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(54) **RAW PRESSURE DIE CASTINGS IN NON-FERROUS ALLOYS AND THE METHOD OF PRODUCING RAW PRESSURE DIE CASTINGS IN NON-FERROUS ALLOYS**

(57) A raw pressure casting in non-ferrous alloys containing material allowances as structural elements has, according to the invention, at least one excess overflow designed to evacuate gases and impurities from the mould without connecting it with the atmosphere. The excess overflow has a form of a flat-wall membrane (2) fitted inside a casting sleeve constituting the central hole (3) and/or a peripheral overflow (4) permanently

fixed to the wall of the central hole (3).

The method of producing the raw pressure casting in non-ferrous alloys wherein material allowances are applied is, according to the invention, characterized in that at least one material allowance is applied in a form of an excess overflow designed to evacuate gases and impurities from the mould without connecting it with the atmosphere.

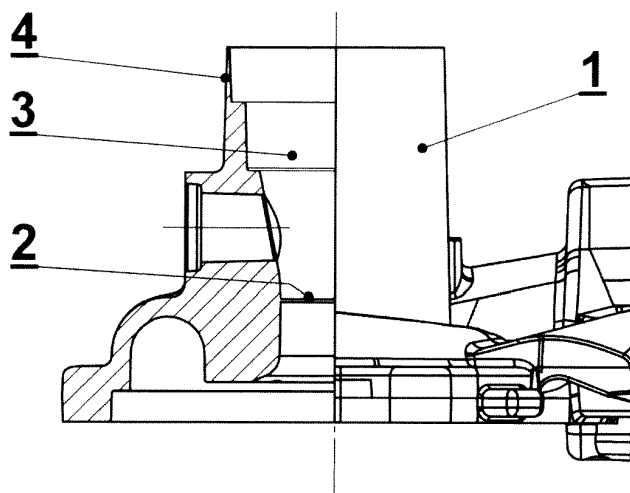


Fig. 1

Description

[0001] The invention relates to raw pressure die castings in non-ferrous alloys and the method of producing raw pressure die castings in non-ferrous alloys (mostly zinc, aluminium, magnesium, lead and titan alloys) that can be applied particularly in the precision engineering, armaments, automotive, aerospace, shipbuilding, tool-making or engineering industry and wherever serial and big-lot production of frequently precise, small or very small castings of any, frequently complex, shape, different thickness of walls or very thin walls, and highest dimensional precision and surface smoothness.

[0002] A frequent problem die casters encounter, irrespective of the type of technology applied (pressure die casting, permanent mould casting, sand casting, continuous casting or centrifugal casting), is the selection of the most appropriate die casting method which guarantees highest accuracy of raw castings that comply with the general tolerance standards. This also inextricably involves the issue of finding solutions for the efficient evacuation of gases accumulated inside the casting mould and removing of different impurities occurring in the process so as to obtain the most accurate possible casting.

[0003] The difficulties in establishing the accuracy of a raw pressure casting appear already at the stage of casting design, especially in preparing such elements as a casting mould - which has to form a cavity (recess) corresponding to the casting in shape, a pattern - to reproduce outer shape of the casting in the casting mould, or a movable core reproducing internal shape of the casting and being removed in the final phase of the die casting process. In addition, it is essential to correctly design two systems, namely the gating system (with the complete system of runners feeding molten metal to the appropriate sections of the mould cavity and regulating thermal processes during casting solidification and cooling, and preventing slag and other impurities from entering the mould) and the venting system to remove gases from the casting mould. Moreover, each raw casting must have additional surfaces formed as material allowances, i.e. risers supposed to feed the casting with molten metal thus causing that any casting defect will be located in the said risers.

[0004] The volume of the material allowance for machining is specified in the relevant standard and depends on the casting precision grade, the size of a given surface and the type of material cast. The most frequent material allowances include risers produced in casting holes, grooves, recesses etc., overflows designed to evacuate gases from the mould, situated at the top of the casting and furthest from the entry to the gating system, and additional allowances for gripping a casting during machining. Moreover, material allowances also include connecting sections preventing castings from deformation and cracking during cooling, heat treatment and finishing, and allowances useful in casting solidification to compensate

shrinkage (solidification shrinkage), i.e. reduction in the casting specific volume. They are supposed to prevent the occurrence of shrinkage effects, i.e. cavities and shrinkage porosity that lower mechanical properties of castings.

[0005] Correct design of the gating system, venting system and allowances, and the very shape of the casting enable temperature and pressure distribution to be controlled in the casting during solidification, and potential shrinkage cavities and porosity to be shifted outside the actual casting. Any gating systems, material allowances in a form of risers, gas bubbles, slag impurities, misruns, porosities etc. are removed in subsequent stages of the process - during machining and finishing of the raw casting, i.e. all required processes carried out to obtain the end product.

[0006] In the case of pressure die casting, so far the issue of evacuating gasses accumulated inside casting moulds and removing different kinds of impurities has been sorted out using a heretofore commonly known system of venting channels.

[0007] The nature of pressure die casting involves rapid injection of molten metal into a steel casting mould and cooling it under high pressure of 30 - 100 MPa (the so-called multiplier pressure) exerted by a hydraulic unit. Introduction of atmospheric air into the mould during that process is inevitable. Frequently, the air remains in the casting as gas porosity. Therefore, it is necessary to evacuate that air from the cavity of a casting mould. The heretofore applied venting channels not always ensured complete or at least efficient evacuation of air (gases) from the cavity. In complex castings, with local volume concentrations (the so-called hot spots), regions occur where the evacuation of air (gases) is impossible. Then on the surface of a casting or in the layer located immediately under the surface, as a result of gas (mostly hydrogen) dissolved in molten metal liberating during solidification, occurs gas porosity - pores and blisters in a form of small and round holes causing macro- and microporosity. Another issue associated with gas porosity is shrinkage porosity as well as solid impurities and oxides. In order to minimize that risk overflow traps have been applied so far to gather oxides and impurities, and previously to accumulate gases and lead them to venting channels connected with the overflow traps. The above-mentioned solutions designed to reduce porosity in raw castings employ a heretofore known method of evacuating gases outside a mould cavity into the air, and removing oxides and impurities outside the mould cavity. Heretofore, only the so-called venting solutions with channels that exit into the atmosphere have been used.

[0008] However, during a mould filling process a stream of molten metal injected into a casting mould contains occluded gas bubbles which together with gases accumulated in the mould cavity result in casting discontinuities. Elimination of air (gases) from those two sources requires taking specific measures to channel its (their) evacuation from a casting mould cavity so as to ensure

maximum avoidance of gas occlusions trapped in the newly formed casting (occlusion is the absorption of gases by certain solids). Metal cores, reproducing inner shape of a casting and being removed only in the final phase of its forming in a mould, are evident obstacles for the flow of molten metal, causing difficult to control whirls and turbulences at the head of the stream, which makes even more difficult to evacuate gases after the streams meet having flowed around the core.

[0009] An embodiment of the heretofore known solution for venting the mould cavity during its filling with molten metal has been presented in drawings **Pos. I** and **Pos. II** depicting a side and top view of the system, respectively. The heretofore known system contains typical systems (1) venting the mould cavity and bleeding gases into the atmosphere and overflow systems (2) facilitating gas evacuation and the gathering of impurities.

[0010] The aim of this invention was to develop a new design of a raw casting that would contain sufficient material allowances to eliminate the above-mentioned issues and would not evacuate gases and impurities into the atmosphere.

[0011] A raw pressure casting in non-ferrous alloys containing material allowances as structural elements have, according to the invention, at least one excess overflow to evacuate gases and impurities from the mould cavity with no connection with the atmosphere.

[0012] An excess overflow has a form of a flat-wall membrane fitted inside a casting sleeve or a form of a peripheral overflow permanently fixed to the wall of a central hole of the casting.

[0013] The flat-wall membrane is preferably of 0.8 to 1 mm thick.

[0014] Preferably, the peripheral overflow is of a chimney-like shape.

[0015] The invention relates also to the method of producing raw pressure die castings in non-ferrous alloys in which material allowances are used. According to the invention at least one material allowance is applied in a form of an excess overflow to evacuate gases and impurities from the mould cavity without connecting it with the atmosphere.

[0016] Preferably, an excess overflow is employed in a form of a flat-wall membrane fitted inside a casting sleeve or an excess overflow in a form of a peripheral overflow permanently fixed to the wall of a central hole in the casting.

[0017] A solution according to the invention resulted in a new, unique solution in a form of material allowances that improve the rate of gas flow in the mould cavity and the flow of molten metal inside the mould cavity, and cause that residual air (gases) is (are) gathered in one excess overflow without evacuating it (them) to the atmosphere. As a result, air (gas) pressure distribution has been modified in critical regions of the casting, whereas the application of excess overflows without connecting them with the atmosphere, turns out to be more environment friendly than the heretofore known and applied so-

lutions.

[0018] Next, material allowances are removed during machining. The applied material allowances resulted in the improving of casting mechanical properties and obtaining of accurate castings having much better parameters, most notably very high assumed dimensional precision and good quality of surfaces without casting defects and porosity in particular. In consequence material wastage was reduced, which translates into the improvement of economic effects.

[0019] The invention has been presented as a preferred embodiment in a schematic drawing whose Fig. 1 is a half-sectional elevation of a raw casting of a turbocharger body while Fig. 2 is a top view of a raw casting of a turbocharger body.

[0020] The raw pressure castings in non-ferrous alloys produced according to the invention have heretofore known and not indicated in the drawing structural elements to be removed in the machining process.

[0021] According to the invention a new design of a pressure casting mould was developed to produce turbocharger bodies as a result of which raw castings of the body 1 have two excess overflows designed to evacuate gases and impurities from the mould cavity without connecting it with the atmosphere. One of the said excess overflows has a form of a 0.8 to 1 mm thick flat-wall membrane 2 fitted inside a casting sleeve constituting a central hole 3 serving as an intake diffuser in the end product. The other excess overflow has a form of a ring-shaped peripheral overflow 4 shaped as a little chimney permanently fixed to the wall of the central hole 3 and constituting its continuation, which is easily removed in the machining process.

[0022] In order to produce a raw casting of a body 1 of an automotive turbocharger, a casting mould was filled with a molten aluminium alloy under working pressure of 200 bar. During the injecting of molten aluminium alloy into the mould all gases, including residual air and impurities were gathered in the flat-wall membrane 2 and in the peripheral ring-shaped overflow 4 without evacuating them into the air. Both material allowances containing casting defects were removed from the casting in the subsequent process, namely machining.

[0023] Obviously, details of the solution according to the invention do not exhaust the variants of its application. The peripheral overflow 4 in particular can have a number of forms because its shape is strictly connected with the shape of the section of the central hole 3 in the body casting 1.

Claims

1. A raw pressure casting in non-ferrous alloys containing material allowances as structural elements **characterized in that** it has at least one excess overflow to evacuate gases and impurities from the mould without connecting it with the atmosphere.

2. A raw casting according to claim 1, **characterized in that** an excess overflow has a form of a flat-wall membrane (2) fitted inside a casting sleeve being the central hole (3). 5
3. A raw casting according to claim 1, **characterized in that** an excess overflow has a form of a peripheral overflow (4) permanently fixed to the wall of the central hole (3). 10
4. A raw casting according to claim 2 **characterized in that** the flat-wall membrane (2) is preferably 0.8 to 1mm thick. 15
5. A raw casting according to claim 3 **characterized in that** the peripheral overflow (4) has a shape of a little chimney. 20
6. The method of producing the raw pressure casting in non-ferrous alloys wherein material allowances are applied, **characterized in that** at least one material allowance is applied in a form of an excess overflow designed to evacuate gases and impurities from the mould without connecting it with the atmosphere. 25
7. The method according to claim 6 **characterized in that** an excess overflow is applied in a form of a flat-wall membrane fitted inside a casting sleeve. 30
8. The method according to claim 6 **characterized in that** an excess overflow is applied in a form of a peripheral overflow permanently fixed to the wall of the central hole. 35

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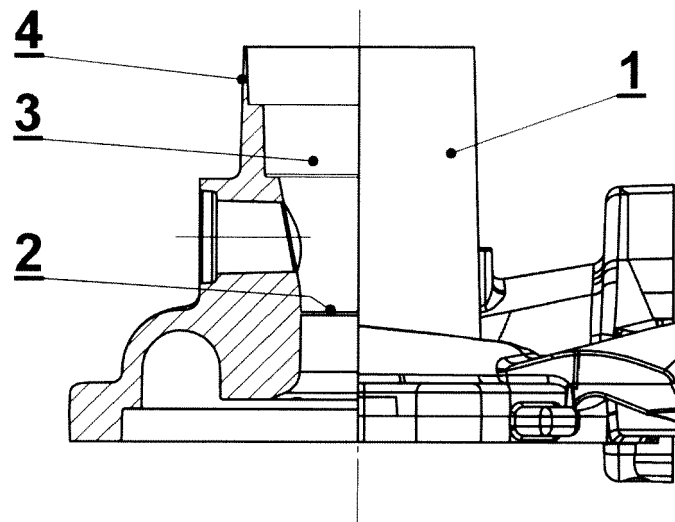


Fig. 1

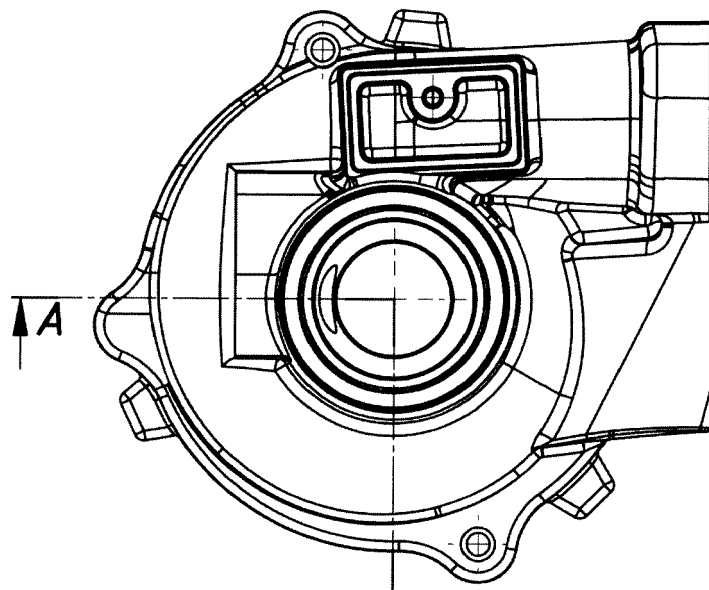
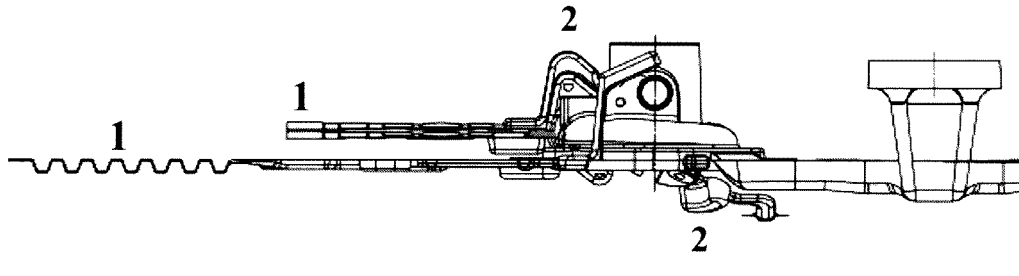
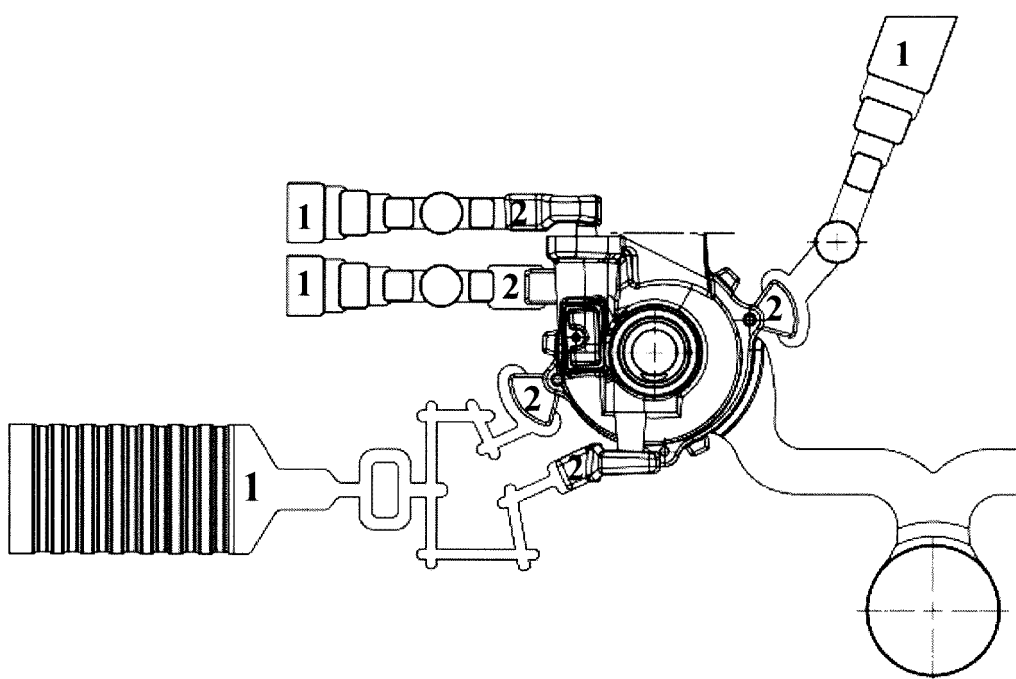


Fig. 2



Pos. I



Pos. II



EUROPEAN SEARCH REPORT

Application Number
EP 15 46 0010

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Place of search Munich		Date of completion of the search 9 March 2016	Examiner Zimmermann, Frank
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The present search report has been drawn up for all claims			
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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