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(54) Titre : PROCEDE ET DISPOSITIF DE MOULAGE EN COQUILLE
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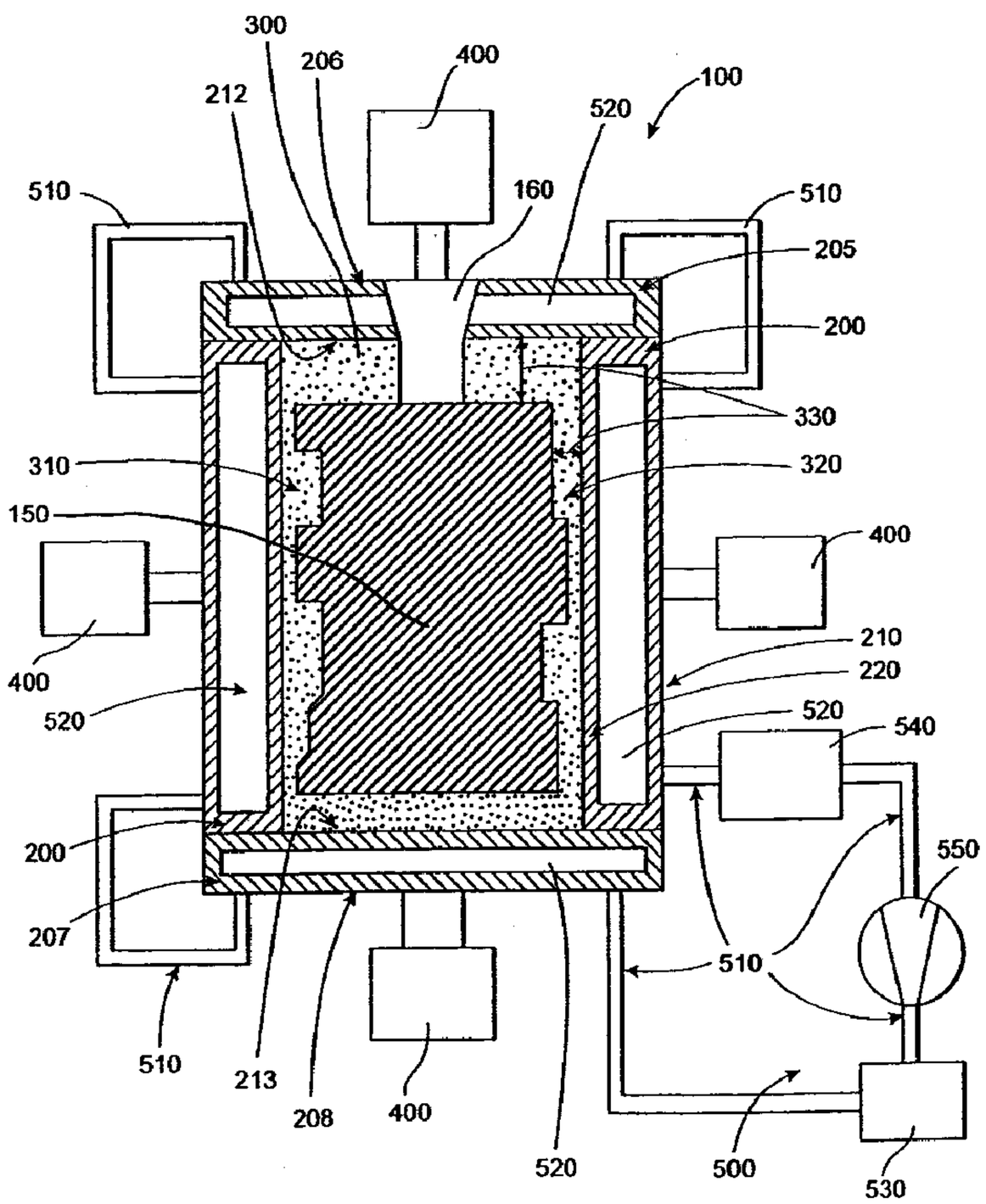

(57) Abrégé/Abstract:
A device for casting cast iron including a metal chill mould (100) having outer walls (206, 208, 210) and inner walls (212, 213, 220). The inner walls are in contact with a mould (300). The device further includes pressurising means (400) for applying a variable

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(57) Abrégé(suite)/Abstract(continued):
pressure on the outer walls (206, 208, 210) of the chill mould, in order to control changes in volume of molten material enclosed by the chill mould, and chill mould cooling means (500) for variable cooling of the inner walls (212, 213, 220) of said chill mould. A method using said device for carrying out the invention is also disclosed.

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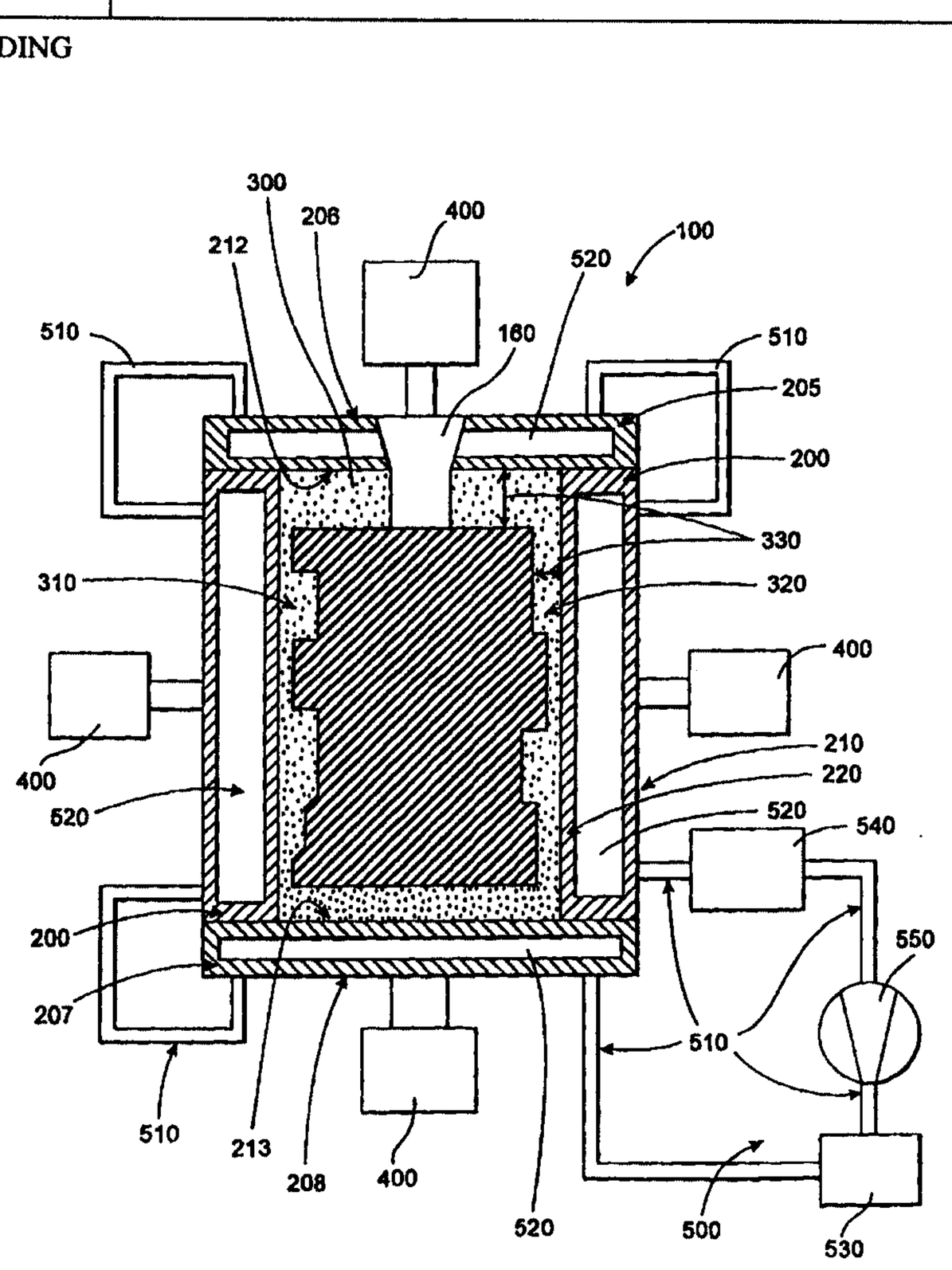
(54) Title: METHOD AND DEVICE FOR CHILL MOULDING

(57) Abstract

A device for casting cast iron including a metal chill mould (100) having outer walls (206, 208, 210) and inner walls (212, 213, 220). The inner walls are in contact with a mould (300). The device further includes pressurising means (400) for applying a variable pressure on the outer walls (206, 208, 210) of the chill mould, in order to control changes in volume of molten material enclosed by the chill mould, and chill mould cooling means (500) for variable cooling of the inner walls (212, 213, 220) of said chill mould. A method using said device for carrying out the invention is also disclosed.



METHOD AND DEVICE FOR CHILL MOULDING

TECHNICAL FIELD

The present invention relates to a method and a device for chill moulding cast iron.

BACKGROUND ART

A method and a device for the manufacture of cast iron parts by casting in a stationary metal mould, which is lined with a layer of hardening moulding material or green sand, is shown in SE-C-506508. A tubular metal mould is used whereby a tubular, upwardly open space in the mould is lined using an insulating form material. Molten cast iron is filled from above, in such a way that the cooling effect of the mould and lining gives a directional frontage of solidification from the lower end of the lining and upwards to a feeder volume at the top for the last of the iron to solidify.

The described method and device give excellent results for cast parts of even thickness and relatively thin walls, such as cylinder linings, but are less suitable for casting of parts with varying cross-section and more complex geometry, where the rate of cooling will vary too much between different parts of the casting. Demands for improved mechanical properties combined with good ductility means that alloyed materials, which are traditionally used for improving mechanical properties, can not be used as the workability will be reduced due to the high carbide content and casting becomes difficult due to its tendency to shrink.

DISCLOSURE OF INVENTION

Therefore, a general purpose of the invention is to provide a method and a device for chill moulding of cast iron parts of varying cross-sectional area and of relatively complex geometry, where the mechanical properties of the cast material is not controlled and limited by the added alloying materials alone.

A further purpose of the casting method according to the invention is to provide increased possibilities for influencing the rate of cooling of the casting, primarily through the pearlite transformation temperature range, which makes it possible to improve the mechanical properties even further. An increased rate of cooling will also increase productivity, i.e. a larger number of cast parts per unit of time and production unit.

A further purpose of the invention is to fulfil high level environmental requirements, such as low emissions of pollutants, reduced use of energy, a clean working environment, reduced use of moulding material or sand, calculated per unit of weight for castings with a corresponding reduced need for depositing moulding material or sand and a significantly improved recovery of added energy.

According to the present invention, these purposes are achieved by a device for casting cast iron, which device includes a chill mould having outer walls and inner walls, wherein the inner walls are in contact with a mould, characterised in that said device also includes pressurising means for applying a variable pressure against the outer walls of said mould, as well as a chill mould cooling means for variable cooling of the inner walls of said metal chill mould.

The wall thickness of the mould is chosen so that the desired rate of heat transfer for the required mechanical properties of the cast part is achieved. The mould is preferably made of moulding material or green sand.

Furthermore, it is advantageous to include an hydraulic or a pneumatic press in said pressurising means for acting on the outer walls of the metal chill mould.

Said chill mould cooling means preferably includes a number of cooling circuits arranged in said metal chill mould, a coolant container, a heat exchanger and a coolant pump, whereby said coolant pump circulates a coolant through a coolant conduit interconnecting said cooling circuits with said coolant container , said heat exchanger and said coolant pump.

These purposes are, according to the present invention, achieved by a method for manufacturing cast iron parts according to the invention, whereby a metal chill mould, having outer walls and inner walls and where the inner walls are in contact with a mould, is filled with molten cast iron. The method is characterised in that pressurising means can apply a variable pressure against the outer walls of said metal chill mould, and that chill mould cooling means can variably cool the inner walls of said metal chill mould during the cooling of the casting.

Said mould is preferably made from a hardening moulding material or green sand. The thickness of the walls of the mould is chosen to achieve the required rate of cooling.

The casting method allows casting of materials having a low C-equivalent, as well as materials having high levels of carbide stabilising alloying materials used to obtain castings with a considerably higher flexural strength, fatigue strength and modulus of elasticity, which in all will give good mechanical properties.

By casting materials with a low C-equivalent and by adding moderate amounts of carbide stabilising alloying materials, a strong material, virtually free of carbides and with a good machinability, can be obtained.

The casting method will also give less dimensional scatter for the casting compared to conventional green sand casting.

BRIEF DESCRIPTION OF DRAWINGS

Preferred embodiments of the invention will be described in more detail below, with reference to the appended figure, wherein;

Fig. 1 shows a schematic cross-section of a device for chill mould casting of cast iron according to the invention.

MODE(S) FOR CARRYING OUT THE INVENTION

Fig. 1 shows a device 100 chill mould casting of cast iron according to the present invention. The device includes a rigid, thick-walled metal chill mould 100, with side elements 200, a top element 205 and a bottom element 207. Each of the side elements 200 has an outer wall 210, facing away from a mould cavity 150 into which molten cast iron is to be poured, and an inner wall 220, facing the mould 300. The top element 205 is provided with a corresponding outer side 206 and an inner side 212. Similarly, the bottom element 207 has an outer side 208 and an inner side 213. The thickness of the mould wall 330 is chosen so that a desired heat transfer rate is obtained. The mould material, wall thickness, pressure and temperature controls the heat transfer rate, whereby a thin wall will give a fast cooling rate and a thick wall a slow cooling rate. The mould 300 is produced by conventional methods, alternatively in a air-squeezing core machine, a core forming machine or by manual manufacture, using a hardening, insulating mould material, with a suitable known organic or inorganic binding agent, or green sand. The moulding is performed using a template which shapes the mould cavity 150. The thickness of the mould wall 330 is generated by conventional means, alternatively in the core box or by the height of the mould block. The mould 300 preferably includes a first mould part 310 and a second mould part 320. The mould parts 310 and 320 are joined by means of an adhesive or a bolt connection after the core has been assembled, should a core be required. The mould 300 is placed in the chill mould 100 whereupon the side elements 200, the top element 205 and the bottom element 207 of the chill mould 100 closes around the mould 300 by pressurising one or more

pressurising means 400. Molten material is poured into the mould through an inlet port 160 which is connected to the mould cavity 150. The inlet port is made by conventional methods.

In this way it is possible to apply variable pressure on the side elements 200, the top element 205 and the bottom element 207 of the chill mould, using pressurising means 400 arranged in connection with the chill mould. The pressurising means 400 preferably include hydraulic or pneumatic presses arranged to act on the outer walls, 206, 208 and 210 respectively, of the chill mould. During solidification of the molten material in the chill mould 100 volume reductions (e.g. during forming of austenite) and increases (e.g. during forming of graphite) will occur during different phase transformations. These changes in volume will be larger or smaller depending on factors such as the relationship in size between the molten material, the mould and cores, if any, as well as the chemical composition of the basic material, inoculation, treatment of the smelt, etc. . By making it possible to control the pressure applied to the outer walls, 206, 208 and 210 respectively, of the chill mould, it is also possible to partially control the force by which residual molten material is transferred from areas of increasing volume to areas of decreasing volume, without being forces into the mould or core, nor causing shrinkage porosity.

The device according to the invention is also provided with variable cooling by a chill mould cooling means 500, with acts on the inner walls of the chill mould 212, 213 and 220 respectively. The chill mould cooling means 500 includes several, preferably six, cooling circuits 520 arranged in or on the side elements 200, top element 205 and bottom element 207 of the chill mould. The chill mould cooling means 500 preferably includes a coolant container 530, in which a coolant such as water is stored, a heat exchanger 540 for recovering heat from the coolant and a coolant pump 550 for circulating the coolant through a coolant conduit 510 to and from the coolant circuits 520.

The mould cavity 150 is cooled by the coolant in the chill mould 100 during the entire casting process. The rate of cooling is regulated by the heat transfer rate of the mould wall 330, the heat transfer rate of the inner wall 220 of the chill mould, the mould cavity 150 and the temperature of the coolant. The heat transfer is also affected by the pressurisation of the pressurising means 400. The rate of cooling is controlled during the entire cooling process, until the pearlite transformation has been completed, to achieve the desired mechanical properties for the casting; a high cooling rate will give a high strength. The cooling rate through the pearlite transformation phase can be increased by opening the chill mould when the temperature of the casting is above the temperature for pearlite transformation. The air cooling which will then occur, increases the cooling rate further giving an even higher strength. On the other hand, the cooling rate can also be reduced by opening the chill mould when the temperature of the casting is in the austenite range. Immediately after the opening the casting is immersed in and covered by an insulating medium and is kept in this state until the temperature of the casting has dropped below the pearlite transformation temperature. This method can also be used for reducing stresses in the cast part, but the casting must then be kept in the insulating medium until its temperature is lower than 200 °C, in the case of cast iron. The opening of the chill mould can take place before or after the pearlite transformation phase, depending on the material properties desired.

The invention is not limited to the embodiments shown in the figure or described above, but can be modified within the scope of the appended claims. It is, for instance, possible to construct the mould in more than two mould parts, e.g. by using three or four parts assembled into one mould unit.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A device for casting cast iron including a metal chill mould having outer walls and inner walls, which inner walls are in contact with a mould, and wherein said device further includes a pressurising means for applying a variable pressure on the outer walls of the chill mould, and a chill mould cooling means for variable cooling of the inner walls of said chill mould.

2. A device according to claim 1, wherein said pressurising means includes hydraulic or pneumatic presses arranged to act on the outer walls of said chill mould.

3. A device according to claims 1 or 2, wherein said chill mould cooling means includes several cooling circuits arranged in said chill mould, a coolant container, a heat exchanger and a coolant pump, and wherein said coolant pump circulates a coolant through a coolant conduit connecting said coolant circuits with each other and with said coolant container, said heat exchanger and said coolant pump.

4. A device according to any one of claims 1 to 3, further comprising a mould wall having a thickness chosen so that a desired rate of heat transfer is obtained, in order to achieve desired mechanical properties in the cast material.

5. A device according to any one of claims 1 to 4, wherein said mould is made of a hardening mould material or green sand.

6. A method for making iron castings, said method comprising:

i) filling a metal chill mould with molten cast iron; said metal chill mould having inner walls in contact with a mould, and outer walls; and

ii) cooling the metal chill mould, wherein during cooling, a pressurising means acts with variable pressure on the outer walls of said metal chill mould, and a chill mould cooling means variably cools the inner walls of said chill mould.

7. A method according to claim 6, wherein said mould is made of a hardening mould material or green sand.

8. A method according to claim 6 or 7, wherein said pressurising means includes hydraulic or pneumatic presses arranged to act on the outer walls of said chill mould.

9. A method according to any one of claims 6 to 8, wherein said chill mould cooling means includes several cooling circuits arranged in said chill mould, a coolant container, a heat exchanger and a coolant pump, and wherein said coolant pump circulates a coolant through a coolant conduit connecting said coolant circuits with each other and with said coolant container, said heat exchanger and said coolant pump.

10. A method according to any one of claims 6 to 9, wherein a wall of said mould has a thickness chosen so that a desired rate of cooling of the casting is obtained.

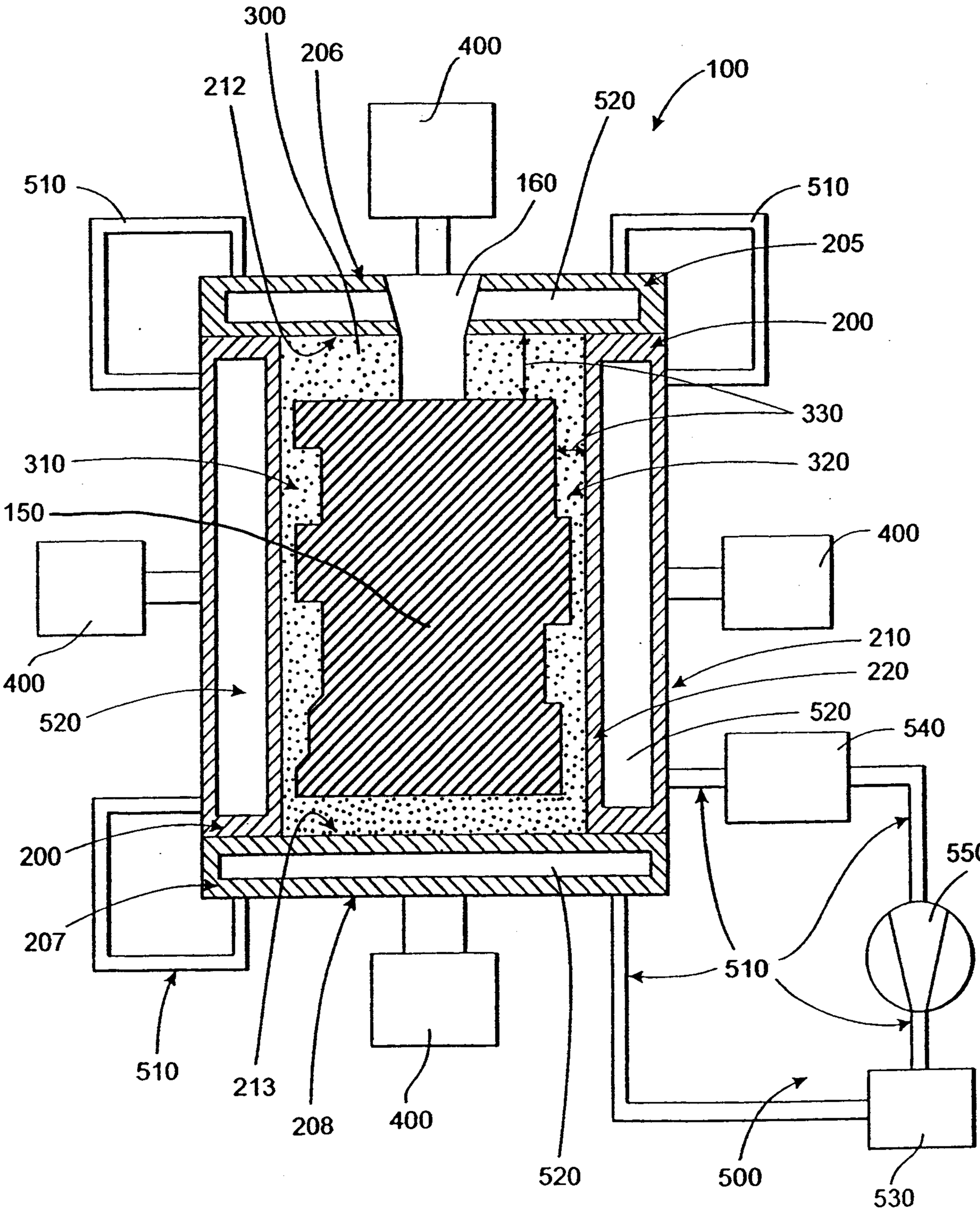

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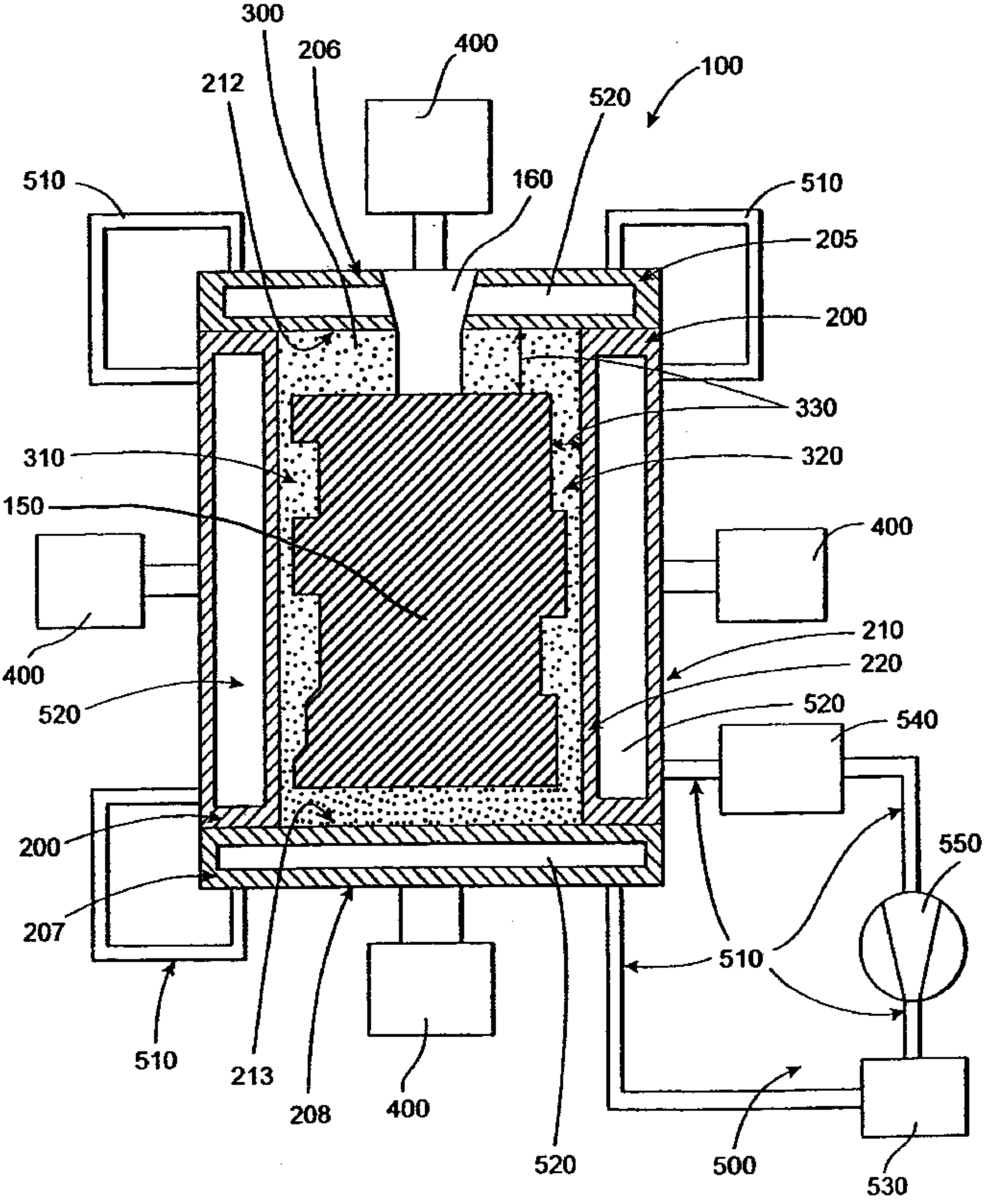
Fig.1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