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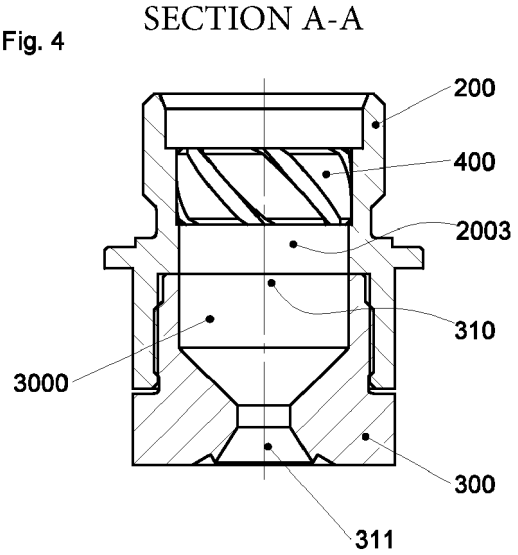
(54) **DISASSEMBLABLE ATOMIZER MOUTH OR NOZZLE**

(57) A nozzle (100) for dispensing an atomized fluid, said nozzle (100) comprising a first main hollow body (200) defining a first inner chamber (2000), said first main hollow body (200) comprising fixing means adapted to allow said first main hollow body (200) to be fixed to a main pipe or fitting (500), wherein, with said first main hollow body (200) fixed to said main pipe or fitting (500) said first inner chamber (2000) is in communication with introduction means of said main pipe or fitting (500) for introducing into said first inner chamber (2000) at least one liquid and at least one gas, wherein said nozzle (100) comprises a diffuser insert (400) accommodated in said first inner chamber (2000).

Fig. 4

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## Description

### Technical field of the invention

**[0001]** The present invention belongs to the field of dispensing atomized fluids for the purposes of cooling, in particular, for cooling fabricated metal products obtained by continuous casting. In particular, the present invention relates to an atomizer nozzle adapted to cool fabricated metal products, such as billets and/or the like during the solidification step defined as continuous casting. More specifically, an innovative mouth or nozzle adapted to be used for cooling fabricated metal products of the aforesaid type forms the subject of the present invention. Even more specifically, a mouth or nozzle of the aforesaid type adapted to be dismantled into several parts and thus facilitate maintenance, in particular, the cleaning of said several parts, forms the subject of the present invention. A system for dispensing atomized fluids also forms the subject of the present invention, said system comprising an innovative nozzle of the aforesaid type.

### Background art

**[0002]** The process of continuous casting developed successfully last century ,from the fifties, with the object of increasing the productivity of iron and steel plants for producing rough-shaped items made of steel, which had been made until then by means of the ingot casting method.

**[0003]** The principle of the continuous casting method is that of continuously casting liquid steel, turning it into solid bars after cooling and relative solidification. Various semi-finished products, such as slabs, blooms and billets are distinguished according to the dimensions reached by the bar, which semi-finished products are destined, in turn, for successive processing to obtain a finished iron and steel product.

**[0004]** Thus, continuous casting can be defined as an industrial production process, by means of which liquid material is pushed, by gravitational force, into an ingot mold (usually made of copper alloy) with the object of obtaining manufactured products having a predefined shape depending on the needs.

**[0005]** One of the main advantages offered by the continuous casting method is that of allowing the production, with contained costs and times, of finished section bars of a suitable shape adapted to allow the further processing thereof, for example, by means of rolling mills roughers and finishing rolling mills.

**[0006]** In order to implement the process, a container is usually used, which is also coated with a refractory material, the tundish, designed to receive the jet (casting) of molten steel from the ladle. The main task of the tundish is to keep an iron shutter - constant static, i.e. to ensure a regular outflow of the steel; in the case of several casting lines, the flow of steel is equally distributed among the various ingot molds.

**[0007]** The quality of the product is checked during the first steps of solidification, which take place in the ingot mold, a die made of copper alloy with forced water cooling, provided with an oscillating motion generated by a machine called an oscillator.

**[0008]** Thus, the heat is disposed of in the ingot mold mainly by the cooling water in forced circulation, wherein said cooling by means of water in forced circulation, and thus of the steel in the ingot mold, results in the formation of a solid film, called a skin or shell, the thickness of which increases along the ingot mold until reaching even about 3 cm. However, the material positioned more internally in the ingot mold remains liquid or semi-solid (mushing zone) for many meters along the casting descent path, wherein the state thereof depends on the casting speed and the thickness of the line. As soon as a shell with a sufficient thickness to contain the liquid steel solidifies, the casting line, with a partially solid bar (on the outside) and a partially liquid bar (on the inside), leaves the ingot mold and descends into the curved section. The time spent in the ingot mold is generally less than one minute. The thickness of the skin depends on the shape and size of the bar cross-section and for such requirements, the casting speed, i.e. the line advancing speed, varies from 0.5-1.8 m/min for slabs to 2-5 m/min for billets. The reason why the bar isn't cooled completely inside the ingot mold can be attributed to the fact that during the cooling the skin contracts (solidification shrinkage), wherein the ingot mold (bar)-line contact is lost, thus reducing the transmission efficiency of the heat (and thus of the cooling) due to the presence of a layer of air, which is interposed between the walls made of copper alloy of the ingot mold and the solid shell of the newly formed bar. After the cooling step by means of forced water circulation, the bars are further cooled during the curved descent path thereof with biphasic atomizers (liquid - gas), which allow a regular and uniform cooling along the whole perimeter of the bar.

**[0009]** The first cooling systems were made exclusively of water nozzles, whereas the use of an atomized fluid by means of special nozzles or mouths, called atomizers, has recently been introduced. A liquid (usually water) and a gas (usually air), are mixed by means of such atomizers so as to form a jet of atomized water particles, having a very fine drop diameter. This allows both an optimization of the use of the water, and, due to the reduced drop diameter, a significant improvement in the heat transmission coefficient.

**[0010]** An atomizer is formed by an atomizer body and an atomizer nozzle. The two fluids (liquid and gas) are fed into the atomizer body (or main pipe) and, impacting with the liquid, the high-speed gas causes the fragmentation thereof into tiny drops, a process defined as atomization.

**[0011]** The atomizer nozzle has the function of generating the desired distribution and form of the outgoing flow or jet.

**[0012]** The correct quality of the spray or jet, under-

stood as the quantity and distribution of the water supplied is indispensable for determining a correct cooling speed of the steel.

**[0013]** The main problem with this kind of nozzles according to the prior art is represented by the fact that the swirling member, also defined by the term swirling insert, tends to block, wherein the blockage of the swirling insert results in the interruption of the supply of the atomized cooling fluid. In fact, said swirling insert, positioned inside the atomizer nozzle, blocks easily due to the debris present in the re-circulating water of the system, which ends up blocking the narrow passages of said swirling insert.

**[0014]** Thus, from the previous description it can be clearly seen that in order to ensure the continuity of the supply of the cooling fluid, and in particular, to ensure a constant supply over time, atomizer nozzles have to be subject to regular maintenance with the object of eliminating possible debris deposited inside the inner spaces of the nozzle.

**[0015]** However, atomizer nozzles of the known type do not allow easy maintenance because in order to carry out maintenance (cleaning) of the nozzles of the known type, the same must be completely removed from the cooling line.

**[0016]** Moreover, a further drawback found in nozzles of the known type is represented by the fact that internal cleaning of said nozzles of the known type is nonetheless complicated and dispersive in terms of time, because nozzles of the known type cannot be dismantled, in particular, the orifice mouth thereof not being separable, wherein, on the contrary, the removal of the orifice mouth would allow access inside the nozzle, and thus improved cleaning of the nozzle.

**[0017]** In fact, traditional atomizer nozzles according to the prior art are formed by a single element, already comprising an orifice mouth.

**[0018]** In particular, the atomizer nozzles used to-date are made in a single piece formed by a nozzle body and a swirling insert placed internally, assembled so as to make them integral, the nozzle body being fixed directly to the atomizer body or main pipe by means of a threaded connection.

**[0019]** Thus, the main object of the present invention is to overcome, or at least partially reduce the problems summarized above and affecting atomizer nozzles according to the prior art.

**[0020]** In particular, it is an object of the present invention to propose a new innovative strategy for constructing an atomizer nozzle, which can allow the orifice mouth to be completely or partially dismantled, enabling the person in charge of maintenance to clean the inner components of the nozzle more effectively, in particular, the swirling insert.

Description of the present invention

**[0021]** Thus, the present invention basically arises from the need, highlighted above, according to which it is indispensable to develop an atomizer nozzle with a convenient system for dismantling the orifice mouth thereof.

**[0022]** Thus, according to the innovative architecture underlying the present invention, an atomizer nozzle, made up of separate pieces, which can easily be dismantled, is proposed and realized, wherein the dismantling of the orifice mouth has been conceived to favor the cleaning of the critical parts, subject to clogging, which are adapted to mix and atomize fluids, from any solid particles present in the process fluids, ensuring optimum working of the atomizer nozzle.

**[0023]** According to a consideration underlying the present invention, the atomizer device described and proposed herein comprises a first element, otherwise also known as a nozzle body, formed by an outer coat, provided with a connection, which allows the fixing thereof to a main pipe or fitting, otherwise called an atomizer body. The swirling insert is accommodated and fixed inside the nozzle body. Then, a second element or body, otherwise known as nozzle orifice (or orifice mouth) is fixed to the nozzle body, defining therein a swirling chamber specifically designed to atomize the outgoing spray.

**[0024]** Any debris, which has accumulated along the inner channels of the diffuser and/or in the swirling chamber, which would have a negative influence on the performance of the atomizer, even causing an interruption of the dispensing, can thus be easily removed due to the possibility of dismantling the atomizer nozzle into separate parts, and due to the possibility of accessing the inside of the nozzle, in particular, so as to effectively clean the swirling insert and also rid the swirling chamber of any fragments deposited therein or in the outlet orifice of the nozzle itself.

**[0025]** Based on the previously summarized considerations, and with the object of overcoming, or at least reducing the drawbacks and/or disadvantages affecting atomizer nozzles according to the prior art, the present invention relates to an atomizer nozzle (100) for dispensing an atomized fluid, said nozzle (100) comprising a first main hollow body (200) defining a first inner chamber (2000), said first main hollow body (200) comprising fixing means adapted to allow said first main hollow body (200) to be fixed to a main pipe or fitting (500), wherein, with said first main hollow body (200) fixed to said main pipe or fitting (500), said first inner chamber (2000) is in communication with introduction means of said main pipe or fitting (500), for introducing at least one liquid and at least one gas into said first inner chamber (2000), wherein said nozzle (100) comprises a diffuser insert (400) accommodated in said first inner chamber (2000); wherein said nozzle (100) comprises a second minor hollow body (300) defining a second inner chamber (3000) and adapted to be removably fixed to said first main hollow body (200) wherein said second minor hollow body (300) defines a dispensing orifice (311) by means of which said second inner chamber (3000) is put into communication

with the outside of said second minor hollow body (300); and wherein, with said second minor hollow body (300) fixed to said first main hollow body (200), said second inner chamber (3000) is in communication with said first inner chamber (2000), defining a swirling chamber (310) positioned between said diffuser element (400) and said dispensing orifice (311).

**[0026]** According to an embodiment, said first inner chamber (2000) comprises a first portion (2001) radially delimited by a first substantially cylindrical surface (2010), on which a first inner thread (2011) is obtained, wherein, with said first main hollow body (200) fixed to said main pipe or fitting (500), said first portion (2001) is positioned between said diffuser element (400) and said dispensing orifice (311), wherein said second minor hollow body (300) comprises an engaging portion (301) radially delimited by a second outer cylindrical engaging surface (3010) on which a second outer thread (3011) is obtained, and wherein said second minor hollow body (300) is adapted to be removably fixed to said first main hollow body (200) by mutual engagement by screwing said first inner thread (2011) and second outer thread (3011).

**[0027]** According to an embodiment said first main hollow body (200) comprises an engaging portion (201) radially delimited by a third outer cylindrical engaging surface (2020) on which a third outer thread (2021) is obtained, wherein said first main hollow body (200) is adapted to be removably fixed to said main pipe or fitting (500) by mutual engagement by screwing said third outer thread (2021) and a corresponding thread of said main pipe or fitting (500).

**[0028]** According to an embodiment, said diffuser element (400) is cylindrical in shape and comprises a first circular surface (4001) and a second circular surface (4002) which are opposite to each other and connected by a fourth outer cylindrical surface (4010).

**[0029]** According to an embodiment said diffuser element (400) comprises a plurality of outer helical grooves (4011), each extending from said fourth outer cylindrical surface (4010) towards the inside of said diffuser element.

**[0030]** According to an embodiment, said first inner chamber (2000) comprises a second portion (2002) radially delimited by a fifth substantially cylindrical surface (2050) and a third portion (2003) radially delimited by a sixth cylindrical surface (2060), wherein said fifth cylindrical surface (2050) and sixth cylindrical surface (2060) are mutually joined by a circular crown-shaped connecting shoulder (2130), and wherein said connecting shoulder (2130) is engaged by a circular crown-shaped portion of said second circular surface (4002) of said diffuser element (400).

**[0031]** According to an embodiment said first inner chamber (2000) comprises a fourth portion (2004) radially delimited by a seventh substantially cylindrical surface (2070), wherein said seventh cylindrical surface (2070) and fifth cylindrical surface (2050) are mutually joined by a second circular crown-shaped connecting shoulder (2110), and wherein with said first main hollow body (200) fixed to said main pipe or fitting (500), said fourth portion (2004) is positioned upstream of said diffuser element (400) with respect to said dispensing orifice (311).

**[0032]** According to an embodiment, said first portion (2001) of said first inner chamber (2000) is shaped so as to define a circular crown-shaped engaging shoulder (2200), wherein with said second minor hollow body (300) fixed to said first main hollow body (200), said engaging shoulder (2200) is engaged by a corresponding engaging surface (3019) of said engaging portion (301) of said second minor hollow body (300).

**[0033]** According to an embodiment, said second inner chamber (3000) comprises a fifth portion (3005) radially delimited by an eighth substantially cylindrical surface (3080), wherein with said second minor hollow body (300) fixed to said first main hollow body (200), said fifth portion (3005) is positioned downstream of said diffuser element (400) with respect to said dispensing orifice (311).

**[0034]** According to an embodiment, said corresponding engaging surface (3019) of said engaging portion (301) of said second minor hollow body (300) is circular crown-shaped, wherein said eighth cylindrical surface (3080) of said second minor hollow body (300) extends from said corresponding circular crown-shaped engaging surface (3019) downstream of said corresponding circular crown-shaped engaging surface (3019) with respect to said diffuser element (400), with said second minor hollow body (300) being fixed to said first main hollow body (200).

**[0035]** According to an embodiment, said second inner chamber (3000) comprises a sixth portion (3006) radially delimited by a ninth substantially truncated-cone surface (3090), which extends from said eighth cylindrical surface (3080) towards said dispensing nozzle (311) with a decreasing diameter towards said dispensing nozzle (311).

**[0036]** According to an embodiment, said second inner chamber (3000) comprises a seventh portion (3007) radially delimited by a tenth substantially cylindrical surface (3100), which extends from said sixth truncated-cone portion (3006) towards said dispensing orifice (311).

**[0037]** According to an embodiment, said dispensing orifice (311) is radially delimited by an eleventh substantially truncated-cone inner surface (3111), which extends from said tenth substantially cylindrical surface (3100) towards the outside of said second minor hollow body (300) with an increasing diameter towards the outside of said second minor hollow body (300).

**[0038]** An atomizer system for atomizing a liquid and delivering an atomized fluid further forms the subject of the present invention, said system comprising at least one main pipe or fitting (500) and a nozzle (100) for dispensing said atomized fluid, which are mutually connected, wherein said nozzle (100) defines at least one swirling chamber (310) and comprises at least one dispensing

orifice (311) for dispensing said atomized fluid, and wherein said pipe or fitting (500) comprises means for introducing at least one liquid and at least one gas into said at least one swirling chamber (310) of said nozzle (100), wherein said nozzle (100) is a nozzle according to one of the previously summarized embodiments.

**[0039]** According to an embodiment, said main pipe or fitting (500) is shaped to define a pre-chamber (5001) in which said means for introducing said at least one liquid and said at least one gas converge, wherein, with said first main hollow body (200) of said nozzle (100) being connected to said main pipe or fitting (500), said pre-chamber (5001) is in communication with said first inner chamber (2000) of said first main hollow body (200).

**[0040]** Further embodiments of the present invention are defined by the claims.

Brief description of the figures

**[0041]** The present invention will be further clarified below by means of the following detailed description of possible embodiments depicted in the drawings, in which corresponding or equivalent features and/or component parts of the present invention are identified by the same reference numerals.

**[0042]** Moreover, all those variations and/or changes to the embodiments described below and depicted in the attached drawings, which will become clear and evident to a person skilled in the art, fall within the scope of the present invention.

**[0043]** In the drawings:

Figure 1 shows an isometric view of the atomizer according to an embodiment of the present invention;

Figure 2 shows an exploded isometric view of the atomizer according to an embodiment of the present invention;

Figure 3 shows a lateral view of the atomizer nozzle according to an embodiment of the present invention;

Figure 4 shows a longitudinal section of the atomizer nozzle according to an embodiment of the present invention;

Figure 5 shows an exploded isometric view of the atomizer nozzle according to an embodiment of the present invention;

Figure 6 shows a lateral view of the swirling insert;

Figure 7 shows a lateral view of the nozzle body according to an embodiment of the present invention;

Figure 8 shows a longitudinal section of the nozzle body according to an embodiment of the present invention;

Figure 9 shows a lateral view of the orifice body according to an embodiment of the present invention;

Figure 10 shows a longitudinal section of the orifice body according to an embodiment of the present invention.

Detailed description of the present invention

**[0044]** In the figures, the disassemblable nozzle according to the embodiment of the present invention depicted therein is identified by the reference numeral 100 and, as depicted, can be applied to a main pipe or fitting 500 (also called "air-water atomizer") provided with means (not shown in detail) for introducing at least one liquid (usually water) and at least one gas (usually air) into the nozzle 100. To this end, the nozzle 100 comprises a first main hollow body (also called nozzle body) 200, which, in turn, comprises a substantially cylindrical engaging portion 2020 provided externally with a connecting thread 2021 adapted to allow the body 200 to be fixed to the fitting or atomizer body 500 by means of mutual engagement by screwing said outer thread 2021 and a corresponding thread (not shown) of said main pipe or fitting 500.

**[0045]** The hollow body (see the following description) further has a second portion joined to and opposite to said substantially cylindrical engaging portion 202, with exception of flat portions 203 provided to facilitate the fixing and disassembling of the atomizer body 500 by screwing and unscrewing, respectively.

**[0046]** Once screwed to the atomizer body 500 said connecting thread 2021 compresses a seal 600 in order to ensure the hydraulic seal between the nozzle body 200 and atomizer body 500.

**[0047]** As outlined, the main body 200 is internally hollow, and defines, in particular, an inner cavity 2000, wherein, with the body 200 fixed to the atomizer body according to the previously described procedures, said at least one liquid and at least one gas, are introduced into the inner chamber or cavity 2000 in the flow direction indicated in figure 8 by the arrow F1.

**[0048]** In detail, the main chamber 2000 has a first portion 2001 radially delimited by a cylindrical surface 2010, a second portion 2002 radially delimited by a cylindrical surface 2050, a third portion 2003 radially delimited by a cylindrical surface 2060, and a fourth portion 2004 radially delimited by a cylindrical surface 2070, said portions being mutually communicating, thus defining the inner chamber 2000.

**[0049]** The diameters of the first, second, third and fourth portions vary, defining supporting or engaging shoulders for accommodating further component parts of the nozzle 100. In particular, as depicted, the diameter of the second portion 2002 is smaller than that of the fourth portion 2004, wherein said second portion and fourth portion are mutually joined by a circular crown-shaped connecting shoulder 2110. Furthermore, the diameter of the third portion 2003 is smaller than that of the second portion 2002, wherein said third and second portion are joined by a connecting and engaging shoulder 2130, which is also circular crown-shaped. Finally, the diameter of the first portion 2001 is smaller than the diameter of the third portion 2003, thus, wherein said first portion 2001 and third portion 2003 are joined by a further

circular crown-shaped connecting and engaging shoulder 2200.

**[0050]** As to the first portion 2001, a thread 2011 is obtained on the inner wall 2010 adapted to be engaged by screwing by a corresponding thread 3011 of a second hollow body (also called orifice body) 300 forming part of the nozzle 100 and described in detail below.

**[0051]** As depicted, said second hollow body 300 defines an outer cavity or chamber 3000 and comprises an engaging portion 301 radially delimited on the outside by a cylindrical surface 3010 on which said outer thread 3011 is obtained. Thus, it can be seen that the mutual progressive screwing of the threads 3011 and 2011 results in the progressive insertion of the engaging portion 301 in the first portion 2001 of the main chamber 2000 of the body 200 as shown in figure 4, from which it can also be seen that, with the hollow body 300 fixed to the hollow body 200 according to the previously described procedures, the end surface 3019 (circular crown-shaped) of the engaging portion 301 of the body 300 is placed in abutment (and thus in engagement) against the circular crown-shaped shoulder 2200 of the body 200, thus ensuring the seal between the body 200 and the body 300, preventing liquids and/or gas from leaking or escaping.

**[0052]** Again as depicted, with the hollow body 300 fixed to the hollow body 200 as described previously and as depicted in figure 4, the inner chamber 3000 of the body 300 is put in communication with the inner chamber 2000 of the body 200, defining a common swirling chamber 310 of the nozzle 100.

**[0053]** In particular, it arises from figure 10 that the chamber 300 also comprises different portions, in other words, a portion 3005 radially delimited by a substantially cylindrical surface 3080, a portion 3006, which extends from the portion 3005 and is radially delimited by a truncated-cone shaped surface 3090 with a decreasing diameter away from the portion 3005, a portion 3007, which extends from the truncated-cone shaped portion 3006 and is radially delimited by a cylindrical surface 3100, and finally, a truncated-cone shaped dispensing orifice 311 radially delimited by a surface 3111 and which extends from the portion 3006 to the exterior of the body 300, the orifice having opposite conicity to that of the portion 3006, and thus with an increasing diameter towards the exterior of the body 300.

**[0054]** Thus, it arises that with the body 300 inserted into and fixed to the body 200, as described previously and as depicted in figure 4, said at least one liquid and at least one gas are introduced into the swirling chamber 310 defined by the bodies 200 and 300 as indicated by the arrow F1, wherein the atomized fluid is dispensed through the orifice 311 as indicated by the arrow F2.

**[0055]** Again as depicted, the nozzle 100 comprises a diffuser insert 400 (figure 6) designed to be accommodated in the hollow body 200 (figures 4 and 59), said diffuser insert 400 having a substantially cylindrical shape, being longitudinally delimited by two opposite circular surfaces 4001 and respectively 4002, which are joined to each other by an outer cylindrical surface 4010, wherein the diffuser 400 comprises a plurality of outer grooves with a helical development 4011, each extending from said outer cylindrical surface 4010 towards the inside of said diffuser element and thus wherein each groove opens out into an opening on the surface 4001 and into a second opposite opening on the surface 4002.

**[0056]** In figure 4 the diffuser 400, depicted with the nozzle 100 completely assembled, is accommodated in the second portion 2002 of the chamber 2000 (of the body 200) with the outer surface 4010 in contrast with the inner surface 2050 of the portion 2002, wherein a circular crown-shaped outer peripheral portion of the surface 4002 is placed in abutment against the shoulder 2110, which, as anticipated, joins the portions 2002 and 2004 of the chamber 2000.

**[0057]** Thus, the portion 2004 has the function of a pre-chamber, wherein said at least one liquid and at least one gas, introduced into said pre-chamber 2004 take a swirling motion, due to the diffuser 400, which favors the atomization, wherein the atomized flow is dispensed through the orifice 311 as indicated by the arrow F2.

**[0058]** From the previous description arises the steps of assembling the nozzle can be appreciated, said steps comprising the positioning of the diffuser 400 in the body 200, the fixing of the body 300 to the body 200 and the fixing of the body 200 (and thus of the entire nozzle 100) to the fitting 500. Alternatively, the body 200, with the diffuser 400 positioned therein, can be fixed to the fitting 500 before the body 300 is fixed to the body 200.

**[0059]** Likewise, it arises from the previous description that in the event of the nozzle 100 getting blocked, or needing to undergo maintenance, by removing the body 300 from the body 200 it will be possible to access the inside of the nozzle 100, and, in particular, the diffuser 400, without any need to remove the nozzle 100 from the fitting 500.

**[0060]** Furthermore, by removing both the body 300 from the body 200 and the body 200 from the fitting 500, if necessary, it will be possible to remove the diffuser from the body 300, by acting on the diffuser 400 with pressure through the portions 2001 and 2003 of the chamber 2000.

**[0061]** Thus, it has been demonstrated by the previous detailed description of embodiments of the present invention depicted in the drawings, that the present invention allows the desired results to be achieved and the drawbacks affecting the background art to be overcome or at least reduced.

**[0062]** Although the present invention has been clarified by means of the above description of the embodiments thereof depicted in the drawings, the present invention is not limited to the embodiments thereof described above and depicted in the drawings; to the contrary, all modifications of the embodiments described above and depicted in the drawings which will become clear and obvious to those skilled in the art fall within the

scope of the present invention.

**[0063]** The scope of the present invention is therefore defined by the claims.

## Claims

1. A nozzle (100) for dispensing an atomized fluid, said nozzle (100) comprising a first main hollow body (200) defining a first inner chamber (2000), said first main hollow body (200) comprising fixing means adapted to allow said first main hollow body (200) to be fixed to a main pipe or fitting (500), wherein with said first main hollow body (200) fixed to said main pipe or fitting (500), said first inner chamber (2000) is in communication with introduction means of said main pipe or fitting (500), for introducing at least one liquid and at least one gas into said first inner chamber (2000), wherein said nozzle (100) comprises a diffuser insert (400) accommodated in said first inner chamber (2000); **characterized in that** said nozzle (100) comprises a second minor hollow body (300) defining a second inner chamber (3000) and adapted to be removably fixed to said first main hollow body (200); **in that** said second minor hollow body (300) defines a dispensing orifice (311) by means of which said second inner chamber (3000) is put into communication with the outside of said second minor hollow body (300); **and in that,** with said second minor hollow body (300) fixed to said first main hollow body (200), said second inner chamber (3000) is in communication with said first inner chamber (2000), thus defining a swirling chamber (310) positioned between said diffuser element (400) and said dispensing orifice (311).

2. A nozzle (100) according to claim 1, **characterized in that** said first inner chamber (2000) comprises a first portion (2001) radially delimited by a first substantially cylindrical surface (2010, on which a first inner thread (2011) is obtained, **in that,** with said first main hollow body (200) fixed to said main pipe or fitting (500), said first portion (2001) is positioned between said diffuser element (400) and said dispensing orifice (311), **in that** said second minor hollow body (300) comprises an engaging portion (301) radially delimited by a second outer cylindrical engaging surface (3010) on which a second outer thread (3011) is obtained, **and in that** said second minor hollow body (300) is adapted to be removably fixed to said first hollow main body (200) by mutual engagement by screwing said first inner thread (2011) and second outer thread (3011).

3. A nozzle (100) according to one of the claims 1 and 2, **characterized in that** said first main hollow body (200) comprises an engaging portion (201) radially delimited by a third outer cylindrical engaging surface (2020) on which a third outer thread (2021) is obtained, **and in that** said first main hollow body (200) is adapted to be removably fixed to said main pipe or fitting (500) by mutual engagement by screwing said third outer thread (2021) and a corresponding thread of said main pipe or fitting (500).

4. A nozzle (100) according to one of claims 1 to 3, **characterized in that** said diffuser element (400) is cylindrical in shape and comprises a first circular surface (4001) and a second circular surface (4002) which are opposite to each other and connected by a fourth outer cylindrical surface (4010).

5. A nozzle (100) according to claim 4, **characterized in that** said diffuser element (400) comprises a plurality of outer helical grooves (4011), each extending from said fourth outer cylindrical surface (4010) towards the inside of said diffuser element.

6. A nozzle (100) according to one of claims 4 to 5, **characterized in that** said first inner chamber (2000) comprises a second portion (2002) radially delimited by a fifth substantially cylindrical surface (2050) and a third portion (2003) radially delimited by a sixth cylindrical surface (2060), **in that** said fifth cylindrical surface (2050) and sixth cylindrical surface (2060) are mutually joined by a circular crown-shaped connecting shoulder (2130), **and in that** said connecting shoulder (2130) is engaged by a circular crown-shaped portion of said second circular surface (4002) of said diffuser element (400).

7. A nozzle (100) according to one of claims 1 to 6, **characterized in that** said first inner chamber (2000) comprises a fourth portion (2004) radially delimited by a seventh substantially cylindrical surface (2070), **in that** said seventh cylindrical surface (2070) and said fifth cylindrical surface (2050) are mutually joined by a second circular crown-shaped connecting shoulder (2110), **and in that** with said first main hollow body (200) fixed to said main pipe or fitting (500), said fourth portion (2004) is positioned upstream of said diffuser element (400) with respect to said dispensing orifice (311).

8. A nozzle (100) according to one of claims 1 to 7, **characterized in that** said first portion (2001) of said first inner chamber (2000) is shaped so as to define a circular crown-shaped engaging shoulder (2200), **and in that** with said second minor hollow body (300) fixed to said first main hollow body (200), said engaging shoulder (2200) is engaged by a corresponding engaging surface (3019) of said engaging portion (301) of said second minor hollow body (300).

9. A nozzle (100) according to one of claims 1 to 8, **characterized in that** said second inner chamber

(3000) comprises a fifth portion (3005) radially delimited by an eighth substantially cylindrical surface (3080), **and in that** with said second minor hollow body (300) fixed to said first main hollow body (200), said fifth portion (3005) is positioned downstream of said diffuser element (400) with respect to said dispensing orifice (311).

**10.** A nozzle (100) according to claims 8 and 9, **characterized in that** said corresponding engaging surface (3019) of said engaging portion (301) of said second minor hollow body (300) is circular crown-shaped, **and in that** said eighth cylindrical surface (3080) of said second minor hollow body (300) extends from said corresponding circular crown-shaped engaging surface (3019) downstream of said corresponding circular crown-shaped engaging surface (3019) with respect to said diffuser element (400), with said second minor hollow body (300) being fixed to said first main hollow body (200).

**11.** A nozzle (100) according to one of the claims 9 and 10, **characterized in that** said second inner chamber (3000) comprises a sixth portion (3006) radially delimited by a ninth substantially truncated-cone surface (3090), which extends from said eighth cylindrical surface (3080) towards said dispensing nozzle (311) with a decreasing diameter towards said dispensing nozzle (311).

**12.** A nozzle (100) according to claim 11, **characterized in that** said second inner chamber (3000) comprises a seventh portion (3007) radially delimited by a tenth substantially cylindrical surface (3100) which extends from said sixth truncated-cone portion (3006) towards said dispensing orifice (311).

**13.** A nozzle (100) according to claim 12, **characterized in that** said dispensing orifice (311) is radially delimited by an eleventh inner substantially truncated-cone surface (3111) which extends from said tenth substantially cylindrical surface (3100) towards the outside of said second minor hollow body (300) with an increasing diameter towards the outside of said second minor hollow body (300).

**14.** An atomizer system for atomizing a liquid and delivering an atomized fluid, said system comprising at least one main pipe or fitting (500) and a nozzle (100) for dispensing said atomized fluid mutually connected, wherein said nozzle (100) defines at least one swirling chamber (310) and comprises at least one dispensing orifice (311) for dispensing said atomized fluid, and wherein said pipe or fitting (500) comprises means for introducing at least one liquid and at least one gas into said at least one swirling chamber (310) of said nozzle (100), **characterized in that** said nozzle (100) is a nozzle according to one of claims 1 to 13.

**15.** A system according to claim 14, **characterized in that** said main pipe or fitting (500) is shaped to define a pre-chamber (5001) in which said means for introducing said at least one liquid and said at least one gas converge, **and in that,** with said first main hollow body (200) of said nozzle (100) being connected to said main pipe or fitting (500), said pre-chamber (5001) is in communication with said first inner chamber (2000) of said first main hollow body (200).

Fig. 1

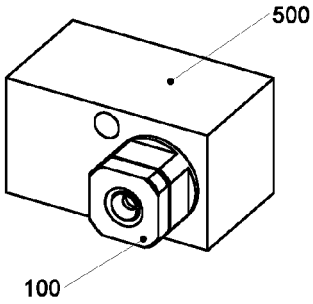



Fig. 2

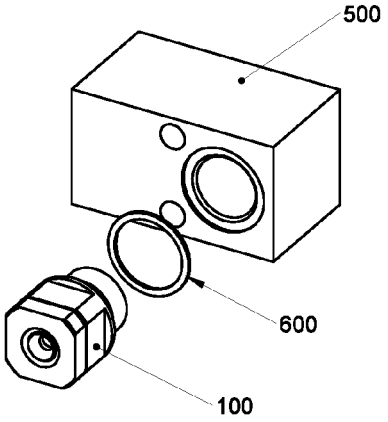



Fig. 3

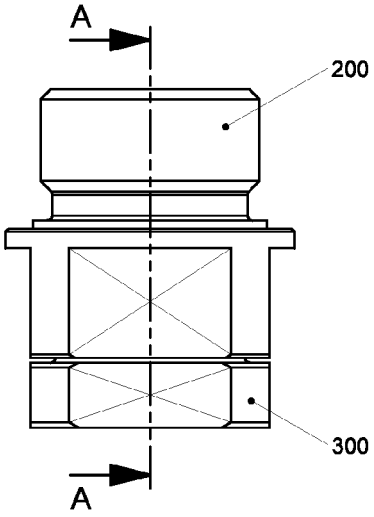



Fig. 4

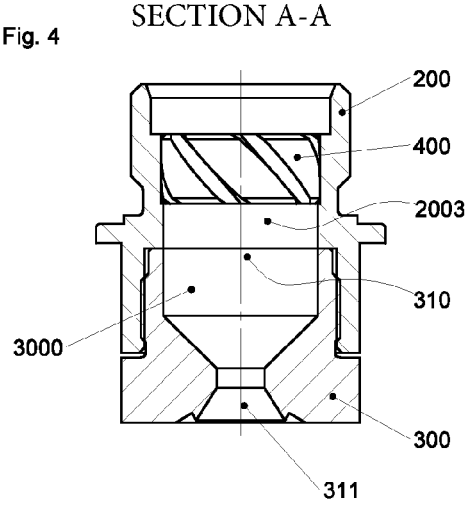



Fig. 5

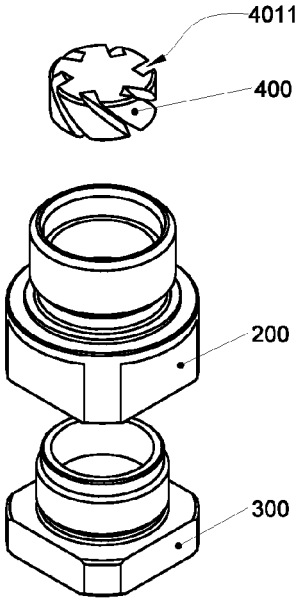



Fig. 6

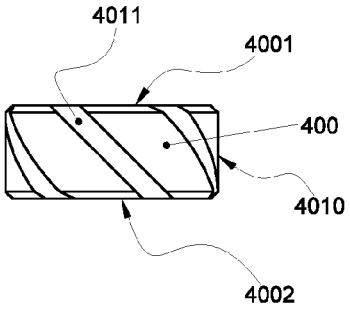
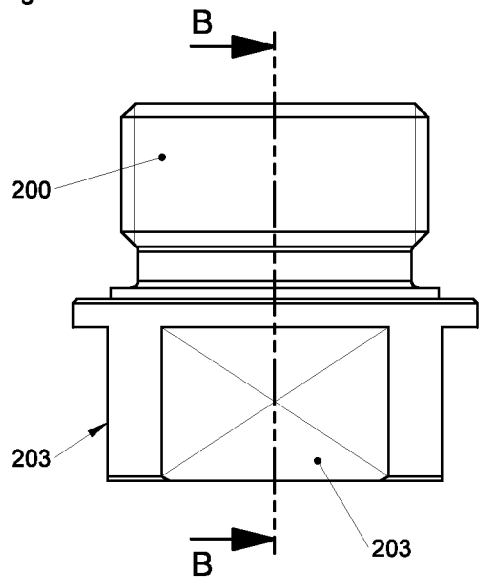


Fig. 7




SECTION B-B

Fig. 8

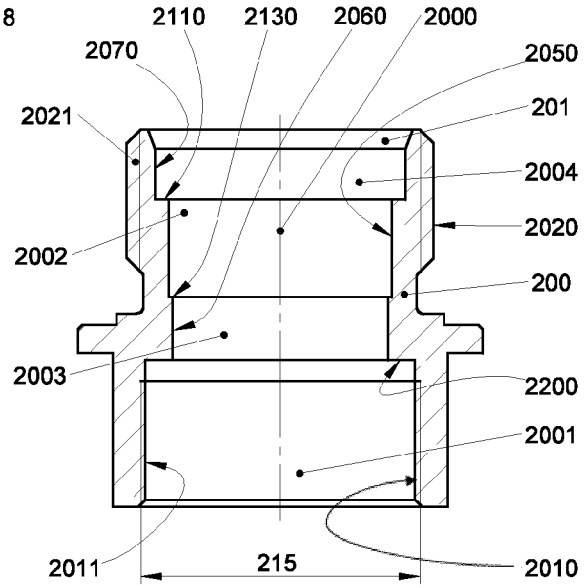
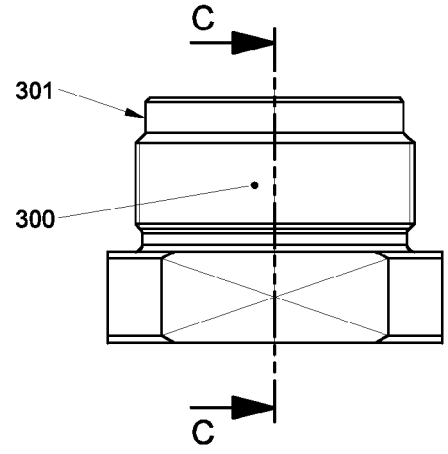
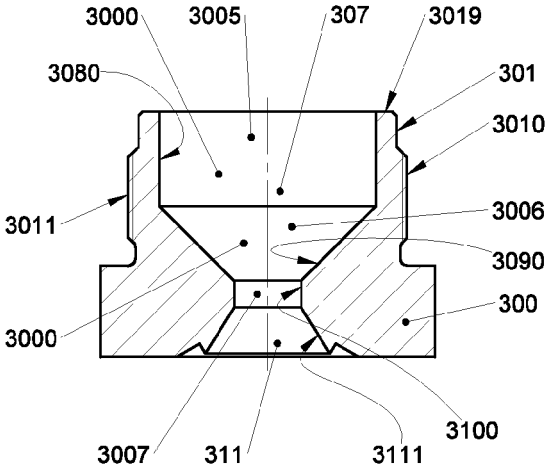



Fig. 9




SECTION C-C

Fig. 10



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# EUROPEAN SEARCH REPORT

Application Number
EP 20 17 5917

## 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 | CH 197 705 A (MICHOUD ARNOLD [CH])<br>15 May 1938 (1938-05-15)<br>* the whole document * | 1-15 | INV.<br>B05B1/34<br>B05B7/10 |
| X | EP 3 395 449 A1 (UNIV ALCALA HENARES [ES] ET AL.) 31 October 2018 (2018-10-31)<br>* abstract; figures 1-3,5, 9, *<br>* page 3, paragraph 12 - page 4, paragraph 17 *<br>* page 6, paragraph 31 - page 7, paragraph 39 * | 1,4,5, 11-15 | |
| X | US 2001/004692 A1 (KIDOOKA SATOSHI [JP] ET AL) 21 June 2001 (2001-06-21)<br>* abstract; figures 1-6 *<br>* page 1, paragraph 21 - page 2, paragraph 35 * | 1-15 | |
| X | EP 0 611 933 A2 (AIR PROD & CHEM [US])<br>24 August 1994 (1994-08-24)<br>* abstract; figures 6-8 * | 1-15 | |
| | | | TECHNICAL FIELDS SEARCHED (IPC)<br>B05B |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 14 October 2020 | Frego, Maria Chiara |

CATEGORY OF CITED DOCUMENTS

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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 17 5917

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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14-10-2020

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| CH 197705 A | 15-05-1938 | NONE | |
| EP 3395449 A1 | 31-10-2018 | EP 3395449 A1 | 31-10-2018 |
| | | US 2020179966 A1 | 11-06-2020 |
| | | WO 2018197025 A1 | 01-11-2018 |
| US 2001004692 A1 | 21-06-2001 | JP 4441025 B2 | 31-03-2010 |
| | | JP 2001169997 A | 26-06-2001 |
| | | US 2001004692 A1 | 21-06-2001 |
| EP 0611933 A2 | 24-08-1994 | BR 9400598 A | 23-08-1994 |
| | | CA 2115619 A1 | 18-08-1994 |
| | | DE 69402892 T2 | 14-08-1997 |
| | | EP 0611933 A2 | 24-08-1994 |
| | | JP H06300410 A | 28-10-1994 |
| | | TW 258784 B | 01-10-1995 |
| | | US 5630321 A | 20-05-1997 |
| | | ZA 941031 B | 15-08-1995 |

EPO FORM P0459

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