United States Patent [19]

Smith

[11] **3,927,502**

[45] **Dec. 23, 1975**

[54] **METHOD OF LINING A FURNACE**

[75] Inventor: **Joe H. Smith**, Bluff Park, Ala.

[73] Assignee: **United States Steel Corporation**, Pittsburgh, Pa.

[22] Filed: **Feb. 15, 1974**

[21] Appl. No.: **443,055**

Related U.S. Application Data

[62] Division of Ser. No. 253,217, May 15, 1972, Pat. No. 3,853,204.

[52] **U.S. Cl.** **52/747**; 52/749

[51] **Int. Cl.²** **E04G 21/00**

[58] **Field of Search** ..... 104/1 B; 52/747, 749; 182/128, 129; 214/1 R, 1 H

[56] **References Cited**

UNITED STATES PATENTS

3,285,390	11/1966	Puxkandl	52/749
3,439,794	4/1969	Park	182/128

FOREIGN PATENTS OR APPLICATIONS

634,602	2/1962	Italy	182/128

Primary Examiner—John E. Murtagh

[57] **ABSTRACT**

Apparatus and method are described for lining with refractory brick the interior of metallurgical furnace, especially, one having a removable bottom closure. A tower structure is extensible into the furnace interior and carries a work platform that is positionable to various elevation within the furnace.

31 Claims, 15 Drawing Figures

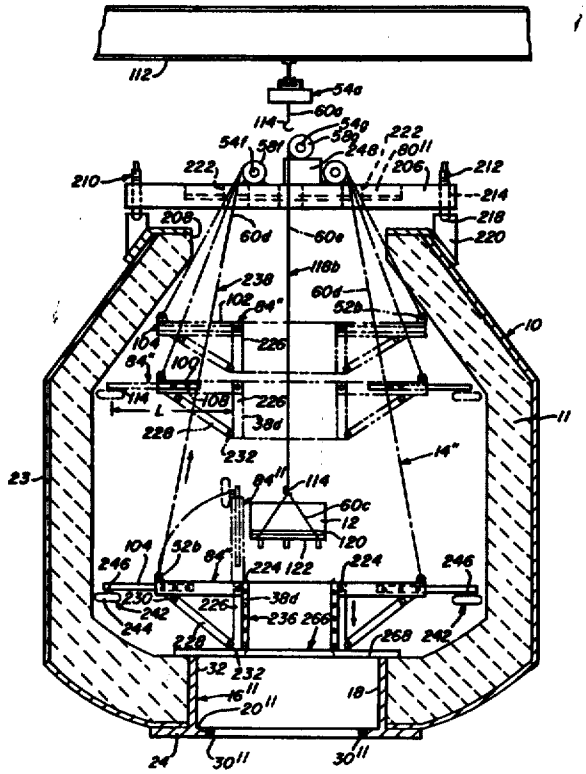
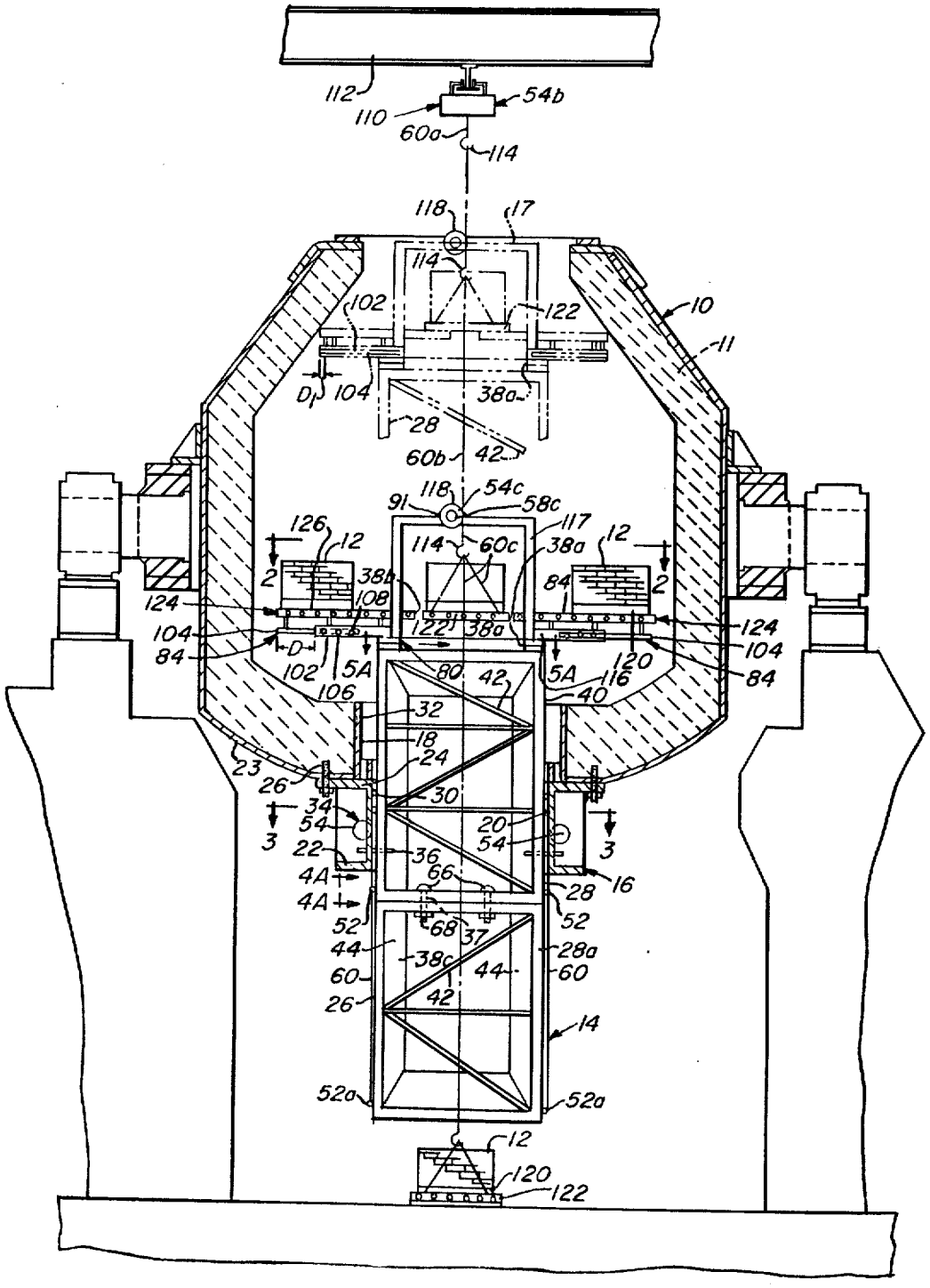


FIG. 1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38a
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60b
42
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54c
58c
126
12
117
60c
2
38b
108
84
124
122
80
5A
106
32
18
24
30
23
26
34
54
3
22
36
66
4A
28
16
52
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38c
60
68
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28a
14
52a
120
116
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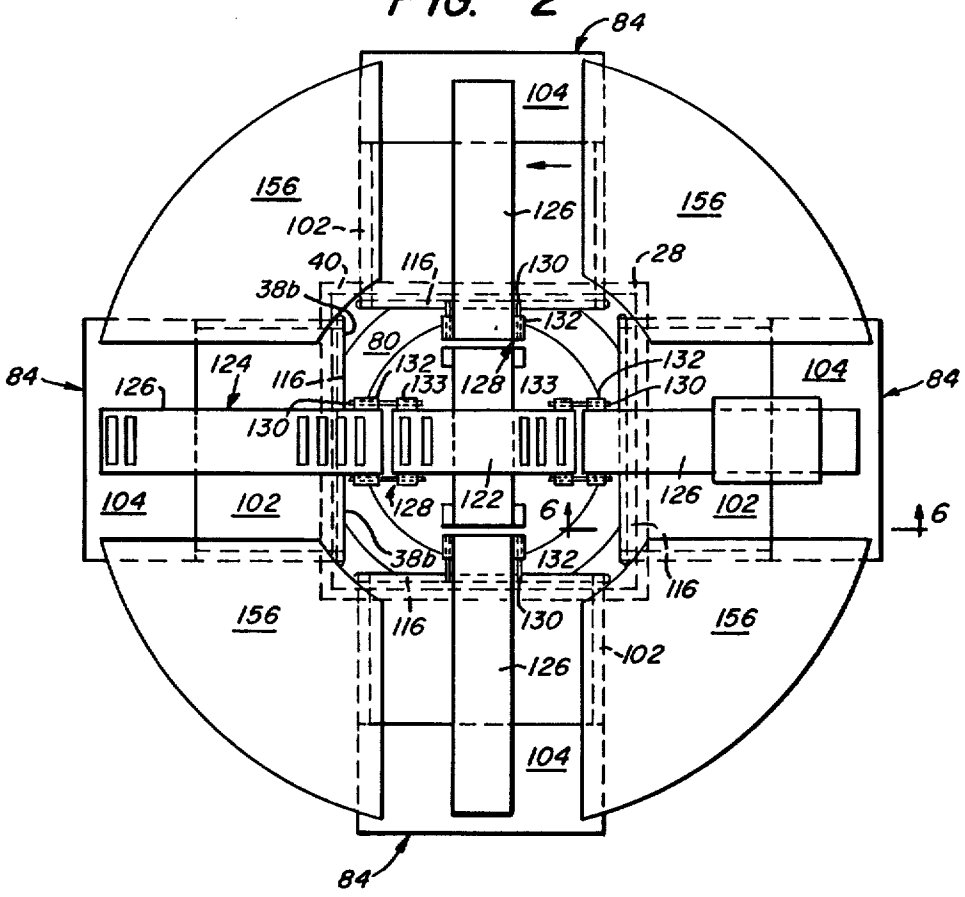
FIG. 2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156
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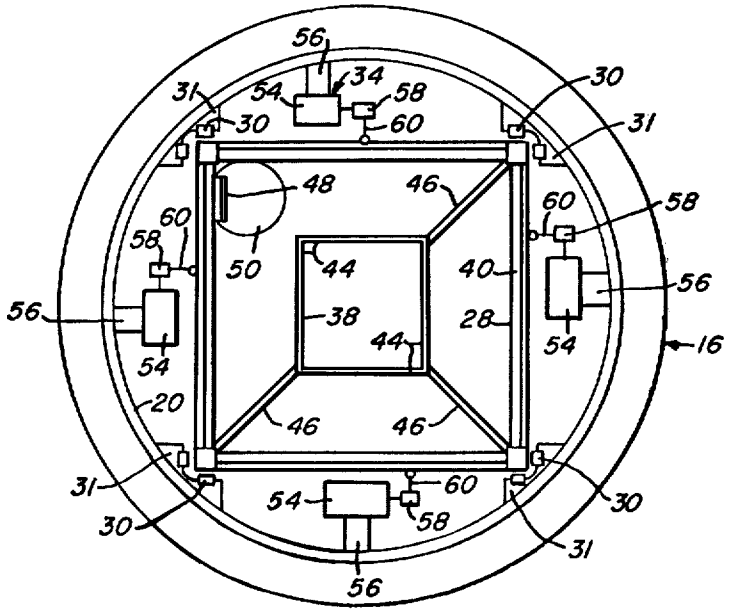
6
122

FIG. 3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20
16

FIG. 4A

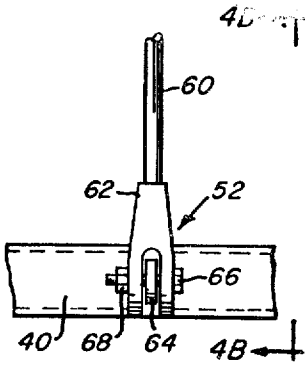


FIG. 4B

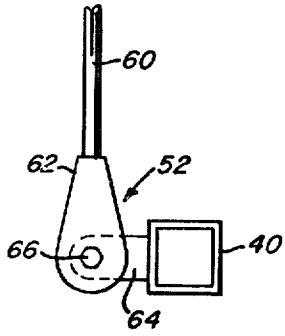


FIG. 6

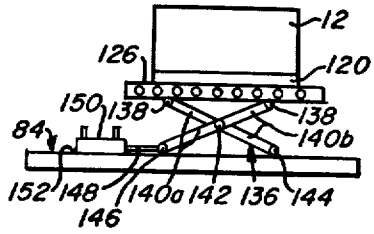


FIG. 5A

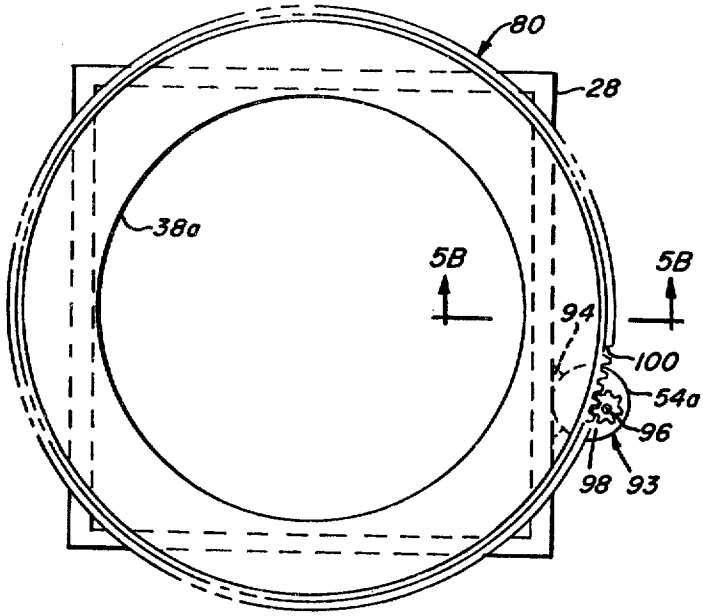


FIG. 5B

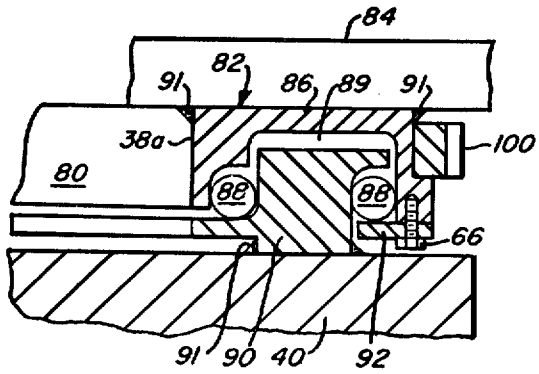
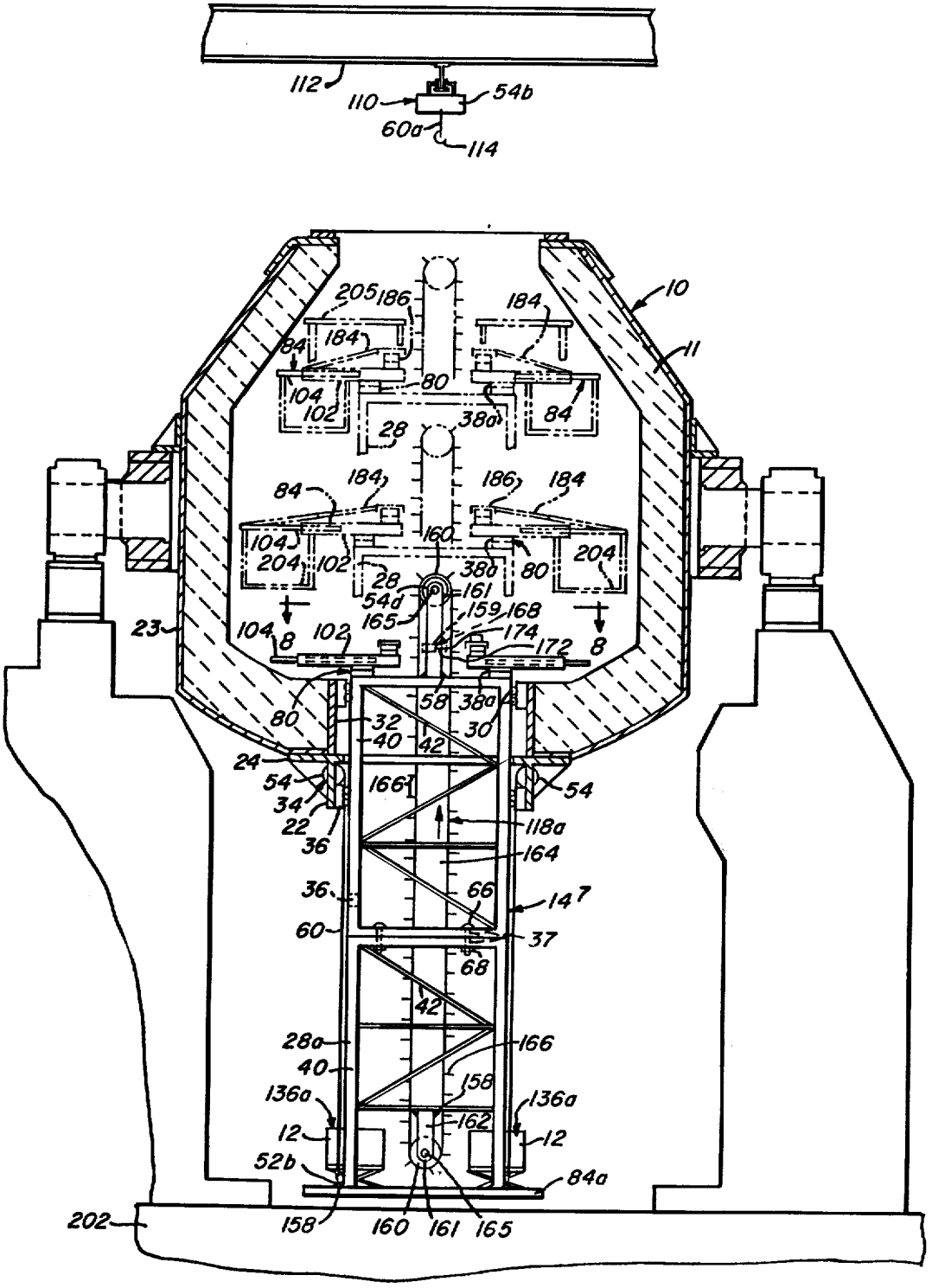


FIG. 7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84
104
102
80
28
380
204
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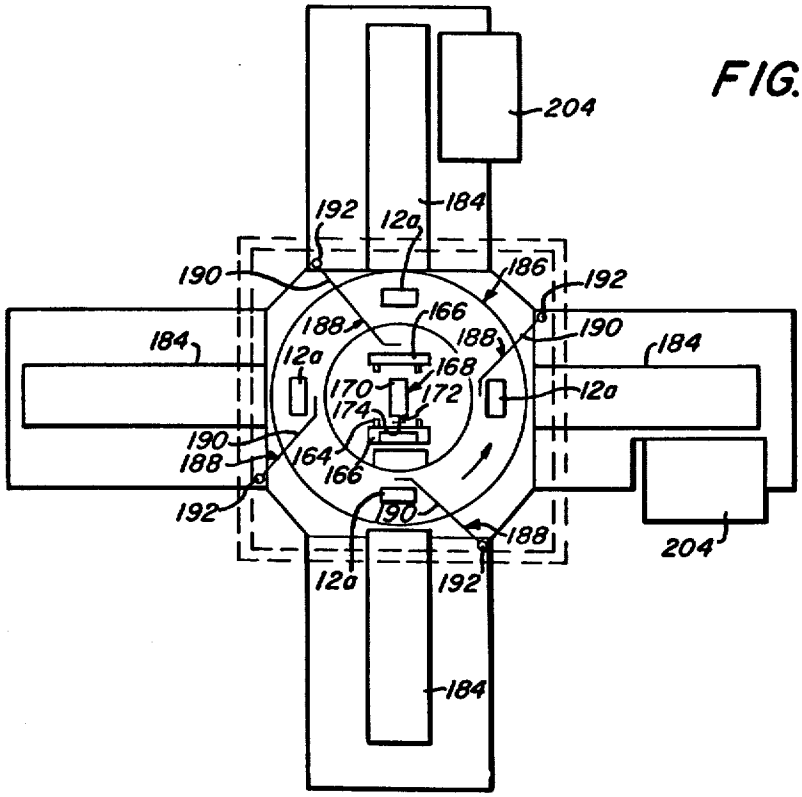
161
159
168
165
174
172
8
23
58
32
40
42
30
24
54
34
22
36
166
118a
164
66
147
37
68
28a
158
136a
162
12
52b
84a
202
160
161
165

FIG. 8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12a
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188
166
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170
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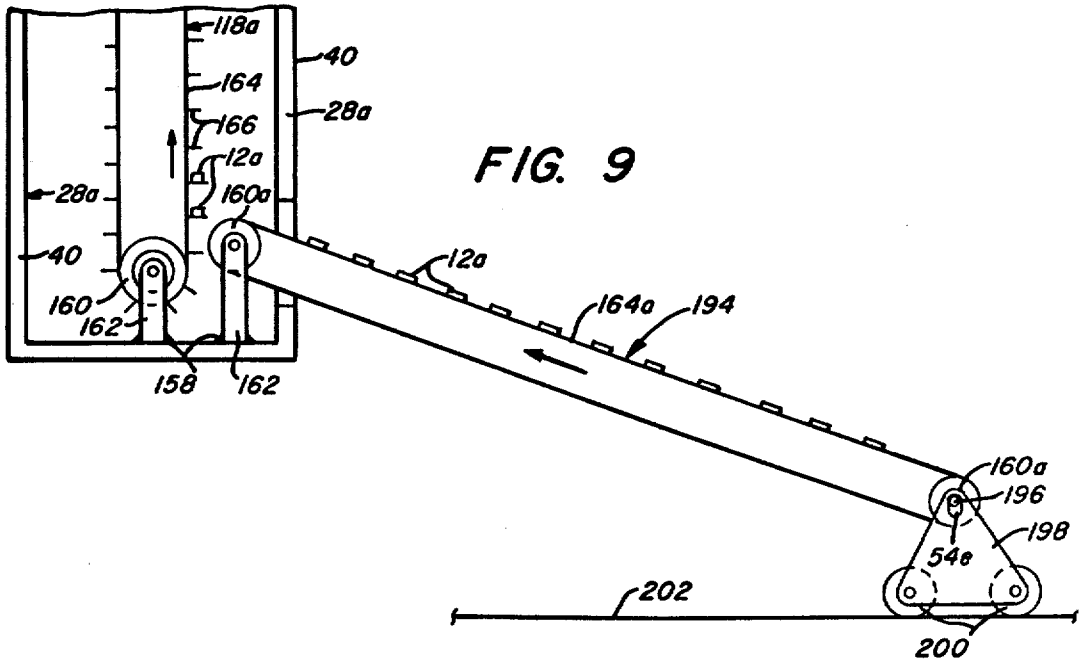
174
164
12a
204

FIG. 9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28a
166
12a
160a
28a
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160
162
158
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12a
164a
194
160a
196
198
54e
202
200

FIG. 10

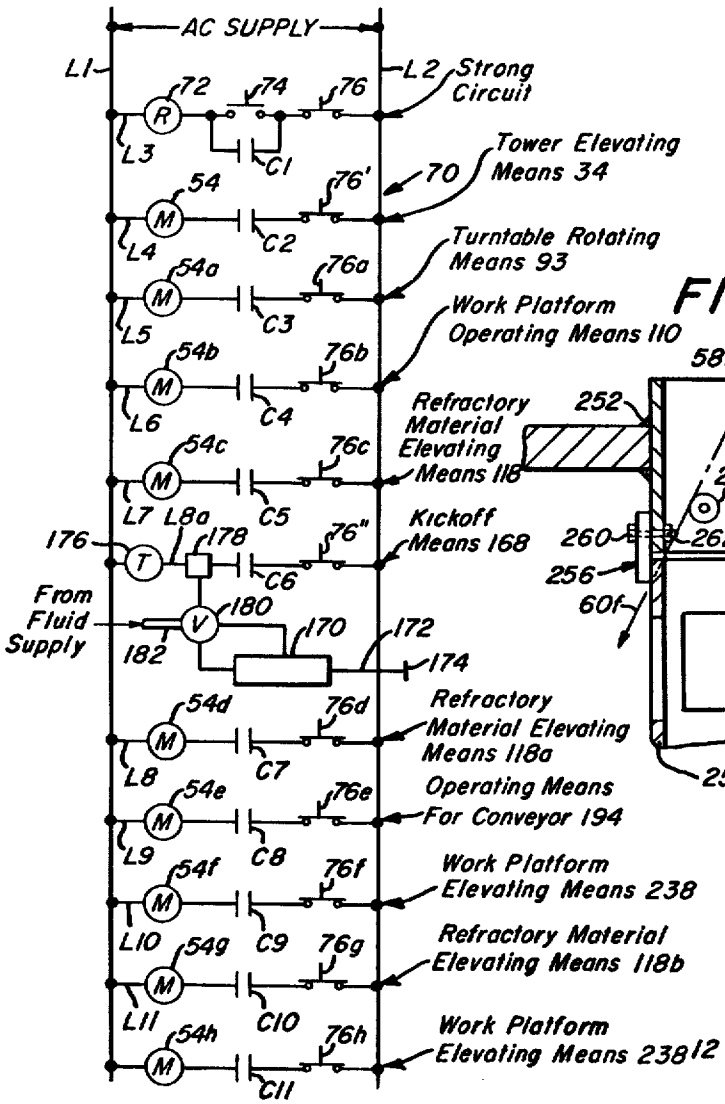
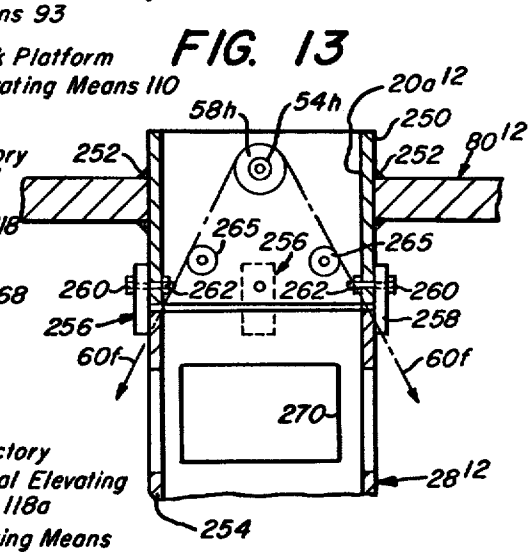

AC SUPPLY
L1
L2
Strong Circuit
72
74
76
R
L3
C1
Tower Elevating Means 34
70
54
76'
M
L4
C2
Turntable Rotating Means 93
54a
76a
L5
C3
Work Platform Operating Means 110
54b
76b
L6
C4
Refractory Material Elevating Means 118
54c
76c
L7
L8a
C5
Kickoff Means 168
176
T
178
76"
C6
From Fluid Supply
180
V
182
170
172
174
Refractory Material Elevating Means 118a
54d
76d
L8
C7
Operating Means For Conveyor 194
54e
76e
L9
C8
Work Platform Elevating Means 238
54f
76f
L10
C9
Refractory Material Elevating Means 118b
54g
76g
L11
C10
Work Platform Elevating Means 238
54h
76h
C11

FIG. 13


58h
54h
20a
12
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252
Refractory Material Elevating Means 118
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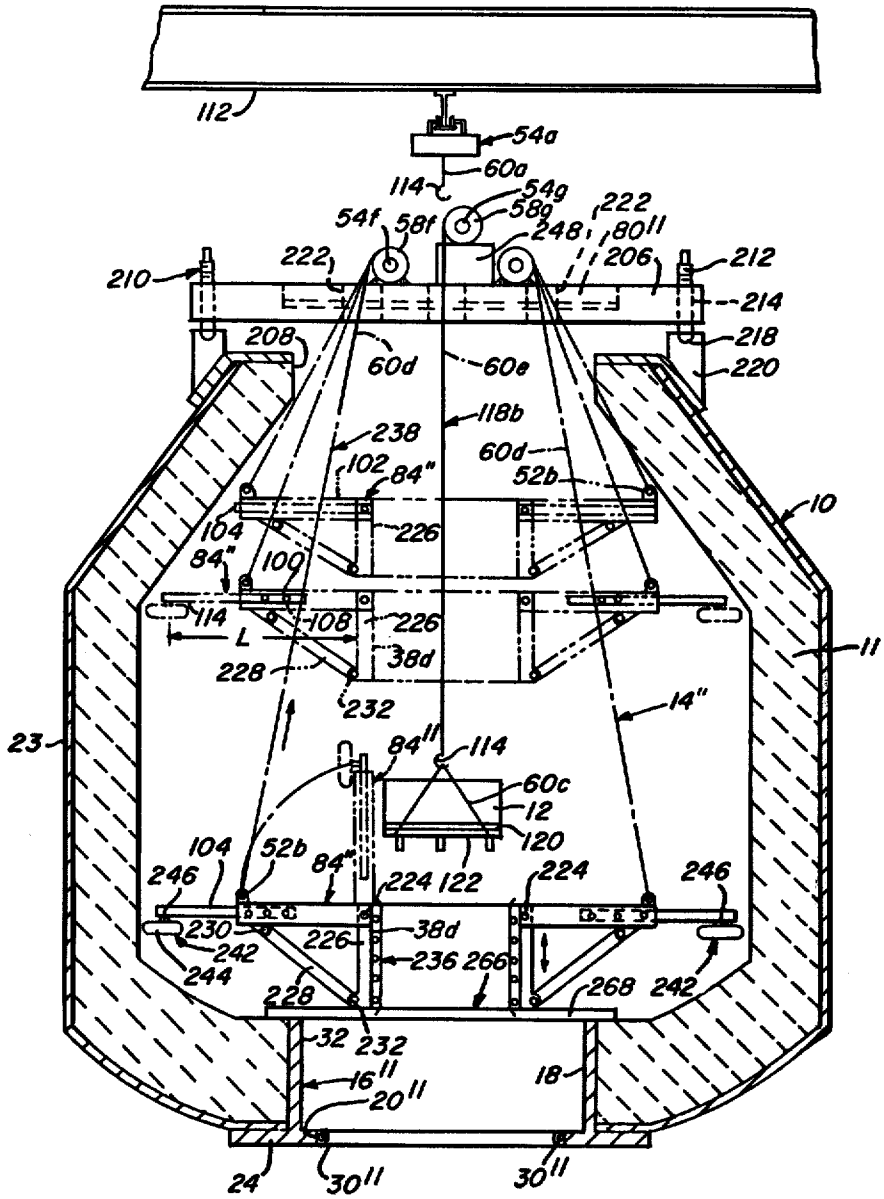
262
260
258
256
60f
60f
270
28
12
254

FIG. 11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60d
60e
220
118b
238
60d
102
84"
52b
10
104
226
84"
100
114
L
108
226
11
38d
228
232
14"
23
84"
114
60c
12
120
104
52b
84"
224
122
224
246
246
230
226
38d
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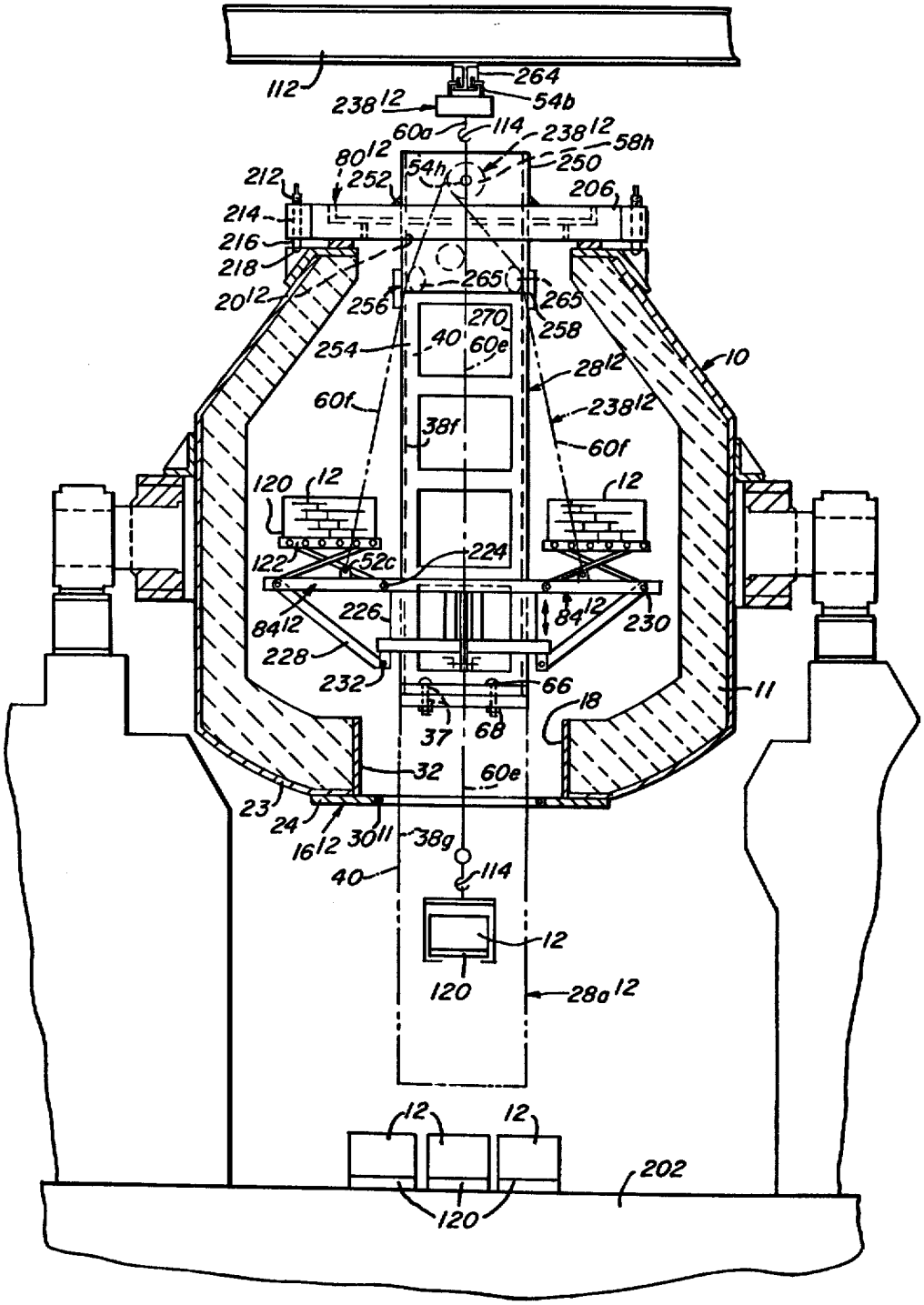
236
266
244
228
268
242
32
232
16"
18
20"
24
30"
30"

FIG. 12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258
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60e
28 12
10
60f
238 12
38f
60f
120
12
12
122
52c
224
84 12
226
84 12
230
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232
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18
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METHOD OF LINING A FURNACE

This is a division, of application Ser. No. 253,217, filed May 15, 1972, now U.S. Pat. No. 3,853,204.

BACKGROUND OF THE INVENTION

A quality basic oxygen process ("Q-BOP") furnace utilizes a bottom blown oxygen process developed recently in West Germany and in the United States. Q-BOP is a trade name of Eisenwerk-Gesellschaft Maximilianshutte GmbH (Maxhutte) of West Germany and the assignee of the present invention. The Q-BOP furnace utilizes a method of processing steel in which molten iron and other metallics are charged into the furnace. Oxygen, enveloped in a protective fluid stream, is blown through a tuyere or tuyeres located in the bottom of the furnace. Powdered lime, or other furnace additions together with the oxygen are blown through the tuyere while a protective fluid, which can be natural gas, propane, fuel oil or the like, envelops the oxygen and acts as a coolant to increase both the life of the bottom of the tuyere and the furnace bottom.

The tuyere or tuyeres in the bottom of a Q-BOP furnace are contained in a removable plug in the bottom of the furnace, which plug is removed therefrom by means of an apparatus of the type shown in U.S. Pat. No. 3,388,501 issued June 18, 1968, to Puhringer et al. After the bottom plug has been removed, the Q-BOP furnace is relined with a refractory material by the apparatus for and method of lining such furnaces herein disclosed.

I am aware of the following U.S. Patents relating to apparatus for and methods of lining furnaces.

U.S. Pat. No.	Inventor	Class	Issued
3,033,389	Abarotin et al	214/1	5/ 8/62
3,439,794	Park et al	198/83	4/22/69
3,601,245	Monroe	198/101	8/24/71
2,346,033	Jordan	304/12	4/ 4/44
3,236,397	Lakin	214/1	2/22/66
3,241,634	Prosser	182/144	3/22/66
3,285,390	Puxkandl et al	198/103	11/15/66
3,388,501	Puhringer et al	49/324	6/18/68
3,256,956	Puhringer	182/128	6/21/66
3,259,208	Behr	182/128	7/ 5/66
3,298,154	Behr et al	52/749	1/17/67
3,517,771	Mahringer et al	182/128	6/30/70

Puhringer U.S. Pat. No. 3,256,956

As shown in FIGS. 3–7, a carriage **20** aligns the frame **6** (carrying the first scaffold element **12**) with the opening in the bottom ring plate 2(FIG. 3). The frame **6** is raised adjacent to and attached to the flange **4** of the lower part **3** of crucible **1** (FIG. 4). The platform **18** on element **12** swings out (FIG. 5). In FIG. **6**, the second tubular element **13** is attached by key and slot to the first tubular element **12**.

The elevating of the elements **12,13** is accomplished by rack **11** on towers **12,13** and pinion **14,14'** on collar **6** and the material by the winch **16** and rope **17** (FIG. **1**).

Behr U.S. Pat. No. 3,259,208

A main telescoping piston **10** raises the main (expandable) work platform **8** through the opening **3** in the converter **1**. Bricks are fed through passage **9** (FIG. **5**) in platform **8**. An auxiliary work platform **6** is

mounted on supports **7** upstanding from main platform **8**, has a brick opening **12** (FIG. **6**) and is used to line the top portion **11** of the converter **1** (FIG. **6**).

Behr et al U.S. Pat. No. 3,298,154

A working stage **1** is inserted into the converter **2**, carries a rotatable turntable **3** rotatable on balls **4** and has a block opening **12** which registers with a like opening in the turntable **3** to permit the elevator **4** to deliver a stone **14** onto a first carriage movable on rails **5** on the turntable **3**. A lifting device **8** is mounted on a second carriage **7** movable on rails **6'** on the first carriage **6**.

The apparatus moves the stone **14** from the position shown in FIG. **1** to the "in-place" position shown in FIG. **2**.

Mahringer et al U.S. Pat. No. 3,517,771

A support platform **50** has a travel frame **2** movable on wheels **4** on the ground **5** (FIG. **1**) so that a work platform **7** can be inserted into the converter **1** and elevated on telescoping lift rods **8,9,10**, inner guides **8',9',10'**, (supported by brackets **15,16,17** on top wall of the work platform **50**) and lower guides **12,13,14**. An elevator **23** reciprocates by its rollers **25,26** on telescoping outer guides **19,20**, inner guides **19',20'** and lower guides **21,22** (FIG. **1**) and through opening **27** in work platform **7** (FIG. **2**). A collapsible winch **28** on work platform **7** operates the elevator **22**.

OBJECTS OF THE INVENTION

It is the general object of this invention to avoid and overcome the foregoing and other difficulties of and objections to prior art practices by the provision of an improved apparatus for and methods of lining a furnace, which apparatus and methods are:

a. simple and rugged in construction;
b. capable of a long maintenance-free operational life;
c. are efficient and economical in operation; and
d. reduce the normal down time of the furnace due to relining of the inner lining thereof with a refractory material.

BRIEF SUMMARY OF THE INVENTION

The aforesaid objects of this invention and other objects which will become apparent as the description proceeds are achieved by providing improved apparatus for and methods of lining a furnace, provided with a bottom aperture in the furnace bottom, with an inner lining of a refractory material.

I. The preferred embodiment of the apparatus has a support member secured to the furnace in registry with the bottom aperture for guiding the apparatus through the bottom aperture and such support member is provided with a tower aperture. A first tower is adapted to pass through the tower aperture in the support member and is provided with a refractory material aperture. Tower elevating means are on one member of the support member and the first tower, are connected to the other member of the support member and the first tower, and are operable to raise the first tower through the tower aperture in the support member. A turntable is rotatable on the top of the first tower and is provided with a second refractory material aperture in registry with the refractory material aperture in the first tower. A work platform is mounted on the turntable, which work platform is provided with a third refractory mate-

rial aperture, and is movable on the turntable from a storage position on the turntable where the work platform passes through the tower aperture in the support member, to a work position where the work platform extends beyond the turntable to enable a workman to stand on the work platform. Refractory material elevating means are mounted on the work platform, are engageable with the refractory material, and are operable to raise the refractory material through the refractory material aperture in the first tower, the second refractory material aperture in the turntable, and the third refractory material aperture in the work platform into alignment with the work platform so that the refractory material can be transferred to the work platform.

II. An alternative embodiment of the apparatus has a table support member secured to the furnace adjacent a top aperture of the furnace. The turntable is rotatable on the table support member and is provided with work platform elevating means clearance apertures. The work platform is movable through the bottom aperture in the furnace while it is in the storage position and is then further movable from the storage position to a work position where a workman may stand on the work platform. The work platform is provided with a refractory material aperture. Work platform elevating means are on one member of the turntable and the work platform, extend through the table support member, and are connected to the other member of the turntable and the work platform for moving the work platform through the bottom aperture in the furnace to a desired work position within the furnace. Refractory material elevating means extend through the table support member and are connectable to the refractory material for moving the refractory material through the refractory material aperture in the work platform so that the refractory material can be transferred from the refractory material elevating means to the work platform.

III. The preferred method of lining a furnace includes the steps of:

a. securing a support member to the bottom of the furnace in registry with a bottom aperture in the furnace;

b. moving a work platform mounted on a turntable, which turntable is rotatable on the top of the first tower, through a tower aperture in the support member to a desired work position within the furnace;

c. moving the work platform from a storage position on the turntable, where the work platform passes through the tower aperture in the support member, to a work position where the work platform extends beyond the turntable to enable a workman to stand on the work platform;

d. elevating the refractory material through a refractory material aperture in the first tower, a second refractory material aperture in the turntable and a third refractory material aperture in the work platform into alignment with the work platform so that refractory material can be transferred to the work platform;

e. transferring the refractory material to the work platform;

f. rotating the turntable and the work platform to align the work platform with an inner portion of the furnace where the inner lining of the refractory material is to be applied; and

g. applying the refractory material to the inner portion of the furnace.

IV. An alternative method of lining the furnace includes the steps of:

a. securing a table support member to the furnace adjacent a top aperture in the furnace;

b. moving the work platform through a bottom aperture in the furnace to a work position within the furnace;

c. moving the work platform from a storage position where the work platform passes through the bottom aperture in the furnace to a work position where a workman is able to stand on the work platform;

d. moving the refractory material through a refractory material aperture in the work platform to align the refractory material with the work platform so that the refractory material can be transferred to the work platform;

e. transferring the refractory material to the work platform;

f. rotating the work platform and the turntable on the table support member to align the work platform with an inner portion of the furnace where the inner lining of the refractory material is to be applied; and

g. applying refractory material to the inner portion of the furnace.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

For a better understanding of this invention, reference should be had to the accompanying drawings wherein like numerals of reference indicate similar parts throughout the several views and wherein:

FIG. **1** is a diagrammatic side elevational view partially in section of a preferred embodiment of the apparatus for lining a furnace and showing the furnace provided with a bottom aperture, a support member secured to the furnace in registry with the bottom aperture for guiding the apparatus through such bottom aperture and provided with a tower aperture; a first tower adapted to fit through a tower aperture in the support member and provided with a refractory material aperture, a tower elevating means on the support member and connected to the first tower and operable to raise the first tower through the tower aperture in the support member; a turntable rotatable on the top of the first tower and provided with a second refractory material aperture in registry with the refractory material aperture in the first tower; work platforms mounted on the turntable, each of which work platforms is provided with a third refractory material aperture, and is movable on the turntable from a storage position on the turntable where the work platform passes through the tower aperture in the support member, to a work position where the work platform extends beyond the turntable to enable a workman to stand on the work platform; and refractory material elevating means mounted on the work platforms, engageable with the refractory material and operable to raise the refractory material through the refractory material aperture in the first tower, the second refractory material aperture in the turntable and the third refractory material aperture in the work platforms into alignment with the work platforms so that the refractory material can be transferred to one of the work platforms;

FIG. **2** is a horizontal sectional view taken along the line **2—2** of FIG. **1** in the direction of the arrows and showing the work platforms mounted on the first tower, the refractory material supported by a pallet, which pallet in turn is carried by a conveyor section, the conveyor section in alignment with a conveyor means on the work platform and secured to the conveyor means

by locking means and showing also the work platforms in the extended work position;

FIG. 3 is a horizontal sectional view taken along the line 3—3 of FIG. 1 in the direction of the arrows and showing a cross section of the first tower, the tower elevating means for raising the first tower, the pallet guide means mounted on the inside of the first tower, the tower roller guide means mounted on the support member and a ladder mounted in one corner of the interior of the first tower and surrounded by a ladder cage;

FIG. 4A is a fragmentary vertical sectional view taken along the line 4A—4A of FIG. 1 in the direction of the arrows and showing the connecting means between the frame of the first tower and the cable of the first tower elevating means;

FIG. 4B is a fragmentary side elevational view taken along the line 4B—4B of FIG. 4A in the direction of the arrows;

FIG. 5A is a horizontal sectional view taken along the line 5A—5A of FIG. 1 in the direction of the arrows and showing diagrammatically the turntable rotatable upon the first tower, and the drive means for rotating continuously the turntable at a speed of about 30 rpm;

FIG. 5B is a vertical sectional view taken along the line 5B—5B of FIG. 5A in the direction of the arrows and showing the thrust bearing between the turntable and the first tower, which thrust bearing takes thrust in a vertical and horizontal direction;

FIG. 6 is a fragmentary side elevational view taken along the line 6—6 of FIG. 2 in the direction of the arrows and showing an auxiliary elevating means on one of the work platforms for elevating the refractory material (carried by a pallet) and the conveying means on the work platform for supporting the pallet and for eliminating bending by a workman to pick up the refractory material;

FIG. 7 is a view similar to FIG. 1 of an alternative embodiment of the apparatus showing a second tower secured to the bottom of the first tower; the tower elevating means connected to the second tower, second work platforms secured to the bottom of the second tower; an alternative embodiment of the refractory material elevating means which is operable to convey a single predetermined amount of the refractory material (such as a single brick) from the second work platforms into alignment with the first work platforms; kick off means mounted on the work platforms for removing the refractory material or single brick from the refractory material elevating means onto the work platforms; material feeding means on the work platforms movable with respect to such work platforms and for feeding the single brick, when such single brick is adjacent the work platforms to a predetermined position on one of the work platforms; wiping means on the work platforms extending into the rotary path of movement of the single brick on the material feeding means to engage and cause the single brick to transfer from the material feeding means to one of the work platforms; brick mason stands dependong from the work platforms to eliminate bending of the workman to pick up the refractory material or single brick; and other auxiliary elevating means on the second work platforms for elevating the refractory material or bricks above the second work platforms to eliminate bending of the workman to pick up the refractory material;

FIG. 8 is a horizontal sectional view taken along the line 8—8 of FIG. 7 in the direction of the arrows and showing the work platforms; the brick mason stands depending from the work platforms, the refractory material elevating means operable to elevate a single brick from the lower or second work platforms; the kick off device; the rotatable materkal feeding means on the turntable; the wiper means mounted on the upper work platforms and material chutes for guiding the single brick from the wiping means onto work platforms and breaking off the material chutes adjacent the inner ends of the work platforms for clarity;

FIG. 9 is a fragmentary side elevational view partially in section of the lower portions of the second tower, and the refractory material elevating means for conveying a single brick from the second or lower work platforms into alignment with the upper work platforms and showing a second material feeding means connected at one end to the bottom of the refractory material elevating means and adapted to feed the single bricks to the bottom of the refractory material elevating means as the first tower and the second tower are raised by the tower elevating means;

FIG. 10 is a diagrammatic wiring diagram showing the controls for operating the motors for the turntable, for the tower elevating means, for a first hoist for operating the refractory material elevating means, for an auxiliary or second hoist affixed to the building framework above the top aperture of the furnace; and for an indexing motor for alternatively indexing the turntable of the apparatus and the like;

FIG. 11 is a view similar to FIG. 1 of another alternative embodiment of the apparatus and showing a table support member secured to the furnace adjacent the top aperture of the furnace; a turntable rotatable on the table support member and provided with work platform elevating means clearance holes or apertures; the work platforms movable through the bottom aperture in the furnace to a desired work position within the furnace; refractory material elevating means on the turntable, extending through the table support member, and connectable to the refractory material (mounted on a pallet) for moving the refractory material through the refractory material aperture in the work platform so that the refractory material can be transferred from the refractory material elevating means to the work platform;

FIG. 12 is a view similar to FIG. 11 of another alternative embodiment of the apparatus and showing a tower head secured to the turntable (rotatable on the table support member); a first tower secured to the tower head; a second tower connected to the lower portions of the first tower; and the work platforms vertically reciprocable on both the first tower and the second tower; and

FIG. 13 is a fragmentary enlarged vertical sectional view showing the means of securing the tower head to the turntable, as by welding or the like, and the means for connecting the first tower to the tower head.

Although the principles of this invention are broadly applicable to apparatus for and methods of lining a crucible or converter type furnace, this invention is adapted for use in conjunction with a Q-BOP type furnace, and hence it has been so illustrated and will be so described.

DETAILED DESCRIPTION

With specific reference to the form of this invention illustrated in the drawings and referring particularly to FIG. 1, an apparatus for lining a furnace 10 (of the

Q-BOP type) with an inner lining **11** (FIG. 1) of a refractory material **12**, such as refractory brick or the like, is indicated generally by the reference numeral **14** (FIG. 1).

Apparatus 14 (FIGS. 1–6, 10)

The apparatus **14** (FIGS. **1–6, 10**) has a support member **16** (FIGS. **1,3**) secured to the furnace **10** in registry with a bottom aperture **18** (FIG. 1) for guiding the apparatus **14** through such bottom aperture **18** in the furnace **10.** Such support member **16** is also provided with a tower aperture **20** (FIGS. 1–3).

Support Member 16

This support member or collar **16** has a lower flanged ring portion **22** (FIG. 1), which portion **22** is secured through its upper flange **24** (FIG. 1) to the bottom portions of the shell **23** (FIG. 1) of the furnace **10** as by a plurality of bolts **26** (FIG. 1). For the purpose of guiding the path of movement of a first tower **28** (FIGS. 1–3) through the tower aperture **20** in the support member **16,** the support member **16** is provided with a plurality of tower guide rollers **30** (FIGS. 1 and 3) mounted on the support member **16** by brackets **31** (FIG. 3). The means utilized to define the end of the refractory lining **11** on the bottom of the furnace **10** adjacent the bottom aperture **18** in the furnace **10** is a form means, such as a form ring **32** (FIG. 1) or the like, projecting upwardly from the upper flange **24** of the support member **16.** As shown in FIGS. **1** and **3,** a tower elevating means **34** (FIGS. **1,3, 4A,4B**) is mounted on the support member **16** and such support member **16** and first tower **28** are provided with registering tower locking apertures **36** (FIG. 1) for use in securing the first tower **28** to the support member or collar **16** when a second tower **28*a*** (FIG. 1) is secured to the first tower **28** and the tower elevating means **34** is disconnected from the first tower **28** and connected to the second tower **28*a*** as hereafter explained.

The First Tower 28 (FIGS. 1–3, 5A, 5B)

This first tower **28** (FIGS. **1–3, 5A,5B**) is, of course, adapted to pass through the tower aperture **20** in the support collar **16.** Such first tower **28** is provided with a refractory material aperture **38** (FIG. 3). As shown in FIGS. **1–3,** such first tower **28** is a generally open-ended box-like structure having an outer frame **40** (FIGS. **1–3**), suitably formed of angles secured together as by welding or the like, and is provided with a plurality of intersecting horizontal and generally zig-zag plate members **42** (FIG. 1) for reinforcing each generally open face of the frame **40.** The means utilized to define the refractory material aperture **38** in the first tower **28,** shown particularly in FIGS. **1** and **3,** comprises a plurality of guides **44** (FIGS. **1,3**) with guides **44** form a generally rectangular or square cross section to provide the refractory material aperture **38** and a plurality of three supporting plates **46** (FIG. 3) extending as shown in FIG. 3, from three corners of the guides **44** to adjacent corners of the outer frame **40** of the first tower **28.** For the purpose of permitting guarded access to the interior of the first tower **28,** a ladder **46** (FIG. 3) is secured as by welding or the like, to the left hand end side of the outer frame **40** of the first tower **28** and such ladder **46** is surrouned by a ladder cage **50** (FIG. 3).

Such first tower **28** is secured to the tower elevating means **34** at **52** (FIGS. **1,4A,4B**).

Tower Elevating Means 34 (FIGS. 1, 3, 4A, 4B)

Such tower elevating means **34,** best shown in FIGS. **1** and **3,** has a plurality of motors **54** (in this case, four, FIGS. **1,3**) mounted on brackets **56** (FIG. 3) secured to the support member or collar **16.** Such hoists **54** each drive an individual drum **58** (FIG. 3) from which a cable **60** (FIGS. **3, 4A, 4B**) depends and is connected as shown in FIGS. **4A** and **4B** at the connection point **52** by means of a clevis or the like **62** (FIGS. **4A, 4B**) secured on the end of the cable **60,** as by welding or the like. Such clevis **62** is secured to a lug **64** (FIGS. **4A, 4B**) extending from the tower frame **40** of the tower **28** by means of a bolt **66** and nut **68.**

The control means **70** for operating the tower elevating means **34** and other operating means hereinafter described is shown in FIG. **10.**

Control Means 70 (FIG. 10)

This control means **70** (FIG. **10**) has a pair of lines **L1** and **L2** extending from a suitable source of voltage indicated in FIG. **10** by the legend "AC Supply" to a branch line **L3** extending through a relay **72,** a normally open manually operated starting switch **74** and a normally closed manually operated stop switch **76.** The holding means utilized to maintain energization of the circuit through lines **L1,L2** is a normally open holding contact **C1** disposed in parallel about the normally open manually operated starting switch **74** so that when such starting switch **74** is manually closed, the relay **72** is energized and the normally open holding contact **C1** is closed, thereby maintaining a closed circuit through the relay **72** from the AC source of supply.

Simultaneously therewith upon energization of the relay **72,** the drive motor **54** for each of the hoists of the tower elevating means **34** are energized by closure of a second normally open holding contact **C2** of the now energized relay **72** by the connecting line **L4** which is disposed in parallel between the supply lines **L1** and **L2** with respect to the branch line **L3.** The means utilized to deenergize the drive motors **54** for the hoists of the tower elevating means **34** and the hoists **54** themselves is, of course, the manually operated normally closed stop switch **76** which upon manual opening thereof deenergizes the control means **70** for the hoist motors **78** of the tower elevating means **34.**

It will be understood that a manually operated normally closed stop switch **76** can be installed in the line **L4** to deenergize the hoist motors **54** for the tower elevating means **34** without deenergizing the relay **72.**

A turntable **80** (FIGS. **1,2,5A,5B**) is mounted on the top of the first tower **28** (FIG. 1) and is rotatable continuously at about **30** rpm on such tower **28** or indexable with respect to the tower **28.**

Turntable 80 (FIGS. 1, 2, 5A, 5B)

This turntable **80** (FIGS. **1,2,5A,5B**) is provided with a second refractory material aperture **38*a*** (FIGS. **1,5A,5B**) disposed in registry with the refractory material aperture **38** in the first tower **28.** The turntable **80,** shown partcularly in FIGS. **1,5A** and **5B,** is rotatable on the top of the first tower **28** by means of a thrust bearing **82** (FIG. **5B**) disposed between the tower frame **40** of the first tower **28** and work platforms **84** (FIGS. **1,2,5B**).

This thrust bearing **82** shown particularly in FIGS. **5A** and **5B** takes thrust during the operation of the apparatus **14** in both a vertical and horizontal direc-

tion. Such thrust bearing **82** has an upper portion **86** (FIG. **5B**) on the turntable **80** adapted to receive a plurality of roller bearings **88** (FIG. **5B**) in a cavity **89** (FIG. **5B**) defined by the upper portion **86** and a lower portion **90** (FIG. **5B**) of the thrust bearing **82** upstanding from the tower frame **40** of the first tower **28** (FIG. **5B**) and secured to the first tower **28** as by welds **91** (FIG. **5B**) or the like. After the ball bearings **88** have been inserted into the cavity **89**, a removable ring type plate **92** (FIG. **5B**) is secured, as by bolts **66** or the like, to the upper portion **86** of the thrust bearing **82** to retain such ball bearings **88** within the cavity **89**.

The turntable drive means **93** (FIG. **5A**) for continuously rotating the turntable **80** at a relatively slow speed, such as about 30 rpm, with respect to the first tower **28** has a turntable drive motor **54***a* (FIGS. **5A,10**) mounted by means of brackets **94** (FIG. **5A**) on the side of the tower frame **40** of the first tower **28** and has its drive shaft **96** (FIG. **5A**) provided with a rotating pinion gear **98** (FIG. **5A**) engageable with a girth gear **100** (FIGS. **5A,5B**) on the periphery of the turntable **80**.

The control means **70** has, as shown in FIG. **10**, a line L5 disposed in parallel with the lines L3,L4 between the supply lines L1,L2 to energize the turntable rotating motor **54***a* upon closure of the normally open holding contact C3 of the relay **72** in the line L5.

Alternatively, it will be understood by those skilled in the art that a conventional indexing mechanism of the type shown in U.S. Pat. No. 2,569,852 issued to J. Greene on Oct. 2, 1951, (not shown) may be interposed between the pinion gear **98** (FIG. **5A**) and the motor **54***a* (FIGS. **5A,10**) on the drive shaft **96** for the purpose of intermittently indexing the turntable **80** a predetermined number of degrees, such as about 30°, for each short period of time, such as about 30 seconds.

The work platforms **84** (FIGS. **1,2,5B,6**) are mounted on the turntable **80** and disposed thereon in quadrential spaced relation.

Work Platforms **84** (FIGS. **1, 2, 5B, 6**)

Each work platform **84** (FIGS. **1,2,5B,6**) is mounted on the turntable **80** as by welds **91** (FIG. **5B**) or the like, is provided with a third refractory material aperture **38***b* (FIG. **2**) and is movable on the turntable **80** from a vertical storage position (not shown in FIGS. **1** and **2**) where each work platform **84** passes through the tower aperture **20** in the support member or collar **16**, to a work position shown in FIGS. **1** and **2** where each work platform **84** extends beyond the turntable **80** to enable a workman (not shown) to stand on such work platform **84**.

Each of the work platforms **84** has an inner portion **102** (FIGS. **1,2**) extending from the turntable **80**, which inner portion **102** telescopically surrounds an outer portion **104** (FIGS. **1,2**) of the work platform **84** so that such outer platform **104** may be disposed a predetermined or desired distance D (FIG. **1**) from the extremities of the inner portion **102** of the work platform **84**. The work platform locking means utilized to lock the inner portion **102** to the outer portion **104** of the work platform **84** my suitably comprise a plurality of registering holes **106** (FIG. **1**) in both the inner portions **102** and the outer portion **104** of such work platform **84**. A locking means, such as a pin **108** (FIG. **1**) may be inserted into such registering holes **106** in the inner portion **102** and in the outer portion **104** of the work platform **84**.

It will be appreciated from a consideration of FIG. **1** that as the work platform approaches the upper portions of the refractory lining **11** in the furnace **10**, the outer portion **104** of each work platform **84** is retracted inwardly from the original distance D to the smaller distance D_1 (FIG. **1**) with respect to the inner portion **102** of the work platform **84**.

A work platform operating means **110** (FIG. **1**) is used to move each of the work platforms **84** from the above mentioned vertical storage position (not shown) on the turntable **84** to the work position shown in FIGS. **1,2**.

Work Platform Operating Means **110** (FIG. **1**)

This work platform operating means **110** (FIG. **1**) may take the form of a hoist motor **54b** depending from a beam **112** (FIG. **1**) of the building in which the furnace **10** is housed. A plurality of four cables **60***a* (only one cable **60***a* being shown in FIG. **1**) having hooks **114** are lowered so that each hook **114** engages the outer portion **104** of each work platform **84** and moves such work platforms **84** about the pivot **116** (FIGS. **1** and **2**) when the hooks **114** and the cables **60***a* are elevated by the hoist **54***a* from the work position shown in FIG. **1** to a vertical storage position (not shown) where such work platforms **84** are substantially perpendicular to the turntable **80** (not shown).

Referring again to the control means **70** in FIG. **10**, another parallel line L6 connects the hoist motor **54***b* for the hoist of the work platform operating means **110** through the normally open holding contact C4 of the relay **72** so that when such relay **72** is, of course, energized, the normally open holding contact C4 closes and the motor **54***b* for the hoist of the platform operating means **110** is energized.

A refractory material elevating means **118** (FIGS. **1,10**) is mounted on a platform head **117** (FIG. **1**) the work platforms **84**.

Refractory Material Elevating Means **118** (FIGS. **1,10**)

Such refractory material elevating means **118** (FIGS. **1,10**) is engageable with the refractory material **12**, suitably a pile of bricks **12a** (FIGS. **1,6**), mounted on a pallet **120** (FIGS. **1,6**), which pallet **120** carries a conveyor roller section **122** (FIGS. **1, 2,6**). The refractory material elevating means **118** has a hoist motor **54***c* (FIGS. **1,10**) and utilizes a cable **60***c* (FIG. **1**) extending from a drum **58***c* (FIG. **1**) to a hook **114** (FIG. **1**). The hook **114** is engageable with a plurality of cables **60***c* (FIG. **1**) extending upwardly from the corners of the conveyor roller section **122** and gathered together to form a loop engageable with the hook **114** on the hoist cable **60***c*.

As shown in FIG. **10**, the control means **70** has another parallel line L7 connecting the motor **54***c* for the hoist associated with the refractory material elevating means **118** to another normally open holding contact C5 of the relay **72** so that upon energization of the relay **72**, the motor **54***c* for the refractory material elevating means **118** is energized.

Upon energization of the motor **54***c* for the hoist associated with the refractory material elevating means **118**, the refractory material **12** on the pallet **120** and the conveyor roller section **122** are raised through the refractory material aperture **38** in the first tower **28**, the second refractory material **38***a* in the turntable **80** and the third refractory material aperture **38***b* in the work platforms **84** so that the refractory material **12**

can be transferred to an individual work platform **84** on a conveyor means **124** (FIGS. **1,2**).

Conveyor Means 124 (FIGS. 1,2)

As shown in FIGS. **1** and **2**, each work platform **84**, when in the extended work position shown in FIGS. **1** and **2**, is provided with a conveyor means **124**, such as a conveyor section **126**, which conveyor section **126** (FIGS. **1,2**) is registerable with the conveyor roller section **122** on the pallet **120** when the refractory material elevating means **118** raises such refractory material **12**, pallet **120** and conveyor roller section **122** to the transfer position shown in FIG. **1**. The conveyor locking means utilized to lock the conveyor section **126** on the work platform **84** to the conveyor roller section **122** is a door-type slide lock **128** (FIG. **2**) having a slide **130** (FIG. **2**) retained in a slide holder **132** (FIG. **2**) on the conveyor section **126** and movable into engagement with a slide holder **133** (FIG. **2**) mounted on the end portions of the conveyor roller section **122** on the pallet **120**. This locked position for transferring the pallet **120** and the refractory material **12** to a conveyor section **126** on a work platform **84** is shown in FIG. **2**. In such locked position shown in FIG. **2**, the pallet **120** and the refractory material **12** are rolled off the conveyor roller section **122** onto the conveyor section **126** on the individual work platform **84** to a work position on such work platform **84** thereby completing the delivery of the refractory material **12** on the pallet **120** from adjacent the third refractory material aperture **38***b* in the work platform **84** to the work position shown in FIG. **1**.

SUMMARY OF THE PREFERRED EMBODIMENT OF THE APPARATUS 14 (FIGS. 1–6,10)

From the above description of the apparatus **14** (FIGS. **1–6,10**) it will be apparent the present invention contemplates the provision of guide means such as the tower guides **42** (FIGS. **1,2**) within the first tower **28** to guide the refractory material **12** through the refractory material aperture **38** in the first tower **28** (FIG. **2**). The tower elevating means **34** is either mounted on the support member or collar **16** as shown in FIGS. **1** and **2** or is mounted on the first tower **28** (not shown). As shown in FIG. **2**, the conveyor locking means, such as the door type slide lock **128** shown in FIG. **2** may be disposed on one member of the conveyor roller section **122** for carrying the pallet **120** and the conveyor section **126** to lock the other member of the conveyor roller section **122** and the conveyor section **126** to the one member. Connecting means, such as the cable **60**, clevis **62** and the lug **64** on the frame **40** of the first tower connects the tower elevating means **34** to the first tower **28** (FIGS. **4A,4B**).

Auxiliary Elevating Means 136 (FIG. 6)

Referring now to FIG. **6**, it will be understood that auxiliary elevating means **136** may be disposed on each of the work platforms **84** for elevating the pallet **120** and the refractory material **12** carried thereby above the work platform **84** to eliminate bending of a workman (not shown) to pick up the refractory material **12**. In this embodiment, the conveyor section **126** is pivotally mounted at **138** (FIG. **6**) on scissored levers **140***a* and **140***b* (pivoted on each other at **142**). As shown in FIG. **6**, the lower portion of the lever **140***a* is pivoted on the work platform **84** at **144** while the lower end of the other scissored lever **140***b* has its lower end portion pivotably connected at **146** to a piston **148** of a hydraulic fluid cylinder **150** secured to the work platform **84** as by welds **152**.

In addition, it will be understood that form means, such as the form ring **32** or the like (FIG. **1**), are provided on the support member or collar **16** and extend into the bottom aperture **18** of the furnace **10** for defining the end of the refractory lining **11** adjacent the bottom of the furnace **10**.

As shown in FIG. **1**, tower locking means (such as the registerable locking apertures **36** in the support member or collar **16** and in the first tower **28** and the pin **54** extending through such registerable holes **36**) is disposed between the support member **16** and the first tower **28** to lock the first tower **28** to the support member **16**, thereby permitting removal of the connecting means, i.e., the cable **60**, clevis **62**, etc. (FIGS. **4A,4B**) between the tower elevating means **34** and the first tower **28** at **52**, so that such connecting means may later be reconnected to the second tower **28***a* at **52***a* (FIG. **1**).

Second Tower 28a (FIG. 1)

This second tower **28***a* (FIG. **1**) is similar in construction to the first tower **28** and is provided with another refractory material aperture **38***c* (FIG. **1**). Such second tower **28***a* is connected to the bottom of the first tower **28** by tower connecting means, such as bolts **66** (extending through holes **37** (FIG. **1**) in the two towers **28,28***a*) and nuts **68** (FIG. **1**) so that the refractory material aperture **38** in the first tower **28** registers with the other refractory material aperture **38***c* in the second tower **28***a*.

Thereafter, the connecting means shown in FIGS. **4A,4B** are connected to the second tower **28***a* at **52***a* (FIG. **1**).

Again as shown in FIG. **2**, the space between adjacent work platforms **84** (FIG. **2**) is covered or filled by a platform section **156** (FIG. **2**) thereby providing a continuous peripheral work space about the turntable **80**.

It will also be understood that the work platform operating means **110** (FIG. **1**) is connectable to each of the four work platforms **84** for moving each of the work platforms **84** between the storage position (not shown) and the work position shown in FIGS. **1,2**.

Further, the turntable **80** (FIGS. **1,2,5A,5B**) has a unique thrust bearing **82** (FIGS. **5A,5B**) which takes the thrust of the apparatus **14** both in a vertical and a horizontal direction as shown in FIGS. **5A** and **5B**.

ALTERNATIVE EMBODIMENTS

It will be understood by those skilled in the art that alternatively as shown in FIGS. **7–9**, the preferred embodiment **14** (FIGS. **1–6**) may be modified to form the alternative embodiment of the apparatus **14'**.

Second Work Platforms 84a (FIG. 7)

A series of second work platforms **84***a* (FIG. **7**) are secured as by welds **158** (FIG. **7**) or the like to the bottom of the second tower **28***a* for receiving the pallet **120***s* carrying the refractory material **12**. The refractory material elevating means **118***a* shown in FIG. **7** is operable to convey a single predetermined amount of the refractory material **12**, such as one brick **12***a* (FIGS. **8,9**) from these second work platforms **84***a* into alignment with the first work platforms **84** on the top of the first tower **28**.

Refractory Material Elevating Means **118***a* (FIGS. 7-9)

As shown in FIG. 7, the refractory material elevating means **118***a* has a pair of sprockets **160** (FIG. 7) mounted on bearings **161** (FIG. 7) in brackets **162** (FIGS. 7,9) extending from the frame portions **40** of the first tower **28** and the second tower **28***a*. An endless belt or chain **164** (FIGS. 7,8,9) provided with spaced carriers **166** (FIGS. 7,8,9) for elevating the single bricks **12***a* from a receiving position adjacent the lower portions of the refractory material elevating means **118***a* upwardly into alignment with one of the work platforms **84** on the top of the first tower **28** in the direction of the arrow shown in FIG. 7.

As shown in FIG. 7, the upper sprocket **160** of the refractory material elevating means **118***a* (FIG. 7) is driven by a shaft **165** (FIG. 7) extending from a motor **54***d* (FIGS. 7 and **10**). The control means **70** (FIG. **10**) utilizes another parallel line L8 to connect the motor **54***d* for the refractory material elevating means **118***a* through a normally open holding contact C7 of the relay **72** between the voltage supply lines L1 and L2.

Kick Off Means **168** (FIGS. 7,8,10)

Kick off means **168** (FIGS. **7,8,10**), such as a fluid cylinder **170** (FIGS. 7 and 8) mounted as by welds **158** (FIG. 7) to the bracket **162** has its piston **172** (FIGS. **1,8,10**) provided with a pusher **174** (FIG. **7,8,10**) for removing a single refractory brick **12***a* from a spaced carrier **166** on the refractory material elevating means **118***a* when such single brick **12***a* comes into alignment with the kick off means **168.**

The control means **70** for the kick off means **168** (shown in FIG. **10**) has another parallel line L8*a* connecting a timer **176** (FIG. **10**) through a solenoid **178** (FIG. **10**) and a normally open holding contact C6 of the relay **72** and another manually operated normally closed stop switch **76**[11] (FIG. **10**). At the appropriate timed interval, the timer **170** energizes the solenoid **178** to operate a valve **180** (FIG. **10**) to cause the fluid pressure in a supply line **182** (extending from a fluid source indicated by the legend "From Fluid Supply") to the left hand end (as viewed in FIG. **10** of the fluid cylinder **170**) to advance the piston **172** and the pusher **174** thereby causing the removal of a single brick **12***a* from an adjacent carrier **166** of the refractory material elevating means **118***a* (FIG. 7). Thereafter, after the removal of the single brick **12***a* by the kick off means **168,** the timer **176** causes retraction of the solenoid **178** thereby reversing the flow of fluid to the right hand end of the fluid cylinder **170** and causing retraction of the piston **172** and the pusher **174** carried thereby (FIG. **10**).

Material Guide Means **184** (FIGS. 7,8)

As shown particularly in FIGS. 7 and **8,** each of the work platforms **84** is provided with a material guide means, such as a telescoping or extendable chute **184** or the like for receiving the single brick **12***a* which has been fed by the kick-off means **168** onto a frusto conical rotatable material feeding means or table **186** (FIGS. 7 and **8**).

Material Feeding Means **186** (FIGS. 7,8)

This rotatable frusto conical inclined material feeding table **186** receives the single brick **12***a* from the carrier **166** of the refractory material elevating means **118***a* (FIG. 7) due to the timed operation of the kick-off means **168** and delivers such single brick **12***a* down its inclined surface until the brick is transported contiguous to a wiper means **188** (FIG. **8**). The material feeding table **186** is mounted on the rotatable work platforms **84** on the rotatable turntable **80** and rotates or indexes, as desired, with such turntable **80.**

Wiper Means **188** (FIGS. 7,8)

Each of the wiper means **188** (FIG. **8**) comprises a resilient arm **190** (FIG. **8**) mounted on an inside corner of each work platform **84** at **192.** Each such wiper arm **190** extends into the rotary path of movement of the single refractory brick **12***a* on the rotatable material feeding table **186,** engages the brick **12***a* and causes such brick **12***a* to transfer from the inclined surface of the material feeding table **186** onto the material chute **184** on the adjacent work platform **84** (FIG. **8**).

Auxiliary Elevating Means **136***a* (FIG. 7)

Also as shown in FIG. 7, auxiliary elevating means **136***a* of the type shown in FIG. **6** may be mounted on the second work platforms **84***a* secured to the bottom of the second tower **28***a* to elevate the refractory material **12** above the second work platforms **84***a* thereby eliminating bending of a workman (not shown) to pick up such refractory material **12.**

Second Material Feeding Means **194** (FIG. **9**)

Referring now to FIG. **9,** a second material feeding means or conveyor **194** is shown for feeding the refractory material **12** or single bricks **12***a* to the bottom of the refractory material elevating means **118***a* (FIGS. 7 and **9**). The left hand sprocket **160***a* (FIG. **9**) of the conveyor **194** is pivotably mounted on a bracket **162** (FIG. **9**) upstanding from the frame **40** of the second tower **28***a*.

The right hand sprocket **160***a* (FIG. **9**) of the conveyor **194** is pivotably mounted at **196** on a carriage **198** (FIG. **9**), which carriage **198** rides by means of wheels **200** (FIG. **9**) on the floor **202** of the building which houses the furnace **10.** As shown in FIGS. **9** and **10,** a motor **54***e* drives the right hand sprocket **160***a* and hence the conveyor belt or chain **7**⁄**8***a* in the direction of the arrow shown in FIG. **9.** As the bricks **12***a* fall off the end of the left hand sprocket **160***a* of the conveyor **194,** the bricks **12***a* are deposited on a carrier **166** of the refractory material elevating means **118***a* and transmitted upwardly in the direction of the arrow (FIG. **9**) as hereinbefore explained.

The control means **70** (FIG. **10**) has a line L9 connecting the motor **54***e* through contact C8 to switch **76***e*.

Brick Mason Stand **204** (FIGS. 7,8)

Referring again to FIGS. **7,8,** each of the work platforms **84** mounted on the turntable **80** may be provided with a removable fold-up type brick mason stand **204** which depends below each of the work platforms **84** thereby enabling a workman (not shown) to stand on such brick mason stand **204** to eliminate bending of the workman (not shown) to pick up the refractory bricks **12***a* (FIGS. 7 and **8**).

As shown in FIG. 7, a wood scaffold **205** may be mounted on the work platforms **84** for work on the top of the furnace **10.**

The hoist **54***a* (FIG. 7) can be used to move work platforms **84** between the work position (FIG. 7) and the storage position (not shown).

Alternative Apparatus 14^{11} (FIG. 11)

The apparatus 14^{11} shown in FIG. 11 for lining a furnace 10 with the innerlining 11 of the refractory material 12 has a table support member 206 (FIG. 11) secured to the furnace 10 adjacent a top aperture 208 (FIG. 11) in the furnace 10. For the purpose of levelling the table support member 206, the apparatus 14^{11} is provided with levelling means 210 (FIG. 11).

Levelling Means 210 (FIG. 11)

As shown in FIG. 11, a plurality of levelling screws 212 are threadable into suitable threaded holes 214 in the table support member 206 and have their projecting ends 216 engageable in sockets 218 provided in brackets 220 (FIG. 11) upstanding from the outer shell 23 of the furnace 10.

In the embodiment of FIG. 11, the turntable 80^{11} is rotatable on the table support member 206 in the manner described with respect to the apparatus 14 shown in FIGS. 1–6, 10 and 14^{7} (FIGS. 7–9,10) and such turntable 80^{11} is provided with work platform elevating means clearance apertures 222 (FIG. 11).

The work platforms 84^{11} (FIG. 11) are again movable through the bottom aperture 18 in the furnace 10 while they are in the vertical storage position (shown in dotted lines in FIG. 11) and are then further movable as hereinbefore described with respect to the apparatus 14 shown in FIGS. 1–6,10 and 14^{7} (FIGS. 7–10) to the work position shown in solid lines in FIG. 11 to enable a workman (not shown) to stand on the work platforms 84^{11}. Each of the work platforms 84^{11} are pivotably mounted at 224 (FIG. 11) on a frame 226 (FIG. 11) of such work platform 84^{11}. Supporting rods 228 (FIG. 11) are fixedly and pivotably connected at 230 (FIG. 11) to the outer end of the outer section 104 of each work platform 84^{11} and have their lower portion pivotably and removably secured by means of a removable pin 232 to the lower portion of the frame 226 of each work platform 82^{11}.

In addition, each work platform 84^{11} is provided with a refractory material aperture 38*d*, which aperture 38*d* (FIG. 11) has mounted on the walls thereof pallet guide means suitably a plurality of rollers 30^{11} similar to the tower guide rollers 30 shown in FIGS. 1 and 2.

Work Platform Elevating Means 238 (FIG. 11)

A work platform elevating means 238 (FIG. 11) comprises a plurality of hoists driven by motors 54*f* (FIGS. 10 and 11). Each hoist has its cable 60*d* (FIG. 11) extending through the clearance holes 222 in the table support member 206 (FIG. 11) to a connecting means 52*b* (FIG. 11) of the type shown in FIGS. 4A and 4B and indicated diagrammatically in FIG. 11 at 52*b*.

After removal of the pin 232 (FIG. 11) and energization of the relay 72, closure of its normally open holding contact C9 (FIG. 10) energizes the motor 54*f* for the hoist of the work platform elevating means 238. This motor 54*f* (FIGS. 10,11) is mounted on the turntable 80^{11} to cause the hoists (and the drums 58*f*, FIG. 11, driven by the hoist motors 54*f*) to move each of the work platforms 84^{11} from the solid line working position shown in FIG. 11 to the dotted line position or vertical position shown in FIG. 11.

It will be understood that the work platform elevating means 238 may be mounted on either the turntable 80^{11} or the work platforms 84^{11}, will extend through the clearance holes 222 in the table support member 206 and may be connected to the other member of the turntable 80^{11} and the work platforms 84^{11} for moving the work platforms 84^{11} (while in the storage position shown in the vertical dotted line position of FIG. 11) through the bottom aperture 18 in the furnace 10 to a desired work position within the furnace shown in the various solid line positions of FIG. 11. It will also be appreciated from a consideration of FIG. 11 that each work platform 84^{11} is provided with an inner portion 102 telescopically surrounding an outer portion 104, the outer portion 104 being extendable with respect to the inner portion 102.

Platform Guide Means 242 (FIG. 11)

A platform guide means 242 (FIG. 11) is suitably a plurality of rubber guide wheels 244 mounted by means of a shaft 246 on the end of outer portion 104 of each work platform 84^{11}. Each wheel 244 is engageable in the embodiment shown in FIG. 11 with the refractory lining 11 of the furnace 10 to stabilize and center the work platforms 84 within such furnace 10 (FIG. 11). It will be understood that the platform guide means 242 can be carried by the innerlining 11 of the furnace 10, and be engageable with the outer extremmities of the outer portion 104 of each of the work platforms 84^{11}.

Refractory Material Elevating Means 118*b* (FIG. 11)

This refractory material elevating means 118*b* (FIG. 11) is mounted on a bracket 248 (FIG. 11) upstanding from the turntable 80^{11}, has its cable 60*e* extending through a clearance nole 222 in the table support member 208 and has its hook 114 on the end of the cable 60*e* connected to the cables 60*c* extending from the conveyor roller section 122, which section 122 supports the pallet 120 carrying the refractory material 12. Such refractory material elevating means 118*b* has a drum 58*g* (FIG. 11) driven by a hoist having a motor 54*g* (FIG. 11). The control means 70 shown in FIG. 10 utilizes a parallel line L10 for connecting the motor 54*g* of the refractory material elevating means 118*b* (FIG. 11) to a normally open holding contact C_{10} of the relay 72.

It will be noted that the lower portions of the support member 16^{11} has guide rollers 30^{11} disposed adjacent a work platform aperture 20^{11} for guiding the movement of the work platforms 84^{11} through the bottom aperture 18 in the furnace 10.

Work Platform Support Means (FIG. 11)

It will be appreciated from a consideration of FIG. 11 that a work platform support means 266 (FIG. 11) may be utilized in the apparatus 14^{11} shown in FIG. 11 and the apparatus 14^{12} shown in FIGS. 12 and 13. This work platform support means 266 (FIG. 11) bridges the bottom aperture 18 in the furnace 10 and supports the work platforms 84^{11} (FIG. 11) or 84^{12} (FIG. 12) during movement of the work platforms 84^{11} and 84^{12} between the storage positions shown in the dotted vertical position of FIG. 11 and the work position shown in solid lines in FIGS. 11 and 12.

This work platform support means 266 has one or more removable plates or rods 268 which are disposable beneath the work platforms 84^{11} or 84^{12} (as shown in FIG. 11) and engage the bottom portions of such work platforms 84^{11} and 84^{12}.

SUMMARY OF ALTERNATIVE EMBODIMENTS OF FIGS. 7 and 11

It will be understood as shown in FIG. 1 that the work platform locking means for the apparatus 14^{11} (FIG. 11) for connecting the outer portion **104** to the inner portion **102** of each work platform 84^{11} may comprise the registering holes **106** in such sections **102,104** and the removable pins **108.** Such work platform locking means secures the outer portion **104** and the inner portion **102** of each work platform 84^{11} together in a desired predetermined length such as L or L_1 (FIG. 11).

It will be understood from a consideration of FIG. **11** that the work platform elevating means **238** may be either mounted on the table support member **206** or on the work platforms 84^{11}.

In addition, it will also be understood that the apparatus 14^{11} may include the following features described with respect to the apparatus **14** shown in FIGS. **1-6,10** and 14^{7} (FIGS. 7–10):

a. the conveyor means **124,** i.e., the conveyor sections **106** (FIGS. **1,2**) on the work platforms 84^{11} extending from the refractory material aperture **38***d* in each work platform 84^{11} to the work position (FIG. **11**) on each work platform 84^{11} for delivering the refractory material **12** from such refractory material aperture **38***d* (FIG. **11**) in the work platform 84^{11} to the work position on the work platform 84^{11} (FIG. **11**);

b. the refractory material **12** may be carried by a pallet **120** (FIG. **11**) which pallet **120** in turn is supported by a conveyor section **122,** the conveyor section **122** being alignable with the conveyor means **124** to permit the transfer of the pellet **120** and the refractory material **12** from the conveyor section **122** to the conveyor means **124** on the work platforms 84^{11} as shown in FIGS. **1,2;**

c. a refractory material elevating means **118***a* (FIG. **7**) may be employed to convey a single brick **12***a* of the refractory material **12** into alignment with the work platform 84^{11} (FIG. **11**);

d. the kick-off means **168** (FIGS. **7** and **8**) may be mounted on the work platforms 84^{11} (FIG. **11**) for removing the refractory brick **12***a* from the refractory material elevating means **118***a* (FIG. **7**) onto the work platform 84^{11} (FIG. **11**);

e. the material guide chute **184** (FIGS. **7** and **8**) can be utilized on the work platforms 84^{11} (FIG. **11**) for guiding the refractory brick **12***a* from the rotatable material feeding means **186** (FIGS. **7** and **8**) when the refractory brick **12***a* is adjacent the work platform 84^{11} (FIG. **11**);

f. form means, such as the form ring **32** shown in FIG. **1,** may be disposed adjacent the bottom aperture **18** of the furnace **10** for defining the end of the refractory material **11** in the bottom of the furnace **10** (FIG. **11**);

g. the plurality of spaced work platforms 84^{11} (FIG. **11**) may be connected by platform sections **156** (FIG. **2**) to bridge the space between the adjacent work platforms 84^{11} (FIG. **11**);

h. the second material feeding means or conveyor **194** (FIG. **9**) may be connected at one end to the bottom of the refractory material elevating means **118***a* (FIG. **9**) and adapted to feed the refractory brick **12***a* to the bottom of such refractory material elevating means **118***a* (FIG. **9**) as the work platforms 84^{11} (FIG. **11**) are raised by the work platform elevating means **238** (FIG. **11**);

i. brick mason stands **204** shown in FIGS. **7** and **8** may depend from the work platforms 84^{11} (FIG. **11**) to eliminate bending of a workman (not shown) to pick up the refractory material or brick **12***a;*

j. the turntable 80^{11} (FIG. **11**) may be a thrust bearing **82** of the type shown in FIGS. **5A,5B** and takes the thrust of the apparatus 14^{11} (FIG. **11**) in both the vertical and horizontal directions;

k. the wiping means **188** shown in FIGS. **7,8** may be mounted on the work platforms 84^{11} to extend into the rotary path of movement of the refractory brick **12***a* on the material feeding means or table **186** (FIGS. **7,8**) to engage and cause the refractory brick **12***a* to transfer from the material feeding table **186** to chutes **184** on the adjacent work platform 84^{11} (FIG. **11**).

The hoist **54***a* (FIG. **11**) may be used to move the work platforms 84^{11} between the solid line work position and the dotted line storage position.

Apparatus 14^{12} (FIGS. 12,13)

The apparatus 14^{12} (FIGS. **12,13**) has the table support member **206** provided with a tower aperture 20^{12} and the turntable 80^{12} is provided with a second tower aperture $20a^{12}$. A tower 28^{12} (FIGS. **12,13**) is adapted to pass through the tower aperture 20^{12} in the table support member **206** and the second tower aperture $20a^{12}$ in the turntable 80^{12}. The tower 28^{12} is provided with a refractory material aperture **38***f* and is secured to the turntable 80^{12}, as shown in FIG. **13** as by welds **252** or the like.

As shown in FIG. **12,** the work platforms 84^{12} are provided with a tower aperture $20b^{12}$ and are reciprocable on the outside of the tower 28^{12}. The tower 28^{12} has a tower head **250** (FIGS. **12,13**) which head **250** has its projecting upper portion secured, as by welds **252,** to the turntable 80^{12} and its lower depending portions secured by means of tower locking means **256** (FIGS. **12,13**). This tower locking means **256** consists of a locking ring **258** (FIGS. **12,13**) projecting from the upper portion **254** of the tower 28^{12} and secured to the lower portion of the tower head **250** by bolts **260** and nuts **262** (FIG. **13**).

In this embodiment, the work platform elevating means 238^{12} (FIG. **12**) can be mounted on either a tower elevating mounting means, such as a bracket **264** (FIG. **12**), depending from the beam **212** of the building in which the furnace **10** is housed or on the tower head **250** as shown in FIG. **12.** The work platform elevating means 238^{12} is then connected to the other member of the tower elevating mounting bracket **264** or to the tower 28^{12} to elevate the work platforms 84^{12} to a predetermined position within the furnace **10** with respect to the turntable 80^{12}.

The work platform elevating means 238^{12} may utilize a hoist motor **54***h* (FIGS. **10,12**) for a drum **58***h* (FIG. **12**), cables **60***f* passing around guide sheaves **265** on the tower head **250,** hooks **114** and the connections **52***c* between the cables **60***f* and the work platforms 84^{12} of the type shown in FIGS. **4A** and **4B.** The hoist motor **54***h* is mounted on the tower head **250** as shown in FIGS. **12, 13.** Alternatively, the work platform elevating means 238^{12} may have hoist motor **54***b* (FIG. **12**), may be similarly connected, as above described, to accomplish the elevating of the work platforms 84^{12} on the tower 28^{12} or to raise the work platforms 84^{12} from the working position shown in FIG. **12** to the storage position not shown in FIG. **12.**

SUMMARY OF ALTERNATIVE EMBODIMENT OF FIGS. 12,13

The tower 28^{12} is provided with guide means, such as the guides **44** shown in FIGS. **1** and **3** to guide the refractory material **12**, the pallet **120** and if necessary, the roller section **122** beneath the pallet **120** through the refractory material apertures **38***f* (FIG. **12**) in the tower 28^{12} (FIG. **12**) defined by the guides **44** of FIGS. **1,3**.

The work platform elevating means 238^{12} (as shown in FIG. **12**) is mounted on the tower 28^{12}. Alternatively, the work platform elevating means 238^{12} may be mounted on the work platforms 84^{12}. The connecting means **52***c* (FIG. **12**) of the type shown in FIGS. **4A** and **4B** include the cables **60***f*, the clevis **62** and the lugs **64** (FIGS. **4A,4B**) to connect the platform elevating means 238^{12} to the tower 28^{12} (FIGS. **4A,4B**). Further, as shown in FIG. **7**, a second work platform (not shown in FIG. **12**, but similar to the work platforms **84***a*, FIG. **7**) may be mounted on either the bottom of the tower 28^{12} or a second tower $28a^{12}$. This second tower $28a^{12}$ (FIG. **1**) is provided with another refractory material aperture **38***g* and such second tower $28a^{12}$ is connected to the bottom of the tower 28^{12} so that the refractory material aperture **38***f* in the tower 28^{12} registers with the other refractory material aperture **38***g* in the second tower $28a^{12}$.

It will be further understood that the tower 28^{12} and the second tower $28a^{12}$ may be telescopic with respect to each other.

Referring again to FIGS. **12,13**, it will be noted that each of the towers 28^{12} and $28a^{12}$ are provided on their side faces with openings **270** through which the refractory material **12** and the pallet **120** can be passed for transfer to a selected work platform 84^{12}.

Method

It will be understood by one skilled in the art from the above description of the apparatus **14** (FIGS. **1–6,10**) the apparatus 14^{7} (FIGS. **7–9,10**), the apparatus 14^{11} (FIG. **11**) and the apparatus 14^{12} (FIGS. **12** and **13**) that improved methods of lining a furnace are part of the present invention. The preferred method includes the steps of:

a. securing at **26** a support member or collar **16** (FIG. **1**) to the bottom of the furnace **10** in registry with a bottom aperture **18** of such furnace **10**;

b. moving a work platform **84** mounted on a turntable **80** (FIG. **1**), which turntable **80** is rotatable on the top of a first tower **28** through a tower aperture **20** in the support member **16** to the desired work position within the furnace **10**;

c. moving the work platform **84** from a storage position (not shown in FIG. **1**) on the turntable **80**, where the work platform **84** passes through the tower aperture **20** in the support member **16**, to a work position (FIG. **1**) where the work platform **84** extends beyond the turntable **80** to enable a workman to stand on the work platform **84**;

d. elevating the refractory material **12** through a refractory material aperture **38** in the first tower **28**, a second refractory material aperture **38***a* in the turntable **80** and a third refractory material aperture **38***b* in the work platform **84** into alignment with the work platform **84** so that the refractory material **12** can be transferred to the work platform **84** (FIG. **1**);

e. transferring the refractory material **12** to the work platform **84**;

f. rotating the turntable **80** and the work platform **84** to align the work platform **84** with an inner portion of the furnace **10** where the inner lining **11** of the refractory material **12** is to be applied; and

g. applying the refractory material **12** the inner portion of the furnace **10**.

In addition, the preferred method includes the following additioinal steps (either alone or in combination) of:

a. guiding the work platform **84**, the turntable **80** and the first tower **28** through the bottom aperture **18** in the furnace **10** (FIG. **1**);

b. guiding the refractory material **12** through the refractory material aperture **28** in the first tower **28** (FIG. **1**);

c. conveying the refractory material **12** from the third refractory material aperture **38***b* in the work platform **84** to the work position (FIG. **1**) on the work platform **84** (FIG. **2**);

d. supporting the refractory material **12** on a pallet **120** and the pallet **120** on a conveyor section **122**, aligning the conveyor section **122** with the work platform **84**, and conveying the pallet **120** and the refractory material **12** onto the work platform **84** (FIG. **1**);

e. locking the conveyor section **122** to the work platform **84** (FIG. **2**);

f.connecting at **52** the first tower **28** to the tower elevating means **34** (FIGS. **4A,4B**);

g. elevating the refractory material **12** above the work platform **84** to eliminate bending by a workman to pick up the refractory material (FIG. **6**);

h. receiving the refractory material **12** on a second or bottom work platform **84***a* on the bottom of the first tower **28** (FIG. **7**);

i. conveying the single predetermined amount of the refractory material **12**, such as a single brick **12***a*, from the second work platform **84***a* into alignment with the work platform **84** (FIG. **7**);

j. kicking off the refractory brick **12***a* adjacent the work platform **84** onto such work platform **84** (FIGS. **7** and **8**);

k. guiding the refractory material or brick **12***a*, when the refractory brick **12***a* is adjacent the work platform, onto such work platform **84** (FIG. **7**);

l. feeding the refractory material **12***a* when the refractory brick **12***a* is adjacent to the work platform **84** to a predetermined position on the work platform **84** (FIG. **7**);

m. forming the end of the refractory material **12** on the bottom of the furnace **10** (FIG. **1**);

n. locking the support member **16** to the first tower **28** to permit the removal of the connections **52** (FIGS. **4A,4B**) between the tower elevating means **34** and the first tower **28** (FIG. **1**);

o. connecting at **37,66,68** a second tower **28***a* to the bottom of the first tower **28** so that the refractory material aperture **38** in the first tower **28** registers with the refractory material aperture **38***c* in the second tower **28***a*, and connecting at **52***a* the second tower **28***a* to the tower elevating means **34** (FIG. **1**);

p. mounting another work platform **84** on the turntable **80** adjacent the first work platform **84** (FIGS. **1** and **2**);

q. disposing a platform section **156** between the first work platform **84** and the other or second work plat-

form **84** to bridge the space between such work platforms **84** (FIG. 2);

r. elevating the refractory material **12** above the bottom work platform **84***a* to eliminate bending of a workman (not shown) to pick up the refractory material **12** (FIG. 7);

s. feeding the refractory material **12** or **12***a* to the bottom of a refractory material elevating means **118***a* as the first tower **28** is raised by the tower elevating means **34** (FIG. **9**);

t. standing on a brick mason stand **204** depending from the work platform **84** to eliminate bending of the workman (not shown) to pick up the refractory material **12** or **12***a* (FIGS. 7 and **8**); and

u. wiping the refractory material **12***a* from the material feeding means **186** (FIG. **8**) adjacent the work platform **84** to cause said refractory material **12** or **12***a* to transfer from the material feeding means **186** to the work platform **84** (FIGS. **7,8**).

An alternative method of lining the furnace **10** includes the steps of:

a. securing a table support member **206** to the furnace **10** adjacent the top aperture **208** of the furnace **10** (FIG. **11**);

b. moving the work platform **84**^{11} through the bottom aperture **18** in the furnace **10** to a desired work position within the furnace **10** (FIG. **11**);

c. moving the work platform **84**^{11} from a dotted line storage position (FIG. **11**) so that the work platform **84**^{11} passes through the bottom aperture **18** in the furance **10**, to a solid line work position (FIG. **11**) where a workman (not shown) is able to stand on the work platform **84**;

d. moving the refractory material **12** through a refractory material aperture **38***d* in the work platform **84**^{11} into alignment with the work platform **84**^{11} so that the refractory material **12** can be transferred to the work platform **84**^{11};

e. transferring the refractory material **12** to the work platform **84**^{11};

f. rotating the work platform **84**^{11} on a turntable **80**^{11} on a table support member **206** to align the work platform **84**^{11} with an inner portion of the furnace **10** where the inner lining **11** of the refractory material **12** is to be applied; and

g. applying the refractory material **12** to the inner portion of the furnace **10** (FIG. **11**).

In addition, the alternative method includes the following additional steps (either alone or in combination) of:

a. stabilizing and centering the work platform **84**^{11} within the furnace **10** (FIG. **11**);

b. moving one portion **104** of the work platform **84**^{11} with respect to the other portion **102** of the work platform **84**^{11} to provide a predetermined length L for the work platform **84**^{11} (FIG. **11**);

c. locking the one portion **104** of the work platform **84**^{11} (FIG.**11**);

d. levelling table support member **206** with respect to the furnace **10** (FIG. **11**);

e. guiding the refractory material **12** through the refractory material aperture **38***d* in the work platform **84**^{11} (FIG. **2**);

f. conveying the refractory material **12** from the refractory material aperture **38***d* in the work platform **84**^{11} in a work position on the work platform **84**^{11} (FIG. **2**)); g. supporting the refractory material **12** on a pallet **120** and the pallet **120** on a conveyor section **122**, aligning the conveyor section **122** with the work platform **84**^{11}, and transferring the refractory material **12** from the conveyor section **122** to the work platform **84**^{11} (FIG. **1**);

h. locking the conveyor section **122** to the work platform **84**^{11} (FIG. **2**);

i. connecting (FIGS. **4A,4B**) the work platform **84**^{11} to a work platform elevating means **238** at **52***b* (FIG. **11**);

j. elevating the refractory material **12** above the work platform **84**^{11} to eliminate bending of a workman (not shown) to pick up the refractory material **12** (FIG. **6**);

k. conveying a predetermined amount of the refractory material **12**, such as a single brick **12***a*, into alignment with the work platform **84**^{11} (FIG. **7**);

l. kicking off the refractory brick from a refractory material elevating means **118***a* onto the work platform **84**^{11} (FIGS. **7** and **8**);

m. guiding the refractory material **12***a*, when the refractory brick **12***a* is adjacent the work platform **84**^{11}, onto the work platform **84**^{11} (FIGS. **7** and **8**);

n. guiding the work platform **84**^{11} (FIGS. **7** and **8**);

n. guiding the work platform **84**^{11} through the bottom aperture **18** in the furnace **10** (FIGS. **11** and **12**);

o. feeding the refractory material **12** or **12***a*, when such refractory material **12** or **12***a* is adjacent the work platform **84**^{11}, to a predetermined position on the work platform (FIGS. **7** and **8**);

p. forming the end of the refractory material **12** on the bottom of the furnace **10** (FIG. **1**);

q. mounting another work platform **84**^{11} adjacent the work platform **84**^{11} (FIGS. **1** and **2**);

r. disposing a platform section **156** between the work platforms **84**^{11} to bridge the space between them (FIGS. **1** and **2**);

s. bridging the bottom aperture **18** in the furnace **10** to support the work platform **84**^{11} during movement of the work platform **84**^{11} between the storage position shown in the dotted lines (FIG. **11**) and the work position shown in the solid lines of FIG. **11**;

t. feeding the refractory material **12** to the bottom of the refractory material elevating means **118***a* (FIG. **9**);

u. standing on a brick mason stand **204** depending from the work platform **84**^{11} to eliminate bending of a workman (not shown) to pick up the refractory material **12** or **12***a* (FIGS. **7** and **8**);

v. wiping the refractory material **12***a* from a material feeding means **186** adjacent the work platform **84**^{11} onto such work platform **84**^{11} (FIG. **8**);

w. securing a tower **28**^{12} to the turntable **80**^{12} (FIG. **12**);

x. sliding the work platform **84**^{12} on the tower **28**^{12} (FIG. **12**);

y. guiding the refractory material **12** through a refractory material aperture **38***f* in the tower **28**^{12} (FIG. **2**);

z. mounting a work platform elevating means **238**^{12} on a work platform elevating mounting means **112** above the furnace **10** (FIGS. **12** and **2**);

a′. mounting a work platform elevating means **238**^{12} on the tower **28**^{12} (FIG. **12**);

b′. connecting at **52***c* a work platform elevating means **238**^{12} (FIGS. **4A,4B**) to the work platform **84**^{12} (FIG. **12**);

c′. mounting a second work platform **84***a* on the bottom of the tower **28**^{12} for receiving the refractory material **12** (FIG. **7**);

d'. connecting a second tower $28a^{12}$ to the bottom of the first tower 28^{12} so that a refractory material aperture $38f$ in the tower 28^{12} registers with another refractory material aperture $38g$ in the tower $28a^{12}$ (FIG. 1); and

e'. telescopicing the tower 28^{12} and the second tower $28a^{12}$ with respect to each other.

SUMMARY OF THE ACHIEVEMENTS OF THE OBJECTS OF THE INVENTION

It will be recognized by those skilled in the art that the objects of this invention have been achieved by providing improved apparatus **14** (FIGS. **1–6,10**), 14^{7} (FIGS. **7–9,10**), 14^{11} (FIGS. **10,11**), 14^{12} (FIGS. **10,12** and **13**) for and methods of lining a furnace **10** (provided with a bottom aperture **18**) with an inner lining **11** of a refractory material **12**, the apparatus and methods being simple and rugged in construction; capable of a long, maintenance-free operational life; efficient and economical in operation; and capable of reducing the normal down time of the furnace due to the relining of the inner lining **11** thereof with the refractory material **12**.

While in accordance with the patent statutes, preferred and alternative embodiments of this invention have been illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby.

In the claims, each claim is followed by the Figure number to which it refers and in the case of the method claims, also by the apparatus claim number to which it corresponds.

I claim:

1. A method of lining a furnace, provided with a bottom aperture in its bottom and a top aperture in its top, with an inner lining of a refractory material, said method including the steps of:

a. securing a table support member to said furnace adjacent said top aperture of said furnace;

b. moving a work platform through said bottom aperture in said furnace to a desired work position within said furnace;

c. moving said work platform from a storage position, where said work platform passes through said bottom aperture in said furnace, to a work position where a workman is able to stand on said work platform;

d. moving said refractory material through a refractory material aperture in said work platform into alignment with said work platform so that said refractory material can be transferred to said work platform;

e. transferring said refractory material to said work platform;

f. rotating said work platform and a turntable on said table support member to align said work platform with an inner portion of said furnace where said inner lining of said refractory material is to be applied; and

g. applying said refractory material to said inner portion of said furnace.

2. The method recited in claim **1** and including the step of:

a. stabilizing and centering said work platform within said furnace.

3. The method recited in claim **1** and including the step of:

a. moving one portion of said work platform with respect to the other portion of said work platform to provide a predetermined length of said work platform.

4. The method recited in claim **2** and including the step of:

a. locking said one portion of said work platform to said other portion of said work platform.

5. The method recited in claim **1** and including the step of:

a. leveling said table support member with respect to said furnace.

6. The method recited in claim **1** and including the step of:

a. guiding said refractory material through said refractory material aperture in said work platform.

7. The method recited in claim **1** and including the step of:

a. conveying said refractory material from said refractory material aperture in said work platform to a work position on said work platform.

8. The method recited in claim **1** and including the step of:

a. supporting said refractory material on a pallet and said pallet on a conveyor section;

b. aligning said conveyor section with said work platform; and

c. transferring said refractory material from said conveyor section to said work platform.

9. The method recited in claim **8** and including the step of:

a. locking said conveyor section to said work platform.

10. The method recited in claim **1** and including the step of:

a. connecting said work platform to a work platform elevating means.

11. The method recited in claim **1** and including the step of:

a. elevating said refractory material above said work platform to eliminate bending of a workman to pick up said refractory material.

12. The method recited in claim **1** and including the step of:

a. conveying a predetermined amount of said refractory material into alignment with said work platform.

13. The method recited in claim **1** and including the step of:

a. kicking off said refractory material from a refractory material elevating means onto said work platform.

14. The method recited in claim **1** and including the step of:

a. guiding said refractory material, when said refractory material is adjacent said work platform, onto said work platform.

15. The method recited in claim **1** and including the step of:

a. guiding said work platform through said bottom aperture in said furnace.

16. The method recited in claim **1** and including the step of:

a. feeding said refractory material, when said refractory material is adjacent said work platform, to a predetermined position on said work platform.

17. The method recited in claim **1** and including the step of:

a. forming the end of said refractory material on the bottom of said furnace.

18. The method recited in claim **1** and including the step of:

a. mounting another work platform adjacent said work platform.

19. The method recited in claim **18** and including the step of:

a. disposing a platform section between said work platform and said other work platform to bridge the space between said work platform and said other work platform.

20. The method recited in claim **1** and including the step of:

a. bridging said bottom aperture in said furnace to support said work platform during movement of said work platform between said storage position and said work position.

21. The method recited in claim **1** and including the step of:

a. feeding said refractory material to the bottom of a refractory material elevating means.

22. The method recited in claim **1** and including the step of:

a. standing on a brick mason stand depending from said work platform to eliminate bending of a workman to pick up said refractory material.

23. The method recited in claim **1** and including the step of:

a. wiping said refractory material from a material feeding means adjacent said work platform onto said work platform.

24. The method recited in claim **1** and including the step of:

a. securing a tower to said turntable.

25. The method recited in claim **24** and including the step of:

a. sliding said work platform on said tower.

26. The method recited in claim **24** and including the step of:

a. guiding said refractory material through a second refractory material aperture in said tower.

27. The method recited in claim **24** and including the step of:

a. mounting a work platform elevating means on a work platform elevating mounting means on said furnace.

28. The method recited in claim **24** and including the step of:

a. mounting a work platform elevating means on said tower.

29. The method recited in claim **1** and including the step of:

a. connecting a work platform elevating means to said tower.

30. The method recited in claim **24** and including the step of:

a. mounting a second work platform on the bottom of said tower for receiving said refractory material.

31. The method recited in claim **24** and including the step of:

a. connecting a second tower to the bottom of said tower so that a refractory material aperture in said tower registers with another refractory material aperture in said second tower.

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