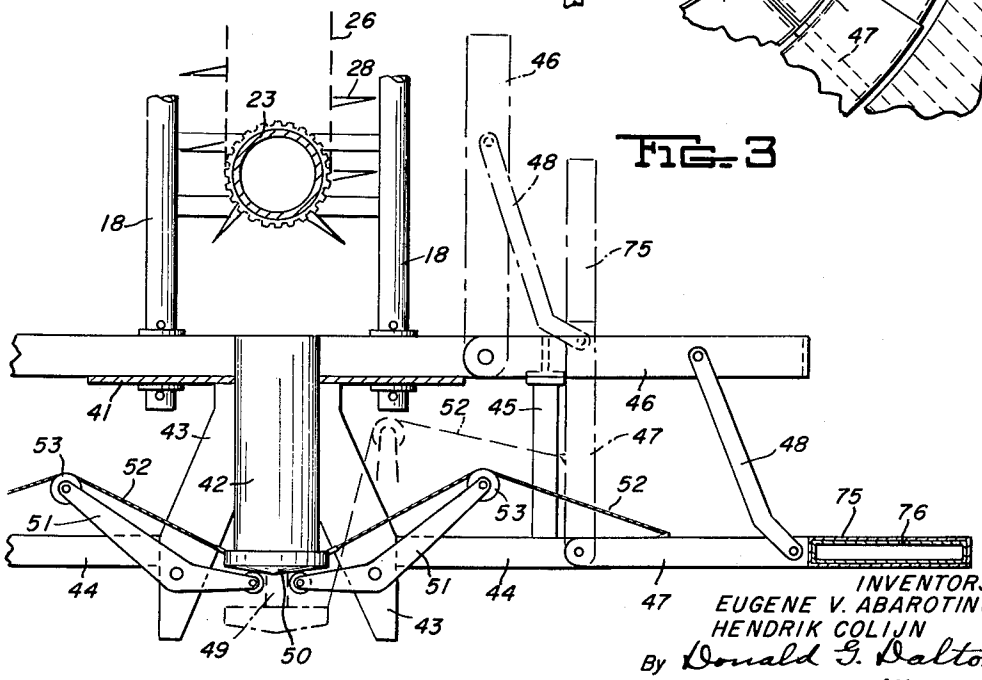


FIG. 3



INVENTORS
EUGENE V. ABAROTIN and
HENDRIK COLIJN
By Donald G. Dalton
Attorney

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FIG. 5

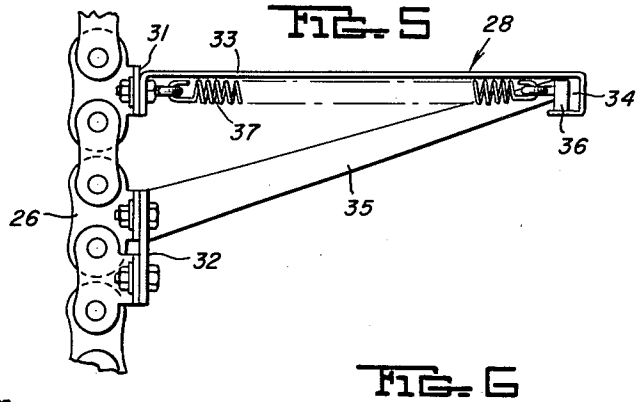


FIG. 6

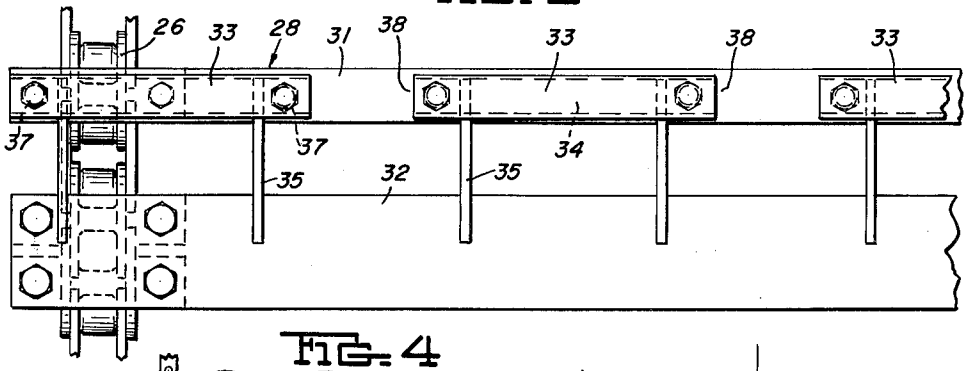
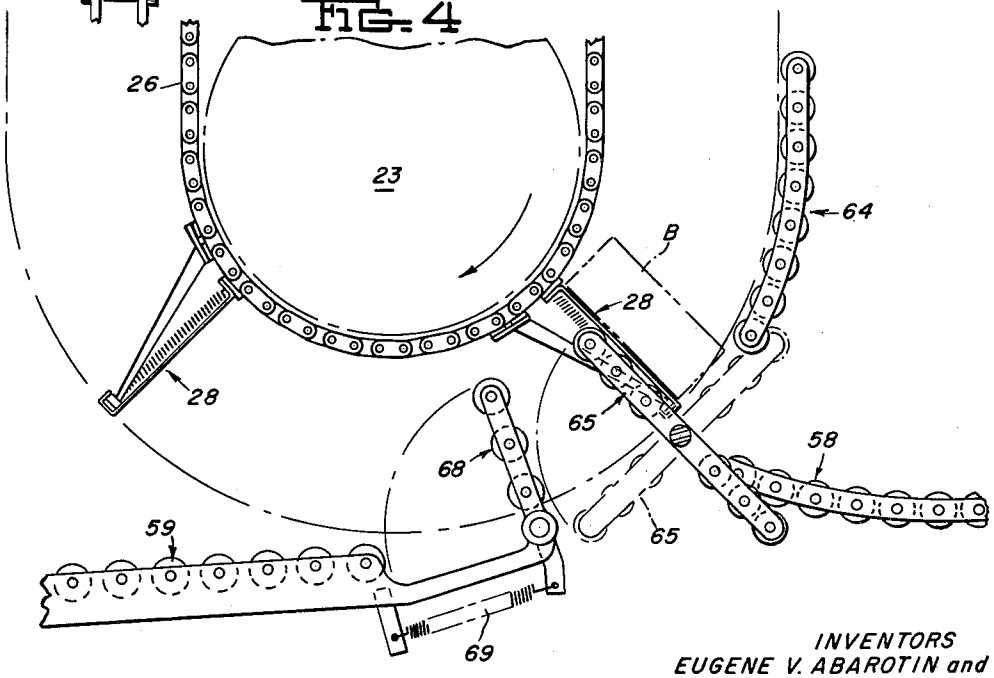


FIG. 4



INVENTORS
EUGENE V. ABAROTIN and
HENDRIK COLIJN
By Donald G. Dalton
Attorney

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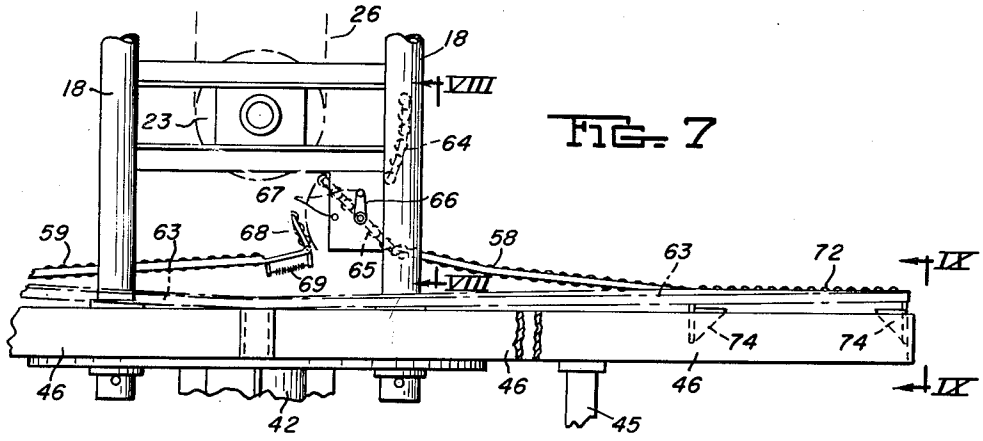


FIG. 7

FIG. 8

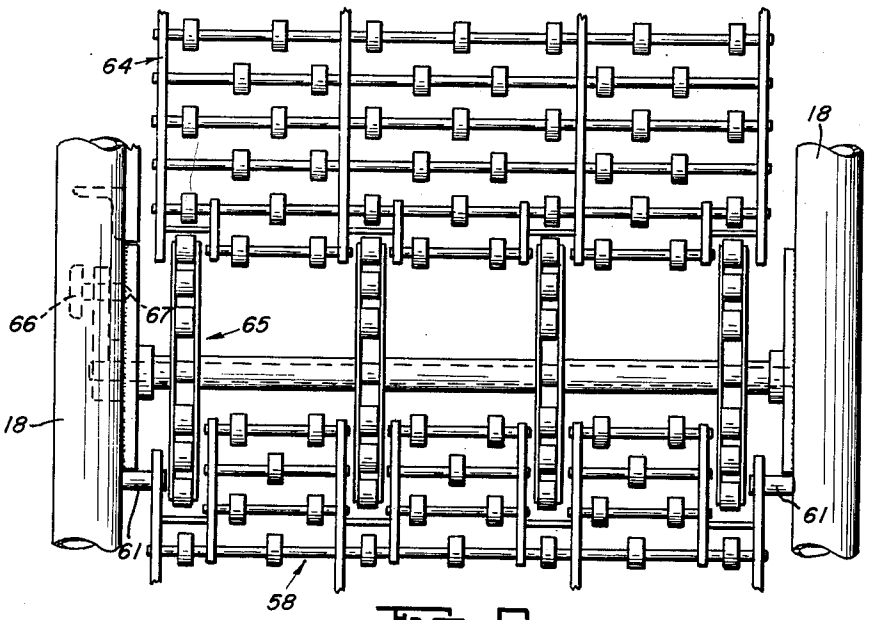


FIG. 9

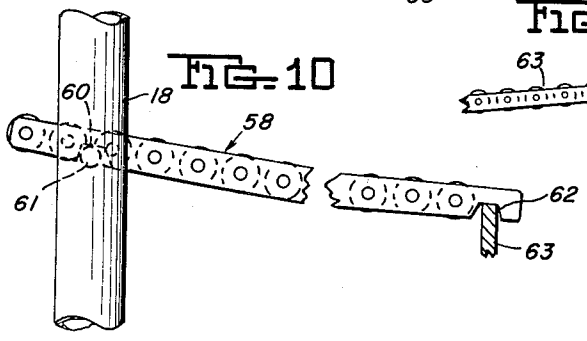
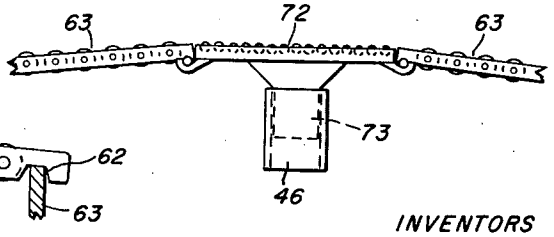


FIG. 10



INVENTORS
EUGENE V. ABAROTIN and
HENDRIK COLIJN
By Donald G. Dalton
Attorney

United States Patent Office

3,033,389

Patented May 8, 1962

3,033,389

APPARATUS FOR USE IN LINING VESSELS

Eugene V. Abarotin, Pittsburgh, and Hendrik Colijn, Monroeville, Pa., assignors to United States Steel Corporation, a corporation of New Jersey

Filed Sept. 26, 1960, Ser. No. 58,565

11 Claims. (Cl. 214—1)

This invention relates to an apparatus for use in lining vessels, such as oxygen steelmaking furnaces.

A conventional oxygen steelmaking furnace includes a large open-topped vessel which has a lining of refractory brick. This lining must be replaced regularly after only a few days service. The usual practice in relining these furnaces has been to erect scaffolds within the furnace on which bricklayers stand and to lower bricks through the open top on pallets. For safety reasons bricklayers usually leave the furnace while bricks are lowered. As relining progresses, the work must be interrupted further while scaffolds are raised. Consequently relining such a furnace is unduly time-consuming and necessitates keeping the furnace out of service as long as a week. While our apparatus is particularly useful in lining this type of furnace, it is apparent it may be used elsewhere for overcoming similar problems.

An object of our invention is to provide an apparatus which expedites operations such as lining an oxygen steelmaking furnace by overcoming the need for interruptions.

A further object is to provide a portable apparatus which can be inserted in an open-topped vessel to furnish both a platform for workmen and an elevator for lowering material to the workmen.

A further object is to provide an apparatus of the foregoing type which folds to enable it to be inserted through a restricted opening.

A further object is to provide an apparatus of the foregoing type which conveys material from the elevator to easy reach of workmen on the platform.

In accomplishing these and other objects of the invention, we have provided improved details of structure, a preferred form of which is shown in the accompanying drawings, in which:

FIGURE 1 is a vertical sectional view of an oxygen steelmaking furnace with our apparatus installed;

FIGURE 2 is a horizontal section on a larger scale on line II—II of FIGURE 1;

FIGURE 3 is a vertical section on a still larger scale on line III—III of FIGURE 2;

FIGURE 4 is a diagrammatic side elevational view of the lower end of the elevator and associated parts;

FIGURE 5 is a side elevational view on a larger scale of one of the brick-carrying trays of the elevator;

FIGURE 6 is an elevational view on a still larger scale of the tray taken from the right of FIGURE 5;

FIGURE 7 is a side elevational view on an intermediate scale of the structure at the lower end of the elevator;

FIGURE 8 is a vertical section on line VIII—VIII of FIGURE 7;

FIGURE 9 is an elevational view on line IX—IX of FIGURE 7; and

FIGURE 10 is a vertical section on line X—X of FIGURE 2.

FIGURES 1 and 2 show a portion of a conventional oxygen steelmaking furnace which includes a shell 10 and a lining 12 of refractory bricks. The top of the furnace has a restricted opening 13. Our apparatus, indicated generally at 14, is suspended from a crane hook 15 through the open top for lowering individual bricks B into the furnace and furnishing a platform for bricklayers working therein.

Our apparatus 14 comprises a rigid elevator casing

formed essentially of uprights 18, cross bracing 19, and top members 20. Hook 15 engages an eye 21 carried by these top members. Upper and lower double sprockets 22 and 23 for the elevator are journaled in the casing adjacent its respective ends. We drive the upper sprocket 22 in a clockwise direction, as viewed in FIGURE 1, through a motor 24 mounted on a platform 25 fixed to uprights 18 above the sprocket. A pair of spaced apart endless elevator chains 26 run over sprockets 22 and 23 and preferably over idler sprockets 27 journaled to the casing intermediate its height. A plurality of spaced brick-carrying trays 28 are fixed to these chains. We load a brick B on each tray 28 as it travels downwardly past a loading station 29 above the furnace. We can load manually, but we prefer to employ a suitable automatic transfer device, not shown. We enclose our elevator casing with removable screens or the like to prevent any falling bricks from striking workmen in the furnace. As work in the furnace progresses, we raise our apparatus in steps and of course remove whatever screen is opposite the loading station 29. One side of our elevator casing carries a ladder 30 to enable workmen to enter and leave the furnace.

As FIGURES 5 and 6 best show, each tray 28 includes upper and lower cross bars 31 and 32 which are rigidly fixed to links of the two chains 26 and extend therebetween. A horizontal wear plate 33 is fixed to the upper cross bar 31 and projects therefrom. The free edge of the wear plate is bent downwardly and inwardly to form a guideway 34. A plurality of inclined braces 35 are fixed to the lower cross bar 32 and to a bar 36 slidably mounted in guideway 34. Preferably tension springs 37 extend between the upper cross bar 31 and the slidable bar 36. This construction enables the braces 35 to support the wear plates 33 while they are carrying bricks, but affords flexibility to permit the trays to travel around sprockets 22 and 23. The wear plate contains a pair of horizontally spaced slots 38 extending inwardly from its free edge to accommodate our unloading means, hereinafter described. The slidable bar 36 is formed in sections and does not extend across the slots. In describing cross bars as "upper" and "lower," we refer to their relation on the carrying flight of the chains; their positions of course are reversed on the return flight.

As FIGURE 3 best shows, a base 41 is detachably fixed to the lower ends of uprights 18. The underside of the base carries a centrally-located double-acting fluid pressure cylinder 42 and a plurality of gussets 43, illustrated as eight in number. FIGURE 3 omits several of the gussets to show other mechanism more clearly. Each gusset carries a respective radially extending spoke 44, the outer portion of which carries a vertical post 45. Base 41, cylinder 42, gussets 43, spokes 44 and posts 45 form a rigid assembly. A plurality of upper arms 46 are pivoted to base 41, corresponding to the respective gussets, spokes and posts. A plurality of lower arms 47 are pivoted to the outer ends of the respective spokes 44. Respective links 48 are pivoted at opposite ends to the upper arms 46 and lower arms 47. We can move the arms either to a horizontal operative position, in which the upper arms rest on the respective posts 45 and the links support the lower arms, or to a vertical folded position in which both upper and lower arms extend upwardly from their respective pivots. Cylinder 42 contains a piston 49 whose lower end has a cam surface 50. Respective bell cranks 51 are pivoted to gussets 43, and one arm of each carries a roller which rides against the cam surface 50. Respective cables 52 are fixed at one end to piston 49, pass over rollers 53 on the other arms of the bell cranks, and are fixed at the other end of the lower arms 47. Thus, by moving piston 49 in cylinder 42, we

move the lower arms in unison to their operative or folded positions, while the links 48 move the upper arms with the lower arms. Cylinder 42 of course has appropriate connections for admitting and discharging fluid, which we do not show in the interest of simplicity.

We removably support short and long radial roller conveyors 58 and 59 over two opposed upper arms 46. At its inner or entry end, the short conveyor 58 carries hooks 60 which engage pins 61 on the casing uprights 18 (FIGURE 10). At its outer or discharge end the short conveyor carries hooks 62 which engage circumferential conveyor sections 63, hereinafter described. The long conveyor 59 is similarly supported, but we do not illustrate the support means in detail. The entry ends of both conveyors 58 and 59 lie adjacent the lower end of the carrying flight of the elevator chains 26, and the conveyors slope downwardly therefrom toward their discharge ends. A series of retaining rollers 64 are mounted on the lower portion of the elevator casing to prevent bricks from prematurely sliding off the trays 28 as the trays commence to travel around the lower sprockets 23 (FIGURES 7 and 8).

As FIGURES 4, 7 and 8 best show, a distributing gate 65 is pivoted to the lower portion of the elevator casing and includes prongs aligned with slots 38 in the wear plates 33. Each prong carries short length conveyor rollers. We can position the gate to direct bricks from the trays to either the short or long conveyor 58 or 59 after the bricks clear the retaining rollers 64. For this purpose the gate shaft carries a crank 66 accessible from one side of the elevator casing (FIGURE 7). Preferably the plate to which the shaft is pivoted carries stops 67. The crank engages one or the other of these stops to locate the gate accurately in its respective positions. When the gate is positioned to direct bricks to conveyor 58, the prongs intercept bricks on the trays, whereupon the bricks gravitate onto the conveyor. An impact absorbing device is mounted on the entry end of conveyor 59. This device includes a short length conveyor section 68 pivoted to conveyor 59 and a tension spring 69 normally holding it in an upright position. When the conveyor section 68 pivots downwardly, it forms a continuation of conveyor 59. When the gate 65 is positioned to direct bricks to conveyor 59, bricks drop from trays 28 onto the gate prongs and abut the upright conveyor section 68. The weight of a brick is sufficient that the conveyor section 68 pivots downwardly against the action of spring 69, whereupon the brick is deposited on conveyor 59.

As FIGURES 2 and 9 best show, we removably support ball transfer devices 72 on the upper arms 46 at the discharge ends of the short and long conveyors 58 and 59. The arms are of box-like construction to receive dowels 73 on the undersides of the transfer devices 72. Sections 63 of the circumferential roller conveyors, hereinbefore mentioned, are hinged to each edge of the transfer devices. These conveyor sections also have dowels 74 on their undersides removably received in other arms 46 (FIGURE 7). The circumferential conveyors slope away from each side of each ball transfer device and reach low points 90° removed from the center lines of the transfer devices. Bricks deposited on either radial conveyor 58 or 59 travel outwardly by gravity until they reach one of the ball transfer devices 72. Next they can be diverted manually to right or left, whereupon they continue to travel by gravity along one of the circumferential conveyor sections 63. As they travel therealong, they are accessible to the bricklayers, as hereinafter more fully explained.

As FIGURES 2 and 3 best show, the lower arms 47 extend radially outwardly of the upper arms 46. Box-like platform sections 75 are fixed to each side of each arm. With eight arms 47 there are thus sixteen sections 75, each extending through an arc of about 11° from its respective arm. Each platform section 75 carries a respective telescoping platform section 76 of similar arcuate extent. We removably bolt together the abutting faces of each adjacent pair of platform sections 76 to form a continuous platform which extends around the inner circumference of the furnace. Bricklayers or other workmen can stand on this platform for working on the furnace lining. Such workmen have easy access to bricks traveling on the circumferential conveyor sections.

When we wish to fold our apparatus to remove it from the furnace, we remove the radial conveyors 58 and 59, the circumferential conveyor sections 63 and the ball transfer devices 72. We next unbolt the platform sections 76 from each other and telescope these sections into the platform sections 75. We then operate the hydraulic cylinder 42 to force piston 49 downwardly and thus swing arms 46 and 47 upwardly to their folded positions. The apparatus readily passes through the restricted opening 13 in the top of the furnace when thus folded.

From the foregoing description it is seen that our invention provides a simple apparatus which enables workmen to install a new lining in a furnace with a minimum of interruption. Our apparatus is useful also for lowering bricks into the furnace for relining the bottom. In this instance we detach the elevator casing from the base and insert the casing by itself in the furnace. We drive the elevator slowly so that a workman can remove bricks manually from the trays. After the bottom is lined, we remove the elevator casing from the furnace, attach the base with the arms folded and conveyors removed, and insert the whole apparatus in the furnace. Thereafter we open the parts to their operative position, install the conveyors etc., and proceed as already described. As relining progresses, we raise the apparatus in steps whereby bricklayers always work at a convenient height.

While we have shown and described only a single embodiment of the invention, it is apparent that modifications may arise. Therefore, we do not wish to be limited to the disclosure set forth but only by the scope of the appended claims.

We claim:

1. An apparatus for use in lining a vessel having a restricted opening in its top comprising an elevator adapted to be suspended in the vessel for lowering material thereinto, upper and lower foldable supports carried by the lower end of said elevator, a platform carried by said lower supports for supporting workmen, a radial conveyor overlying said upper supports for receiving material from said elevator, and a circumferential conveyor carried by said upper supports for receiving material from said radial conveyor and delivering it to workmen on said platform.

2. An apparatus for use in lining a vessel having a restricted opening in its top comprising an elevator adapted to be suspended in the vessel for lowering material thereinto, upper and lower sets of arms pivotally related to the lower end of said elevator and adapted to occupy folded positions for passing the opening in the vessel or horizontal operative positions, a platform carried by said lower arms for supporting workmen, a removable radial conveyor overlying said upper arms for receiving material from said elevator, and a removable circumferential conveyor carried by said upper arms for receiving material from said radial conveyor and delivering it to workmen on said platform.

3. An apparatus for use in lining a vessel having a restricted opening in its top comprising an elevator casing adapted to be suspended in the vessel, endless elevator chains movably supported in said casing, spaced trays carried by said chains for supporting material and lowering it into the vessel, upper and lower foldable supports carried by the lower end of said casing, a platform carried by said lower supports for supporting workmen, a radial conveyor overlying said upper supports for receiving material from said trays, and a circumferential conveyor carried by said upper supports for receiving material from

said radial conveyor and delivering it to workmen on said platform.

4. An apparatus for use in lining a vessel having a restricted opening in its top comprising an elevator casing adapted to be suspended in the vessel, endless elevator chains movably supported in said casing, spaced trays carried by said chains for supporting material and lowering it into the vessel, upper and lower sets of arms pivotally related to the lower end of said casing and adapted to occupy folded positions for passing the opening in the vessel or horizontal operative positions, a platform carried by said lower arms for supporting workmen, a removable radial conveyor overlying said upper arms for receiving material from said trays, and a removable circumferential conveyor carried by said upper arms for receiving material from said radial conveyor and delivering it to workmen on said platform.

5. An apparatus for use in lining a vessel having a restricted opening in its top comprising an elevator casing adapted to be suspended in the vessel, endless elevator chains movably supported in said casing, spaced trays carried by said chains for supporting material and lowering it into the vessel, a base fixed to the lower end of said casing, upper and lower sets of arms pivoted to said base and adapted to occupy folded positions for passing the opening or horizontal operative positions, means carried by said base for moving said arms between these positions, a platform carried by said lower arms for supporting workmen, a removable radial conveyor overlying said upper arms for receiving material from said trays, and a removable circumferential conveyor carried by said upper arms for receiving material from said radial conveyor and delivering it to workmen on said platform.

6. An apparatus for use in lining a vessel having a restricted opening in its top comprising an elevator casing adapted to be suspended in the vessel, endless elevator chains movably supported in said casing, spaced trays carried by said chains for supporting material and lowering it into the vessel, a base fixed to the lower end of said casing, upper and lower sets of arms pivoted to said base and adapted to occupy folded positions for passing the opening or horizontal operative positions, means carried by said base for moving said arms between these positions, a platform carried by said lower arms for supporting workmen, removable radial conveyors overlying two of said upper arms and sloping downwardly from beneath said trays toward the extremities of the upper arms, means for directing material selectively from said trays to said conveyors, and a removable circumferential conveyor carried by said upper arms and sloping downwardly from said radial conveyors for receiving material therefrom and delivering it to workmen on said platform.

7. An apparatus as defined in claim 6 including ball transfer devices removably supported on the upper arms at the extremities of said radial conveyors, and in which said circumferential conveyor includes sections hinged to said ball transfer devices.

8. An apparatus as defined in claim 6 in which the means for moving said arms includes a fluid pressure cylinder fixed to said base, a piston in said cylinder, bell cranks pivotally related to said base and operated by said piston, cables connecting said piston, bell cranks and lower arms, and links pivoted to respective lower and upper arms.

9. An apparatus as defined in claim 6 in which said platform includes arcuate sections fixed to said lower arms, and other arcuate sections adapted to telescope into said first named sections, said other arcuate sections being bolted to one another at their extremities.

10. An apparatus as defined in claim 6 in which the means for directing material selectively from the trays to the radial conveyors includes a gate pivoted to said casing and having a position in which it intercepts material on the trays and directs it to one conveyor and another position in which it receives the material from the trays and directs it to the other conveyor.

11. An apparatus as defined in claim 10 in which said trays have slots extending from their free edges and said gate has prongs aligned with said slots for intercepting material on the trays.

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