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DEVICE AND METHOD FOR SAMPLING MOLTEN METAL

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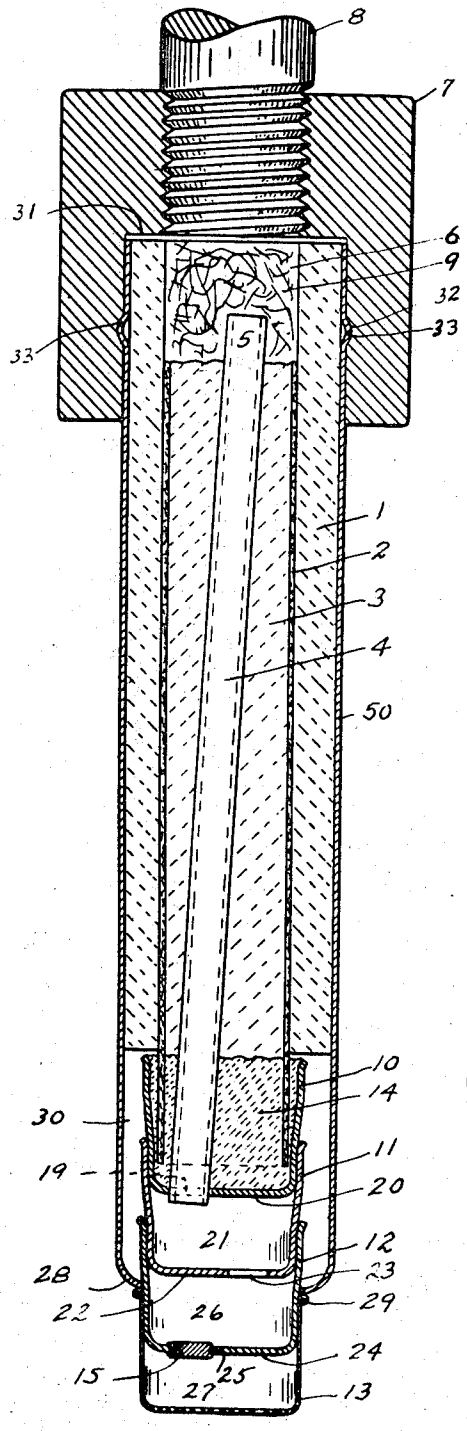


FIG. 2

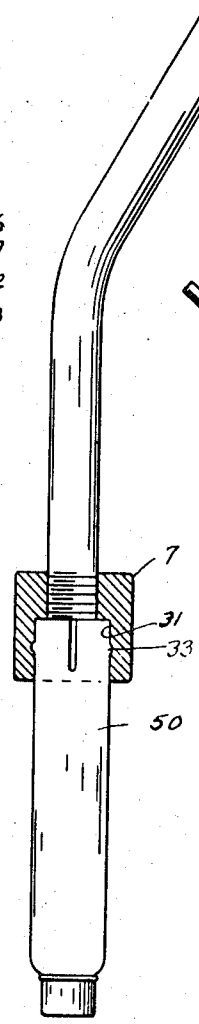


FIG. 3

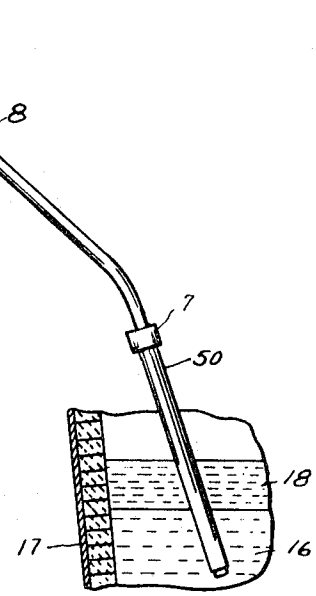


FIG. 1

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DEVICE AND METHOD FOR SAMPLING MOLTEN METAL

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U.S. Cl. 73—425.4 7 Claims

ABSTRACT OF THE DISCLOSURE

A molten metal sampling device having a tubular housing adapted to be dipped into a molten metal pool and able to withstand the high temperatures for at least a short period. A receiver for the sample is held within the housing and extends beyond the lower end thereof. The invention involves an additional sheath embracing the housing and extending beyond the lower end thereof and beyond the lower end of the receiver forming an air-space for protecting the lower ends of the two elements.

This application is a division of my continuation-in-part application Ser. No. 731,640.

The device, embodying the invention, may be employed wherever applicable and has proven very efficient and reliable in obtaining samples of molten metal for chemical analysis of all of its elements including the amount of gases, such as oxygen, hydrogen and nitrogen contained therein may be ascertained. The sample may be obtained from any chamber such as an open hearth furnace, a basic oxygen vessel, electric furnace or related metal making facility. The sample obtained may also be tested to determine its physical characteristics.

Another important object of the invention is to provide a device which, among other things, comprises a tubular housing; means preferably of a frangible material disposed in the housing for receiving a hot liquid such as molten metal; supporting means, such as a mass of frangible insulating material, which surrounds and aids in supporting the receiving means in the housing; means communicatively connected with the receiving means and providing an upper or escape chamber; means providing a lower entrance structure or chamber means communicating with the receiving means, and means disposed in relation to the entrance structure for deoxidizing the molten metal prior to its entry into the receiving means.

Another object is to provide a device in which the housing is preferably tubular and constructed of a molded frangible insulating material and provided with an internal elongated tubular member which has an upper end inset from an upper end of the housing and a lower end which extends beyond a lower end of the housing.

A significant object of the invention is to provide a receiving means which is preferably in the form of an elongated Pyrex glass tube or equivalent frangible material and the supporting means, above referred to, is tubular and disposed in the tubular member and surrounds the tube throughout the major portion of its length.

Another object of the invention is to provide a setup in which the lower entrance structure constitutes an assembly or unit preferably comprised of a plurality of connected cups forming chambers having partitions or walls therebetween which are respectively provided with apertures which are preferably so disposed that the molten metal, upon being successively received in the chambers will be caused to flow in a tortuous path into the receiving means.

A specific object is to provide an organization in which an uppermost of the connected cups contains cement for anchoring a lower extremity of the receiving means and tubular member in the cup and so that the tube will register with or extend through the aperture of the cup into a chamber of an adjacent cup.

Another specific object is to locate the assembly or unit comprising the cups including the lower extremities of the receiving means and tubular member externally of and below the housing.

A further object of the invention is to provide a device of the above character which preferably includes an outer metal casing, sleeve or shield which surrounds the housing, receiving means, tubular member, insulating material, cement and certain of the caps and assists in supporting the same relative thereto.

A specific object of the invention is to provide a wand with a socket and the socket and an end of a sampling device are so designed and constructed that the device may be readily detachably held in the socket whereby to facilitate safe manipulation of the device and the socket and/or wand seals off the upper chamber.

Additional objects reside in providing a device which offers advantages with respect to manufacture and assembly, efficiency, safety, and destruction whereby to obtain access to a recovered sample or specimen.

Other objects and advantages of the invention will become apparent after the description hereinafter set forth is considered in conjunction with the drawings annexed hereto.

Referring to the drawings:

FIG. 1 is a view showing at least one mode of manipulating the device for use in obtaining a sample or specimen from a vessel of molten metal, with only a portion of the vessel being shown;

FIG. 2 is a vertical section taken through the device; and

FIG. 3 is a partial view of a wand having a fitting, shown in section, for detachably receiving the device to facilitate dipping of the latter into the molten metal.

Referring particularly to FIG. 1, the device preferably comprises, among other things, an elongated cylindrical tubular housing **1**, an inner elongated cylindrical tubular member **2** surrounding a mass of insulating material **3**, an elongate cylindrical tubular element **4** constituting a receiving means substantially surrounded and carried by the mass and having an upper end **5** extending beyond the mass and member **4** into an upper venting chamber **6** defined primarily by the upper ends of the housing, mass **3** and a fitting **7** detachably connected to a wand **8** for manipulating the device. The chamber **6** preferably contains a fibrous mass of filter material **9** such as steel wool.

The device also preferably includes an entrance structure or unit comprising a plurality of stacked cups or members **10**, **11** and **12**, and an end cap or cup **13**, a mass of high temperature cement **14** in the upper cup **10**, and a fusible element **15** carried by the cup **12**. The aforesaid components or parts will be described more in detail subsequently.

The housing may be designed and constructed as desired but is preferably made from a frangible molded insulating or refractory material, as shown, or it may be made from heavy cardboard so as to provide a rigid unit for protecting the inner structure substantially contained therein from the high temperature of the molten metal bath for a time sufficient to obtain a sample or specimen.

The wand **8** is preferably solid in cross-section and externally threaded as shown for engaging a threaded opening in the fitting **7**, or if desired, may be in the form of a pipe. The wand is preferably of a length in the neigh-

borhood of ten feet to promote safety in dipping of the device, for example, into a molten steel bath **16** contained in a vessel **17**, for penetration through a slag covering or layer **18** to a depth of about fifteen or twenty inches as depicted in FIG. 1.

The tubular element **4** and mode of mounting or supporting the same will now be described. This element may be designed and constructed from any material and in any shape suitable for the purpose and provides a chamber or mold for receiving a quantity of the molten metal. More specifically, the member is preferably made from a glass known as Pyrex which will withstand high temperatures. The use of glass has proven particularly advantageous because it is frangible and can be readily broken to obtain access to the solidified sample following recovery. The length of the element may be varied depending on the type or character of sample or specimen desired.

The tubular element or tube **4** is preferably imbedded in the mass of material **3** which serves to protect and impart stability to the tube as well as assist in insulating and supporting it in the housing **1**. The mass **3** may be any material suitable for the purpose. Material, such as plaster of paris, has proven very satisfactory in use and is preferably molded within the confines of the tubular member **2**. The member **2** is preferably constructed of cardboard or any suitable frangible material.

The lower end of the member **2** and the lower end of the glass tube **4** are preferably secured and sealed in the uppermost cup **10** by utilizing the mass of cement **14** which surrounds the lower ends of the tube and member in such a manner that a lower end of the tube **4** registers with or extends through an opening **19** provided in a bottom wall **20** of the cup **10**. This opening has an axis which is spaced from the center of the wall. The cement **14** is preferably of a refractory character and offers protection or insulation against the high temperature of the molten metal and promotes its upward flow in the tube **4**, and the same is generally true of the mass **3**. Otherwise expressed, the masses **3** and **14** serve to insulate and protect the glass tube and constitute a means whereby to promote or encourage uniform cooling of the molten metal as it travels upwardly in the tube.

The cup **11** is preferably connected to the uppermost cup **10** by a telescoping pressed fit so that these cups are positioned in a nested sealing relationship and define a chamber **21**, with the bottom wall **20** of the cup **10** being disposed in axially spaced relationship to a bottom wall **22** of the cup **11**. The bottom wall **22** constitutes a partition provided with an opening **23** having an axis disposed in a position spaced from its center.

The cup **12** is preferably adapted to be connected to the cup **11** in a mode corresponding to that connecting the cups **10** and **11** and it has a bottom wall **24** constituting a partition provided with an opening **25** having an axis disposed in a spaced relation to the center of this wall. The fusible means or element **15**, above referred to, is preferably made of aluminum and is preferably secured in the opening **25** by a peening or upsetting operation. It will be observed that the bottom wall **24** of the cup **12** is disposed in axially spaced relationship to the wall **22** of the cup **11** and that these cups define a chamber **26**.

The cap **13**, above referred to, is also preferably made in the form of a cup and is preferably adapted to be press fitted into nesting relationship with the cup **12** and defines in combination therewith a chamber **27**. This cap is preferably made of metal of such a character that it will at least become partially disintegrated or ruptured when immersed in the molten metal.

Attention is directed to the fact that the lower end of the glass tube **4** and the opening **19** in the bottom wall **20** of the cup **10** are both generally aligned with the opening **25** and the fusible means **15**, and that the opening **23** in the bottom wall or partition **22** of the cup **11** is disposed in a staggered or off-center position with respect

to the axes of the openings **19** and **25** so that when the cap **13** is disintegrated or otherwise ruptured by the molten metal, the latter will melt the element **15** and thereby allow the metal to successively flow in a tortuous path through the aperture **25** into the chamber **26**, the opening **23** into the chamber **21** and thence upwardly into the glass tube **4** and out its upper end **5** into or against the fibrous mass of filter material **9**. The element **15** serves to deoxidize the molten metal received in the tube or receiving means **4** or that amount of metal which is expected to form the final sample. It is believed that this deoxidation serves to promote homogeneity. The metal is deoxidized in the chamber **26** and is mixed by turbulence in the chamber **21** prior to entry into the tube **4**. Attention is also directed to the fact that the cup members and the cap **13** constitute a fabricated lower entrance structure or unit and that this structure including the member **2**, masses **1** and **14** and glass tube **4** are all connected together to preferably provide a subassembly or unit which is adapted to be supported in relation to the housing **1** of the device. More specifically in this regard, the unit or subassembly is also partially supported or stabilized by a metal sleeve or shield **50** which is secured about the housing **1** and has a rounded end wall **28** having an opening therein which accommodates the cup **12** so that a bead **29** on the cap **13** may be press fitted onto the cup **12** and into engagement with the end wall **28** of the sleeve to prevent flow of metal into an annular space **30** about the lower ends of the member **2**, tube **4**, mass **14** and cups **10**, **11**, and **12**. The lower ends of the member **2**, tube **4**, mass **14** and cups **10**, **11**, and **12** are thus substantially supported below the housing **1** and mass **3**, as shown, as distinguished from being disposed within the confines of the housing.

Referring now to the procedure in obtaining or recovering a sample, the preferred method comprises plunging or dipping the device into the molten bath, through a layer of slag or impurities **18** so that the lower end of the device is below the layer as evidenced in FIG. 1. The long wand **8** is utilized to manipulate the device and the device is preferably held in the bath for a very brief period of time, for example, a period of from three to ten seconds which causes the cap **13** to be blown free, or otherwise disintegrate or rupture, due to the expanding trapped air in the chamber **27**, resulting from the enormous temperature change from, for example, from seventy degrees to twenty-nine hundred degrees Fahrenheit of the metal bath.

The cap and mass of cement **14** and annular space **30** serve to momentarily insulate the interior of the device as it is being inserted into the molten metal and the cap protects the device against the premature admission of any slag and/or any other surface impurities until the lower end of the device is well below the layer **18**. As the cup disintegrates or otherwise enables the molten metal to melt the element **15**, the latter diffuses into the molten metal for deoxidizing the same and the two are mixed or conditioned as they successively tortuously flow through the openings **25**, chamber **26**, opening **23** and chamber **21** into the glass tube **4**. Deoxidation substantially occurs in the chamber **26** and the mixing substantially in the chamber **21**, although some mixing does occur in the chamber **26** prior to entry of the metal into the chamber. The metal thus treated, conditioned or deoxidized flows upwardly through the tube and against the filter means **9** in the upper chamber **6**, allowing air to pass through the filter means while substantially preventing any great quantity of metal to flow into the chamber. After a few seconds or a sufficient time interval has elapsed in order to permit filling of the tube **4**, the device is quickly lifted from the bath of molten metal and then may be subjected to a cooling medium, such as cold water, a blast of cool air or it may be placed on a work bench and allowed to cool. In any event, the sample retrieved from the molten bath is not utilized

until after it has solidified and cooled to such an extent that it can be operated on for analysis. The specimen or sample solidifies or begins to solidify while the device is immersed in the molten metal. It is desirable that the analysis of the specimen be obtained expeditiously so that it may be quickly analyzed in order to determine or ascertain whether the molten metal is in accord with preselected or predetermined specifications or requirements. If, for example, the specimen indicates that the molten metal is not of the character desired, then the metal in the vessel **17** may be modified or changed. In some instances, it may be necessary to obtain more than one sample or specimen of the molten metal or a hot liquid before the latter is brought up to a required standard.

The device, upon being subjected to the molten metal, deteriorates or becomes damaged to some extent. For example, the cap **13**, in some instances, may be completely disintegrated into the molten metal and in other instances, a portion of the cap may still remain attached to the cup **12**. Moreover, in some instances, portions of the cups **11** and **12** may disintegrate. In other words, the disintegration or destruction of various components of the device is dependent on their design and construction, the temperature of the molten metal, and the time that the device is held in the latter.

After the device is removed from the molten bath, the sleeve **50** is removed and the housing **1**, tubular member **2**, masses **3** and **14**, tube **4** and cups may be cut or otherwise broken apart or separated to obtain the sample formed in the tube **4**. Attention is directed to the fact that the housing **1**, member **2**, and masses **3** and **14** constitute tubular layers of frangible material which protect the tube **4** and that all of these components may be readily destroyed to facilitate access to the sample received in the tube.

The fitting **7** on the wand **8** has a socket **31** therein which receives an end of the device. Detachability between the device and fitting may be accomplished in various ways but, as illustrated in FIG. 2, for example, an internal annular surface of the socket is provided with a depression or annular groove **32** which is adapted to detachably snap-receive detents **33** projecting laterally from portions of a split cylindrical portion of the sleeve **50**.

Having thus described my invention, it is obvious that various modifications may be made in the same without departing from the spirit of the invention, and therefore, I do not wish to be understood as limiting myself to the exact forms, construction, arrangements, and combinations of parts herein shown and described.

I claim:

1. A device of the kind described comprising: a housing, vented means disposed in said housing for receiving a hot liquid, means for anchoring and insulating said receiving means so that a lower part of said receiving means is disposed below said housing, means extending axially

beyond said housing for surrounding and protecting said lower part, and means whereby a handle may be connected to said housing for dipping the device into a hot liquid so that a quantity will flow into said receiving means through its lower part.

2. The device defined in claim **1**, in which said housing is constructed of insulating material and provided with an upper chamber, and said receiving means has an upper part disposed in said chamber.

3. A device of the kind described comprising a frangible housing, frangible means for receiving a hot liquid, frangible means surrounding and supporting said receiving means in said housing, said supporting means and said housing defining an upper chamber communicating with said receiving means, structure defining a lower chamber communicating with said receiving means, and tubular means connected to said housing and extending axially therebeyond whereby to assist in stabilizing said structure and provide a chamber thereabout.

4. The device defined in claim **3**, including a fitting having a socket detachably receiving an upper end of said sleeve, and a wand detachably connected to said fitting.

5. A device of the kind described comprising: a housing, means disposed in said housing for receiving a hot liquid, means for supporting and insulating said receiving means so that a lower part of said receiving means is disposed below said housing, a sleeve having a lower portion surrounding at least a portion of said housing and defining an annular space about said lower part,, and means whereby a handle may be connected to said housing for dipping the device into a hot liquid so that a quantity will flow into said receiving means through said lower part.

6. The device defined in claim **5**, in which said sleeve has an upper resiliently flexible portion which surrounds said housing and is provided with means for detachable reception in a socket of a wand.

7. The device defined in claim **5**, in which said sleeve has an upper portion provided with a cooperable means, including a fitting having a socket for accommodating said sleeve, means provided on said fitting engagable with said cooperable means for detachably holding said sleeve in said socket, and a wand detachably connected to said fitting.

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