July 26, 1949. G. A. RUBISSOW 2,477,092

ROTATING DISTRIBUTION GATE FOR CENTRIFUGAL CASTING

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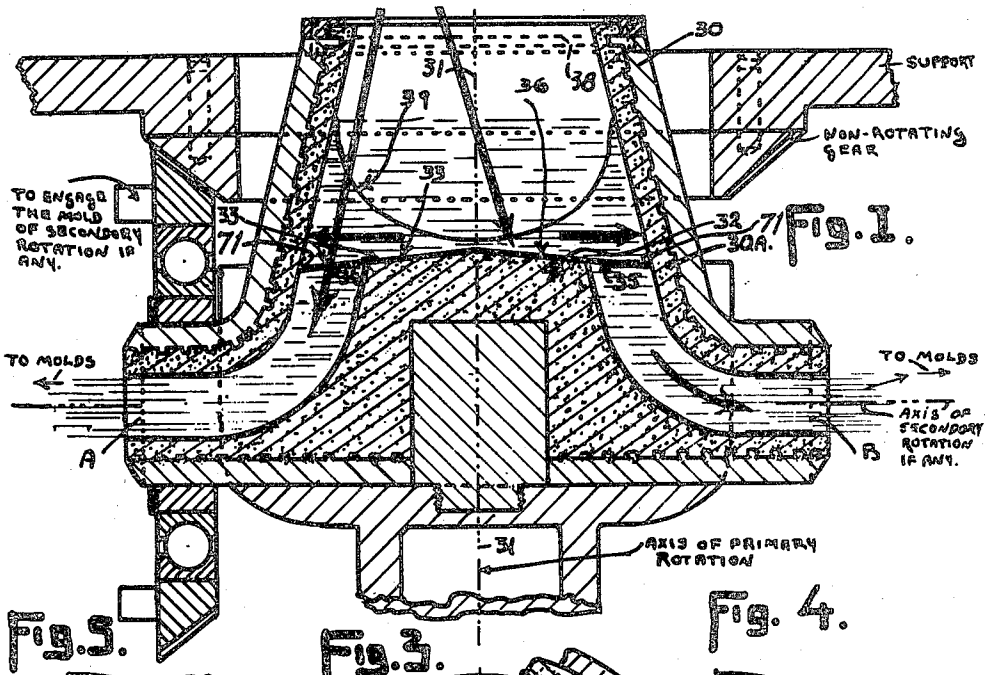


Fig. 1.

Fig. 5.

Fig. 3.

Fig. 4.

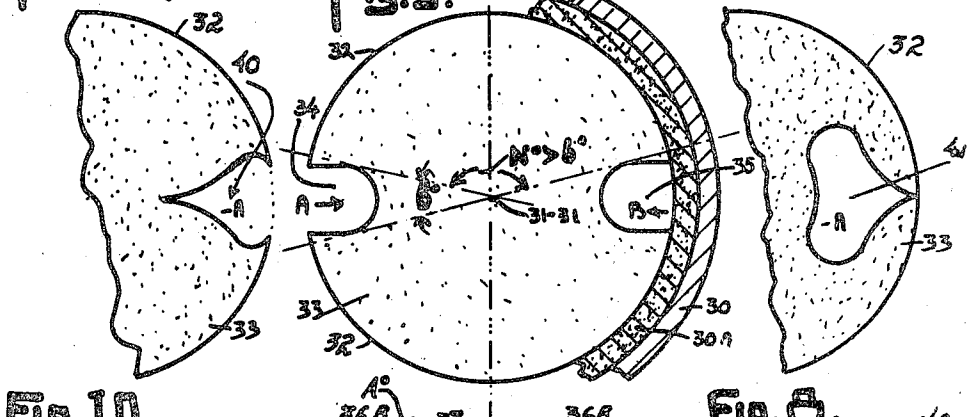


Fig. 10.

Fig. 8.

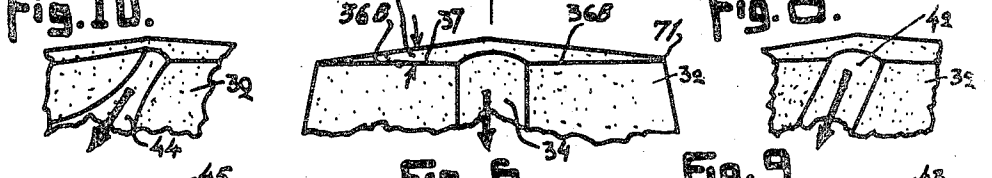


Fig. 6.

Fig. 9.

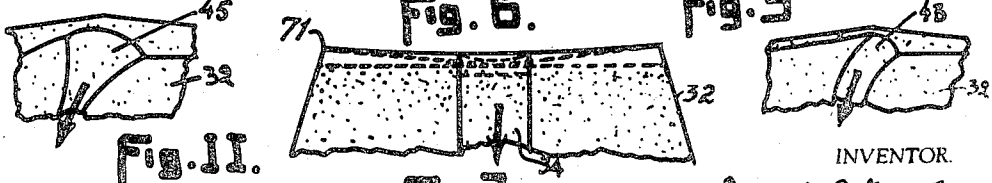


Fig. 11.

Fig. 7.

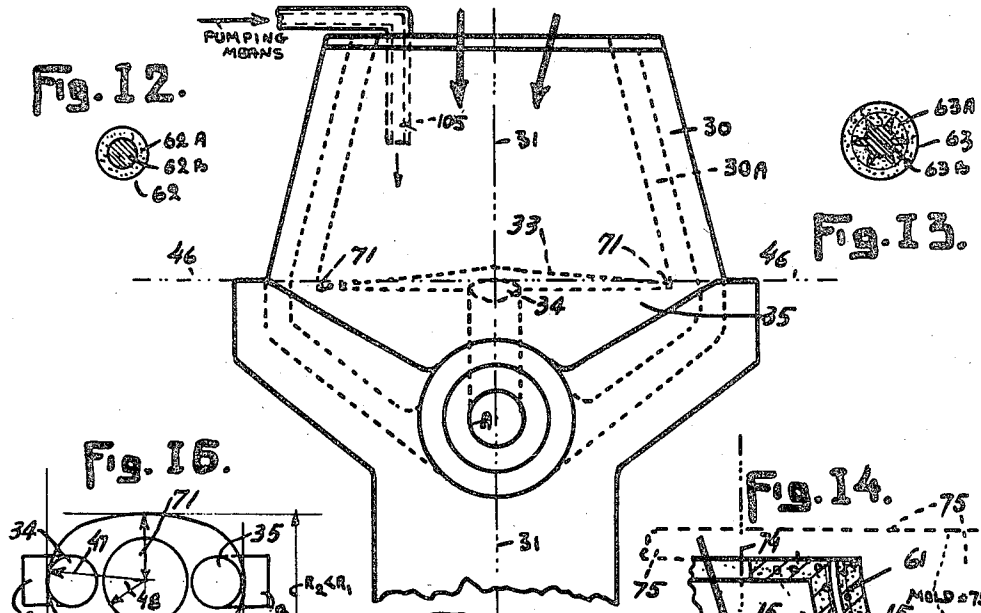
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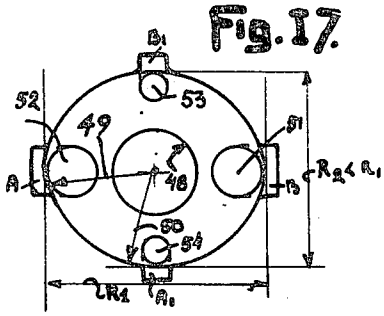
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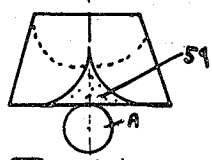
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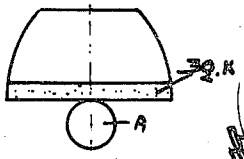
ROTATING DISTRIBUTION GATE FOR CENTRIFUGAL CASTING

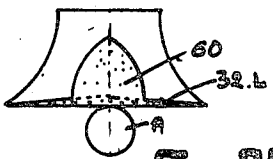
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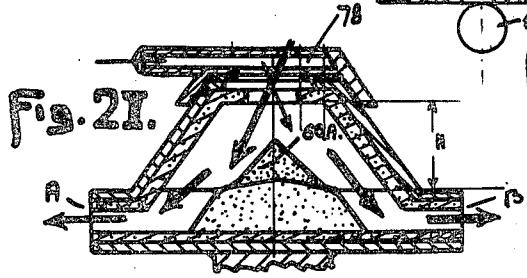


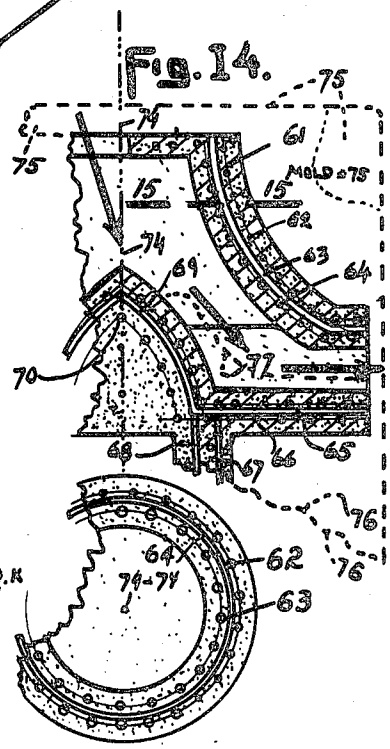












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ROTATING DISTRIBUTION GATE FOR CENTRIFUGAL CASTING

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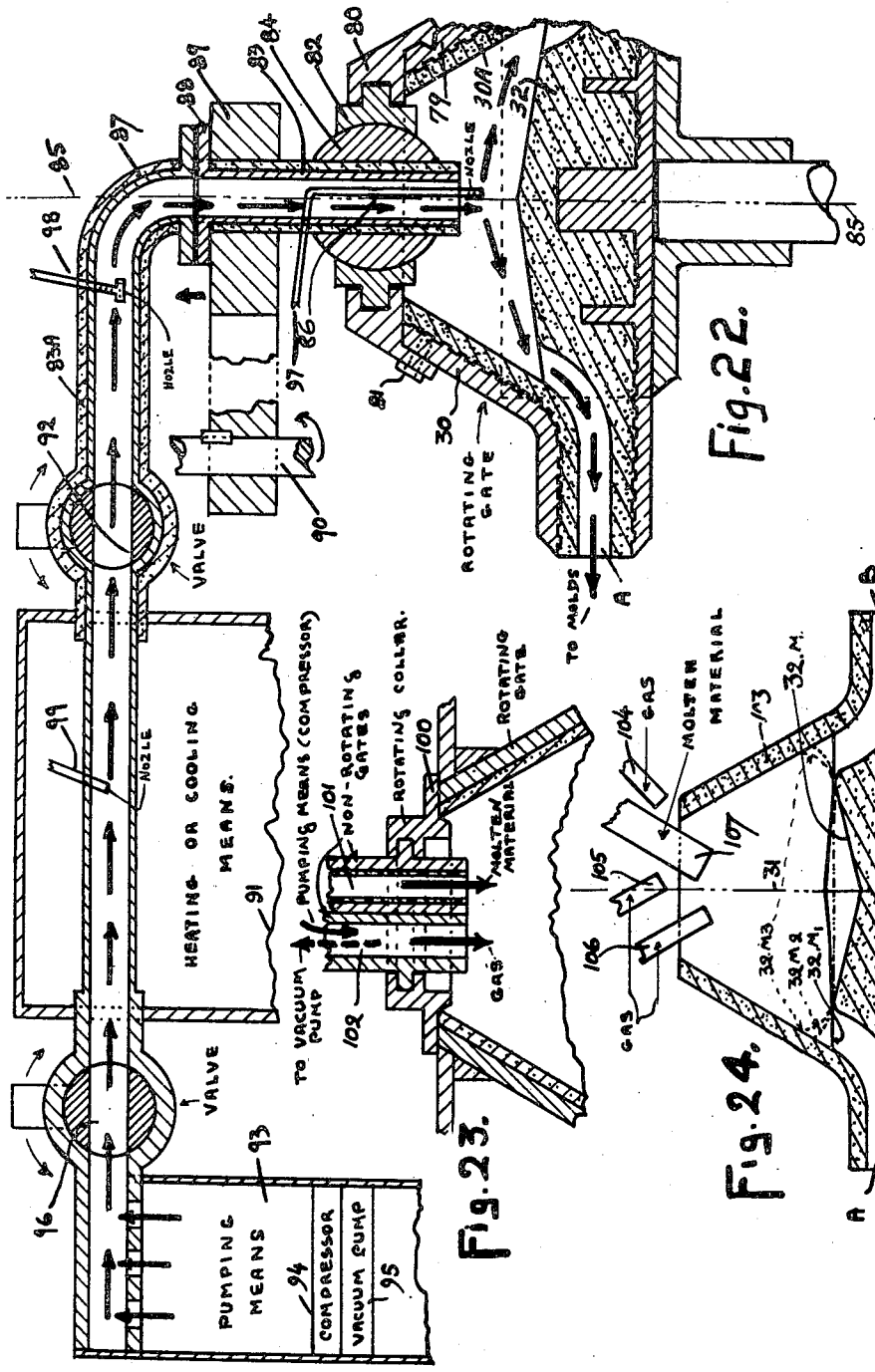


Fig. 22.

Fig. 23.

Fig. 24.

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ROTATING DISTRIBUTION GATE FOR CENTRIFUGAL CASTING

George A. Rubissow, New York, N. Y.

Application May 12, 1944, Serial No. 535,314

1 Claim. (Cl. 22—65)

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This invention and improvement is a continuation in part of the United States patent applications, Serial #501,360, Casting method, pouring gates and molds used in combination therewith, filed September 17, 1943, and Serial #525,028, filed March 4, 1944, for Centrifugal casting apparatus and method, both now abandoned.

Like references and like numbers wherever possible will be used to describe like elements on the various figures and in the description thereof.

Figure 1 is a cross-sectional side view with parts broken out of a main pouring rotating gate.

Figure 2 is a side view of Figure 1 with parts broken out.

Figures 3, 4 and 5 are diagrammatical plan views with parts broken out of the distributing member described herein.

Figures 6 and 7 are side views with parts broken of different aspects of a distribution member.

Figures 8, 9, 10 and 11 are diagrammatical cross-sectional side-views showing different aspects of the distributing member with parts broken out.

Figures 12 and 13 are diagrammatical side views of refractory reinforcement means.

Figure 14 is a schematical cross-sectional side view with parts broken out of another embodiment of a main pouring gate.

Figure 15 is a cross-sectional plan view 15—15 of Figure 14 with parts broken out.

Figures 16 and 17 are diagrammatical plan views of the distributing member of the character herein described.

Figures 18, 19, and 20 are diagrammatical side views of the main pouring gate and distributing member.

Figure 21 is a schematical cross-sectional side view of another main pouring gate with parts broken out.

Figures 22, 23 and 24 are schematical side views partly in cross section of the main pouring gates provided with atmosphere-making equipment.

Figure 1 shows a rotating pouring gate 30 employed as a main distributing gate—i. e. for feeding the molten metal into two molds rotatable around the symmetry axis of the main pouring gate, namely, its own axis of rotation 31—31.

Where the main pouring rotating gate has at least two exit orifices through which the molten material is distributed into the molds, as schematically shown on Figure 23, it is obvious that when the material is poured, the distribution cannot be expected to be homogeneous through each of the orifices. When two molds are used a possibility exists that one mold will overflow and the metal will spill over it while the other mold will be only partly filled.

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This invention provides means to automatically divide the amount of the poured-in molten metal with great accuracy through as many exit orifices as may be provided.

This improvement comprises a main rotating gate which has a circular opening on its top (other openings may be used but are not practical). The opening gradually flares—i. e. increases in diameter from its top to bottom until it reaches the distributing member 32, the upper surface of which forms the bottom 33 of such main rotating pouring gate in which bottom, exit orifices are provided, preferably distributed symmetrically around the axis of rotation.

If two orifices are used, they may be placed 180° apart from each other. If three orifices are used, they may be placed 120° apart; if four orifices are used, 90°, and so on.

The bottom surface in which two or more orifices are provided is to be so designed that the sum of the cross-sections of the orifices in the plane of the surface of the bottom, is substantially smaller than the remaining solid surface thereof.

By way of example—on Figure 3, the solid surface 33 is much larger than the sum of the cross-section surfaces of the two orifices 34 and 35.

Another important aspect resides in that the distributing surface 33 is of such a nature that it is formed by a movement of a line or curved line around the axis of rotation 31—31. In case this line 36, as shown on Figures 1 and 6, is at a very small angle A to a line which is perpendicular to the axis of rotation 31—31, the cone thus formed will constitute the distributing member 32.

If the line 36 will be parallel to a line 36B which is perpendicular to the axis of rotation 31—31—i. e. angle A on Figure 6 equal to zero—the surface will then be perpendicular to the axis of rotation 31—31.

The angle A may vary from plus to minus—namely, the cone 37 may taper towards the top or the bottom of the gate. Only a cone tapering towards the top is shown, on Figure 6, being the most practical design.

Instead of forming the cone by a straight line as shown on Figures 1 and 6, it may be formed by any type of curve or combination of curve and straight line.

Due to the flaring of the walls of the main gate, the metal as it is poured through the entrance opening 38 will be strongly urged by centrifugal

force and by its own gravity towards the bottom **32** which it will strike and on which it will be distributed according to the laws of hydraulics, forming a curved or substantially parabolic cavity **39**. The metal thus partly rests on the bottom **33** and partly flows continuously out through the exit orifices **34** and **35**, until all the metal has been distributed into molds. The sum of the cross-sectional surfaces of the orifices being smaller than the solid surface of the bottom **33**, the time element for the distribution, being very minute due to the considerable centrifugal force, enables a homogeneous distribution of the flow of molten material through the orifices being such that each of the molds will be filled with the same amount of material and within the same period of time.

By way of example, on Figure 3, the volume of the molten material urged towards the surface **33** is about 20 times greater than that part of the volume urged through the cross-sectional surfaces of orifices **34** and **35**, thus giving, according to the theory of variations, sufficient accuracy for control of the homogeneity of the flow. The smaller the opening the higher the accuracy.

In other known in the art distributing gates, even where some exit orifices are provided, there is not any distributing member of the character herein referred which enables the control of a homogeneous distribution of poured in material. In fact, this device specifically provides for the molten metal to remain, if only for a very short time, on the distributing plate **33** before it passes through the exit orifices.

Exit orifices **34**, **35** or a plurality thereof, if desired, may be situated as far away from the axis of rotation as possible.

The shape of the orifices **34—35** may be as shown on Figures 3 and 6, or they may be shaped in the form of a heart or triangle **40**, shown on Figure 5, larger towards the mold, or as shown by the numeral **41** on Figure 4, tapering towards the mold. Such forms control the flow in its own characteristic way. The walls of orifices may follow a plane parallel to the axis of rotation and directed downwards, as shown on Figures 6 and 7, or they may follow an incline, such as shown on Figure 8, by the numeral **42**, or they may be curbed as shown by **43** on Figure 9, or they may be flared and curved as shown by **44** on Figure 10. They may also be tapering and curved as shown by **45** on Figure 11, or they may have any combination of any of these shapes herein referred.

The bottom surface itself, taken, for instance, along the cross-section **46—46**, Figure 2, may be elliptical or elliptoid as shown on Figures 16 and 17. This will urge the metal towards the greater radius of rotation **47**, Figure 16, wherein the entrance opening **48** is substantially smaller than the axes of the elliptical bottom surface.

In Figure 17, the radius **49** is shown slightly larger than the radius **50**. This is done to provide homogeneous distribution through the four exit orifices **51** and **52** and **53** and **54**, the diameter of **51** and **52** being larger than that of **53** and **54**, in the same gate.

On Figures 18, 19 and 20, the central part of the distributing member **32** is shown diagrammatically, having a head member **59** in the form of a concave tapering cone **60**. The flare of the outer walls may either be straight or curved, concave or convex, as shown on Figures 14, 18 or 19.

One of the most suitable arrangements is to design the bottom surface so that there are two

exit orifices therein, each placed at 180° from each other, the radius of the bottom surface being slightly larger towards the outer walls of the exit orifices (relatively to the axis of rotation) than the radius taken at 90° to the first mentioned radius. This is shown in exaggerated proportions, for instance, on Figure 16 where the radius **47** is larger than **48**. In practice, this difference may be very small, namely—just large enough to command the flow of the molten material through the orifices.

According to this invention there may be "N" exit orifices placed symmetrically in respect to the axis of rotation (the vertical axis of rotation —such as **31—31**, **Fig. 2**) placed symmetrically at

$$\frac{360}{N}$$

degrees one from another, and in this case the diameter taken between the furthest away inner wall (the outer periphery) of said exit orifices have to be bigger than the diameter taken at the bottom part of the inner walls for the flaring downwardly main entrance orifice taken at

$$\frac{230}{2N}$$

N being a whole integral number such as 1, 2, 3, 4, etc. Example in Fig. 16, N is equal to "2," then there are two exit orifices at

$$\frac{360}{N}=\frac{360}{2}=180°$$

one from another, and the diameter or distance inbetween them to be bigger than the diameter or distance taken at

$$\frac{360}{2N}=\frac{360}{2.2}=\frac{360}{4}=90°$$

For 4 exit orifices such as shown in Figure 17, N=4, and

$$\frac{360}{N} \text{ is } 90°$$

The diameter or distance in between each of juxtaposed inner walls of such exit orifices taken at 90°, will have to be bigger than the diameter or distance between the inner walls at the bottom part of the flaring downwardly main entrance orifice at

$$\frac{360}{2N}=\frac{360}{8}=45°$$

Still another aspect of this invention comprises a rotating gate with or without the bottom surface member herein described. The gate may be made of refractory material of any suitable nature and provided with reinforcements of the same kind as used for instance in reinforcing of concrete.

Special type of reinforcements such as **62**, Fig. 12, composed of a round wire **62B** surrounded with a refractory coating **62A**, or as **63**, Fig. 13, composed of a star shaped wire **63B** and covered with a refractory layer **63A** may be used.

The refractory material **61** may be of any nature—for example: oxides of metals such as aluminum oxide, magnesium oxide, Carborundum, etc. mixed, if necessary, with cementation means or with porcelain and provided with a plurality of reinforcing means such as **62**, **63**, **64**, **65**, **66**, **67**, **68**, **69**, **70**, and the like, shown by way of example on Figures 14 and 15.

A rotating gate such as this will be very cheap to manufacture as a skeleton may first be made

from the reinforcements and thereafter the refractory material in powdered, pasty or other state, may be applied therein by suitable means, among them comprising compression of the same by mechanical or centrifugal forces.

The rotating gate above described may also be maunufactured in the manner of pottery—by rotating the reinforced skeleton around an axis 74—74 and by applying the reinforced material thereon.

This invention thus covers the process for making such reinforced refractory gates which will be of great use in all modern centrifugal casting machinery, either for rotation of molds in one plane or in two planes.

The process of setting such refractory reinforced gates may also take place under the influence of centrifugal force—i. e. rotating the gate around the axis 74—74, the gate being itself placed in a mold provided for this purpose—for instance, in the mold shown in dotted line 75—76—77—to permit the reinforced material to be compacted by centrifugal force during setting, and when required, the same may be heated by any kind of direct or indirect heat, as well as high frequency and ultra violet heating, while at a standstill or under rotation.

This also represents a new process for making such centrifugally compacted rotating gates.

On Figure 21, another aspect of a rotating gate is shown provided with a non-rotatable collar 78 which may be mounted on the gate while it is at a standstill. This arrangement is used for purpose of blowing a gas or vapor into the gate and through its orifices into the cavities of the mold or molds. The gas or vapor may be for instance a neutral gas, such as nitrogen, helium, or any other gas, such as carbon monoxide, for instance, or air mixed with neutral gases or pure air or any suitable vapors. The gas may be introduced under any desired pressure and when heating of the mold and gate is required, the gas may be pre-heated to a desired temperature and thereafter cooled accordingly, if required.

This is more explicitly shown on Figures 2, 23 and 24.

On Figure 22, the gate 79 may be supplied with gas or vapor of the character above described, while the gate is at a standstill or under rotation. For this purpose, a rotatable collar 80 may be mounted by suitable means on the outside (or, if desired, on the inside) and if necessary, affixed thereon by suitable fixation means, such as, for instance, a nut or screw 81, or key and the like.

The rotatable collar may be mounted in another collar 82 which may be either rigid relative to the non-rotating conduit 83, or may be rotatable, and mounted on a bearing 84, for instance. The bearing, if spherical, as shown on Figure 22, will permit not only rotation around the axis of rotation 85—85, but will also permit angular displacement thereon around its center 86. The interior and/or the exterior 83A, of the pipe or conduit 83 may be either metal, ceramic, or other refractory material, as required.

If the conduit is a monolithic structure, then the wall may be either metallic, ceramic, plastic, or of refractory material, as required.

The conduit may be sectional, having for instance, sections 87 and 88. If desired, a support 89 may be provided on the conduit to support it, or a part thereof, for facilitating the disconnection of it from the gate when desired.

The support may also, if desired, be mounted

on an axle 90 in order to be additionally pivotal in a desired plane—for instance, perpendicular to the axis 85. The heating or cooling means 91 may be provided in a suitable place to heat or cool the gases or vapors passing through the conduit 83. A valve 92 may be interposed between the heating and/or cooling means and the gate.

Whenever the gases or vapors are introduced under pressure, or are in the state of partial vacuum, the pumping means 93 such as a compressor 94 or vacuum pump 95, shown diagrammatically may be provided before or after the gases are heated and/or cooled.

On Figure 22, such arrangement is shown before the gases are heated, with a valve means 96 interposed between the pumping and/or the heating and cooling means. When the valve 96 is opened and the valve 92 is closed, a desirable degree of compression or of vacuum may be provided in that section of the pipe 83. It is obvious that when a large amount of calories for cooling or heating is required, and large quantities of such hot or cold gas or vapors have to be provided, the section 83C may comprise a container of any suitable form and volume—it may, for instance, be a coil of pipe, it may be a zigzag pipe or be a suitable tank.

Another very important aspect of this invention consists in additionally providing the conduit 83 or 87 or 83C with an injector system 99 shown schematically. The injector system comprised an injector nozzle or similar arrangement, through which a suitable coating means, for the coating of the inside of the cavities of the molds, may be injected and is thus admixed with the gas or vapor that is conducted through the conduit into the molds. Such coating is of particular importance for obtaining a better cast-face and/or for obtaining an easier peeling off or separation of the non-permanent refractory mold from the cast-in product, or an easier removal of the cast products from the permanent or semi-permanent mold.

The use of inert gases such as heated nitrogen for instance, under considerable pressure, introduced into the rotating gate, is of great importance in general, and in particular, but not limiting thereto, it may be used also as a carrier of the coating material injected into such a stream of gas, because it permits a considerable reduction of the required amount of pulverized coating and increases the adherence of such coating to the walls of the cavities of the mold.

An inert gas may also be used in order to provide a neutral atmosphere and to prevent an undesirable oxidation or other chemical side reactions. Special gases may be used in some cases to provide a desired chemical reaction between such gases and the poured-in metal or between surfaces of the coating of the mold.

By way of example, waterglass powdered charcoal, or waterglass graphite, or waterglass talc coating will provide very interesting results in the atmosphere of hot nitrogen in which the molten metal or metal alloys are poured in.

For other uses, instead of waterglass solution, cottonseed oil, linseed oil, or other vegetable oils may be employed as coatings. Also a mixture of waterglass solutions with one or more vegetable oils, particularly cottonseed, linseed, which will produce satisfactory results due to the fact that after the coatings have been dried by inert or other gases, or by heat during the pouring in of the molten material, they will provide brittle

layers which will facilitate the removal of the cast material without altering the chemical composition thereof.

Coatings used today for casting glass in metallic molds may also be used for the casting of glass in accordance with this invention.

On Figure 24, another arrangement is shown wherein the rotating collar **100** is provided with two or more conduits **101**, **102**; one for injecting gas under pressure if pumping means are used, or for evacuating gas if a vacuum pump is used, and the other (**101**) may be a funnel of a crucible through which the molten material can be poured in at the same time that the gas is being introduced or vacuum provided.

It is obvious that the pressure of the gas should be smaller than the pressure including gravity at which the molten material is being poured in. Where vacuum is present, the depression will not interfere with the pouring in of the molten material—i. e. it will not suck in the same, being easily controllable.

On Figure 25, a refractory rotating gate **103** is shown having several gas injecting conduits—**104**, **105**, **106**, and a conduit or funnel **107** through which the molten material can be poured in simultaneously with the injection of the gas. No rotating collars are used in this particular embodiment, and the method resulting therefrom is extremely suitable for several applications, as it provides the creation of a gas atmosphere in the mold while the molten material is being poured therein.

Having now particularly described and ascertained the nature of this invention and the manner in which it is to be employed, I declare that what I claim is:

A rotatable pouring device for pouring molten material into a plurality of rotatable molds arranged symmetrically about a vertical axis of rotation comprising a hollow member rotatable about said axis, said hollow member having a bottom plate provided with a flat top and with channels one of which leads downwardly from said flat top to each mold, said flat top of the bottom plate presenting a deformed circle with the radii at the openings of the channels being slightly larger than at other points, and said hollow member having walls extending upwardly from the outline of the flat top of the bottom plate to a circular-molten-material-receiving opening at the top of said hollow member, said walls inclining toward said axis as they extend upwardly.

GEORGE A. RUBISSOW.

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