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(54) **METHOD FOR CASTING MOULDED PIECES**

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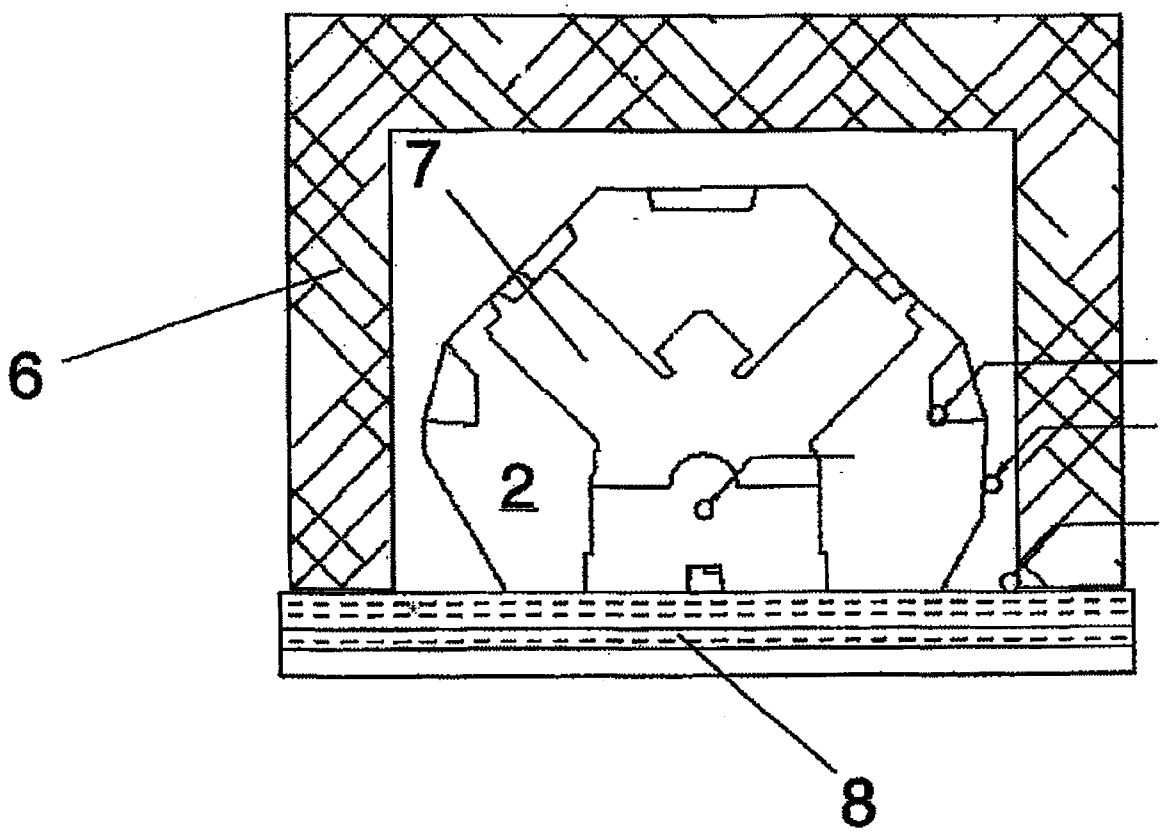
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(57) **ABSTRACT**

There is provided a method for casting molded pieces comprising production of a casting mold comprising a core of molding material, forming a complete core packet positioning the core packet in a support mold with a separation to the core packet back-filling the space between the core packet and the support mold with a free-flowing bulk material, casting the metal melt into the casting mold, opening or removing the support mold after the solidification of the melt, removing at least the majority of the bulk material and the thermal insulation of the remaining core packet with the cast molded piece therein.



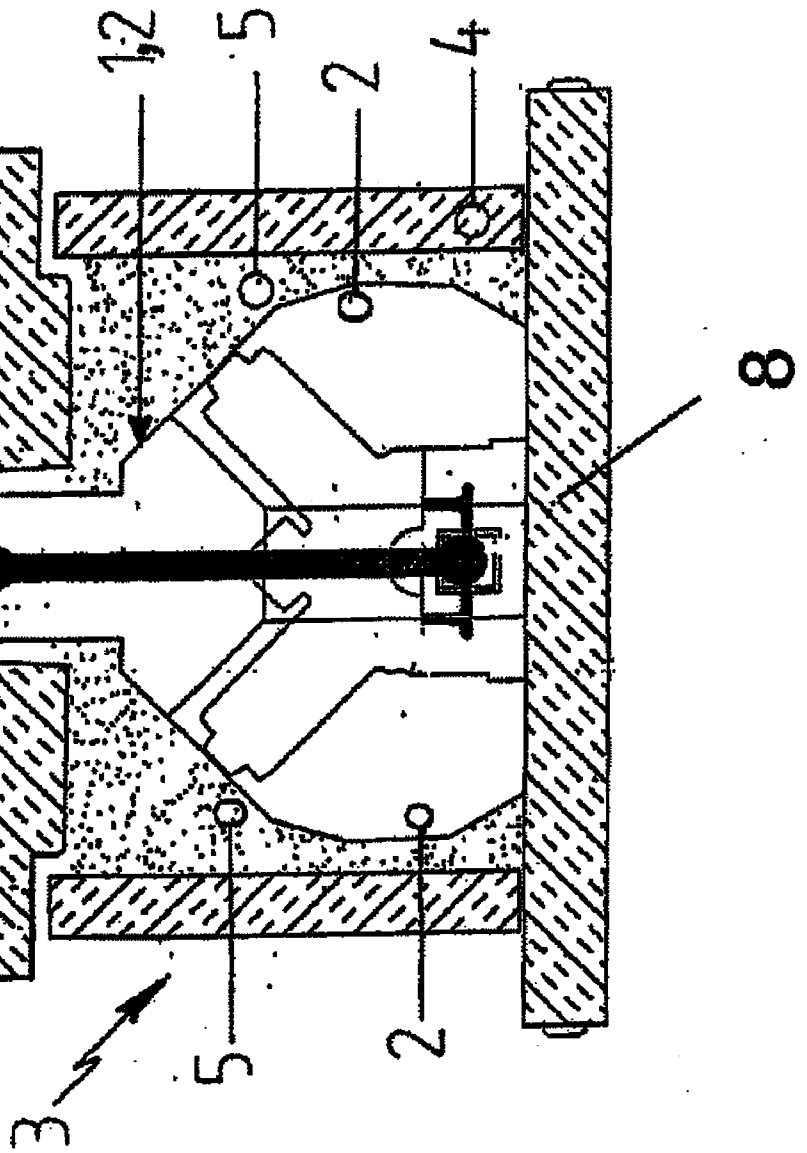
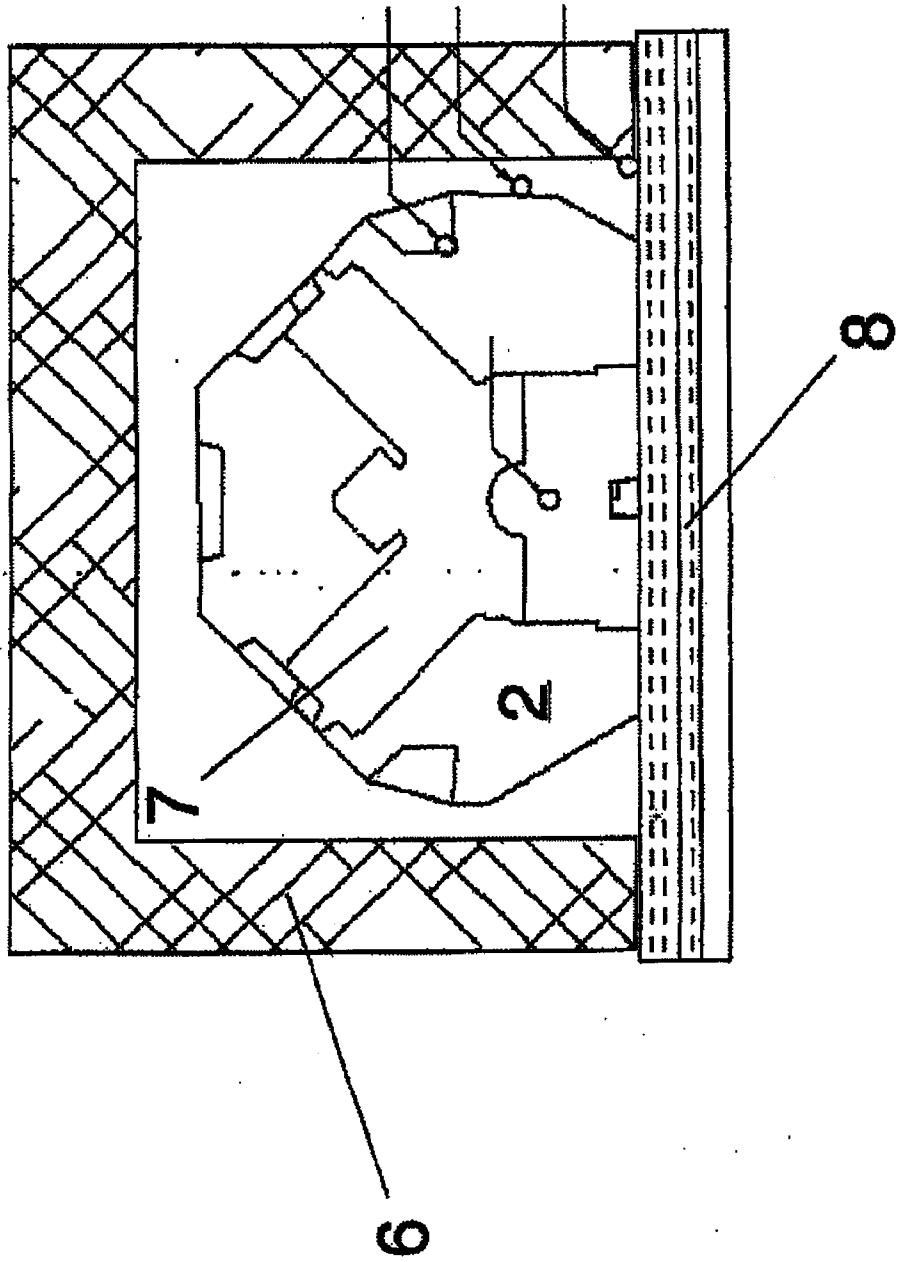


Fig. 1

Fig. 2



METHOD FOR CASTING MOULDED PIECES

[0001] The invention relates to a method for casting molded pieces.

[0002] The invention relates very generally to the casting of molded pieces, i.e. to foundry technology. For casting of molded pieces of any type, foundry cores and/or molds are usually produced from separate parts, put together, and joined to form a casting mold or to form a core packet or mold packet. These mold/core packets are then filled with molten metal for producing, for example, a metal workpiece, whereby in mass production the mold/core packets to be filled with molten metal pass through the assembly line in succession.

[0003] Core and shell mold shooting machines for producing cores to be joined together have been known in practice for decades. Solely by way of example, reference is made here to DE 31 48 461 C1 which discloses such a core and shell mold shooting machine.

[0004] In the past, molded pieces have been cast in a mold consisting in turn of cores or a core packet. After the mold is shot and formed, it is integrated into a further mold or enclosure made of core sand, i.e. into a type of support mold, in order, that is, to be able to ensure the required mechanical stability. Specifically in the case of grey cast iron or cast steel, the static pressure during casting is so high that one core packet alone is not sufficient and the provision of the support mold is crucial. In the past, the support mold has been in the form of green sand molds into which the core packet is inserted. In the past, metal molds have likewise been used, wherein such metal molds are extremely expensive and, in addition, wear rapidly.

[0005] Regardless of the actual casting procedure, afterwards the molding material which forms the mold/core packet must be removed from the cast molded piece. The binder necessitates special disposal or recycling of the molding material. The same applies to previously used support molds or green sand molds which must likewise be provided with binder. The costs associated with the recycling of the molding sand/green sand are considerable, especially as additives such as bentonite, etc. must be removed in expensive preparation systems.

[0006] In addition, there is a further problem in the production of the support molds or green sand molds which are, after all, produced on very expensive molding systems. Also, the sand is prepared in very complex and thus expensive sand preparation systems. The preparation of green sand molds to support the core packet and also the preparation of the sand are therefore disproportionately expensive.

[0007] The present invention is therefore based on the object of configuring and developing the above-discussed generic method in such a way as to reduce, especially in the case of grey cast iron or cast steel, the costs to be incurred with reproducible results, in particular with regard to the recycling of the materials used. The residual heat in the set molded piece should also be utilized.

[0008] The foregoing object is achieved by a method with the following method steps:

[0009] preparing the casting mold consisting of cores of molding material which combine to form a core packet,

[0010] positioning the core packet in a support mold which is set apart from the core packet,

[0011] back-filling the space between the core packet and the support mold with a free-flowing bulk material,

[0012] casting the metal melt into the casting mold,

[0013] opening and removing the support mold once the melt has solidified,

[0014] removing at least the majority of the bulk material, and

[0015] repeated thermal insulation of the remaining core packet with the already set molded piece located therein.

[0016] The invention has found that although the support mold, which in the past has consisted of green sand, is required, the costs associated on the one hand with manufacture and on the other hand with recycling, i.e. the overall production costs, can be reduced quite considerably. For this purpose, there is still provided a support mold which is however—deliberately—set apart from the core packet. The support mold may thus, for example, be generated from plates of differing thermally stable materials, i.e. in accordance with the building block principle. For the purposes of cohesion, the individual parts could be positionable one within another, engageable with one another or otherwise fastenable to one another. The important thing in this regard is that a space is left between the casting mold itself, i.e. the core packet, and the support mold. This space between the core packet and the support mold is back-filled with a free-flowing bulk material. This bulk material defines all the way round the core packet an isostatic pressure so that, owing to this pressure, the core packet is able to resist the outwardly directed pressure which forms during casting with metal melt. In any case, the bulk material ensures that the core packet withstands the pressure which forms during casting while at the same time preventing any melt from seeping outward through any joints, cracks or the like. Simple means ensure, based on an isostatic pressure, that the metal melt can be cast into the casting mold without jeopardizing the dimensional stability of the core packet.

[0017] Furthermore, the invention has found that the energy stored in the melt or in the molded piece and in the core packet is not immediately sufficient to carry out a more extensive process, i.e. for example to burn the binder contained in the core packet. This is due to the fact that the mass to be heated is, not least owing to the bulk material located in the interior of the support mold, too large. Thus, the invention also provides for the support mold to be opened or removed, once the melt has solidified, so that the actual supporting function of the support mold is no longer required. At least the majority of the bulk material is removed. Afterwards, the remaining core packet with the already set molded piece located therein is repeatedly insulated, thus allowing the residual heat contained therein to be utilized without the mass of the bulk material.

[0018] Advantageously, for positioning the core packet in the support mold, the core packet is placed on a thermally insulating base as part of the support mold. This base remains under the core packet. A thermally insulating wall and a thermally insulating lid part are added to the base to form the support mold.

[0019] The support mold is opened or completely removed by removing the lid part and the walls. The bulk material may then be removed without difficulty. Drawing-off of the bulk material is conceivable.

[0020] For repeated thermal insulation, use is advantageously made of a thermally insulating hood which may be configured in one piece or else in a plurality of pieces. In the case of a one-piece configuration, the hood could for example

be slipped over the core packet via a lifting block, a manipulator or using other aids. Specifically, the hood is placed on the base around the core packet with the molded piece located therein and the base is added to the hood to form all-round thermal insulation. As soon as the binders of the core packet have been burned or at least dissolved, the hood is repeatedly removed, thus leaving the molded piece, which now contains substantially no molding sand, on the base.

[0021] Particularly advantageously, the bulk material is substantially the same material as the molding material for producing the cores, preferably without any additives. If the cores consist of molding material (for example of quartz sand) with binder, the bulk material used may be the same molding material, preferably without binder. Likewise, the bulk material could have substantially the same grain size as the molding material, thus allowing the molding material to be reused in conjunction with the bulk material—once the molding material has been recycled—at identical or differing grain size.

[0022] Specifically, the bulk material used could be pure sand, preferably what is known as dry sand without additives, which does not cause any problems during further processing with the molding sand. This applies, in particular, in the case of identical or almost identical grain size. Quartz sand is a particularly suitable bulk material.

[0023] The back-filling in the space between the core packet and the support mold may be carried out by means of funnels or suitable technical aids by mere pouring-in of the bulk material so as to obtain a bulk density. The weight of the bulk material produces an isostatic pressure which acts on the core packet and counteracts the outwardly directed pressure which occurs during casting with metal melt so as to obtain the mold. The individual cores of the core packet are thus securely held together.

[0024] If the bulk density of the bulk material achieved by pouring-in is not sufficient, the back-filling can be carried out by blowing in the bulk material. This allows a density of the bulk material to be achieved that is above bulk density. Furthermore, it is conceivable to post-compact the bulk material by means of compressed air once the bulk material has been poured in.

[0025] Further compaction of the bulk material, preferably until tap density is obtained, may be achieved when the back-filling by means of bulk material is assisted by vibration. The vibration can be induced, for example, ultrasonically or else mechanically, for which purpose the entire support mold, or a functional element which is located therein or can be introduced into the support mold, serves as a resonator. In any case, the important thing is that preferably ultrasonically induced vibration promotes compaction of the bulk material.

[0026] It is equally conceivable, for the purposes of further compaction of the bulk material, for post-compaction to be carried out mechanically, i.e. by pressing or even forcibly pressing the bulk material into the mold using mechanical equipment. Point-by-point or zone-by-zone post-compaction by means of punches or the like used for this purpose is conceivable.

[0027] Also advantageously, the support mold is used to thermally insulate the casting mold before and/or after the casting and purposefully to utilize the process heat within the casting mold or insulation for the controlled treatment of the cast molded piece and/or of the molding material forming the core packet.

[0028] Thus, the process heat can be used to burn the organic or inorganic binder in the molding material, so that special recycling measures are subsequently no longer required. Special disposal of the molding material as special waste is then no longer required either, should it no longer be desirable to use the molding material.

[0029] Equally, the process heat may be used for the thermal treatment of the cast molded piece.

[0030] Most particularly advantageously, the molded part could be cooled in a regulated manner, in which case thermal insulation by means of the support mold, in addition to back-filling, is most particularly important.

[0031] Equally, it is conceivable during the in situ heat treatment for gases to be removed from the interior of the mold and/or the insulation or from the support part, in addition to back-filling.

[0032] Most particularly important is a further measure according to which, that is, it is advantageous to use individual cores, which are configured as hollow bodies, to form the core packet. This has the enormous advantage of keeping the mass of the core sand material as low as possible, thus allowing the energy, which is present in the form of heat, within the total system to be utilized almost entirely for the treatment of the poured molded piece and/or of the core packet, i.e. for example to burn the binder. In addition, far fewer gases, which can still be collected and drawn off, form from the outset.

[0033] It is also advantageous if the flue gases which form during burning of the binder are retained within the device for heat insulation. They may be drawn off at the end of the insulation process. The concentrated presence of the harmful gases facilitates disposal or destruction thereof quite considerably, thus greatly simplifying the method.

[0034] There are various possibilities for configuring and developing the teaching of the present invention in an advantageous manner. Reference may be made in this regard, on the one hand, to the claims following claim **1** and, on the other hand, to the subsequent description of an exemplary embodiment given with reference to the drawings. Generally preferred configurations and developments of the teaching will also be described in conjunction with the description of the preferred exemplary embodiment of the invention given with reference to the drawings, in which:

[0035] FIG. **1** is a schematic view of the arrangement of a core packet with a set-apart support mold and space, back-filled by means of bulk material, between the core packet and the support mold; and

[0036] FIG. **2** is a schematic view of the arrangement of a core packet according to FIG. **1**, but without bulk material and with a hood slipped thereon for the purposes of thermal insulation.

[0037] To illustrate the method according to the invention, FIG. **1** shows an arrangement in which the casting mold **2**, which is to be understood as a core packet **1**, is prepared for casting-in of the melt. The core packet **1** comprises a plurality of individual cores which are combined jointly to form the core packet **1**. The core packet **1** forms the casting mold **2**.

[0038] FIG. **1** furthermore reveals that the core packet **1** is positioned in a support mold **3** which, in turn, is composed in a frame-like manner of individual parts **4** or configured in one piece. A space, which is back-filled by a free-flowing bulk material **5** and thus builds up between the support mold **3** and the core packet **1** an isostatic pressure which is defined by the weight, is formed between the support mold **3** and the core

packet **1**. In this state, the metal mold is cast into the casting mold or into the core packet **1** and it is ensured that the core packet **1** withstands in a dimensionally stable manner the internal pressure which forms during casting.

[0039] In the exemplary embodiment selected in the present case, the parts **4** of the support mold **3** may be used a plurality of times. The casting mold **2** or the core packet **1** is supported via the bulk material **5** which is specifically what is known as dry sand without any form of additives. An example of dry sand is quartz sand, preferably having the same grain size as the molding material of the individual cores or of the core packet **1**.

[0040] Furthermore, it will be recalled at this point that the bulk material **5** can be compacted beyond bulk density, for example by means of vibration, in order to increase the isostatic pressure with respect to the core packet **1**. With regard to further measures for compacting the bulk material **5**, reference is made to the general part of the description so as to avoid repetition.

[0041] Furthermore, the support mold **3**, in addition to the bulk material **5**, serves to thermally insulate the casting mold **2** and may therefore be used, before or after the casting, purposefully to utilize the process heat within the casting mold or insulation and thus for the controlled treatment of the cast molded piece and/or of the molding material forming the core packet. However, it has been found that the process heat is excessively absorbed by the bulk material **5** and also by the support mold **3**.

[0042] In the illustration shown in FIG. **2**, both the support mold **3** and the bulk material **5** have been removed. Instead, a thermally insulating hood **6** is placed on the likewise thermally insulating base **8**, thus allowing the residual heat held under the hood **6** to be used, for example, to burn the binder contained in the molding material. At the end of the process, the hood **6** is removed and the molded piece **7** now contains substantially none of the molding material of the former core packet **1** as, that is to say, the bond between the constituents of the molding material has been eliminated.

[0043] The method according to the invention has the enormous advantage, on the one hand, of utilizing process heat and, on the other hand, of requiring no molding system to mold the molded piece. The utilization of process heat is promoted as a result of the fact that removal of the bulk material benefits the sand-to-iron ratio.

[0044] With regard to further features which may not be inferred from the figures, reference is made to the general part of the description so as to avoid repetition.

[0045] Finally, it will be noted that the above-discussed exemplary embodiment serves merely to describe the claimed teaching by way of example without thereby limiting the teaching to the exemplary embodiment.

1-25. (canceled)

26. A method for casting molded pieces, comprising:

preparing the casting mold consisting of cores of molding material which combine to form a core packet;

positioning the core packet in a support mold which is set apart from the core packet;

back-filling the space between the core packet and the support mold with a free-flowing bulk material;

casting metal melt into the casting mold;

opening and removing the support mold once the melt has solidified;

removing at least the majority of the bulk material; and

repeated thermal insulation of the core packet with the cast molded piece located therein.

27. The method as claimed in claim **26** wherein said positioning step comprises positioning the core packet on a thermally insulating base as part of the support mold.

28. The method as claimed in claim **27** further comprising adding thermally insulating walls and a thermally insulating lid part to the thermally insulating base to form the support mold.

29. The method as claimed in claim **28** wherein said opening step comprises removing the thermally insulating lid part and the thermally insulating walls.

30. The method as claimed in claim **26** wherein said repeating step comprises providing a thermally insulating hood and a thermally insulating base and placing the thermally insulating hood on the thermally insulating base around the core packet with the molded piece located therein.

31. The method as claimed in claim **30** wherein the thermally insulating hood is configured in one piece.

32. The method as claimed in claim **1** wherein the bulk material is substantially the same material as that used to produce the cores.

33. The method as claimed in claim **32** wherein the bulk material and the cores are substantially without additives.

34. The method as claimed in claim **1** wherein the bulk material has at least one of substantially the same grain size as the molding material or a grain size differing therefrom.

35. The method as claimed claim **1** wherein the bulk material used is dry sand without additives.

36. The method as claimed in claim **1** wherein the bulk material used is quartz sand.

37. The method as claimed in claim **1** wherein said back-filling step comprises pouring the bulk material in to obtain a bulk density.

38. The method as claimed in claim **1** wherein said back-filling step comprises blowing in the bulk material.

39. The method as claimed in claim **1** wherein said back-filling step further comprises post-compacting the bulk material using compressed air for the purpose of further compaction.

40. The method as claimed in claim **1** wherein said back-filling step further comprises post-compacting the bulk material using vibration for the purpose of further compaction.

41. The method as claimed in claim **40** wherein the vibration is ultrasonically induced.

42. The method as claimed wherein said back-filling step further comprises mechanically post-compacted for the purpose of further compaction.

43. The method as claimed in claim **1** further comprising:

using the support mold to at least one of thermally insulate the casting mold before and after said casting step;

providing a thermally insulating hood and a thermally insulating base; and

placing the thermally insulating hood on the thermally insulating base with the support mold and casting mold being contained within the thermally insulating hood to thereby use the process heat within the support mold and casting mold for the controlled treatment of at least one of the casting molded piece and the cast mold.

44. The method as claimed in claim **43** wherein molding material comprises at least one of an organic and inorganic binder and wherein the process heat serves to burn at least one of the organic or inorganic binder in the molding material.

45. The method as claimed in claim **43** wherein the process heat is used for the thermal treatment of the cast molded piece.

46. The method as claimed in claim **1** further comprising cooling at least one of the cast molded piece or the casting mold and the cast molded piece in a regulated manner.

47. The method as claimed in claim **43** further comprising removing gas from at least one of the interior of the casting mold or the thermally insulating hood following the placing step.

48. The method as claimed in claim **44** further comprising:

retaining the gas which forms during the burning of the binder within the thermal insulating hood; and

thereafter, drawing off the gas.

49. The method as claimed in claim **43** further comprising supplying additional heat into the thermally insulating hood.

50. The method as claimed claim **1** wherein at least one of the cores is hollow so as to have a reduced mass.

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