March 24, 1970 W. J. COLLINS 3,501,963

DEVICE FOR SAMPLING MOLTEN METAL

Filed March 25, 1969 2 Sheets-Sheet 1

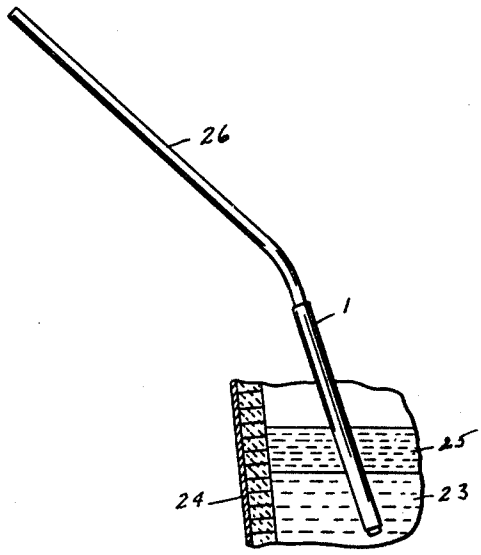


FIG. 1

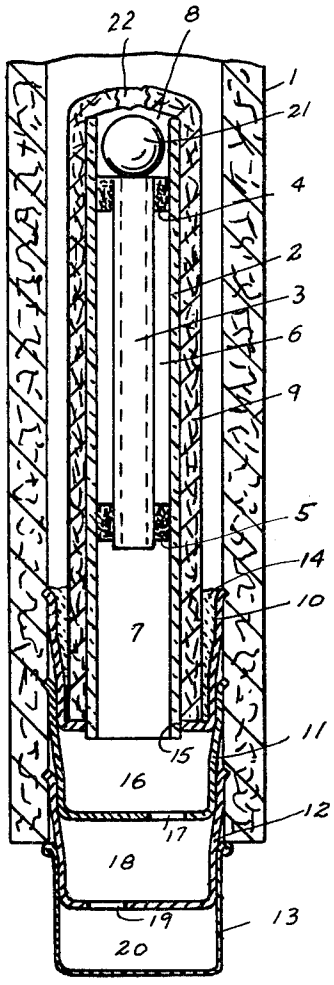


FIG. 2

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DEVICE FOR SAMPLING MOLTEN METAL

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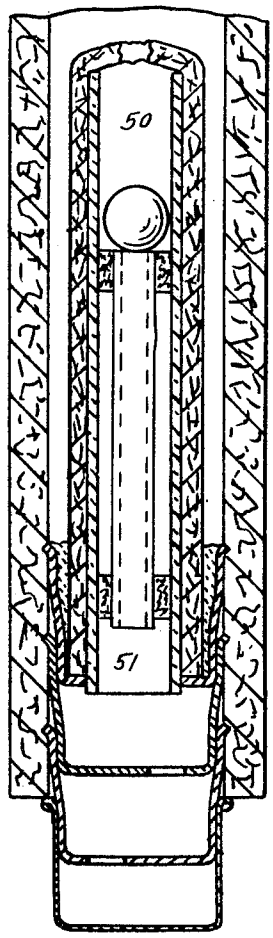


FIG. 3

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DEVICE FOR SAMPLING MOLTEN METAL

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Continuation-in-part of application Ser. No. 713,640, Mar. 18, 1968. This application Mar. 25, 1969, Ser. No. 810,232
Int. Cl. G01n 1/10
U.S. Cl. 73—425.4 10 Claims

ABSTRACT OF THE DISCLOSURE

A molten metal sampling device of the type incorporated in the end of a cardboard tube. The specific structure comprises two concentric tubes with appropriate spacers, fixed in the receiving end of the cardboard tube handle so that two chambers with a connecting passageway are formed. A tortuous entryway is formed by a series of apertured nested cups. The device is utilized by inserting the sampler in the molten metal which flows into the chambers and passages and solidifies. Access to the sample is obtained by breaking away the surrounding structure.

This application is a continuation-in-part of my application Ser. No. 713,640 filed Mar. 18, 1968 and the latter is a continuation-in-part of my applications Ser. Nos. 391,654; 590,829 and 649,764.

The device may be employd 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 an outer protective tubular housing; an inner tube in the housing; elongated tubular means supported by seals at its extremities in the tube for receiving the molten metal, the seals in combination with the extremities of the tube defining an entrance chamber communicating with one end of the tubular means and a venting chamber at its opposite end.

A specific object of the invention is to provide a device in which a tubular member snugly surrounds the inner tube and there is a cylindrical space about the tubular means and a cylindrical space about the tubular member for insulating purposes.

Another object of the invention is to provide a device in which the lower extremities of the inner tube and tubular member are anchored or cemented in a cup which is connected to the outer housing.

Additional objects reside in providing a device which offers advantages with respect to manufacture and assembly, efficiency, durability, safety, and destruction whereby to obtain access to the recovered 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:

FIGURE 1 is a partial view showing a least one mode of obtaining a sample from a bath of molten metal;

FIGURE 2 is a partial vertical section of the device; and

FIGURE 3 is a partial vertical section of a modified device.

Referring particularly to FIGURE 2, the device preferably comprises, among other things, an outer elongated cylindrical tubular housing 1, an inner elongated cylindrical tube 2, elongate cylindrical tubular means 3 constituting a receiving means and supported at its extremities in the tube by a pair of annular partition-like seals 4 and 5. The length and diameter of the tubular means 3 are less than that of the tube 2 so that the tubular means and tube define a cylindrical space 6 and the ends of the tube in combination with the partitions define a relatively large lower entrance chamber 7 and an upper smaller chamber 8. The seals may be constructed of any material which serves to firmly anchor the tubular means 3 in place and so that a hot liquid such as molten metal will not flow into the space 6. A tubular member 9, preferably constructed from cardboard or other insulating or frangible material snugly receives the inner tube 2. The components 2, 3 and 9 generally constitute means for receiving the hot liquid or metal since it enters the tubular means 3 via the chamber 7 primarily formed by the inner tube 2 which is surrounded by the tubular member 9.

The device also preferably includes a plurality of stacked cups or members 10, 11, and 12, an end cap or cup 13, and a mass of high temperature cement 14 in the upper cup 10. These components or parts will be described more in detail subsequently.

The housing 1 may be designed and constructed as desired but is preferably made from a frangible insulating material, such as a heavy cardboard 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 tubular means 3 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 means 3 is preferably in the form of a glass tube constructed from 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 size or length of the means 3 may be varied depending on the type or character of sample or specimen desired.

The inner tube 2 also is preferably made of Pyrex and this tube and the tubular member 9 are preferably supported or imbedded in the mass of heat resistant cement 14 in the cup 10 so that the lower end of the member 9 is sealed in the cup and the lower end of the inner tube extends through or registers with an opening 15 in the bottom wall of the cup.

The cement 14 is preferably of a refractory and frangible character and offers protection or insulation against the high temperature of the molten metal and promotes or encourages uniform cooling of the molten metal as it travels upwardly in the inner tube 2 and tubular means 3.

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 16, with the bottom wall of the cup 11 being provided with an opening 17. The cup 12 is similarly connected to the cup 11 and define a chamber 18, with an opening 19 in a bottom wall of the cup 12. The cap 13 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 20. 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. The cups 10, 11 and 12 have relatively sharp external rims which bite into the outer housing when forced thereon to cause a rim on the cap 13 to engage the lower end of the housing. In this way the internal structure is

firmly supported and the lower end of the housing is sealed. It should be noted that the openings **17** and **19** in the bottom walls of the cups **11** and **12** are disposed in a staggered or off-center position with respect to one another and to the axis of the tube **2** so that when the cap **13** is disintegrated or otherwise ruptured by the molten metal, the metal will successively flow in a tortuous path through the opening **19** into the chamber **18**, the opening **17** into the chamber **16** and thence upwardly into the tubular means **3** via the tube **2**. A ball valve **21** is disposed in the upper chamber and serves to automatically vent the upper chamber through an outlet **22** provided in the tubular member **9** and substantially retain the metal in the tubular means **3** and tube **2**. After a sample of metal has been obtained, it will conform to the size of the lower chamber **7** and the tubular means **3**.

Referring now to the procedure in obtaining or recovering a specimen, the preferred method comprises plunging or dipping the device into the molten bath, through a layer of slag or impurities **25** so that the lower end of the device is below the layer as evidenced in FIGURE 1. A relatively long wand **26** is preferably press-fitted into the upper open end of the housing **1** to facilitate manipulation of the device. 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 **20**, resulting from the enormous temperature change from, for example, seventy degrees to twenty-nine hundred degrees Fahrenheit of metal bath.

After a few seconds or a sufficient time interval has elapsed in order to permit filling of the tube **2** and tubular means **3**, 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 specimen 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 specification or requirements. If, for example, the specimen indicates that the molten metal is not of the character desired, then the metal contained in the vessel **24** may be modified or changed. In some instances, it may be necessary to obtain more than one sample or specimen of the molten metal before the latter is brought up to a required standard.

The device, upon being subjected to the molten metal, deteriorates or becomes damaged to the extent that at least a portion of the outer housing is burned away, charred or disintegrated so that, in some instances, a portion of the mass of material disposed about the glass tube may be visible. Also, 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 housing **1** is cut or otherwise broken apart to obtain the internal structure, after which the tubular member **9**, tube **2**, tubular means **3**, cement **14** and cups and/or cup **12** may be removed and/or destroyed whereby to obtain access to the sample.

The structure exemplified in FIGURE 3 of the drawing substantially corresponds to that of FIGURE 2, but differs therefrom to the extent that it has upper and lower chambers **50** and **51** which are respectively larger and smaller than the chambers **8** and **7** of the structure of FIGURE 2 so that the sample obtained by utilizing the structure of FIGURE 3 will have a lower extremity of smaller size than that obtained in chamber **7**. Obviously, the chambers **50** and **51** may be of corresponding sizes.

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 unit for use in obtaining a sample of molten metal comprising an inner non-metallic tube, an outer non-metallic tube of a greater length than said inner tube, a pair of axially spaced partitions secured in said outer tube and about the ends of said inner tube to provide a sealed space therebetween, one of said partitions in combination wtih said outer tube defining a first chamber communicating with said inner tube, and said other partition in combination with said outer tube defining a second chamber which has a cross-dimension greater than the cross-dimension of said inner tube and communicates with the latter whereby a quantity of molten metal may be caused to flow into said inner tube via said second chamber.

2. A device of the kind described comprising: a housing, tubular means for receiving a hot liquid, means for supporting said tubular means in said housing with a space surrounding said tubular means throughout the major portion of its length, and said supporting means defining upper and lower chambers communicating with said receiving means whereby when the device is dipped into a bath of hot liquid, a sample thereof will flow through said lower chamber into said receiving means.

3. The device defined in claim **2**, in which said upper chamber is smaller than the lower chamber.

4. The device defined in claim **2**, in which said lower chamber is larger than the upper chamber.

5. The device defined in claim **2**, in which said housing is tubular and said supporting means is disposed in concentric spaced relation to said housing and said receiving means and said chambers are disposed within the confines of said housing.

6. The device defined in claim **2**, in which said upper chamber is provided with means whereby to assist in retarding the flow of the sample into said upper chamber.

7. The device defined in claim **2**, in which said tubular means is inset from the lower end of said housing, including disintegrable means for normally sealing said tubular means and said lower chamber from the atmosphere.

8. A device of the kind described comprising an outer cylindrical housing of non-metallic material, a plurality of nested cups connected to said housing and defining a plurality of axially aligned chambers, a tubular member of non-metallic material having a lower end cemented in an upper of said cups, elongated frangible receiving means secured in said member, and additional chambers respectively connecting with the extremities of said receiving means.

9. The device defined in claim **8**, in which a space is disposed about said receiving means.

10. The device defined in claim **8**, in which said receiving means is in the form of a tube which is supported only adjacent its extremities, and insulating material is disposed in said member and about said receiving means.

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