May 12, 1959 A. J. BOYNTON 2,886,308

LANCE HANDLING APPARATUS

Filed April 15, 1957 2 Sheets-Sheet 1

Fig. 1

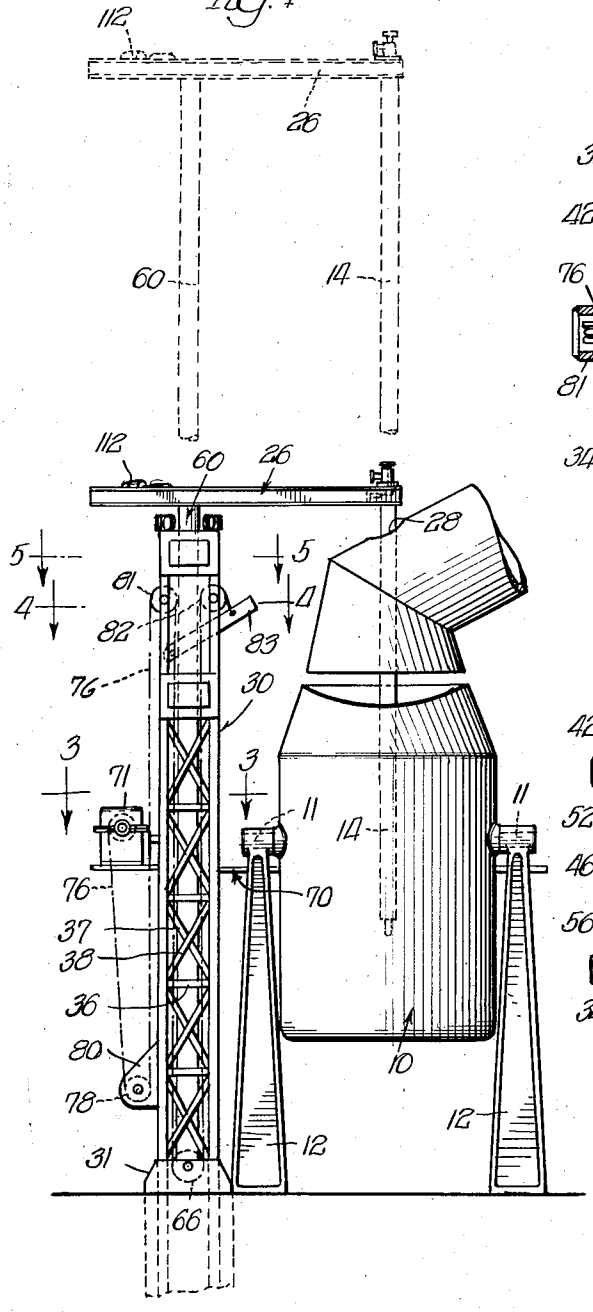


Fig. 4

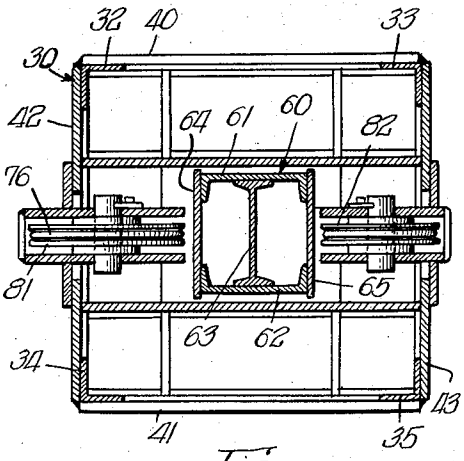
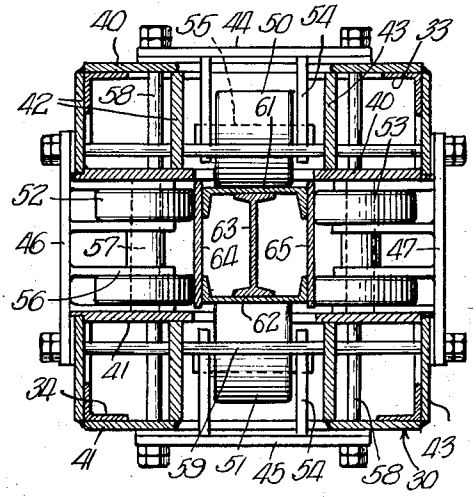


Fig. 5



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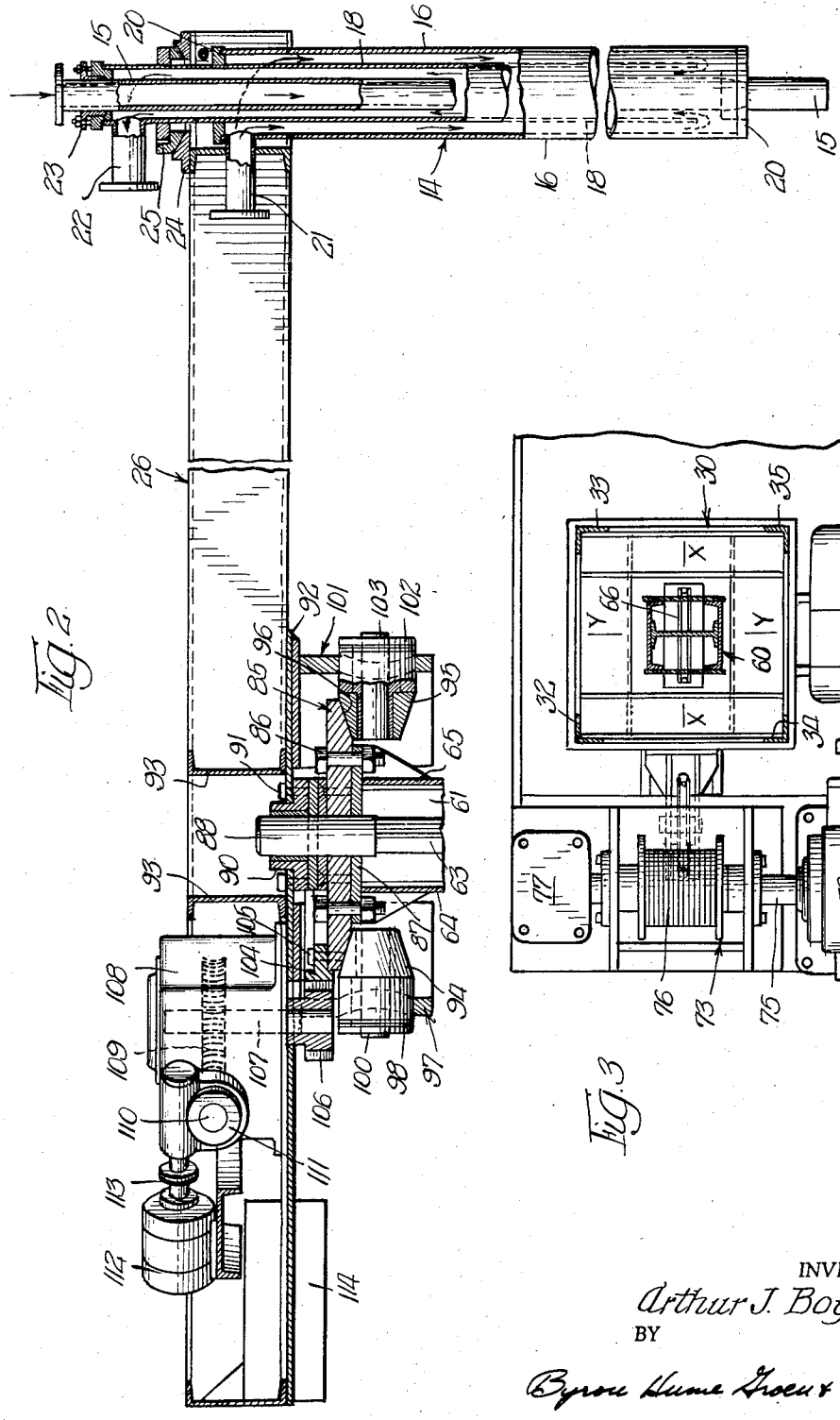


Fig. 2

Fig. 3

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LANCE HANDLING APPARATUS

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2 Claims. (Cl. 266—34)

The invention relates to an improvement in apparatus for use in the oxygen converter process of steel making, and has reference more particularly to novel means for suspending the oxygen lance whereby to permit the passage of cranes above the converter and which in addition will afford greater convenience in inspecting, cleaning and servicing the lance.

The oxygen converter process is carried on in a metal vessel lined with refractory material and having an open upper end and which is supported at about its mid-height by two trunnions for permitting oscillatory movement of the converter about a horizontal axis. Oxidation of the metalloids contained in the charge is effected by blowing onto the surface of the charge a continuous jet of oxygen at high pressure with the resultant formation of steel. The lance through which the oxygen is passed contains a central passage for the oxygen and two concentric walls for the inlet and outlet of water for cooling purposes. When receiving oxygen the converter is vertically positioned and the lance passes through a hood and depends into the converter relatively close to the surface of the charge. The height of the point of clearance above the hood is approximately fifty feet. Withdrawal of the lance, so that its lowest point clears the hood, requires an upward movement from the working position of thirty feet or more. Thus the height for suspending the lance must be at least eighty feet which is in excess of any other requirement and so involves expensive construction. Furthermore, the permanent suspension of the lance above the converter prevents the passage of cranes at this point.

In order to avoid the necessity of a high building for lance suspension, and to provide means whereby the main cranes can pass over the converter, and also permit the entire operation to take place in one bay with one system of cranes, the invention has for its objective the provision of tower means for supporting the lance with power driven mechanism in associated relation therewith for raising and lowering the lance, whereby the lance will not present any obstruction to the passage of cranes, excepting momentarily during raising and lowering operations, and which will not extend the height of the crane rails beyond that otherwise required. In addition the improved lance supporting structure will afford greater convenience in inspecting, cleaning and servicing the lance.

Another object of the invention is to provide supporting means for the purposes described which will essentially consist of a tower located at floor level and having a vertically movable mast equipped with a horizontally movable arm for suspending the lance and which accordingly may be raised and lowered with respect to the converter by movement of the mast.

A more specific object is to provide a structural tower having a vertically movable mast mounted within the same and to the upper end of which is fixed a table for a horizontally disposed lance suspending arm, with power means

for raising and lowering the mast and independent power means for oscillating the arm.

A further object of the invention is to provide lance suspension means of the character as described wherein the tower and mast may be constructed of conventional structural elements and wherein cable means are employed for effecting vertical movement of the mast.

With these and various other objects in view, the invention may consist of certain novel features of construction and operation, as will be more fully described and particularly pointed out in the specification, drawings and claims appended hereto.

In the drawings which illustrate an embodiment of the invention and wherein like reference characters are used to designate like parts—

Figure 1 is a front elevational view showing a typical oxygen converter for producing steel with the improved lance supporting apparatus of the invention in associated relation therewith;

Figure 2 is a longitudinal sectional view through the lance supporting arm showing the journalling means for the arm and also showing the lance in suspended relation at one end of the arm;

Figure 3 is a transverse sectional view through the structural tower of the lance supporting apparatus taken approximately on line 3—3 of Figure 1;

Figure 4 is a transverse sectional view taken approximately on line 4—4 of Figure 1; and

Figure 5 is a transverse sectional view taken approximately on line 5—5 of Figure 1.

The oxygen converter process of steel making is carried on in a steel vessel lined with refractory material and having a solid bottom and an open top end. The vessel, which is termed a converter, is identified by numeral **10** in Figure 1, and trunnions such as **11** project laterally from the converter approximately midway of its height for rotatably supporting the vessel on the standards **12** whereby the converter can be rocked about a horizontal axis for loading and for discharging purposes. Oxidation of the metalloids contained in the charge is effected by blowing onto the surface of the molten metal within the converter a continuous jet of oxygen at high pressure and the lance through which the oxygen is passed is identified in its entirety by numeral **14**. The oxygen flows through the central passage formed by the tubular member **15** and said member is surrounded by concentric cylinders **16** and **18** for the passage of water under pressure for cooling purposes. The outer cylinder **16** is closed at both ends by the end closure members **20** and the inlet **21** when suitably connected supplies the cylinder with water which flows downwardly to the bottom of the cylinder and then enters the open bottom end of the inner cylinder **18**. In flowing upwardly through the inner cylinder the liquid is in direct contact with the oxygen supply pipe **15** and eventually the liquid is discharged through the outlet **22** since the top end of cylinder **18** is closed by member **23**. A self-aligning seat for the lance structure is provided by the parts **24** and **25** and said parts suspend the lance **14** from the outer end of a lance supporting arm identified in its entirety by numeral **26**.

The hot gases which issue from the open top end of the converter are collected by a hood such as **27** and conducted to the atmosphere. Accordingly, during the conversion process the lance depends through an opening **28** in the hood and into the converter **10**, being positioned approximately two feet above the charge in the converter. The lance must necessarily be suspended above the converter and the same is lowered through the hood and into the converter at the start of the blowing period and is withdrawn at the conclusion of said period. In accordance with the invention, supporting structure is provided

for the lance suspending arm **26** in the form of a structural tower having a vertically movable mast mounted within the confines of the tower, said mast journalling the arm to permit rotation of the arm in a horizontal plane above and over the converter, all as best shown in Figures 2 to 5 inclusive, which structure will now be described in detail.

Referring first of all to the structural tower **30**, the same is supported at ground level by any suitable supporting structure such as **31** which may extend some distance into the ground with only a part of the same, as shown in Figure 1, extending above ground level. The tower essentially consists of four structural beams **32**, **33**, **34** and **35** disposed vertically and which form the four corners, respectively, of the tower. Said structural beams are suitably joined at vertically spaced intervals by the horizontal members **36** and the structural elements of the tower are largely completed by the crossed members **37** and **38** which are located on each side of the four-sided tower for connecting adjacent pairs of structural beams. The tower may incorporate additional bracing as illustrated in Figure 5, wherein facing plates such as **40**, **41**, **42** and **43** are employed in addition to members such as **44**, **45**, **46** and **47**, which provide journalling means for the rollers **50**, **51**, **52** and **53**. Members **44** and **45** have welded thereto the inwardly extending arms **54** which carry the stud shafts **55** for rotatably supporting the rollers **50** and **51**, respectively. In a similar manner the members **46** and **47** have welded thereto the inwardly extending arms **56** which carry the stud shafts **57** for rotatably supporting the rollers **52** and **53**, respectively. The tie bolts **58** serve to the hold the members **44** and **45** in place and similar tie bolts **59** are provided for the members **46** and **47**.

A structural mast indicated in its entirety by numeral **60** is disposed longitudinally within the tower **30** and which is additionally mounted by the tower for movement in directions vertically for the purpose of raising and lowering the lance supporting arm and thus the lance. The mast is fabricated from structural sections and plates and, as best shown in Figure 4, it will be observed that a pair of channel sections **61** and **62** are positioned in facing relation to each other and said channel sections are secured together in desired spaced relation by the central eye-beam **63**. Facing plates such as **64** and **65** complete the structural mast and it will be understood that the structural sections extend for the length of the mast and that the same are suitably welded to each other to form a unitary integral structure. The mast has a length in excess of that of the tower when measured from ground level to the top end of the tower since it is desired that the mast project above the tower in all positions thereof, whereby the lance suspending arm is thus located above the tower and over the converter **10**.

As described in connection with Figure 5, the rollers **50** and **51** are suitably journalled so as to have contacting relation with the channel sections **61** and **62** and thus the mast is supported and guided at the upper end of the tower by said rollers with respect to a Y—Y axis, as shown in Figure 3. The rollers **52** and **53** are journalled so as to have contacting relation with the facing plates **64** and **65** and thus these rollers in a similar manner guide and support the mast with respect to an X—X axis, also shown in Figure 3. The bottom of the mast carries a pulley such as **66** and by means of a cable and pulley structure to be presently described the mast is suitably guided and the mast can be caused to move up and down within the tower for raising and lowering the lance supporting arm. The numeral **70** indicates a converter platform which extends around the converter **10** with sufficient clearance to permit rocking of the converter for charging and discharging purposes, and said platform also extends around the tower **30** to provide, among other things, a support for the electric motor **71**, the gear reduction unit **72**, and the winch mechanism **73**. The electric motor **71** drives the shaft **74** which has a coupling connection with the gear reducing unit **72** and said unit through shaft **75** is suitably connected to the winch **73** which controls the winding and unwinding of the cable **76**. The winch is additionally connected to brake mechanism such as **77**, and this unit is also supported on the converter platform **70**.

The cable from the winch **73** extends downwardly, as shown in Figure 1, to pass around pulley **78** suitably journalled by the member **80** fixed to the tower **30** adjacent the lower end thereof. From the pulley **78** the cable extends upwardly and passes around the pulley **81** journalled by structure forming part of the tower, as best shown in Figure 4. From the pulley **81** the cable extends downwardly within the tower and passes around pulley **66** carried by the mast **60** at its lower end. From pulley **66** the cable passes upwardly, also within the tower, and over pulley **82** for attachment to the fixed arm **83**. It will be seen therefore that the pulley structure for raising and lowering the mast **60** is also constructed and arranged so as to provide a desirable lever ratio so that the heavy mast and arm supported thereby can be elevated and lowered at a desired rate of travel but which, however, does not place any excessive energy demands on the electric motor **71**.

The lance supporting arm **26** is journalled by the mast at the top end of the mast and as a result the arm may rotate in an arc of at least 90 degrees to permit the lance to service the converter and to be moved away from the converter when not in use. The journalling structure, as shown in Figure 2, includes a top plate **85**, which is secured by bolts **86** to an underplate **87**, the said underplate being welded or otherwise secured to the top end of the mast and forming a right angle with the longitudinal axis of the mast. This built-up top plate structure provides a support for the pintle **88** which projects vertically from the top plate structure in an upward direction to receive the collar **90**. Said collar is fixed to the lance supporting arm by means of the circular underplate **92** and the bolts **91**. To increase the strength and rigidity of the arm in the vicinity of the pintle **88** the arm is provided with transverse channel sections such as **93**. It is also desirable to stabilize the arm, particularly during its rotary movement with respect to the mast, and for this purpose stabilizing rollers such as **94** and **95** are provided and which are cone-shaped so that said rollers have a surface complementary to the tapering outer surface **96** formed around the periphery on the underside of the top plate **85**. For journalling the rollers **94** an arcuate member such as **97** is suitably welded to the undersurface of the lance supporting arm **26** in concentric relation with the pintle **88**. At spaced intervals around the arcuate member **97** a collar **98** is inserted through an opening in the member and said collar is welded in place. The collar carries a stud shaft **100** on which a roller **94** is journalled.

In a similar manner an arcuate member **101** is welded to the undersurface of the arm on the side opposite member **97** and also in concentric relation with the pintle **88**. Collars such as **102** are retained by said member at spaced intervals and each collar provides a stud shaft **103** on which a roller **95** is journalled. Thus the arcuate members **97** and **101**, together with their collars and the cone-shaped rollers **94** and **95**, comprise a unit and which has bodily movement with the lance supporting arm **26** as said arm is caused to rotate. The structure is highly successful in stabilizing the arm and maintaining the arm in a horizontal plane approximately at right angles to the longitudinal axis of the mast while permitting freedom of the arm to rotate with respect to the pintle **88**. Whereas, the weight of said arm and structures carried thereby is applied to the top plate **85** as a downward force in compression, it will be seen that any bending stresses of the arm caused by deviation from its horizontal plane will be applied by the cone-shaped rollers **94** and **95** to the underside of said top plate and there-

fore in an upward direction in opposition to the compression forces.

For rotating the lance supporting arm **26**, a gear segment **104** is secured by bolts **105** to the top surface of plate **85** and on that side of the plate adjacent rollers **94**, as viewed in Figure 2. A driving pinion **106** is adapted to mesh with the gear segment **104** and the pinion is suitably journalled by the drive shaft **107** located within the gear housing **108** and having the worm gear **109** fixed thereto. The worm gear **109** has meshing relation with a pinion, not shown, fixed to shaft **110** of the gear reducing unit **111**, and an electric motor **112** has driving connection with the gear reducing unit through the shaft and coupling unit identified by numeral **113**. Accordingly, energization of the electric motor **112** will rotate shaft **110** of the gear reducing unit **111**, and through worm gear **109** the shaft **107** is driven to produce rotation of the pinion **106**. Since the gear segment **104** is stationary, being fixed to the top plate structure **85** and **87** of the mast **60**, it will be understood that the arm **26** is caused to rotate with respect to the gear segment and for most installations it is desirable that the gear segment and associated parts be constructed and arranged to permit the arm to rotate in an arc of at least 90 degrees.

The gear housing **108**, gear reducing unit **111**, and electric motor **112** are located on the arm **26** on that side of the pintle **88** opposite the lance **14**, and accordingly, this driving structure for effecting rotation of the arm additionally functions as a counterbalancing weight for counterbalancing the lance. Since the lance is located at a much greater distance from the pintle **88**, it may be necessary to supply additional counterbalancing means and the same may take the form of a concrete block such as **114** suitably fixed to the end of the arm **26** below the motor **112**.

For servicing the converter at the start of an oxygen blowing period the motor **71** is energized to wind up the cable **76**, which has the effect of elevating the mast **60** and the cable is wound on the winch until the mast, the lance supporting arm, and the lance are all located in the elevated position as illustrated by the dotted lines in Figure 1. While the parts are held in this position the motor **112** is energized to effect rotation of the lance from an inoperative position disposed to one side of the converter to a position directly over the converter and in line with opening **28** in the hood **27**. The brake **77**, having associated relation with the winch structure **73**, is then actuated to release the winch to effect a lowering of the mast **60** and a lowering of the lance through opening **28** and into the converter **10**. The lance is now in a position to supply oxygen to the surface of the molten metal within the converter and at the conclusion of this operation the lance is withdrawn from the converter and by rotation of the arm the lance is again located to one side of the converter. Upon movement of

the mast to its lowered position the parts remain as thus located until the start of another oxygen blowing period. The motors **71** and **112** may be electrically interlocked one with the other and both motors may be interlocked with the motors of a crane positioned above and adapted to pass over the converter. As a result the lance supporting structure cannot be actuated when the crane is over the converter and likewise the crane cannot be operated when the lance structure is over the converter, so that operation of one cannot interfere with that of the other.

I claim:

1. In lance supporting structure, the combination with an oxygen converter for producing steel, of a structural tower terminating at a height above the open top end of the converter when said converter is vertically positioned, a structural mast disposed within the tower for vertical movement parallel to the longitudinal axis of the tower, roller means journalled by the tower for guiding the mast during its vertical movement, said mast having its top end extending above the top end of the tower in all vertical positions of the mast, top plate structure fixed to the extending end of the mast and having a right angle relation with the mast, a pintle anchored by the top plate structure and projecting upwardly from said structure, a lance supporting arm, journalling means including said pintle and top plate structure for supporting and rotatably mounting the lance supporting arm for movement in a horizontal plane, a gear segment fixed to the top plate structure, a pinion gear journalled by the arm and having meshing relation with said gear segment, motor mechanism carried by the arm for driving the pinion gear whereby to effect rotation of the arm, an oxygen supplying lance suspended from the end of the arm opposite the motor mechanism, and means in associated relation with the mast and tower for effecting vertical travel of the mast with respect to the tower.

2. Lance supporting structure as defined by claim 1, additionally including stabilizing rollers supported from the arm and having contact with the undersurface of the top plate structure for stabilizing the arm during rotation of the same.

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