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(54) **Plasma arc cutting torch**

Plasmabogenschneidbrenner

Torche de coupage à plasma d'arc

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Description

[0001] The present invention relates to a plasma arc cutting torch, particularly for cutting by thermal plasma generated by an electric arc.

[0002] Conventional torches of the above kind operate by supplying the excitation and ionization energy to the gas whose plasma is to be produced. For this purpose, the gas is passed through an electric arc which is triggered between a negative electrode or cathode and the part to be cut, which acts as an anode.

[0003] In order to facilitate the formation of the plasma jet, coaxially to the negative electrode there is provided a sleeve which has a nozzle and defines, together with the electrode, a tubular channel which is connected to the supply of the gas whose plasma is to be generated. The sleeve can temporarily act as an anode in order to generate a pilot arc which is suitable to facilitate the starting of the main arc between the negative electrode and the part. During steady-state operation, the main arc lies, through the nozzle, between the negative electrode and the part, while the gas flows out of the nozzle in the form of a plasma jet which strikes the part at high temperature and high speed.

[0004] In current torches, however, the problem is felt of adequately cooling the plasma ejection nozzles.

[0005] An example of gas cooled torch is available from the document GB-A-1 453 100.

[0006] The aim of the present invention is to provide a plasma torch whereby the problem is effectively solved.

[0007] Within the scope of this aim, an object of the present invention is to provide a torch in which the stability of the plasma jet is further improved, so as to ensure a cleaner and more precise cut.

[0008] Another object of the present invention is to provide a torch which can operate in less accessible regions and in compliance with safety standards in order to avoid electric shocks to users.

[0009] This aim, these objects and others which will become apparent hereinafter are achieved with a plasma arc cutting torch, according to the invention, which has the features set forth in claim 1.

[0010] Further characteristics and advantages of the present invention will become apparent from the following detailed description of embodiments thereof, on the basis of the accompanying drawings, wherein:

figure 1 is a partially sectional view, taken along a longitudinal plane, of a torch according to the present invention;

figure 2 is a partially sectional view, taken along a longitudinal plane, of the tube for conveying the cooling air;

figure 3 is an axial view of the tube of figure 2;

figure 4 is an enlarged-scale view of a portion of the end of the tube shown in figure 2;

figures 5, 6 and 7 are views, similar to figures 1, 2

and 3, of a second embodiment of the tube for conveying the cooling air;

figures 8, 9, 10, 11, 12 and 13 are partially sectional views, taken along a longitudinal plane, of torches according to six further embodiments of the present invention.

[0011] With reference to figures 1, 2, 3 and 4, the reference numeral 1 generally designates the portion of a torch that comprises the elements meant to generate the plasma jet. The torch part that comprises the handle and the various electrical and pneumatic connections is not shown, since it is fully conventional and known to operators in this field of technology.

[0012] The portion 1 comprises a central electrode 2, which acts as a cathode and protrudes axially from a cylindrical body 3. A sleeve 4 is coaxially superimposed on the electrode 2 and forms, together with the electrode, an interspace or tubular chamber 5.

[0013] The sleeve 4 has an end which tapers in a conical fashion and ends with a flattened region 6, at the center whereof a port 7 is provided which makes the sleeve act as a nozzle.

[0014] The tubular chamber 5 is connected to the supply of a gas whose plasma is to be generated through holes and passages formed in the body 3 and through the torch handle.

[0015] The sleeve 4 is centered on an insulating ring 8 which is coaxial to the electrode 2, rests thereon and has an outer flange 9 which acts as an engagement element for a locking bush 10. The bush 10 has, at the top, an internally threaded portion 11 which is suitable to couple by screwing on an external thread 12 of the body 3. In this manner, by screwing the bush 10 on the thread 12 it is possible to lock the sleeve 4 against the shoulder formed by the body 3 with the interposition of the ring 8.

[0016] A tubular chamber 13 is enclosed between the bush 10 and the body 3 and is connected on one side to an air supply and on the other side to a plurality of holes 14 which pass through the inner collar 15 of the bush 10, which engages under the flange 9.

[0017] The bush 10 is externally covered with a cladding 16 of thermally insulating material and, in a downward region, by a bush 17. The cladding 16 and the bush 17 are anchored to the bush 10 so as to provide a rotary coupling.

[0018] The bush 17 is externally threaded, and a ring 18 is formed thereon; said ring is an integral part of a tube 19 which coaxially covers the sleeve 4.

[0019] The tube 19 forms, together with the sleeve 4, a tubular interspace 20 which is connected to the holes 14.

[0020] The lower portion of the tube 19 is conical, duplicates the conical end of the sleeve 4, and ends with an annular expansion 21 which is concentric to the port 7. The expansion 21 has an edge which protrudes toward the sleeve 4 until it almost touches the flattened

region 6 (see figure 4) and surrounds a circular opening 22 which is concentric to the port 7.

[0021] The tube 19 is completed by a plurality of slots 23, which are provided radially in its portion which is proximate to the annular expansion 21 and are distributed angularly, and by teeth 24 which protrude downward from the annular expansion 21 and form abutments for resting on the part to be cut when using the torch.

[0022] From the above description it is evident that when using the torch, the air conveyed through the chamber 13, the holes 14 and the interspace 20 flows along the outer surface of the sleeve 4 and effectively cools it. The slots 23 allow the cooling air to flow out radially without affecting the plasma jet projected through the port 7 and the opening 22. In particular, the narrow gap that remains between the flattened portion 6 and the edge of the annular expansion 21 that faces it is so narrow that the outflow of air through the opening 22, surrounded by the annular expansion 21, is practically insignificant.

[0023] In any case, it is always possible to interpose, between the flattened portion 6 and the annular expansion 21, a washer made of heat-resistant material which, by acting as a gasket, blocks any seepage of cooling air toward the central opening 22.

[0024] The described invention fully achieves the intended aim and objects. In particular, it should be noted that the tube 19 does not appreciably increase the size of the sleeve 4 and therefore the torch maintains its operating features even in less accessible regions.

[0025] Figures 5, 6 and 7 illustrate an embodiment in which the tube 19 has a substantially reduced length.

[0026] In the embodiment of figure 8, the tube 19 has no slots 22 and is shorter than the sleeve 4, so that said sleeve protrudes downward with respect to the end edge of the tube.

[0027] Finally, figures 9 and 10 illustrate two embodiments in which the tube 19, instead of being screwed onto the bush 17, is simply superimposed thereon and retained by friction. For this purpose, the tube 19, instead of the ring 15, has a cup-shaped element 25 inside which there is provided a groove for accommodating a ring 26 made of heat-resistant elastic material which is suitable to produce friction on the bush 17.

[0028] Figures 11, 12 and 13 are views of three embodiments in which the tube 19, instead of the ring 18, has an external collar 27. The ring constitutes an independent element which, screwed onto the bush 17, engages below the collar 27 and locks the tube 19 against the bush 17.

[0029] With respect to the preceding embodiments, the annular expansion 21 forms an annular cusp 28, which divides the stream of the air that arrives from the tubular interspace 20 into two streams, one stream flowing out through the slots 23 while the other stream flows out through the opening 22.

[0030] In the embodiment of figure 12, the tube 19 is

significantly shorter and the cusp 28 is located at the conical tapering end of the sleeve 4.

[0031] Finally, the embodiment of figure 13 differs from the one of figure 12 in that there are no teeth 24.

[0032] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A plasma arc cutting torch, comprising: a sleeve (4) having a substantially conical end terminating with a flattened region (6) axially provided with a port (7) for passage of a plasma jet; a negative electrode (2) from which an electric arc starts, said sleeve (4) being arranged coaxial around said electrode (2) so as to define a tubular chamber (5) through which a gas usable for the formation of the plasma jet is conveyed; and a tube (19) arranged coaxially around said sleeve (4) so as to form a tubular interspace (20) therewith through which air is conveyed to cool said sleeve (4), the tube (19) having an end portion the conical shape thereof duplicates the conical shape of the sleeve end, **characterized in that** said end portion of the tube (19) is provided with a plurality of slots (23) distributed radially around said conical portion of the tube (19) so as to allow the cooling air to flow out radially without affecting the plasma jet projected through said port (7), said end portion of the tube (19) terminating with a lower end thereof which extends under said flattened region (6) so as to form an annular expansion (21) with an edge portion surrounding an opening (22) arranged underneath and coaxial to said port (7), said edge portion of the annular expansion (21) closely facing said flattened portion (6) with a gap remaining therebetween so narrow that air outflow towards said opening (22) is practically insignificant.
2. A torch according to claim 1, **characterized in that** it further comprises a washer made of heat-resistant material to act as a gasket which blocks cooling air seepage between said flattened region (6) and the edge of said annular expansion (21).
3. A torch according to claim 1, **characterized in that** said tube (19) is provided with a ring (18) which can be screwed on a cylindrical body (17) of said torch.
4. A torch according to claim 3, **characterized in that** said tube (19) can be provided with a cup-shaped element (25) which can be superimposed on the cylindrical body (17) of said torch, a groove being

formed inside said cup-shaped element to accommodate a ring (26) made of heat-resistant elastic material which is suitable to produce friction on said body (17).

5. A torch according to claim 3, **characterized in that** said tube (19) is further providable with an external collar (27) which can be locked against the cylindrical body (17) of said torch by a ring (18) which can be screwed onto said body (17).
6. A torch according to any of the preceding claims, **characterized in that** teeth (24) are further provided under said edge portion of the tube (19) surrounding said opening (22) so as to protrude downward from said annular expansion (21) and form abutments for resting of the torch, in use, on the part to be cut.

Patentansprüche

1. Plasmabogen-Schneidbrenner, der die folgenden Merkmale aufweist: eine Hülse (4), die ein im Wesentlichen konisches Endstück aufweist, das mit einem ebenen Bereich (6) endet, der mit einer Ausnehmung (7) versehen ist, um einen Durchtritt eines Plasmastrahles zu ermöglichen; eine negative Elektrode (2), ausgehend von der ein elektrischer Bogen startet, die Hülse (4) ist derart coaxial um die Elektrode (2) herum angeordnet, daß eine tubusförmige Kammer (5) bereitgestellt wird, durch die hindurch ein Gas gefördert wird, das zur Bereitstellung des Plasmastrahles verwendbar ist; und ein Tubus (19) ist derart coaxial um die Hülse (4) herum angeordnet, daß ein tubusförmiger Abstand (20) bereitgestellt ist, durch welchen Luft gefördert wird, um die Hülse (4) zu kühlen, der Tubus (19) weist einen Endbereich auf, dessen konusförmige Gestaltung die konusförmige Gestaltung der Hülse (4) dupliziert, **dadurch gekennzeichnet, daß** der Endbereich des Tubus (19) mit einer Mehrzahl von Schlitz (23) ausgestattet ist, die radial um den konusförmigen Bereich des Tubus (19) herum verteilt sind, so daß der Kühlluft eine Strömung in radialer Richtung heraus ermöglicht wird, ohne daß der Plasmastrahl, der durch die Ausnehmung (7) austritt, beeinflußt wird, der Endbereich des Tubus (19) endet mit einem unteren Ende, das sich unter dem abgeflachten Bereich (6) erstreckt, so daß eine ringförmige Verlängerung (21) bereitgestellt wird, die einen Randbereich aufweist, der eine Öffnung (22) umgibt, die unterhalb und coaxial zur Ausnehmung (7) angeordnet ist, der Randbereich der ringförmigen Verlängerung (21) liegt dem ebenen Bereich (6) dicht und mit einem verbleibenden Abstand gegenüber, der so eng gestaltet ist, daß ein Austritt von Luft durch die Öffnung (22) praktisch

nur unwesentlich auftritt.

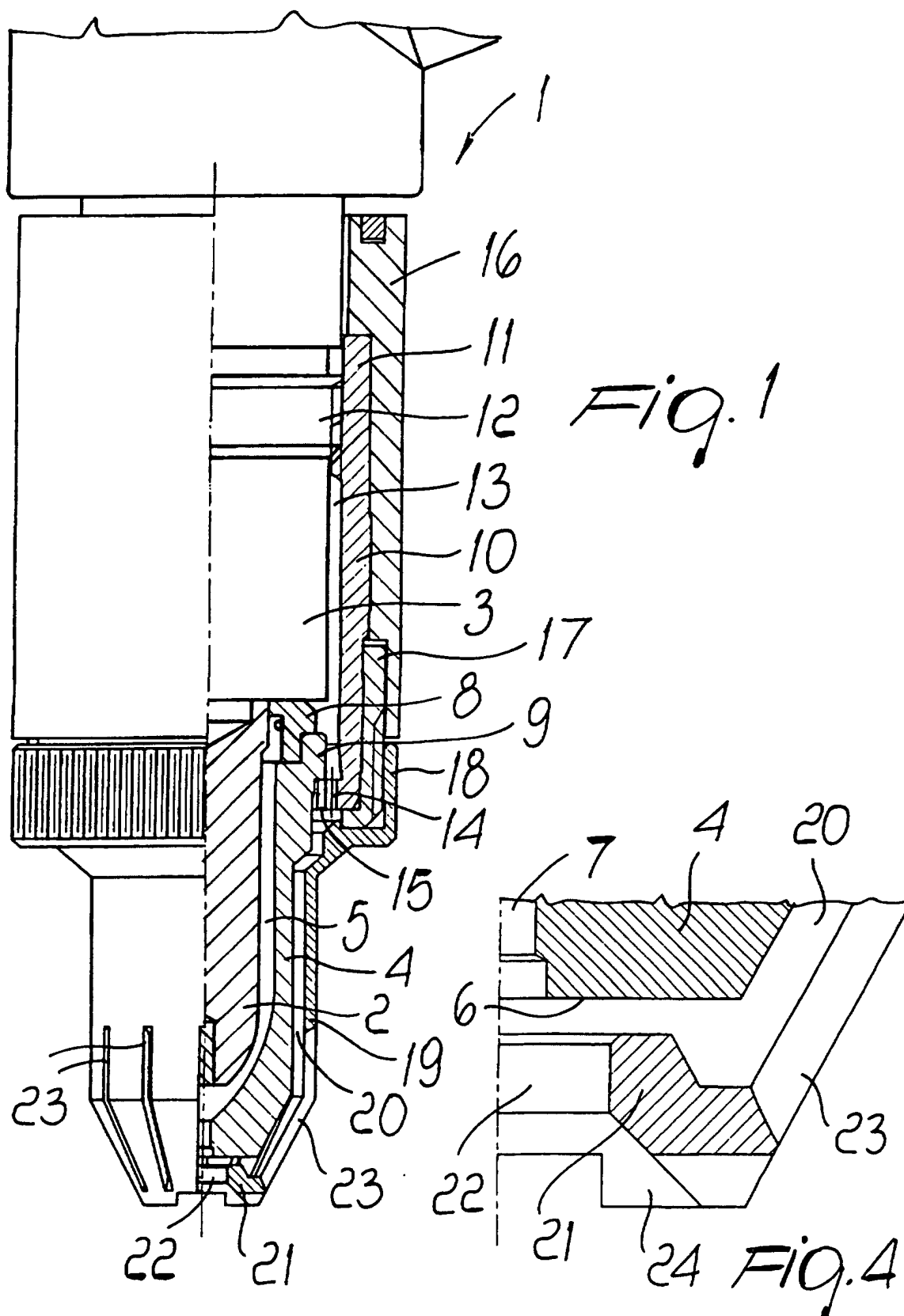
2. Schneidbrenner nach Anspruch 1, **dadurch gekennzeichnet, daß** dieser zusätzlich ein Dichtelement aufweist, das aus einem hitzebeständigen Material ausgebildet ist, um als eine Dichtung zu wirken, die einen Durchtritt von Kühlluft zwischen dem abgeflachten Bereich (6) und dem Rand der ringförmigen Verlängerung (21) verhindert.
3. Schneidbrenner nach Anspruch 1, **dadurch gekennzeichnet, daß** der Tubus (19) mit einem Ring (18) ausgestattet ist, der auf einen zylinderförmigen Körper (17) des Schneidbrenners aufschraubbar ist.
4. Schneidbrenner nach Anspruch 3, **dadurch gekennzeichnet, daß** der Tubus (19) mit einem kappenförmigen Element (25) ausgestattet werden kann, welches überlagert auf dem zylinderförmigen Körper (17) des Schneidbrenners anordbar ist, eine Vertiefung ist innerhalb des kappenförmigen Elementes angeordnet, um einen Ring (26) aufzunehmen, der aus einem hitzebeständigen elastischen Material ausgebildet ist, welches dafür geeignet ist, Reibung auf dem Körper (17) zu erzeugen.
5. Schneidbrenner nach Anspruch 3, **dadurch gekennzeichnet, daß** der Tubus (19) zusätzlich mit einem externen Kragen (27) ausgestattet ist, der gegenüber dem zylinderförmigen Körper (17) des Schneidbrenners durch einen Ring (18) befestigt werden kann, welcher auf den Körper (17) aufschraubbar ist.
6. Schneidbrenner nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, daß** Zähne (24) zusätzlich unterhalb des Randbereiches des Tubus (19) angeordnet sind, der die Öffnung (22) umgibt, so daß diese sich ausgehend von der ringförmigen Verlängerung (21) abwärts erstrecken und Begrenzungen zur Halterung des im Gebrauch befindlichen Schneidbrenners auf dem zu schneidenden Teil aufweisen.

Revendications

1. Torche de découpe à plasma comportant : un manchon (4) pourvu d'une extrémité sensiblement conique ayant une zone aplatie (6), pourvue axialement d'une sortie (7) destinée au passage d'un jet de plasma ; une électrode négative (2) à partir de laquelle s'amorce un arc électrique, le manchon (4) étant disposé axialement autour de l'électrode (2) de façon à définir une chambre tubulaire (5) à l'intérieur de laquelle circule un gaz, utilisable pour la formation du jet de plasma ; et un tube (19) disposé

coaxialement autour du manchon (4) de façon à former un espace tubulaire (20) à l'intérieur duquel de l'air est alimenté, de façon à refroidir le manchon (4), le tube (19) comportant une zone extrême dont la forme conique reproduit la forme conique de l'extrémité du manchon, **caractérisée en ce que** ladite zone extrême du tube (19) est pourvue d'une pluralité de fentes (23) distribuées radialement autour de ladite partie conique du tube (19) de façon à permettre à l'air de refroidissement de s'écouler radialement sans affecter le jet de plasma projeté par l'orifice de sortie (7), ladite zone extrême du tube (19) se terminant par une extrémité inférieure qui s'étend sous la zone aplatie (6), de façon à former une extension annulaire (21) comportant un bord entourant une ouverture (22) coaxiale à la sortie (7) et sous celle-ci, ce bord de l'extension annulaire (21) se trouvant rapproché et faisant face à la partie aplatie (6) avec un espace restant entre ces parties si faible que le flux d'air de sortie dirigé vers l'ouverture (22) est pratiquement insignifiant.

2. Torche suivant la revendication 1 **caractérisée en ce qu'elle** comprend un joint fait d'un matériau résistant à la chaleur qui agit en tant que garniture de façon à bloquer les fuites d'air de refroidissement existant entre la zone aplatie (6) et le bord de l'extension annulaire (21).
3. Torche suivant la revendication 1 **caractérisée en ce que** le tube (19) comporte une bague (18) qui peut être vissée sur un corps cylindrique (17) de la torche.
4. Torche suivant la revendication 3 **caractérisée en ce que** le tube (19) peut être pourvu d'un élément (25) en forme de coupe qui peut être disposé sur le corps cylindrique (17) de la torche, une rainure étant formée à l'intérieur de cet élément en forme de coupe pour recevoir une bague (26) réalisée en un matériau élastique résistant à la chaleur apte à créer une friction sur le corps (17).
5. Torche suivant la revendication 3 **caractérisée en ce que** le tube (19) est de plus pourvu d'un bossage externe (27) qui peut être serré contre le corps cylindrique (17) de la torche par une bague (18) qui peut être vissée sur ledit corps (17).
6. Torche suivant l'une des revendications précédentes **caractérisée en ce qu'elle** comporte des dents (24) disposées sous ledit bord du tube (19) entourant l'ouverture (22), de façon qu'elles s'étendent vers le bas de l'extension annulaire (21) et qui forment des butées pour appuyer la torche, en cours d'usage, sur la partie à découper.



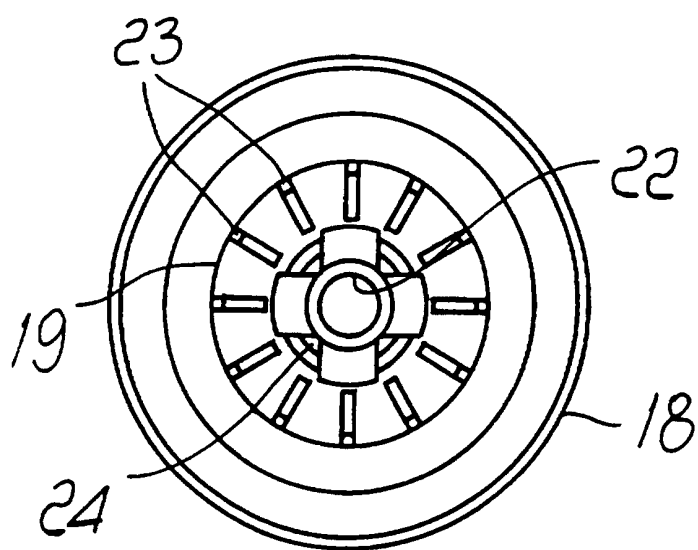


Fig. 3

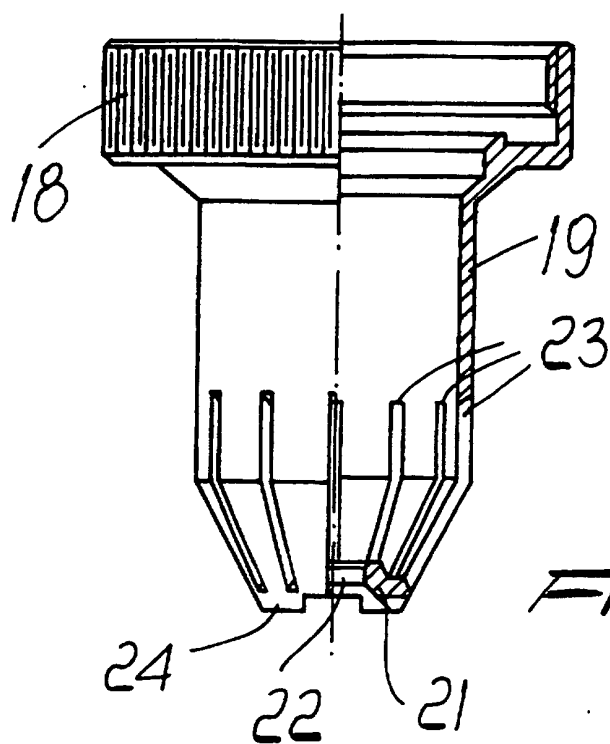


Fig. 2

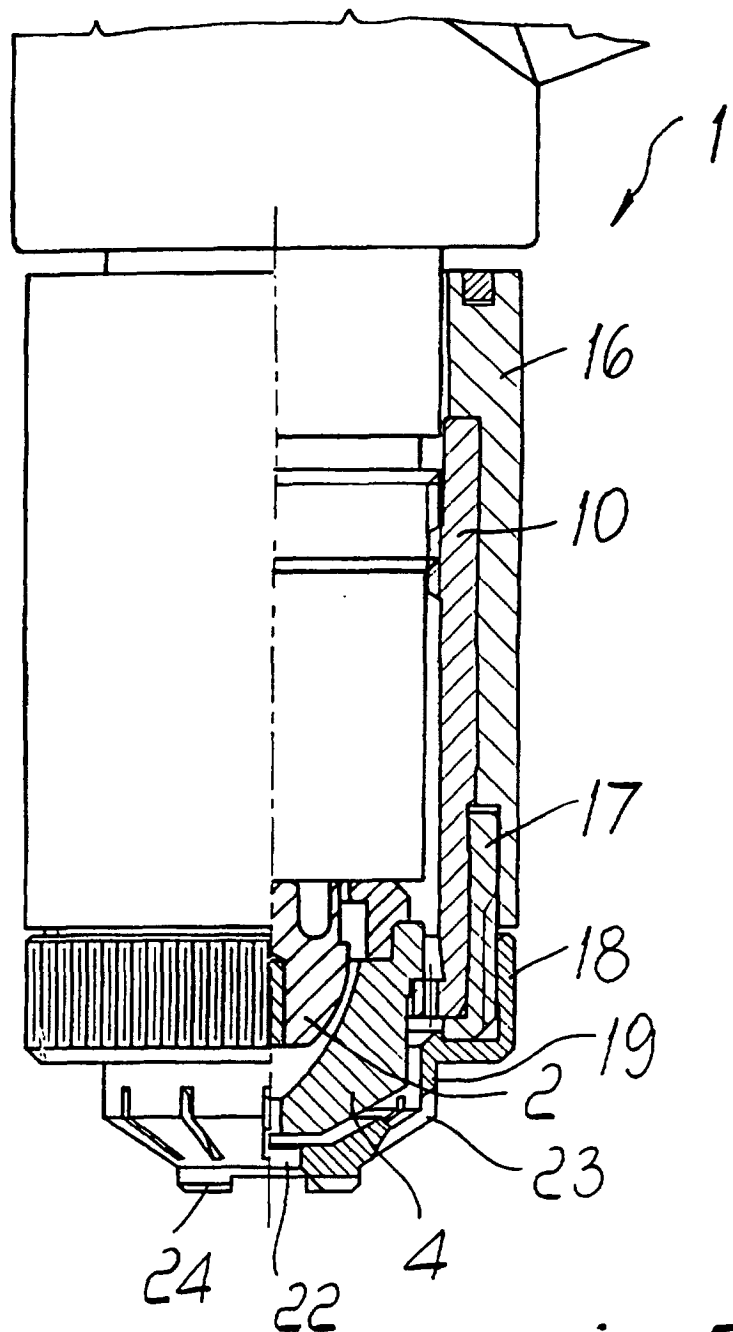


Fig. 5

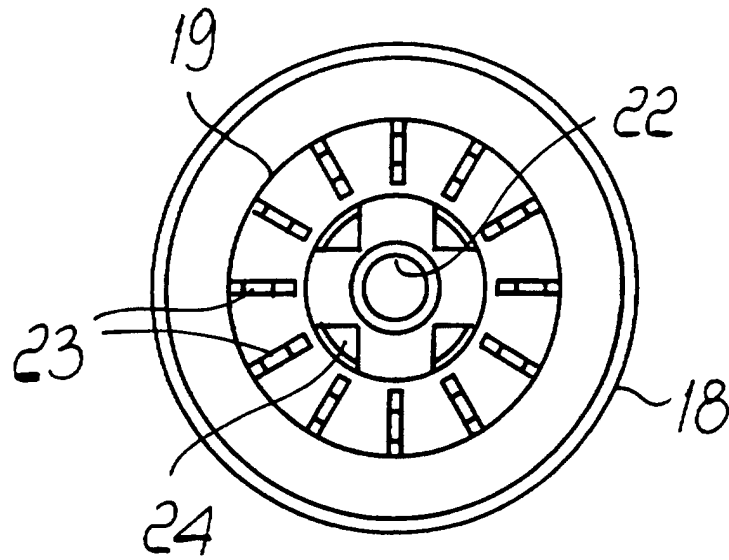


Fig. 7

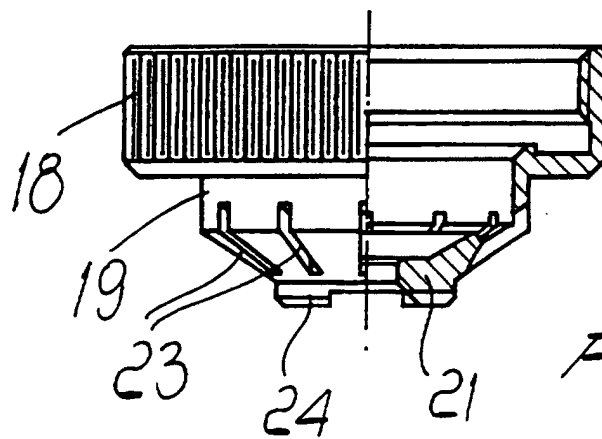


Fig. 6

