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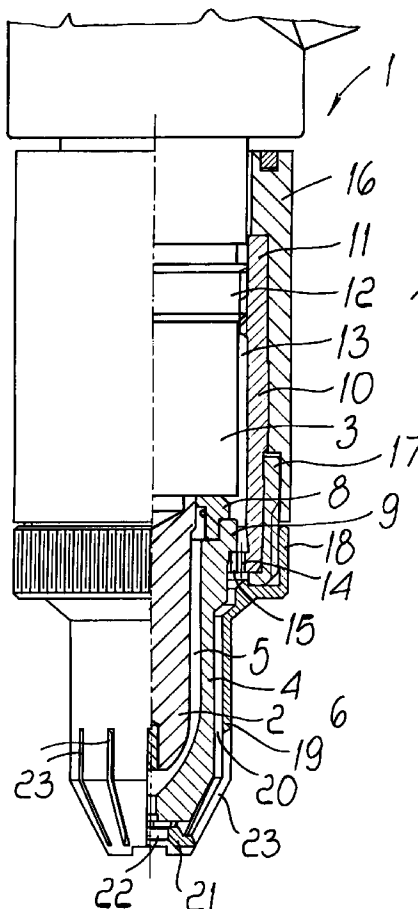
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(54) **Plasma arc cutting torch**

(57) A plasma arc cutting torch, comprising a sleeve (4) which is coaxial to a negative electrode (2) from which the arc starts, and defines, together with the electrode, a tubular chamber (5) through which a gas whose plasma is to be obtained is conveyed, a tube (19) being arranged coaxially around the sleeve (4) and forming a tubular interspace (20) through which air is conveyed to cool the sleeve.



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Description

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

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.

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.

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

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

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.

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.

This aim, these objects and others which will become apparent hereinafter are achieved with a plasma arc cutting torch, which comprises a sleeve coaxial to a negative electrode from which the arc starts, and defines, together with said electrode, a tubular chamber through which a gas whose plasma is to be obtained is conveyed; characterized in that a tube is arranged coaxially around said sleeve and forms a tubular interspace through which air is conveyed to cool said sleeve.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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

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.

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.

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.

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.

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.

Numerous modifications and variations are possible in the practical embodiment of the invention, all of which are within the scope of the same inventive concept.

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

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.

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.

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.

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.

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.

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

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) which is coaxial to a negative electrode (2) from which the arc starts, and defines, together with said electrode, a tubular chamber (5) through which a gas whose plasma is to be obtained is conveyed; characterized in that a tube (19) is arranged coaxially around said sleeve (4) and forms a tubular interspace (20) through which air is conveyed to cool said sleeve.
2. A torch according to claim 1, characterized in that said sleeve (19) has an end portion whose conical shape duplicates the conical end of the sleeve (4) and ends with an annular expansion (21) which forms an opening (22) which is concentric to a port (7) for ejecting the plasma jet and is provided with an edge which almost touches a flattened region (6) of said sleeve (4) which surrounds said port (7), a plurality of radial and angularly distributed slots (23) being formed in the portion of said tube (19) which is proximate to 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) has 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) has 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 claim 2, characterized in that said annular expansion (21) has an annular cusp (28) adapted to divide the stream of the air conveyed through said annular interspace (20) into a first stream, which is conveyed through said radial slots (23), and into a second stream, which is conveyed toward said opening (22) which is concentric to said port (7). 5
7. A torch according to claim 2, characterized in that a washer made of heat-resistant material is interposed between said annular expansion (21) and said sleeve (4). 10

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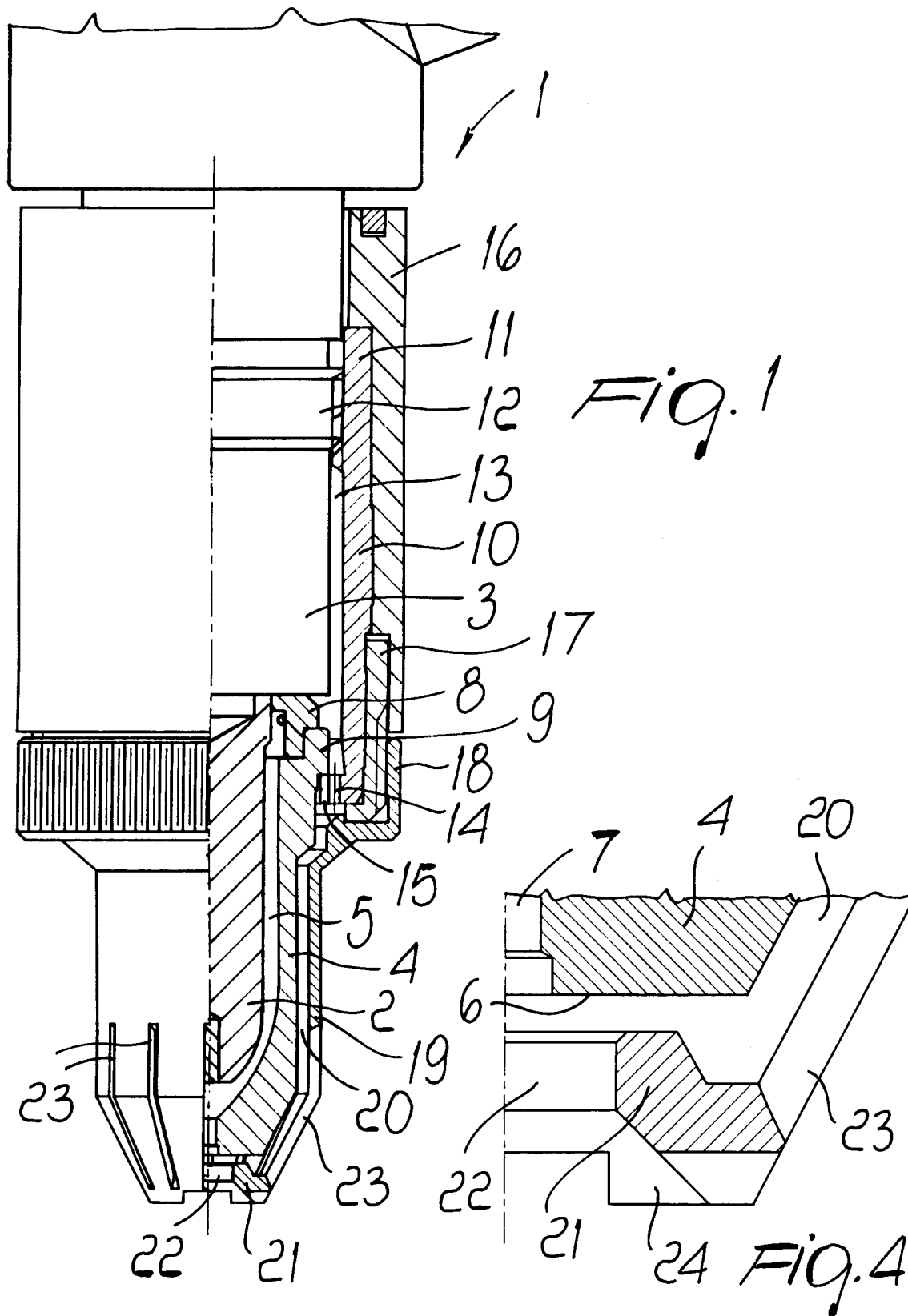
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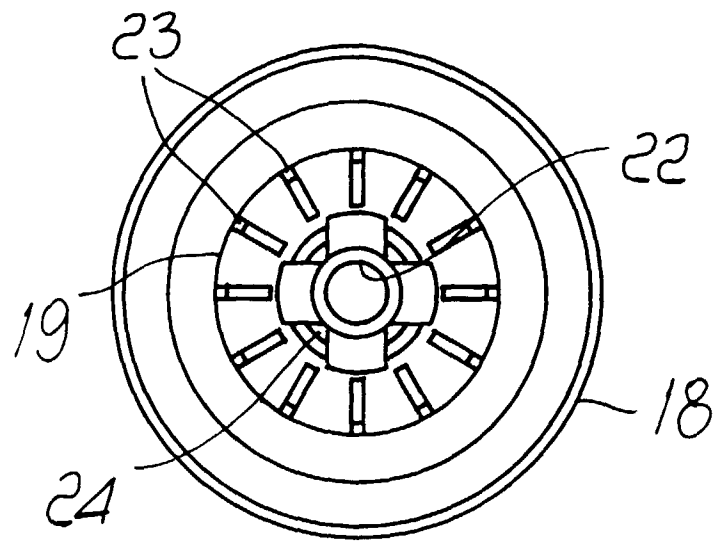


Fig. 3

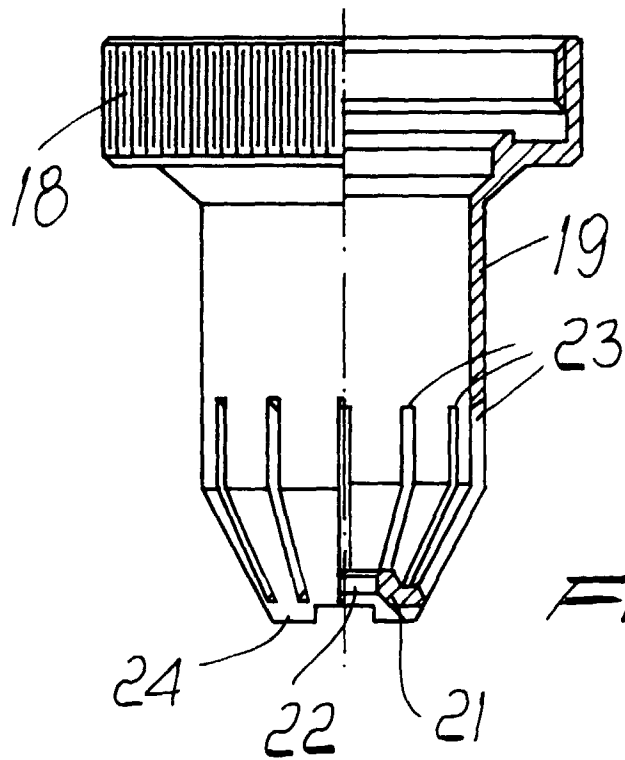


Fig. 2

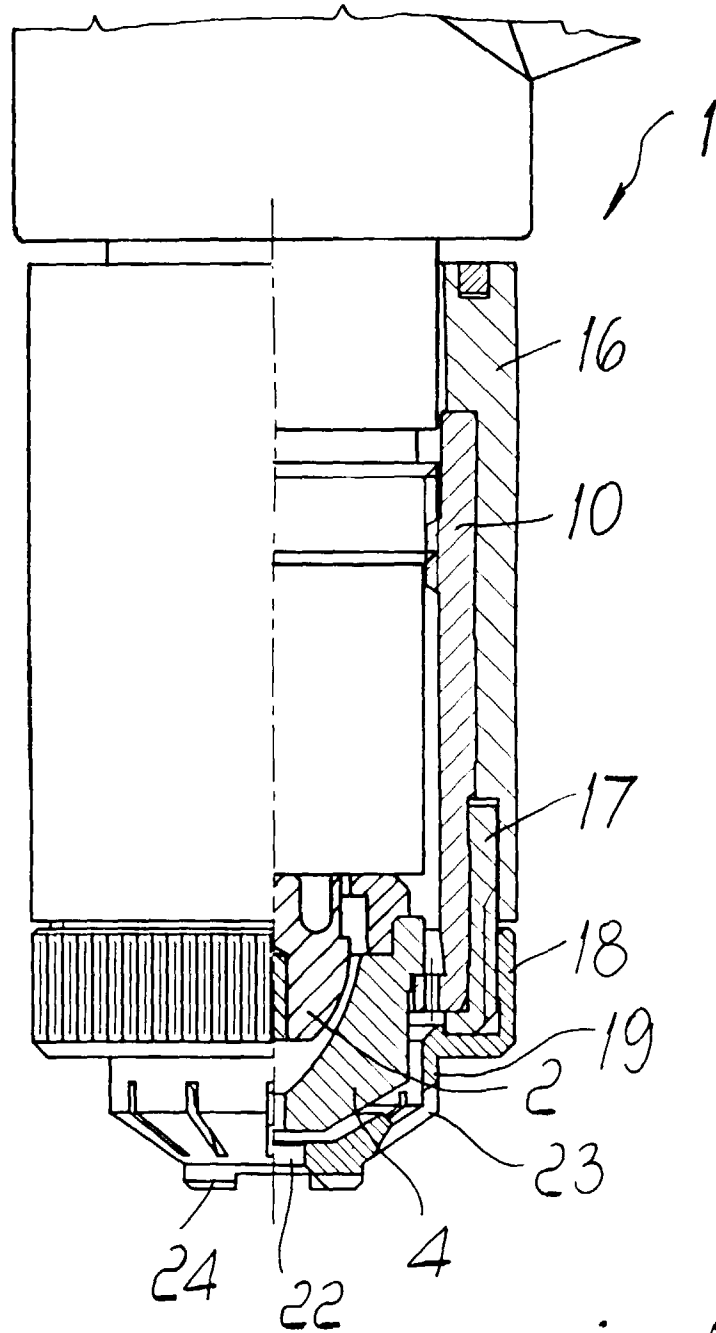


Fig. 5

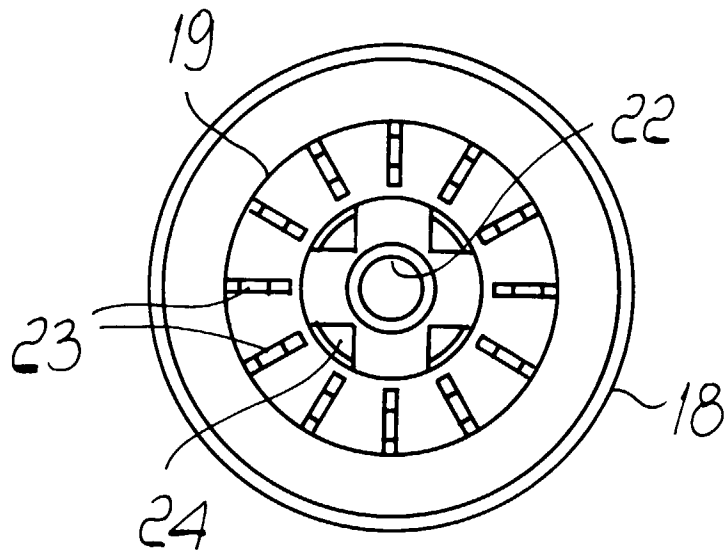


Fig. 7

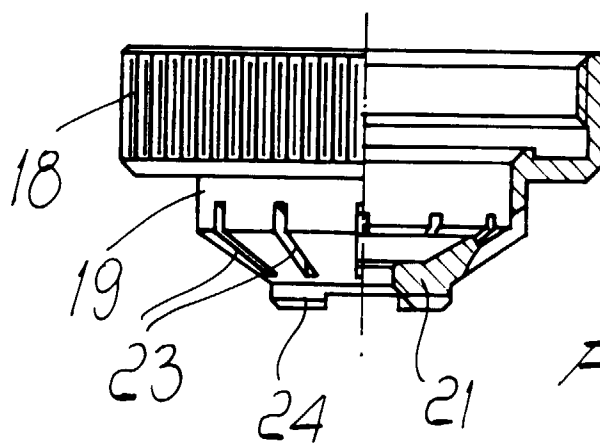
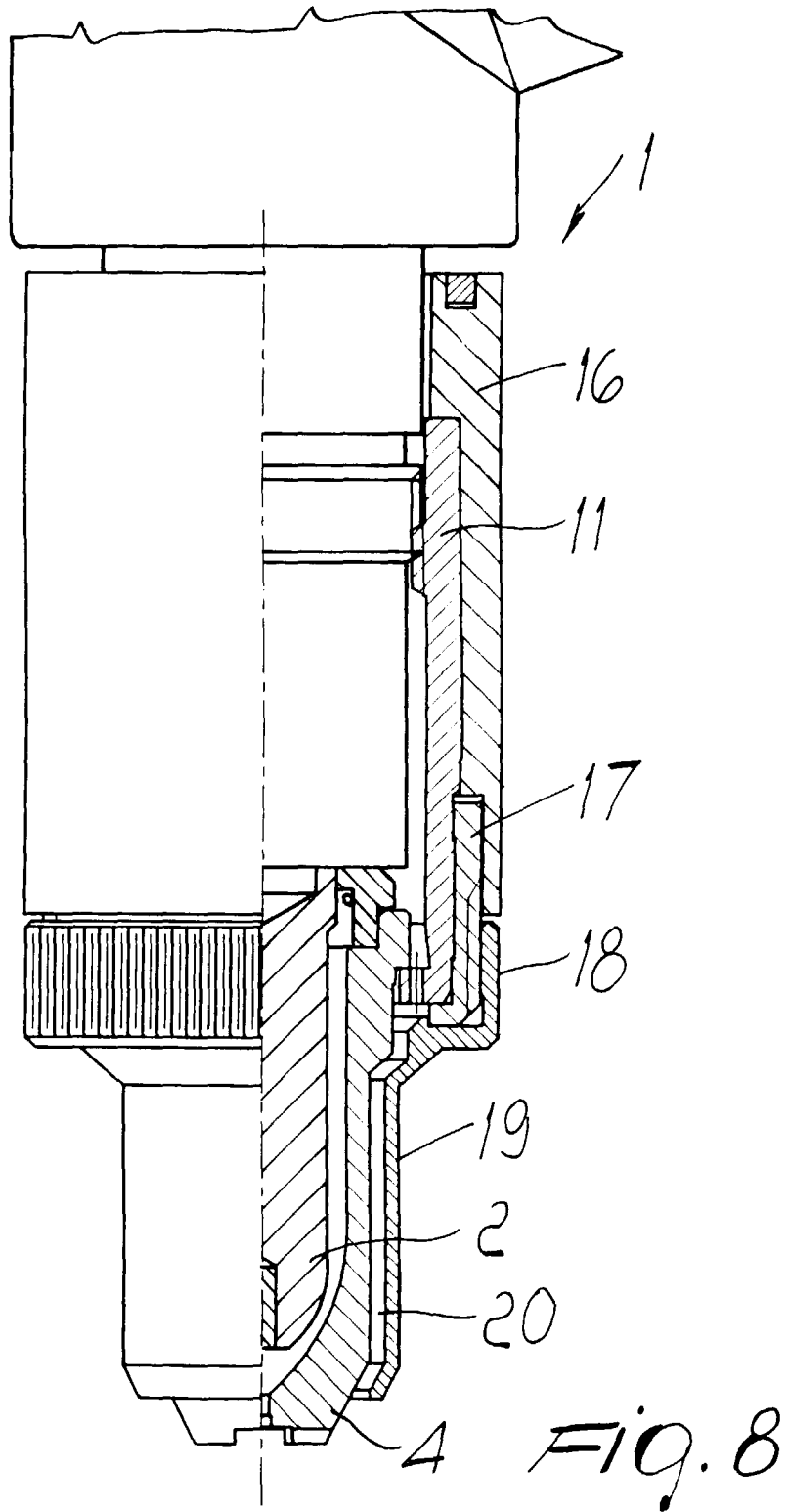
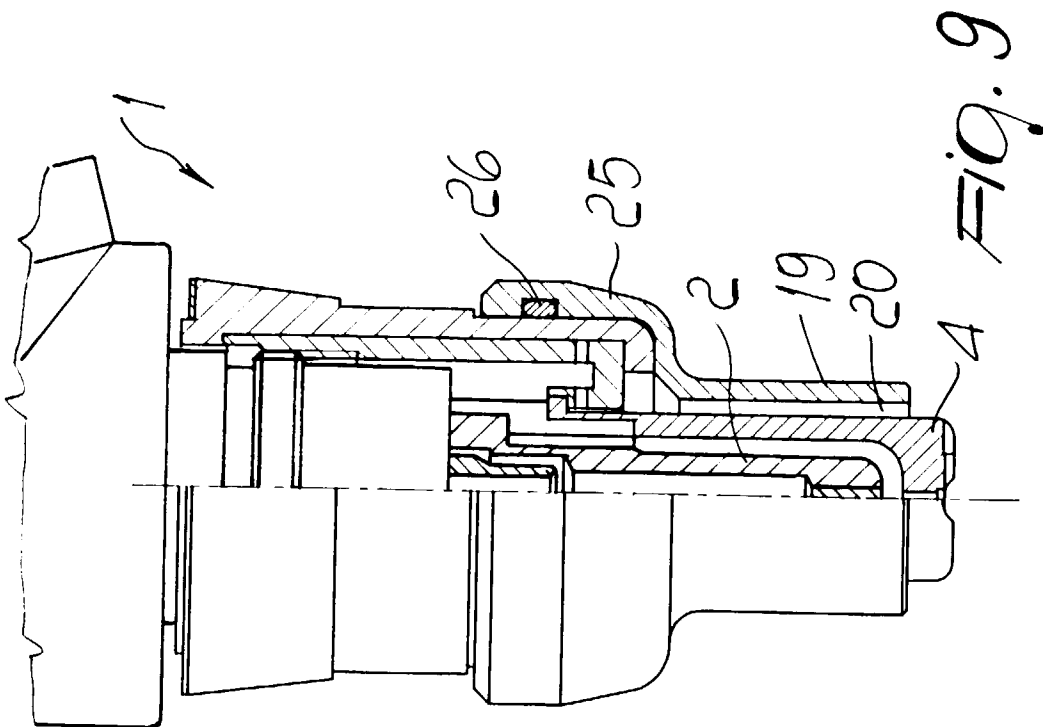
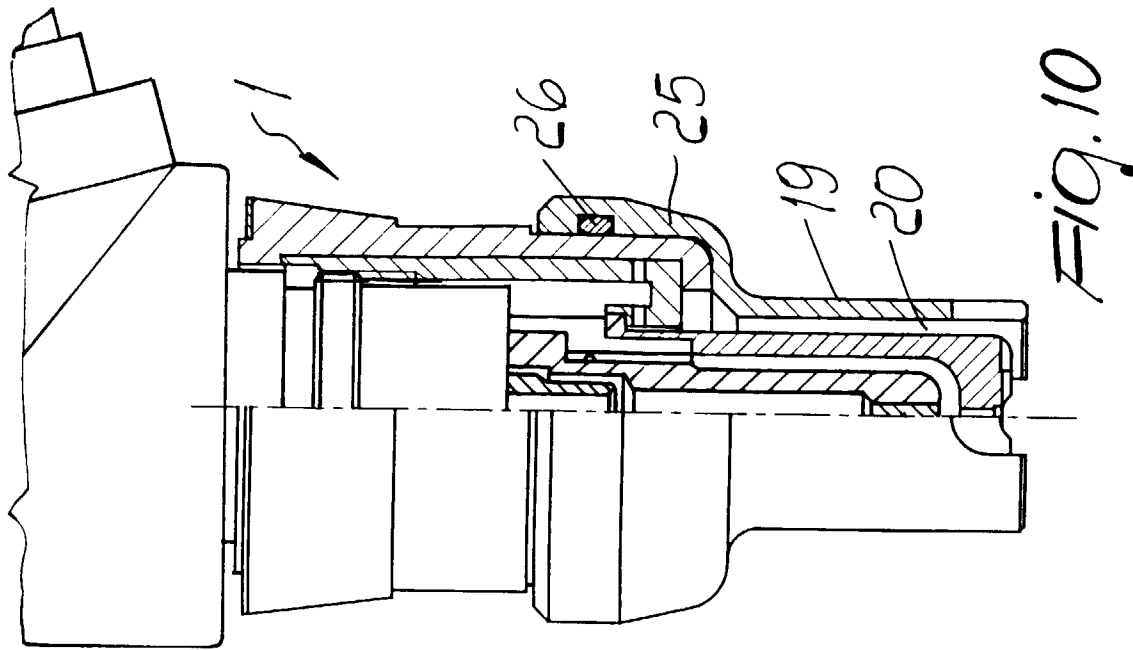
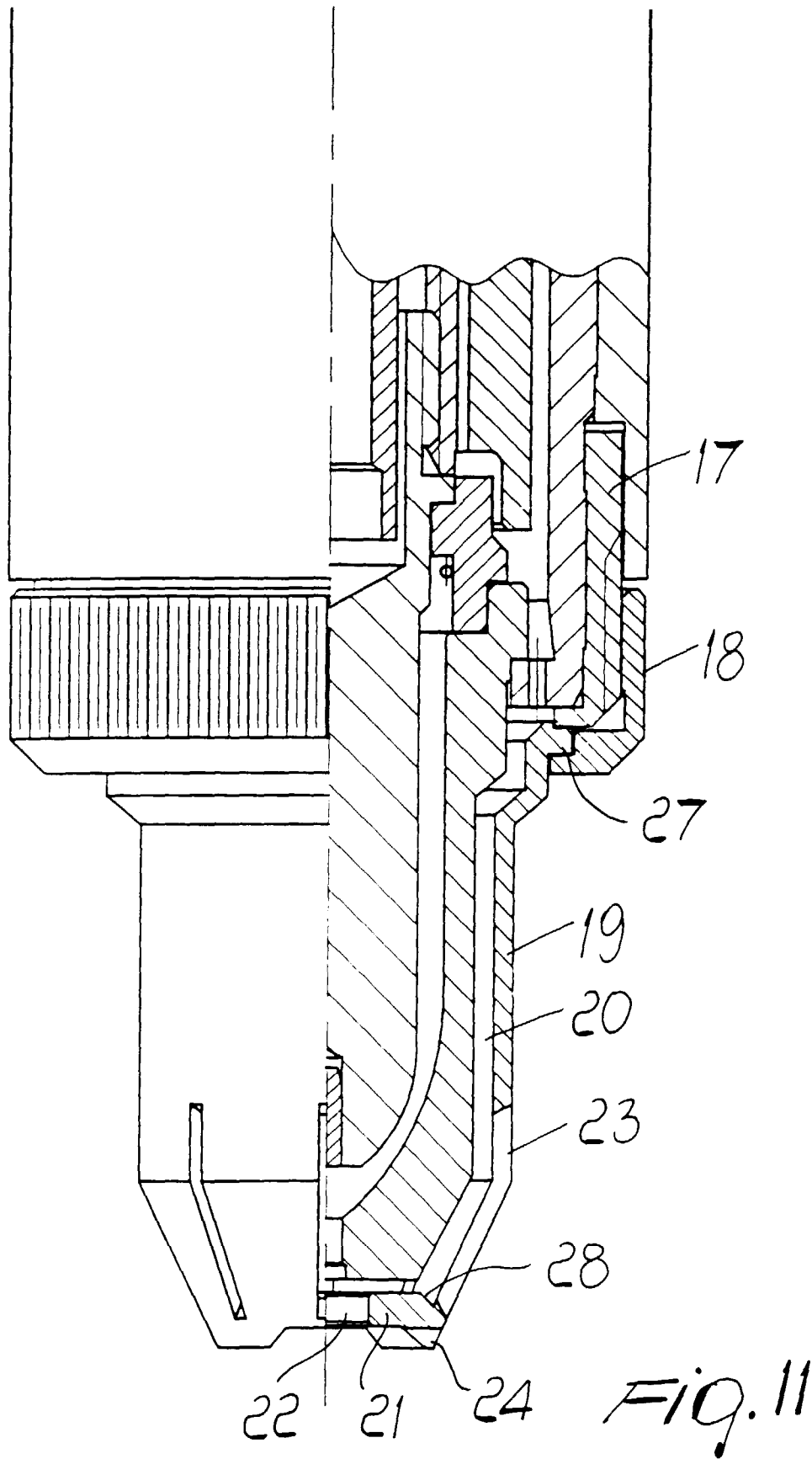
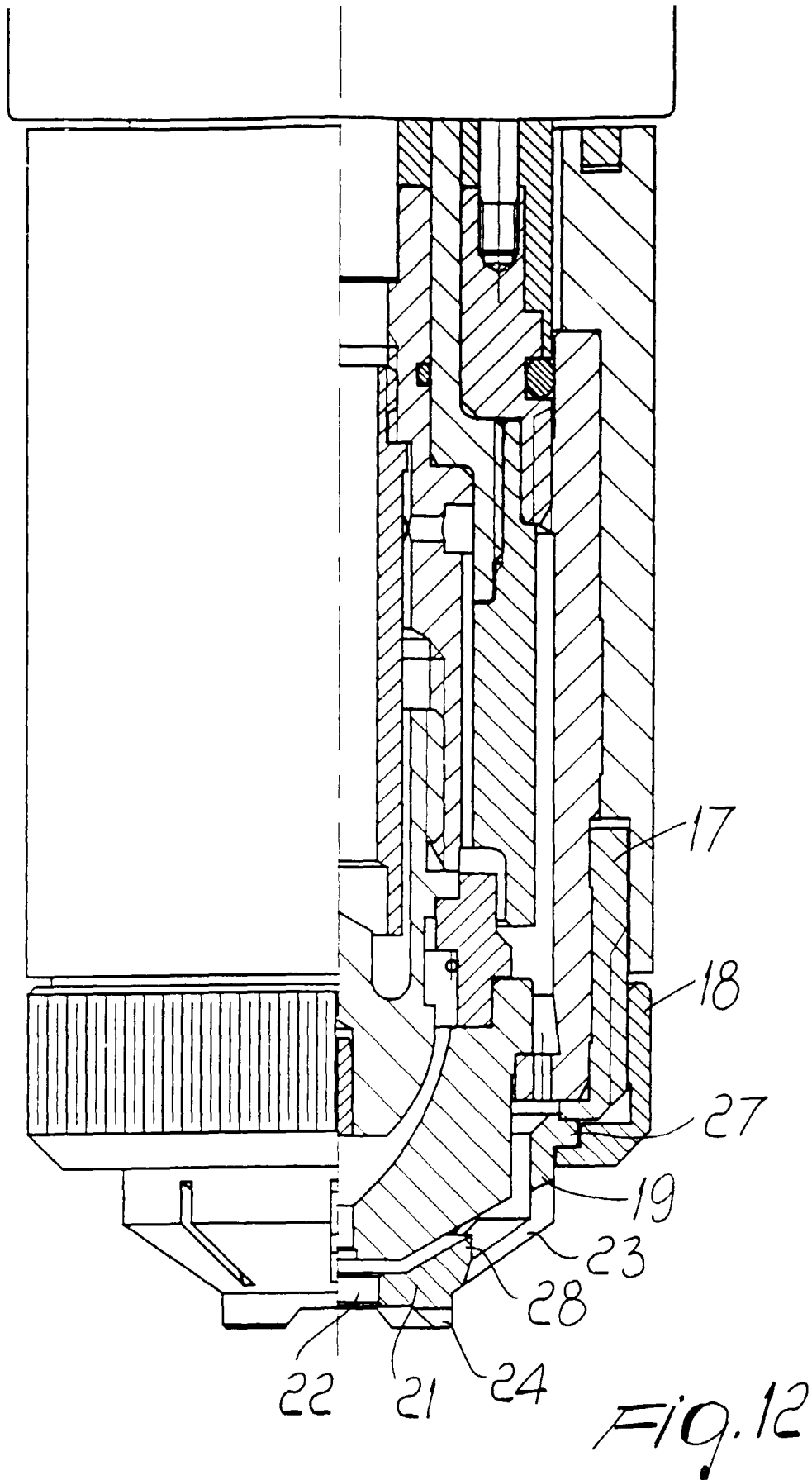


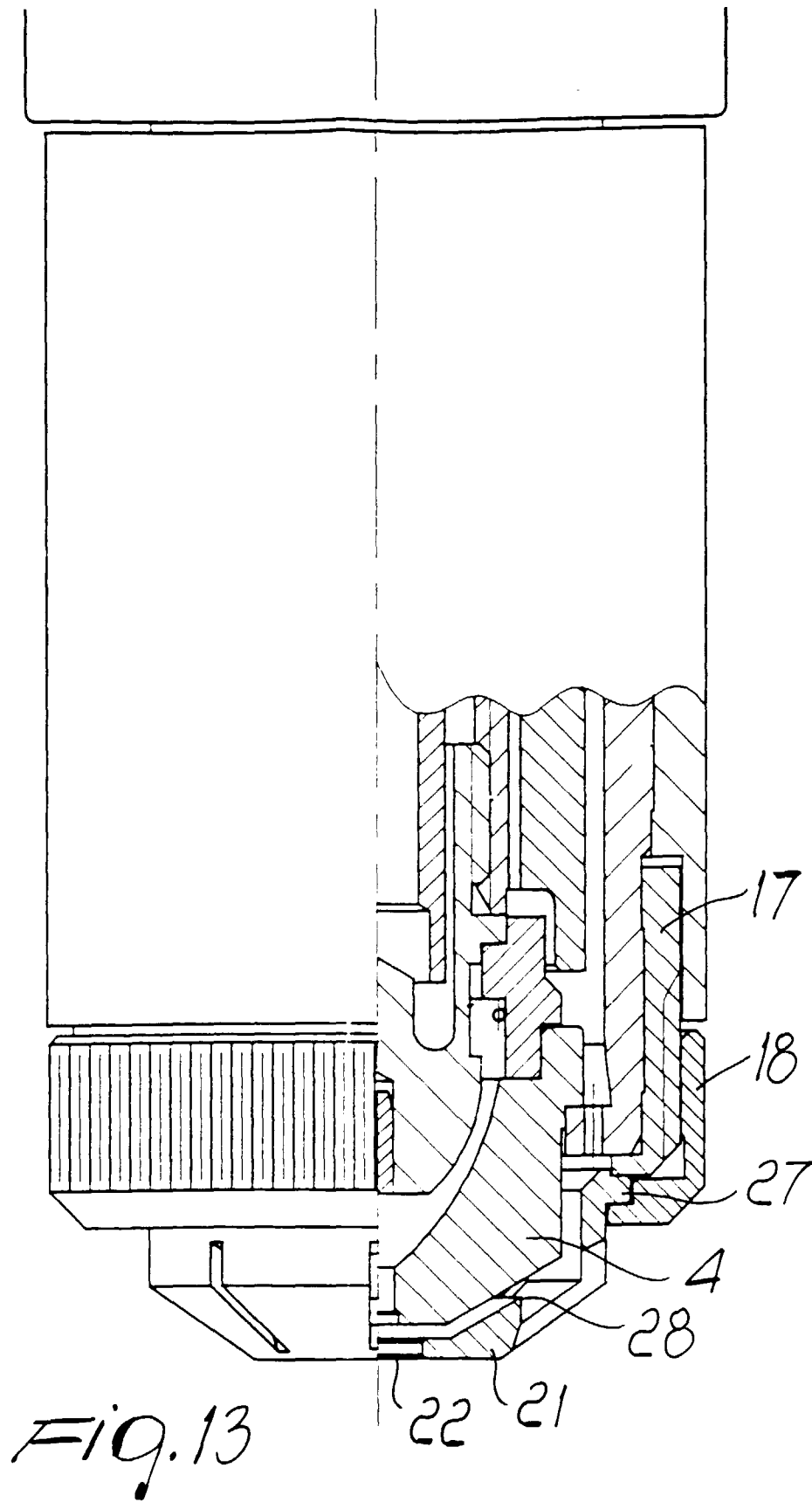
Fig. 6













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EUROPEAN SEARCH REPORT

Application Number
EP 97 12 0002

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	WO 91 02619 A (HYPERTHERM INC) * page 11, paragraph 2 * * page 13, paragraph 1 * * page 14, paragraph 2 *	1, 3, 4	H05H1/34 H05H1/28
A	* figures 3A-3B * ---	2, 6	
X	DE 26 42 649 A (NUC WELD GMBH) * page 6, last paragraph - page 7, last paragraph; figure *	1	
A	---	2, 6	
X	DE 42 34 267 A (BINZEL ALEXANDER GMBH CO KG) * page 7, line 46 - page 8, line 26 * * figure 4 *	1, 3	
X	DE 40 18 423 A (INST ZAVARYAVANE) * column 1, line 67 - column 2, line 14 * * figure *	1, 3 2	
X	GB 1 453 100 A (V N I PK I T I ELEKTROSVAROCHN) * page 4, line 44 - line 79 * * figure 3 *	1, 3 2, 6	TECHNICAL FIELDS SEARCHED (Int.Cl.6) H05H
X	FR 2 673 352 A (LINCOLN ELECTRIC CO) * page 20, line 14 - page 21, line 21 * * figure 3 *	1, 3 2, 5	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 23 February 1998	Examiner Capostagno, E
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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