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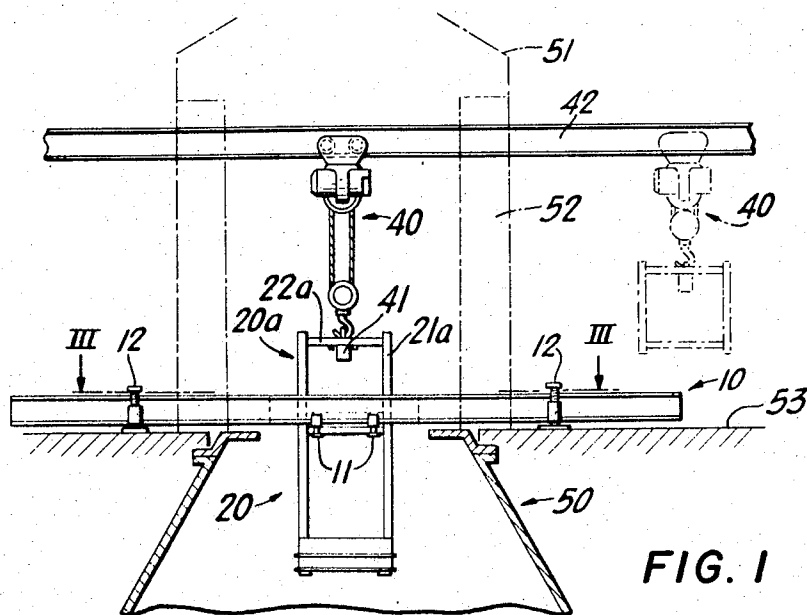
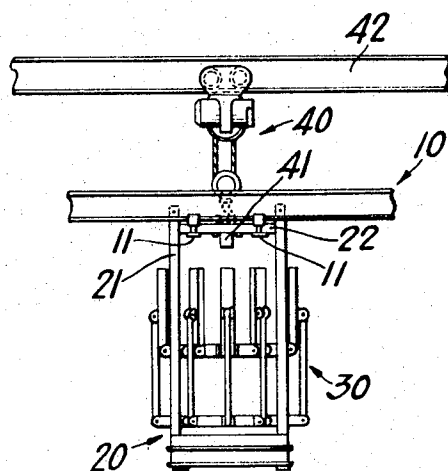
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3,454,133

PORTABLE WORK TOWER FOR USE IN VESSELS HAVING LIMITED CLEARANCE

Filed March 4, 1968

Sheet 1 of 2



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Sheet 2 of 2

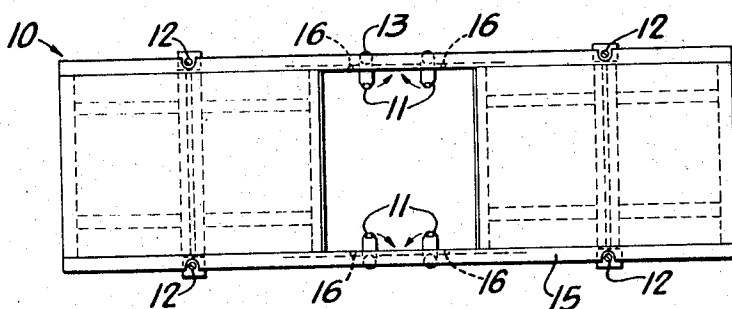


FIG. 3

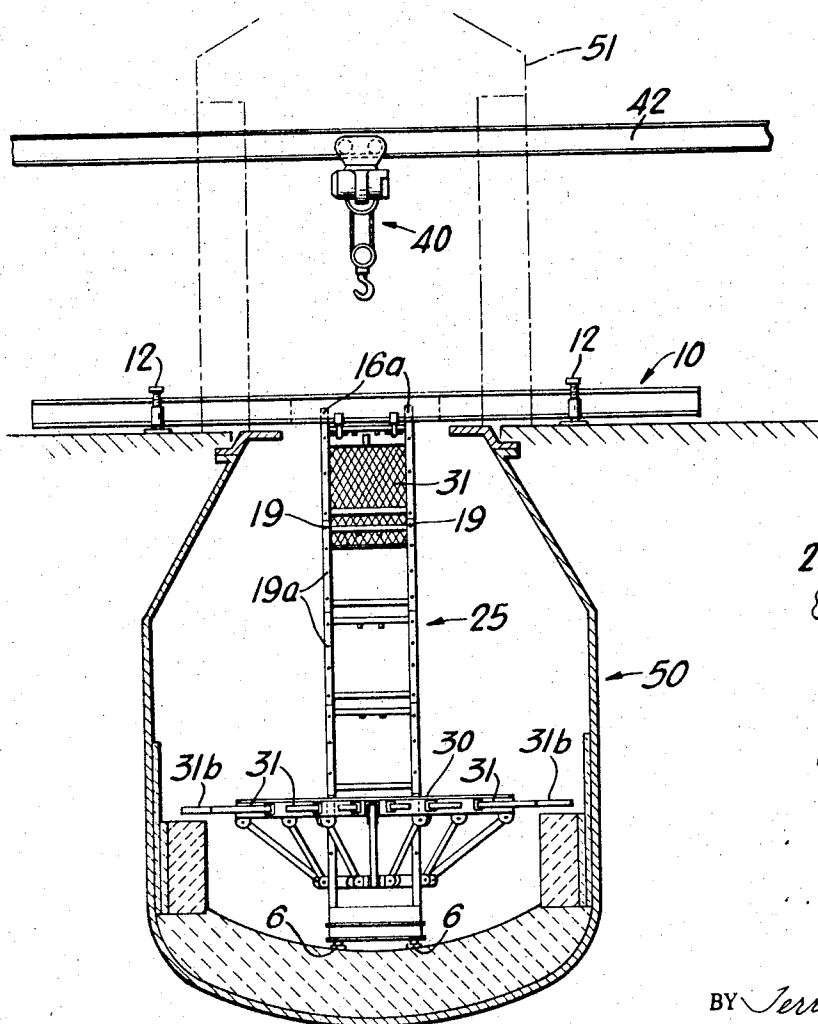


FIG. 4

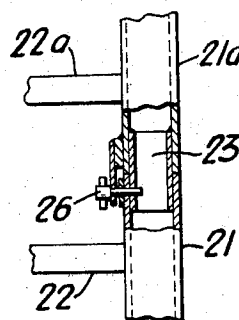


FIG. 5

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3,454,133

PORTABLE WORK TOWER FOR USE IN VESSELS HAVING LIMITED CLEARANCE

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9 Claims

ABSTRACT OF THE DISCLOSURE

A portable work tower for use with a top-blown steel-making vessel having limited overhead clearance is provided which may be assembled and disassembled directly over the vessel's top-opening. The tower comprises a plurality of rigid frame sections which are assembled one-over-the-other in the vessel's top-opening with the aid of a bridge adapted to be positioned over the vessel's top-opening which has grasping means for selectively supporting and releasing a tower section. The bridge retains a first tower section suspended in the vessel while a second section is fixed thereto, and the two joined sections are then lowered further into the vessel by a hoist means to a position where the grasping means on the bridge supports the two sections suspended in the vessel while a third is fixed thereto, and so on until the entire tower is constructed.

Background of the invention

By far, the single most efficient method of manufacturing steel is with the use of the top-blown oxygen steel-making vessel. In such a steel-making process, molten pig iron, with or without scrap, and additives such as limestone, are first charged to the vessel. The charge is then subjected to a high-velocity stream of oxygen and the pig iron is thereby "blown" to steel.

Associated with the blowing operations are violent chemical reactions, and great volumes of dust, smoke, and extremely hot gases escape from the vessel at the great rate. In order to collect the escaping gases and the solids entrained therein, large hoods are located over the vessels into which those gases are drawn and directed to waste heat recovery, cleaning, etc., areas. It is desirable to position the hood as near the top-opening of the vessel as possible so as to minimize the escape of the hot gases and solids from the vessel into the surrounding area especially since a large portion of the escaping gas is $\text{CO} + \text{CO}_2$ which can be recovered either for its heating values or for use as a synthesis gas, or both. Recently, hoods have been located fixed to the vessel's top-opening or in a fixed position just a matter of inches from the top of the vessel, and the escape of the gases (and, incidentally, the entrance into the hood of atmospheric air) has been substantially eliminated in that manner. Also, by having the hood in a stationary position, much elaborate equipment which had been used to remove the hood to an out-of-the-way position has been eliminated.

Unfortunately, an additional problem has been created by locating the hood in a permanent position so near to the vessel's top-opening when it comes time to reline the vessel. It is practice in the industry to reline a steel-making vessel about once a week. The hood, when located so near the top-opening of the vessel, severely limits the work space above the vessel, and conventional relining towers simply are not usable in such an arrangement since they require too much overhead space for installation and operation. It has been necessary, then, to go back to the old practice of building a wooden scaffold by hand to remove the old lining and install the

new. This results in a tremendous loss of time, manpower, and money. A need, therefore, exists for a relining tower suitable for use with steel-making vessels having a limited overhead work area.

It is an object of this invention to provide a work tower suitable for use in relining a steel-making vessel having a hood in a fixed position on or near the top-opening of the vessel.

Another important object of this invention is to provide a work tower for use with vessels above-described which may be rapidly assembled and disassembled in the vessel's top-opening with a minimum expenditure of time and manpower.

Summary of the invention

A work tower is provided for use with an open-top steel-making vessel having limited overhead clearance which includes a bridge located over the top-opening of the vessel, the bridge being equipped with grasping means for supporting frame sections which make up the work tower. The frame sections are adapted to be interconnected to form a unitary tower extending from the bottom of the vessel to its top-opening and are assembled, one by one, in that top-opening. The grasping means on the bridge holds a tower section suspended in the vessel while a second section is fixed thereto, and the two sections are then further lowered into the vessel by a hoist means to a position where the grasping means on the bridge supports the two sections while a third section is joined thereto, and so on until the tower is constructed.

Brief description of the drawings

FIGURE 1 is a sectional view which shows the novel work tower of the invention partially constructed within a typical top-blown steel-making vessel.

FIGURE 2 shows the lower frame section of the work tower, the bridge means adapted to support the tower sections, and a platform movable the length of the constructed tower in a position ready to be hoisted into the vessel's top-opening.

FIGURE 3 is a view taken along line 3—3 of FIGURE 1 and shows the bridge of the work tower of the invention in a position over the steel-making vessel's top-opening.

FIGURE 4 shows the completely constructed tower of the invention including cage and attendant apparatus in a typical working position within the vessel.

FIGURE 5 shows a connection between two tower sections whereby the tower sections are rigidly connected.

Detailed description

Referring to FIG. 2, bridge means 10, tower section 20, and movable scaffold 30 (described more fully later) in collapsed position as suspended from hoist means 40 by a suitable means such as lifting bale 41. Tower section 20 consists of spaced-apart frame sections having vertically extending members 21 and cross members 22. Movable scaffold 30 preferably is of the type described in U.S. Patent 3,166,154, lines 16—36 assigned to the assignee of this application. Scaffold 30 is secured to tower section 20 by removable pins (not shown). Tower section 20 is supported by novel grasping means on bridge 10 such as holding arms 11.

Referring now to FIG. 1, a partial elevation of a typical top-blown steel-making vessel 50 is shown having a top-opening and a stationary hood 51 fixed thereto shown in phantom. Hood 51 is stationary and severely limits the available work space around the vessel's top-opening since it cannot be moved to an out-of-the-way position and extends to the level of the service floor 53.

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In order to construct the novel work tower of the invention, hoist means 40 is activated and the entire apparatus of FIG. 2 is hoisted, with the aid of monorail 42, through the vessel's hood opening 52 and lowered until bridge means 10 rests on service floor 53 (FIG. 1). With bridge 10 resting on service floor 53 and having tower section 20 and movable platform 30 (not shown) suspended from its holding arms 11, lifting bale 41 is removed. Bridge means 10 is provided with leveling jacks 12 which are adjusted to plumb the bridge (and hence the tower) over the vessel's top-opening.

Hoist means 40 is removed from the furnace and moved along monorail 42 to a point where a second tower section 20a is attached to lifting bale 41 and hoisted into hood 51 as shown in FIG. 1. Second tower section 20a is similar in construction to tower section 20 consisting of spaced-apart frames having vertically extending members 21a and cross members 22a, and is adapted to be mated to tower section 20. Hoist means 40 is activated and tower section 20a is lowered atop tower section 20 which is suspended off bridge holding arms and the two sections are joined to form a unitary tower section. A suitable means for joining the two tower sections comprises a tube fixed to vertical members 21a and extending downwardly therefrom having a cross section somewhat less than that of member 21 whereby it may extend within and be pinned to member 21. [A coupling of this type (pinned-sleeve) is shown in detail later.]

With the lifting bale still in place and the two sections pinned together, a grasping means 11 on bridge 10 are contracted and the first and second tower sections are suspended from hoist means 40. The hoist means is activated and the two sections (now a unitary section) are lowered into vessel 50 (as in FIG. 1) to a position where cross member 22a is in position to be supported by the grasping means 11. When in that position, the grasping means are released to support the joined tower sections whereby they are suspended off bridge means 10. Lifting bale 41 and hoist means 40 are then removed from hood 51 to secure a third tower section which is transported, lowered, pinned, and suspended as described above. The operation is repeated until the entire tower, extending from bottom to top of the vessel is constructed.

FIG. 3 is a view taken along line 3—3 of FIG. 1 and shows the novel bridge means 10 of the invention. Bridge 10 is adapted to be positioned over the vessel's opening and allow for the passage therethrough of the tower sections comprising the tower means of the invention. The bridge is provided with novel grasping means for alternately supporting and releasing the tower means of the invention. The grasping means here shown comprises holding arms 11 fixed to members 15 of bridge 10. Holding arms 11 are pivotally mounted on members 15 around point 13. When in supporting position, the holding arms are in the position shown in FIG. 3 and support the tower sections under their cross members. When in releasing position, the holding arms are pivoted to an out-of-the-way position as indicated in the figure. Bridge 10 is equipped with leveling means such as jacks 12 for plumbing the bridge, and hence the tower suspended therefrom, along the center line of the vessel.

In a preferred embodiment of the invention, the final (uppermost) tower section of the tower means is adapted to be bolted to bridge members 15 rather than merely suspended off the holding arms to lend additional stability to the novel work tower of the invention. In that case, the upper cross members or vertically extending members of the tower section and bridge member 15 are provided with matching bolt holes, e.g. at 16, FIG. 3, to receive bolts for securing the tower means rigidly to the bridge means.

FIG. 4 shows the novel work tower of the invention bolted at 16a to bridge means 10 in a typical working position for relining vessel 50. After the tower means designated generally 25 is constructed and fixed to bridge

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means 10, cab 31 is transported to the vessel's hood and lowered with hoist means 40 through bridge means 10 into tower means 25. Guides (not shown) are provided within the tower for guiding cab 31 in vertical movement. Cab 31 which is moved vertically with hoist means 40, may be pinned to tower means 25 at selected locations in the tower by means, e.g. of pins 19 in holes 19a. Cab 31 may be selectively coupled, as with pins, to movable platform designated generally 30 for moving the platform vertically on the tower means. Platform 30 likewise may be pinned at any desired location on tower means 25. Platform 30 carries a plurality of spaced-apart support arms (for supporting flooring) which are pivoted thereon and may be pivoted from a position parallel to the tower means (for insertion through the bridge and vessel openings) to a position transverse thereto (to provide support for flooring to be laid thereon). Support arms 31 may have telescoping sections for extending their length to the vessel's outer periphery for relining its walls. Tower means 25 may have additional support means such as jacks 6 for stability during the relining operation.

Monorail guide and support means 42 shown in the figures may be fixed or movable parallel to the service floor 53. When the monorail is movable, a relatively short section of rail is required which may be moved along with its attendant hoist means from within the hood to a station where tower sections are stored and vice versa. Otherwise, the monorail may be fixed in position having hoist means 40 movable thereon, as shown in phantom in FIG. 1. In either case, the need for an overhead crane in a relining operation is substantially eliminated.

Referring now to FIG. 5, a typical pinned-sleeve joint between tower sections is shown. In the figure, vertically extending member 21a has downwardly extending member 23 fixed thereto as by welding. Member 23 is adapted to pass within vertically extending member 21 of a second tower section and be fixed thereto by means of pin 26 which passed through matching holes provided in members 21 and 23. The connection shown will maintain the two tower sections in fixed relation whether the tower is being lowered into the vessel (during construction) or withdrawn therefrom (during disassembly).

The foregoing has described the novel work tower of the invention useful for relining vessels having limited overhead clearance. The component parts of the tower are portable and the tower itself may be assembled within the top-opening of a steel-making vessel requiring very little work space for assembly. Certain equivalent variations of the tower may, of course, be made by those skilled in the art without departing from the scope of the invention.

What is claimed is:

1. A work tower for use with a vessel having a top-opening and limited overhead clearance comprising:

(a) bridge means adapted to be positioned over said opening in said vessel;

(b) tower means adapted to pass through said bridge means into said vessel;

(1) said tower means comprising a plurality of tower sections adapted to interconnect to form a unitary rigid tower;

(2) each of said tower sections comprising spaced-apart frame sections having vertically extending members;

(c) grasping means located on said bridge means alternately supporting and releasing said tower sections; and

(d) hoist means for selectively raising and lowering said tower sections and for cooperating with said grasping means for supporting said tower sections.

2. The work tower of claim 1 wherein said tower sections include an uppermost section, said uppermost section being rigidly affixed to said bridge means.

3. The work tower of claim 1 wherein said bridge

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means includes adjustable leveling means whereby said bridge may be plumbed with the center line of said vessel.

4. The work tower of claim 1 wherein said grasping means comprises spaced-apart holding arms on said bridge means, said holding arms being pivotally connected to said bridge means.

5. The work tower of claim 1 wherein said tower sections are interconnected by means of a pinned-sleeve coupling through said vertically extending members.

6. The work tower of claim 2 including a movable platform vertically movable on said tower means, cab means vertically movable within said tower along guide means located in said tower, said platform being selectively coupled to said cab means for vertical movement therewith, and said cab means being operably connected to said hoist means.

7. Apparatus for relining a top-blown oxygen steel-making vessel having limited overhead clearance comprising:

(a) bridge means located over the top-opening in said vessel;

(b) tower means adapted to pass through said bridge means into said vessel;

(1) said tower means comprising upper, lower, and intermediate tower sections;

(2) each of said tower sections comprising spaced-apart frame sections having vertically extending members;

(3) said tower sections being adapted to be interconnected to form a unitary rigid tower means;

(c) movable platform means vertically movable on said tower means;

(1) a plurality of support arms spaced about said movable platform and pivoted thereon from a position parallel to said tower means to a position transverse thereto to form a working platform;

(2) guides within said tower means forming an

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inner cab guide extending the length of said tower means;

(3) cab means vertically movable on said cab guides within said upper, lower, and intermediate tower sections;

(d) grasping means located on said bridge means for alternatively supporting and releasing said tower sections; and

(e) hoist means for selectively raising and lowering said tower sections, for cooperating with said grasping means for supporting said tower sections, and for selectively raising and lowering said cab means, said cab means being selectively coupled with said movable platform for raising or lowering said movable platform with said cab means.

8. The work tower of claim 7 wherein said bridge means includes adjustable leveling means whereby said bridge may be plumbed with the center line of said vessel and wherein said upper section is rigidly affixed to said bridge means.

9. The work tower of claim 7 wherein said grasping means comprises spaced-apart holding arms on said bridge means, said holding arms being pivotally connected to said bridge means.

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U.S. Cl. X.R.

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