United States Patent

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[54] **METAL CASTING APPARATUS**
6 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **164/337,** 164/255, 249/54, 266/38, 222/556
[51] **Int. Cl.** **B22d 27/16**
[50] **Field of Search** 164/258, 255, 337, 251, 51, 376; 222/556; 266/38

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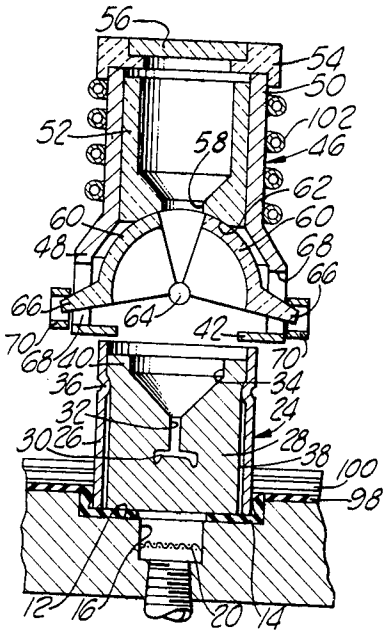
ABSTRACT: A crucible having a bottom outlet opening with heating means disposed about the sidewall and downwardly as far as the outlet, mold supporting means beneath the crucible outlet, a gate for closing and opening the outlet, the underside of the bottom of the crucible being concave and the gate comprising a pair of upwardly convex members in movable sealing engagement with the underside of the crucible bottom and having the same curvature as the concave underside, whereby the outlet and gate are located in the heating zone provided by the heating means.



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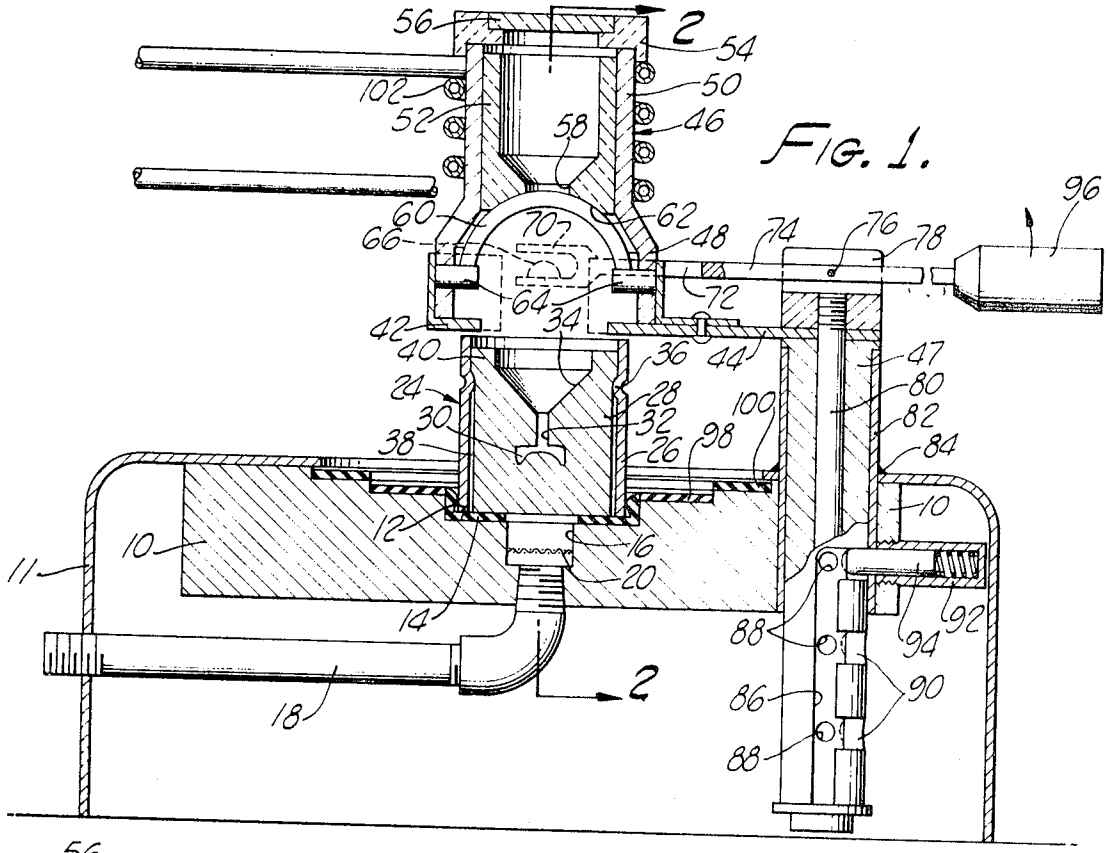

FIG. 1.

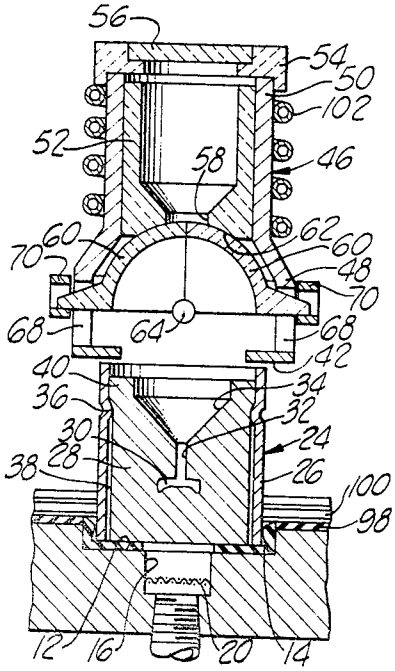

FIG. 2.

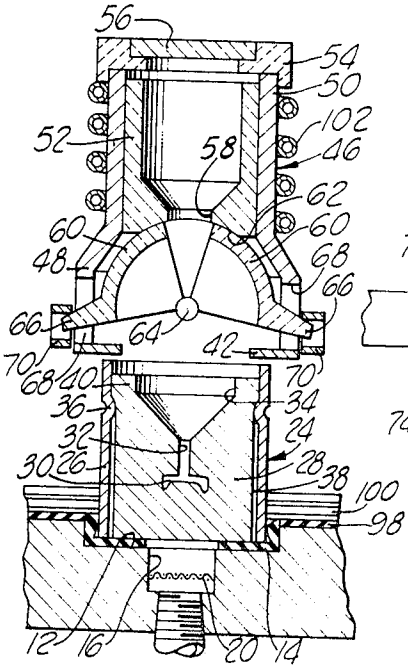

FIG. 3.

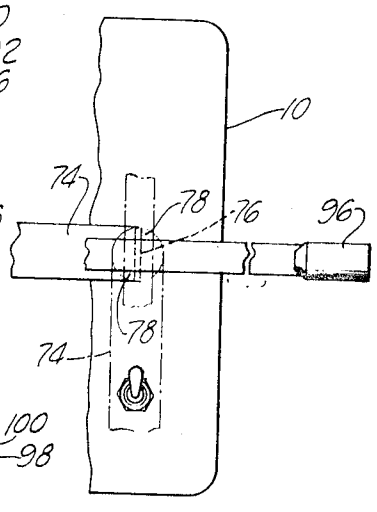

FIG. 4.

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METAL CASTING APPARATUS

Prior Art

The present invention is an improvement upon the "casting apparatus" disclosed in my prior U.S. Pat. No. 2,685,718, issued Aug. 10, 1954.

DISCLOSURE

This invention relates to casting apparatus and more particularly to the construction of a crucible and gate to be used in conjunction with the mold, for heating molten materials, primarily metals, wherein the structure is such that the molten material is quickly and efficiently discharged from the crucible to a mold located closely therebelow.

Another object of the invention is to provide casting apparatus wherein there is a crucible with a bottom outlet and a gate movable across and away from said outlet so that molten material, such as that used in dental and jewelry casting, is drawn from the bottom of the pool of molten metal in the crucible so that particles of carbon and other impurities will remain on top of the button of molten metal in the crucible instead of in the casting. This feature provides castings which are uniform and do not have particles therein which are foreign to the particular metal or alloy being cast.

A further object of the invention is to provide a crucible with a simple yet effective closure gate for the outlet of the crucible wherein means is provided for maintaining the gate in its normal closed position.

Another object is to provide a construction for adjustably supporting the crucible to accommodate molds of different heights.

The above and other objects will more fully appear from the following description in connection with the accompanying drawing:

FIG. 1 is a vertical sectional view through an embodiment of the device;

FIG. 2 is a section taken approximately on the line 2—2 of FIG. 1 with the crucible gate closed;

FIG. 3 is a view similar to FIG. 2 but with the crucible gate in an open position;

FIG. 4 is a fragmentary detail of a portion of the crucible supporting means for alternate positions in full and broken lines.

In my prior patent there is disclosed and claimed apparatus by means of which castings are made while the mold and molten metal are maintained under negative pressure to insure proper filling of the mold, and to eliminate porous or pitted castings.

My prior patent shows a base **10** in a casing **11** and in the top of which there is formed a depression **12** in which depression is a gasket **14**, preferably of compressible or resilient material which is resistive to high heats. A silicone rubber may be used for the gasket. In the center of the base in an opening **16** in communication with a pipe **18** leading to a source of negative pressure. Preferably, the bottom of the opening **16** is covered by a screen **20**.

Also shown in my prior patent is a mold **24** having a tubular impervious shell **26** filled with a porous molding material **28**, such as a conventional self-hardening dental investment. A mold cavity **30** may be formed therein by the usual "lost wax" method and a bore **32** connects the cavity **30** with a cup **34** formed in the upper face of the molding material **28**. All of this structure, or structure similar thereto, is shown in my prior patent.

The shell **26** has an inwardly disposed bead **36** which closely fits the main outer wall portion **38** of the block of porous molding material **28**, the latter having an upper enlarged portion **40** defining a shoulder resting upon the bead **36**. Thus, when negative pressure is applied through the conduit or pipe **18**, a certain amount of air, or air and other gases, are drawn through the molding material **28**, which is somewhat previous to such gases but impervious to the molten metal deposited in the cavity **30**. The bead **36** in the sleeve **26** sufficiently seals

said sleeve **26** and the molding material **28** above the cavity **30** to prevent undesirable bypassing of airflow between the sleeve **26** and the molding material **28**.

Adapted to rest upon the upper end of the sleeve **28** is the enlarged and apertured outer end **42** of an arm **44** which is carried by a supporting post **47**. Resting upon said enlarged end **42** is a vertically disposed crucible sleeve **46** having an enlarged lower end **48** and a reduced diameter upper end **50** which lies about a graphite crucible **52**. Removably resting upon the top of the crucible sleeve **46** is a ceramic cover **54** in which is a fused quartz window **56**.

The graphite crucible **52** has a bottom outlet **58** which may be closed by a pair of gate elements **60** which are of concavo-convex shape, the convex portions of which are disposed upwardly and closely fit concave portions **62** formed on the underside of the crucible bottom. The gates **60** partially rotate about pins **64** which are supported by and extend inwardly from the enlarged bottom portion **48** of the sleeve **46**. Each gate **60** has a projecting lug **66** which extends through a notch **68** in the crucible sleeve bottom **48** and the outer end of each projecting lug **66** extends into a fork **70** on each end of a pair of fork arms **72**, which extend horizontally from a lever **74** pivoted at **76** between a pair of spaced lugs **78** on the upper end of a bolt **80** which extends downwardly through the vertical post **47**.

The post **47** extends downwardly into the housing **11** through a sleeve **82** which is welded in the housing as at **84**. Said post **46** in its lower portion is provided with a vertical groove **86** having vertically spaced depressions **88**, and extending partially around the post from the vertical groove **86** and at the same height as the depressions **88**, are grooves **90**. Extending from the right side of the base **10** is a sleeve **92** carrying a spring pressed pin **94** which fits into the grooves **86** and **90** and also is removably receivable in the depressions **88**. When a handle **96** on the horizontal lever **74** is swung counterclockwise, as viewed in FIG. **4**, the post **47** will rotate and cause the vertical groove **86** to align with the pin **94**. In this position the pin will yieldably seat in one of the depressions **88** to hold the horizontal arm **74** and handle **96** in the broken line position of FIG. **4**. In this position the entire crucible assembly is swung 90° counterclockwise from its position over the mold **28**. It is clear that the horizontal lever **74** and handle **96** can be raised, causing the post **46** to raise with them and the crucible can be adjusted to higher elevations than that indicated in FIG. **1**. This is to provide accommodation for larger mold elements. For example, one of greater diameter and height would rest on the rubber ring **98** and an even wider and higher mold would be received on the rubber ring **100**. The molds of course would be of heights to be accommodated by the vertical adjustment of the post **47**.

Around the crucible sleeve portion **50** is a coil **102** in the form of an electrical conductor which heats by induction the graphite crucible liner **52** which is a susceptor for the induction heater, and the graphite susceptor **52** in turn heats the gold or other material in the crucible to be molded and cast. While I prefer induction heating because of the speed at which gold and other metals can be melted, it is of course to be understood that other types of heating can be utilized if desired.

It should be noted that the upper surfaces of the gate elements **60**, which normally close the bottom of the graphite crucible **52**, are yieldably held in their closed position of FIG. **2** by reason of the weight of the handle **96** on the pivoted lever **74**, whose fork arms **72** and forks **70** are the actuators for the gate elements. The forks **70** being normally urged upwardly by reason of the weight **96** on the outer side of the pivot **76**, the gates will be held in the position of FIG. **2** until the weight **96** is raised by the hand of the user.

The upper surfaces of the gate elements **62** closely fit the underside of the crucible and the fit is such that molten metals heated in the crucible will not leak out when the gate elements are closed.

The gate elements **60** when closed are shown located approximately no lower than the bottom of the heating coil **102**

so that the molten metal is maintained in its molten condition immediately at the gate and has no opportunity to cool objectionably when it is dropped from the crucible to the mold. This is important in the case of some metals such as gold wherein a temperature change of 25° to 50° F. below the heat required to keep it molten will permit the gold to solidify. Consequently, the feed from the crucible to the mold must be short in distance as well as time. For that reason the arrangement of the concavo-convex crucible gates and their location with respect to the bottom interior portion of the crucible and the heating coil are rather critical.

There are other methods which are used in casting gold for dentistry, these being the centrifugal method and the air pressure method. The centrifugal method of casting is not practical where vacuum casting is utilized because of the difficulty in maintaining the reduction of pressure in conjunction with a rapidly rotating mold. The use of the vacuum is important and advantageous because it eliminates bubbles in the casting which are quite objectionable in dental inlays and other molded shapes. In the centrifugal casting type of apparatus the upper portion of the pool of molten metal leaves the crucible first and carries with it foreign matter, such as slag, oxides, carbon flux, into the mold, contaminating the casting.

It should be noted that in my apparatus when the molten metal, such as gold, drops through the gate elements **60**, the sprue hole **32** is sealed by gold. The application of negative pressure to the somewhat porous mold material **28** removes air from within the mold cavity **30** while the molten gold is flowing into it, so that the cavity is completely filled with the molten metal before it has time to solidify. The rapid reduction of pressure or removal of air from the mold cavity is considerably assisted by the seal provided by the internal bead **36** in the mold sleeve **26** and the houlder formed by the enlarged upper portion **40** of the mold material **28**. This is the only seal needed in the apparatus. The crucible being subjected to ordinary atmospheric pressure, no seal is required for the gates **60** and the bottom of the graphite crucible **52**.

It will of course be understood that various changes can be made in the form, details, arrangement and proportions of the various parts without departing from the spirit of the invention.

I claim:

1. Casting apparatus for molten materials including a vertical crucible having a sidewall and having a bottom wall with a concave bottom face having an outlet therethrough, wherein the improvement comprises: electrical heating means lying about the sidewall and the bottom portion of the sidewall; of the crucible, means for supporting said crucible and its bottom outlet above a mold, and a gate supported beneath said crucible in sealing contact with the concave bottom face of said bottom wall about said outlet and pivotally movable in sliding contact with said concave bottom face; from a position closing said bottom outlet to an open position out of vertical alignment with said outlet permitting free gravity drop of molten materials directly from the outlet of the crucible.

2. The structure in claim **1**, and the bottom wall of said crucible increasing in thickness radially outwardly from the outlet.

3. The structure in claim **1**, and said gate having a convex surface conforming to the curvature of the concave bottom face of said bottom wall.

4. The structure in claim **3**, and said gate comprising a pair of jaws movable toward each other to a closed position and away from each other to an open position.

5. The structure in claim **4**, and means connected to said gate jaws to actuate the same, said means including means biasing said jaws to a closed position.

6. The structure in claim **1**, said crucible outlet being located at the apex of said concave bottom face, and said gate having a convex surface conforming in curvature to the concave bottom face of the bottom wall of the crucible, and said mold positioned directly beneath said gate and said outlet.

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