April 11, 1967 A. G. VANDERBECK 3,313,159

APPARATUS FOR EXTRACTING A METAL SAMPLE DURING A STEEL MAKING OPERATION

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Fig. 1

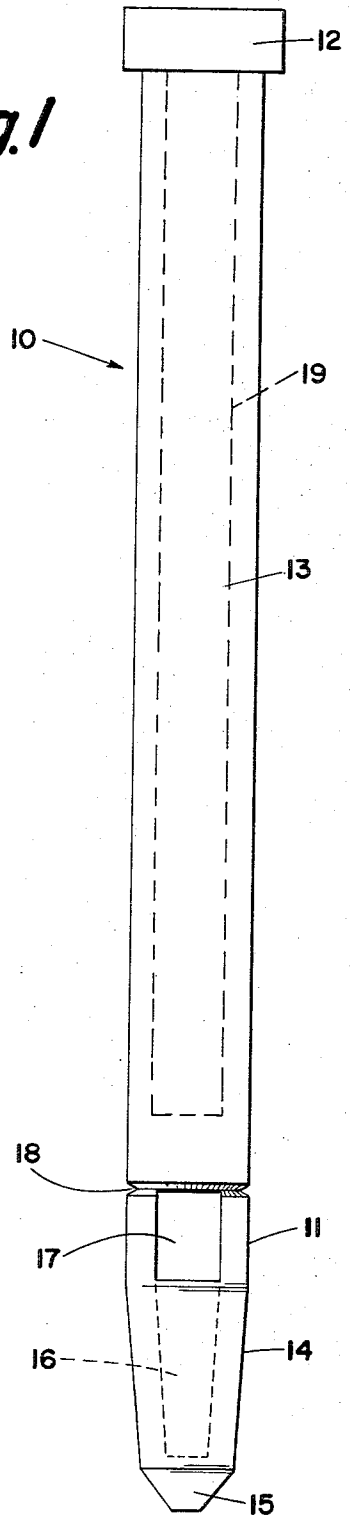

Fig. 2

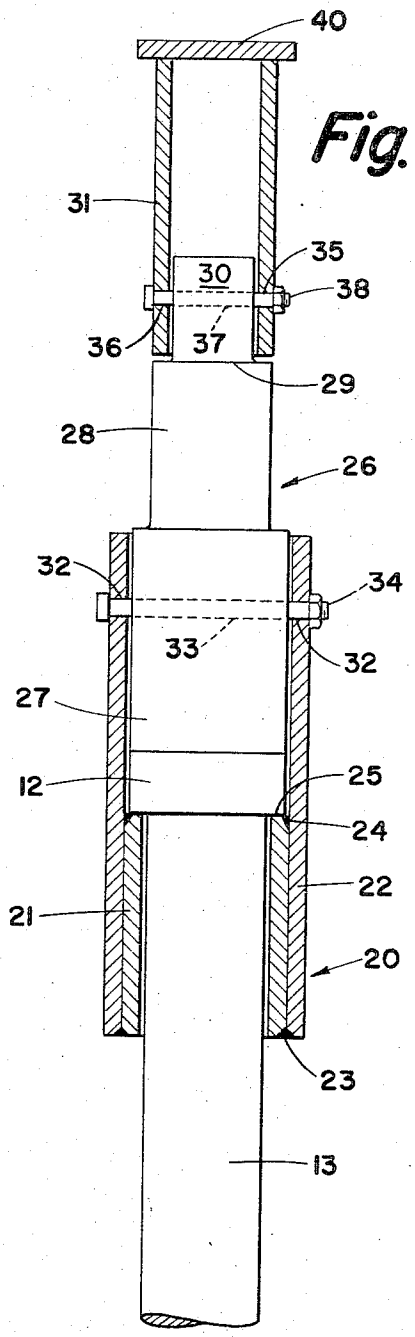

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Fig. 3

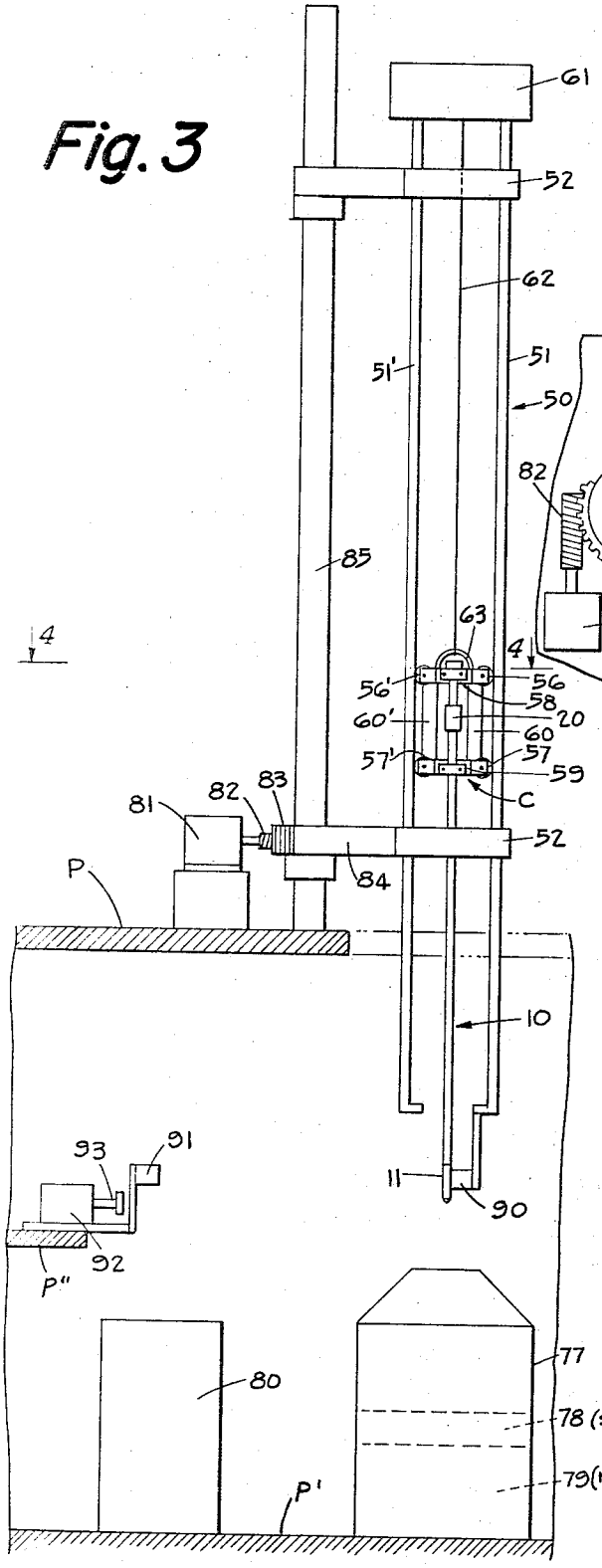
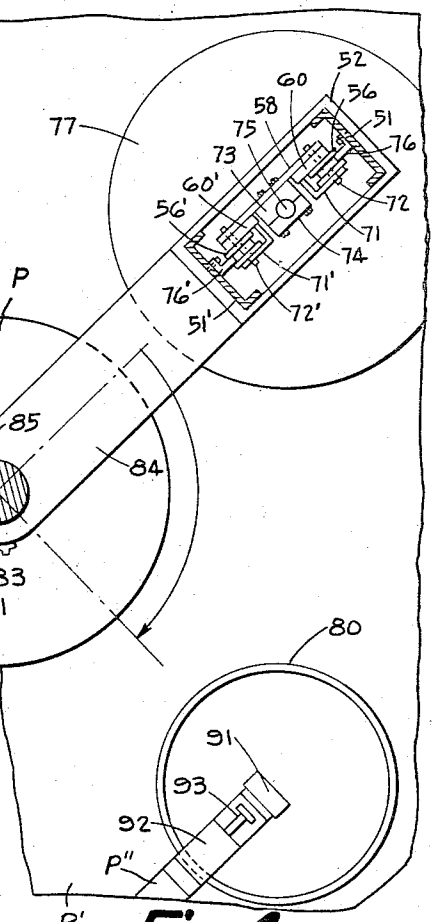


Fig. 4



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APPARATUS FOR EXTRACTING A METAL SAMPLE DURING A STEEL MAKING OPERATION

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The invention relates to improvements in apparatus for use in steel making and is directed more particularly to novel means for taking a sample from a converter for testing purposes in an expedient manner and in a minimum of time.

The invention has particular utility in the oxygen converter process which is carried out in a metal vessel lined with refractory material and having an open access end. Such converters are supported between their upper and lower ends by side trunnions permitting adjustment of a converter, from its vertical operating position, about a horizontal axis. Oxidation of a charge is effected by directing a jet of oxygen by means of lance equipment including a tube through which the oxygen flows under pressure into the converter to form steel of the desired carbon content.

During such steel making operations a converter acquires a lower phase or layer of metal and an upper phase or layer of slag and in order to take a metal sample it is usually necessary to adjust the converter, by tipping, in order to expose the metal for ready accessibility. The purpose of obtaining a sample is to determine the chemical content of the metal and the most desirable operation is to take metal samples frequently in order that the converter operation may be varied as necessary to obtain the desired steel end product.

The apparatus of this invention is directed to the taking of a metal sample while a converter is in operation, that is, while the converter is in a vertical position and provides for the taking of a sample through the upper layer of slag and for the immediate transfer of the sample from a converter to cooling equipment to thus permit continuous operation of the converter.

The equipment used for taking a sample in accordance with this invention utilizes a high tower for mounting hoisting means for lowering and raising a sampler device in a vertical plane into and out of the converter in a vertical path. The tower and hoisting means are arranged to be revolved through an arc to rapidly position the sampler device above a cooling bath and out of the zone of lance, crane and other auxiliary equipment. The sampler device is unique in that it is designed with a probe end which forms a receptacle for the metal and is readily separable from the sampler device after each sampling operation.

Details of the apparatus reside in clamp or guide means mounted on the hoisting equipment and cooperating clamp or guide means located above the cooling bath which releases the sampler probe or receptacle and directs it into the cooling bath. The sampler device is provided with a weakened or circular groove area which permits its lower probe or receptacle end to be separated, for example, by a pressure blow to fall by gravity into the cooling bath.

The broad object of this invention is to provide apparatus for extracting a sample of molten metal from an upright converter during its operation and rapidly removing the sample from the converter zone.

Another object of this invention is to provide apparatus which permits a sample of molten metal to be taken and removed vertically from a converter while in operation and removed to a cooling zone.

Another object is to provide a sampler device having a probe or receptacle end which is readily moved through the slag layer during a steel making operation for extracting a sample of molten metal.

A more specific object is to provide a sampler device formed of ceramic heat resistant material having a probe or receptacle end which is readily separable from the sampler device.

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 one embodiment of the invention and wherein like reference characters are used to designate like parts:

FIGURE 1 is a view in elevation of the sampler device.

FIGURE 2 is a sectional view of certain details to show the manner of assembling and disassembling the sampler device and the hoisting equipment.

FIGURE 3 is view in elevation of the entire assembly for raising and lowering the sampler device in one vertical plane and positioning it in the vertcal plane of the cooling bath.

FIGURE 4 is a sectional view through 4—4 of FIGURE 3.

Referring to FIGURE 1, the sampler device is indicated at 10 and is an elongate unit having a lower probe or receptacle end 11, an upper flanged end 12 with an interconnecting central shaft 13, all of which is constructed of a light weight porous material such as a ceramic or graphite composition for withstanding high temperatures. The probe end has a tapering wall portion 14 terminating in pointed tip 15 and provides a cavity like receptacle 16 having an open communicating mouth 17. A ring groove or channel 18 provides a weakened or fracturable zone permitting the probe to be readily separated from the central portion 13 which as indicated may have a metal reinforcing rod 19 to strengthen the unit.

In FIGURE 2 a coupling is indicated at 20 and is formed of inner sleeve 21 and an outer concentric sleeve 22 into a unit by the weld connections 23 and 24. The inner sleeve provides a socket having an upper ring shoulder 25 on which the upper flange 12 of the sampler device 10 is supported. An adapter 26 has a lower end 27 which extends into the outer sleeve 22 and a central portion 28 which provides a shoulder 29 with its reduced upper end 30 for receiving a tubular shaft 31, as shown. The coupling 20 and adapter 26 provide an arrangement for assembling and disassembling a sampler device 13 and the hoisting equipment and to this end the coupling sleeve 21 is provided with aligned apertures 32 and 32^1 while the lower end 27 of the adapter is provided with a passageway 33 for the reception of a connector assembly 34. Similarly the tubular shaft 31 is provided with aligned apertures 35–36 and the upper end 30 of the adapter is formed with a passageway 37 for the reception of a connector assembly 38. The tubular shaft 31 may be provided with a cap piece 40.

In FIGURE 3, a tower indicated at 50 is formed of spaced generally similar U-shaped beams $51–51^1$ which are interconnected, for example, by a number of clamps 52 for strengthening purposes. A carriage indicated generally at C is shown located adjacent the lower end of the tower 50 and is formed of a pair of upper and a pair of lower grooved wheels $56–56^1$ and $57–57^1$, respectively. The upper pair of wheels is interconnected by a horizontal support 58 and the lower pair by a similar horizontal support 59 while vertical braces $60–60^1$ are provided to form a unitary structure.

The carriage is arranged to mount the assembled struc-

ture of FIGURE 2 in a manner permitting the sampler device **10** to be connected to and disconnected from the coupling **20** and for this purpose a service floor or platform P is provided from which access may be had to the carriage between the beams **51** and **51¹**. The carriage is raised and lowered by means of a winch **61** mounted on the tower upper end and cable **62** which is attached to a bail **63** secured to the carriage horizontal support **58**.

The structural details of the horizontal supports **58** and **59** are shown in FIGURE 4 and since the support structures are similar only the details of support **58** will be described. These supports are mounted between U-shaped beams **51** and **51¹** and each has a pair of L-shaped axle mounts. Support **58** has the axle mounts **71–71¹** fixed thereto to receive axles **72–72¹** for rotatably carrying the wheels **56–56¹**. A split socket is formed by a section **73** which is bolted to the support **58** and a section **74** which is bolted to section **73** to form a cylindrical passageway **75** sufficiently large to permit entry of the element of FIGURE 2. The split socket permits the passageway **75** to be adjusted in size and also provides for clamping of the tubular shaft **31** of FIGURE 2 in position while the cover piece **40** provides an outer flange for supporting the assembly of FIGURE 2 in the passageway **75**. Rails **76–76¹** for the carriage C extend vertically of the beams **51** and **51¹** and as shown in FIGURE 4, the rails may be L-shaped and secured by bolt connections for receiving the grooved wheels **55–55¹** and **57–57¹**.

As explained in connection with FIGURE 3, the carriage C is raised and lowered in a vertical path by means of the winch **61** and cable **62**. This operation is for the purpose of inserting the sampler device **10** into the converter **77** through the slag layer **78** and into the metal layer **79** to extract a metal sample which is retained in the receptacle **16** of probe **11** and withdrawn from the converter. The upper slag layer **78** is lighter than the lower metal layer **79** and as the sampler device **10** is inserted into the converter the pointed end **15** and tapered wall **14** in effect tend to form a conical passageway in the slag layer which permits the metal to enter the aperture **17** and fill the receptacle **16** to thus prevent slag from entering the receptacle as the device is withdrawn from the converter. In this connection it will be understood that the insertion of the probe and its removal from the converter is accomplished in a minimum of time since the converter is in operation.

After the sample is extracted or picked up, it is removed from the zone above the converter for the purpose of examination. To this end a cooling bath **80** is provided conveniently on the same floor level P¹ as the converter and the entire tower structure is rotated to a position directly above the bath. This may be accomplished, as shown in FIGURES 3 and 4 by motor means **81** driving a pinion **82** which meshes with a worm gear **83** mounted on a bearing support **84**. The bearing support **84** may be an extension of lower clamp **52** and mounted for rotative movement about a standard **85** fixedly attached to the platform P.

As the sampler device **10** is raised by the carriage C to the position shown in FIGURE 3 and the tower **50** is rotated to a position above the bath **80** means is provided for clamping the probe end **11**. This means may take the form of a first arcuate jaw **90** fixed to the lower end of beam **51** and a second arcuate jaw **91** which is fixedly positioned above the cooling bath **80** on a support **92** located on an intermediate platform P¹¹ in horizontal alignment with the jaw **90**. As the tower **50** is positioned directly above the cooling bath, the jaws **90** and **91** will coact to hold the probe **11** when an impact of sufficient force to sever the probe is applied through an air hammer **93** and jaws **90** and **91** are separated, the probe will fall into the cooling bath **80**.

I claim:

1. In combination:

(a) an upright converter having an upper open end and operated in an industrial steel making process wherein a body of molten metal is accumulated,

(b) tower structure disposed above the converter and mounting a carriage therein for vertical movement,

(c) means supported by the tower structure for effecting vertical movement of the carriage in alternate downward and upward directions,

(d) said carriage having brace structure providing a vertical socket,

(e) a sampler device formed of an elongated shaft having a probe at one end,

(f) said elongated shaft being receivable in said vertical socket to position the probe below the carriage,

(g) said probe forming a receptacle and being operable when the carriage is moved in the downward direction to extract a sample of the molten metal from the converter and to remove the sample from the converter when the carriage is moved in the upward direction and

(h) a grooved area between the elongate shaft and the probe to permit the probe to be readily separated after a sample has been extracted.

2. The combination as set forth in claim **1**, further characterized by the sampler device being formed of ceramic material and having a grooved area between the elongated shaft and the probe to permit the probe to be readily separated after a sample has been extracted from the converter.

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