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**EUROPEAN PATENT APPLICATION**

②① Application number: **87108470.3**

⑤① Int. Cl. 4: **C 21 C 1/10, B 22 D 1/00,**  
**B 22 C 9/08**

②② Date of filing: **11.06.87**

③⑩ Priority: **11.06.86 IT 2076286**

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④③ Date of publication of application: **23.12.87**  
**Bulletin 87/52**

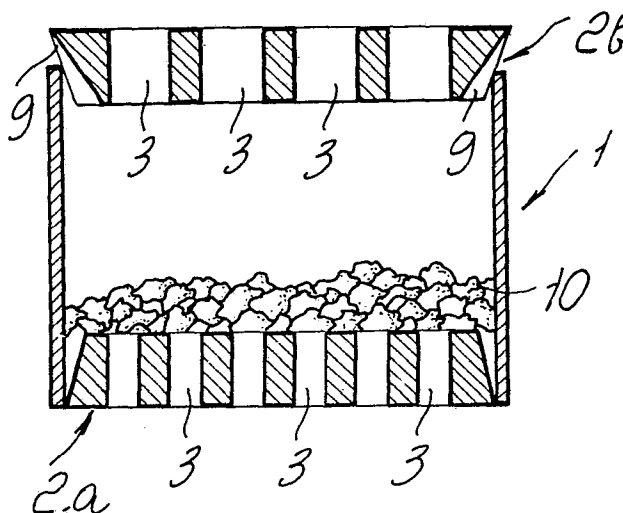
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⑧④ Designated Contracting States: **AT BE CH DE ES FR GB GR LI LU NL SE**

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⑤④ **Process for the degassing, refining or filtering treatment of liquid metals or alloys and related apparatus.**

⑤⑦ A process for the degassing, refining or filtering treatment of liquid metals or alloys wherein the metallic liquid is treated with a solid treatment agent. The process comprises the steps consisting of providing the treatment agent in the form of solid granules (10) in a closed container (1) having two counterposed walls in the shape of perforated diaphragms (2a, 2b), with holes having such dimensions as to retain said granules, and having further lateral walls; interposing said container in the pouring channel, at the base thereof; and passing said metallic liquid through said container through said diaphragms to make contact with said treatment agent in said container. An apparatus for performing the process is also described.



PROCESS FOR THE DEGASSING, REFINING OR FILTERING TREATMENT  
OF LIQUID METALS OR ALLOYS AND RELATED APPARATUS

The present invention relates to a process for the treatment of liquid metals or alloys with solid treatment agents, in particular for the degassing, refining or filtering of said metallic liquids.

5 During the processing of metallic alloys, especially by casting without protective slag, atmospheric gaseous elements are absorbed and decompose, in particular water vapor, in amounts which depend not only on the type of alloy being processed but also on the temperature and on the  
10 degree of humidity in the air.

Since the retained gases contribute to the formation of defects and alterations in the structure of the alloy during solidification and subsequent cooling, the practice has ensued, in cast iron metallurgy, to add, before die-casting  
15 or in the die itself, silicon-based alloys which have the function of reacting with the absorbed gases, this practice being known as "inoculation".

Independently of the chemical and structural composition of the alloys employed for this purpose, in  
20 order to achieve an inoculating effect the alloy must dissolve and diffuse homogeneously in the entire volume of the metallic compound required for the complete filling of the die.

An even partial inhomogeneity in inoculation causes a  
25 consequent partial inhomogeneity in the cast piece and the presence of defects, thus, for example, porosities, blowholes etc. due to the presence of gas.

Thus, the inoculation process depends partly on the

composition or on the type of alloy employed, and partly on the manner in which the addition of the inoculating alloy is performed.

5 Various inoculation systems are currently in use, but none ensures the homogeneity required by the process; in fact, if the inoculation alloy is fed into the ladle before casting, a rapid evanescence occurs; if alloy powder is sprayed on the flow of cast metal, the powder partially oxidizes.

10 The most advanced method consists of introducing the inoculation alloy into the die itself, so that the contact with the liquid occurs in a reducing atmosphere.

For this purpose the alloy is used in grains arranged in adapted seats provided inside the die or mould, or in a  
15 compact and geometrically defined form, usually in the shape of a truncated cone, arranged in the dome at the base of the pouring channel.

The use of grains, besides affecting negatively the casting/spray yield due to the volume required by the seat,  
20 entails dangers of entrainment of said grains, which cause undesirable inclusion conditions.

Alloys in the shape of a truncated cone, instead, do not start dissolving upon contact with the first part of the liquid metallic compound introduced, and this depends on the  
25 thermal conductivity and on the specific heat of the inoculation alloy which requires some time to reach melting point.

If the truncated-cone insert is furthermore provided on the surface with an even partial oxidation state (this being  
30 a constant intrinsic aspect of the manufacturing process of

any alloy which has to be obtained in a defined geometric shape), the instant at which the inoculant starts to melt is delayed further, and the first part of cast iron to be poured will consequently not be inoculated.

5       The main aim of the present invention is to eliminate the disadvantages of the prior art techniques of inoculation, by providing a process which allows to obtain cast parts which are free from gas inclusions or from degassing alloy, and, that is, free from defects.

10       Still another object of the present invention is to provide a process which, besides allowing the inoculation treatment, also allows to perform all the treatments of liquid metals and alloys with solid treatment agents, for example refining treatments for non-ferrous alloys or of  
15 filtering during the refining of pure metals or of their master alloys, with direct economic advantages on the yield of the finished product.

      A further object of the present invention is to provide the above described processes in a technologically simple  
20 and economic manner.

      Finally, a further object of the invention is to provide a device for performing the process according to the present invention.

      This aim, these objects and others which will become  
25 apparent hereinafter are achieved by a process for the degassing, refining or filtering treatment of metals or alloys, wherein during the die-casting of a said liquid metal or alloy, the same is treated with a solid treatment agent, characterized in that it comprises the steps of  
30 providing the treatment agent in the form of solid granules

in a closed container having two counterposed walls in the shape of perforated diaphragms, with holes having such dimensions as to retain said granules, and having further lateral walls; interposing said container in the path of the  
5 metallic liquid in the pouring channel wherein it is poured; and passing said metallic liquid through said container through said diaphragms to make contact with said treatment agent in said container.

In one of its further aspects, the present invention  
10 relates to an auxiliary apparatus for devices for forming by casting of metals and alloys, said apparatus being intended for the treatment of said liquid metals with a solid treatment agent, and being characterized in that it comprises a closed container having two counterposed walls  
15 in the shape of perforated diaphragms and further lateral walls, said container being adapted to contain said treatment agent in the form of solid granules, the holes of the diaphragms being such as to allow the passage of the liquid metal but not to allow said granules to leave said  
20 container, said auxiliary apparatus being removably positionable in a device for forming by casting, upstream of the actual dies or moulds wherein said metallic materials are cast and subsequently solidified.

The invention will become apparent from the following  
25 detailed description, given with reference to the accompanying drawings, wherein:

Figure 1 is a vertical cross section view of the closed container which provides the apparatus according to the present invention;

Figures 2 and 3 illustrate the perforated diaphragms, respectively lower and upper, of the closed container of figure 1;

5 Figure 4 is a view of a possible arrangement of the device according to the invention in a pouring channel; and

Figure 5 is a view of the apparatus according to the invention, adapted for use with a device for casting into vertical moulds.

10 The process according to the invention is provided by inserting, directly into the casting channel, a container 1, for example cylindrical (figure 1) and closed at the two bases by diaphragms 2a and 2b (figs. 2 and 3).

15 The diaphragms are provided with holes 3 the diameter whereof is calculated, for the upper one 2b, that is to say for the one arranged upstream with respect to the flow of metallic liquid, so as to prevent the outflow of the granules of treatment agent, which in the case of the silicon alloy used in inoculation, due to their lesser density with respect to cast metal, tend to rise.

20 For the lower diaphragm 2a, that is to say for the one arranged downstream, the holes have dimensions according to the ideal flow rate for the filling of the mould in a specific amount of time.

25 The passage section of the lower filter is preferably smaller than the upper one so as to create a condition of overpressure inside the cylindrical tube.

30 The container of the granules of treatment agent can be removably inserted in the pouring channel 4, where its supporting seat (fig. 4) is preferably provided at the base of said channel at the connecting midpoint of the mould with

a shoulder 6 with adequate dimensions on the edge of the dome facing the pouring basin 5.

5 This system, indicated by way of non-limitative example, allows to insert the cylindrical container 1 easily both manually and with automatic devices, even in the case of horizontal castings.

10 In the case of casting into vertical moulds (Fig. 5), the seat of the cylindrical container is provided below the pouring tray 6 along the main feed channel 7 and in this case the support of the container has a volume equal to the unit of the volume of said container for each pour. Current automatic devices can be used for the accommodation, and a slight pressure when inserting the container is sufficient to ensure stability before the joining of the two vertical  
15 parts 8a and 8b of the mould 8.

The container according to the invention, as described and arranged in the provided manner, solves, by virtue of its fluid-dynamic configuration, the problem of free gases contained in the metallic flow when the same is introduced  
20 into a mould, as well as of the absorption of external and internal air, and of humidity inside the mould.

These negative phenomena are favoured by conventional casting methods by the fact that the metallic flow introduced into the mould is in depression while it falls,  
25 freely so that it tends to retain and aspirate gases, causing possible chemical reactions with the metals or compounds in the die during solidification. According to the present invention, instead, due to the difference between the passage sections of the upper diaphragm and of the lower  
30 one, inside the container there is an overpressure which

facilitates the release of the dissolved gases.

In order to facilitate the evacuation of the gases expelled by the liquid metal, the upper diaphragm 2b is provided, on its peripheral regions, with grooves 9 which  
5 are not affected by the flow. The gases, which tend to escape upwards, are then absorbed by the porosity of the die.

The possibility to operate similarly on the lower diaphragm 2a or on the walls of the cylinder, that is to  
10 say, to provide grooves also on the lower diaphragm or to provide on the lateral walls of the container 1 both porosities which are intrinsic to the material employed for its manufacture and holes produced artificially, is also advantageously provided.

15 The present invention also extends both to other possible forms of the container, be they in the shape of a truncated cone, square, and by extension to any geometrical form adapted to be accommodated in the pouring channel or in another part of the die, and to the material whereof the  
20 diaphragms and the lateral wall are made.

The diaphragms can be ceramic or of any other natural or artificial refractory product capable of resisting and ensuring a flow of liquid metal at the melting points thereof.

25 The walls of the container 1 can be of ceramic, cardboard or any other natural or artificial product capable of ensuring the life and dimensional stability of the container and the stability of the diaphragms for the period of filling of the die at the temperature of the flow of  
30 liquid metal introduced to fill the latter.



In order to achieve an inoculation treatment inside the container, inoculating alloys are introduced, appropriately selected according to the type of metallurgy, in rough granulometry 10 freshly crushed and therefore free from oxidation, quantitatively calculated according to the volume  
5 of the container and so as to offer a wide surface of contact to the flow of metal, so that the dissolution of the alloy in the metal occurs from the beginning and subsequently gradually and uniformly for the time required  
10 to fill the mould or die.

The double diaphragm and an adequate granulometry of the alloy avoid the phenomenon of entrainment and the rise of the granules in the upper part of the casting channel.

The process according to the invention can be  
15 advantageously employed in the metallurgy of non-ferrous alloys or in the refining thereof, replacing the silicon alloys with granules or small blocks of salts commonly used for degassing or refining, such as hexachloroethane salts or potassium fluorides.

20 In this manner, besides the usual beneficial effect of an intervention a short time before solidification in a reducing environment, there is also the advantage of the evacuation of the exhaled gases, sometimes undoubtedly harmful, through the grooves 9 provided on the diaphragms 2a  
25 and 2b to allow them to be absorbed by the porosity of the mould or die.

The container according to the present invention can also be conveniently inserted in machines for pressure forming by means of shell casting. Gas collection is in this  
30 case ensured by a tubular conduit arranged above the

container which conveys the fumes towards an aspirator.

5 The process and the related apparatus according to the invention can be advantageously used as a filtering system by inserting, as solid treatment agents 10, in appropriate granulometry, mineral filtering elements, such as, by way of non-limitative example, wood coal, silica gel or whatever is naturally or artificially produced with adapted absorption characteristics.

10 This is particularly advantageous to eliminate non-metallic impurities during the refining of the pure metals or of their master alloy.

The following examples are intended to further illustrate the invention, without however having any limitative effect on the manner of its application.

15 EXA. PLE 1

A cast iron foundry, specialized in the manufacture of brake drums for tractors having the peculiarity of being provided with a considerable variation in thickness, suffered a reject rate of 20-30%. These rejects were due to the presence, in the thick portions, of dendritic cavities presumably originated by the presence of gases trapped during the closing of the dendritic needles in the pasty phase.

25 The container for the treatment agent, according to the invention, was provided with a cylindrical cardboard tube, 2 mm thick, the upper part whereof was closed with a conical ceramic diaphragm provided with 18 holes of 8-mm diameter. Eight grooves on the edge of the diaphragm ensured the escape of the gases, while the lower part was closed with a

ceramic diaphragm with 45 holes of 3.5 mm diameter. A paper bag, containing 30 g of In-Gor alloy at 1-10 mm granulometry and consisting of silicon iron in the proportion of 75% silicon with the addition of a total of 0.5% of selenium  
5 bromine iodine in ionic form by activated chemical absorption, was placed inside. For comparison, a corresponding number of brake drums, manufactured according to the foundry's conventional process of inoculation in the ladle, was cast using the same cast iron from an electric  
10 furnace.

The casting times for the two ladles were assessed at 19" for each cast part.

The brake drums treated with inoculation by means of the container of treatment agent according to the invention,  
15 appropriately cross sectioned in the point of greatest thickness where the preceding anomalies were located, showed no defects.

On the contrary, the brake drums treated according to the conventional process, appropriately cross sectioned in  
20 the same point as the first ones, all showed more or less considerable dendritic cavities.

#### EXAMPLE 2

In an aluminium foundry which casts in sand according to the Pep Set system, starting partly from scrap and partly  
25 from ingots, dehydrogenation is usually performed by introducing hexachloroethane in the oven after melting is achieved. This use causes the evacuation of malodorous gases which are irritating for the operators. The cast parts have a variable amount of porosities due to hydrogen leaks, and

this defect leads to rejects.

By way of demonstration, the pouring channels were fitted with a double-diaphragm container, wherein a piece of a hexachloroethane cube was placed. During the casting, no  
5 presence of malodorous and irritating gases was detected, this being an indication that the sand of the mould had collected and retained them; moreover, all the parts cast appeared to be free from porosities.

### EXAMPLE 3

10 It is known that casting ingots or master alloys of aluminum obtained by recasting of selected scrap have the peculiarity of containing variable proportions of alumina, which cannot be eliminated in the course of the subsequent smeltings which are performed to obtain the flask casting or  
15 shell casting of parts.

This disadvantage is eliminated by arranging, in the flask or shell which is to receive the aluminum casting, the double-diaphragm container, containing, besides hexachloroethane, an appropriate amount of OXY grains  
20 essentially containing silica gel.

These are able to absorb the alumina spray, freeing the cast parts from the presence of hard points due, indeed, to  $Al_2O_3$ .

CLAIMS

1        1. Process for the degassing, refining or filtering  
2 treatment of metals and alloys, wherein, during the casting  
3 in a die of a said metal or alloy in the liquid state, the  
4 same is treated with a solid treatment agent, characterized  
5 in that it comprises the steps of providing the treatment  
6 agent in the form of solid granules (10) in a closed  
7 container (1) having two counterposed walls in the shape of  
8 perforated diaphragms (2a, 2b), with holes having such  
9 dimensions as to retain said granules, and having further  
10 lateral walls; interposing said container (1) in the path of  
11 the metallic liquid in the pouring channel (4) wherein it is  
12 cast; and passing said metallic liquid through said  
13 container (1) through said diaphragms (2a, 2b) to make  
14 contact with said treatment agent (10) in said container  
15 (1).

1        2. Process for the degassing or inoculation of cast  
2 iron or steel by inoculation in said metals in the liquid  
3 state of a silicon alloy adapted to react with the gases  
4 contained in said metallic liquids, characterized in that it  
5 comprises the steps consisting of providing said silicon  
6 alloy in the form of solid granules (10) in a closed  
7 container (1) having two counterposed walls in the shape of  
8 perforated diaphragms (2a, 2b), with holes having such  
9 dimensions as to retain said granules, and having further  
10 lateral walls; interposing said container in the path of  
11 said metallic liquids in the pouring channel (4) wherein  
12 they are cast; and passing said metallic liquids through  
13 said container through said diaphragms to make contact with  
14 said silicon alloy contained therein.

1           3. Process for the degassing or refining of non-ferrous  
2 alloys by means of their treatment in the liquid state with  
3 salts adapted for degassing or refining, characterized in  
4 that it comprises the steps consisting of providing said  
5 salts in the form of solid granules (10) in a closed  
6 container (1) having two counterposed walls in the shape of  
7 perforated diaphragms (2a, 2b), with holes having such  
8 dimensions as to retain said granules, and having further  
9 lateral walls; interposing said container in the path of the  
10 metallic liquid in the pouring channel (4) wherein it is  
11 cast; and passing said metallic liquid through said  
12 container through said diaphragms to make contact with said  
13 salts in said container.

1           4. Process for the refining of pure metals or of their  
2 master alloys, wherein said metals in the liquid state are  
3 filtered through mineral filtering elements, characterized  
4 in that it comprises the steps consisting of providing the  
5 filtering elements in the form of solid granules (10) in a  
6 closed container (1) having two counterposed walls in the  
7 shape of perforated diaphragms (2a, 2b), with holes having  
8 such dimensions as to retain said granules, and having  
9 further lateral walls; interposing said container in the  
10 path of the metallic liquid in the pouring channel (4)  
11 wherein it is cast; and passing said metallic liquid through  
12 said container by means of said diaphragms to make contact  
13 with said filtering elements in said container.

1           5. Process according to any one of the preceding  
2 claims, wherein said closed container is provided with a  
3 first said perforated diaphragm (2b), arranged upstream with  
4 respect to the direction of the flow of said metallic

5 liquid, with a total cross section of the holes greater than  
6 the total cross section of the holes of said second  
7 diaphragm (2a) arranged downstream to create an overpressure  
8 of the metallic fluid inside said closed container.

1       6. Process according to any one of the preceding  
2 claims, wherein said closed container comprises, on at least  
3 one of said diaphragms, grooves (9) for the expulsion of the  
4 gases developed by said metallic liquid, arranged on a  
5 peripheral area of the diaphragm not affected by said flow.

1       7. Process according to claim 6, wherein said closed  
2 container furthermore comprises said lateral walls provided  
3 with vents for the release of said gases.

1       8. Process according to any one of the preceding  
2 claims, wherein at least the perforated diaphragms of said  
3 container are in refractory material.

1       9. Auxiliary device for apparatus for forming by  
2 casting of metals and alloys, said apparatus being intended  
3 for the treatment of said metals in the liquid state with a  
4 solid treatment agent, characterized in that it comprises a  
5 closed container (1) having two counterposed walls in the  
6 shape of perforated diaphragms (2a, 2b), and further lateral  
7 walls; said container being adapted to contain said  
8 treatment agent in the form of solid granules (10), the  
9 holes of the diaphragms being such as to allow the flow of  
10 the metals in the liquid state but not the release of said  
11 granules from said container, said auxiliary device being  
12 removably arrangeable in a said apparatus for forming by  
13 casting in said pouring channel (4) of said apparatus.

1       10. Device according to claim 9, wherein the holes of  
2 the diaphragm (2b) arranged in use upstream with respect to

3 the direction of flow of said metals in the liquid state  
4 have a total cross section which is greater than the cross  
5 section of the holes of the diaphragm (2a) arranged  
6 downstream.

1 11. Device according to claim 9, wherein at least one  
2 of said perforated diaphragms comprises grooves (9) for the  
3 release of gas arranged on a peripheral region of the  
4 diaphragm which in use is not affected by the flow of the  
5 metals in the liquid state.

1 12. Device according to claim 9, wherein at least said  
2 diaphragms are made of refractory material.

1 13. Device according to claim 9, wherein said closed  
2 container comprises a cylinder having the bases consisting  
3 of said perforated diaphragms in ceramic material and the  
4 lateral walls made of cardboard.



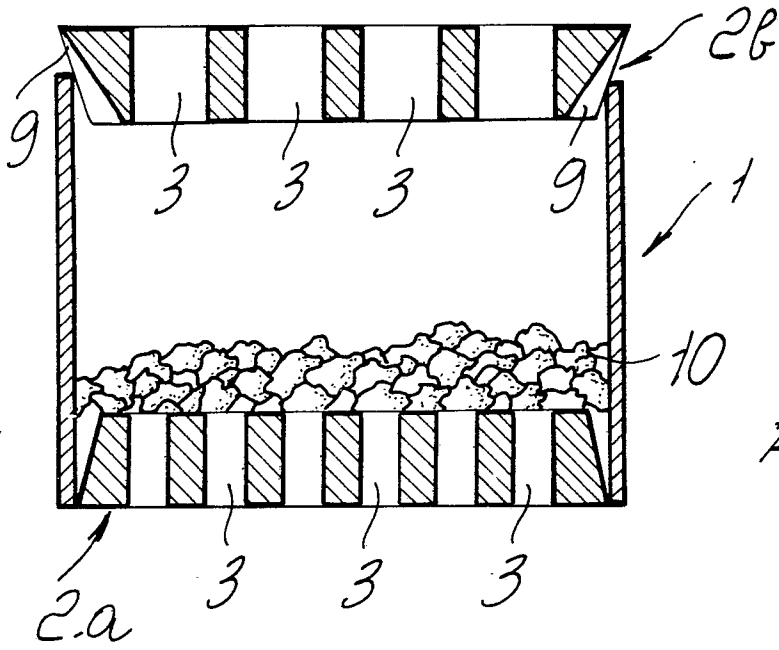


Fig. 1

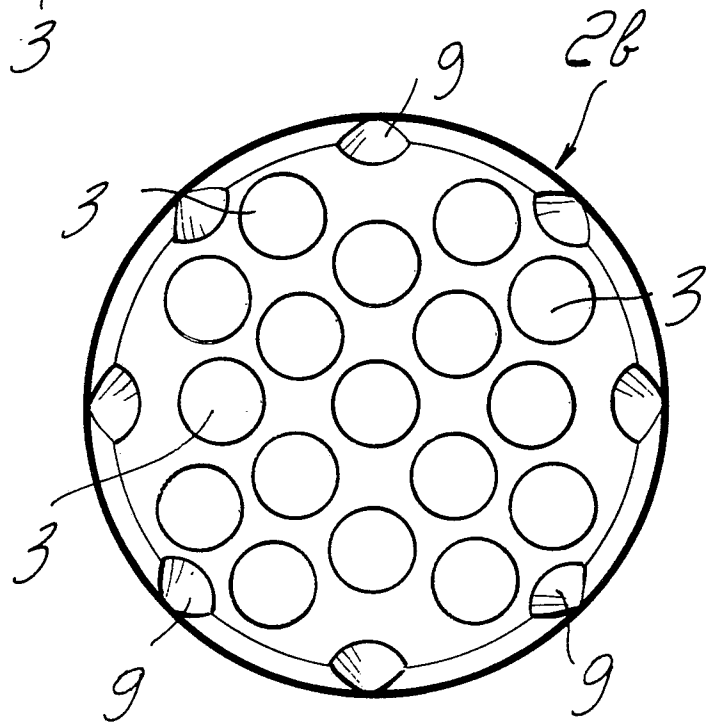


Fig. 3

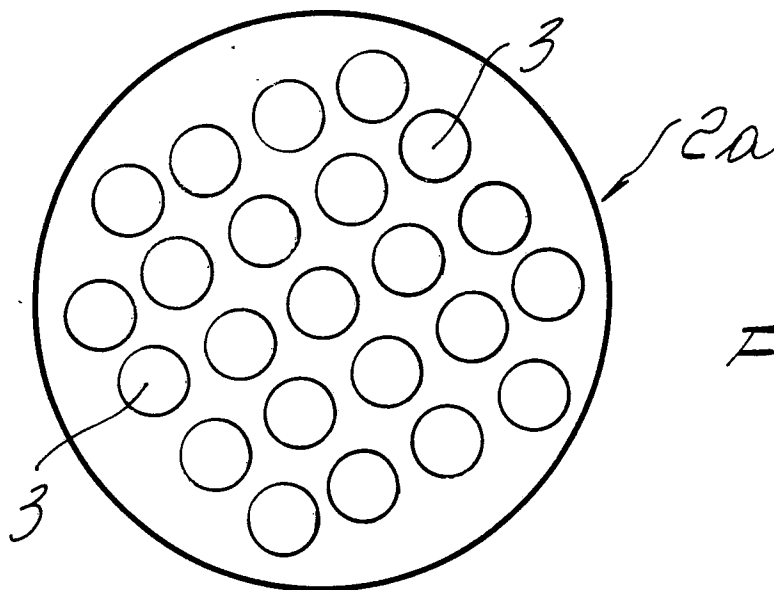


Fig. 2

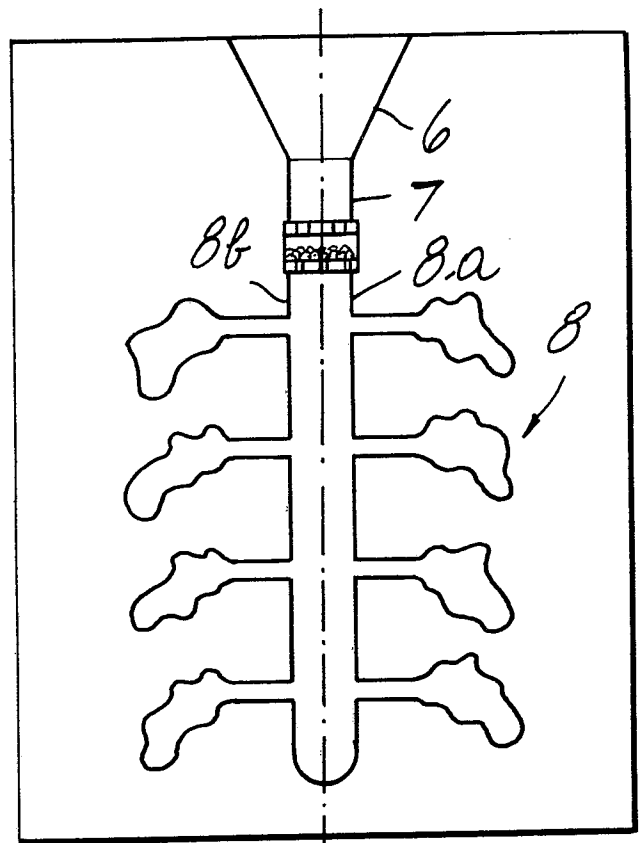
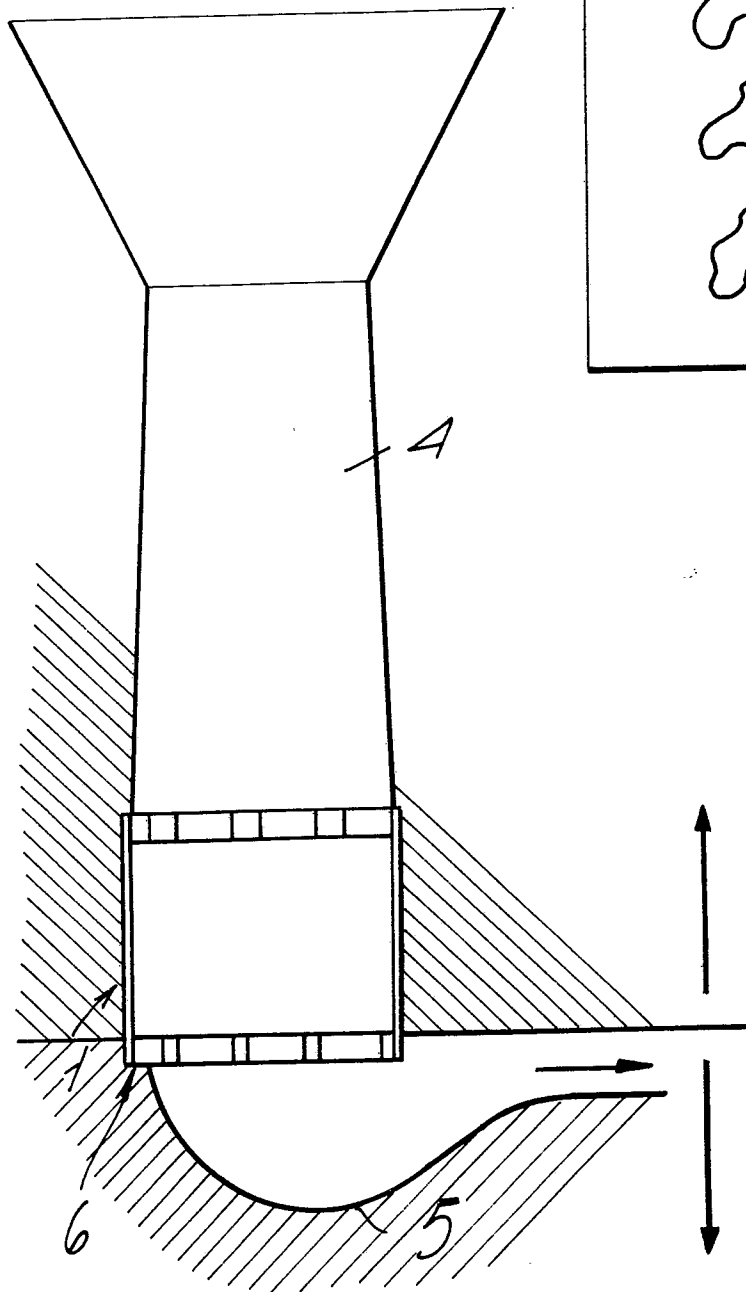


Fig. 5

Fig. 4



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
Y	EP-A-0 032 282 (MATERIALS AND METHODS) * Abstract; figure; claims *	1,9	C 21 C 1/10 B 22 D 1/00 B 22 C 9/08
Y	EP-A-0 011 478 (THE INTERNATIONAL MEEHANITE) * Abstract; figure 1 *	1,9	
A	US-A-3 658 115 (RYNTZ Jr. et al.)		
A	FR-A-2 219 231 (STETTNER)		
			TECHNICAL FIELDS SEARCHED (Int. Cl. 4)
			C 21 C B 22 D B 22 C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 06-10-1987	Examiner OBERWALLENEY R.P.L.I
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		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	