The invention relates to apparatus for servicing a converter as employed in the oxygen converter process of making steel and has reference in particular to apparatus for operatively suspending the oxygen lance used in the process and for removabley supporting the hood which is positioned over the converter during periods of blowing in order to divert the flue gases and finely divided solid particles contained in these gases to a discharge conduit.

The oxygen converter process of making steel is carried on in a vessel having general resemblance to a Bessemer converter, and the same is charged with molten pig iron and cold scrap of iron or steel. A water-cooled pipe called a lance is lowered through the hood and into the converter to a point where the nozzle of the lance is relatively close to the molten metal. Oxygen under pressure is conveyed to the operation through this lance. Oxidation of the metalloids is effected by blowing onto the surface of the molten metal a continuous flow of oxygen with resultant formation of steel. When discharging oxygen the lance extends through a hood covering the upper open end of the converter, the said hood forming part of the conduit means through which the carbon gases and some fuscous oxide fumes are led to gas washing apparatus. With the hood supported in stationary position, withdrawal of lance from converter and through hood requires upward movement from the working position of thirty feet or more. With lance suspended from above, as hereinafter practiced, the height of the lance suspension must be at least eighty feet, which is in excess of any other requirement and so involves expensive construction. The permanent suspension of the lance above the converter prevents the passage of cranes at this point. As a result of these conditions the converter has hereinafter been located within a narrow side bay in such a way that the lance may be suspended within the bay and be vertically lowered to a central position within the converter, while the converter may be tipped to the charging side and so receive a charge from the main crane. An auxiliary crane is located in the side bay above the lance suspension, making a total height of the side bay of one hundred feet or more. Further, the stationary position of the hood limits access to the converter and prevents free and full use of the crane for charging and for maintenance.

In order to avoid the necessity of a high building for lance suspension, to provide means whereby the charging and the lance through which the oxygen lance and for supporting the hood. The lance is suspended so that it can be lowered into and withdrawn from the converter. Also the lance and hood have bodily movement upon movement of the carriage to and from an operative position over the converter.

Another object of the invention resides in the provision of a movable carriage in combination with track structure for supporting the carriage for movement on the operating floor of the converter from an inoperative position on one side of the converter to an operative position over the same. When the carriage is properly positioned, free access may be had to the converter. Also, it is possible to lower the lance to the operating floor to permit removal of the slag formed on the outside of the lance during the blowing period, or the lance may be lowered to ground level for convenient servicing or for lance replacement.

A further object is to provide a carriage which will support the hood and the lance in such associated relation that both the length of the lance and its vertical travel are materially shortened. Also by moving the hood from its operative position over the converter the space directly over the converter is made available for use by the overhead charging crane.

Another object is to provide a carriage which will have a vertically reciprocable supporting standard structurally combined therewith and which carries a fixed arm for in turn supporting the lance.

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 thereto.

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

FIGURE 1 is a side elevational view illustrating the typical oxygen converter for producing steel with the improved lance and hood carriage of the invention associated therewith although inoperatively positioned to one side of the converter;

FIGURE 2 is a side elevational view similar to FIGURE 1 but showing the carriage in operative position over the converter and with the lance in suspended position within the converter;

FIGURE 3 is a view of the right hand end of the apparatus as shown in FIGURE 2, looking in a direction toward the left;

FIGURE 4 is a fragmentary side elevational view showing structural details of the vertically reciprocable standard, the lance supporting arm fixed thereto, and the lance which is suspended from the arm; and

FIGURE 5 is an end elevational view similar to FIGURE 3 but illustrating a modified form of carriage coming within the invention.

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 the drawings and trunnions such as 11 project laterally from the converter approximately midway of its height for rotatably supporting the vessel on the standards 12 and 13, whereby the converter can be rocked about a horizontal axis for charging and for discharging purposes. Oxidation of the metalloids contained in the molten metal within the converter is effected by blowing onto the surface of the charge a continuous jet of oxygen and the lance through which the oxygen is introduced at an elevated temperature. A platform extends about the converter, being disposed a short distance above the trunnion level and the same provides an operating floor 15 for the converter. The said platform is spaced a sufficient distance from the converter to provide clearance for rocking the same, which operations are necessary in the charging of the converter and in the pouring of the hot steel into the ladles located below the converter at floor level.

In the illustrated embodiment of the invention the operating platform is formed by the horizontally positioned structural beams 16 and 17 which are conveniently supported from ground level by the columns 18. As best shown in FIGURE 5, the converter is located in the vicinity of a wall 19 of the building which houses the steel making apparatus as shown in the drawings.
3. 20 serves as a support for one side of the carriage runway and also extends upward for support of the overhead charging crane runway girder. Said column may also be connected to or integral with the building column, which column or columns are supported by foundation 21. The charging crane is not shown since the same is conventional equipment being required in such steel making apparatus for charging the converter with the necessary materials and for tilting the ladle for pouring the molten steel into the converter.

The carriage of the invention for suspending the lance 14 is indicated in its entirety by numeral 24 and it will be observed from FIGURE 3 that the said carriage at one side is supported by the operating floor and at its opposite side the carriage is supported by the column 20. The carriage essentially consists of a plurality of connected beams and girders, the flat top of the carriage being substantially rectangular and comprising a plurality of longitudinal beams such as 25, 26 and 27 and the end beams 30 and 31. The carriage is supported by the vertical legs 32 and 33. At respective ends strengthening and reinforcing plates 34, of substantially triangular shape, are suitably welded to the end beams 30 and 31 and to the vertical legs 32 and 33, respectively, for strengthening the structure and for rendering the structure rigid to withstand the stresses and strains to which the same is subjected in operation. The vertical legs are thus secured to the longitudinal beam 25. Longitudinal beam 26 supports the vertically reciprocable standard 35 and the mechanism for operating the same, whereas beam 27 joins the end beams at the side adjacent the column 20.

To support the carriage 24 for movement to and from an operative position over the converter the longitudinal beam 16 of the operating floor 15 is provided with a rail 36 and the vertical legs 32 and 33 of the carriage are equipped with the flanged wheels 41 which have rolling movement on the rails 40. The rails 36 and 40, although parallel with each other, are disposed at different levels to accommodate the special shape of the carriage. In FIGURE 1, said carriage is positioned to one side of the converter and the lance is shown in its elevated position for clearing the top of the converter. In FIGURE 2, the carriage has been moved on the rails 36 and 40 to an operative position over the converter and the lance has been lowered into the converter, as shown. The structure for supporting the lance and for supplying the same with oxygen and with a cooling liquid, such as water, will now be described.

The lance supporting structure is best shown in FIGURE 4, wherein it will be observed that the longitudinal beam 26 has supporting framework, including the triangular plates 42, suitably secured thereto by means of the securing nuts 43. Said supporting framework includes additional plates 44 and 45 for mounting the standard 35 for vertical reciprocating movement. Guiding means for the standard are provided in the form of a plurality of rollers 46 and 47, the former being suitably journaled by shafts 48 positioned in the upper part of the supporting framework and the rollers are journaled by shafts 50 in the lower part of the framework adjacent the supporting beam 26. The housing 51 is suitably suspended from the supporting framework 42. Said housing mounts an electric motor 52 which has the hoisting drum 53 suitably secured to its drive shaft 54. The cable 55 is wound around said drum and said cable depends from the same so as to pass around the sheave 56 carried by the standard 35 as described.

The flexible cable 55, after passing around sheave 56, extends upwardly for connection at 57 with the supporting framework 42. The standard 35, which essentially consists of a structural member such as a channel section, can thus be raised and lowered with respect to the said supporting framework by rotation of the hoisting drum 53.

The supporting arm 60 for the oxygen lance 14 is suitably fixed to the top end of the standard 35. For this purpose the top end of the standard 35 has the metal plate 61 welded thereto as required in such steel making apparatus. A portion of standard 35 is shown in FIGURE 5, with an hanger 62 and a feature of this structure resides in the provision of a cap such as 63 at the top end of the lance which is in the form of a truncated cone. The said cone-shaped top end is adapted to fit within an opening of similar shape formed in the casting 64 carried by the lance suspending end of the arm 60. The sheaves 65 and 66 at respective ends of the arm together with the idler pulleys 67 support the chain 62 and it will be observed that the said chain in passing around sheaves 66 extends downwardly to the hoisting drum 68. The electric motor 70 is carried by the counterweight member 71 and the drive shaft 72 is rigidly connected, so that operation of the motor will in turn control the raising and lowering of the lance.

The counterweight 71 through its arm 73 is pivoted at 74 to the supporting arm 60. However, pivotal movement of the counterweight is limited by the slotted link 75. The counterweight substantially balances the weight of the lance 14. Assuming that a lance has been attached to the chain 62, the hoisting drum 68 is therupon rotated to wind up the chain and elevate the lance, eventually causing engagement of the cone-shaped cap 63 with the counterweight 65. The motor 70 will result in upward pivotal movement of counterweight 71 about the pivot 74 and to an extent as permitted by the slot in link 75. When the parts assume such a position a brake on the motor holds the same against reversal and accordingly the counterweight will continuously supply sufficient tension to the chain 62 so as to assure a snug fit of the lance in its seat.

The lance 14 is provided with an inlet and an outlet connection for the cooling water, only one of which, namely, 77, is shown. The third connection to the lance, namely, 78, is indicated in FIGURE 5. The oxygen is supplied to a middle pipe and the same is aspirated downward to the discharge end of the lance. The cold water enters between the oxygen pipe and an intermediate pipe and is likewise directed to the lower end of the lance for cooling said end. The water then returns upwardly in an outer concentric pipe and is subsequently discharged to the sewer. The two supply pipes for the lance and the one discharge pipe are located one above the other, as shown in FIGURE 4, wherein numeral 80 indicates the supply pipe for oxygen, numeral 81 the supply pipe for the cooling water, and numeral 82 the discharge pipe for the returning water. Each of these pipes has connection with a standpipe such as 83. The standpipes are suitably secured to the supporting framework by the fastening means 84 and all three standpipes extend upwardly to a height which is level with the elevated position of the supporting arm 60. As heretofore described, the elevated position of the supporting arm 60, the standpipes maintain their connection to the lance by means of the flexible connecting conduits such as 85. Whereas one end of each flexible conduit 85 connects with its particular standpipe, the opposite end is joined at 86 to a pipe such as 87 carried by the arm 60. The pipes 87 are in turn joined at an intermediate lower end.

The hood 90 for the converter is also carried by the carriage and in accordance with the invention the hood has a fixed position on the carriage so that the same is
centrally positioned over the converter when the carriage is operatively positioned. Said hood essentially consists of a relatively large diameter pipe in the form of an elbow having a lower depending end 91 and an upper horizontally disposed flanged end 92. The three members 93 secure the hood to the carriage in the proper position longitudinally of the crane and said members also provide for adjustment of the hood in a vertical direction. When the desired position of the hood vertically of the carriage has been established to the satisfaction of the operator no further adjustment need be made. Since the hood 90 is adapted to be located vertically of the converter and since the lance must also pass through the open mouth of the converter into the same, it is necessary for the lance to thus pass through the said hood 90. For this purpose the hood is provided with a suitable opening which is restricted in size to just accommodate the lance. Also it may be observed that the hood is generally water-cooled since it is subjected to extremely high temperatures when in centered position over the converter during the blowing period of the lance.

Actually the hood forms the initial section of the conduit means through which the carbon gases and some ferrous oxide fumes derived from the metal are conducted from the converter during the blowing period and delivered to gas washing apparatus. The conduit leading to said washing apparatus is indicated by numeral 94 and the terminal end of this conduit is provided with the vertical flange 95. As best shown in FIGURE 2, the flange 92 of the hood is adapted to contact with flange 95 of the conduit during the blowing period of the converter. In fact, the parts of the apparatus are disposed that movement of the carriage to properly position the hood over the converter will bring the flange 92 of the hood in substantially sealing contact with flange 95. Thus the products of combustion are conducted by the hood from the converter and delivered to the conduit with practically no leakage.

It will be apparent from the foregoing that the length of the lance and also the extent of its vertical travel has been materially reduced by use of the carriage of the invention. It is not necessary to raise the lance to clear the hood, but only a sufficient height to clear the converter. Also when the carriage is in inoperative position the lance can be lowered to the operating floor for cleaning and servicing or the lance can be lowered to ground level for replacement. Another desirable advantage of the carriage resides in the fact that the hood and lance are associated as a unit and, as a result of this joint relation, movement of the carriage will locate both in the proper position over the converter. Also the mechanism for suspending the lance and the mechanism for effecting vertical reciprocating movement of the lance supporting arm are both carried by the carriage and the same are conveniently accessible to the operator for repairs or for replacement of the parts. By employing the carriage it is possible to locate the converter in the main charging bay with the charging crane being completely available for all other operating and maintenance service. In fact, the height of the converter building may be somewhat less, with only slight interruptions to travel of the charging crane, if an electrical interlock is provided between the means for raising and lowering the lance and the mechanism for effecting travel of the charging crane.

In the modification of the invention shown in FIGURE 5, the converter is illustrated as having its trunnion axis below floor level and the carriage is shown as supported for movement by a pair of legs identical in construction and which have location at respective sides of the carriage platform. The converter 110, having the trunnions 111, is suitably journalled thereto oscillating movement for raising in the pit or well 119 and which is located below the floor level 120. Accordingly, in this modification the beam 117 is at floor level, being supported at one end on the ground or on a foundation and at the other end by column 118. Thus a platform 115 is formed from which the operations of servicing the converter may be performed. Additional beams 116 are located on respective sides of the converter at floor level, with the beam on the left being additionally supported by the column such as 118.

The carriage 124 is formed of structural members and which are suitably connected to each other to constitute a unit adapted to have rolling movement on the rails 136 and 140. The flat top of the carriage is similar in all respects to that as shown in FIGURE 3, the same being formed of the longitudinal beams 125, 126 and 127 and is end girders 130. A web is a single plate, four corners of the flat top, the legs 132 and 133 depend to complete the carriage. Triangular plates 134 serve to connect the legs to the end girders and to thus additionally strengthen the entire structure of the carriage.

The lance supporting structure is also substantially similar to that as previously described since the standard 135, having the supporting arm 160 fixed thereto, suspends the lance 114 and in so doing provides for movement of the lance for lowering and elevating the same with respect to the converter. The standard 135 is carried by the carriage and the standard may be mounted for vertical reciprocating movement which is accomplished by the cables 155. Likewise the lance is cable supported from the arm 160 and which normally holds the lance in position with its upper end in contact with the extending end of the arm. However, the lance can be easily and conveniently lowered to the floor by actuation of the hoisting drum 68, as best shown in FIGURE 4. Actuation of the hoisting drum to raise and lower the lance in this manner does not require movement of the standard 135 and thus the standard could be of a fixed height. Also the carriage not only supports the lance and hood for movement to and from an operative position over the converter but also additionally facilitates access to the converter from above. Thus the nose of the converter is conveniently accessible to permit easy cleaning of the same or for relining the converter. The converter can also be charged with scrap or other additions, all of which can be done more conveniently than by tipping the converter.

In order to guide and steady the lance during its blowing period, the invention contemplates the provision of means such as 97 having location immediately above the opening 96 in the hood through which the lance extends. The clamping and steadying means for the lance could be mounted on a bracket provided by the hood or by the carriage or the said means can be disposed directly to the hood as shown in FIGURE 1 and 2.

The invention is not to be limited to or by details of construction of the particular embodiment thereof illustrated by the drawings, as various other forms of the device will of course be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

What is claimed is:
1. In a lance supporting structure, the combination with an oxygen converter for producing steel, of an operating platform for the converter, a carriage supported by the platform for movement from an inoperative position at one side of the converter to an operative position over the converter, a standard carried by the carriage, a supporting arm fixed to the standard, a lance supported from one end of the arm by cable means, mechanism supported by the supporting arm and including a hoist drum for the cable means, whereby the lance can be raised and lowered with respect to the arm, a hood in supported relation on the carriage, said hood having an opening therein through which the lance extends, whereby said hood and lance are located over the converter when the carriage is operatively positioned, and said hood coacting with conduit means when located over the converter for con-
ducting products of combustion from the converter and delivering the same to said conduit means.

2. In a lance supporting structure, the combination with an oxygen converter for producing steel, of an operating platform for the converter, a carriage supported by the platform for movement from an inoperative position at one side of the converter to an operative position over the converter, a standard carried by the carriage and mounted thereby for vertical reciprocating movement, mechanism including a hoist drum supported by the carriage and operative to effect vertical movement of the standard, a supporting arm fixed to the top end of the standard, a lance suspended from one end of the arm by cable means, mechanism also including a hoist drum for said cable means whereby the lance can be raised and lowered with respect to the arm, said last mentioned mechanism being carried by the arm at the end thereof opposite the lance, a hood in supported relation on the carriage, said hood having an opening therein through which the lance extends, whereby said hood and lance are located over the converter when the carriage is operatively positioned, and said hood coacting with conduit means when located over the converter for conducting products of combustion from the converter to said conduit means.

3. In a carriage, in combination, an oxygen converter having an operating platform, a carriage including a top horizontally disposed portion and vertical legs depending from said portion on at least one side thereof, means mounting said carriage for movement on the platform to and from an operative position over the converter, said means including a rail in fixed position on said platform and a wheel carried by each of said legs and having rolling movement on the rail, a standard carried by the top horizontally disposed portion of the carriage, a supporting arm fixed to the top of the standard, a lance suspended from one end of the supporting arm by cable means, mechanism supported by the supporting arm and including a hoist drum for the cable means, a hood in supported relation on the top horizontally disposed portion of the carriage, said hood comprising an elbow section of relatively large diameter pipe and said hood being so located on the carriage that when the same is in operative position the hood is directly over the converter, and said hood having an opening therein through which the lance extends.

4. In a carriage, in combination, an oxygen converter having an operating platform, a carriage including a top horizontally disposed portion and vertical legs depending from said portion on at least one side thereof, means mounting said carriage for movement to and from an operative position over the converter, said means including a rail in fixed position on said platform and a wheel carried by each of said legs and having rolling movement on the rail, a standard carried by the top horizontally disposed portion of the carriage and mounted thereby for vertical reciprocating movement, a supporting arm fixed to the top of the standard, a lance suspended from one end of the supporting arm, mechanism supported by the

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