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(54) **Device for plasma cutting**

Plasmaschneidgerät

Dispositif de coupage par plasma

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Description

[0001] The present invention relates to the technical field concerning the plasma jet devices and it refers to a torch device for plasma cutting, manually or mechanically operated.

[0002] There are known plasma torch devices provided with an electrode contained in a nozzle and separated from this latter by means of an interspace flowed by a gas, generally air, fit to form the plasma jet coming out from a hole of the nozzle and for cutting metallic pieces.

[0003] The nozzle is sometimes cooled by air flowing trough an interspace delimited by a sleeve, external to the nozzle, and by the latter.

[0004] Document US4029930A discloses an underwater wire welding torch having an external sleeve, a nozzle equipped with an exit for the plasma jet and separated from the external sleeve by a cavity, said jet flowing outside at least through an opening of said sleeve and said nozzle having a protrusion with the exit, said protrusion being housed in the opening of the external sleeve said protrusion being approximately truncated cone shaped with side wall that diverges in the direction of an external outlet of the exit.

[0005] Document EP0444346A discloses a plasma torch having an external sleeve, a nozzle equipped with an exit for the plasma jet, and separated from the external sleeve by means of a cavity, said jet flowing outside at least through an opening of said sleeve and said nozzle having a protrusion having said exit, said protrusion being approximately truncated cone shaped with side wall that diverges in the direction of an external outlet of the exit. It furthermore discloses a compressor for flowing a cooling fluid consisting of compressed air through said cavity.

[0006] Documents WO91/02619A and EP0735805 disclose respective plasma are torches.

[0007] The main drawback of said known devices consists in that the cooling air, coming out from the interspace, interferes with the plasma reducing the cutting efficiency thereof.

[0008] Other drawback consists in the small cooling capability of the end portions of the nozzle and of the sleeve.

[0009] An object of the present invention is to propose a device for plasma cutting having a very good cooling also of the end portions of nozzle and of sleeve and fit to produce a not disturbed plasma jet and thus very efficient. Other object is to propose a torch having high reliability and a long life nozzle.

[0010] The above-mentioned objects are achieved according to claim content.

[0011] The characteristics of the present invention are underlined in the following, with particular reference to the attached drawings, in which:

- figure 1 shows a partial and schematic view of device of the present invention in which some parts have been removed for better underlining others;
- figure 2 shows a schematic enlarged longitudinal section view of a nozzle of figure 1 device;
- figure 3 shows a schematic enlarged section view of a sleeve of figure 1 device;
- figure 4 shows a section view according to plane IV - IV of figure 3;
- figure 5 shows a front view of a variant of the sleeve of figure 3;
- figure 6 shows a longitudinal section view of the sleeve of figure 5;
- figure 7 shows a section view according to plane VII-VII of figure 6;
- figure 8 shows a front view of a variant of figure 2 nozzle;
- figure 9 shows a side view of the figure 8 nozzle.

[0012] Referring to figures 1 to 4, numeral 1 designates the device for plasma cutting, of pneumatic or electric high frequency arc striking or equivalents of the present invention and particularly fit for robotized arms and generally for automatic plasma cutting systems.

[0013] The device 1 is provided with an external sleeve 2 for a hollow nozzle 3 containing an electrode and provided with an exit 4 from whose external outlet 9 the plasma jet 30, provided for cutting, comes out.

[0014] A tubular wall shaped cavity 5 separates the external sleeve 2 from the nozzle 3 guaranteeing the mutual isolation. The cavity 5 is flowed by a cooling fluid F for the nozzle 3 and for the sleeve 2, consisting of compressed air produced by an external compressor and flowed in the cavity 5 by means of known and not shown ducts. The fluid F flows outside the device 1 through an opening 6 and a plurality of holes 15 of the external sleeve 2.

[0015] The nozzle 3 has a protrusion 7, nearly coaxial to the said nozzle, in which the exit 4 for the plasma is carried out. Said protrusion is approximately truncated cone shaped with a side wall 8 divergent in direction of the external outlet 9 of the exit 4 to deflect the cooling fluid F in direction of leaving from the plasma jet 30 in order to avoid disturbing, or perturbing, this latter. The length, or the axial extension, of the protrusion 7 is proportional to the value of the feeding electric current of the plasma jet 30 of the device 1.The maximum diameter of the protrusion 7 is smaller than that of the remaining cylindrical part of the nozzle 3 and it is smaller than the minimum diameter of the opening 6.

[0016] In an assemblage condition of the device 1, the protrusion 7 is housed in the opening 6 of the external sleeve 2. Said opening 6 has an inner wall 10 having a first portion 11 approximately conical shaped and facing the side wall 8 of the protrusion 7. The first portion 11 of the opening 6 is divergent toward the outside of the sleeve 2 and defines an angle B equal to the angle A, defined by the side wall 8 of the protrusion 7.

[0017] Alternatively, the invention also provides that the angle B of the inner wall 10 is greater than the angle A of protrusion 7 to realize a divergent tubular duct with

sections for the passage of the cooling fluid F that increase very quickly toward the outside of the device 1.

[0018] The angles A and B of the protrusion 7 and of the first portion 11 of opening 6 range between 4° and 120°, and preferably they have respective values of around 14° - 20°.

[0019] Upstream the opening 6, in comparison to the fluid F flow , the nozzle 3 and the sleeve 2 have respective linking walls 13, 14 side by side arranged and approximately conical shaped convergent toward the opening 6 and fit to join the side wall 8 of the protrusion 7 and the inner wall 10 of the opening 6 with the portion of the cavity 5 corresponding to the cylindrical portion of the nozzle 3.

[0020] The holes 15 have axis that are parallel to the axis of the exit 4 of the nozzle 3, and they flow inside the device into an annular groove 16, carried out in the inner wall of the sleeve 2 upstream the opening 6; the annular groove 16 has a cylindrically shaped wall 17 for narrowing the cavity 5.

[0021] The external exits of the holes 15 face deflector means 18 consisting of an external portion 19, nearly conic and divergent, of the sleeve 2 fit to deflect the fluid flow coming out from said holes 15 in a direction away from the plasma jet 30.

[0022] The sleeve 2 is detachably fixed to the device 1 by dap joint means or threaded means 20.

[0023] The operation of the device 1 provides that the plasma 30 coming out from the device forms a jet almost rectilinear and unperturbed thanks to the radial deflection toward the outside of the cooling fluid F, performed by the divergent conicity of the side wall 8 of the protrusion 7, of the inner wall 10 of the opening 6 and by the deflector means 18. Said radial deflection allows to increase the total flow of the cooling fluid F advantageously ensuring a better cooling of the nozzle 3 and of the sleeve 2.

[0024] The variant of the sleeve 2 of figures 5 to 7 is particularly suitable for manually operated devices.

[0025] The inner wall 10 of the opening 6 of said variant has a second portion 12, externally located with respect to the first portion 11 and similarly having a truncate cone shape defining an angle C bigger than the angle B of the first portion 11.

The external edge of the sleeve 2, at the second portion 12 of the opening 6, has a plurality of recesses 23 for the passage of fluid F coming from the opening 6, in a contact condition of the sleeve 2 with the piece to be cut. The angle C of the second portion 12 of the opening 6 ranges between 40° and 160°, preferably 60°.

[0026] In the variant of figures 8 and 9, the conic linking wall 13 of the nozzle 3 and the side wall 8 of the protrusion 7 have respective pluralities of grooves 35, 36 arranged according to the straight generating lines of the respective cones.

[0027] Said grooves 35, 36 increase the thermal exchange between the portion of the nozzle 3 next to the exit of the plasma 30 and the cooling fluid F providing an advantageous reduction of the temperature for increasing the life of the nozzle 3.

[0028] Besides the invention provides that the grooves 35, 36 can be tilted, in concordant directions, to obtain a further improvement of cooling.

[0029] In the device 1 including variants of figures 5 to 9, the angle B of first portion 11 of the opening 6 of the sleeve 2 is greater than the angle A of protrusion 7 of the nozzle 3. Such angle A of protrusion 7 ranges between 4° and 26°, preferably 16°, and said angle B of first portion 11 of the opening 6 ranges between 10° and 30°, preferably 20°.

[0030] The present invention further provides that the sleeve 2 and the nozzle 3 could be elongated and that the axial length/maximum diameter ratio of each of them could be up to about 3 or 4. More precisely, said ratio of the sleeve 2 could range from 0,6 to 2,5 and the ratio of the nozzle 3 could range from 1 to 4.

[0031] Preferably, to improve cooling and, in the same time, to facilitate the operation in internal corners, grooves and recesses, the axial length/maximum diameter ratio of the sleeve 2 is about 1 - 1,5 and that the ratio of the nozzle 3 is about 2. Of course the electrode could be elongated accordingly to the nozzle length.

[0032] The main advantage of the present invention is to provide a device for plasma cutting having a very good cooling also of the end portions of the nozzle and the sleeve and also fit for producing an unperturbed plasma jet and therefore very efficient.

[0033] Other advantage is to provide a high reliability torch and a long life nozzle.

Claims

1. Device (1) for plasma cutting provided with an external sleeve (2) and a nozzle (3), said external sleeve being external to the nozzle, said nozzle being equipped with an exit (4) for the plasma jet (30), said exit having an external outlet (9), said nozzle (3) being separated from the external sleeve (2) by means of a cavity (5) and said plasma jet (30) being arranged, in operation, to flow outside at least through an opening (6) of said external sleeve (2); the device further comprising a compressor arranged, in operation, to produce a cooling fluid (F) consisting of compressed air which is arranged to flow through the cavity (5); the nozzle having a protrusion (7), said protrusion having the exit (4) and said protrusion being housed in the opening (6) of said external sleeve (2); said protrusion being approximately truncated cone shaped with side wall that diverges in the direction of the external outlet (9) of the exit (4), in order to deflect said cooling fluid (F) in a direction away from the plasma jet (30).

2. Device according to claim 1 wherein the opening (6) has an inner wall (10) having a first portion (11) approximately conic at least partially facing the side wall (8) of the protrusion (7).

3. Device according to claim 2 wherein the first portion (11) of the opening (6) is divergent toward the outside of the sleeve (2).

4. Device according to claim 3 wherein the angle (A) defined by the side wall (8) of the protrusion (7) is smaller than, or equal to, the angle (B) defined by the first portion (11) of the opening (6).

5. Device according to claim 2 wherein the inner wall (10) of the opening (6) has a second portion (12) approximately conic.

6. Device according to claim 5 wherein the angle (B) defined by the first portion (11) of the opening (6) is smaller than the angle (C) defined by the second portion (12) of the same opening (6).

7. Device according to claim 1 wherein upstream the opening (6) with respect to the flow of fluid (F), the nozzle (3) and the sleeve (2) have respective faced and approximately conical shaped linking walls (13, 14), converging towards the opening (6).

8. Device according to claim 1 wherein, upstream the opening (6), the sleeve (2) has a plurality of holes (15) for the partial exit of the fluid (F).

9. Device according to claim 8 wherein the axis of holes (15) of the sleeve (2) are parallel to the axis of the exit (4) of the nozzle (3).

10. Device according to claim 8 wherein the holes (15) flow into an annular groove (16) carried out inside the sleeve (2).

11. Device according to claim 10 wherein the annular groove (16) has a wall (17) for narrowing the cavity (5).

12. Device according to claim 8 wherein the external exits of the holes (15) face deflector means (18).

13. _Device according to claim 12 wherein the deflector means (18) consist of an external nearly conic portion (19) of sleeve (2).

14. Device according to claim 1 wherein the maximum diameter of protrusion (7) is smaller than that of the cylindrical part of nozzle (3).

15. Device according to claim 1 wherein the external edge of sleeve (2) has a plurality of recesses (23).

16. Device according to claims 5 and 15 wherein the recesses (23) are carried out at the second portion (12) of opening (6).

17. Device according to claim 1 wherein the sleeve (2) is detachably fixed to the device (1) by dap joint means or threaded means (20).

18. Device according to claims 4 and 6 wherein the angle (A) of the protrusion (7), the angles (B, C) of the portions first (11) and second (12) of the opening (6) have measures respectively between 4° and 26°, between 10° and 30°, between 40° and 160°.

19. Device according to claim 7 wherein the linking wall (13) of the nozzle (3) has a plurality of grooves (35).

20. Device according to claim 1 wherein the side wall (8) of protrusion (7) has a plurality of grooves (36).

21. Device according to claims 19 and 20 wherein the grooves (35, 36) of linking wall (13) and of side wall (8) of the nozzle (3) are arranged according to the straight generating lines of the respective cones.

22. Device according to claims 19 and 20 wherein the grooves (35, 36) of linking wall (13) and of side wall (8) are tilted with respect to the straight generating lines of the respective cones.

23. Device according to claim 1 wherein the sleeve (2) and the nozzle (3) have elongated shape.

24. Device according to claim 23 wherein the sleeve (2) and the nozzle (3) have the axial length/maximum diameter ratios respectively ranging from 0,6 to 2,5 and from 1 to 4.

Patentansprüche

1. Vorrichtung (1) zum Plasmaschneiden, versehen mit einer äußeren Hülse (2) und einer Düse (3), wobei sich die äußere Hülse (2) außen an der Düse befindet, die Düse mit einem Austritt (4) für den Plasmastrahl (30) ausgestattet ist, der Austritt einen äußeren Auslass (9) aufweist, die Düse (3) mit Hilfe eines Hohlraums (5) von der äußeren Hülse (2) getrennt ist und der Plasmastrahl (30) bei Betrieb wenigstens durch eine Öffnung (6) der äußeren Hülse (2) hindurch nach außen strömen kann; wobei die Vorrichtung außerdem einen Kompressor umfasst, der bei Betrieb ein aus Druckluft bestehendes Kühlmedium (F) erzeugen kann, das den Hohlraum (5) durchströmen kann; die Düse einen Vorsprung (7) aufweist, wobei der Vorsprung den Austritt (4) aufweist und der Vorsprung in der Öffnung (6) der äußeren Hülse (2) untergebracht ist; wobei der Vorsprung annähernd die Form eines Kegelstumpfes mit einer Seitenwand besitzt, die in der Richtung des äußeren Auslasses (9) des Austritts (4) auseinanderläuft, um das Kühlmedium (F) in Richtung von dem Plasma-

strahl (30) weg abzulenken.

2. Vorrichtung nach Anspruch 1, wobei die Öffnung (6) eine Innenwand (10) mit einem ersten, annähernd konischen Abschnitt (11) aufweist, der wenigstens teilweise zu der Seitenwand (8) des Vorsprungs (7) weist.

3. Vorrichtung nach Anspruch 2, wobei der erste Abschnitt (11) der Öffnung (6) in Richtung zu der Außenseite der Hülse (2) auseinanderläuft.

4. Vorrichtung nach Anspruch 3, wobei der von der Seitenwand (8) des Vorsprungs (7) gebildete Winkel (A) kleiner als der von dem ersten Abschnitt (11) der Öffnung (6) gebildete Winkel (B) oder gleich diesem ist.

5. Vorrichtung nach Anspruch 2, wobei die Innenwand (10) der Öffnung (6) einen zweiten, annähernd konischen Abschnitt (12) aufweist.

6. Vorrichtung nach Anspruch 5, wobei der von dem ersten Abschnitt (11) der Öffnung (6) gebildete Winkel (B) kleiner als der von dem zweiten Abschnitt (12) der gleichen Öffnung (6) gebildete Winkel (C) ist.

7. Vorrichtung nach Anspruch 1, wobei die Düse (3) und die Hülse (2) stromauf der Öffnung (6) in Bezug auf den Strom des Mediums (F) einander gegenüberliegende und annähernd konisch geformte Verbindungswände (13, 14) aufweisen, die in Richtung zu der Öffnung (6) zusammenlaufen.

8. Vorrichtung nach Anspruch 1, wobei die Hülse (2) stromauf der Öffnung (6) mehrere Bohrungen (15) für den Teilaustritt des Mediums (F) aufweisen.

9. Vorrichtung nach Anspruch 8, wobei die Achse der Bohrungen (15) der Hülse (2) parallel zu der Achse des Austritts (4) der Düse (3) ist.

10. Vorrichtung nach Anspruch 8, wobei die Bohrungen (15) in eine Ringnut (16) münden, die im Innern der Hülse (2) ausgeführt ist.

11. Vorrichtung nach Anspruch 10, wobei die Ringnut (16) eine Wand (17) zum Verengen des Hohlraums (5) aufweist.

12. Vorrichtung nach Anspruch 8, wobei die äußeren Austritte der Bohrungen (15) zu Ablenkungsmitteln (18) weisen.

13. Vorrichtung nach Anspruch 12, wobei die Ablenkungsmittel (18) aus einem äußeren, fast konischen Abschnitt (19) der Hülse (2) bestehen.

14. Vorrichtung nach Anspruch 1, wobei der maximale Durchmesser des Vorsprungs (7) kleiner als derjenige des zylindrischen Teils der Düse (3) ist.

15. Vorrichtung nach Anspruch 1, wobei der Außenrand der Düse (2) eine Mehrzahl von Ausnehmungen (23) aufweist.

16. Vorrichtung nach den Ansprüchen 5 und 15, wobei die Ausnehmungen (23) an dem zweiten Abschnitt (12) der Öffnung (6) ausgeführt sind.

17. Vorrichtung nach Anspruch 1, wobei die Hülse (2) mit Nutenverbindungs- oder Gewindemitteln (20) lösbar an der Vorrichtung (1) befestigt ist.

18. Vorrichtung nach den Ansprüchen 4 und 6, wobei der Winkel (A) des Vorsprungs (7), die Winkel (B, C) des ersten (11) und des zweiten (12) Abschnitts der Öffnung (6) jeweils Maße zwischen 4° und 26°, zwischen 10° und 30° und zwischen 40° und 160° aufweisen.

19. Vorrichtung nach Anspruch 7, wobei die Verbindungswand (13) der Düse (3) eine Vielzahl von Nuten (35) aufweist.

20. Vorrichtung nach Anspruch 1, wobei die Seitenwand (8) des Vorsprungs (7) eine Vielzahl von Nuten (35) aufweist.

21. Vorrichtung nach den Ansprüchen 19 und 20, wobei die Nuten (35, 36) der Verbindungswand (13) und der Seitenwand (8) der Düse (3) gemäß den Erzeugungsgeraden der jeweiligen Konen angeordnet sind.

22. Vorrichtung nach den Ansprüchen 19 und 20, wobei die Nuten (35, 36) der Verbindungswand (13) und der Seitenwand (8) in Bezug auf die Erzeugungsgeraden der jeweiligen Konen geneigt sind.

23. Vorrichtung nach Anspruch 1, wobei die Hülse (2) und die Düse (3) eine lang gestreckte Form aufweisen.

24. Vorrichtung nach Anspruch 23, wobei die Hülse (2) und die Düse (3) Axiallängen/Maximaldurchmesser-Verhältnisse aufweisen, die jeweils im Bereich von 0,6 bis 2,5 und von 1 bis 4 liegen.

Revendications

1. Dispositif de découpe au plasma (1) comportant un manchon externe (2) et une buse (3), ledit manchon externe se situant à l'extérieur de la buse, ladite buse comportant une évacuation (4) pour le jet de plasma

(30), ladite évacuation possédant une sortie externe (9), ladite buse (3) étant séparée du manchon externe (2) par une cavité (5) et ledit jet de plasma (30) étant conçu pour s'écouler, lors du fonctionnement, vers l'extérieur au moins à travers une ouverture (6) dudit manchon externe (2), lequel dispositif comprend en outre un compresseur conçu pour produire, lors du fonctionnement, un fluide de refroidissement (F) comprenant de l'air comprimé qui s'écoule à travers la cavité (5), la buse comportant une protubérance (7), ladite protubérance comportant l'évacuation (4) et ladite protubérance étant logée dans l'ouverture (6) dudit manchon externe (2), ladite protubérance ayant approximativement la forme d'un cône tronqué dont la paroi latérale diverge en direction de la sortie externe (9) de l'évacuation (4) afin de dévier ledit fluide de refroidissement (F) dans une direction où il s'écarte du jet de plasma (30).

2. Dispositif selon la revendication 1, dans lequel l'ouverture (6) possède une paroi interne (10) comportant une première partie (11) approximativement conique faisant face en partie au moins à la paroi latérale (8) de la protubérance (7).

3. Dispositif selon la revendication 2, dans lequel la première partie (11) de l'ouverture (6) diverge vers l'extérieur du manchon (2).

4. Dispositif selon la revendication 3, dans lequel l'angle (A) défini par la paroi latérale (8) de la protubérance (7) est inférieur ou égal à l'angle (B) défini par la première partie (11) de l'ouverture (6).

5. Dispositif selon la revendication 2, dans lequel la paroi interne (10) de l'ouverture (6) comprend une seconde partie (12) approximativement conique.

6. Dispositif selon la revendication 5, dans lequel l'angle (B) défini par la première partie (11) de l'ouverture (6) est inférieur à l'angle (C) défini par la seconde partie (12) de cette même ouverture (6).

7. Dispositif selon la revendication 1, dans lequel, en amont de l'ouverture (6) par rapport à l'écoulement de fluide (F), la buse (3) et le manchon (2) possèdent des parois de liaison respectives se faisant face et approximativement coniques (13, 14) qui convergent vers l'ouverture (6).

8. Dispositif selon la revendication 1, dans lequel, en amont de l'ouverture (6), le manchon (2) comporte plusieurs trous (15) pour l'évacuation partielle du fluide (F).

9. Dispositif selon la revendication 8, dans lequel les axes des trous (15) du manchon (2) sont parallèles à l'axe de l'évacuation (4) de la buse (3).

10. Dispositif selon la revendication 8, dans lequel les trous (15) donnent dans une gorge annulaire (16) formée à l'intérieur du manchon (2).

11. Dispositif selon la revendication 10, dans lequel la gorge annulaire (16) comprend une paroi (17) pour rétrécir la cavité (5).

12. Dispositif selon la revendication 8, dans lequel les évacuations externes des trous (15) font face à un moyen déflecteur (18).

13. Dispositif selon la revendication 12, dans lequel le moyen déflecteur (18) comprend une partie externe presque conique (19) du manchon (2).

14. Dispositif selon la revendication 1, dans lequel le diamètre maximal de la protubérance (7) est inférieur à celui de la partie cylindrique de la buse (3).

15. Dispositif selon la revendication 1, dans lequel le bord externe du manchon (2) comprend plusieurs renfoncements (23).

16. Dispositif selon les revendications 5 et 15, dans lequel les renfoncements (23) sont formés au niveau de la seconde partie (12) de l'ouverture (6).

17. Dispositif selon la revendication 1, dans lequel le manchon (2) est fixé de manière amovible au dispositif (1) par des moyens de type joint à encoche ou des moyens filetés (20).

18. Dispositif selon les revendications 4 et 6, dans lequel l'angle (A) de la protubérance (7), et les angles (B, C) des première (11) et seconde (12) parties de l'ouverture (6) mesurent respectivement de 4° à 26°, de 10° à 30°, et de 40° à 160°.

19. Dispositif selon la revendication 7, dans lequel la paroi de liaison (13) de la buse (3) comporte plusieurs gorges (35).

20. Dispositif selon la revendication 1, dans lequel la paroi latérale (8) de la protubérance (7) comporte plusieurs gorges (36).

21. Dispositif selon les revendications 19 et 20, dans lequel les gorges (35, 36) de la paroi de liaison (13) et de la paroi latérale (8) de la buse (3) sont orientées selon les lignes génératrices droites des cônes respectifs.

22. Dispositif selon les revendications 19 et 20, dans lequel les gorges (35, 36) de la paroi de liaison (13) et de la paroi latérale (8) sont inclinées par rapport aux lignes génératrices droites des cônes respectifs.

23. Dispositif selon la revendication 1, dans lequel le manchon (2) et la buse (3) ont une forme allongée.

24. Dispositif selon la revendication 23, dans lequel le manchon (2) et la buse (3) ont des rapports longueur axiale/diamètre maximal allant respectivement de 0,6 à 2,5 et de 1 à 4.

FIG.1

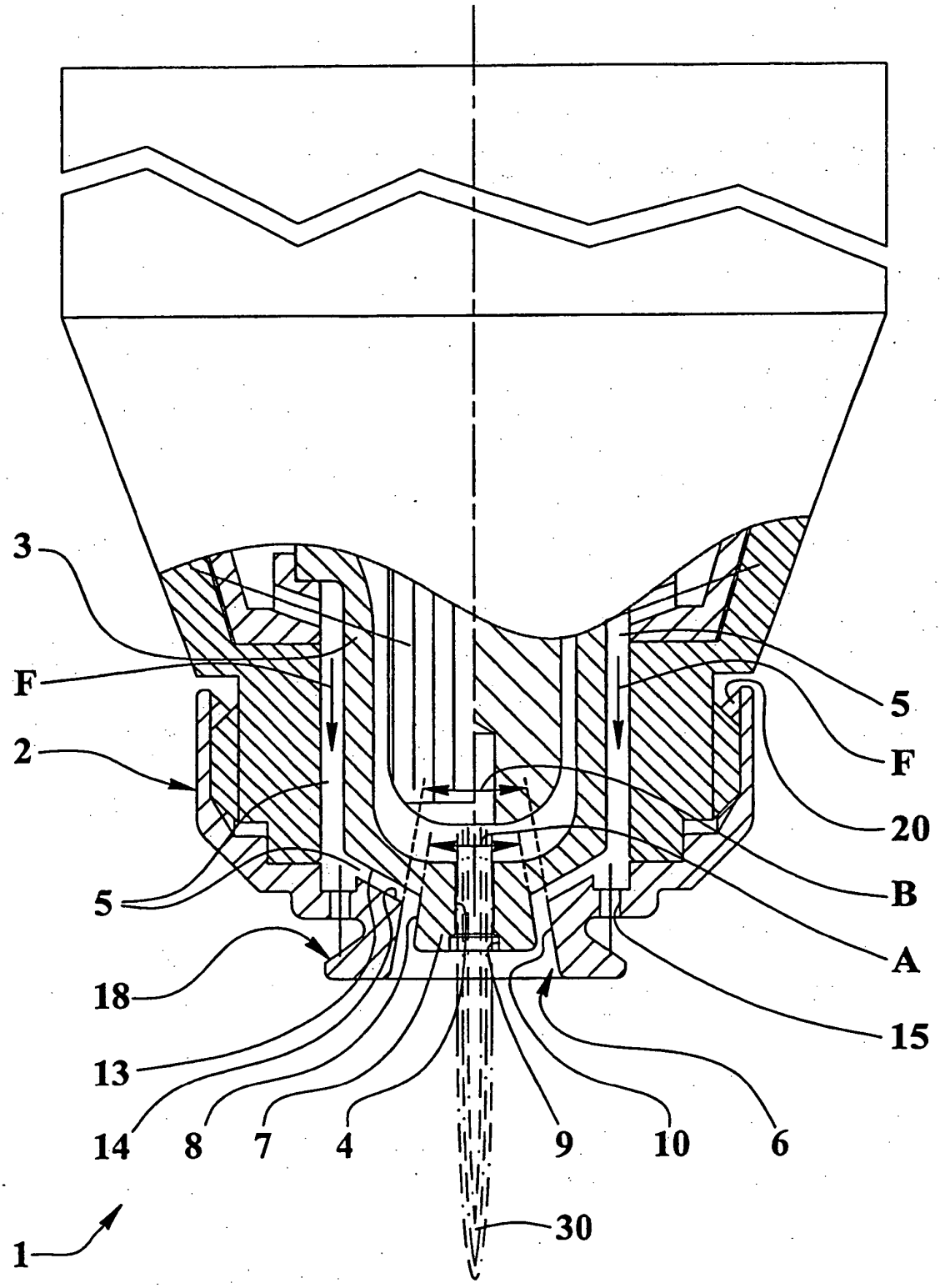
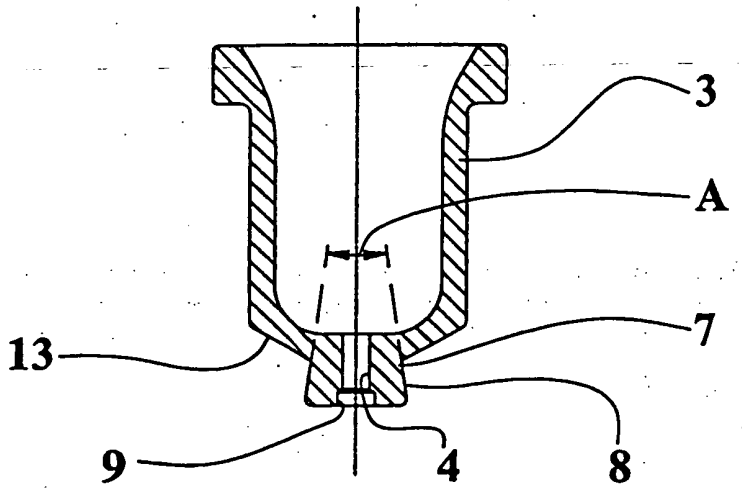


FIG.2



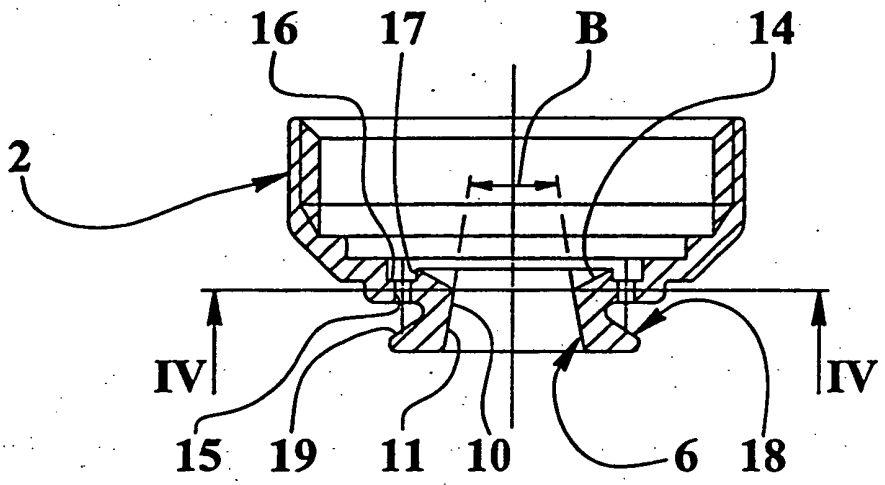


FIG.3

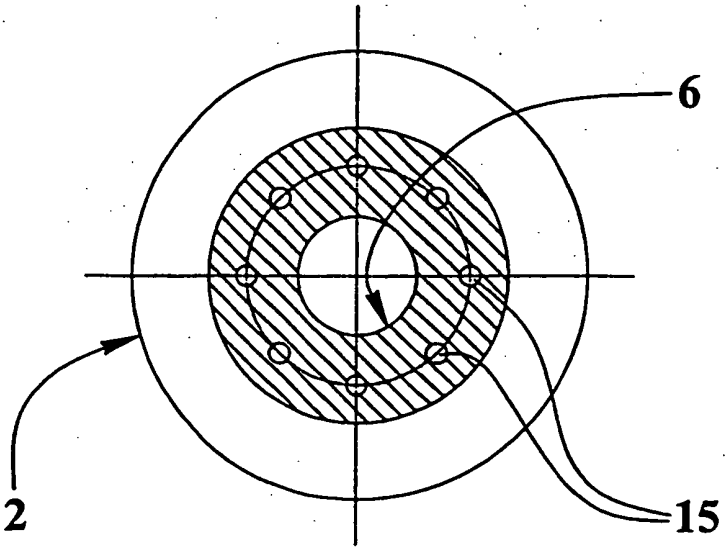
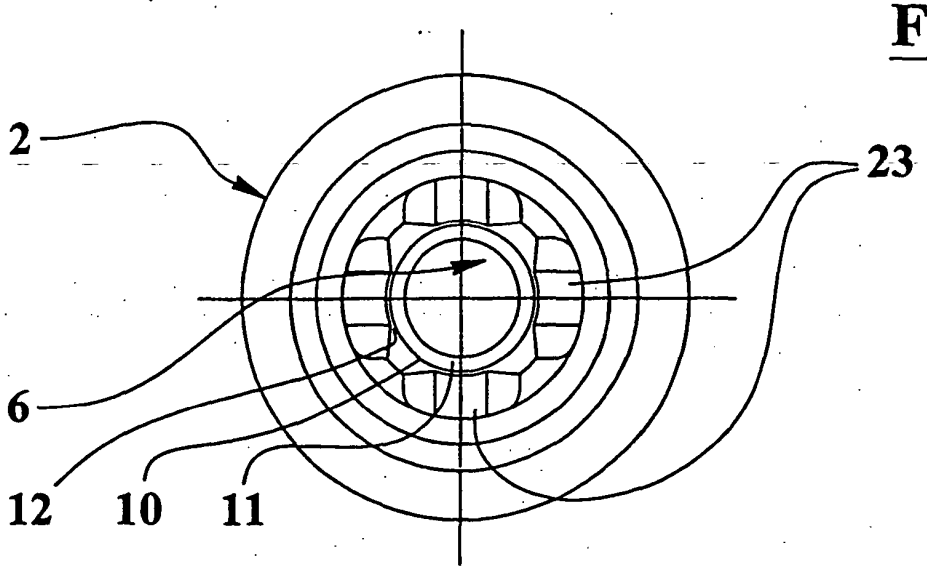


FIG.4

FIG.5



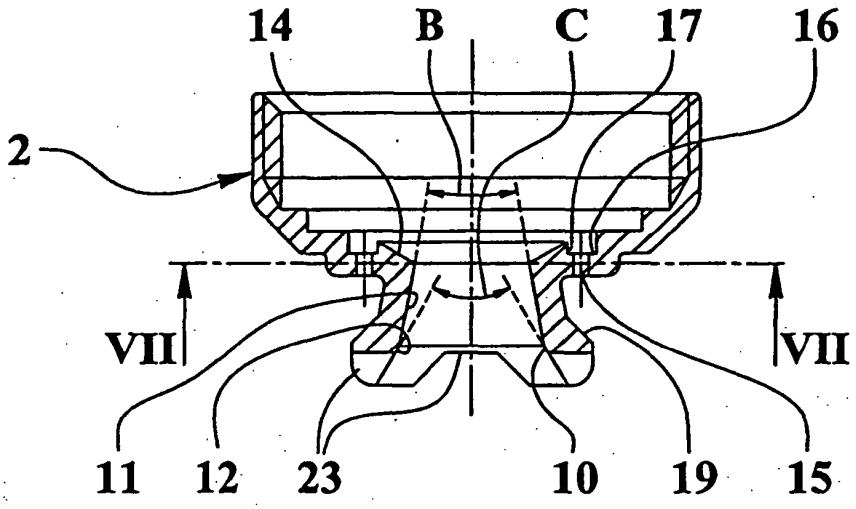


FIG.6

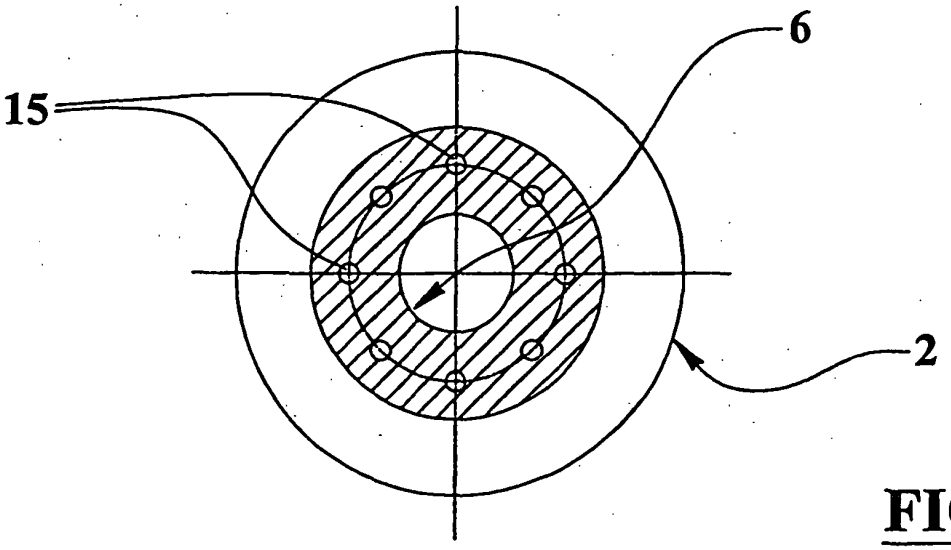
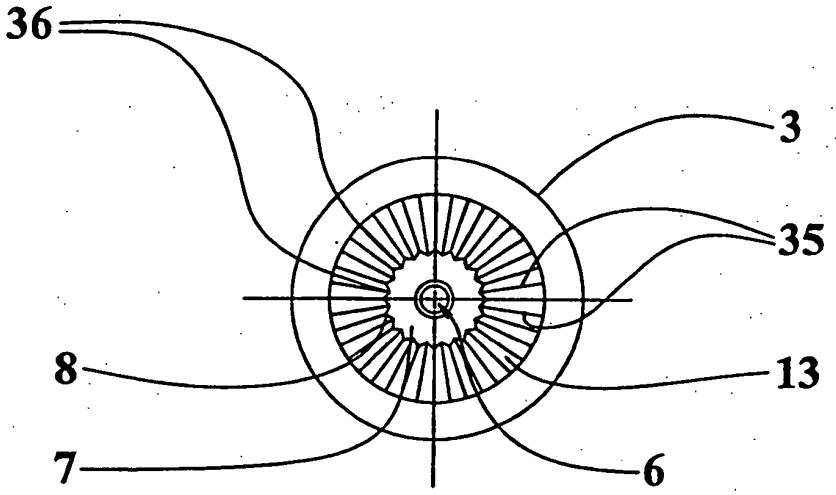


FIG.7

FIG.8



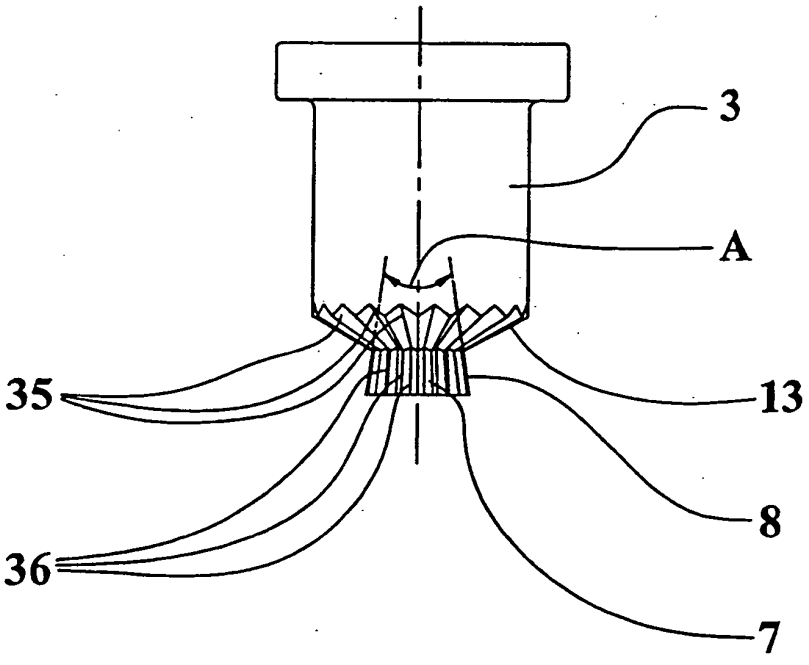


FIG.9

REFERENCES CITED IN THE DESCRIPTION

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