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(54) **DISTRIBUTOR FOR STEEL CASTING**

VERTEILER ZUM STAHLGIESSEN

DISTRIBUTEUR POUR LA COULÉE D'ACIER

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EP 2 965 838 B1

Description

Field of the invention

[0001] The present invention relates to a distributor for steel casting, for the use thereof in obtaining steel ingots produced via the casting plate mould system, made such that it enables the defects due to the impurities that may affect special steels to be reduced.

Background of the invention

[0002] Currently, mould casting consists of casting the molten metal from a ladle, once the metallurgy is completed, over a vertical refractory duct (formed by an initial piece referred to as a pouring basin and a succession of down runners), which conducts the molten metal to a refractory distributor (referred to as a brick) that is situated on the casting plate on which the ingots are arranged. A number of tubes (referred to as through-tubes) come out of this distributor, and they conduct the molten metal until it is situated below each one of the ingots. The last tube (final or stop tube) has a small vertical conduit with which it enables the molten metal to enter through the base of the mould.

[0003] In this regard, a distributor is known comprising a chamber equipped with a central inlet opening at the base thereof, to which a vertical tube for supplying molten metal is connected, and a series of radial outlet ducts on the side wall thereof, to which other respective tubes that conduct molten metal are connected.

[0004] The molten steel is freed from the ladle by the closure through which a stream falls at a speed defined by the filling level of the molten metal inside the ladle. The molten metal in the vertical duct accelerating due to the effect of gravity until it hits the bottom of the distributor at a speed of approximately 10 m/s (in the most common conditions). The impact of the steel with the bottom of the distributor causes energy to be released, which translates into the erosion of the inner surfaces of the refractory.

[0005] The speed of the molten metal through the horizontal channels maintains almost the same speed with which it reached the distributor. This creates a large amount of mechanical friction on the refractory duct, with the resulting wear on the surface, which causes the inclusion of impurities in the cast steel.

[0006] The quality of the steel is conditioned by the impurities included in the process for obtaining ingots during the casting process.

[0007] These impurities have several origins, among which the main ones are:

- Slag in the molten metal situated in the ladle before casting.
- Refractory material that is carried along during the casting process through the refractory conduits that take the molten metal to the mould.
- Oxidisation of elements of the molten metal due to being exposed to oxygen in the atmosphere.

[0008] The fundamental moment of the casting process is at the start thereof, when the closure of the ladle that stores the cast steel is opened. The molten metal falls through the vertical tube, reaching a speed of approximately 40 kms/h, and thus producing a considerable impact on the distributor. Due to the traditional configuration of this distributor, edges or weak points form at the intersection of the radial ducts with the chamber, which give rise to the erosion on the same that is carried by the molten metal and is the cause of significant inclusion in the resulting steel.

[0009] In the current design, after the first impact on the distributor, the flow is projected through the through-tubes almost without losing speed. Due to the speed that gravity has transmitted to it, the Froude number for the flow at this point is greater than one, thus meaning it is a supercritical flow. This fact means it is inevitable that a hydraulic jump is caused in the area comprised between the through-tubes, stop tubes and the mould inlet. The main feature of the hydraulic jump is air being trapped, which results in the oxidisation of the cast steel. Furthermore, the high speed of the flow through the through-tubes pushes the air in the through-tubes themselves towards the mould, this airflow lifting the coating powder that is situated at the bottom of the mould precisely to prevent the oxidisation of the steel when it enters the mould. All these facts increase inclusions in the steel.

[0010] US 1,757,549, US 1,533,067 and FR 2 767 082 disclose refractory distributors which use a sump or an impact member to reduce the flow speed of the molten metal.

Description of the invention

[0011] The object of the present invention is to provide a refractory distributor made such that it prevents the slag already present in the ladle from reaching the mould, furthermore reducing the erosion and displacements of the refractory ducts to a minimum and limiting the oxidisation phenomenon that is produced during conducting itself and when entering the mould.

[0012] The distributor of the invention is of the type described above, made up of a chamber equipped with a central intake opening at the base thereof, to which a vertical tube for supplying molten metal is connected, whilst on the side wall it is provided with a series of radial outlet ducts, to which other molten metal duct tubes are connected.

[0013] In accordance with the invention, the chamber of the distributor has a greater diameter than the vertical duct for supplying molten metal and is situated above the radial outlet ducts, to which it is connected through vertical passages that originate from the bottom of the chamber and each one opens onto each radial duct.

[0014] According to another feature of the invention,

the chamber of the distributor has a central hollow at the bottom that is closed at the sides and below and forms a vessel, which is open at the upper base thereof, with a diameter approximately equal to that of the vertical tube for supplying molten metal.

[0015] With the make-up described, the weak points of the traditional distributors at the intersection between the radial outlet tubes and the chamber of the distributor are removed. In the distributor of the invention, there are no edges with a reduced thickness constituting weak points that are easily eroded by the flow of molten metal.

[0016] In the distributor of the invention, the chamber has a horizontal cross section that is at least equal to and preferably greater than the sum of the transversal cross sections of the radial ducts.

[0017] As such, in the distributor of the invention, the molten metal that falls through the vertical tube loses practically all its speed when it reaches the vessel, without exiting the distributor. This causes the hydraulic jump to occur inside the distributor itself. Due to the inner make-up of the distributor of the invention, with the vessel, the chamber situated above the radial outlet ducts and the connection labyrinth between the radial outlet tubes and the chamber, the distributor even acts as a filter from the moment of the initial impact. The reduction in speed caused by preventing it to continue and the increasing the cross section of the chamber, means that the inclusions can return upwards, due to being less dense than the cast steel, instead of continuing towards the mould with the steel.

Brief description of the drawings

[0018] A non-limiting exemplary embodiment is shown in the accompanying drawings, which will enable a better understanding of the features and advantages of the invention via the description thereof.

[0019] In the drawings:

- Figure 1 shows a plan view of a traditional installation for mould casting.
- Figure 2 shows a vertical cross section of the same installation according to the cross-section line II-II in figure 1.
- Figure 3 is a horizontal cross section of the distributor including the installation in figures 1 and 2.
- Figure 4 shows a side elevation view of the distributor of the invention.
- Figure 5 is an upper plan view of the distributor in figure 4.
- Figure 6 is a horizontal cross section of the distributor of the invention, taken according to the cross-section line VI-VI in figure 4.
- Figure 7 is a cross section of the distributor of the invention, taken according to the cross-section line VII-VII in figure 5.
- Figure 8 shows a perspective view of the same cross section in figure 7.

Detailed description of an embodiment

[0020] Figures 1 and 2 show a traditional mould casting installation, in which the molten metal is poured from a ladle (not shown) over a vertical refractory duct (1), which is formed by an initial pouring basin (2) and a succession of down runners (3). This vertical duct (1) conducts the molten metal to a refractory distributor (4), which forms a chamber (5) from the wall of which a series of radial ducts (6) originate, to which tubes (7) are connected that conduct the molten metal until it is situated below the moulds, where they may be finished in an inlet bend (8) at the bottom of the mould.

[0021] The molten metal poured into the pouring basin (2) reaches a relatively high speed through the vertical tube (1), thus producing an impact on the distributor (4) that causes a certain amount of erosion on the same. This effect is increased by the inner geometry of the distributor (4) due to the fact that the opening of the radial ducts (6) in the chamber (5) delimits edges (9), figure 3, between consecutive ducts (6), which constitute easily eroded weak points, creating materials that are carried by the molten metal and that are the cause of significant inclusions in the resulting steel.

[0022] Another negative effect of the geometry of the distributor in figures 1 to 3 is, as stated above, the hydraulic jump produced between the end of the horizontal tubes (7), the bend (8) and the bottom of the mould, which causes air bubbles to be trapped, in turn producing the oxidisation of the cast steel. Furthermore, the high speed of the flow through the horizontal tubes (7) pushes the air in the tubes themselves towards the mould, lifting the coating powder that is situated at the bottom of said mould to prevent the oxidisation of the steel.

[0023] The drawbacks caused by the distributor shown in figures 1 to 3 are removed with the distributor (10) of the invention, shown in figures 4 to 8.

[0024] This distributor (10) comprises a chamber (11) with a central inlet mouth (12) to which the vertical tube (13) for supplying molten metal is connected. As may be seen in figures 7 and 8, the chamber (11) has a larger diameter than the vertical duct (13) for supplying molten metal.

[0025] The distributor (10) is provided with a central hollow (14) at the bottom thereof, which is closed at the sides and below and forms a vessel (15), which is open at the upper base thereof, the diameter of which is approximately equal to the vertical tube (13) and the central inlet mouth (12). Radial outlet ducts (16), to which other respective tubes (17) for conducting the molten metal towards the mould are connected, originate from around the vessel (15). The radial ducts (16) are linked to the chamber (11) through the vertical passages (18) that originate from the bottom of the chamber (11) and open up below onto the radial ducts (16).

[0026] With the make-up described, the chamber (11) is situated above the radial ducts (16), which it is linked to through the vertical passages (18).

[0027] The chamber (11) has a cross section equal to and preferably greater than the sum of the transversal cross sections of the set of radial ducts (16).

[0028] With the make-up described and as may be seen in figures 6 to 8, no sharp edges are formed between the radial ducts, vertical passages (18) and the chamber (11) that may constitute easily eroded points.

[0029] Furthermore, the molten metal that reaches the distributor through the vertical tube (13) falls into the vessel (14), from where it overflows and passes to the radial ducts (16) through the vertical passages (18), thus considerably reducing the speed of the molten metal. This reduction in speed caused, along with the larger cross section of the chamber (11), means that the inclusions can return upwards, due to being less dense than the cast steel, instead of continuing towards the mould with the current of steel.

[0030] When the molten metal falls into the vessel (11) it forces the current of metal to rise until it reaches the chamber (11), thus reducing its kinetic energy.

[0031] Furthermore, with the make-up described it is made possible for the hydraulic jump to be produced in the centre of the distributor (10), due to the vessel (15) that receives the molten metal and overflows until the chamber (11) is reached.

[0032] Via the distributor of the invention, it is achieved that the forward-movement speed of the molten metal, towards the mould, depends on the flow and no the falling speed, thus achieving a reduction in the forward-movement speed of up to approximately three metres per second. This reduction in speed constitutes a reduction in friction between the current of molten metal and the surface of the refractory ducts, thus significantly reducing the risk of refractory material becoming detached as a result of the mechanical action of the flow.

[0033] Another effect of reducing the speed of the molten metal in the distributor is that the speed with which the air contained in the tubes (17) is freed towards the mould is substantially reduced.

Claims

1. A refractory distributor for steel casting comprising a chamber (11) equipped with a central inlet opening (12) at the upper base thereof, to which a vertical tube (13) for supplying molten metal is connected, and a series of radial outlet ducts (16) on the side wall thereof, to which other respective tubes (17) for conducting molten metal are connected, **characterised in that** the aforementioned chamber:

   - Has a greater diameter than the vertical duct (13) for supplying molten metal;
   - Is situated above the radial outlet ducts (16);
   - Is linked to the radial ducts (16) through the vertical passages (18) that originate from the bottom of the chamber (11), each one opening onto one of the radial ducts (16);
   - Has a central hollow (14) at the bottom that is closed at the sides and below and forms a vessel (15), which is open at the upper base thereof, with a diameter approximately equal to that of the vertical tube (13) for supplying molten metal.

2. The distributor according to claim 1, **characterised in that** the chamber (11) has a horizontal cross section that is at least equal to and preferably greater than the sum of the transversal cross section of the set of radial ducts (16).

Patentansprüche

1. Feuerfester Verteiler für Stahlgießen, umfassend eine Kammer (11), welche mit einer zentralen Einlassöffnung (12) auf der oberen Grundfläche derselben ausgerüstet ist, mit welcher ein vertikales Rohr (13) für die Zuführung von geschmolzenem Metall verbunden ist, und mit einer Reihe von radialen Auslassleitungen (16) auf der Seitenwand derselben ausgerüstet ist, mit welchen andere jeweilige Rohre (17) zur Leitung von geschmolzenem Metall verbunden sind, **dadurch gekennzeichnet, dass** die zuvor genannte Kammer:

   - einen größeren Durchmesser als die vertikale Leitung (13) für die Zuführung von geschmolzenem Metall aufweist;
   - über den radialen Auslassleitungen (16) liegt;
   - mit den radialen Leitungen (16) mittels der vertikalen Durchgängen (18), welche von dem Boden der Kammer (11) ausgehen, gekoppelt ist, wobei jeder in eine der radialen Leitungen (16) mündet;
   - auf dem Boden eine zentrale Ausnehmung (14) aufweist, welche seitlich und unten geschlossen ist, und ein Gefäß (15) bildet, welches an der oberen Grundfläche desselben offen ist, mit einem Durchmesser, der ungefähr gleich demjenigen des vertikalen Rohrs (13) für die Zuführung von geschmolzenem Metall.

2. Verteiler nach Anspruch 1, **dadurch gekennzeichnet, dass** die Kammer (11) einen horizontalen Querschnitt aufweist, welcher zumindest gleich und bevorzugt grösser als die Summe des transversalen Querschnitts des Satzes von radialen Leitungen (16).

Revendications

1. Distributeur réfractaire pour la coulée d'acier comprenant une chambre (11) équipée d'une ouverture centrale d'entrée (12) à sa base supérieure, à la-

quelle est relié un tube vertical (12) pour fournir du métal fondu, et une série de conduites radiales de sortie (16) sur sa paroi latérale, à laquelle sont reliés d'autres tubes (17) respectifs pour conduire le métal fondu, **caractérisé en ce que** ladite chambre :

- a un diamètre supérieur à la conduite verticale (13) pour fournir du métal fondu ;
- est situé au-dessus des conduits radiales de sortie (16) ;
- est relié aux conduites radiales (16) à travers les passages verticaux (18) qui proviennent du fond de la chambre (11) chacun s'ouvrant sur une des conduites radiales (16) ;
- a une cavité centrale (14) au fond qui est fermée sur les côtés et le dessous et forme un récipient (15), qui est ouvert sur sa base supérieure, avec un diamètre approximativement égal à celui du tube vertical (13) pour fournir du métal fondu.

2. Distributeur selon la revendication 1, **caractérisé en ce que** la chambre (11) a une section transversale horizontale qui est au moins égale à et de préférence supérieure à l'addition de la section transversale de l'ensemble de conduites radiales (16).

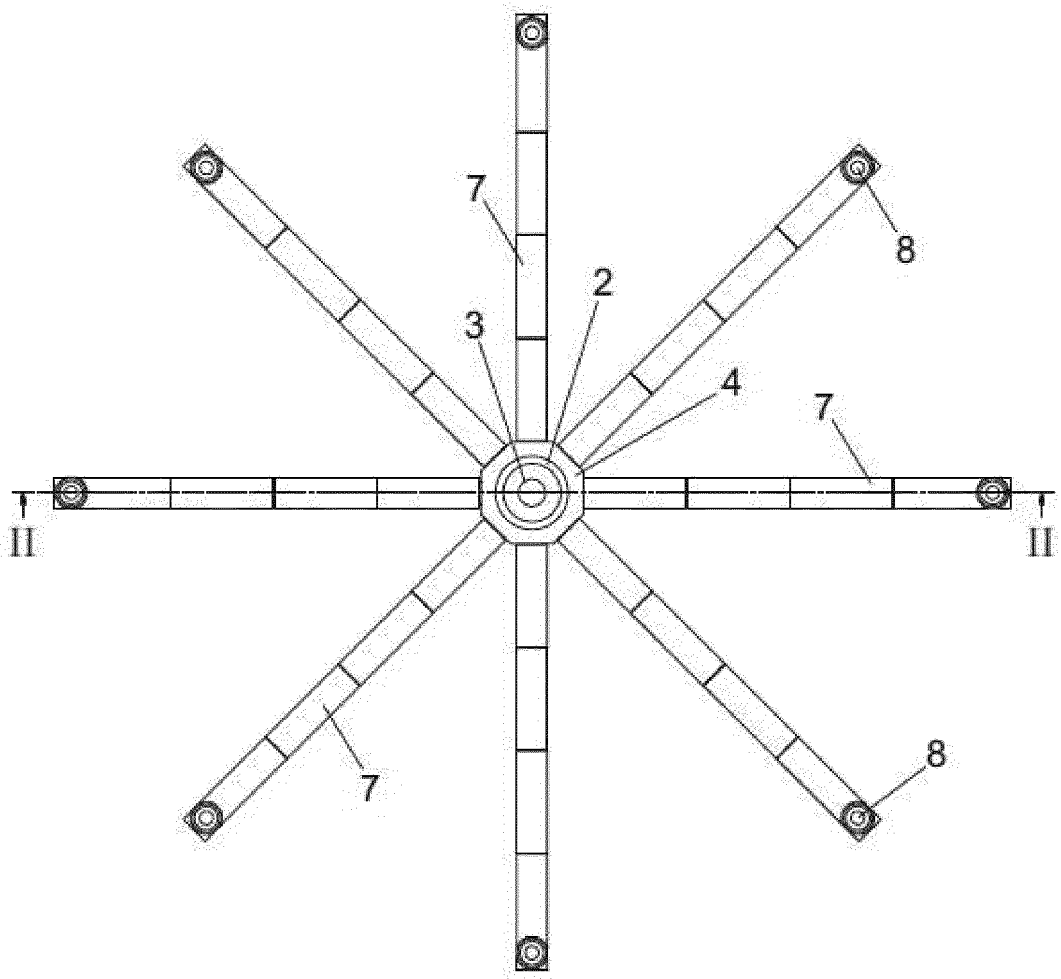


Fig. 1

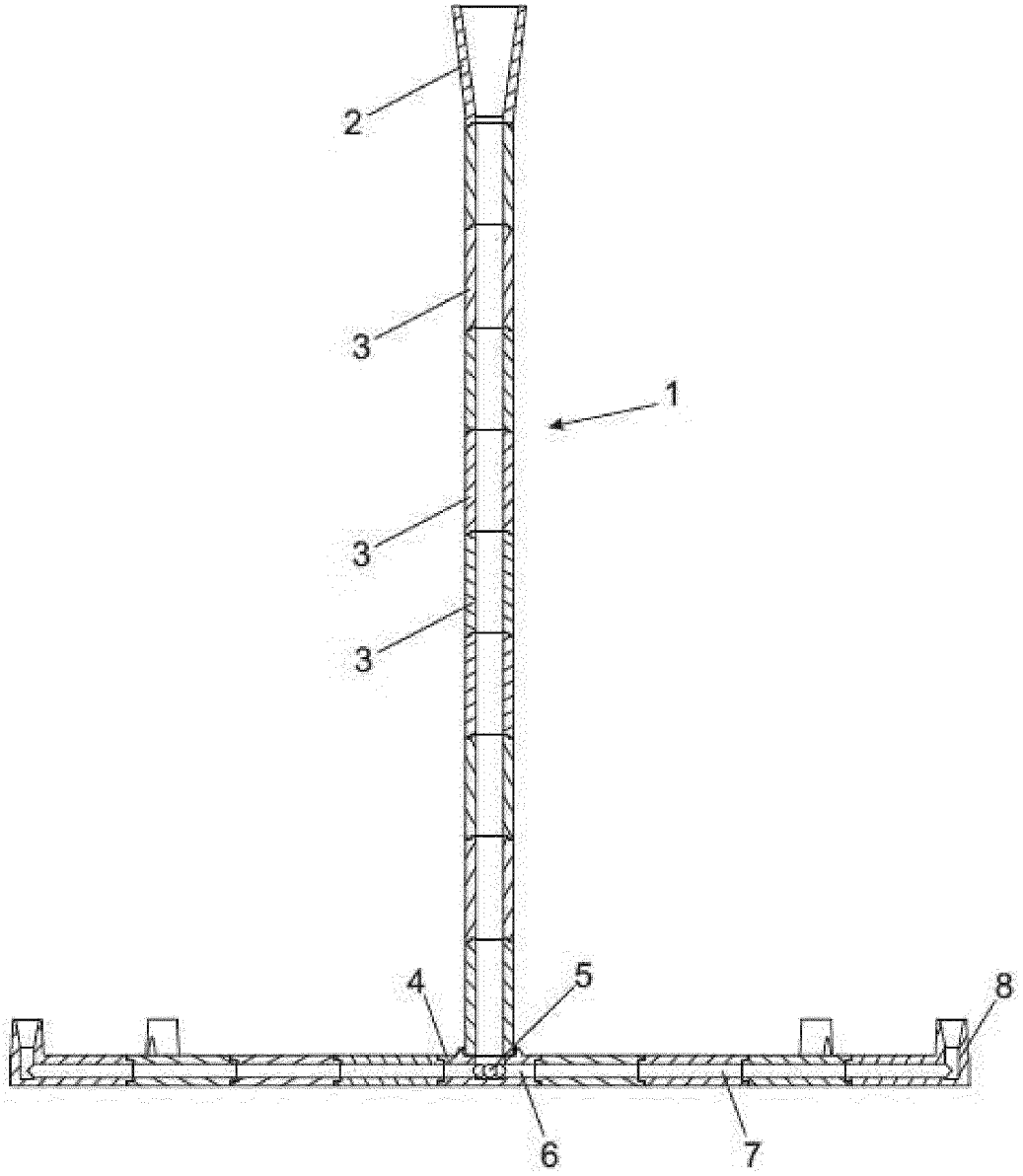


Fig. 2

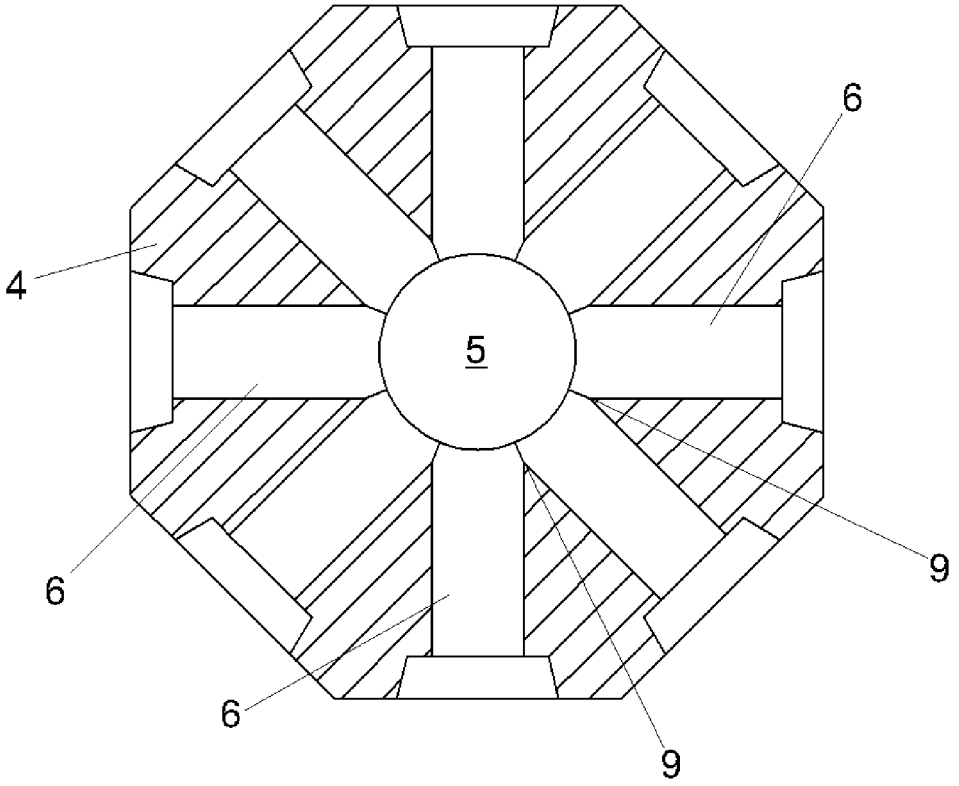


Fig. 3

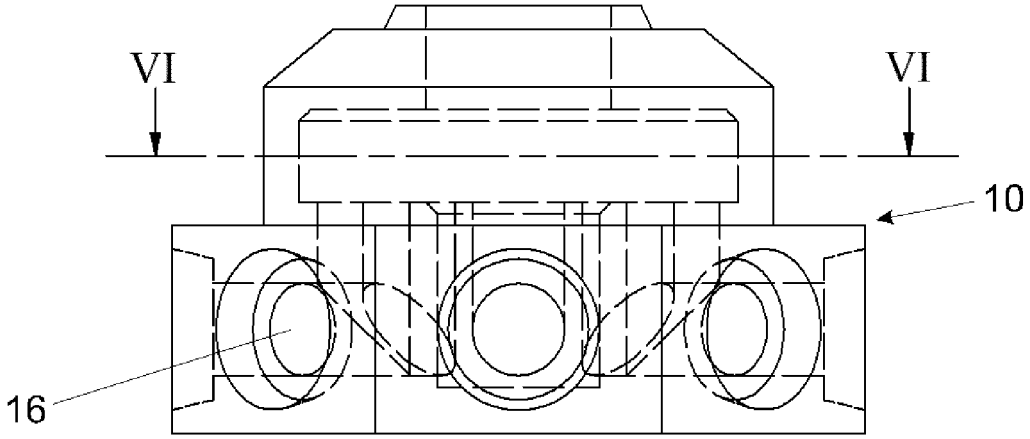


Fig. 4

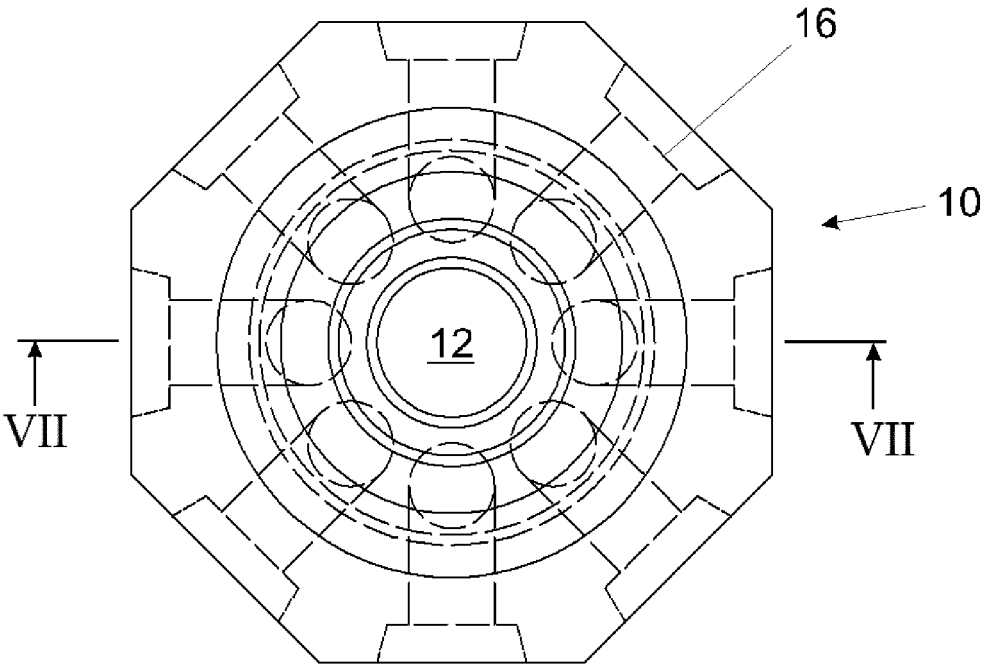


Fig. 5

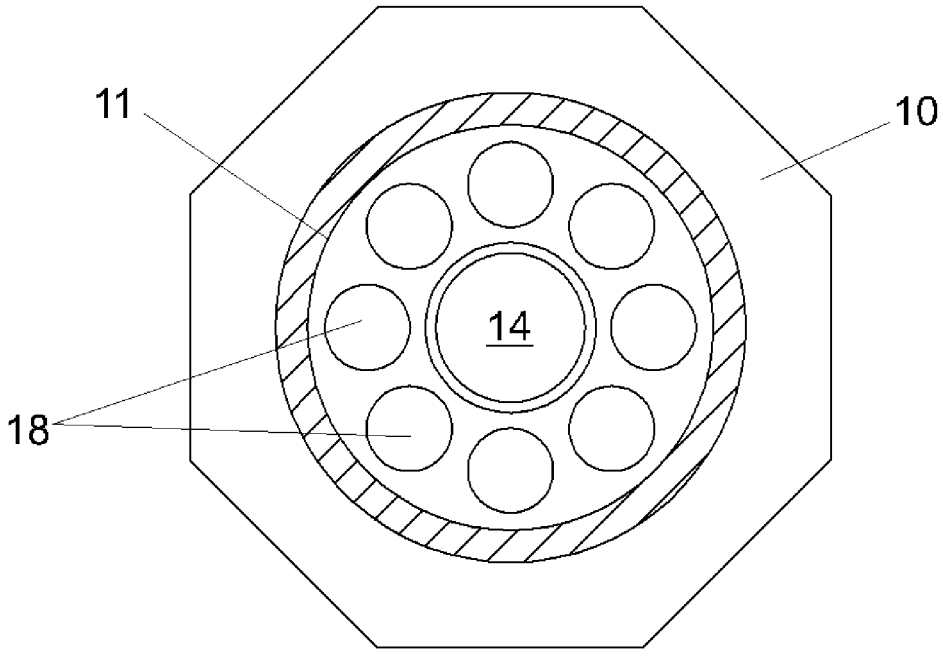


Fig. 6

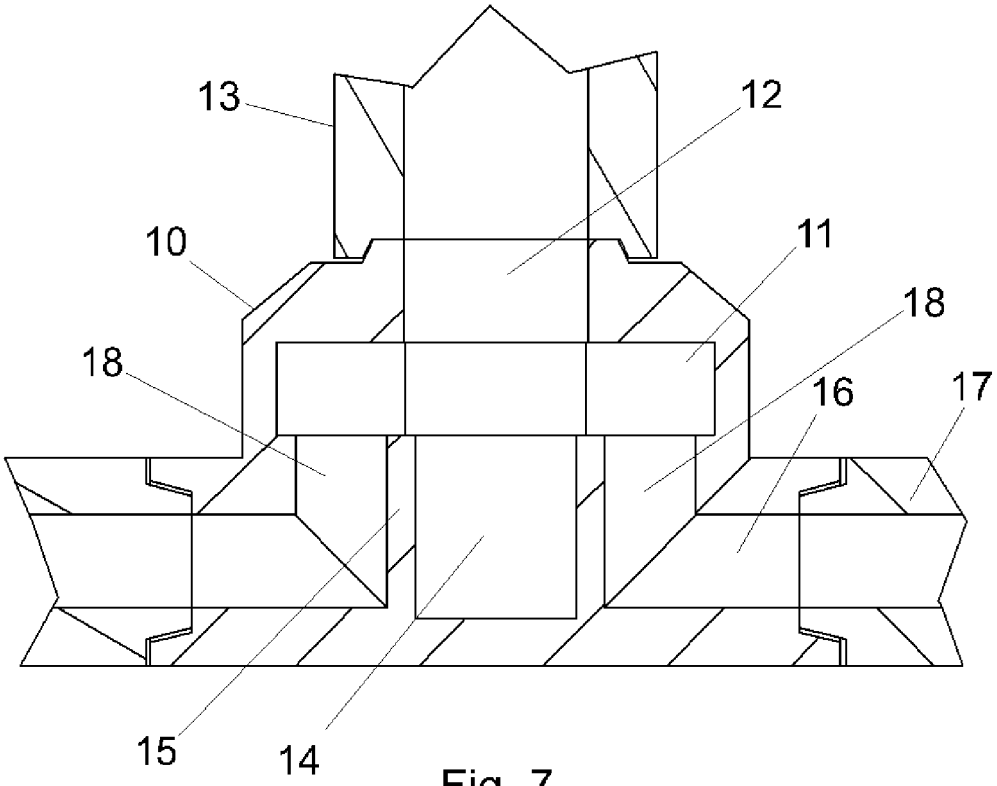


Fig. 7

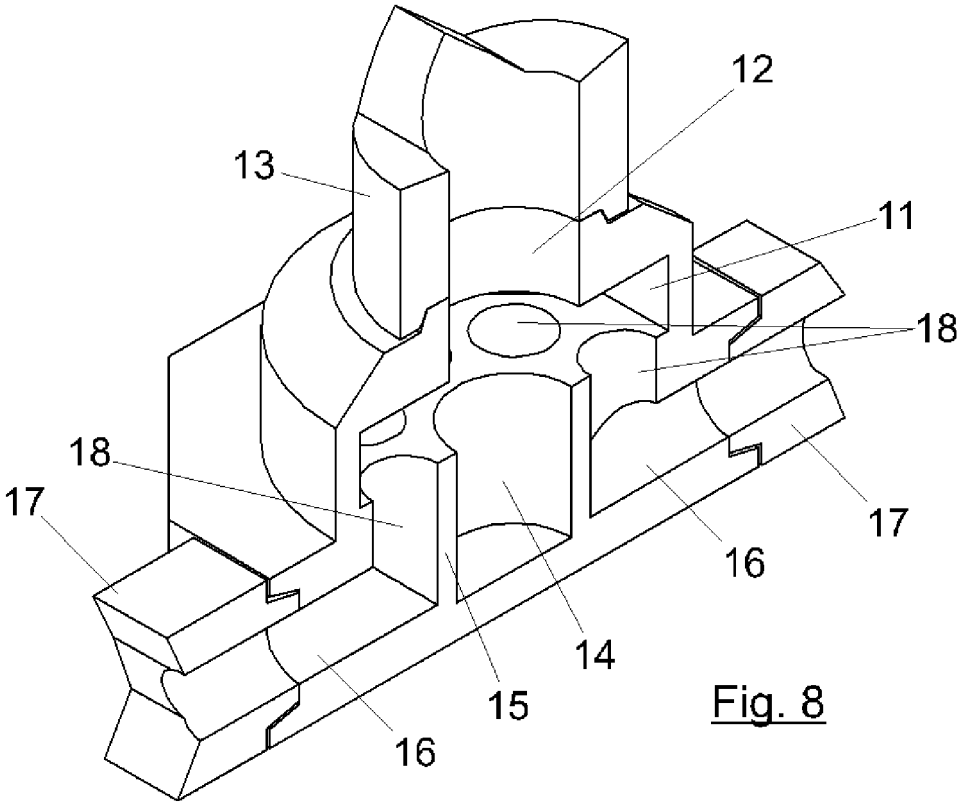


Fig. 8

REFERENCES CITED IN THE DESCRIPTION

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- US 1533067 A **[0010]**
- FR 2767082 **[0010]**