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(54) **Method an machine for manufacturing hollow cores**

(57) A method for manufacturing hollow cores consists substantially in forming two mutually complementary hollow core halves and in joining them into a single

body. The two hollow core halves are formed simultaneously and automatically by a machine which subsequently joins them into a single body.

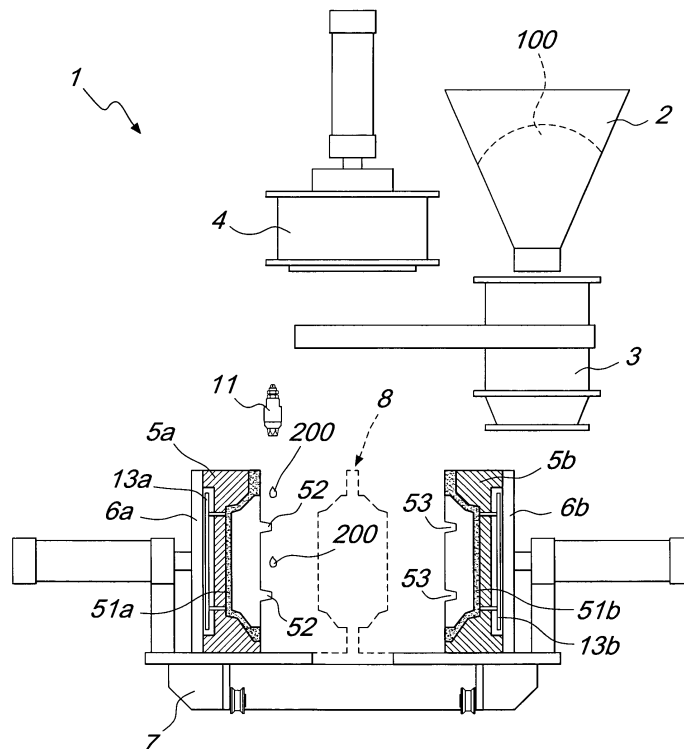


Fig. 5

Description

[0001] The present invention relates to a method and a machine for manufacturing hollow cores, commonly used in core shop and in foundries, which can be used for cold processes and hot processes.

[0002] As is known, cores are elements which reproduce the hollow parts of the object to be manufactured and are introduced in the molds before casting. The cores are used to provide castings with internal cavities or with profiles which cannot be formed by simple molding.

[0003] When following a cold process, also known as "cold box" or "Ashland" process, the cores are made by packing a suitable mixture, composed of sand and binding additives, inside vessels which reproduce the shape of the parts of the casting that must remain hollow and are generally composed of two or more elements and are known as core boxes.

[0004] The filling and compaction process is performed by a specific core blowing machine, which fills the core boxes and, by using compressed air, compacts the mixture of components.

[0005] When the core box is completely filled by the mixture of sand and binding additives, the core is hardened by injecting suitable catalysts in the gaseous phase by means of a gas injection plate; after this, it is extracted by means of extractors.

[0006] When instead following a hot process, otherwise known as "hot box", "shell molding" or "Croning process", the mixture is composed of sand granules pre-coated with thermosetting resins and is packed by means of the core blowing machine inside the core boxes, which are heated by means of electric resistors or gas-fired burners.

[0007] The high temperature melts the precoating of the granules, making them stick to each other and hardening the core.

[0008] In order to reduce the weight of the cores, reduce the amount of raw material needed to provide them and limit the amount of substances to be disposed at the end of their life cycle, the cores can also be made with a hollow space inside them.

[0009] That result is currently obtained essentially in two ways, according to a first way, a body without undercuts, commonly known as plug, is inserted within the core box, resting it on the bottom of the mold before filling the mold with the mixture of sand and binding additives and extracting it after the hollow core has been hardened.

[0010] Such method has several drawbacks: it does not allow to provide hollow cores in which the outer surface is completely closed and it forces the core maker to use plugs with a very simple shape, which are easier to extract but do not allow to optimize the saving of material during the provision of the hollow core.

[0011] The second conventional system entails dividing each hollow core into multiple parts, generally two, which are made separately and are subsequently assembled manually by workers which bond them by using hot-

melt or cold-bonding adhesive.

[0012] Specifically, each hollow core half is made by arranging a plug inside the corresponding core box half, before filling with the mixture of sand and binding additives; the plug is suitably shaped and is extracted after the hardening of the hollow core half.

[0013] Such system allows to obtain hollow cores in which the outer surface is completely closed, but it has drawbacks: the need to repeat the same operations for each hollow core half, doubling production times or the resources used, and the need to intervene manually to obtain the finished product, further increasing manufacturing times and inevitably introducing inaccuracies caused by a less than perfect mating of the two hollow core halves.

[0014] As regards cold processes, it should also be noted that the injection of each hollow core, or hollow core half, with the catalysts in the gaseous state occurs by means of a gas injection plate, which is rested against a partially open outer wall of the core box, generally the same wall on which the blowing head of the core blowing machine acted previously.

[0015] In order to achieve the correct hardening of the entire hollow core, or core half, the gas must therefore impregnate it by traveling along its entire height or width, depending on the side chosen for gas injection, and as a consequence of this fact the gas injection time is greatly conditioned by the geometric proportions of the hollow core or core half.

[0016] The aim of the invention is to solve the problems described above by providing a method and a machine for manufacturing hollow cores which allow the manufacturing hollow cores in a completely automatic manner, shortening the molding times and the hardening times of the hollow core both in cold processes and in hot processes.

[0017] Within the scope of this aim, a particular object of the invention is to provide a method and machine for manufacturing hollow cores which allow to provide hollow cores by saving material and thus reducing the amount of catalysts in the gaseous state to be used and the amount of sand and binding additives to be disposed of after casting.

[0018] Another object of the invention is to provide a method and machine for manufacturing hollow cores which, by requiring a smaller quantity of additives and catalysts, allow to produce hollow cores which can generate less gas during casting.

[0019] Another object of the invention is to provide a method and machine for manufacturing hollow cores which allow to facilitate the assembly and handling of hollow cores in addition to facilitating their knockout.

[0020] Another object of the invention is to provide a method and a machine for manufacturing hollow cores which allow to achieve an economic saving due to the reduced use of raw materials and chemical products and allow to have environmental advantages by reducing the amount of gas to be eliminated and purified and the

amount of sand to be disposed.

[0021] Another object of the invention is to provide a method and a machine for manufacturing hollow cores which, by never moving the hollow core halves from the core box before joining them into a single body, allows to obtain hollow core halves which are perfectly mated.

[0022] This aim and these and other objects which will become better apparent hereinafter are achieved by a method for manufacturing hollow cores, comprising forming two hollow core halves which are mutually complementary and joining them into a single body, characterized in that said two hollow core halves are formed simultaneously and automatically by a machine for manufacturing hollow cores and are joined into a single body automatically by said machine for manufacturing hollow cores.

[0023] This aim and these and other objects which will become better apparent hereinafter are also achieved by a machine for manufacturing hollow cores, comprising a structure which supports a core blower arranged above a core box which is moved automatically, said core box comprising at least two complementary portions and a plug which is moved automatically, said plug being insertable within said core box, characterized in that it comprises an automatic forming means, which is suitable to form simultaneously and automatically two complementary hollow core halves and join them into a single body to constitute a hollow core.

[0024] Further characteristics and advantages will become better apparent from the description of a preferred but not exclusive embodiment of a method and a machine for manufacturing hollow cores according to the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a schematic view of a machine for manufacturing hollow cores according to the invention in a first step of operation;

Figure 2 is a schematic view of the machine of the preceding figure, in a subsequent step of operation;

Figure 3 is a schematic view of the machine of Figure 1, in still a subsequent step of operation;

Figure 4 is a schematic view of the machine of Figure 1 in a subsequent step of operation;

Figure 5 is a schematic view of the machine of Figure 1 in a subsequent step of operation;

Figure 6 is a schematic view of the machine of Figure 1 in a subsequent step of operation;

Figure 7 is a schematic view of the machine of Figure 1 in a subsequent step of operation.

[0025] With reference to the cited figures, the method for manufacturing hollow cores substantially comprises forming two hollow core halves, 51 a and 51 b, which are mutually complementary, and joining them into a single body, so that they form a hollow core 50 which can be used to provide a casting with internal cavities or with particular profiles.

[0026] According to the invention, the two hollow core halves 51 a and 51 b are simultaneously and automatically made by means of a machine, generally designated by the reference numeral 1, and are joined together in a single body automatically by the same machine.

[0027] The method comprises a first step in which a plug 8 is inserted automatically within a core box, in order to maintain an empty space within the hollow core 50 and form a parting plane between the two hollow core halves 51 a and 51 b.

[0028] If the hollow core 50 has a longitudinal parting, as shown in the figures, the core box is composed of two portions 5a and 5b which are mutually complementary, whereas if the hollow core 50 has a transverse parting, the core box is composed of four complementary portions.

[0029] As a consequence of that, the plug 8 is inserted within the core box by first opening the core box, separating the two portions 5a and 5b, and then closing it again.

[0030] Subsequently, inside the core box, in the space left empty by the plug 8, by using a core blower, a mixture 100 formed by sand and binding additives is packed through ducts 17a and 17b provided on the core box.

[0031] The method continues by causing the hardening of the hollow core halves 51 a and 51 b by means of the plug 8.

[0032] More particularly, if forming is performed with a cold process, as in the case shown in the accompanying figures, the hardening of the hollow core halves 51 a and 51 b occurs by injecting omnidirectionally catalysts in the gaseous phase 150, which enter the hollow core halves 51 a and 51 b, reacting with the binding additives that are present in the mixture 100.

[0033] Gas injection, i.e. the injection of the catalysts in the gaseous phase 150, occurs by means of an integrated gas injection means, which is inserted within the plug 8 and acts after plugging with a plate 16 the ducts 17a and 17b.

[0034] If forming is performed with a hot process, the mixture 100 is formed by sand which is precoated with thermosetting resins and the hardening of the hollow core halves 51 a and 51 b occurs by diffusing heat omnidirectionally by virtue of an integrated heating means inserted within the plug 8.

[0035] The heat affects the hollow core halves 51 a and 51 b and dissolves the precoating of the granules that compose the mixture 100 and produces their consequent bonding.

[0036] At this point, the core box is opened again and the plug 8 is extracted.

[0037] While the two portions 5a and 5b of the core box are still separated and respectively contain the two hollow core halves 51 a and 51 b, adhesive 200 is deposited on the halves by virtue of a gluing means which is provided on the machine for manufacturing hollow cores 1, and the core halves are subsequently joined, closing the core box for such a time as to ensure the

setting of the adhesive 200, which joins the two hollow core halves 51 a and 51 b in a single body so that they constitute the hollow core 50.

[0038] The refinement of gluing and joining the two hollow core halves 51 a and 51 b when they are still respectively inserted in the two portions 5a and 5b allows to obtain a perfect mating between the two hollow core halves 51 a and 51 b and thus form a hollow core 50 which has no irregularities.

[0039] In order to facilitate the gluing operation and automate its execution, the two hollow core halves 51 a and 51 b are provided respectively with a plurality of protrusions 52 and with a plurality of notches 53, which mutually correspond and match up and are formed by the plug 8 during forming.

[0040] The protrusions 52 and the notches 53 are formed at the edges of the hollow core halves 51 a and 51 b related to the parting plane and are arranged so as not to be mutually superimposed vertically.

[0041] This refinement, together with the fact that each of the protrusions 52 has a substantially flat and horizontal upper surface, allows to dose and deposit the glue 200 automatically by using glue guns 111 which are arranged above the core box and therefore above the hollow core halves 51 a and 51 b.

[0042] The method ends with the extraction of the hollow core 50, which is now completely formed, from the core box by using extractors 13a and 13b.

[0043] The edges of the hollow core halves 51a and 51 b, related to the parting plane, have a contour with a complementary profile which runs along their entire length, interrupting the planarity of the parting plane and allowing to mate the two hollow core halves 51 a and 51 b hermetically, avoiding infiltrations during casting.

[0044] Hereinafter, with reference to the cited figures, a machine for manufacturing hollow cores 1 is described which is particularly suitable to perform forming with a cold process and is constituted essentially by a metallic structure, not shown in the accompanying figures, which supports a core blower, which is per se known and is substantially composed of a hopper 2, in which the mixture 100 formed by sand and binding additives is stored, and a tube 3 which collects the mixture 100 from the hopper 2, making it available to a blowing head 4.

[0045] The blowing head 4 is arranged above a core box, also supported by the metallic structure, which if the hollow core 50 has a longitudinal parting, as shown in the accompanying figures, is composed of two mutually complementary portions 5a and 5b, which are suitable to form respectively two hollow core halves 51a and 51 b which are mutually complementary.

[0046] If the hollow core 50 has a transverse parting, not shown in the accompanying figures, the core box would be preferably composed of four mutually complementary portions, suitable to form two hollow core halves 51 a and 51 b which are mutually complementary and facilitate their extraction, allowing to open the core box both horizontally and vertically.

[0047] The two portions 5a and 5b are provided respectively with ducts 17a and 17b for the insertion of the mixture 100 and are moved automatically by hydraulic clamps 6a and 6b which are supported by a clamp carriage 7, on which a plug 8 is also moved automatically which can be inserted within the core box composed of the two portions 5a and 5b.

[0048] According to the invention, the machine for manufacturing hollow cores 1 comprises an automatic forming means, which allows to automatically form the two hollow core halves 51 a 51 b and join them in a single body, so that they constitute the hollow core 50.

[0049] Specifically, the automatic forming means includes an integrated gas injection means, which is inserted within the plug 8 and is constituted by a feed duct 12 and a plurality of openings 9 which are formed omnidirectionally in the plug 8.

[0050] The integrated gas injection means allows, after closing the ducts 17a and 17b by means of a plate 16 arranged above the core box, to inject into the hollow core halves 51 a and 51 b catalysts in the gaseous phase 150, so that they propagate from the inside outward, reacting with the binding additives that are present in the mixture 100.

[0051] The plug 8 is supported by a support 10, with a perimetric space occupation which corresponds substantially to the external space occupation of the two portions 5a and 5b and shaped so as to be able to define, at the edges of the hollow core halves 51 a and 51 b related to the parting plane, a plurality of protrusions 52 and a plurality of notches 53, which mutually correspond and match up but are not vertically superimposed.

[0052] Each of the protrusions 52 has a substantially flat and horizontal upper surface which allows to distribute the glue 200 thereon automatically.

[0053] The automatic forming means in fact also includes a gluing means, which in practice is constituted by a plurality of glue guns 11, which are arranged above the core box so as to be able to dose automatically the glue 200 and deposit it on the upper surface of the protrusions 52.

[0054] The shape of the support 10 allows to form on the edges of the hollow core halves 51 a and 51 b related to the parting plane a contour with a complementary profile which runs along their entire length, so as to interrupt the planarity of the parting plane.

[0055] The machine according to the invention also comprises a first plurality of extractors, arranged inside the plug 8 and not shown in the accompanying figures, in order to facilitate the separation of the hollow core halves 51 a and 51 b, and there is a second plurality of extractors 13a and 13b which are arranged respectively within two portions 5a and 5b to allow automatic extraction of the hollow core 50 from the core box.

[0056] The machine for manufacturing hollow cores 1 can also be provided with a core extraction device, not shown in the accompanying figures, which is constituted for example by a moving belt which is arranged proximate

to the core box. The core extraction device may be constituted by any other apparatus suitable to facilitate the movement of the hollow cores 50, especially in mass production.

[0057] According to a further embodiment of the invention, not shown in the figures, the machine may be particularly suitable to forming with a hot process. The integrated gas injection means is replaced by an integrated heating means, which is inserted within the plug 8 and is constituted by at least one immersion heater which is preset so as to be able to diffuse heat in the hollow core halves 51 a and 51 b, so that it propagates from the inside outward in order to make the binding additives that are present in the mixture 100 react.

[0058] According to a further embodiment, the integrated heating means can be constituted by a hot fluid circuit, which is formed within the plug 8, or by at least one gas-fired burner.

[0059] In practice it has been found that the method and the machine for manufacturing hollow cores according to the invention fully achieve the intended aim, ensuring the possibility to manufacture hollow cores in a completely automatic manner, shortening the forming times and the hardening times of the hollow core, both in cold processes and in hot processes.

[0060] The method and the machine for manufacturing hollow cores according to the invention allow to provide hollow cores so as to save material and thus reduce the amount of catalyst in the gaseous state to be used and the amount of sand and additives binding additives to be disposed after casting, with advantages both from an economic standpoint and from an environmental standpoint.

[0061] The method and the machine for manufacturing hollow cores according to the invention also allow to produce hollow cores which are capable of developing less gas during casting and in which the hollow core halves are perfectly mated.

[0062] This application claims the priority of Italian Patent Application No. VI2007A000219, filed on August 3, 2007, the subject matter of which is incorporated herein by reference.

Claims

1. A method for manufacturing hollow cores, comprising forming two hollow core halves which are mutually complementary and joining them into a single body, **characterized in that** said two hollow core halves are formed simultaneously and automatically by a machine for manufacturing hollow cores and are joined into a single body automatically by said machine for manufacturing hollow cores.
2. The method for manufacturing hollow cores according to the preceding claim, **characterized in that** it comprises the following steps:

- inserting a plug within a core box to form simultaneously two hollow core halves;
- packing sand and binding additives into said core box;
- hardening said hollow core halves by virtue of said plug;
- extracting said plug from said core box;
- joining said hollow core halves to make a single body in an automatic manner;
- extracting the formed hollow core.

3. The method for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said step for inserting the plug within said core box comprises the prior opening and subsequent reclosure of said core box, said core box being composed of at least two complementary portions.
4. The method for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said plug forms a parting plane between said two hollow core halves.
5. The method for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said step for packing the sand and the binding additives within said core box comprises the use of a core blowing apparatus.
6. The method for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said hardening step comprises the omnidirectional injection of catalysts in the gaseous phase through said plug.
7. The method for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said hardening step comprises the omnidirectional diffusion of heat through said plug.
8. The method for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said step for extracting the plug from said core box comprises the opening of said core box.
9. The method for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said step for joining in a single body the hollow core halves comprises the gluing of said two hollow cores and the closure of said core box.
10. The method for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said two hollow core halves respectively comprise a plurality of protrusions and a plurality of notches which mutually match, said protrusions

sions not being mutually superimposed vertically and said notches not being mutually superimposed vertically.

11. The method for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** each of said protrusions comprises at least one upper surface which is substantially flat and horizontal and is suitable to accommodate a pre-set amount of adhesive, said adhesive being dosed automatically from above said core box during said step for joining the hollow core halves into a single body.
12. The method for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said two hollow core halves comprise a contoured portion with a complementarily shaped profile, which is formed on the edges of said hollow core halves related to said parting plane, said contoured portion being suitable to mate hermetically said two hollow core halves, interrupting the planarity of said parting plane.
13. The method for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said step for extracting the hollow core comprises the use of extractors, said core box comprising said extractors.
14. A machine for manufacturing hollow cores, comprising a structure which supports a core blower arranged above a core box which is moved automatically, said core box comprising at least two complementary portions and a plug which is moved automatically, said plug being insertable within said core box, **characterized in that** it comprises an automatic forming means, which is suitable to form simultaneously and automatically two complementary hollow core halves and join them into a single body to constitute a hollow core.
15. The machine for manufacturing hollow cores, according to the preceding claim, **characterized in that** said automatic forming means comprises an integrated gas injection means inserted within said plug.
16. The machine for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said integrated gas injection means comprises at least one supply duct and a plurality of openings which are formed omnidirectionally in said plug in order to inject catalysts in the gaseous phase within said hollow core halves.
17. The machine for manufacturing hollow cores according to the preceding claim, **characterized in that**
- said automatic forming means comprises an integrated heating means inserted within said plug.
18. The machine for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said integrated heating means comprises at least one immersion heater inserted within said plug in order to diffuse heat omnidirectionally within said hollow core halves.
19. The machine for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said integrated heating means comprises a hot fluid circuit which is formed within said plug.
20. The machine for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said integrated heating means comprises at least one combustible gas burner.
21. The machine for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said automatic forming means comprises a gluing means in order to join into a single body said hollow core halves.
22. The machine for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** said gluing means comprises a plurality of glue guns which are arranged above said core box in order to dose automatically said glue onto said protrusions.
23. The machine for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** it comprises a plurality of extractors arranged inside said core box.
24. The machine for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** it comprises a plurality of extractors which are arranged inside said core box.
25. The machine for manufacturing hollow cores according to one or more of the preceding claims, **characterized in that** it comprises at least one device for extracting the cores which is arranged proximate to said core box.

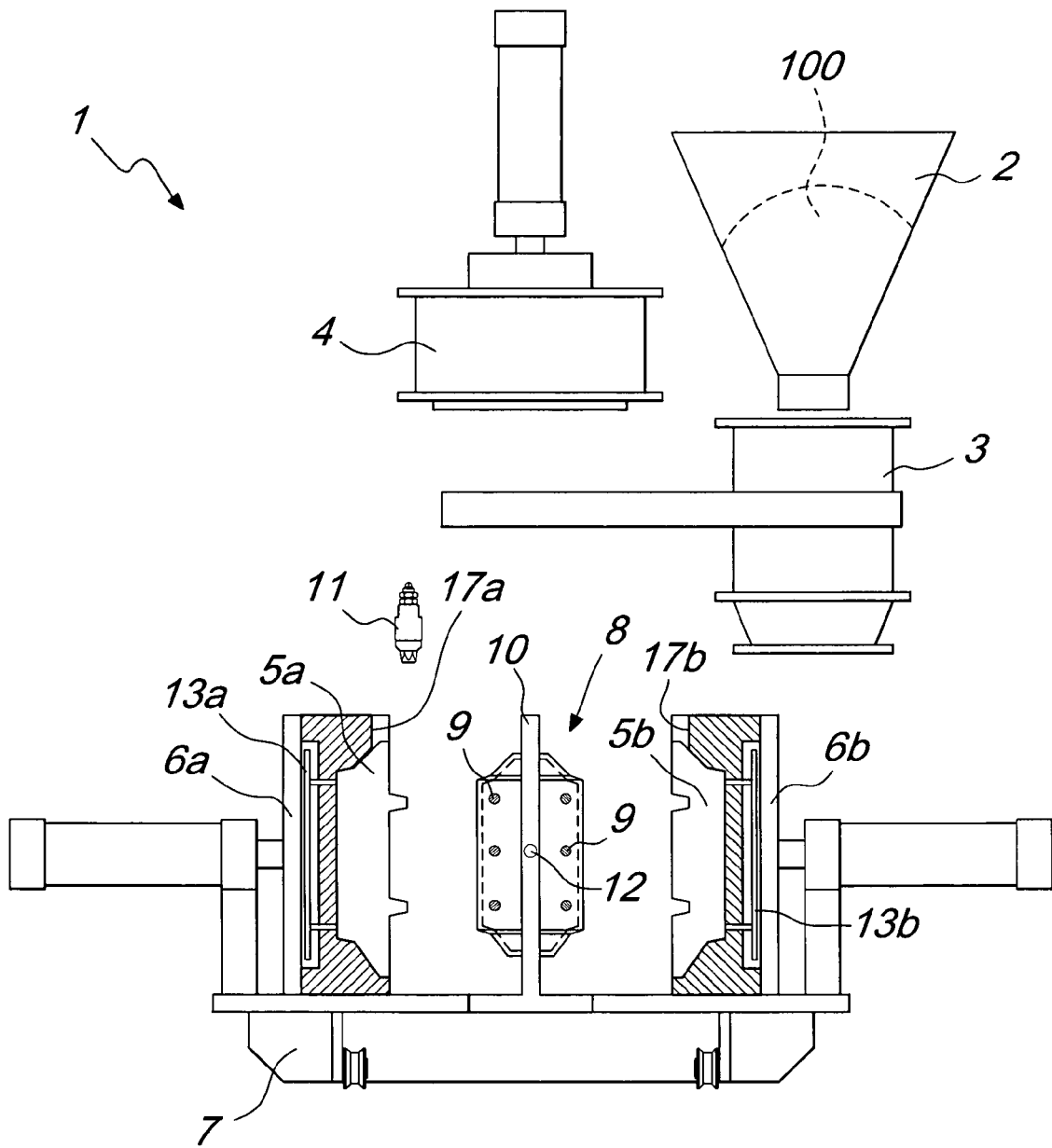


Fig. 1

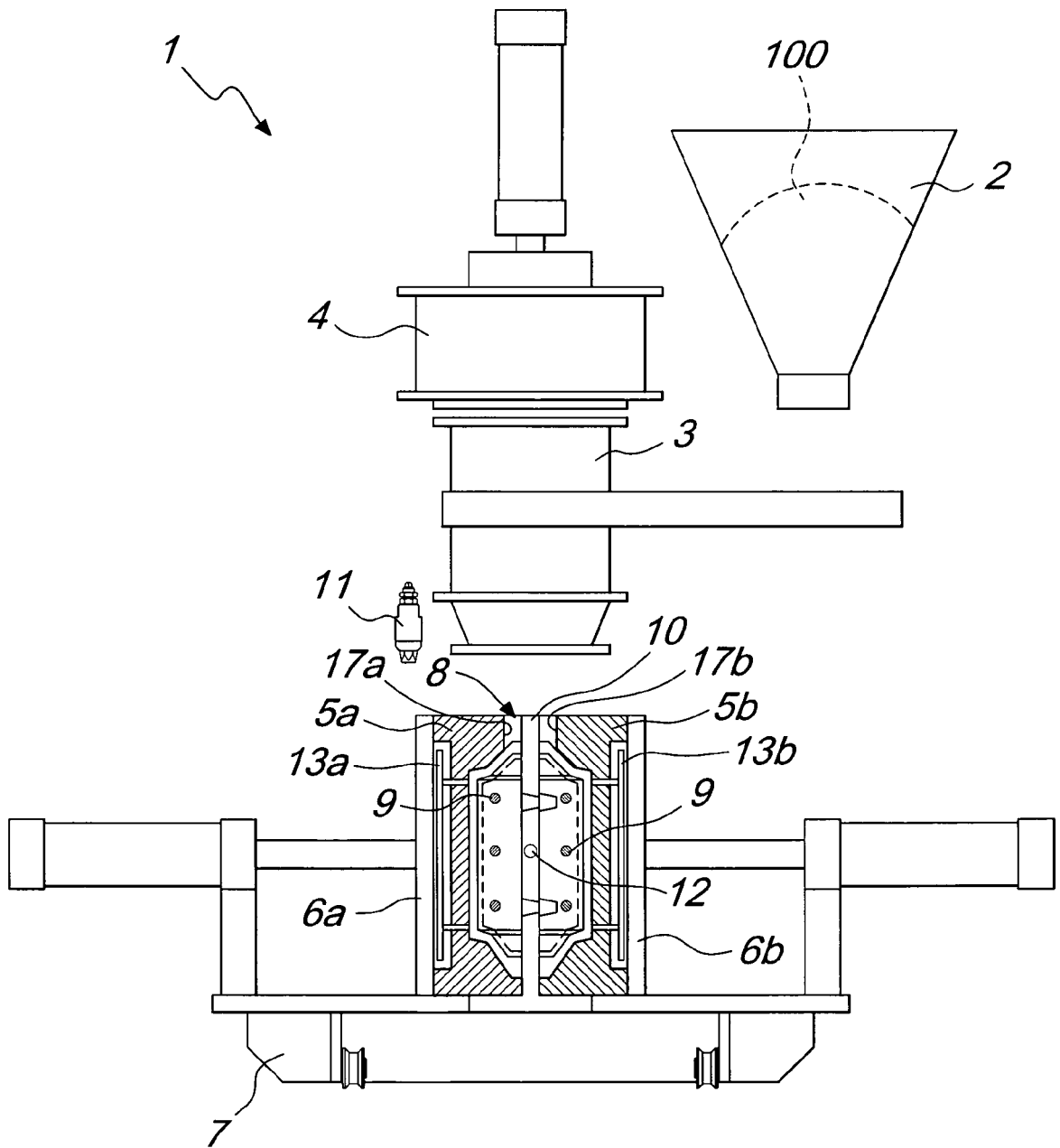


Fig. 2

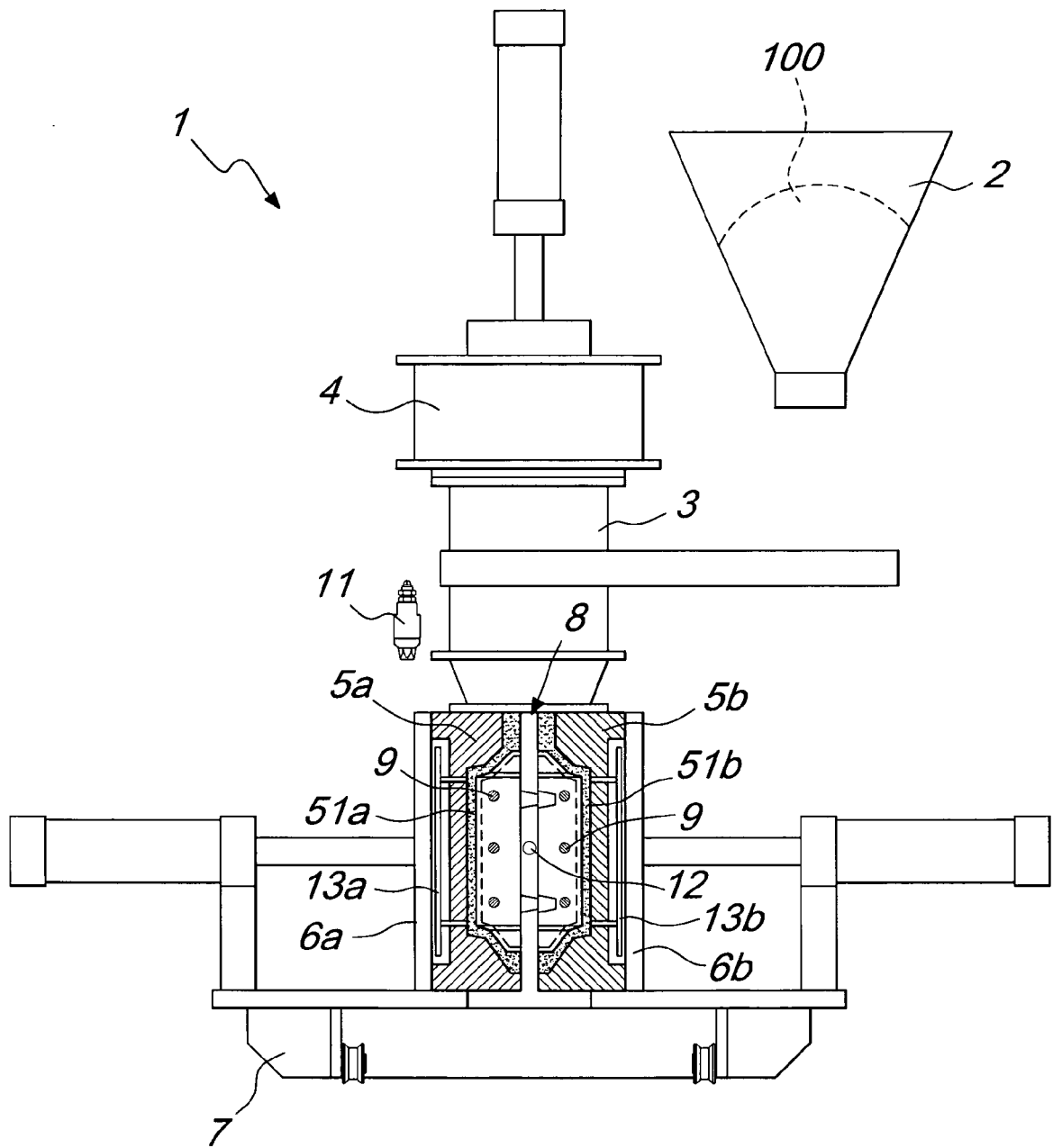


Fig. 3

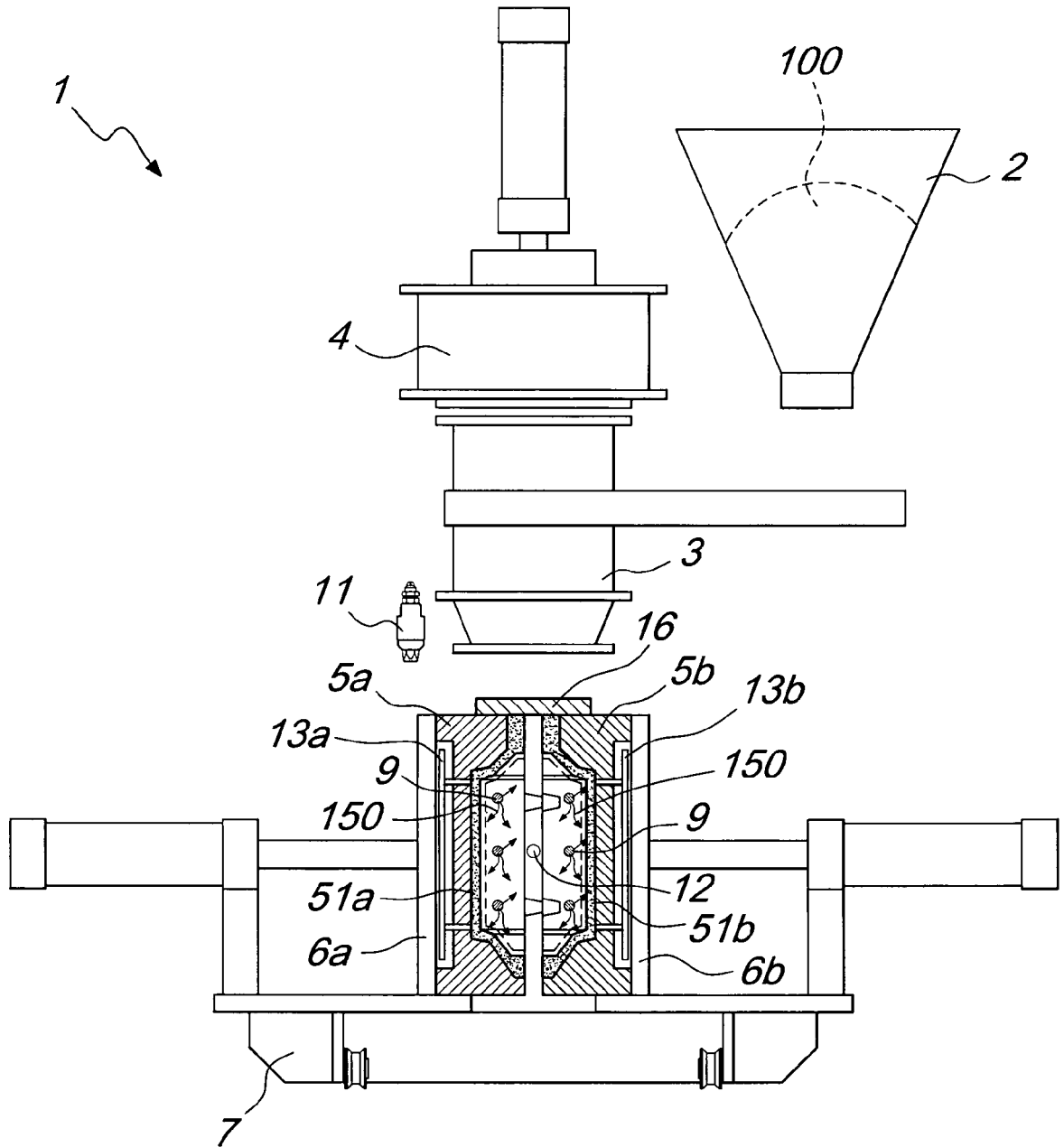


Fig. 4

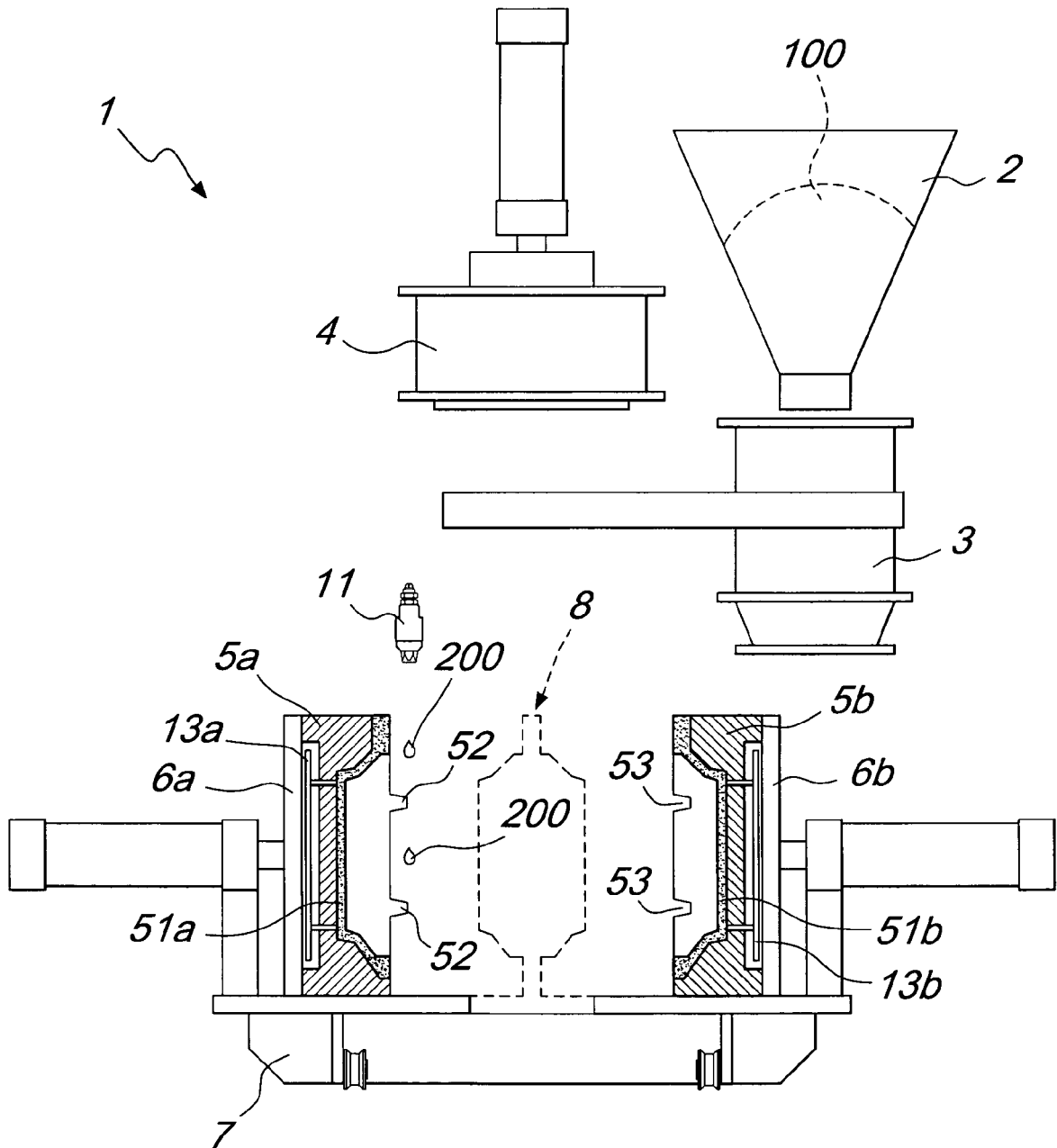


Fig. 5

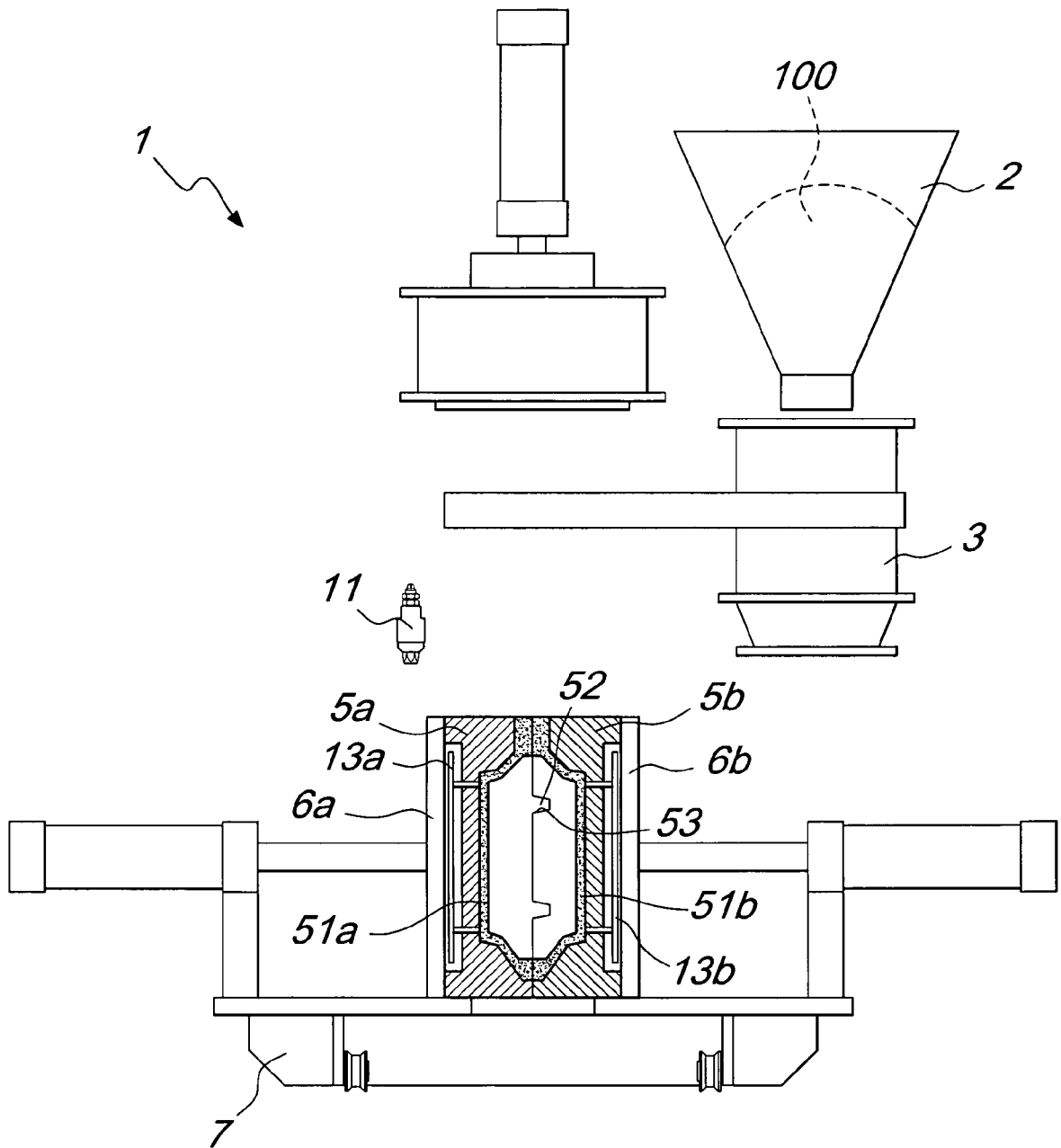


Fig. 6

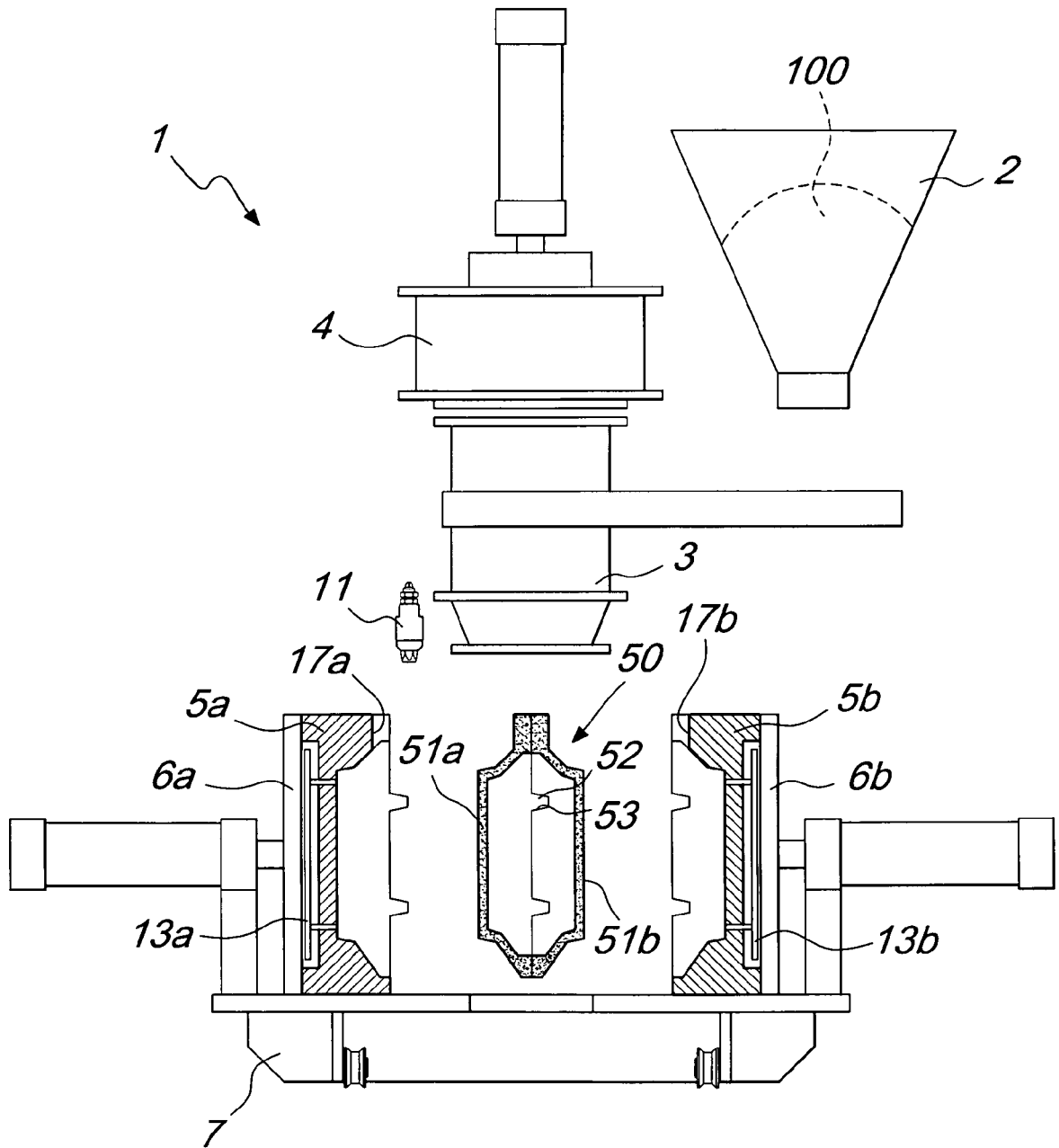


Fig. 7



EUROPEAN SEARCH REPORT

Application Number
EP 08 01 3589

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 083 713 A (KLOECKNER HUMBOLDT DEUTZ AG [DE]) 20 July 1983 (1983-07-20) * claims 1-10; figures 1-4 * & US 4 694 883 A (HAIDUK KLAUS [DE]) 22 September 1987 (1987-09-22) * claim 1; figures 1-4 * -----	1-25	INV. B22C9/10
X	JP 61 129256 A (TOYOTA MOTOR CORP) 17 June 1986 (1986-06-17) * abstract; figures 1-3 * -----	1-25	
A	JP 61 063336 A (NANIWA SEISAKUSHO KK) 1 April 1986 (1986-04-01) * abstract; figures 1-11 * -----	1-25	
A	JP 61 063337 A (NANIWA SEISAKUSHO KK) 1 April 1986 (1986-04-01) * abstract; figures 1-9 * -----	1-25	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			B22C
1	Place of search Munich	Date of completion of the search 19 November 2008	Examiner Lombois, Thierry
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 01 3589

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19-11-2008

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0083713	A	20-07-1983	DE 3200193 A1	14-07-1983
			JP 58119435 A	15-07-1983
			US 4694883 A	22-09-1987

US 4694883	A	22-09-1987	DE 3200193 A1	14-07-1983
			EP 0083713 A2	20-07-1983
			JP 58119435 A	15-07-1983

JP 61129256	A	17-06-1986	NONE	

JP 61063336	A	01-04-1986	JP 1048105 B	18-10-1989
			JP 1562791 C	12-06-1990

JP 61063337	A	01-04-1986	NONE	

EPO FORM P0458

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- IT VI20070219 A [0062]