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(71) Applicant: **Nemak, S.A.B. de C.V.**
66000 García, Nuevo León (MX)

(72) Inventors:
- **Martinez Dominguez, Cesar Benjamin**
  Nanjing, Jiangsu (CN)
- **Zhao, Qingsong**
  Nanjing, Jiangsu (CN)
- **Fan, Dongxu**
  Nanjing, Jiangsu (CN)

(74) Representative: **Cohausz & Florack Patent- & Rechtsanwälte Partnerschaftsgesellschaft mbB**
Bleichstraße 14
40211 Düsseldorf (DE)

(54) METAL CASTING WITH CORES

(57) The invention relates to a method for producing a core (10) to be used in metal casting of a metal component having a cavity structure, the core (10) at least partially defining the cavity structure in the metal component, wherein the method comprises: placing a venting element (1) in a core box; and forming the core (10) at least partially around the venting element (1), such that the venting element (1) is integrated in the core (10) and establishes a hollow passage in the core (10). The invention also relates to a core for metal casting, to a method for metal casting and to a casting mold arrangement (20) for metal casting.

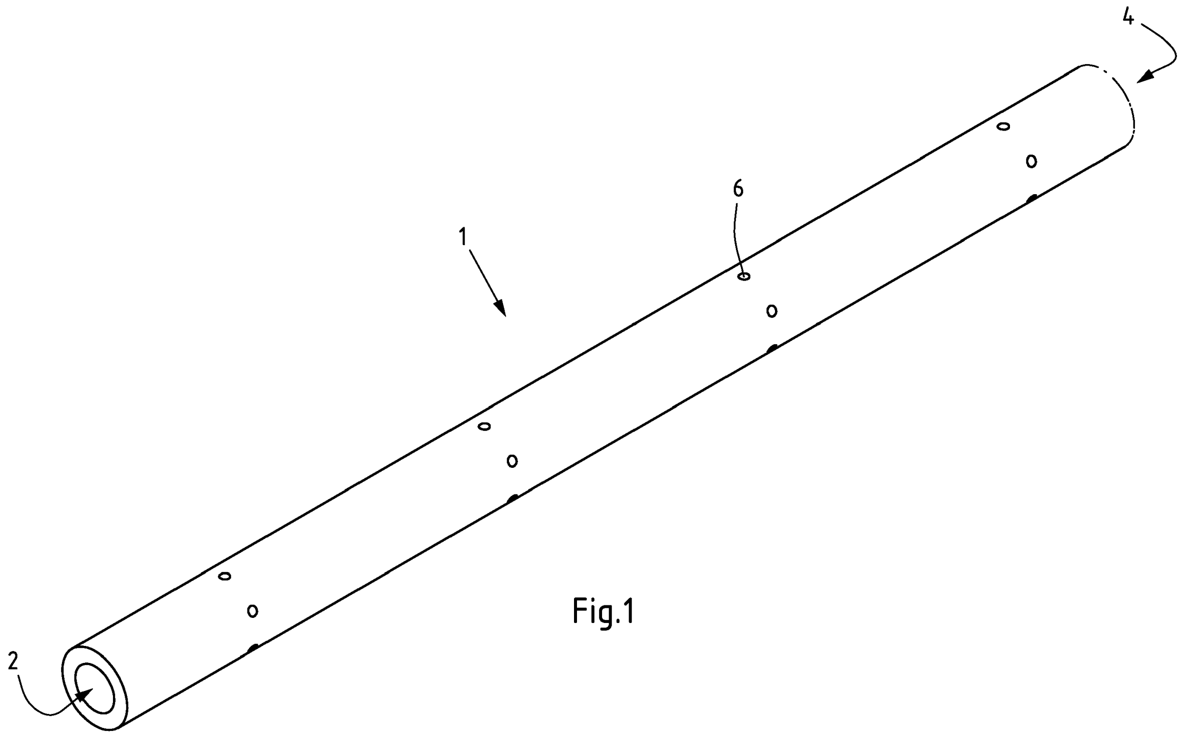

Fig.1

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Description

[0001] The present invention relates to a method for producing a core to be used in metal casting of a metal component having a cavity structure, wherein the core at least partially defines the cavity structure in the metal component. The invention also relates to a corresponding core for metal casting of a metal component having a cavity structure. The invention also relates to a method for metal casting of a metal component having a cavity structure. The invention further relates to a casting mold arrangement for metal casting of a metal component having a cavity structure.

[0002] In the casting production of complex shaped components, such as engine blocks or cylinder heads, cores or casting cores are used to create cavities and other moulded elements in the cast component. The casting cores have so-called core prints or core marks at which they are held in the respective casting mould.

[0003] Cores of the type mentioned above are usually made of a mixture of sand and a binder (e.g. resin-bonded moulding sand) in order to ensure the dimensional stability required for their handling during the preparation and set-up of the mould. When the metal melt is poured into the casting mould, a decomposition of the cores begins as a result of the temperature rise triggered by direct contact with the hot metal melt. At the same time, the cores typically have a certain humidity which will evaporate. Thus, gases and vapours are produced as a result of the heating of the core at contact with the melt. These gases are typically removed or discharged in the area of the core prints. Otherwise, there is a risk that cavities or surface defects are present in the finished cast component which are caused by gas or steam residues which have not escaped.

[0004] In practice, however, it is often difficult to ensure that the gases resulting from the core decomposition can be safely evacuated or discharged from the cores (and thus from the cast component) sufficiently quickly and completely via the core prints. As a result, the scrap rate due to gas related defects can rise above 10%, which is usually not accepted in view of the desired process reliability and thus economy of a process.

[0005] In one approach of the prior art described in EP 1291097 A1, it has been attempted to determine the gas permeability of casting cores by means of measurement technology and to be able to estimate at an early stage any potential defect formation in the casting. However, this approach results in the necessity of additional measurement steps regarding the core formation and potentially shifts an increased scrap rate from the casting to the core production.

[0006] Another approach to this above described problem of gas generation is to try avoiding the generation of gas in the first place. This could be achieved by a core coating, for instance. For this, a layer of coating could be applied on the core to insulate or seal it from the hot metal. This would reduce the core's temperature increase (and gas generation) and prevent the gas from escaping through core areas in contact with the hot metal melt. However, for many core geometries, which are oftentimes rather long and thin, it may not be possible to achieve a sufficient coating in particular without damaging the core. Thus, this solution has been proved not to be effective.

[0007] Another way of avoiding the generation of gas in the first place would be a change of the binder system of the core. For instance, in order to reduce generation of core gas during the metal pouring and solidification processes, a core binder system with a lower level of gas generation could be used or an overall reduced amount of binder could be used in the core production. However, other parameters (e.g. core box, sand system, ambient conditions) may require the use of a certain amount of binder or restrict the use to a certain binders. However, even if it was possible that binder was changed or reduced, the binder levels that need to be used often still generate a certain amount of core gas during filling and solidification at levels that in the end cause undesired defects in the cast components.

[0008] A further approach could be the provision of additional drillings in the core in order to provide a passage from the area where the gas is generated to the location where the gas can be evacuated. However, it turned out that the main problem with this approach is that for cores with critical geometries, in particular rather long (e.g. around 500mm) and thin (e.g. a minimum diameter less than 10mm) cores as for example needed for forming oil galleries in a motor block or cylinder head. Such geometry makes it very difficult, if not impossible, to drill the core over sufficient length without damaging it.

[0009] Thus, there exists the need to reduce or eliminate core gas related defects in cast metal components caused by the gas generated during the filling and solidification processes even for cores with the described critical geometries.

[0010] According to a first aspect of the invention, the above problem is solved by a method for producing a core to be used in metal casting of a metal component having a cavity structure, the core at least partially defining the cavity structure in the metal component, wherein the method comprises:

- placing a venting element in a core box; and
- forming the core around at least partially the venting element, such that the venting element is integrated in the core and establishes a hollow passage in the core.

[0011] According to a second aspect of the invention, the above problem is also solved by a core for metal casting of a metal component having a cavity structure, in particular produced by a method of the first aspect, wherein the core at least partially defines the cavity structure in the metal component, and wherein the core comprises a venting element integrated in the core and establishing a hollow passage in the core.

[0012] According to a third aspect of the invention, the above problem is also solved by a method for metal casting of a metal component having a cavity structure, wherein the method comprises:

- providing a casting mold at least partially defining an outer geometry of the metal component;
- arranging, in the casting mold, a core at least partially defining the cavity structure in the metal component, wherein the core comprises a venting element integrated in the core and establishing a hollow passage in the core;
- casting metal into the casting mold for producing the metal component having a cavity structure formed by the core; and
- removing the metal component from the casting mold.

[0013] According to a fourth aspect of the invention, the above problem is also solved by a casting mold arrangement for metal casting of a metal component having a cavity structure, wherein the casting mold arrangement comprises:

- a casting mold at least partially defining an outer geometry of the metal component; and
- a core, in particular according to any of claims 9 to 13, comprising a venting element integrated in the core and establishing a hollow passage in the core.

[0014] The approach described by virtue of the different aspects of producing and using a core in metal casting, wherein the core comprises an integrated venting element establishing a hollow passage in the core allows to reduce or even eliminate core gas related defects in cast metal components and thus reducing the scrap rate related to these defects. This is because by the gas generated due to the cores during the metal filling and solidification process can effectively be evacuated or discharged from the core and surrounding area by the hollow passage formed by the venting element. For instance, the generated gas can be guided to core print areas or venting areas of the used die through the core itself even over longer distances. At the same time, the is not risk of damaging the core, e.g. compared to a subsequent drilling of the core after the core has been manufactured, which is specifically important in case of rather thin and long cores. Rather, the venting element directly manufactured with the integrated venting element, which does not impair the stability of the core or can even provide additional stability to the core.

[0015] Compared to other approaches mentioned in the beginning (such as core drilling, use of different binders or a different amount of binders, using a core coating), the inventive approach according to the different aspects avoids the drawbacks mentioned earlier.

[0016] In particular, compared to core drilling, which may generally also create a path to exhaust gas from central sections of the core to the vents existing on the die, the inventive approach can avoid the drilling process and consequently avoids the risk of damaging the core during the drilling process, in particular for long and thin cores.

[0017] The inventive approach of using a venting element integrated into the core is also advantageous over an approach, where the venting element is for example not integrated into the core, but rather the hollow cores are produced through the use of e.g. sliding inserts in the core box. In this comparative example, a pin shaped insert (with necessary draft angle) would be installed on the front and rear ends of the core box, with necessary hydraulic cylinders to move the inserts. This would require extremely thin inserts, which would result in easy and frequent tooling damage. Also, the draft angle required to withdraw the sliding inserts during core production would make the insert too large to maintain enough core thickness to guarantee acceptable core quality. Similarly to a drilled core, the hollow-unsupported core would make it more susceptible to deformation during the metal filling process. Lastly, the hydraulic system required to move the sliding inserts on the core box would make the core box too large to fit in the existing core machine.

[0018] In the following advantages and preferred exemplary embodiments applicable to all aspects of the invention will be described in more detail.

[0019] The metal used in the casting process may in particular be a light metal, such as aluminum or an aluminum alloy for instance. Accordingly, the metal component may in particular be a light metal component, such as an aluminum or aluminum alloy component.

[0020] Generally, a core may also comprise more than one venting element. Specifically for complex core geometries it may be advantageous to use multiple venting elements. However, using a single venting element for a core results in a simpler positioning of the single venting element during production of the core (since no relative positioning of multiple venting elements needs to be made) and the potential act of removal of a single venting element from the core (as will be described in more detail below) is particularly fast and simple.

[0021] Likewise the venting element (or multiple venting elements) may establish multiple hollow passages in the core element.

[0022] A venting element may generally be understood as an element or structure for guiding or for supporting guiding gas or vapour generated due to the composition of the core element to predefined parts inside or outside the core element. The venting element may in particular be a hollow structure (such as a tube, as will be explained in more detail below) so that the hollow inner area of the venting element establishes the hollow passage in the core. The venting element is in particular integrated such into the core that it guides generated gas of the core to other sections of the core. Preferably, the venting element guides generated gas to one or more end sections of the core. For instance, the venting element is integrated such into the core that gas generated from the decomposition of the core or evaporating humidity to vents provided by the casting mold arrangement.

[0023] A core box may be understood as a machine for manufacturing respective cores. A core box may in particular comprise a first (e.g. upper) and a second (e.g. lower) mold or cavity. For placing the venting element in the core box, the venting element can be arranged or positioned in such an upper or lower mold (as will be explained in more detail below). The core box can be configured for forming multiple cores in one cycle.

[0024] The casting mold, into which a respective core element may be inserted, may generally be realized in different ways depending on the metal and the casting process used. Preferably, the casting process uses "lost" molds, i.e. the molds are destroyed after casting in order to remove the cast metal component from the casting mold.

[0025] According to an exemplary embodiment, the method according to the first aspect further comprises:

- at least partially blocking the venting element before forming the core at least partially around the venting element; and
- removing the blocking of the venting element after forming the core at least partially around the venting element.

[0026] This embodiment has the advantageous effect of preventing the venting element from inadvertently getting clogged by the core material (such as a sand-binder-mixture), thus avoiding or reducing an impairment of the desired discharging or evacuation effect of the generated gas during the metal casting. A blocking of the venting element may comprise applying a seal to one or more opening of the venting element. A blocking of the venting element may comprise the insertion of a blocking element into the venting element. In an exemplary embodiment, the blocking element may be a flexible element, such as a wire, for instance, which is inserted into the venting element. Preferably, the blocking element blocks or seals substantially the whole venting element. Additionally or alternatively, the blocking of the venting element may comprise a blocking by means of the core box itself, e.g. by blocking the ends of the venting element by the upper and/or lower mold of the core box without the need for an additional element. The blocking could then advantageously be removed automatically when the core box is opened.

[0027] According to an exemplary embodiment of the method of first aspect, placing the venting element in the core box comprises positioning the venting element in a support structure provided by the core box, in particular by a first and/or second mold of the core box.

[0028] This embodiment allows for a secure and precise positioning of the venting element in the core box and thus a precise integration of the venting element into the core without affecting the geometry defined by the core. As an example, the support structure may comprise one or more support regions. For instance, a support structure may comprise or be realized by one or more support elements or inserts. A support insert or element may be a defined recess (e.g. integrated in a mold of the core box) for receiving and thus supporting a part of the venting element. The first and second mold of the core box may comprise a corresponding support elements or inserts. In an example, a support structure comprises support regions at least at the ends of a (e.g. tube-like) venting element. Generally, it is preferred that the support structure is located and/or designed such that the cavity structure in the metal component defined by core is not affected.

[0029] According to an exemplary embodiment of the method of the first aspect, the support structure of the core box for supporting the venting element is provided in the area of the core print. The core prints are understood to be those section of the core supporting the core in the casting mold during casting. This allows providing a support structure without (or with only negligibly) affecting the geometry or formation of the cavity structure in the metal component.

[0030] According to an exemplary embodiment of the aspects of the invention, the core is a sand core. A sand core is typically made of sand and a binder or bonding agent. For instance, the sand core may be made of sand and resin. As an example, the sand core may be a green sand core or a dry-sand core. As explained, sand cores typically generate gas or vapor when decomposing during casting. These gases or vapors can advantageously be discharged or evacuated via the hollow passage established by the venting element in the core. Generally, however, the core may also be another type of lost or disposable core or a core with a porous structure generating gas or vapor generation during casting.

[0031] According to an exemplary embodiment of the aspects of the invention, the venting element substantially extends from one end of the core to an opposing end of the core. Gases and vapors generated along the whole core can be effectively discharged and evacuated. For instance, the core may be substantially elongate core. The venting element may be run along the axial direction of the elongate core. Opening may be provided at the respective ends of the venting element functioning as discharge or outlet openings.

[0032] According to an exemplary embodiment of the aspects of the invention, the venting element is a tube, in particular a metal tube, for instance a steel tube. Preferably, the tube has a substantially straight geometry. For instance, the tube may have a cylindrical geometry. However, it may also be conceivable, that the tube has a curved or bent geometry. However, it is advantageous, when the venting element can be easily removed from the core and cast component without destruction of the venting element.

[0033] Alternatively and irrespective of the geometry of the venting element, the venting element may also be made from other materials, such as a synthetic material (e.g. a plastic material) or a natural material. In an example, the venting may be made from cardboard, which would be rigid enough and at the same time disposable resulting in a lower overall cost. The venting element may also be at least partly dissolvable or decomposable so that the venting elements may be used even if further removal from the internal cavities of the casting is not possible (such as inside water jacket cores).

[0034] According to an exemplary embodiment of the aspects of the invention, the venting element comprises venting holes along its surface. The venting holes or perforations may allow the generated gas and vapor to easily enter the inner hollow passage of the venting element. The venting holes may thus be considered as intake openings. However, other intake structures, such as slits, for instance, are possible as well.

[0035] In one example of a venting element, the venting element has a length of at least 100mm, preferably at least 300mm and more preferably at least 500mm. In an example, the venting element has an outer diameter at most 10mm, preferably at most 5mm and more preferably at most 2.5mm. The inner diameter of the venting element is preferably in the range of 1mm to 3mm, for instance 1.5mm.

[0036] In an example, the venting element has at least 50, preferably at least 100, more preferably at least 300 venting holes. In order to effectively prevent material (such as sand) during the core production to enter the venting element, the venting holes preferably have a diameter of at most 0.5mm, preferably at most 0.3mm, more preferably at most 0.15mm.

[0037] According to an exemplary embodiment of the aspects of the invention, the cavity structure defined by the core is an oil channel (in particular a high pressure oil channel) or a water jacket of a motor block, a cylinder head or a part thereof. An oil channel or oil distribution system comprises long, thin cavities. Particularly for high pressure oil channels, a strict control of defects is required. Such a cavity structure can advantageously be formed in a motor block or cylinder head with the help of cores. Utilizing the inventive cores can drastically reduce the scrap rate of motor blocks and cylinder heads due to gas related defects, such as bubble formation on the surface. However, the core may also define other cavities in a motor block or in other components.

[0038] According to an exemplary embodiment, the method of the third aspect further comprises:

- removing the venting element from the metal component after casting of the metal component.

[0039] A removal of the venting element in an intact (e.g. un-bent) state may advantageously allow re-using the venting element in order to increase economic benefits of the described approach. The venting element may for instance be removed manually. The venting element may be removed with a tool. In one example, the venting element may be removed during the de-coring process of the cast metal component. A venting element may also protrude from the core, it is integrated in facilitating a removal of the venting element from the core and cast component.

[0040] As already mentioned, a particularly advantageous use of the core is method for metal casting, wherein the metal component is a motor block, a cylinder head or a part thereof and the cavity structure defined by the core is an (e.g. high pressure) oil channel or water jacket of the motor block, the cylinder head or a part thereof.

[0041] Preferably the metal casting is a sand molded casting process (also called sand casting). Sand casting is a well-known casting technique utilizing sand as the mold. Generally different types of sand and binders can be used, as already explained with respect to the core. Even more generally, the metal casting may utilize other lost molds than sand molds.

[0042] Preferably, the method according to the third aspect comprises producing the core according to a method according to the first aspect.

[0043] Further features of the invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for purposes of illustration of preferred embodiments of the invention. It should be further understood that the drawings are not necessarily drawn to scale and that they are merely intended to conceptually illustrate the structures and procedures described herein.

Fig. 1 is a perspective view of an exemplary embodiment of a venting element;

Fig. 2a, b are a side view and an enlarged cross sectional view of an exemplary embodiment of a core defining a cavity structure of an oil channel of a motor block;

Fig. 3a,b are a side view and an enlarge cross sectional view of an exemplary embodiment of a core defining a cavity structure of an oil channel of a motor block with a blocking element partly inserted into the venting element;

Fig. 4 is a perspective view of an exemplary embodiment of a casting mold arrangement with a casting mold and a core inserted into the casting mold;

Fig. 5a,b are a top view of a lower mold and a upper mold of a core box for manufacturing cores for the oil channel of the exhaust side of a motor block; and

Fig. 6 is a cross sectional view of the venting element positioned between the molds of a core box.

[0044] Fig. 1 is a perspective view of an exemplary embodiment of a venting element 1. The venting element 1 is a straight, cylindrical steel tube. The venting element 1 has openings 2 and 4 at its opposing ends. The venting element 1 has a plurality of venting holes 6 on its surface (around 300 holes in this case), so that the venting element 1 can be considered as a perforated pipe. The venting element 1 has in this example a length of approximately 500mm and, an outer diameter of 2.5mm and an inner diameter of 1.5mm. The diameter of the venting holes 6 is 0.15mm. However, the venting element 1 may also have a different geometry. For instance, the venting element may have different length and diameters. The venting element 1 may also have different cross sections, e.g. an elliptical cross section. The venting element 1 may also be curved, for example. The venting element can be integrated in different cores, as will be explained in the following.

[0045] Fig. 2a is a side view of an exemplary embodiment of a core 10 defining a cavity structure of a high pressure oil channel or oil gallery of a motor block and defines a substantially straight channel. The core 10 comprises core prints 12, which allow the core to be positioned and fixed in the casting mold (cf. Fig. 6). The venting element 1 of Fig. 1 is integrated into the core 10, such that the venting element 1 established a hollow passage in the core 10. The venting element 1 extends within the core 10 from end to end. The openings 2 and 4 of the venting element are open and in communication with the environment. The venting element 1 extends through the core 10, as shown in Fig. 2b, which is an enlarge cross sectional view of the core 10. The venting element 1 protrudes on both sides of the core 10, in other embodiments the venting element 1 may also be flush on one or both sides of the core 10. The core is a sand core comprising of a mixture of sand and a binder. It may occur that the core material does not cover the venting element at certain parts of the venting element. It may then be necessary to cover the venting element with additional paste work. The manufacturing of the core will be explained in more detail with respect to Fig. 5 and 6.

[0046] Fig. 3a shows a side view of another exemplary embodiment of a core 10 defining a cavity structure of an oil channel of a motor block, similarly to the embodiment shown in Fig. 2. Here, a blocking element 14, in this case a wire, is partially inserted into the venting element 1 integrated in the core 10. The blocking element 14 may have substantially the same length as the venting element 1. However, it may be advantageous to have a slightly longer blocking element 14 in order to facilitate removal of the blocking element 14 from the venting element 1. As show in Fig. 3b, the opening 2 (and likewise opening 4) is closed or blocked by blocking element 14. This is advantageous in order to prevent sand form entering the venting element during the forming of the core around the venting element (cf. Fig. 5 and 6). Alternatively, it may be possible to utilize a sealing or caps as blocking elements in order to close opening 2 and 4. The advantage of using a blocking element extending through the venting element or the hollow passage created thereby, such as wire 14, is that also venting holes 6 are closed from the inside.

[0047] Additionally or alternatively, a blocking of the ends of the venting element could also be achieved through the design of the core box, e.g. where the core box (e.g. the upper and/or lower cavity) would block the ends of the venting element. This can reduce the operation time required to prepare the venting element by removing the blockage prior to casting. This can also reduce the overall costs as no additional blocking elements would be required.

[0048] Fig. 4 is a perspective view of an exemplary embodiment of a casting mold arrangement 20 with a casting mold 22 and two cores 10 already inserted into the casting mold 22. The casting mold 22 is a sand mold defining a part of the outer surface of the metal component to be cast, which is a motor block in this example. The casting mold arrangement 20 further comprises dies 24 around the casting mold 22, which can be closed in order to support the casting mold 22 and/or establish a closed cavity. The metal, such as aluminum or an aluminum alloy, will be cast into the casting mold 22. The molten metal will contact the cores 10. The cores 10 will start to decompose and humidity will evaporate and gas and vapor will be generated. The gases and vapors can be evacuated by entering the venting element thorough the venting holes 6, being guided along the venting element and exiting via the openings 2 and 4 and the ends of the core 10. After solidification of the metal, the cast component can be removed from the dies 24 and the casting mold can be removed from the cast component. The venting elements 1 will be extracted from the cast component. For instance, a tool may be used in order to draw the venting elements 1 from the cast component. After successful extraction, the venting elements 1 may advantageously be reused for manufacturing new cores.

[0049] Fig. 5a,b are a top view of a lower mold 30 and a upper mold 40 of a core box for manufacturing cores, such as core 10 of Figs. 2 and 3 defining an oil channel of the exhaust side of a motor block. For manufacturing a core (also called core shooting), venting elements 1 are placed in one of the molds 30, 40, as illustrated by venting elements 1 shown in both molds in this case in Figs. 5a and 5b. In order to support and fix venting elements 1 in the core box, they are supported in a support structure comprising support regions 32, 34 in the lower mold and/or corresponding support regions 42, 44 in the upper mold, which may for instance be inserts or integral parts of the respective mold. The support regions 32, 34, 42, 44 are provided in the area of the core prints 12 at the end regions of the core, so that they do not affect the design of the channel in the cast component.

[0050] The openings of the venting element 1 are blocked by a blocking element, as was for instance illustrated in Fig. 3 with wire 14. The molds 30, 40 are then closed and the core is formed around the venting element 1, without the risk of sand entering into the openings of the venting element.

[0051] Fig. 6 shows a cross sectional view of the venting element 1 positioned between the molds 30, 40 of a core box. Due to the venting element 1 supported between the molds 30, 40, the core 10 can be formed in the space between the molds and the venting element 1, so that the venting element 1 will be integrated into the core 1, as shown in Fig. 2 and 3.

[0052] A corresponding procedure may be used for manufacturing cores to be used e.g. for defining an oil channel of the intake side of a motor block or for defining channels required in other metal components.

[0053] The core can then be placed in a casting mold, and the metal component can be cast, as already explained with respect to Fig. 4. It has been found that the bubble formation on the surface of the cast component can be substantially reduced by using a core with an integrated venting element as described herein. Experiments have shown, that there is heavy bubble formation on the surface of the cast component in case a regular core without any an integrated venting element is used. Using a core with a venting element with only one opening (e.g. only opening 2 or 4) at one end of the core being available already showed an improvement with only minor bubble formation. In case both openings 2, 4 at both ends of the venting element integrated in the core were provided and in communication with the surrounding, practically no bubble formation due to gases and vapors from the core could be observed anymore.

[0054] It will be understood that all presented embodiments are only exemplary, and that any feature presented for a particular exemplary embodiment may be used with any aspect of the invention on its own or in combination with any feature presented for the same or another particular exemplary embodiment and/or in combination with any other feature not mentioned. It will further be understood that any feature presented for an example embodiment in a particular category may also be used in a corresponding manner in an example embodiment of any other category.

Claims

1. Method for producing a core (10) to be used in metal casting of a metal component having a cavity structure, the core (10) at least partially defining the cavity structure in the metal component, wherein the method comprises:

- placing a venting element (1) in a core box; and
- forming the core (10) at least partially around the venting element (1), such that the venting element (1) is integrated in the core (10) and establishes a hollow passage in the core (10).

2. Method according to claim 1, wherein the method further comprises:

- at least partially blocking the venting element (1) before forming the core (10) around the venting element (1); and
- removing the blocking of the venting element (1) after forming the core (10) at least partially around the venting element (1).

3. Method according to claim 1 or 2, wherein placing the venting element (1) in the core box comprises positioning the venting element (1) in a support structure (32, 34, 42, 44) provided by the core box, in particular by a first and/or second mold (30, 40) of the core box.

4. Method according to claim 3, wherein the support structure (32, 34, 42, 44) of the core box for supporting the venting element (1) is provided in the area of the core print (12).

5. Method according to any of claims 1 to 4, wherein the core (10) is a sand core (10).

6. Method according to any of claims 1 to 5, wherein the venting element (1) substantially extends from one end of the core (10) to an opposing end of the core (10).

7. Method according to any of claims 1 to 6, wherein the venting element (1) is a tube, in particular a metal tube, for instance a steel tube.

8. Method according to any of claims 1 to 7, wherein the venting element (1) comprises venting holes (12) along its surface.

9. Method according to any of claims 1 to 5, wherein the cavity structure defined by the core (10) is an oil channel or water jacket of a motor block, a cylinder head or a part thereof.

10. Core (10) for metal casting of a metal component having a cavity structure, in particular produced by a method of any of claims 1 to 9,
wherein the core (10) at least partially defines the cavity structure in the metal component, and
wherein the core (10) comprises a venting element (1) integrated in the core (10) and establishing a hollow passage in the core (10).

11. Method for metal casting of a metal component having a cavity structure, the method comprising:

- providing a casting mold (22) at least partially

defining an outer geometry of the metal component;
- arranging, in the casting mold, a core (10) at least partially defining the cavity structure in the metal component, wherein the core (10) comprises a venting element (1) integrated in the core (10) and establishing a hollow passage in the core (10);
- casting metal into the casting mold (22) for producing the metal component having a cavity structure formed by the core (10); and
- removing the metal component from the casting mold (22).

12. Method according to claim 11, wherein the method further comprises:

- removing the venting element (1) from the metal component after casting of the metal component.

13. Method according to claim 11 or 12, wherein the metal component is a motor block, a cylinder head or a part thereof and wherein the cavity structure defined by the core (10) is an oil channel or water jacket of the motor block, the cylinder head or a part thereof.

14. Method according to any of claims 11 to 13, wherein the metal casting is a sand molded casting process.

15. Method according to any of claims 11 to 14, wherein the method further comprises:

- producing the core (10) according to a method of any of claims 1 to 10.

16. Casting mold arrangement (20) for metal casting of a metal component having a cavity structure, the casting mold arrangement comprising:

- a casting mold (22) at least partially defining an outer geometry of the metal component;
- a core (10), in particular according to any of claims 9 to 13, comprising a venting element (1) integrated in the core (10) and establishing a hollow passage in the core (10).

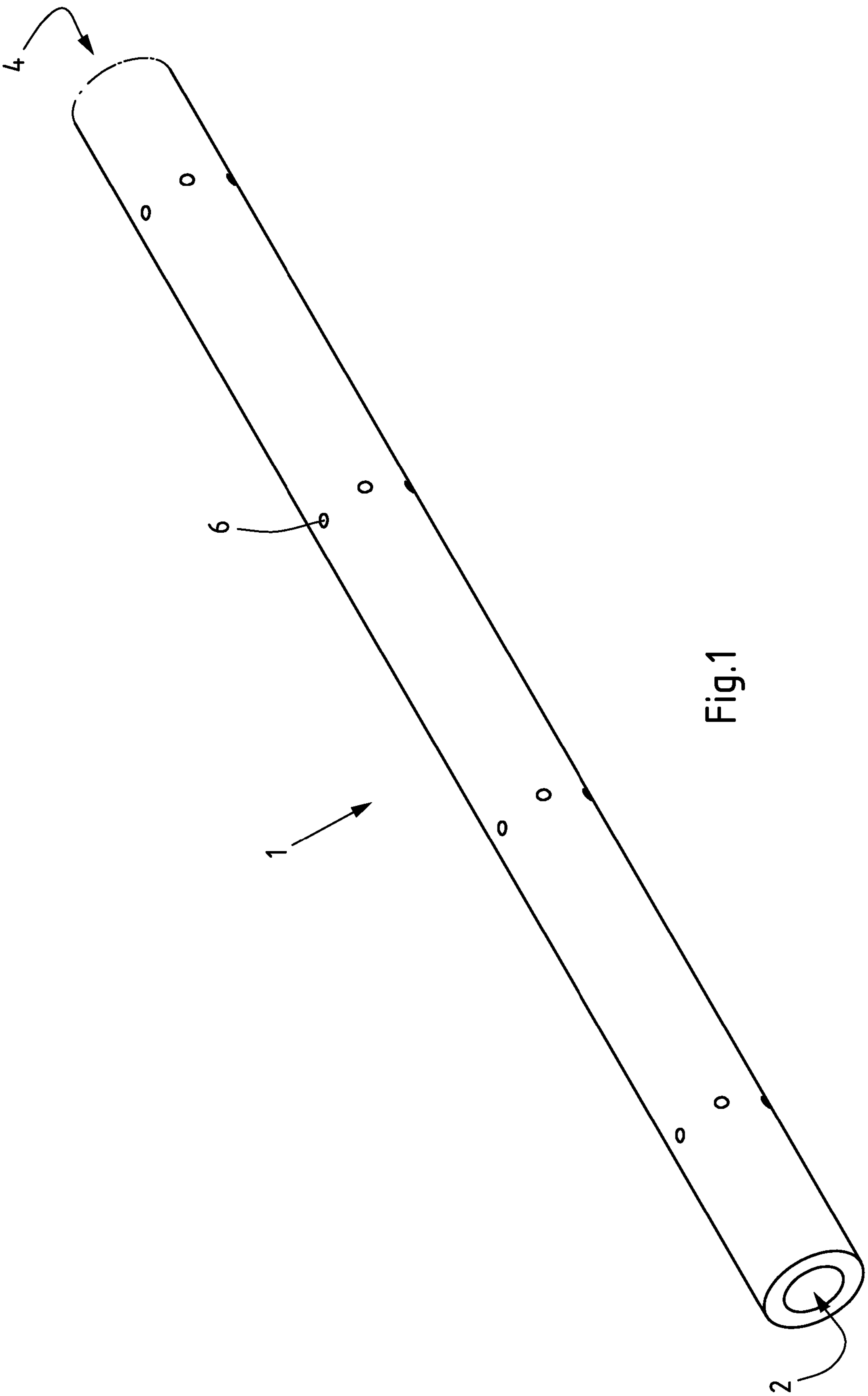


Fig.1

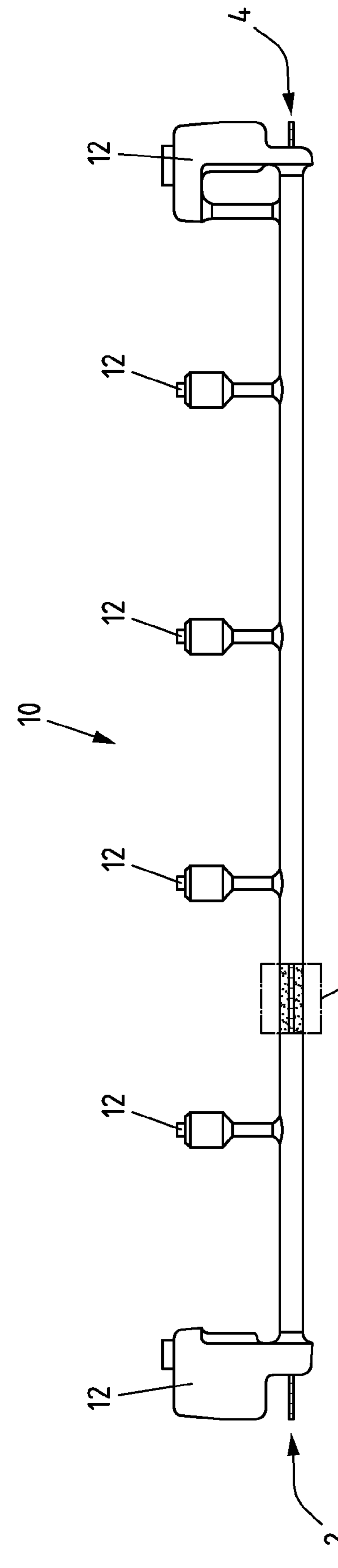


Fig.2a

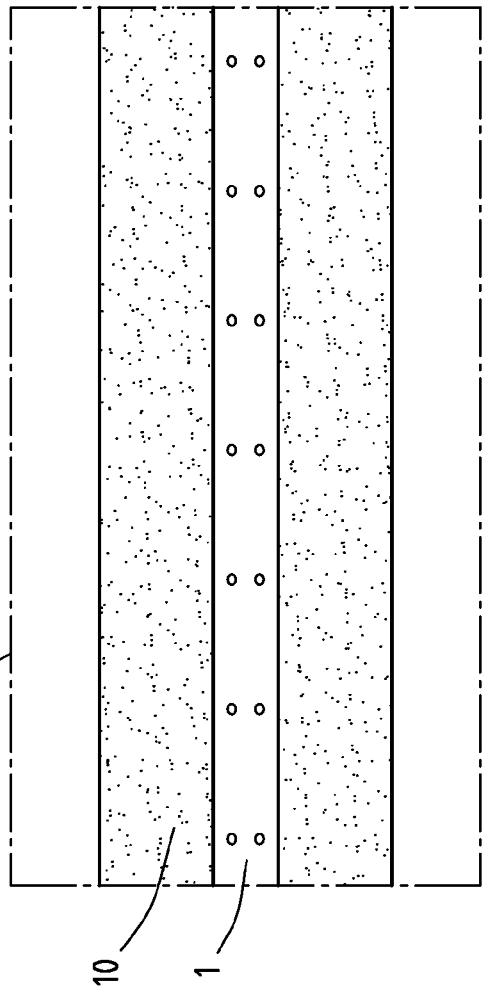


Fig.2b

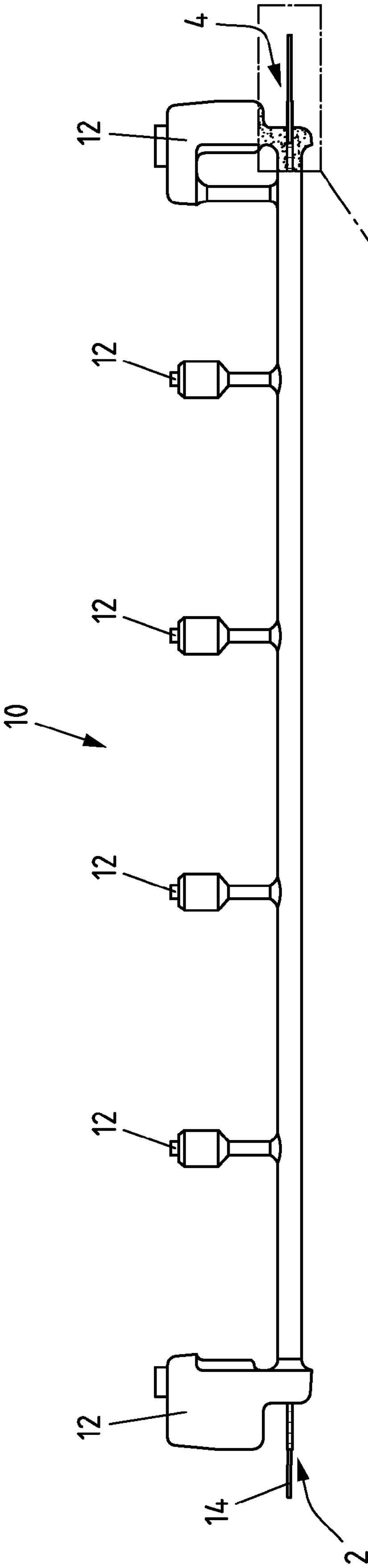


Fig.3a

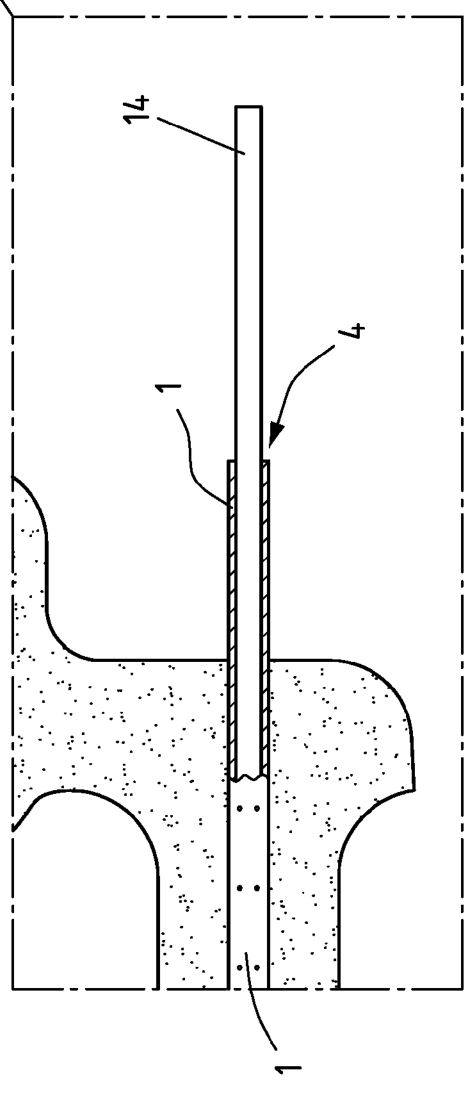


Fig.3b

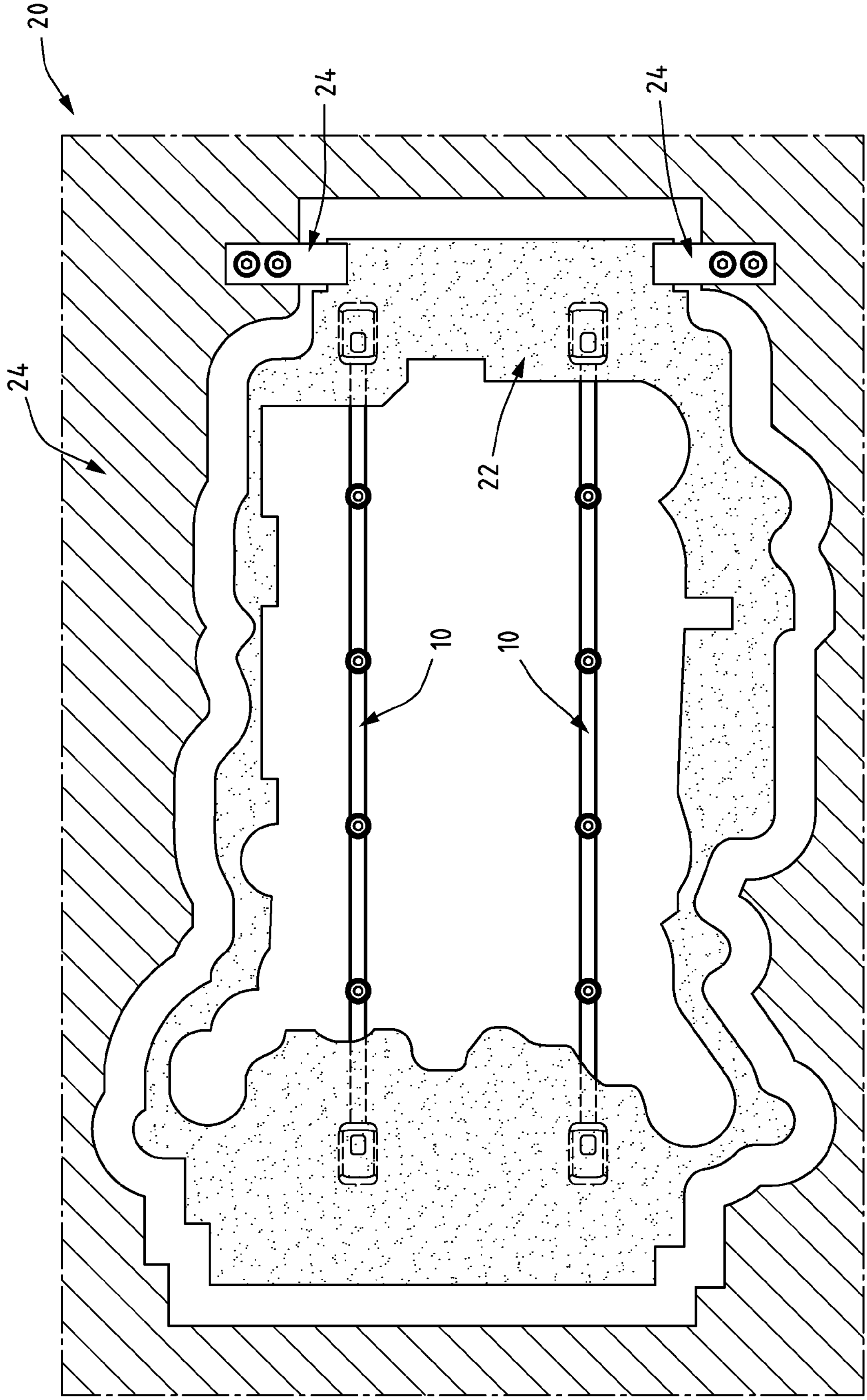


Fig.4

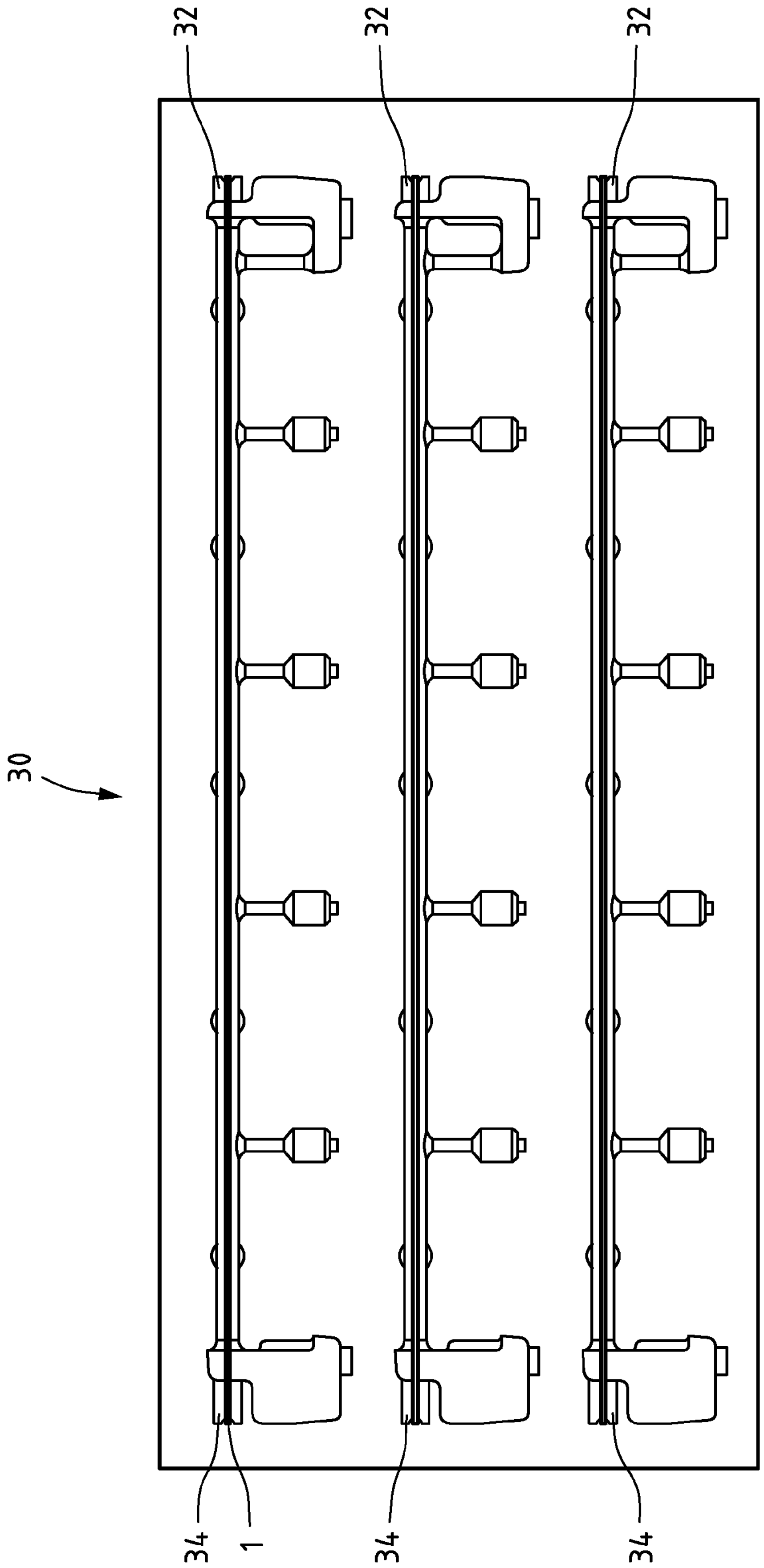


Fig.5a

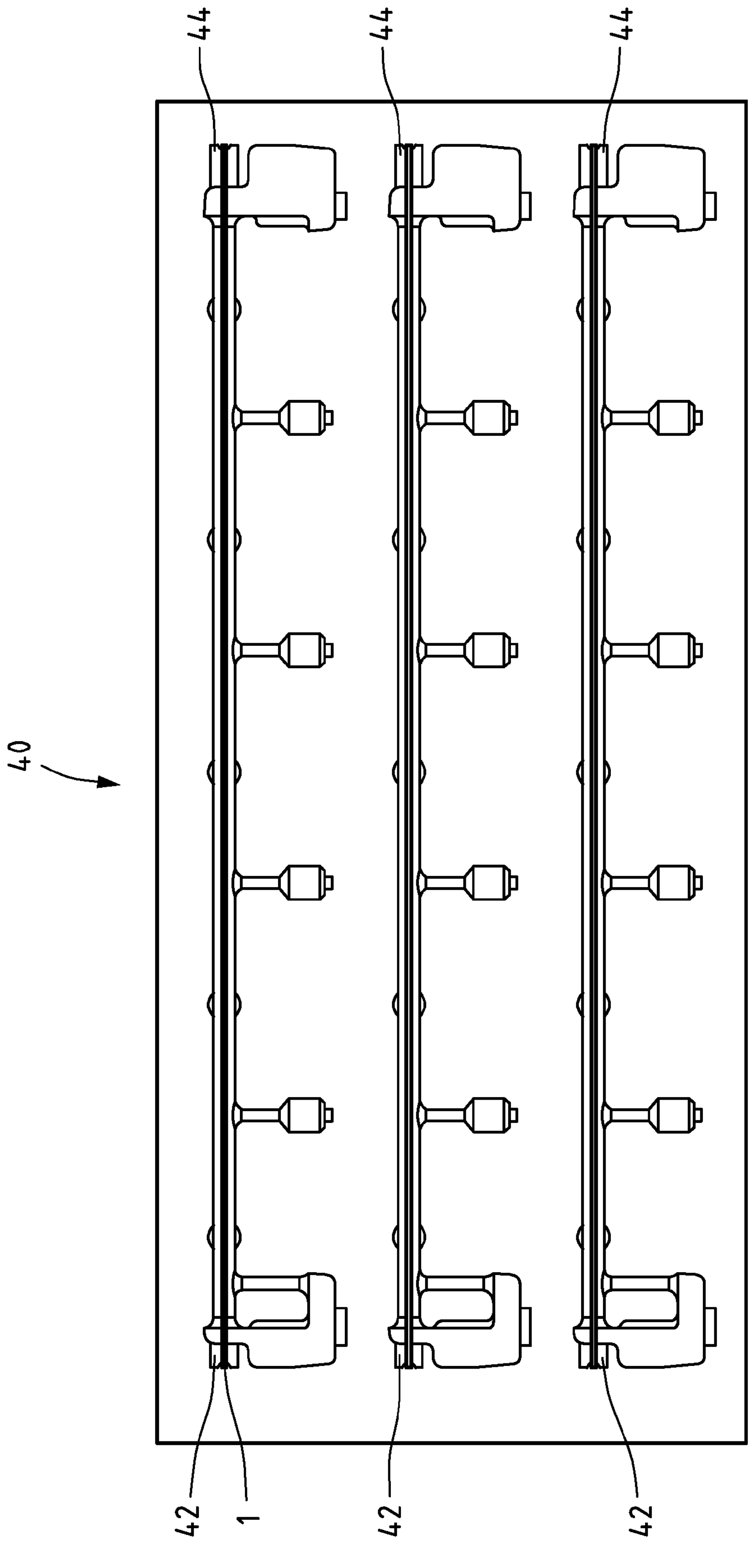
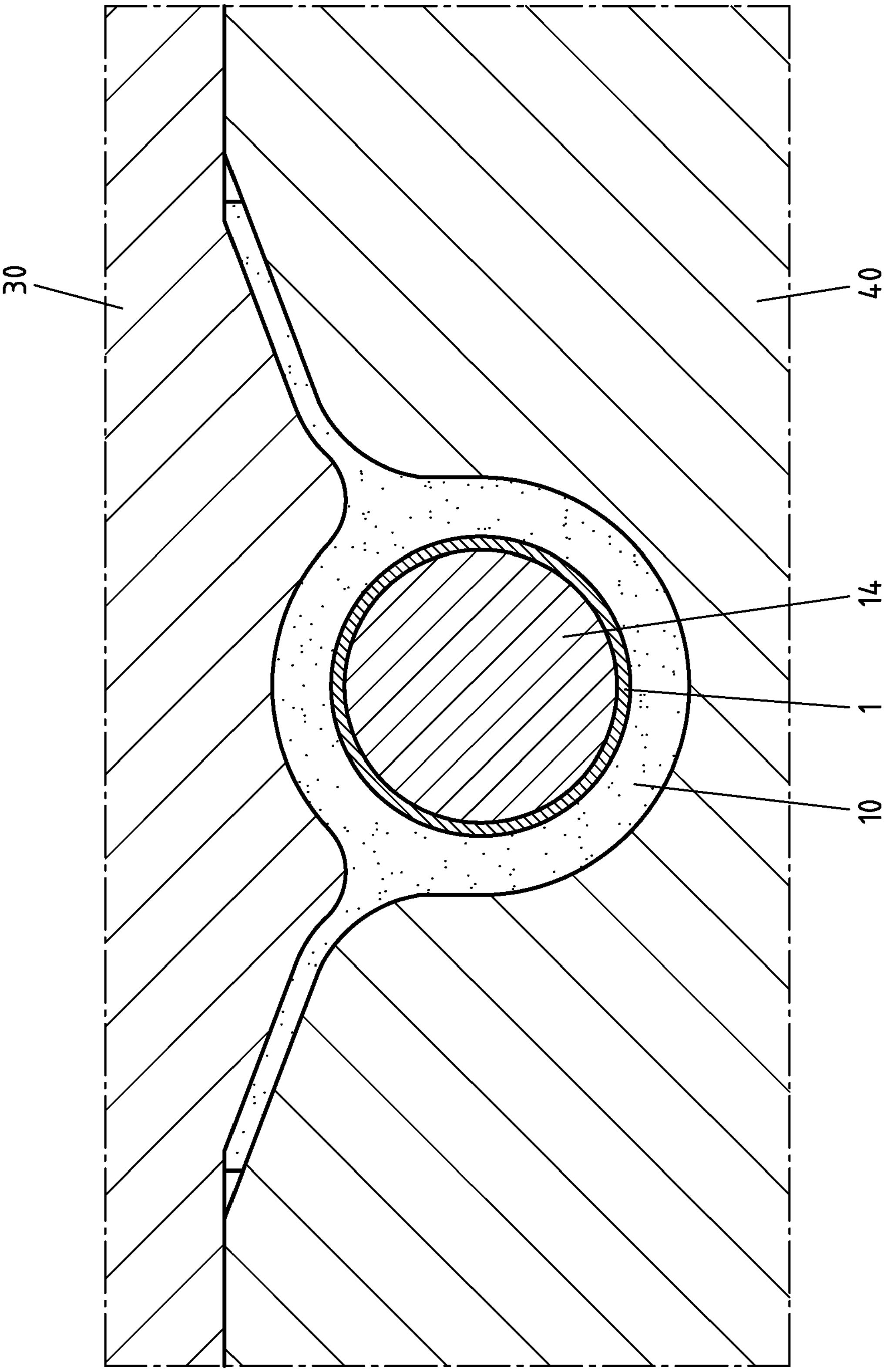


Fig.5b

Fig.6



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EUROPEAN SEARCH REPORT

Application Number
EP 20 20 8614

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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X	ES 1 001 032 U (J. WIZEMANN GMBH & CO) 16 April 1988 (1988-04-16) * the whole document * * paragraph [0005] - paragraph [0011] *	1-16	
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	17 February 2021	Porté, Olivier

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