United States Patent [19]

Boron

[11] **3,751,986**

[45] **Aug. 14, 1973**

[54] **SAMPLING APPARATUS**

[75] Inventor: **Joseph J. Boron**, Doylestown, Pa.

[73] Assignee: **Aikoh Co. Ltd.**, Tokyo, Japan

[22] Filed: **Mar. 31, 1972**

[21] Appl. No.: **240,239**

[52] **U.S. Cl.** ..... **73/425.4 R**, 73/DIG. 9

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

[58] **Field of Search** ..... 73/425.4 R, DIG. 9; 136/234

[56] **References Cited**

UNITED STATES PATENTS

3,552,214	1/1971	Collins	73/425.4 R
3,646,816	3/1972	Hance	73/DIG. 9
3,390,578	7/1968	Moore	136/234

Primary Examiner—S. Clement Swisher

Attorney—Albert P. Sharpe

[57] **ABSTRACT**

The specification and drawings disclose three embodiments of an apparatus for taking samples from a flowing stream of molten metal. The preferred embodiment comprises a separable sample mold having a thermal shock resistant tube connected thereto. The mold and tube are slidably mounted in a cylindrical, open ended housing. The housing is arranged to totally enclose the mold and tube in a first position. In a second position the tube extends out of the housing for sample taking. Other features disclosed include an arrangement for providing a small diameter pin of sample metal and a system for bonding a hook or loop of metal in the sample for tagging purposes.

7 Claims, 14 Drawing Figures

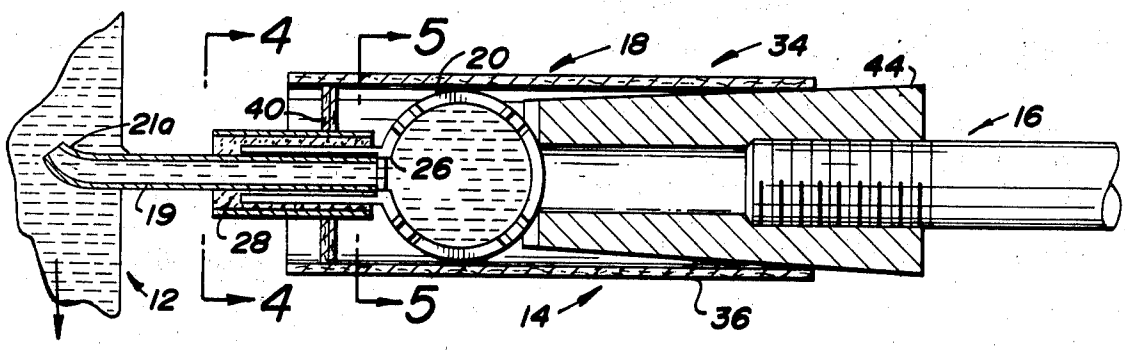


FIG. 1

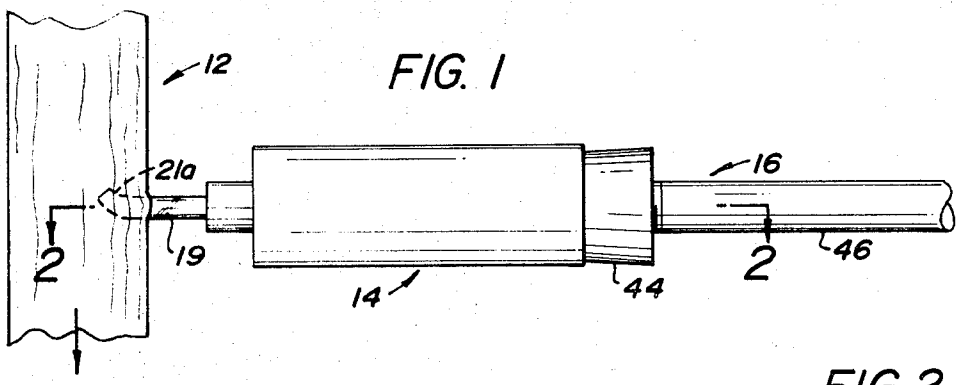


FIG. 2

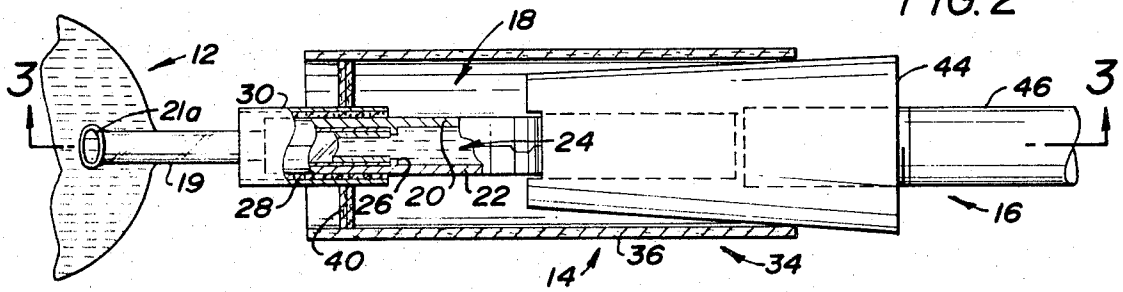


FIG. 3

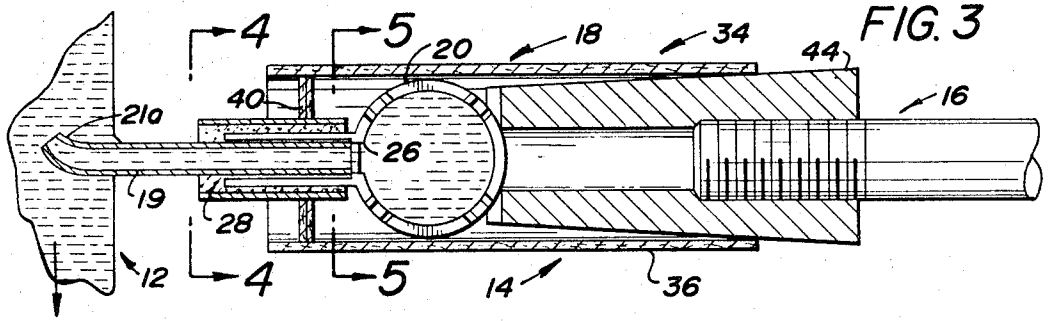
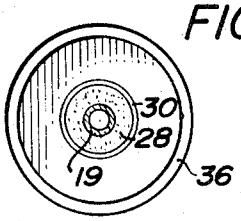


FIG. 4



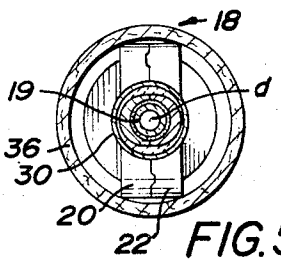


FIG. 5

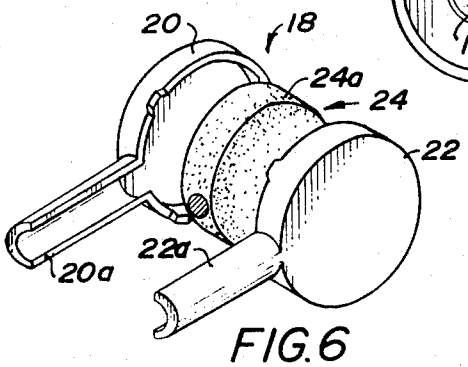


FIG. 6

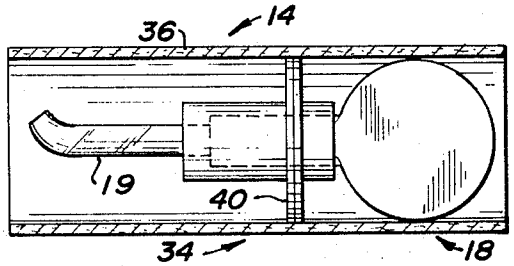


FIG. 7

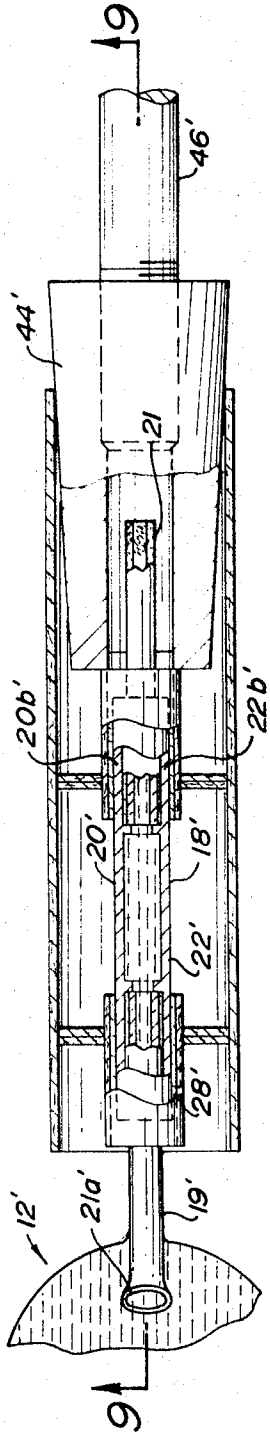


FIG. 8

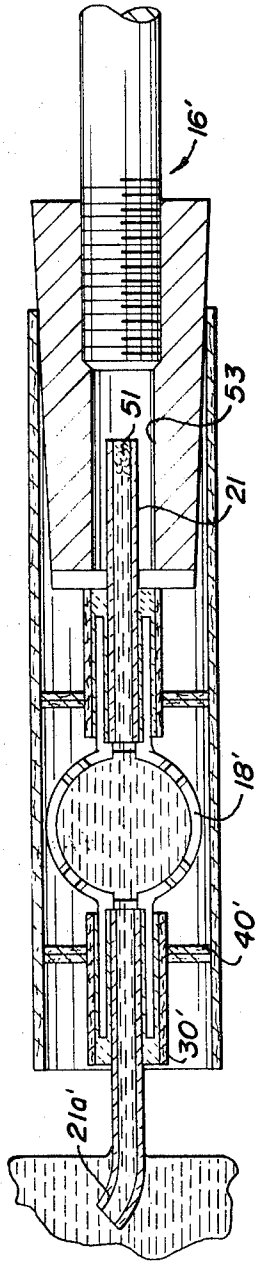


FIG. 9

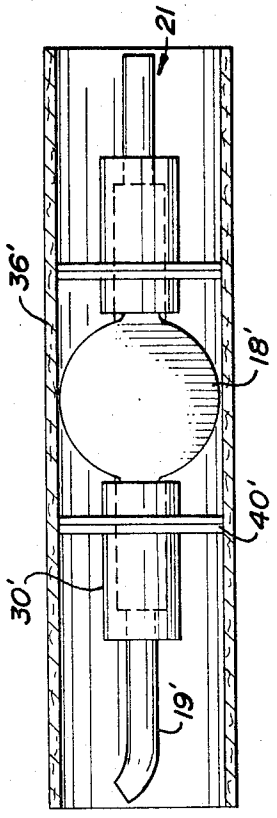
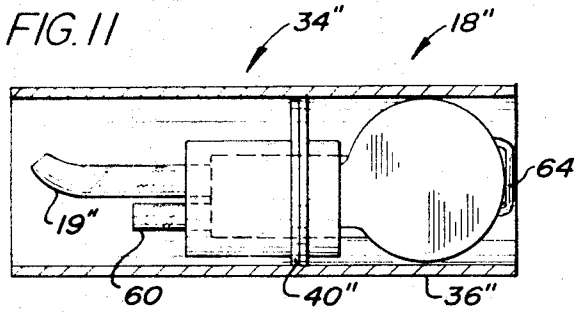


FIG. 10

FIG. 11



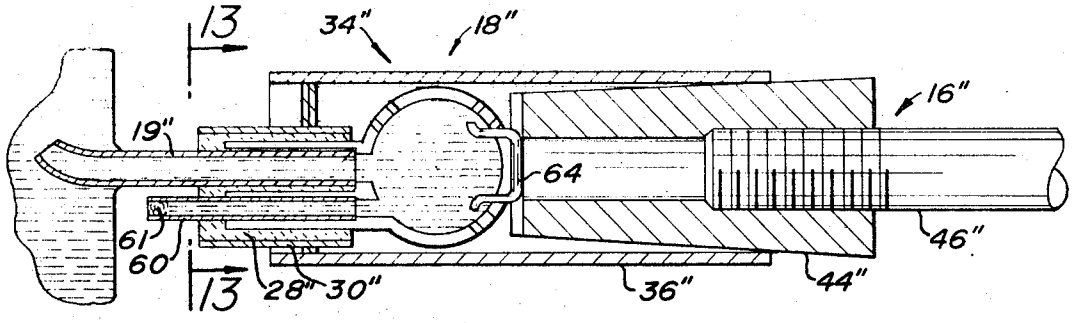


FIG. 12

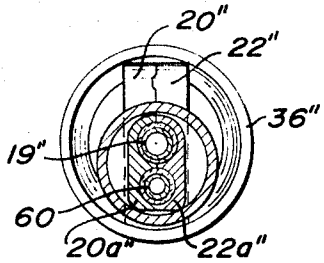


FIG. 13

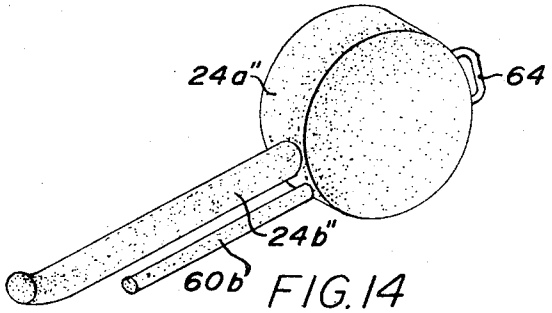


FIG. 14

SAMPLING APPARATUS

The subject invention is directed toward the art of measuring and testing and, more particularly, to an improved sampling device.

The invention is particularly suited for taking samples from streams of molten steel and will be described with special reference thereto; however, as will become apparent, the invention is capable of broader application and could be used for many different types of metals.

One known device for sampling a stream of molten metal comprises a small, separable sample mold container formed, for example, from powdered iron. A quartz tube connects to the sample mold and both the mold and a portion of the tube are encased in core mold sand. The outer end of the quartz tube is open and extends from the core mold sand casing. The unit is mounted in a cylindrical housing tube with the open end of the quartz tube extending outwardly.

To use the assembly, the cylindrical tube is, in turn, mounted on the outer end of a long lance or the like. The person taking the sample can thus stand at a safe distance from the stream of metal and manipulate the lance to move the open end of the quartz tube into the metal stream. The molten metal flows through the quartz tube and into the mold container. In approximately five seconds, the sample mold is filled and the assembly is withdrawn from the stream. After cooling, the core sand surrounding the mold and the quartz tube are broken, mold container separated and the solidified metal sample removed.

The described assembly definitely facilitates sample taking from molten metal streams. However, it has certain disadvantages. For example, the exposed end of the quartz tube must be enclosed by some type of protective cover during shipping and handling. Moreover, manufacturing problems are encountered in applying the core sand casing. Also, the casing increases the weight and cost of the unit.

The subject invention provides an improved construction for the above-described type of sampling device. Sampling devices formed in accordance with the invention are simpler, and less expensive to construct than the prior devices. Further, the subject overcomes problems previously encountered in shipping and handling. In particular, the invention contemplates an assembly which includes a mold container preferably formed from separable sections and having an open end. A sample receiving tube is joined to the mold container. The mold and sample tube are positioned in a tubular, open ended housing. Preferably, the mold and sample tube are movable in the housing between at least two positions including a first position wherein the sample tube is enclosed and protected by the housing and a second position wherein the tube extends from the housing for sample taking.

A more specific aspect of the invention contemplates that preferably, but not necessarily, the housing will comprise a single, open ended cylinder of paper board or the like. The length of the cylinder is desirably at least as great as the total length of the sample tube and mold. Also, the sample tube and mold assembly are preferably slidably received in the cylinder. Thus, merely by shifting the assembly in the cylinder, the sample tube can be moved to a protected position for

shipping and handling, or extended from the housing for sample taking.

Preferably, but not necessarily, when used for sample taking, the housing cylinder is mounted on a handle or the like having an end portion adapted to be received in the cylinder a distance sufficient to cause the sample tube to extend out a suitable distance for sample taking. This assures that the sample tube is properly located relative to the housing when mounted for use.

Accordingly, a primary object of the invention is the provision of a simplified and improved apparatus for taking samples from streams of molten metal.

Another object is the provision of an apparatus of the type described wherein a simple, tubular housing serves as a shipping container and also provides a means for mounting the assembly for sample taking operations.

Another object of the invention is the provision of an apparatus of the type described which is relatively inexpensive to manufacture and easy to use.

The above and other objects and advantages will become apparent from the following description when read in conjunction with the accompanying drawings wherein:

FIG. 1 is an elevational view showing a sampling device formed in accordance with the invention being used for obtaining a sample from a stream of molten metal;

FIG. 2 is an enlarged, cross-sectional view taken on line 2—2 of FIG. 1 (portions of the device have been broken away to show certain details of construction more clearly;

FIG. 3 is a cross-sectional view taken on lines 3—3 of FIG. 2;

FIGS. 4 and 5 are cross-sectional views taken on lines 4—4 and 5—5 respectively of FIG. 3;

FIG. 6 is an exploded pictorial view of the mold container portion of the assembly showing removal of a solidified metal sample;

FIG. 7 is a cross-sectional view showing the assembly in its shipping or handling position;

FIG. 8 is a cross-sectional view similar to FIG. 2 but showing a modified form of the invention;

FIG. 9 is a view taken on line 9—9 of FIG. 8;

FIG. 10 is a cross-sectional view showing the device of FIGS. 9 and 10 in its handling and shipping position;

FIG. 11 is a view similar to FIG. 7 but illustrating a third embodiment of the sampling assembly;

FIG. 12 is a view similar to FIG. 3 but showing the FIG. 11 embodiment being used for sample taking;

FIG. 13 is a cross-sectional view taken on line 13—13 of FIG. 12, and

FIG. 14 is a pictorial view of the solidified sample after removal from the FIG. 11 embodiment.

Referring more particularly to the drawings wherein the showings are for the purpose of illustrating preferred embodiments of the invention only, and not for the purpose of limiting same, FIG. 1 shows a stream of molten steel 12 which can, for example, be coming from a pouring ladle or the like. A sampling device 14 formed in accordance with the invention is illustrated as being mounted at the end of a long handle or lance member 16 and positioned such that a small sample of molten metal is being removed from stream 12 for analysis or testing.

FIGS. 2 and 3 best illustrate the details of the preferred form of the sampling assembly 14. In FIGS. 2 and 3 the assembly is shown in its sampling position. In

general, the sampling assembly is shown as including a separable assembly **18** which defines a small mold container. Joined to assembly **18** is a sample tube **19** formed from quartz or other material capable of withstanding the temperatures and thermal shocks experienced in taking a sample from the molten metal stream.

In the embodiment under consideration, the assembly **18** is formed from two mating sections **20** and **22**. Although sections **20** and **22** could be formed from many different materials and a variety of techniques, in the subject embodiment they are formed from powdered iron using known techniques. As shown, each of the half sections **20, 22** include an outwardly extending neck or inlet forming portion **20***a*, **22***a* respectively. The interiors of the sections **20, 22** dished as shown so that when positioned together they define an open inner chamber **24.**

The sample tube **19** is relatively closely received within the neck portions **20***a* and **22***a* in the manner shown in FIG. **3.** Note that a small shoulder **26** is formed about the inner wall of the neck portions so as to provide a stop for proper positioning of the sample tube **19.**

In the embodiment under consideration, the sample tube **19** is joined to the sample mold **18** by a refractory cement **28.** A thin walled paper tube or the like **30** is positioned circumferentially about the neck portion **20***a* and **22***a* and the refractory ceramic cement fills the annulus between the inner wall of the tube and the outer wall of the neck. During manufacture of the assembly, tube **30** serves to confine the cement until it hardens.

The sample tube and sample mold assembly are mounted in a housing **34** which, in the preferred embodiment, comprises an elongated tubular member **36.** The tubular member **36** comprises a cylinder of relatively heavy paper board having open ends. The total length of the cylinder **36** is preferably at least as great as the total length of the sample tube and mold assembly. Additionally, as best seen in FIG. **5,** the inner diameter of the cylinder **36** is preferably approximately equal to the diagonal dimension "d" across mold **18.** This allows the assembly to be slidably received within the tube **36.**

In order further to orient and position the tube and mold assembly within the housing **34,** a disc member **40** is received on the tube **30** and has a diameter corresponding approximately to the inner diameter of cylinder **36.** This maintains the assembly properly positioned but allows it to slide within the cylinder.

As previously mentioned, the sample tube and mold assembly is slidable within the housing **34.** This allows it to be moved between a shipping, handling or storage position to a sampling position.

The first or shipping position of the sample tube and mold assembly within the housing **34** is illustrated in FIG. **7.** Note that in this position the quartz tube **19** is enclosed and thus protected for shipment and handling. To allow the unit to be used for sample taking, the sample tube mold assembly is merely slid within the housing **34** to the position shown in FIGS. **2** and **3.** It should be understood that there should be sufficient frictional engagement between the housing and the sample tube and mold assembly to prevent inadvertent movement during ordinary handling. However, the engagement should not be such as to make manual movement particularly difficult.

The housing **34** also serves for mounting the unit at the end of a handle or the like for the sample taking operation. Note that the elongated handle **16** includes an end portion **44** which is threadedly connected to a rod **46.** End portion **44** is shown as conically shaped and adapted to enter the end of the cylinder **36.** Preferably, the conical end portion **44** is sized so that when it is extended in the cylinder **36** sufficiently properly to hold the unit, the sample tube **19** is extended out of the tube an amount sufficient to permit it to be inserted into the molten metal stream. Further, the conically shaped end portion **44** of the handle **16** allows the sampling device **14** to be easily removed from the handle after the sample taking operation. For example, by tapping device **14** against the floor it will be released from the handle assembly since there is no fixed positive mechanical connection between the housing and the tube.

Referring again to FIGS. **1–3,** it will be seen that the open outer end **21***a* of sample tube **19** is preferably curved as shown. This allows the sample tube to be inserted in the stream and receive the flowing metal. The metal of course impacts the tube therethrough into the mold **18.** Both the mold **18** and the tube **19** are, of course, filled relatively quickly with molten metal. For example, in approximately five seconds, the internal chamber of both the mold and the tube are completely filled with molten metal. It should be understood that air within mold chamber **24** is driven out through the parting line between mold halves **20,22.**

Although the stream of molten metal is at an extremely high temperature the outer housing **34** can be merely a heavy paper board tube. The paper board is capable of withstanding the temperatures encountered sufficiently to maintain structural integrity throughout the time period required. Moreover, after use the assembly can be easily removed from the housing tube **34** so that the solidified sample can be obtained merely by smashing the refractory cement joining the tube **19** to the mold halves and separating the mold halves as shown in FIG. **6.**

The resulting solidified metal sample has the shape best shown in FIG. **6.** Note that it comprises a main body **24***a* and an elongated cylindrical section **24***b* which corresponds to the interior of the quartz tube **19.** Depending upon the particular test being performed on the sample, the tube **19** can be sized so as to produce a cylindrical portion of desired weight and/or length or, weight per unit of length.

FIGS. **8–10** show a modification of the sampling assembly which is closely similar to the FIGS. **1–7** embodiment. The reference numerals used for corresponding elements are the same as those used in the FIGS. **1–7** embodiment but differ therefrom by the addition of a prime (') suffix. The description of one such element is to be taken as equally applicable to the correspondingly numbered element unless otherwise noted. In this embodiment a second tube **21** extends to the right from the mold container **18'.** This embodiment thus provides a sample with two cylindrical sections of a desired size to allow tests to be conducted with specified, predetermined size sections. Mold container **18'** is constructed generally the same as mold container **18** of FIGS. **1–7;** however, a second neck portion **20***b'* and **22***b'* is formed on each half **20'** and **22'.** The tube **21** is bonded or joined to sections **20***b'* and **22***b'* in the same manner as discussed with reference to quartz tube **19.**

The outer end of tube **21** is not curved in the manner of tube **19.** Additionally, a small portion of metal or ceramic wool or the like **51** is positioned in the end of the tube. This allows air to escape from the tube during the sampling operation while preventing the molten metal from escaping.

FIGS. **8** and **9** show the modified form of sampling devices being used for taking a sample. It should be noted that the end portion **44'** of the handle **16'** has a central opening **53** into which tube **21** is received. Thus, when the assembly is placed on the handle, the tube **21** is not engaged and cannot be accidentally broken.

Referring to FIG. **10** note that the tube or cylinder **36'** is of a length sufficient to enclose tubes **19'** and **21'** when the assembly is in the shipping or handling position. Because of the slightly greater length of the FIGS. **8–10** embodiment, tube **36'** must be correspondingly longer.

FIGS. **11–14** show a third embodiment of the sampling apparatus which also provides a small diameter pin of sample metal so that small pieces of predetermined size or weight can be readily obtained. Elements of this embodiment which correspond to the FIG. **1** embodiment are identified by the same reference numerals differentiated therefrom by a double prime (") suffix. The elements so identified are to be considered as described with reference to FIG. **1** unless otherwise noted.

In FIG. **11–14** embodiment the mold halves **20"** and **22"** are provided with somewhat larger neck portions **20*a*"** and **22*a*"**.** Also, a second smaller tube **60** is carried under the tube **20".** Tube **60** can be formed from any suitable temperature and thermal shock resistant material such as quartz or Pyrex glass. As shown, tube **60** is in communication with the interior of the mold so that metal can flow from the mold into the tube. Additionally, the end of the tube **60** is plugged with metal or ceramic wool or the like so that air can escape while the molten metal is retained.

The tubes **19"** and **60** are joined to the mold through the use of a refractory cement **28".** It should be appreciated that the sleeve **30"** must be somewhat larger in diameter than the corresponding sleeve **30** of FIG. **1.**

FIG. **14** illustrates the shape of the solidified metal sample after it is removed from the mold and tubes. Note that it comprises the main body **24*a*"** and the two cylindrical pin sections **24*b*"** and **60*b*.**

The FIG. **11–14** embodiment also illustrates how a tagging loop can be installed in the sample. As best shown in FIGS. **11** and **12,** a small loop of wire **64** can be positioned at the parting line between the mold halves **20"** and **22"** in the manner shown. The ends of the loop **64** extend into the mold cavity. Thus, after a sample is taken and solidified the loop is permanently attached as shown in FIG. **14.** This allows identifying tags or the like to be readily attached to the sample.

Although not shown, it should be appreciated that materials or substances can be placed within the sample tubes or mold chambers of any of the three embodiments for producing some effect on the sample if desired. For example, a section of aluminum wire can be placed in the sample tubes to serve as a deoxidant.

The invention has been described in great detail sufficient to enable one of ordinary skill to make and use the same. Obviously, modifications and alterations in the preferred embodiments will occur to others upon a reading and understanding of the specification. All such alterations are to be considered as part of the invention insofar as they come within the scope of the claims.

What is claimed is:

1. Apparatus for taking samples from a stream of molten metal comprising:

container means forming a mold chamber for receiving a sample quantity of said molten metal;

a sample tube communicating with said chamber and having an open end adapted to be placed in said stream of molten metal to supply said metal to said chamber;

a tubular housing enclosing said container means and said sample tube, said housing having a length at least as great as the combined length of said container means and said sample tubes, said container means and said sample tube being mounted in said housing for selective movement between a first position wherein said sample tube is within said housing to a second position wherein said sample tube extends from said housing for sample taking.

2. The apparatus as defined in claim **1** wherein said tubular housing comprises an open ended cylinder having an internal diameter to slidably receive said container means.

3. The apparatus as defined in claim **1** wherein said sample tube is joined to said container means by a refractory cement and wherein said sample tube is formed from a temperature and thermal shock resistant material.

4. The apparatus as defined in claim **1** wherein said housing is opened at both ends and slidably receives said container means and wherein a disc-shaped collar is positioned about a said sample tube and extends radially outward into slidable engagement with the walls of said housing.

5. The apparatus as defined in claim **1** wherein said housing comprises a paper board tube opened at both ends.

6. The apparatus as defined in claim **1** wherein said sample tube is formed from quartz.

7. Apparatus for taking a sample from a stream of molten metal comprising:

container means forming a mold chamber for receiving a quantity of said molten metal, said container means including a pair of mating mold sections having cooperating portions providing an inlet channel;

a sample tube positioned in said channel for directing molten metal into said mold chamber, said sample tube being bonded to said container means by a refractory cement;

a housing enclosing said container means and said sample tube, the length of said housing at least as great as the total length of said container means and said sample tube; and,

said container means and said sample tubes slidably mounted within said housing for movement between a first position wherein said sample tube is enclosed by said housing to a second position wherein said sample tube extends from said housing.

* * * * *