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(71) Applicant: **PNR Italia S.r.l.**
27058 Voghera (IT)

(72) Inventor: **TONINI, Federico**
6826 RIVA SAN VITALE (CH)

(74) Representative: **Torti, Carlo Maria Emilio et al**
Notarbartolo & Gervasi S.p.A.
Corso di Porta Vittoria, 9
20122 Milano (IT)

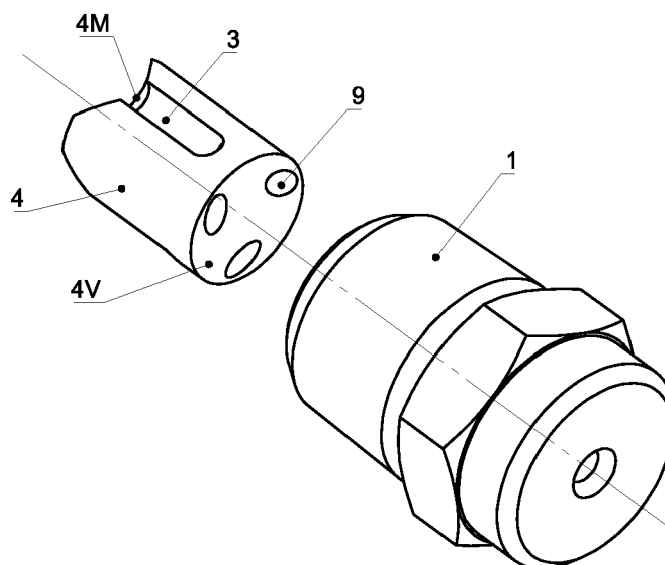
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(54) **INSERT FOR HYDRAULIC NOZZLES AND HYDRAULIC NOZZLE INCLUDING SAID INSERT**

(57) An insert (4) for hydraulic nozzles (100), in particular for hydraulic nozzles (100) adapted to form a substantially conical spray or jet of a fluid, said insert (4) comprising a rigid body which extends in a longitudinal extension direction (0-0) between a first outer end surface (4M) and a second outer end surface (4V) opposite

to said first outer end surface (4M), said first (4M) and second (4V) outer end surfaces being joined by a radial outer surface (4R), said insert (4) comprising at least one channel (3) for the passage of a fluid which extends between said first (4M) and second (4V) outer end surfaces.

FIG.3



Description

Field of the invention

[0001] The present invention belongs to the field of spraying fluids, for example for preventing and/or putting out fires. In particular, the present invention relates to an insert for hydraulic nozzles and to a hydraulic nozzle including said insert, said nozzle being adapted to form a jet or spray of a fluid which may be used for example, for preventing and/or putting out fires. In detail, the innovative aspects of the present invention relate to the shape of an insert of the aforesaid type and to the related manufacturing process.

Background art

[0002] Various types of sprayer nozzles are known in the art, which can be classified according to various features, the most important among same being the type of jet or spray generated. According to the shape of the jet, the sprayer nozzles are divided into flat jet nozzles, in which the drops leave the orifice forming a jet similar to a fan, hollow cone nozzles, in which the drops leave the orifice forming a conical jet, wherein however the drops are distributed only over the outer surface, and full cone nozzles, in which the drops leave the orifice of the nozzle forming a full cone with well-defined opening angle. In this last case, the moving drops are also in the inner volume of the conical-shaped jet according to a more or less uniform distribution. Nozzles of the aforesaid type usually are used in various sectors of industry, such as for example, for painting, washing materials, cooling surfaces, treating waste, and in other various applications, not lastly for preventing and/or putting out fires.

[0003] Generally, a sprayer nozzle of the aforesaid type essentially comprises an insert housed in a hollow body defining a vortex chamber; practically, the fluid entering the nozzle passes through the insert and flows into the vortex chamber in which it takes on a rotary motion, to then leave from the vortex chamber through an orifice, wherein the spray or jet emitted through said orifice takes on a fluid-dynamic shape and features (velocity, pressure, etc.) strictly dependent on, among others but not exclusively, the type of insert, the shape and dimensions of the vortex chamber, and the shape and dimensions of the outlet orifice.

[0004] Therefore, the fluid exiting through the orifice, being subjected to centrifugal force, is broken down into drops which are arranged at the outlet to form jets or sprays having various shapes and dimensions and, as anticipated, dependent on the features of the various nozzle components involved with the fluid.

[0005] In this regard, nozzles are known in the art in which the insert consists of a cylindrical body made of rigid material (usually brass but also plastic) in which there is formed a plurality of holes, each extending between the two opposite end surfaces (one upstream and

one downstream with respect to the flow direction of the fluid) and through which the fluid entering the nozzle is caused to pass; the fluid then longitudinally crosses the insert and is introduced into the vortex chamber to then be sprayed outside, through the orifice.

[0006] Although they may be appreciated from various viewpoints, in particular for their versatility of use, nozzles and related inserts of the type summarized above are not free from drawbacks and/or disadvantages, which the present invention intends overcoming or at least reducing.

[0007] From the brief above disclosure, it is indeed apparent that the performance of the nozzle, and in particular the repeatability thereof, is strongly dependent on the accuracy with which the components forming the nozzles are constructed.

[0008] In particular, considering by way of example a lot of nozzles of the same type, all the nozzles in the lot provide the same performance as long as the components are respectively identical. On the contrary, nozzles in which the related inserts are not perfectly identical but have for example holes with even slightly different diameters, provide different performances, e.g. sprays and/or jets in which the distribution and/or the dimension of the drops are not identical.

[0009] Hence, the repeatability of the performance in the nozzles according to the prior art of the type described above strictly depends on the repeatability (in terms of shape and dimensions) of the components thereof.

[0010] Various manufacturing and/or production methods have been suggested in the past to ensure the repeatability of the components; however, said processes usually are quite difficult to implement and require the use of very costly equipment, wherein the cost of the process thus results in a cost of the nozzle which often is not compatible with the needs of the market, especially in the case of nozzles intended for simple uses and consumers who are not highly specialized.

[0011] It is therefore an object of the present invention to overcome or at least minimize the drawbacks encountered in the nozzles according to the prior art.

[0012] In particular, it is the object of the present invention to suggest a nozzle in which the insert comprises holes for the passage of the fluid, the shape and/or conformation of which allowing the performance desired to be obtained in a repeatable manner, but also the holes for the passage of the fluid to be provided according to simple and affordable processes which can be carried out by using just simple and affordable equipment.

Description of the present invention

[0013] The present invention essentially arises from the consideration according to which the above objects, in particular the repeatability of performance, may be achieved, wherein the holes for the passage of the fluid (and the relative successive introduction into the vortex chamber) are not already present (provided) in the insert

as such, but rather arise from the engagement of shape and/or dimensions between the insert and the related housing body. In particular, according to a further consideration at the basis of the present invention, the above objects may be achieved by manufacturing a nozzle which has longitudinal grooves, wherein each groove, with the insert housed in the related housing body, thus defines a passage bounded by a surface partly belonging to the groove and partly to the inner surface of the housing body.

[0014] The aforesaid longitudinal grooves may indeed be obtained with the accuracy and repeatability desired by means of simple processes, for example using simple cutters, with evident advantages in terms of simplification and cost containment of the production process.

[0015] Therefore, in consideration of the preset objects and of the above description, the present invention relates to an insert for hydraulic nozzles, in particular for hydraulic nozzles adapted to form a substantially conical spray or jet of a fluid, said insert comprising a rigid body which extends in a longitudinal extension direction between a first outer end surface and a second outer end surface opposite to said first outer end surface, said first and second outer end surfaces being joined by a radial outer surface, said insert comprising at least one channel for the passage of a fluid which extends between said first and second outer end surfaces, wherein said at least one channel comprises a first portion which extends from said first outer end surface in a direction substantially parallel to said longitudinal extension direction of said rigid body, and wherein said at least one channel comprises a second portion which extends from said first portion up to said second outer end surface in an oblique direction with respect to said longitudinal extension direction of said rigid body.

[0016] According to one embodiment, said first portion of said at least one channel consists of a groove which extends from said radial outer surface for a predefined depth, thus defining a longitudinal opening through which the inside of said groove communicates with the outside of said rigid body. According to one embodiment, said second portion of said at least one channel extends inside said rigid body and is thus bounded by a radial closed surface.

[0017] According to one embodiment, the angle α between said longitudinal extension axis of said rigid body and the longitudinal extension axis of said second portion of said at least one channel is between 10° and 75° . According to one embodiment, said second outer end surface substantially is perpendicular to said longitudinal extension axis of said rigid body, wherein the intersection of said second portion of said at least one channel with said second end surface defines a substantially elliptical outlet surface.

[0018] According to one embodiment, the angle β between the tangent to said radial surface of said rigid body in the point of intersection between the straight line which joins said longitudinal extension axis of said rigid body

and the center of said substantially elliptical hole and the bigger axis of said substantially elliptical hole is between 0° and 50° .

[0019] The present invention relates moreover to a hydraulic nozzle, in particular for forming a substantially conical spray or jet of a fluid, said nozzle comprising a body with a housing cavity and an insert housed in said housing cavity to define a vortex chamber for creating a vortex of said fluid which communicates with the outside through an orifice, wherein said insert is an insert according to one of the embodiments of the present invention.

[0020] According to one embodiment, said housing cavity comprises a first portion engaged by said insert with a shape and inner dimensions substantially corresponding to the shape and outer dimensions of said insert, and a second portion not engaged by said insert, wherein said vortex chamber is delimited by an inner surface which comprises said second end surface of said insert.

[0021] According to one embodiment, the inner surface of said vortex chamber comprises a portion which lies on a substantially spherical reference surface.

[0022] According to one embodiment, said orifice comprises a first substantially cylindrical portion which extends from said vortex chamber towards the outside, and a second substantially frustoconical portion which extends from said first portion.

[0023] Possible further embodiments of the present invention are defined by the claims.

[0024] The present invention is particularly advantageous for manufacturing hydraulic nozzles of the full cone type, this being the reason whereby the present invention is described below with particular reference to the application thereof in the case of solid cone hydraulic nozzles, wherein however the possible applications of the present invention are not limited to the case of full cone nozzles, but also comprise flat cone, fan cone nozzles, etc.

[0025] Therefore, the present invention is clarified below by means of the description of embodiments thereof depicted in the drawings; however, the present invention is not limited to the embodiments described below and depicted in the drawings.

Description of the drawings

[0026] In the drawings:

Fig. 1 shows a side view of the nozzle according to one embodiment of the present invention;

Fig. 2 shows a section of the nozzle along the plane A-A indicated in Fig. 1;

Fig. 3 shows an isometric exploded view of the nozzle according to one embodiment of the present invention;

Fig. 4 shows a partial oblique cross section of the nozzle according to one embodiment of the present invention;

Fig. 5 shows an isometric view of the insert according

to one embodiment of the present invention;
 Fig. 6a shows a bottom view of the insert according to one embodiment of the present invention;
 Fig. 6b shows a side view of the insert according to one embodiment of the present invention;
 Fig. 7a shows a top view of the insert according to one embodiment of the present invention;
 Fig. 7b shows a cross section of the insert along the plane B-B indicated in Fig. 7a;
 Figures 8a, 8b, 8c show top, cross section and bottom views, respectively, of the insert according to one embodiment of the present invention;
 Figures 9a, 9b, 9c show top, cross section and bottom views, respectively, of the insert according to one embodiment of the present invention;
 Figures 10a, 10b, 10c show top, cross section and bottom views, respectively, of the insert according to one embodiment of the present invention;
 Fig. 11 shows an axial view of the insert according to one embodiment of the present invention;
 Fig. 12 shows an axial view of the insert according to one embodiment of the present invention;
 Fig. 13 shows an axial view of the insert according to one embodiment of the present invention;
 Fig. 14 shows an axial view of the insert according to one embodiment of the present invention.

Detailed description of the present invention

[0027] The nozzle according to the present invention is identified by numeral 100 in the drawings.

[0028] As depicted, the nozzle 100 essentially comprises a hollow housing body 1 in which an insert 4 is housed. Again as depicted, insert 4 only partly occupies the original cavity of the hollow body 1, wherein the portion of the original cavity of body 1 not engaged by insert 4 defines a so-called "vortex" (or also mixing) chamber 5, the purposes of which shall be clarified in greater detail later.

[0029] Again as depicted, in the embodiment thereof depicted in the drawings, insert 4 essentially has a cylindrical shape and therefore has a first outer end surface 4M (upstream with respect to the flow direction of the fluid, see the following description) and a second outer end surface 4V (downstream with respect to the flow direction of the fluid, see the following description), opposite to said first outer end surface 4M, wherein said first 4M and second 4V outer end surfaces are joined by a substantially cylindrical radial outer surface 4R. Moreover, again as depicted, said insert 4 comprises three channels or ducts 3 for the passage of a fluid which each extend between said first 4M and second 4V outer end surfaces.

[0030] The shape of the channels or ducts 3 is a peculiarity of insert 4, wherein a description thereof is given below by way of a non-limiting example of one of the three channels 3 depicted in the drawings, given that the channels or ducts 3 are substantially identical.

[0031] It is indeed apparent that each channel or duct 3 comprises a first portion 3M (upstream with respect to the flow direction of the fluid, see the following description) which extends from said first outer end surface 4M in an axial direction substantially parallel to said longitudinal extension direction O-O of insert 4, wherein each channel or duct 3 comprises a second portion 3V (downstream with respect to the flow direction of the fluid, see the following description) which extends from said first portion 3M up to said second outer end surface 4V in an oblique direction g-g with respect to said longitudinal extension direction O-O of said insert 4. Each of the three axial channels or ducts 3 thus leads to a hole 9 in surface 4V, said hole 9 having substantially elliptical section, given that surface 4V is substantially perpendicular to axis O-O.

[0032] Moreover, for each of said channels or ducts 3, said first portion 3M consists of a groove which extends from said radial outer surface 4R for a predefined depth, thus defining a longitudinal opening 3A through which the inside of said groove communicates with the outside of said rigid body. Whereby, with insert 4 housed in the housing body 1 according to the methods described above and as depicted in the drawings, the "passage" defined by each groove 3M is bounded by an outer surface consisting partly of the inner surface of groove 3M, and partly (at opening 3A) by a portion of the surface of the inner cavity of body 1.

[0033] On the contrary, for each channel or duct 3, said second portion 3V extends inside insert 4 and is thus bounded by a radial closed surface.

[0034] Therefore, the operation of nozzle 100 may be summarized as follows.

[0035] The fluid to be sprayed (water, foam, flame retardant agents or the like) enters nozzle 100 in the direction of arrow 12, flows through the channels or ducts 3, first into portions 3M and then into portions 3V, and then leaves insert 4 through the holes 9 to enter the vortex chamber 5 and finally exits from nozzle 100, first through orifice 6 and then through the outlet mouth 7 in direction of arrow 13.

[0036] Said vortex chamber 5 directs the tangential flow from the cylindrical insert 4 to the discharge orifice 6 with an increasing flow velocity, with a value of the acceleration which depends on the shape and dimension of the vortex chamber 5.

[0037] A description of further embodiments of the present invention is given below with reference to the figures.

[0038] According to one embodiment, the outer part of the hollow body 1 has threading in the upper part (not depicted in the drawings) and a hexagonal profile 2 in the middle part, in order to allow the mounting thereof, for example on the fluid delivery line.

[0039] According to one embodiment, the distance between the middle axis O-O of nozzle 100 (both of body 1 and of insert 4) and the axis f-f of portion 3M of each channel 3 may vary according to the flow and spray angle

of flow 13 to be obtained.

[0040] According to one embodiment, the angle between said middle axis O-O and the bigger middle axis g-g of hole 9 (indicated as angle α) affects the angular velocity of the flow in the vortex chamber 5 and may vary according to the spray angle and the flow rate required.

[0041] The channels or ducts 3 have the middle axis thereof parallel to the longitudinal axis O-O of nozzle 100 (of body 1 and of insert 4) and the initial portion (at surface 4M) 14 of each channel 3 is tapered in order to reduce the loss of pressure of the fluid at the inlet into channel 3 in direction 12.

[0042] Figure 6a shows a bottom view of the cylindrical insert 4. According to this embodiment, the line which joins the middle axis O-O of said cylindrical insert with the center of hole 9 at the lower base (surface 4V) of said cylindrical insert 4 meets the outer circumference of said cylindrical insert 4 at point G.

[0043] The angle formed by the line tangent to the outer circumference of said insert 4 at point G and said axis g-g of hole 9 is indicated as angle β .

[0044] Figure 7b shows angle α between said middle axis O-O of said cylindrical insert 4 and the middle axis g-g of hole 9.

[0045] Angle β in Figure 6a is identified as angle β''' in Figures 8a, 8b, and 8c.

[0046] Figures 9a, 9b and 9c show three corresponding views of the cylindrical insert 4 according to the embodiment with two channels 3 and two holes 9.

[0047] According to the definition given with reference to Figure 6a, the related angle β is identified as angle β'' .

[0048] Figures 10a, 10b and 10c show three corresponding views of the cylindrical insert 4 according to the embodiment, with one peripheral channel 3 and one hole 9. According to the definition given above with reference to Figure 6a, the related angle β is identified as angle β' .

[0049] Figure 11 shows an axial section of the embodiment of insert 4 with the convex lower face (surface 4V).

[0050] Figure 12 shows an axial section of the embodiment of insert 4 with the frustoconical outer lower face (surface 4V).

[0051] Figure 13 shows an axial section of the embodiment of insert 4 with the concave lower face (surface 4V).

[0052] Figure 14 shows an axial section of the embodiment of insert 4 with the conical inner lower face.

[0053] It has thus been demonstrated by means of the above-detailed description of the embodiments of the present invention depicted in the drawings that the present invention allows the preset objects to be achieved.

[0054] Indeed a sprayer nozzle is provided by means of the present invention, in particular for generating circular cone-shaped jets which, in the path which conveys the liquid towards the outlet orifice, forsee the insertion of an element - defined as cylindrical insert - in the upper part, which forces the fluid to take on a component of tangential rotary velocity in the wall of the chamber itself which leads to the orifice, defined as vortex chamber.

[0055] Said cylindrical insert is provided with one or more channels, which are partly rectilinear and parallel to the longitudinal axis of the insert, which originate on the face upstream of the insert, said channels being achievable without any limitation with regard to the distance between the axis thereof and the middle symmetry axis of said insert, said channels also being achievable according to simple and affordable methods, for example by means of cutting and/or similar processes.

[0056] Said cylindrical insert is also provided with one or more holes on the face downstream of the insert, and which are defined by the intersection of said rectilinear channels with the face downstream of the cylindrical insert.

[0057] The significant angles formed by said holes are:

- Angle formed between the direction of the flow emitted from said insert and the middle axis of said nozzle measured on the vertical section of said nozzle. (Defined angle α in the preceding description)
- Angle formed between the direction of the flow emitted from said insert and the middle axis of said nozzle measured on the horizontal section of said nozzle. (Defined angle β in the preceding description)

[0058] The flow oriented to be emitted from the cylindrical insert enters the vortex chamber.

[0059] The vortex chamber has a cross section which reduces in direction of the outlet orifice, thereby causing an increase of the velocity of the fluid flowing through it. The tangential velocity component of the fluid flow at the outlet of the orifice generates a jet which widens on the fluid vein it generates because it is subjected to centrifugal force.

[0060] The drops of fluid into which the fluid flow breaks as soon as it leaves the edge of the orifice thus have a velocity with two components, an axial and a radial component, which values determine the width of the angle formed by the jet and the horizontal range of the jet away from the nozzle.

[0061] Said tangential velocity of the fluid is affected by various factors, the main ones being:

- Said angle α ;
- Said angle β ;
- Number of axial channels of said insert and area of the cross section of each of said channels;
- Ratio between total cross section of the axial channels and the cross section of the vortex chamber;
- Shape and length of the vortex chamber.

[0062] The main effect of said tangential component in flow direction is the creation of a zone having greater pressure in the peripheral zone of said vortex chamber, and accordingly a zone having less pressure in the middle part of said vortex chamber. Said difference in pressure between the middle part and the peripheral part of the vortex chamber directly affects the spray angle and the

distribution of the flow of liquid inside the cone which is generated at the outlet of the nozzle.

[0063] Therefore, the values of the angles α and β , and the diameters of the channels and of the holes which supply the fluid to the vortex chamber, are parameters determined by the tangential flow of liquid entering the vortex chamber.

[0064] Said angles α and β can be modified by acting on the production parameters of the sole hole originating downstream of the insert, the modification thereof may be performed in subtle and continuous manner, without any production limitation other than that caused by the geometry of the cylindrical insert, and therefore they are a significant simplification with respect to the production methods currently used for manufacturing a cone nozzle.

[0065] Moreover, unlike other inserts which, due to the type of process with which they are constructed, do not allow high values of angle α to be achieved, the construction type of the insert according to the present invention allows values up to 75° to be reached for said angle α .

[0066] According to one embodiment, the lower base of the cylindrical insert is concave.

[0067] According to one embodiment, the lower base of the cylindrical insert is convex.

[0068] According to one embodiment, the lower base of the cylindrical insert is conical, with the cone facing the outer part of the cylindrical insert.

[0069] According to one embodiment, the lower base of the cylindrical insert is conical, with the cone facing the inner part of the cylindrical insert.

[0070] According to one embodiment, the lower base of the cylindrical insert is frustoconical, with the truncated cone facing the outer part of the cylindrical insert.

[0071] Although the present invention was clarified by means of the above detailed description of the embodiments thereof depicted in the drawings, the present invention is not limited to the embodiments described and depicted in the drawings.

[0072] On the contrary, the object of the present invention is defined by the claims.

Claims

1. An insert (4) for hydraulic nozzles (100), in particular for hydraulic nozzles (100) adapted to form a substantially conical spray or jet of a fluid, said insert (4) comprising a rigid body which extends in a longitudinal extension direction (12) between a first outer end surface (4M) and a second outer end surface (4V) opposite to said first outer end surface (4M), said first (4M) and second (4V) outer end surfaces being joined by a radial outer surface (4R), said insert (4) comprising at least one channel or duct (3) for the passage of a fluid which extends between said first (4M) and second (4V) outer end surfaces, wherein said at least one channel or duct (3) comprises a first portion (3M) which extends from said first outer end surface (4M) in a direction substantially parallel to said longitudinal extension direction (12) of said rigid body, and wherein said at least one channel or duct (3) comprises a second portion (3V) which extends from said first portion (3M) to said second outer end surface (4V) in an oblique direction (g-g) with respect to said longitudinal extension direction (12) of said rigid body, **characterized in that** said second portion (3V) of said at least one channel or duct (3) extends inside said rigid body and is thus bounded by a radial closed surface.
2. An insert (4) according to claim 1, **characterized in that** said first portion (3M) of said at least one channel or duct (3) consists of a groove which extends from said radial outer surface (4R) for a predefined depth, thus defining a longitudinal opening (3A) through which the inside of said groove communicates with the outside of said rigid body.
3. An insert (4) according to one of the claims from 1 to 2, **characterized in that** the angle α between said longitudinal extension axis (12) of said rigid body and the longitudinal extension axis (g-g) of said second portion (3V) of said at least one channel or duct (3) is between 10° and 75°.
4. An insert (4) according to claim 3, **characterized in that** said second outer end surface (4V) is substantially perpendicular to said longitudinal extension axis (12) of said rigid body, **and in that** the intersection of said second portion (3V) of said at least one channel or duct (3) with said second end surface (4V) defines a substantially elliptical outlet section (9).
5. An insert (4) according to claim 4, **characterized in that** the angle β between the tangent to said radial surface (4R) of said rigid body in the point of intersection between the straight line which joins said longitudinal extension axis (12) of said rigid body and the center of said substantially elliptical hole (9) and the bigger axis of said substantially elliptical hole (9) is between 0° and 50°.
6. A hydraulic nozzle (100), in particular for forming a substantially conical spray or jet of a fluid, said nozzle (100) comprising a body (1) with a housing cavity and an insert (4) housed in said housing cavity to define a vortex chamber (5) for creating a vortex of said fluid which communicates with the outside through an orifice, **characterized in that** said insert (4) is an insert according to one of the claims from 1 to 5.
7. A nozzle (100) according to claim 6, **characterized in that** said housing cavity comprises a first portion engaged by said insert (4) with a shape and inner dimensions substantially corresponding to the shape

and outer dimensions of said insert (4), and a second portion not engaged by said insert, **and in that** said vortex chamber (5) is delimited by an inner surface which comprises said second end surface (4V) of said insert.

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8. A nozzle (100) according to claim 7, **characterized in that** the inner surface of said vortex chamber comprises a portion which lies on a substantially spherical, frustoconical or flat reference surface.

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9. A nozzle (100) according to one of the claims from 6 to 8, **characterized in that** said orifice comprises a first substantially cylindrical portion (6) which extends from said vortex chamber (5) towards the outside, and a second substantially frustoconical, radiused or flat portion (7) which extends from said first portion (6).

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FIG.1

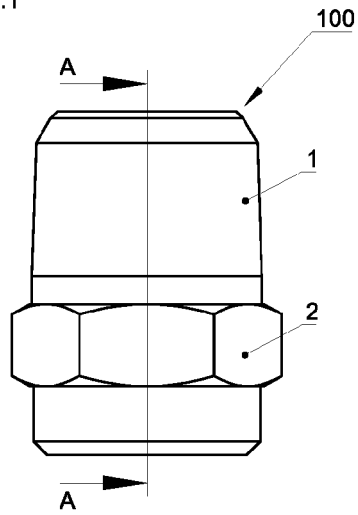


FIG.2

SECTION A-A

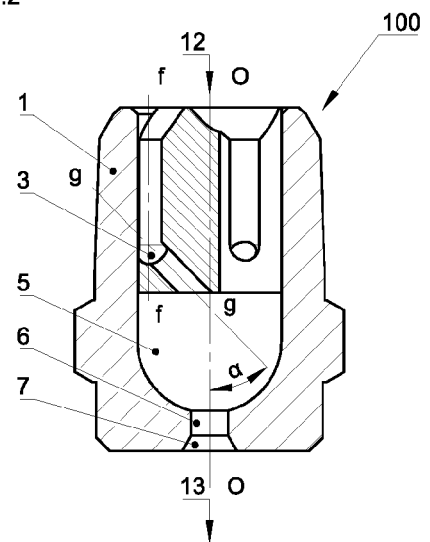


FIG.3

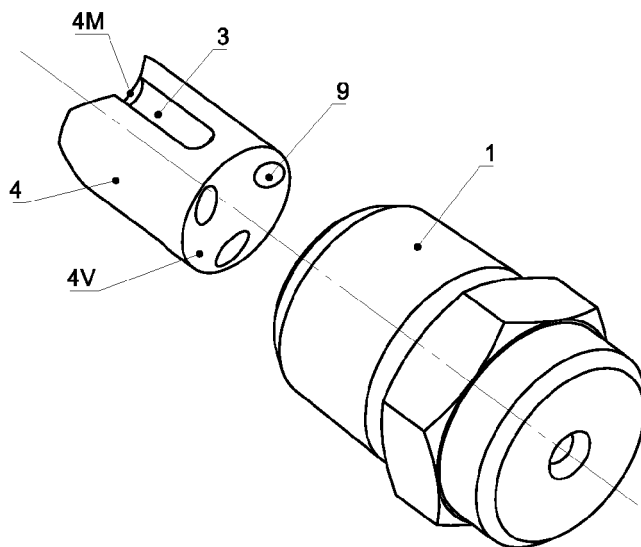


FIG.4

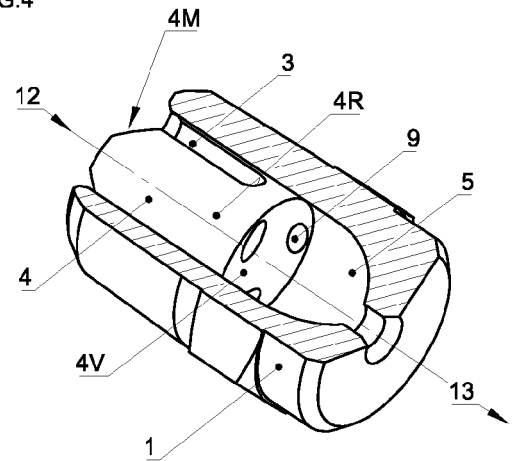


FIG.5

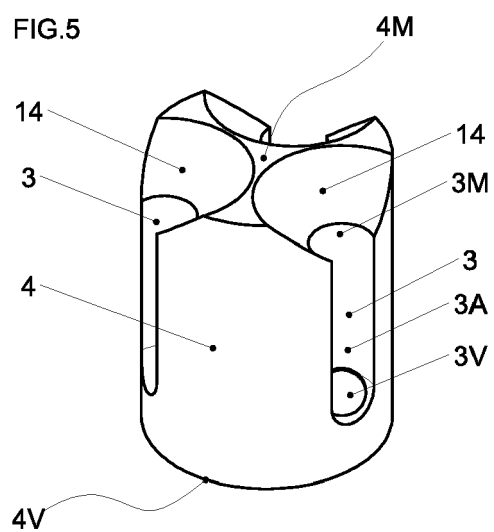


FIG.7b

SECTION B-B

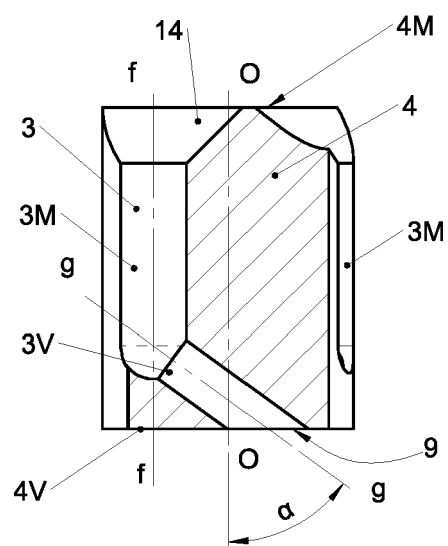


FIG.6a

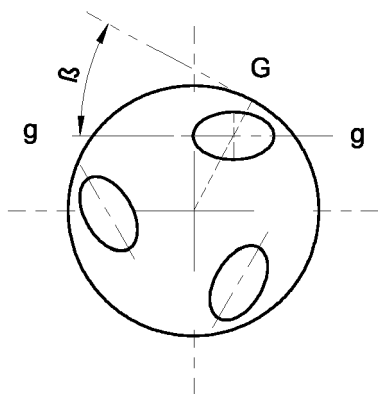


FIG.6b

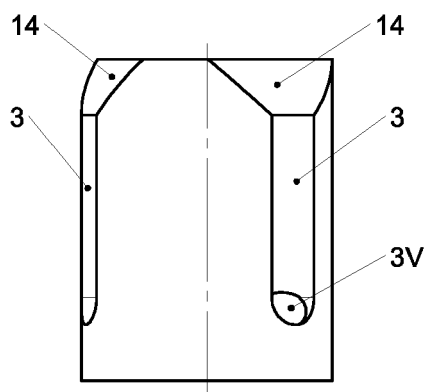
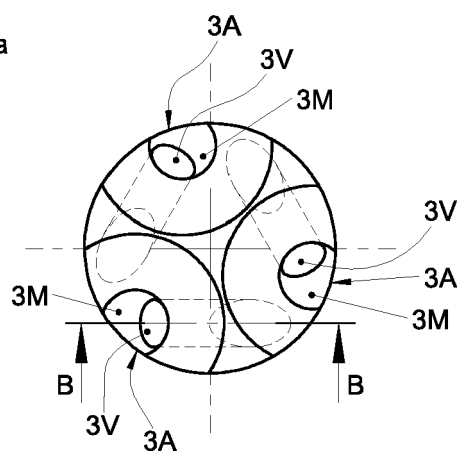


FIG.7a



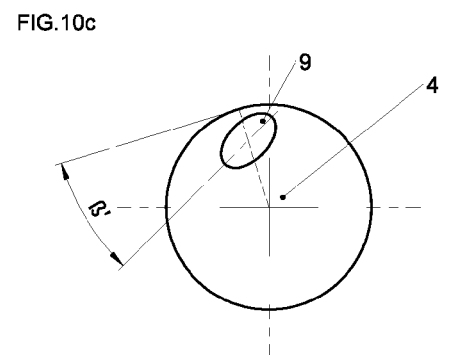
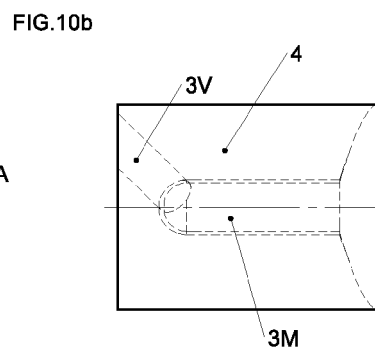
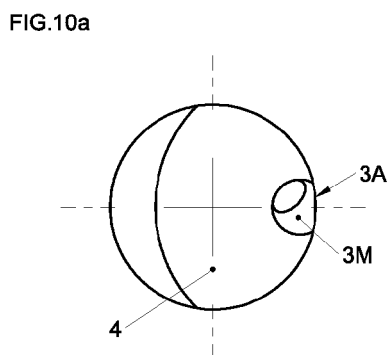
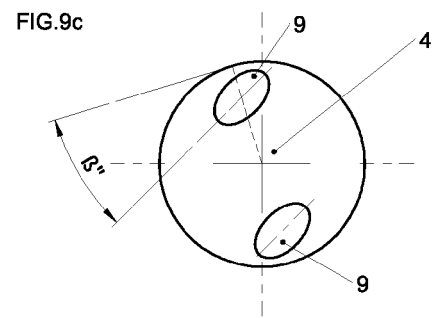
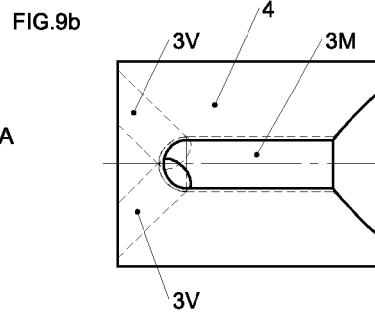
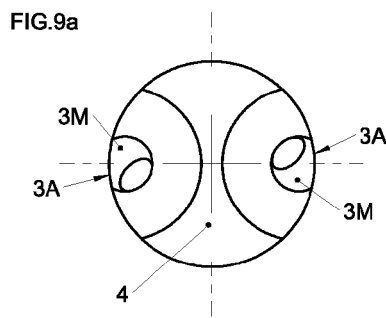
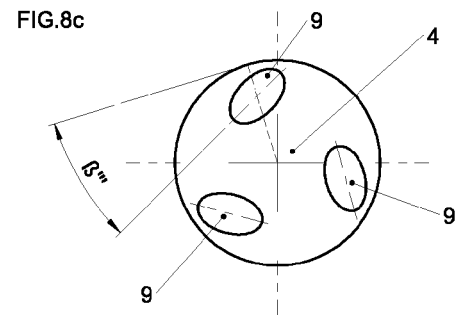
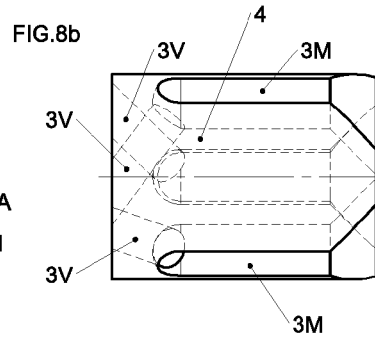
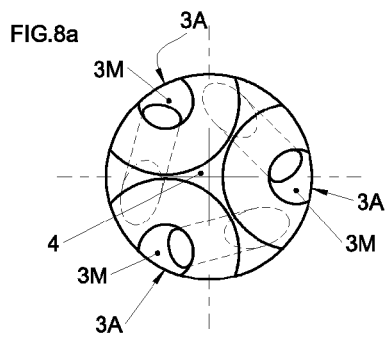


FIG.11

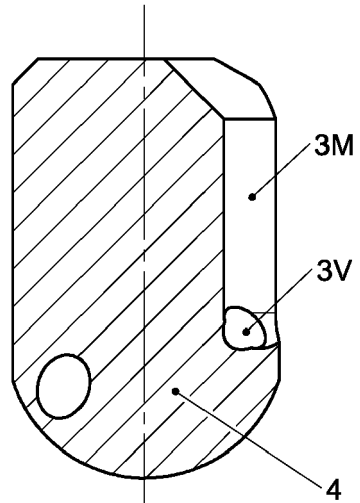


FIG.12

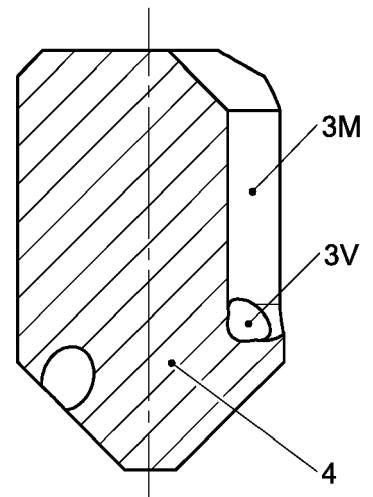


FIG.13

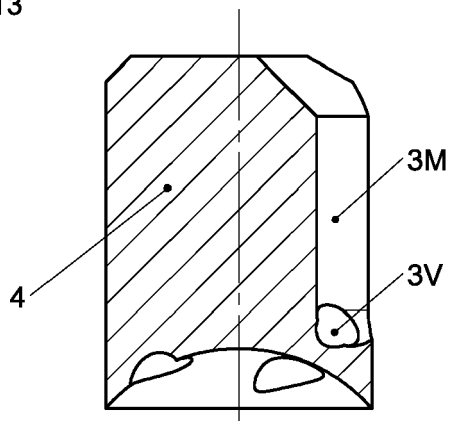
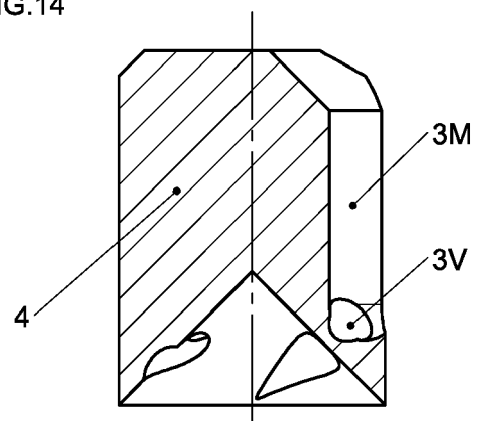


FIG.14





EUROPEAN SEARCH REPORT

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Place of search Munich		Date of completion of the search 11 April 2019	Examiner Rente, Tanja
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			

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