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Heimdal et al.

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[54] **APPARATUS FOR PORTIONING LIQUID METAL**

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[51] **Int. Cl.²** **B22D 17/30**

[58] **Field of Search** 164/303, 312–315; 222/394, 396, 397, 373

[56] **References Cited**

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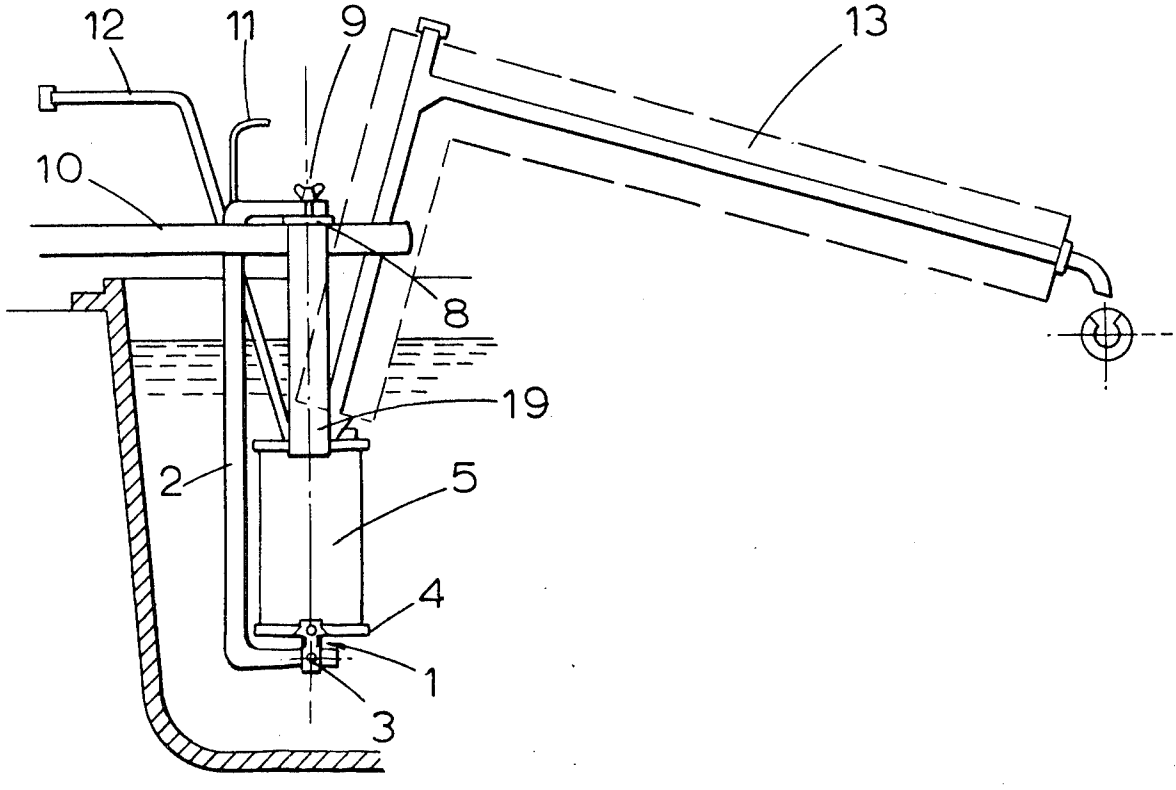
[57] **ABSTRACT**

An apparatus for portioning liquid metal from a holding apparatus using pressure gas to force metal therefrom into a mould. Includes a valve housing to be mounted in an opening in the bottom portion of a pouring container which during operation is submerged in the liquid metal of the holding furnace and provided with a pouring tube and gas supply means. The upper portion of the valve housing extends through the opening with sufficient play or clearance to permit the valve housing to be tilted in relation to a vertical when being inserted into the opening, and the valve housing is provided with an outer, upwardly narrowing, generally conical flange having a contact surface area intended to contact a generally conically shaped seating area at the opening in the bottom portion of the container. The housing is pivoted to a lever adapted to force the contact area of the flange against the seating area at the inlet opening.

5 Claims, 4 Drawing Figures



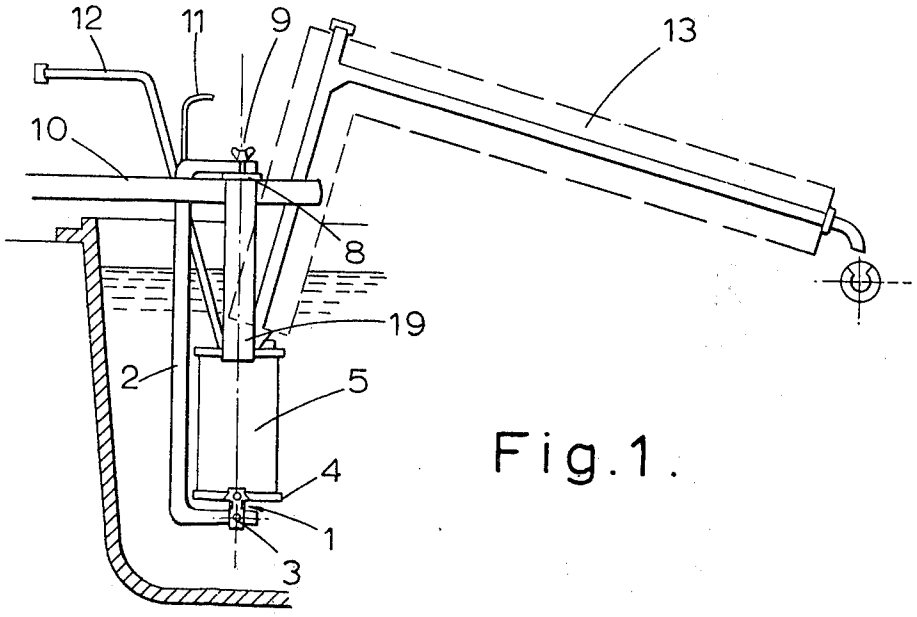


Fig.1.

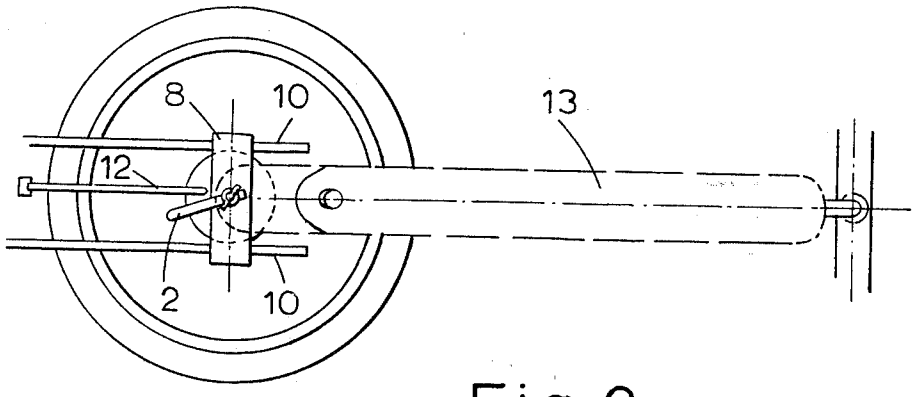


Fig.2.

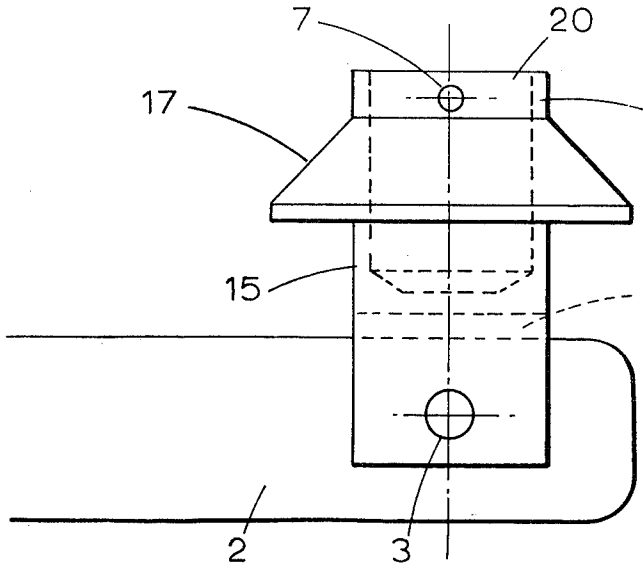


Fig.3.

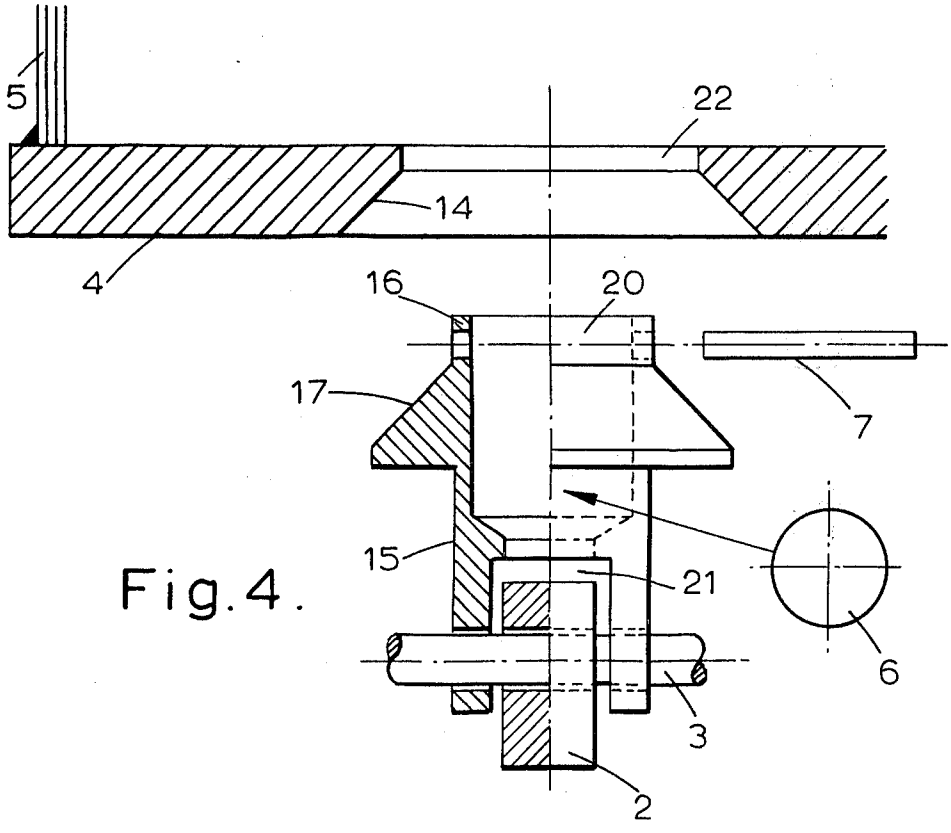


Fig.4.

APPARATUS FOR PORTIONING LIQUID METAL

BACKGROUND OF THE INVENTION

This invention relates to an apparatus for pouring pre-determined portions of liquid metal from a reservoir, such as a holding furnace or the like, into a mould or a die-casting machine.

More particularly the invention relates to a portioning apparatus, preferably intended for portioning molten magnesium, in the form of a portioning container to be submerged into the molten metal, which container is connected with a device for supplying pressurized gas and is provided with a metal outlet in the form of a pouring tube, the container being provided with removable valve means positioned at the bottom of the container.

The pouring action is effected by means of a preferably inert pressurized gas which is supplied to the pouring container from an external pressure source. When the metal is to be forced up from a pouring container which is submerged in the melt and has an inlet opening in the bottom portion for the supply of molten metal from the reservoir, the gas pressure will of course force the metal from the pouring container back to the reservoir (the holding furnace) if no measures are taken to prevent such back-flow. Quite a long time ago it was proposed to use valves to prevent such back-flow. However, so far useful results have not been obtained in practice using valves, the latter being susceptible to functioning defects. After having been in operation for some time unsatisfactory sealing occurs and, further, the back-flow through the valve opening can vary. Primarily this is due to precipitation and deposition of non-metallic compounds which adhere to the steel of the valve ball and the valve seat. Therefore, functioning defects gradually arise, initially in the form of leakages and finally by complete seizure of the valve body. This problem particularly prevails with magnesium.

A natural solution would here be to employ a valve housing and ball unit which is readily removable and replaceable so that the valve ball and/or valve housing can be replaced or cleaned. Incidentally, this has been proposed previously, cf. German Patent 1,194,104, which discloses the use of an open valve housing having a lower portion which is screwed on to the upper portion of the valve housing, the housing being simultaneously seized in a downward narrowing, conically shaped opening in the bottom portion of the pouring container. However, not even this arrangement will be satisfactory when used in practice. In a disassembling operation the entire equipment must be removed from the holding furnace resulting in oxidation and fire hazard. Gradually the screw thread of housing portions will be welded together and on repeated screwing-off and screwing-on will be destroyed. Thus, also this previously proposed solution has been unsatisfactory when employed in practice.

Therefore, in the most recent time the development has been mostly focused on valveless portioning systems, cf. for instance U.S. Pat. No. 2,846,740 and Norwegian Pat. No. 123,618. This type of apparatus has no moving parts within the melt and this should therefore ensure continous and stable operation and high portioning accuracy. However, here another problem arises. Without a highly accurate control of the gas pressure a blowout of gas through the valveless tube through which the metal is drawn into the pouring container can result. To a certain extent this can be counteracted by an exact monitoring of the ultimate pressure, which, however, in practice results in operating with pressures so low that the pouring rate will be too low.

SUMMARY OF THE INVENTION

The invention contemplates providing a valve-controlled pouring apparatus which does not have the disadvantages associated with the known apparatus, and it is a primary purpose of the invention to provide a pouring apparatus where the removal and insertion of the valve means can be carried out while the portioning equipment is maintained within the holding furnace, without it being necessary to even move the pouring container or the gas supply tube. In the attempt to solve this problem, a series of difficulties will present themselves.

How should a readily dismountable construction be made which also provides satisfactory sealing, and how should a correct insertion be ensured when assembling operations must be effected from the outside?

According to the invention there is provided an apparatus where these apparently conflicting aims are fulfilled. The pouring apparatus of the invention consists of a pouring container having an inlet valve for molten metal provided in the bottom portion of the container, means for supplying pressure gas from a source of pressure gas, and a pouring tube which is connected to the container to deliver portioned amounts of molten metal, for instance to a die-casting machine. The valve means includes a preferably cylindrical valve housing the upper portion of which extends through an opening in the bottom portion of the container with sufficient play or clearance to permit the valve housing to be tilted in relation to the vertical when being inserted into the opening. The valve housing is provided with an outer, upward narrowing, generally conical flange having a contact area intended to contact a generally conically shaped seating area at the opening in the bottom portion of the container, and the valve housing is pivoted to a lever. The lever is adapted to force the contact area of the flange against the seating area of the inlet opening when the valve means has been attached to the container.

The combination of the pivoted connection of the valve housing with the lever and the clearance between the upper portion of the valve housing and the inlet opening in the bottom portion of the container makes the valve means self-centering so that it can be directed into position from the outside. This will always provide contact area sealing between the flange of the valve housing and the seating area of the container opening, which surprisingly provides satisfactory sealing during a pressure pouring operation.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages and purposes of the apparatus according to the invention will be apparent from the following detailed description and appended drawings, wherein a preferred embodiment of the invention is described, and in which:

FIG. 1 shows a section through a holding furnace with the portioning pump inserted therein and the valve means fixed into position.

FIG. 2 shows the holding furnace including equipment viewed from above.

FIG. 3 shows a magnified detail of the valve means in a lateral view.

FIG. 4 shows a section through the bottom cover plate of the pouring container the valve means parts disassembled and partially shown in section.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a section through the holding furnace and shows the pouring equipment inserted therein with the new valve means mounted in position. The valve means is designed with an upward open valve housing **15** (FIG. 3 and 4), in which a valve bead, i.e., steel ball **6**, has been provided. The valve ball **6** is maintained in position by a cotter **7** or the like. The lower portion of a lever **2** is rotatably connected with the valve housing **15**, and its upper portion merges into an elongated shaft which extends above the melt and is fastened to a plate **8** by means of fastening means in the form of a wing nut **9** or the like, the plate **8** being rigidly connected with two suspension struts **19** which maintain the portioning container, designated by **5**, in the proper depth in the melt.

The lower portion of the lever **2** extends into a groove **21** in the lower portion of the valve housing, which groove forms the metal inlet to the portioning container. The lever **2** is pivoted to the valve housing **15** by means of a pin or bolt **3** which extends through coaxial holes through the lower part of the lever and the walls defining the groove **21**. Good clearance is provided between the bolt **3** and such coaxial holes and a similar clearance is provided between the walls defining the groove **21** and the portion of lever **2** extending therein. In this way a simple and efficient articulated joint is achieved which is operative in all planes.

The valve housing **15** is shown as being cylindrical and consists of an upper, open portion **16** having a sufficient clearance relative to a corresponding cylindrical portion of the peripheral wall defining the opening **22** in the bottom cover plate of the portioning container, which plate is designated by **4**, to permit the valve housing **15** to be tilted relative to the vertical when inserted into the opening **22**, i.e., relative to a normal to the bottom cover plate **4**.

The cylindrical valve housing further comprises an upwardly narrowing, conical flange **17** having an outer contact area designed to contact a conically shaped seating area **14** which is formed by the lower portion of the wall defining the opening **22** in the bottom cover plate **4**.

In the drawing, the contact area of the flange **17** and the seating area **14** are shown as being simple conical surfaces. However, it will be appreciated that one or both of these areas can very well be double-curved, for instance so as to form part of a sphere.

The conicity or tapering angle of the flange **17**, and of the seating area of the bottom plate, is of importance to ensure a self-centering insertion of the valve housing **15**. If the angle with the horizontal plane is too small, one will not be able to make the valve housing slip into position, while, however, too great of an angle will not provide satisfactory sealing when operating with the clearance required to "hit" when inserting the valve housing **15** into operating position. It has been found in practical tests that the best results are obtained when the angle of conicity of the flange **17** relative to the horizontal plane is from about 45° to about 60°, corresponding to an angle relative to the axis of the valve housing of 30°–45°. Even when the valve housing is inserted obliquely into the opening **22** in the bottom cover plate **4**, its conical contact surface will make it slip into position.

The lever **2** can be lifted and lowered by means of a handle **11**. This operation can readily be performed with one hand. When the valve housing **15** is fixed in proper position, lever **2** is moved into position and secured to the plate **8**. The joint at the bolt **3** permits these movements.

As mentioned above, the plate **8** is rigidly connected with two struts **19** which maintain the portioning container submerged to a suitable depth in the melt. The entire portioning equipment including the lever **2** and the plate **8** can be moved back and forth along rack arms designated by **10**.

The wing nut **9** need only be tightened manually. Theoretically the upward pull power serves only to counteract the excess pressure on the valve means during portioning plus the weight of the lever **2** and the valve means. If the nut **9** is tightened too much, the lever **2** can be strained too much and permanently deformed, which of course is not desirable. Practical tests have shown that the valve provides satisfactory sealing when the wing nut **9** is tightened manually. It is important that the pull power is then acting along the longitudinal axis of the portioning container, so that the valve is pulled towards the center of the opening **22** to finally be centered therein.

As shown in FIGS. 3 and 4, the lower portion of the valve housing **15** is constructed so that there will be ample passage for the metal to flow through the valve.

The opening **22** in the bottom cover plate **4** is made wide enough to permit inspection as required on cleaning the interior of the portioning container **5**.

The lever **2**, which is fastened to the plate **8**, is mounted or located so as not to prevent the portioning tube, which has been designated by **13**, from being moved as desired during portioning operations. The portioning tube **13** must be adjustable into various sloping angles and must be revolvable to either side. The portioning equipment is so constructed that the portioning tube **13** can be taken out of the melt without it being necessary to move any other part of the equipment.

When the valve means is to be inserted, the lever **2** including the ball valve is first placed on the rim of the furnace to be preheated. The lever **2** can then be introduced either on the left-hand side or on the right-hand side of the gas supply tube, which has been designated by **12**, and the valve means is inserted under the bottom cover plate **4**. As explained above, the valve means is self-centered as it slips upward along the contact area **14**.

The lever is then fastened to the plate **8**. After about 5 minutes the lever will be hot and will have acquired maximum length extension. The wing nut **9** is then tightened manually and the pouring apparatus is ready for use.

After about 1 week of continual operation the ball valve must be renewed. The valve must be dismounted immediately after being removed from the melt. The cotter **7** is pulled out and the ball **6** is decanted through the opening **20** before getting stuck due to freezing of the metal residues in the valve. The bolt **3** is then pulled out and the ball valve can be replaced by a new valve. The oxidized (oxide coated) ball valve is cleaned by treatment in dilute nitric acid and can be reused.

After a prolonged time of operation also the portioning container **5** must be removed for cleaning and inspection. In the case of the prior art screwed-on valves, the valve body will prevent the metal from running out of the portioning container when the latter is lifted out of the melt. Often also the problem of oxide clogging of the inlet of the valve means arises, and it may be very difficult to drain the container.

Thus a further substantial advantage of the invention is indeed that the demountable valve means can be removed by simple manipulations and that the metal will then drain through the wide opening **22** in the bottom cover plate.

We claim:

1. In an apparatus for portioning liquid metal comprising a portioning container intended to be submerged into a reservoir of molten metal, means for supplying pressure gas to said container and a metal outlet therein to be connected with a mould, such as a die-casting machine, said container being provided with a demountable valve means positioned at a bottom portion thereof to permit liquid metal to flow into said container when gas pressure is relieved, the improvement wherein: said valve means comprises a valve housing having an upper portion which during operations extends through an opening in the bottom portion of said container with sufficient clearance to permit the valve housing to be tilted in relation to a vertical when being inserted into said opening, said valve housing being provided with an outer, upward narrowing, generally conical flange having a contact area intended to contact a generally conically shaped seating area at said opening in the bottom portion of said container, said valve housing being pivoted to a lever.

2. An improved apparatus for portioning liquid metal as claimed in claim **1**, wherein the contact area of the flange of said valve housing forms an angle of 30° to 45° with the axis of said valve housing.

3. An improved apparatus for portioning liquid metal as claimed in claim **1**, wherein said valve housing has a movable valve ball provided therein, is upwardly open, and is provided in its upper portion with a replaceable cotter to prevent said ball from moving out of said valve housing.

4. An improved apparatus for portioning liquid metal as claimed in claim **1**, wherein the lower portion of said valve housing is pivoted to said lever by means of a horizontally disposed bolt which extends with an ample clearance through bores provided in said lever and in the walls of said valve housing.

5. An improved apparatus for portioning liquid metal as claimed in claim **1**, wherein said lever is provided with an upper inwardly bent portion having fastening means to fasten said lever along a line running centrally through said valve housing.

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