

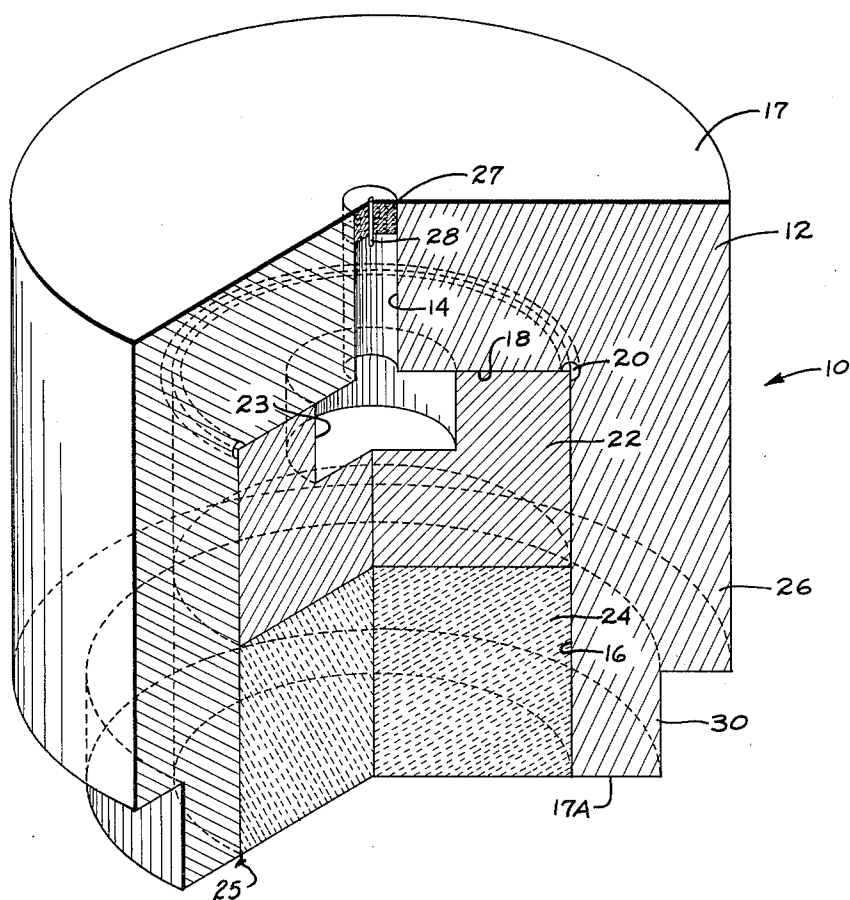
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E. D. MILLER, JR., ETAL

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IMMERSION SAMPLER

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INVENTORS

ELDON D. MILLER, JR., &

BY ROBERT K. SCOTT

William C. Neale

ATTORNEY

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IMMERSION SAMPLER

Eldon D. Miller, Jr., Bridgeville, and Robert K. Scott,
Pittsburgh, Pa., assignors to Harbison-Walker Refractor-
ies Company, Pittsburgh, Pa., a corporation of 5
Pennsylvania

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The present invention relates to a novel article of manu-
fracture and in particular, to an article for obtaining sam-
ples of molten metal.

In the preparation of metals for industry, a great deal
of quality control is required to insure a suitable product
in accordance with design specifications. In practice, the
molten metal to be employed for specific applications, is
tested during the melting process, with respect to a par-
ticular heat, by taking a plurality of spectrographic sam-
ples of the molten metal at various time intervals, and
analyzing them immediately so as to enable a worker to
adjust the heat as necessary in the even of a divergence
from specifications.

Heretofore, particularly in the steel industry, samples
were taken for spectrographic analysis manually by hav-
ing a worker dip a ladle below the slag suspension in a
steel heat, remove the ladle with a sample of the steel and
carry the sample to the spectrographic lab for analysis.
This procedure was found to be very hazardous to the
worker and also tended to yield nonuniform samples
owing to contamination by the slag and other impurities
to which the molten metal was exposed before solidifica-
tion. Further, the cost involved for a worker to take
three or four samples of molten metal from each heat, in
terms of duration of sampling, is very high.

Therefore, it is an object of the present invention to pro-
vide a novel immersion sampler for rapidly obtaining sam-
ples of molten metal.

Another object of the invention is to provide an im-
mersion sampler for taking uniform end representative
samples of molten metal.

A further object of the invention is to provide an im-
mersion sampler for obtaining spectrographic samples of
molten steel without many of the hazards heretofore en-
countered.

Other objects of the invention will become apparent and
will appear hereinafter.

In order to more fully understand the nature and ob-
jects of the invention reference should be had to the
following detailed description and drawing, the single fig-
ure of which is an elevation view in cross section of a
typical sampler unit of the invention.

In accordance with one embodiment of the present in-
vention, there is provided an immersion sampler for
obtaining samples of molten metal. The sampler is of
generally cylindrical configuration and has an upper and a
lower end aperture with a continuous opening or passage
joining these end apertures. The opening through the
upper portion is of substantially smaller cross section
than it is through the lower end. A refractory means is
provided for closing and sealing the lower end aperture.

Referring to the drawing, there is shown an immersion
sampler 10. The sampler consists of a tubular or cylin-
drical refractory body or member 12 having an upper
opening 14 and a lower opening 16. The opening 14 en-
larges into the lower opening 16 a short distance from
the upper end or face 17. In practice, molten metal
sample passes through opening 14 and solidifies almost im-
mediately upon passage into the opening 16, as will be
described subsequently. The upper limit of opening 16 is
determined by an interior horizontal or longitudinal sur-

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face or face 18 which lies more closely adjacent the up-
per face 17 than the bottom 17A. The surface 18 has a
peripheral groove 20 formed about its extremities.

The member 12 may be composed of any refractory
material capable of withstanding the temperatures of the
molten material in which it is immersed. For use in
sampling steel, it is preferable that the refractory ma-
terial have a low linear coefficient of thermal expansion
up to about 1600° C. to prevent cracking and failure of
the member due to rapid change in temperature. Par-
ticularly suitable for these purposes are refractories, such
as, fused silica, dead burned magnesia, stabilized zir-
conia, alumina, and calcined high alumina clays such as
bauxite and calcined fire clays. Refractory member 12
may be produced by any of many methods known to those
skilled in the art, for instance, vibration and slip casting,
hydraulic pressing, impact pressing, and auger machine
repressing.

In order to receive the molten material as it passes
through opening 14, there is provided a generally cup-
shaped receptacle 22 having a cavity 23, which is dis-
posed in the opening 16 and fits snugly against the longi-
tudinal surface 18, the cavity 23 being an alignment with
the upper opening 14. The peripheral groove 20 on the
surface 18 is designed to allow the chill to fit flush against
the surface 18 during the sampling operation, while cor-
respondingly preventing shear stresses in the sidewalls
and ultimate failure of the sampler. The receptacle is
composed of a metal, having good thermal conductivity,
such as, for example, copper and base alloys thereof, so
as to rapidly dissipate heat from the molten sample and
allow it to solidify. Receptacle 22 may also be referred
to as a "chill."

A lower plug 24 is disposed in lower opening 16 to
hold chill 22 firmly in place and to seal and close the
opening. Plug 24 may be secured by a dip coating of
mortar 25 or any other material having thermal proper-
ties similar to the refractory material of cylindrical mem-
ber 12 and plug 24. Walls 26 of cylindrical member 12
are of such thickness that when sampler 10 is immersed
in molten metal, chill 22 will remain relatively cool to in-
sure rapid dissipation of heat from molten metal entering
cavity 23.

Upper opening 14 is closed by means of an upper plug
27 which is composed of a burnable material that will
not contaminate the molten metal. Cork has been found
particularly suitable for this purpose. In steel sampling
practices it may be desirable to rapidly deoxidize the steel
as it enters the opening 14. Accordingly, a sliver 28 of a
known steel deoxidizer, such as, aluminum or ferrosilicon
or the like, may be disposed in the burnable upper plug
27. The deoxidizer could also be placed in cavity 23 of
receptacle 22. A recess 30 may be provided along the
outer periphery of the walls 26 so sampler 10 may be
firmly held by some mechanical means during the sam-
pling operation.

In use, sampler 10 held by, for example, a mechanical
lance attached to a wheeled dolly, and is immersed to
a predetermined depth below the slag in a molten steel
heat to obtain a representative sample. Upper plug 27,
being composed of a burnable material, burns out almost
immediately upon contact with the molten steel to admit
it to the cavity 23 of the chill 22 without contamination
by the slag. The steel sample solidifies upon contact with
the chill. The sliver 28 serves to deoxidize the sample.
The sampler 10 may then be immediately removed from
the molten steel and the cooled sample removed and
analyzed. The entire sampling cycle has been determined
to require about 15 seconds as compared to up to 2
minutes with prior sampling arrangements.

The following example is illustrative of the fabrication of a preferred embodiment according to the teachings of the invention:

Example I

A batch of material was prepared by mixing 70% by weight of calcined South American bauxite, 15% alumina, and 15% ball clay. The typical screen analysis of the mixture is about 30% of -3 mesh material on 10 mesh, about 20% -10 +28 mesh, about 10% -20 +65 mesh, and about 40% -65 mesh. About 10 to 40% of the -65 mesh material rests on a 325 mesh screen, the remainder passing through a 325 mesh screen. The material was mixed with a sufficient amount of tempering agent as to allow slip casting (about 6 to 10%, by weight), and was made in the shape of the cylindrical member of FIG. 1. A lower plug was made similar to that in FIG. 1 by dry pressing (about 3 to 4% tempering water was used) the shape of the same material. The diameter of the cylindrical member was about $4\frac{1}{2}$ " and the length along its longitudinal axis was $4\frac{3}{16}$ ". The diameter of the upper aperture and opening 14 was about $\frac{1}{2}$ " and the length of this opening was about $1\frac{1}{4}$ ". The lower aperture and opening 16 were about $3\frac{1}{16}$ " in diameter. The copper, cup-shaped chill, (3" D x $1\frac{1}{2}$ " thickness) was placed in opening 16 flush against inner surface 18. The lower refractory plug 24 was then dip coated in mortar and placed within the lower opening and pressed firmly against the copper chill to effectively seal the opening. A cork was friction fitted in the upper opening and the sampler unit was tested by immersing it in a molten heat of steel. The results indicated that uniform samples of steel could be obtained for spectrographic analysis and that the refractory member withstood the rapid temperature change without cracking when immersed in the molten steel.

The following sets forth another specific embodiment of the invention:

Example II

A batch of material was prepared by mixing by weight, 45% calcined diaspore, 30% calcined flint clay, and 25% crude flint clay. A typical screen analysis was about the same as that shown in Example I. A cylindrical body and plug were made from this mixture in the same manner as discussed under Example I. An immersion sampler was assembled as in Example I of substantially the same dimensions.

While the immersion samplers in the above examples were of a circular cross sectional shape, it could be understood that the cylindrical member may assume other shapes, such as, square, hexagonal, even spherical if one so desires.

It is intended that the foregoing description and drawing be construed as illustrative and not in limitation of the true spirit and scope of this invention.

We claim:

1. An immersion sampler suitable for obtaining samples of molten metal from a slag covered molten metal bath, comprising a hollow refractory cylindrical member having communicating upper and lower openings, the upper opening enlarging substantially in cross-section a short distance from the upper end into the lower opening, there being an interior longitudinally disposed surface adjacent the upper opening, where said upper opening enlarges, a metal member having an upper cup-like cavity disposed

within the lower opening and having a surface portion in contiguous contact with the longitudinal surface, the cavity in the metal member being in communication with the upper opening, a refractory plug member disposed in and closing the lower opening, a face of said plug member being contiguous with the cup-shaped member, and an upper plug member composed of a burnable material disposed in and closing the upper opening, there being deoxidizing material for the molten metal carried by the upper plug member within the upper opening.

2. An immersion sampler suitable for obtaining samples of molten metal from a slag covered molten metal bath, comprising a hollow refractory cylindrical member having communicating upper and lower openings, the upper opening enlarging substantially in cross-section a short distance from the upper end into the lower opening, there being an interior longitudinally disposed surface adjacent the upper opening, where said upper opening enlarges, a metal member having an upper cup-like cavity disposed within the lower opening and having a surface portion in contiguous contact with the longitudinal surface, the cavity in the metal member being in communication with the upper opening, a refractory plug member disposed in and closing the lower opening, a face of said plug member being contiguous with the cup-shaped member, and an upper plug member composed of a burnable material disposed in and closing the upper opening, there being deoxidizing material for the molten metal carried by said sampler within the upper opening adjacent said upper plug member.

3. The immersion sampler of claim 2 wherein the cup-shaped member is composed of copper.

4. The immersion sampler of claim 2 in which the hollow refractory member and refractory means for closing and sealing the chilling means is composed of refractory material having substantially the same linear coefficient of thermal expansion and being of such a nature that the refractory is not destroyed in the sampling procedure.

5. The immersion sampler of claim 2 wherein the hollow refractory member and refractory means are composed of refractory material selected from the group consisting of fused silica, dead burned magnesia, stabilized zirconia, alumina, and calcined high alumina clays and calcined fireclays.

6. The immersion sampler of claim 2 in which the interior longitudinal disposed surface adjacent the upper opening contains a peripheral groove therein.

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