

# United States Patent

[19]

Falk et al.

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## [54] PNEUMATIC METAL SAMPLER

220,285 4/1968 Sweden ..... 73/DIG. 9

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[51] Int. Cl. .... G01n 1/12

[58] Field of Search 164/254, 256; 73/DIG. 9, 425.6

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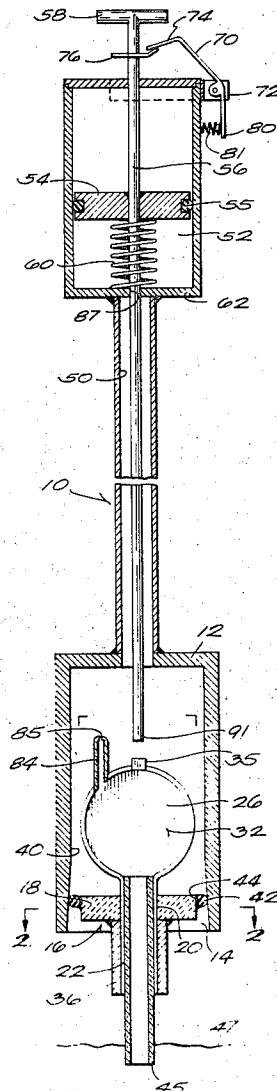
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[57]

## ABSTRACT

Apparatus for obtaining a sample of molten metal includes a sample cartridge with an entry port for receiving the sample and a lance with a cartridge receiving chamber which holds the cartridge while a sample is taken. The lance chamber is sealed by a gasket on the sample cartridge and a pump or other pressure reducing device in the lance in communication with the chamber lowers the pressure in the cartridge to cause a flow of molten metal into the cartridge interior.

8 Claims, 5 Drawing Figures



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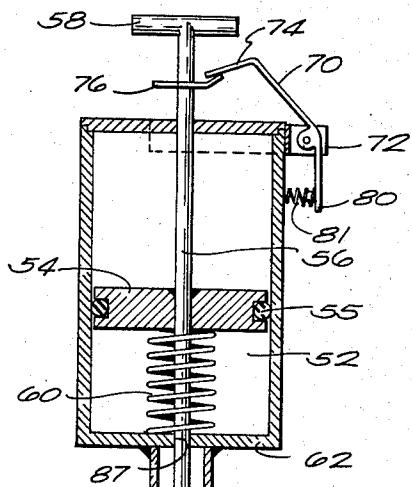


Fig. 1

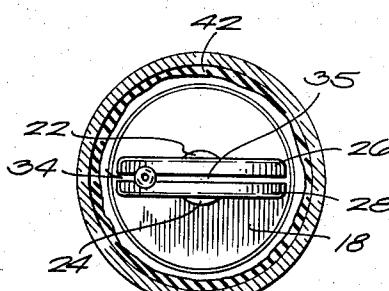


Fig. 2

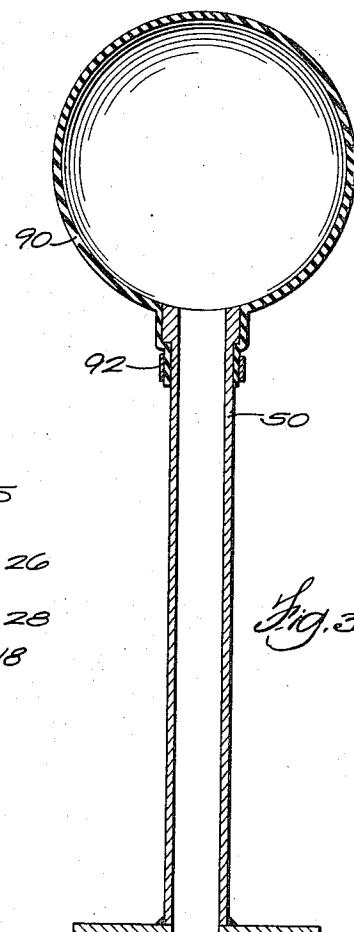
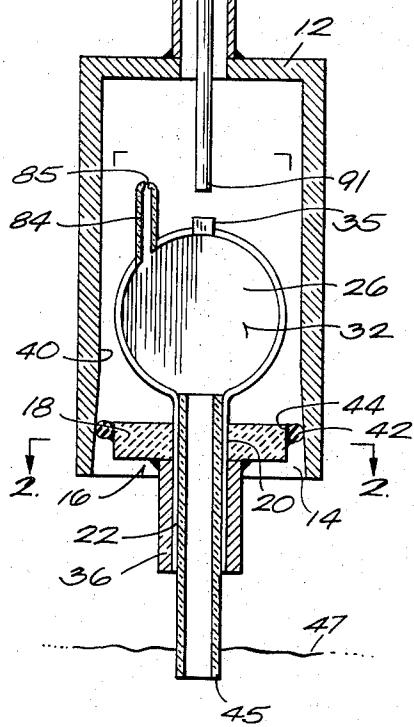


Fig. 3



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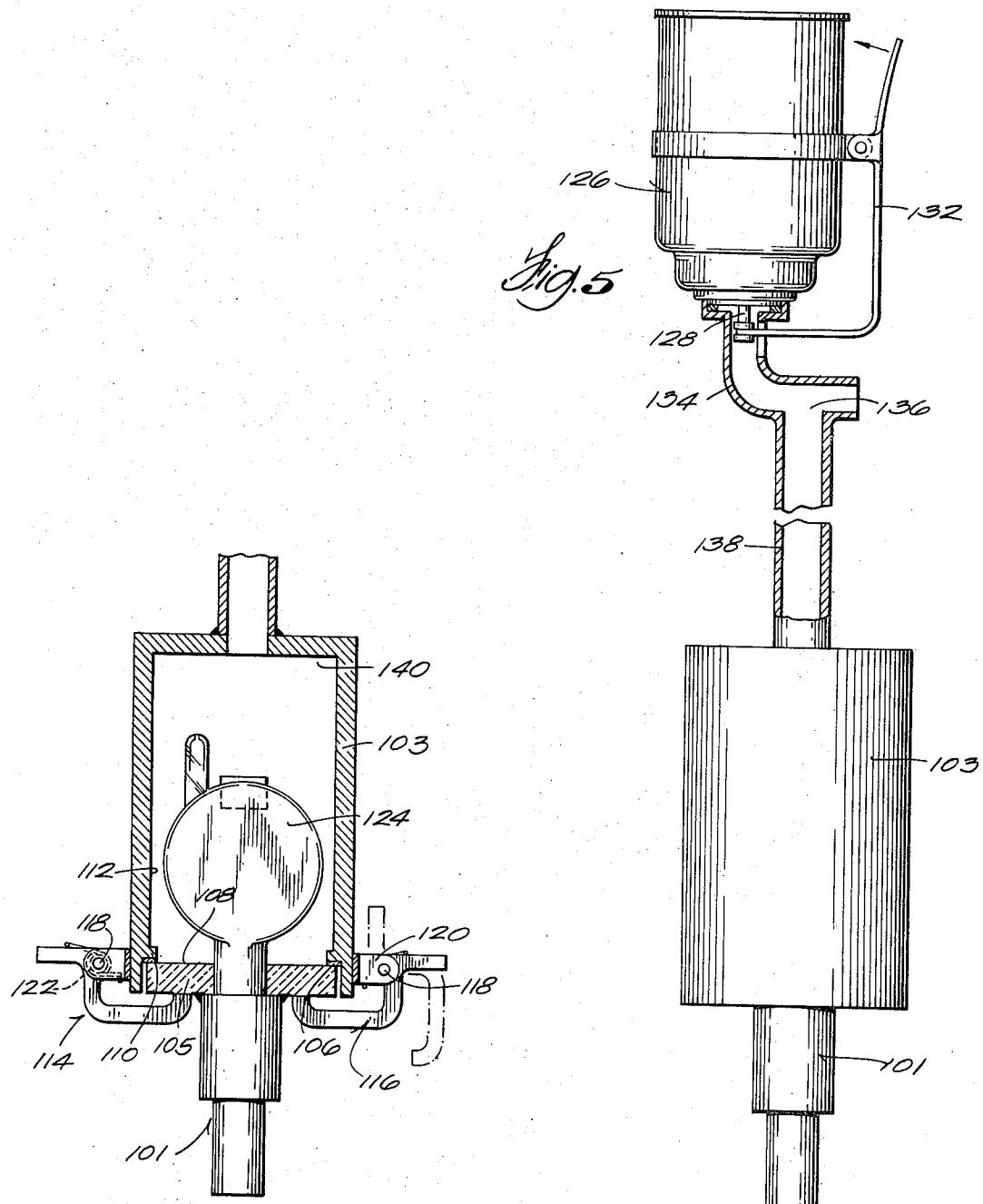


Fig. 4

Fig. 5

## PNEUMATIC METAL SAMPLER

## SUMMARY OF INVENTION

The invention provides apparatus for obtaining a sample of molten metal from any source of clean metal such as an ingot, a ladle or dish by reducing the pressure in the sampler to cause a flow of metal into the sampler. The apparatus consists of two main parts, a disposable sample cartridge and re-usable sample lance. The sample cartridge can be in the form of a sample mold with opposed mold halves or parts with a smooth walled tube projecting from the mold for immersion in the metal. The sample cartridge includes a ceramic or refractory insulator or splash shield which carries a gasket to seal the sample cartridge in a downwardly open cylinder or cup at the end of the lance. The refractory shield minimizes heat transfer from the source of molten metal into the lance cup.

In accordance with the invention metal flow from the source through the projecting tube is caused by reducing the pressure in the mold cavity.

In one embodiment, the pressure in the sampler is reduced by a squeeze bulb at the end of the lance, and in a modified embodiment, a pump having a piston and cylinder is cocked against spring bias prior to immersion of the sample entry port into the molten metal with the piston subsequently released by a trigger to move under bias of the spring and evacuate air in the lance chamber and sample cavity of the cartridge.

In a further modified embodiment, the pressure is reduced by a pressure tank which provides a discharge of air transversely across the end of a tube communicating with the lance cup to reduce the pressure in the mold.

Further objects, advantages and features of the invention will become apparent from the following disclosure.

## DESCRIPTION OF DRAWINGS

FIG. 1 is a side elevational view in fragmentary section showing the sampling lance and sample cartridge of the invention.

FIG. 2 is a view taken along the line 2—2 of FIG. 1.

FIG. 3 is an elevational view in fragmentary section of a modified embodiment of the invention.

FIG. 4 is a side elevational view in fragmentary section of a further modified embodiment of the sample cartridge and lance.

FIG. 5 is a side elevational view in fragmentary section of a modified form of the lance.

Although the disclosure hereof is detailed and exact to enable those skilled in the art to practice the invention, the physical embodiments herein disclosed merely exemplify the invention which may be embodied in other specific structure. The scope of the invention is defined in the claims appended hereto.

In the drawings, FIG. 1 shows a sampling lance 10 which has a housing or bell-shaped receptacle 12 which is open at 14 to detachably receive a sample cartridge 16. As shown in FIG. 1, the sample cartridge is provided with a refractory disc or shield 18 which has a central aperture 20. The aperture 20 receives semi-cylindrical projecting portions 22 and 24 of opposed mold halves or parts 26 and 28. A fused quartz tube 30 provides a metal entry passage into the mold cavity 32. The mold halves 26, 28 can be welded to a spacer 35 which provides a gap 34 forming an air vent for the mold cavity. A paperboard sleeve 36 extending from

the refractory shield 18 protects the quartz tube 30 and encapsulates the projecting portions 22, 24 of the mold halves to securely hold the mold parts together when the sample is taken. The paperboard sleeve 36 is easily removed for retrieval of the sample.

In accordance with the invention, means are provided for releasably securing and sealing the sample cartridge 16 in the interior of the housing 12. In the disclosed construction, the means comprises a tapered wall surface 40 on the inside of the housing and an O-ring sealing gasket 42 which is carried by an annular groove 44 in the disc and desirably adhesively secured to the shield 18. In use, the cartridge 16 is firmly pressed into housing 12.

The invention also provides means for reducing the pressure in the mold cavity 32 when the tip 45 is immersed in molten metal 47. In FIG. 1, the means includes an interior passage 50 in pipe 51 which communicates with a pumping chamber 52 defined by a cylindrical wall 53 located at the upper end of the pipe 51. A piston 54 is reciprocal in the pumping chamber 52 and is provided with a gasket or piston ring 55 to provide an air seal. The piston 54 is connected to a piston rod 56 which projects exteriorly from the cylinder and can be provided with a handle 58. A spring 60 arranged around the piston rod and located between the piston 54 and the end wall 62 biases the piston in a direction away from the sample cartridge.

Means are provided for holding the piston 54 against the spring 60 when the spring 60 is compressed. In the disclosed construction, the means comprises an arm 70 which is pivotally supported to the cylinder by a bracket 72. The arm 70 has an end 74 which is engageable with a projection 76 on the piston rod. The piston 54 is cocked by manual pressure on the handle 58 to compress the spring 60 and engage the arm end 74 with the projection 76. The sample cartridge can then be inserted and the tip 45 of the tube 30 immersed in the molten metal. Pressure on arm portion 80 against the bias of spring 81 will cause dis-engagement of the arm end 74 with projection 76 and allow the piston to move in response to bias of spring 60 to evacuate or reduce the pressure in the mold cavity 32 and cause an in-flow of metal into the mold cavity 32.

The piston rod 56 can be provided with a rod portion 83 which is guided through aperture 87 in the end wall 62 and which projects through passage 50 into the housing 42. Downward pressure on the handle 58 will cause the tip 91 of the ejector to engage and displace the cartridge from the housing 12.

The sampler can also be provided with one or more pin sample molds 84 in the form of glass tubes which project into the mold cavity 32. The tubes 84 are provided with air vents 85. The reduced pressure in the inside of housing 12 will cause the tube 84 to fill.

FIG. 3 shows a modified embodiment in which the means for reducing the pressure in the mold cavity 32 comprises a squeeze bulb 90 connected to the end of the tube 50 by a clamp 92. A modified sealing arrangement is also shown in FIG. 3 in which the O-ring 97 is received in an annular groove 99 in the inside wall 100 of the cylinder 102.

FIG. 4 shows a further modification of the means for releasably securing and sealing the cartridge 101 in the housing 103. The refractory disc 105 is provided with a gasket 106 which can be cemented to the inner face 108 of the disc 105. The gasket 106 is clamped against

an inturned annular flange 110 on the inner wall 112 of the housing 103 by two clamps 114, 116. The clamps 114, 116 are pivotally supported on the housing 103 by pins 118 and pairs of spaced ears 120. Springs 122 bias the clamps into engagement with the disc 105.

FIG. 5 shows a modified embodiment of the lance in which the means for reducing the pressure in the housing 103 and the mold cavity 124 comprises a pressure tank 126 with an outlet 128 controlled by a valve 130 and valve arm 132. The outlet 128 communicates with an elbow 134 which has an opening 136 in communication with the pipe 138. The pipe 138 opens into the interior 140 of the housing 103. A blast of air across the opening 136 reduces the pressure in tube 138 to cause a flow of metal into the cartridge 101.

What is claimed is:

1. A molten metal sampler comprising a sample cartridge having a sample mold with a mold cavity having an air vent and a fill tube having an entry port, and said cartridge including a refractory shield between said mold cavity and said fill tube entry port, a lance having a receptacle for receiving said sample mold means for releasably securing and sealing said shield in said receptacle during immersion to prevent flow of metal into said receptacle and exteriorly of said sample mold and to provide a vacuum seal within said receptacle inside of said shield, and means for reducing the pressure in said receptacle interiorly of said shield and in said mold cavity to cause flow of metal through said entry port into said mold cartridge when said sampler is immersed.

2. A molten metal sampler comprising a sample cartridge having a sample mold with a mold cavity having an entry port and an air vent, a lance having a receptacle for receiving said sample cartridge, means for releasably securing and sealing said sample cartridge in said receptacle, and means for reducing the pressure in said receptacle and said mold cavity to cause flow of metal through said entry port into said mold cartridge and wherein said means for releasably securing and sealing said sample cartridge receptacle comprises a tapered inside wall on said receptacle and a sealing gasket secured to said sample cartridge, said sealing gasket interfitting with said tapered wall to provide an air seal with said tapered wall.

3. A sampler in accordance with claim 2 wherein said sealing gasket comprises an O-ring, and wherein said cartridge has an annular refractory shield supporting said O-ring.

4. A molten metal sampler comprising a sample cartridge having a sample mold with a mold cavity having an entry port and an air vent, a lance having a receptacle for receiving said sample cartridge, means for releasably securing and sealing said sample cartridge in said receptacle, and means for reducing the pressure in

said receptacle and said mold cavity to cause flow of metal through said entry port into said mold cartridge and wherein said lance includes a pipe, and said means for reducing the pressure in said receptacle comprises 5 a pump communicating with said pipe, said pump including a cylindrical housing at one end of said pipe, said cylinder having an aperture in communication with the interior of said pipe, a piston reciprocal in said cylinder, and means for moving said piston to evacuate 10 air in said cartridge to cause a flow of metal into said cartridge including a spring for biasing said piston and manually operable means for releasably holding said piston against the bias of the spring, and causing movement of said piston under bias of said spring when said 15 manually operable means for releasably holding said piston is actuated.

5. A sampler in accordance with claim 4 wherein said means for moving said piston comprises a piston rod having one end projecting through said cylinder end 20 wall and means on said piston rod for manually manipulating the position of said piston.

6. A sampler in accordance with claim 5 wherein said piston rod extends through said passage in said pipe, with said piston rod being located relative to said cartridge so that movement of said piston rod causes contact of said rod and said cartridge to eject said cartridge from said receptacle.

7. A sampler in accordance with claim 1 wherein said lance has a passage in communication with said receptacle and said means for reducing the pressure in said receptacle comprises a pressure tank on said lance, said pressure tank having a supply of gas under pressure and an outlet, and means connected to said outlet and in communication with said passage for reducing pressure in said passage to cause a flow of metal into said mold cavity upon discharge of gas from said pressure tank.

8. The combination of a reusable sampling lance including a pipe adapted for repetitive use with consumable sample cartridges, each of said sample cartridges including opposed mold parts defining a mold cavity, said mold parts being spaced to provide an air vent, wall means connected to and communicating with said mold cavity and defining a passage for filling said mold cavity with molten metal, wall means defining a receptacle open at one end for receiving said opposed mold parts, means connecting said receptacle to said pipe and means connected to said mold parts for supporting said mold parts in said receptacle and providing an air seal between said open end of said receptacle and said mold parts and pressure reducing means connected to and supported on said pipe for evacuating said receptacle and said mold cavity to cause a flow of metal into said mold cavity.

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