March 30, 1965 D. D. CASPERSON 3,175,239

LANCE CARRIAGE MOUNTED PNEUMATIC JACK HAMMER

Filed Aug. 6, 1963 2 Sheets-Sheet 1

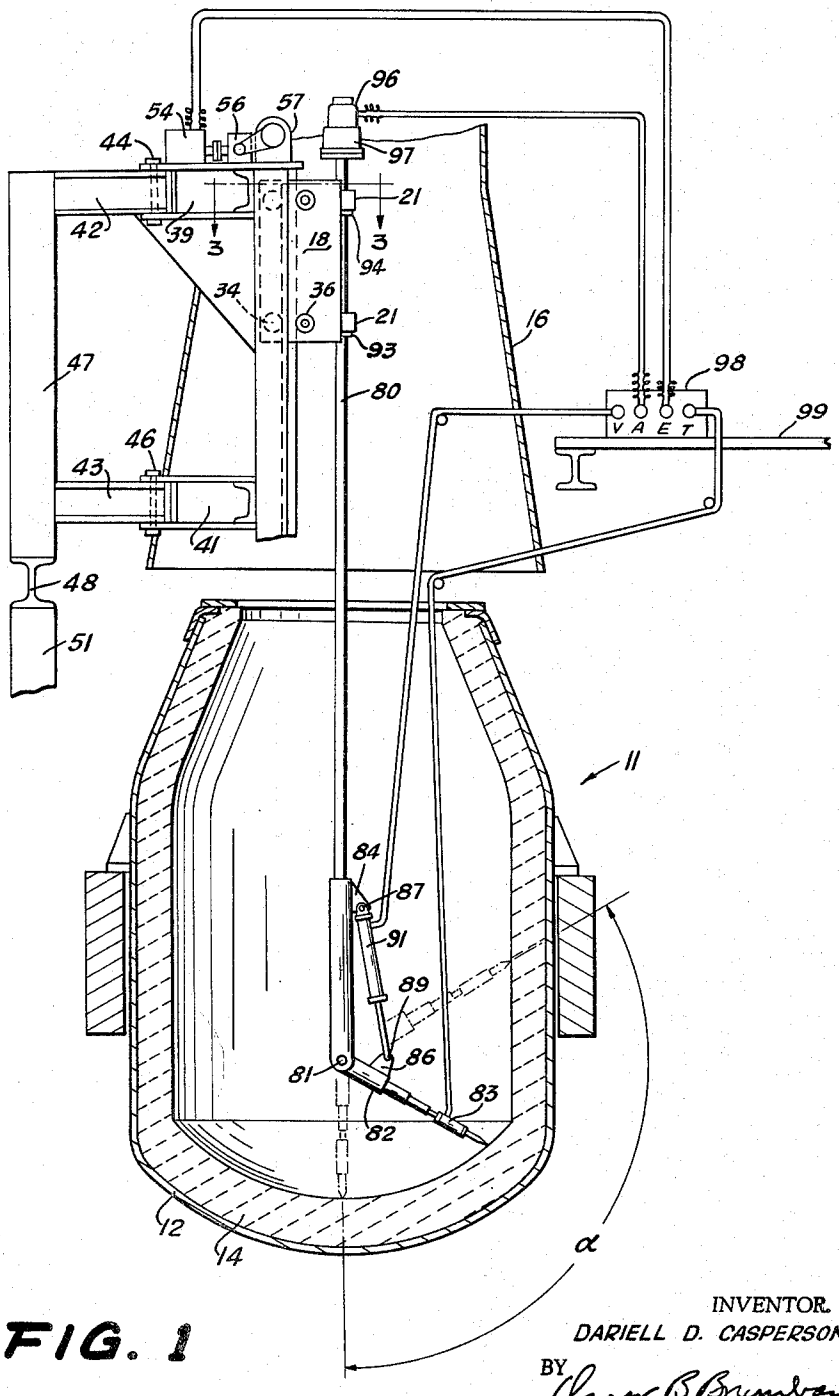


FIG. 1

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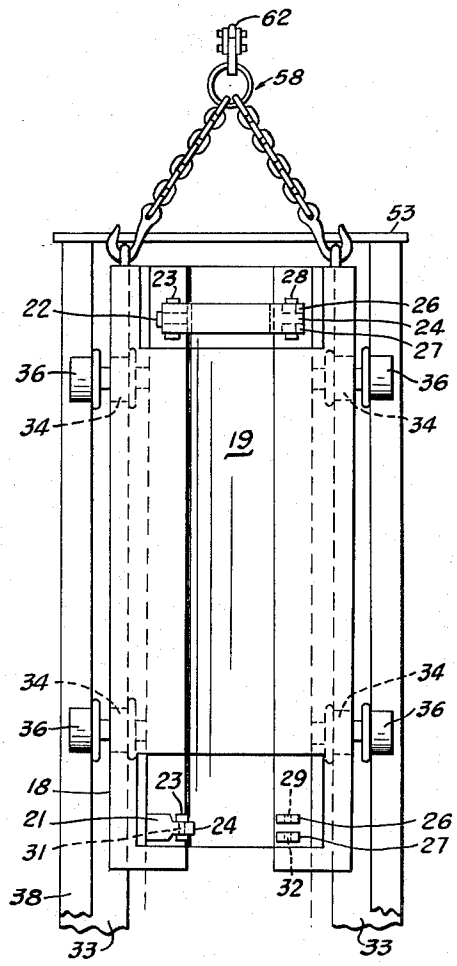


FIG. 2

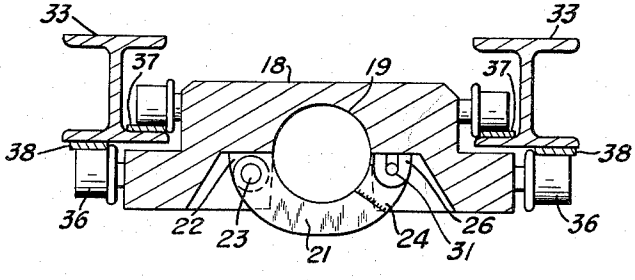


FIG. 3

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LANCE CARRIAGE MOUNTED PNEUMATIC JACK HAMMER

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1 Claim. (Cl. 15—104.1)

This invention relates to an apparatus for use in repairing the linings of vessels such as oxygen steelmaking converters.

In oxygen steelmaking operations, a long lance is inserted into an opening at the top of a furnace, such as a closed bottom converter, and substantially pure oxygen is forced downwardly through the lance at high velocity and, as a jet, into contact with the surface of the molten metal in the converter. The reaction is rapid. The temperature beneath the oxygen jet approaches 6000° F.; and violent stirring and agitation of the metal bath ensues. As a result of this action, the refractory lining of the furnace is rapidly consumed. Thus the linings must be replaced regularly, sometimes after only a few days of service.

An object of this invention is to provide a novel device for use in the repair of oxygen steel furnaces.

The repair device for an oxygen steel furnace contemplated by the invention is an elongated shaft adapted for operation with the oxygen lance handling mechanism so as to be raised and lowered axially in a vertical direction and which has a pneumatic tool pivoted at one end for insertion in the opening at the top of the furnace and has a provision for positioning the tool at desired angles of elevation relative to the axis of the shaft and a provision for revolving the shaft about its axis to position the jack in azimuth whereby the pneumatic tool may be applied to the inner surface of the furnace in any desired direction.

The above and further objects and novel features of the invention will appear more fully from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are not intended as a definition of the invention but are for the purpose of illustration only.

In the drawings wherein like parts are marked alike:

FIGURE 1 illustrates an elevational view not to scale with parts in section with an embodiment novel repair device of the invention associated with a lance carriage;

FIGURE 2 is an elevational view showing the carriage with the lower clamp pivoted to open position and the upper clamp in closed position, the repair device of FIG. 1 removed;

FIGURE 3 is a section taken along line III—III of FIG. 1 with the repair device removed.

A conventional closed-bottom, oxygen steelmaking vessel or converter is illustrated at FIG. 1 as having an outer shell **12** with a lining comprised of magnesia ramming mix and tar-bonded dolomite-magnesia bricks **14**. The top of the vessel has a restricted opening **15**. A hood **16** removes fumes and smoke from the converter **11**.

The converter is illustrated as having a rigid lance holding mechanism associated therewith, such as described in Patent No. 3,025,047. The lance for supplying oxygen to the converter is held in a semi-cylindrical recess **19** in cradle **18** by means of arcuate clamps **21** that are pivotally supported by projections **22** which are formed or welded on the body of cradle **18**. As a clamp **21** is swung about pins **23** into the closed position, tongue-like projection **24** formed on the end of clamp **21** swings between vertically spaced projections **26** and **27**. Wedge **28** is then forced through slot **29** in each projection **26**, through opening **31** in tongue **24** and slot **32** in each projection **27** to urge arcuate clamp **21** forceably against the lance. About a

four-foot spread exists between the arcuate portions **21** so a rigid connection is provided between the lance and guide carriage **18**.

Carriage **18** moves vertically on structural steel guide tracks **33** by means of a series of flanged wheels **34** and **36**, which run on rails **37** and **38**. The weight of the carriage **18** and the lance is usually partially offset by a counterbalance (not shown). Guide tracks **33** are fixed in a substantially vertical position by struts **39** and **41** which are pivotally connected to bearing brackets **42** and **43** by means of pins **44** and **46**.

During the charging and tapping operations of the converter **11**, the entire arrangement of guide tracks **33** and guide carriage **18** may be easily swung to one side, the pivotal connections being so designed as to permit a swing of at least 90°. The load of the entire assemblage is borne by a structural steel column **47** that is supported on girder **48** which is in turn supported on column **51** placed at some distance from the converter **11**. Thus, the entire support is elevated or spaced a safe distance from converter **11**.

A mounting plate **53** supports the actuating mechanism including motor **54** coupled to gear reducer **56** which in turn drives hoist drum **57** to return or to play out cable **62** to raise and lower carriage **18**. Thus chain yoke **58** provides for an in-line lifting and lowering of the carriage. The driving mechanism being affixed to mounting plate **53** moves with the guide tracks **33** and carriage **18** as the assembly pivots about pins **44** and **46**. The guide tracks **33** are interconnected by bracing members (not shown) to keep them parallel to each other and provide stiffer guide means.

The foregoing lance holding structure is described in greater detail in United States Patent No. 3,025,047, When the furnace is shut down for repair, the lance, of course, is not in operation.

The cleaning of the accumulated slag and steel from the walls and floors of the furnace and the removal of brick is often started while the furnace is still hot from the steelmaking process. Such operation has, heretofore, been difficult and hazardous. In accordance with this invention, there is provided a novel repair apparatus which provides for the manipulation of heavy pneumatic tools and which is particularly adapted for use with the apparatus for holding oxygen lances. The tool can be easily inserted into the relatively narrow opening at the top of the converter and readily applied against the inner wall of the furnace in any required direction; horizontally, vertically and obliquely. The lifting and positioning of the tool is handled without the great manual effort required heretofore.

Referring now to FIG. 1, an elongated rod **80** has pivotally attached at one end by conventional means, for example, by a clevis joint **81**, an adapter **82** for a pneumatic tool **83**. The adapter and tool can thus be pivoted in the plane of the axis of shaft **80**. A projection or ear **84** is attached to shaft **80** and a projection or ear **86** is attached to adapter **82**, by suitable means, as for example by welding. Pivotally attached to ear **84** and to ear **86** as by clevis **87** and **89** is a pneumatic ram **91**. Thus actuation of ram **91** will increase or decrease the distance between ears **84** and **86** thereby pivoting tool **83** through an angle α. Advantageously, this angle is about 120°.

At the upper end of shaft **80** are a pair of thrust bearings **93** and **94**. These bearings are adapted to fit recess **19** and be held by clamp arms **21**. Attached to the outer housing of bearing **94** is a conventional reversible electric motor **96** connected by gearbox **97** for rotating shaft **80**.

It can be seen that the pneumatic tool **83** may be applied against the inner wall of the converter at any desired level and direction. By reciprocating carriage **18**, the tool may

be moved up and down in the converter; by actuating motor **96**, the tool may be rotated in the converter to any azimuth direction; and by actuating pneumatic ram **91**, the tool may be swung through an arc α of elevation.

If desired, the controls for the carriage for motor **96** and for ram **91** may be concentrated in a control panel **98** on service floor **99**. Thus the controls are accessible for one operator.

In operation, the lance is removed from recess **19** and replaced by shaft **80**; the bearings **93** and **94** resting in recesses **19**. Clamps **21** are closed and locked. The entire assemblage of carriage **18** and shaft **80** is positioned over the opening at the top of converter **11**. The carriage is lowered to the desired level. The hammer **83**, at this time, is advantageously in a substantially vertical position. After the tool is within the furnace, ram **91** is actuated to pivot the hammer **83**, and to place hammer **80** at the desired angle of elevation. Motor **96** is operated to revolve shaft **80** to place hammer **83** at the desired angle of azimuth. The hammer may then be actuated to loosen the slag, steel, brick, or the like. Then as this is accomplished, the motor **54** may be operated to change the elevation of the hammer. Then hammer **83** may be applied to the inner surface of the converter so that the entire converter may be repaired or cleaned, as the case may be, without hazard to the workmen and through the use of larger tools than could be handled manually for performing these difficult cleaning operations.

While the foregoing has dealt particularly with pneumatic tools, it is evident that other tools may be used where drilling, chiseling, and hammering tasks are required.

The foregoing has described a noved tool for cleaning oxygen furnaces. It can readily be substituted for the oxygen lance and the normal oxygen lance carrier. It permits the cleaning and repair of the converter without the laborious manual operations of lifting and holding the tools and the difficult manipulation of the tools along the work surface. In addition, it dispenses with the hazard of removing the deposits at angles disposed to the vertical and horizontal directions which constitute extreme hazards to the workers. In addition, the tools may be used under temperature conditions that would not be possible in the manual handling of the tools.

I claim:

In a system for cleaning a wall of an oxygen furnace, wherein a carriage is reciprocably movable on guideways fixed above said furnace and a mechanism is mounted on said guideways for vertically reciprocating said carriage relative to said guideways, the combination with said carriage of:

(*a*) an elongate rod;

(*b*) a pair of spaced apart thrust bearings mounted adjacent one end of said rod whereby said rod is mountable and supportable in said carriage;

(*c*) an adapter pivotally mounted adjacent the other end of said rod;

(*d*) a power tool removably secured in said adapter;

(*e*) a fluid actuated ram pivotally connected to both said rod and said adapter whereby said adapter and tool are operable in a plane containing the axis of said rod through an angle that is greater than a right angle; and

(*f*) a motor drivingly connected to said rod whereby said adapter and tool are movable through an angle not greater than 360° to selected azimuthal positions, as said tool operatively engages the wall of said furnace and is reciprocated in said vessel.

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