(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 395 097 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
03.03.2004 Bulletin 2004/10

(51) Int Cl.[7]: **H05H 1/34**

(21) Application number: **03018298.4**

(22) Date of filing: **12.08.2003**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(30) Priority: **30.08.2002 IT BO20020553**

(71) Applicant: **Tec.Mo S.r.l.**
40067 Rastignano (Bologna) (IT)

(72) Inventor: **Bassi, Giorgio, c/o TEC. MO S.R.L.**
40067 Rastignano (Bologna) (IT)

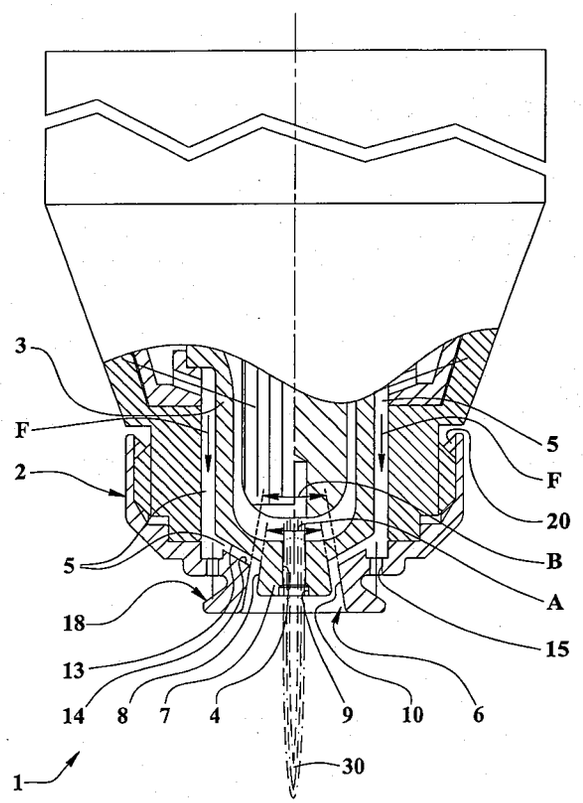
(74) Representative: **Negrini, Elena et al**
Agazzani & Associati S.r.l.
Via dell'Angelo Custode 11/6
40141 Bologna (IT)

(54) Device for plasma cutting

(57) A device for plasma cutting is provided with an external sleeve (2) for a nozzle (3) equipped with an exit (4) of the plasma jet (30) and separated by the external sleeve (2) by means of a cavity (5) outside flowing at least through an opening (6) of such sleeve (2).

The device (1) includes a protrusion (7) of the nozzle (3) carrying the exit (4) and being approximately truncated cone shaped with side wall (8) that diverges in the direction of the external outlet (9) of the exit (4) to deflect, in direction away from the jet (30), a cooling fluid (F) flowing trough the cavity (5).

FIG.1



EP 1 395 097 A2

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] 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.

[0005] Other drawback consists in the small cooling capability of the end portions of the nozzle and of the sleeve.

[0006] 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.

[0007] Other object is to propose a torch having high reliability and a long life nozzle.

[0008] The above-mentioned objects are achieved according to claim content.

[0009] 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.

[0010] 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.

[0011] 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.

[0012] 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.

[0013] 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.

[0014] 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.

[0015] 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.

[0016] 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°.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] The sleeve 2 is detachably fixed to the device 1 by dap joint means or threaded means 20.

[0021] 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.

[0022] The variant of the sleeve 2 of figures 5 to 7 is particularly suitable for manually operated devices.

[0023] 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°.

[0024] 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.

[0025] 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.

[0026] Besides the invention provides that the grooves 35, 36 can be tilted, in concordant directions, to obtain a further improvement of cooling.

[0027] 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°.

[0028] 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.

[0029] Preferably, to improve cooling and, in the same time, to facilitate the operation in internal corners, groves 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.

[0030] 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 also and fit for producing an unperturbed plasma jet and therefore very efficient.

[0031] Other advantage is to provide a high reliability torch and a long life nozzle.

Claims

1. Device for plasma cutting provided with an external sleeve (2) for a nozzle (3) equipped with an exit (4) of the plasma jet (30) and separated by the external sleeve (2) by means of a cavity (5) outside flowing at least through an opening (6) of such sleeve (2); the device (1) is **characterized in that** includes a protrusion (7) of the nozzle (3) having the exit (4) and being approximately truncated cone shaped with side wall (8) that diverges in the direction of the external outlet (9) of the exit (4) in order to deflect, in direction away from the jet (30), a cooling fluid (F) flowing trough the cavity (5).

2. Device according to claim 1 **characterized in that** the protrusion (7) is at least partially contained in the opening (6) of the external sleeve (2).

3. Device according to claim 2 **characterized in that** 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).

4. Device according to claim 3 **characterized in that** the first portion (11) of the opening (6) is divergent toward the outside of the sleeve (2).

5. Device according to claim 4 **characterized in that** 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).

6. Device according to claim 3 **characterized in that** the inner wall (10) of the opening (6) has a second portion (12) approximately conic.

7. Device according to claim 6 **characterized in that** 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).

8. Device according to claim 1 **characterized in that**, 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).

9. Device according to claim 1 **characterized in that**, upstream the opening (6), the sleeve (2) has a plurality of holes (15) for the partial exit of the fluid (F).

10. Device according to claim 9 **characterized in that** the axis of holes (15) of the sleeve (2) are parallel to the axis of the exit (4) of the nozzle (3).

11. Device according to claim 9 **characterized in that** the holes (15) flow into an annular groove (16) carried out inside the sleeve (2).

12. Device according to claim 11 **characterized in that** the annular groove (16) has a wall (17) for narrowing the cavity (5).

13. Device according to claim 9 **characterized in that** the external exits of the holes (15) face deflector means (18).

14. Device according to claim 13 **characterized in that** the deflector means (18) consist of an external nearly conic portion (19) of sleeve (2).

15. Device according to claim 1 **characterized in that** the maximum diameter of protrusion (7) is smaller than that of the cylindrical part of nozzle (3).

16. Device according to claim 1 **characterized in that** the external edge of sleeve (2) has a plurality of recesses (23).

17. Device according to claims 6 and 16 **characterized in that** the recesses (23) are carried out at the second portion (12) of opening (6).

18. Device according to claim 1 **characterized in that** the sleeve (2) is detachably fixed to the device (1) by dap joint means or threaded means (20).

19. Device according to claims 5 and 7 **characterized in that** 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°.

20. Device according to claim 8 **characterized in that** the linking wall (13) of the nozzle (3) has a plurality of respective grooves (35).

21. Device according to claim 1 **characterized in that** the side wall (8) of protrusion (7) has a plurality of respective grooves (36).

22. Device according to claims 20 and 21 **characterized in that** 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.

23. Device according to claims 20 and 21 **characterized in that** 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.

24. Device according to claim 1 **characterized in that** the sleeve (2) and the nozzle (3) have elongated shape.

25. Device according to claim 24 **characterized in that** 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.

FIG.1

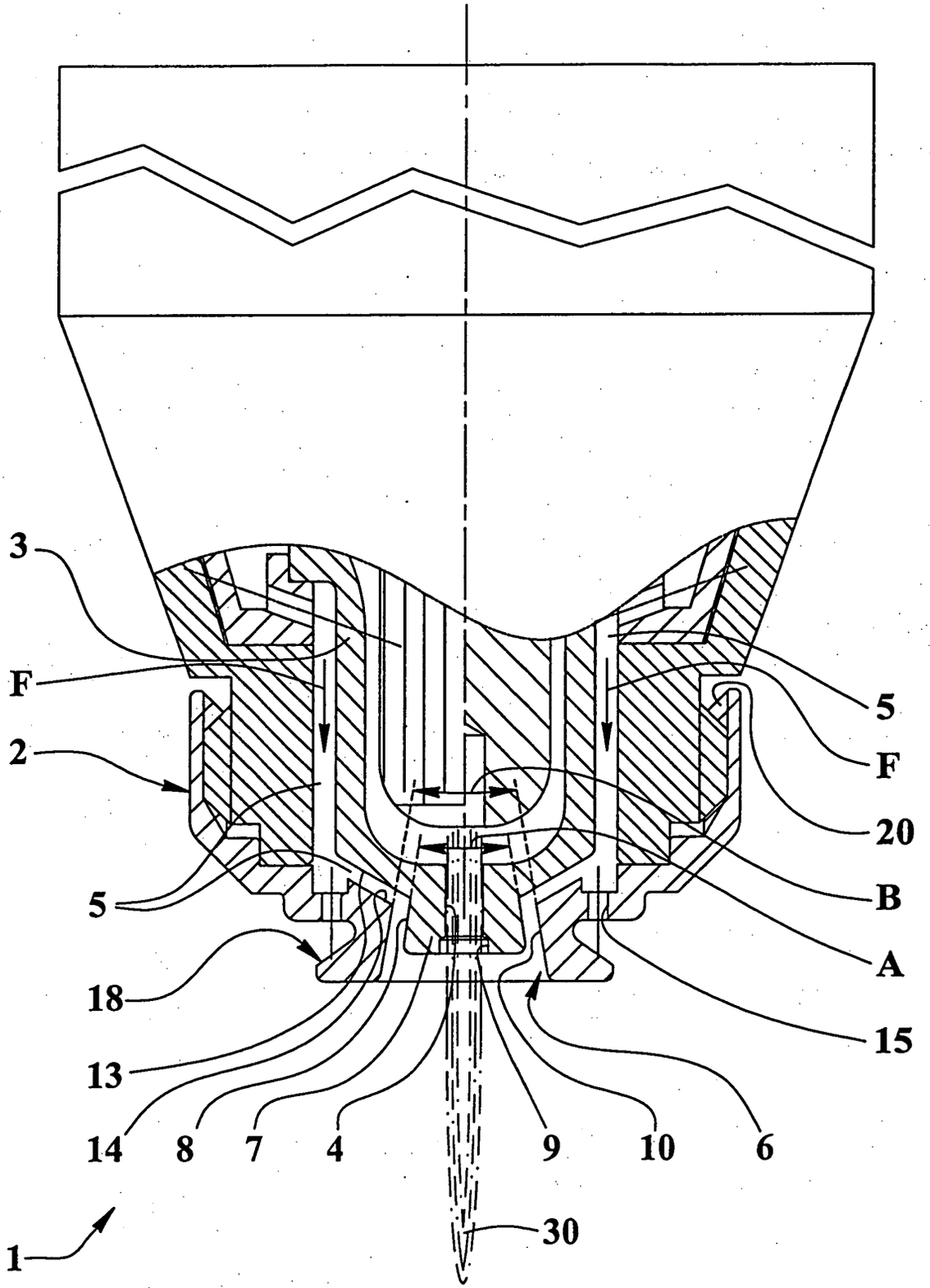
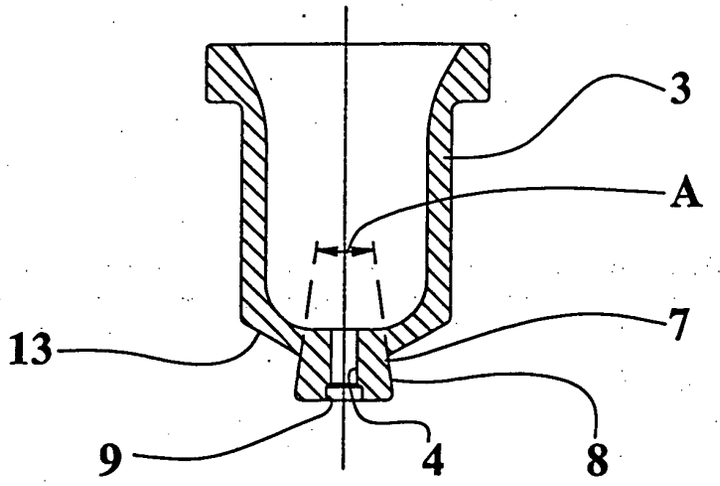


FIG.2



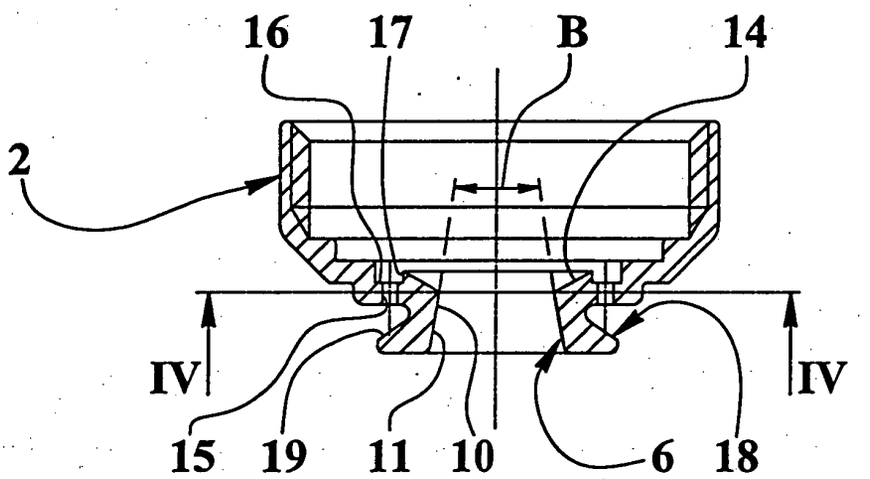


FIG.3

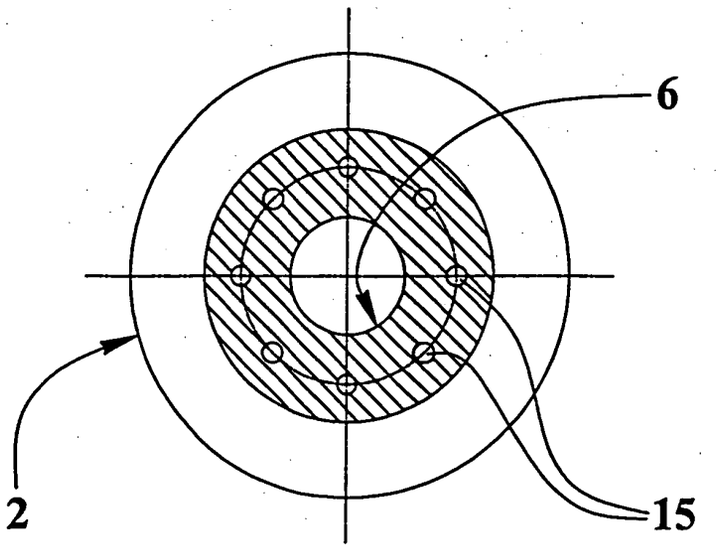
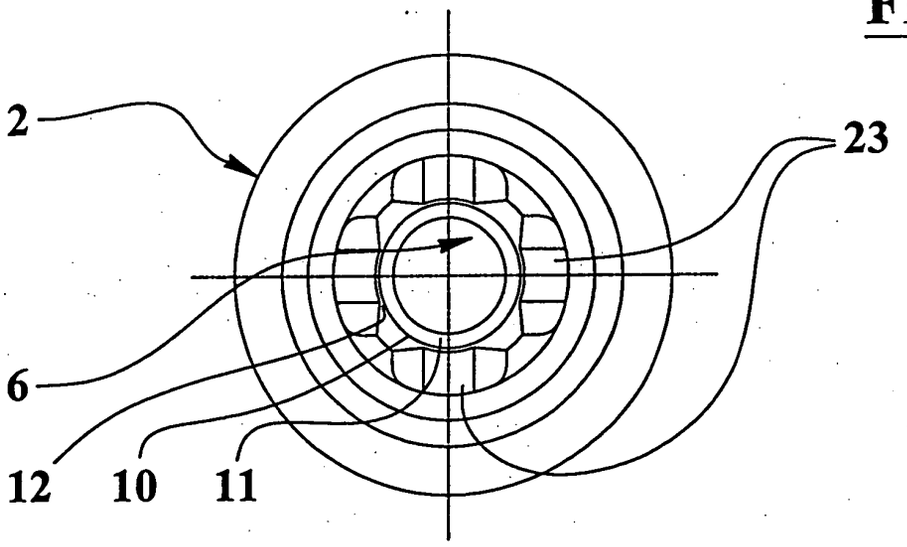


FIG.4

FIG.5



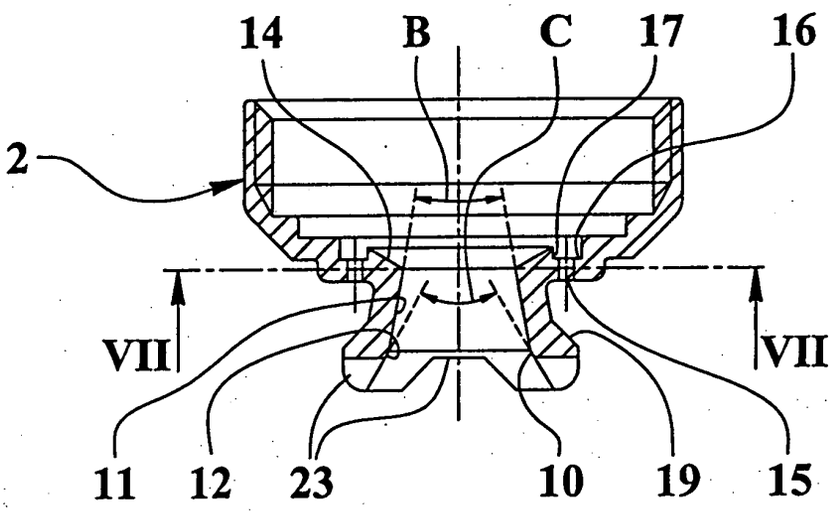


FIG.6

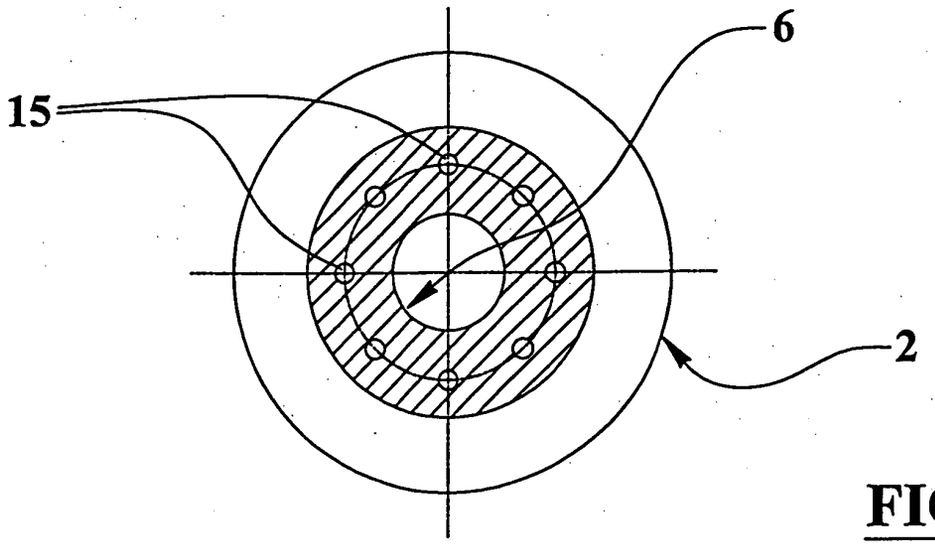
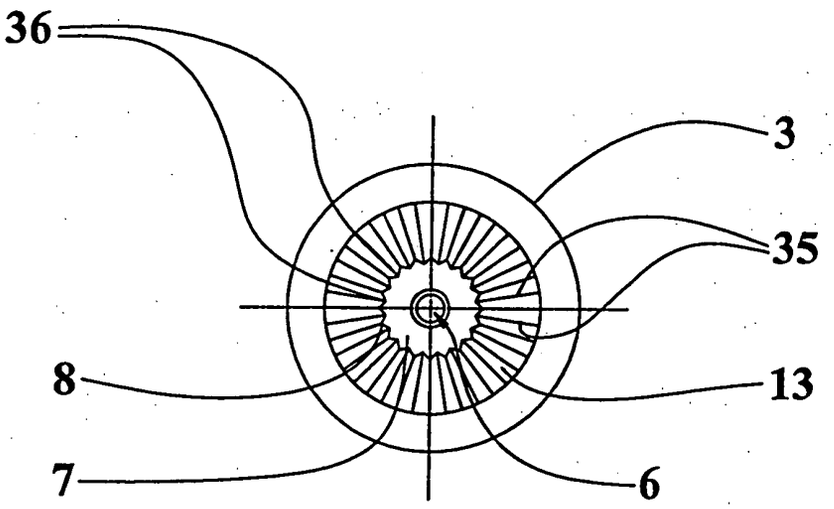


FIG.7

FIG.8



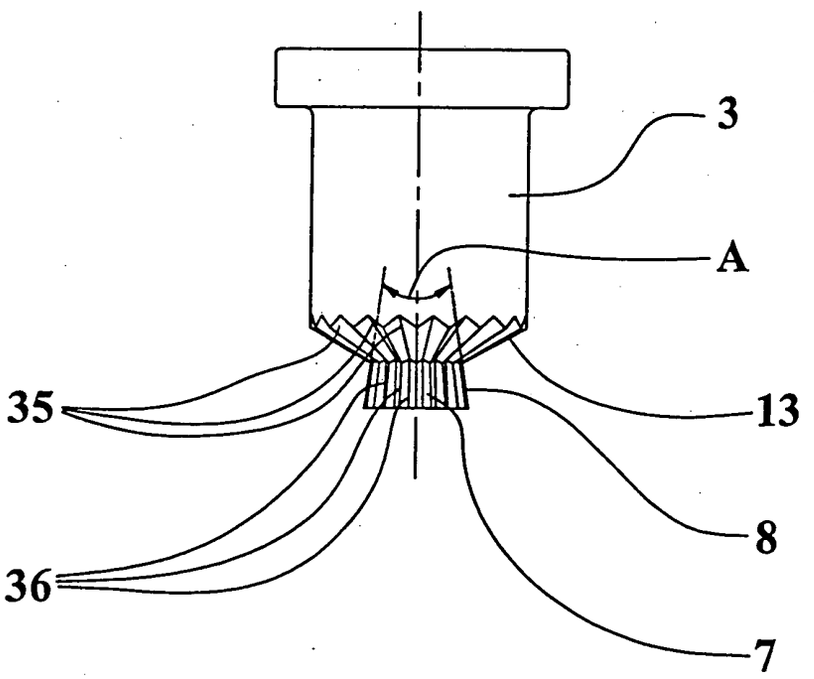


FIG.9