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FORM 1
REGULATION 9

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952-1973

APPLICATION FOR A PATENT

I/We AEROSPATIALE SOCIETE NATIONALE INDUSTRIELLE

of 37bd de Montmorency, 75016 PARIS, FRANCE

hereby apply for the grant of a Patent for an invention entitled:

TUBULAR ELECTRODE FOR PLASMA TORCH AND PLASMA TORCH
PROVIDED WITH SUCH ELECTRODES

which is described in the accompanying complete specification. This Application is a Convention Application and is based on the Application(s) numbered: 87 06085 for a Patent or similar protection made in France on 29 April 1987.

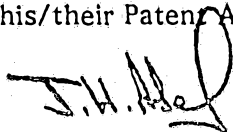
My/Our address for service is:

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DATED this 28th day of April, 1988.

AEROSPATIALE SOCIETE NATIONALE INDUSTRIELLE

By his/their Patent Attorneys



GRIFFITH HASSEL & FRAZER

TO: THE COMMISSIONER OF PATENTS
COMMONWEALTH OF AUSTRALIA

2856A:rk

APPLICATION ACCEPTED AND AMENDMENTS

RECEIVED

Patents Act 1952

DECLARATION IN SUPPORT OF A CONVENTION OR NON-CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

Name(s) of Applicant(s)

In support of the application made by Société Anonyme dite :
AEROSPATIALE SOCIETE NATIONALE INDUSTRIELLE

Title

for a patent for an invention entitled
TUBULAR ELECTRODE FOR PLASMA TORCH AND
PLASMA TORCH PROVIDED WITH SUCH ELECTRODES

Name(s) and address(es) of person(s) making declaration

~~I/we~~, Jacques BALAZARD, 37 bld de Montmorency - 75016 PARIS - France

do solemnly and sincerely declare as follows:-

1. I ~~am/we are~~ ~~the applicant(s) for the patent~~ ~~of~~ ~~am/are~~ authorised by the abovementioned applicant to make this declaration on its behalf.

2. The basic application(s) as defined by Section 141 of the Act was/were made in the following country or countries on the following date(s) by the following applicant(s) namely:-

Country, filing date and name of Applicant(s) for the or each basic application

in FRANCE on April 29, 1987 19 87
by AEROSPATIALE SOCIETE NATIONALE INDUSTRIELLE
in _____ on _____ 19
by _____

3. The said basic application(s) was/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

Name(s) and address(es) of the or each actual inventor

4. The actual inventor(s) of the said invention is/are
Maxime LABROT, 26, rue Wilson - 33200 BORDEAUX - France
Didier PINEAU, 97 rue Jean Souba - 33000 BORDEAUX - France
Jean FEUILLERAT, 19, rue du Lavoisier - 33000 BORDEAUX - France

See reverse side of this form for guidance in completing this part

5. The facts upon which the applicant(s) is/are entitled to make this application are as follows:-

The said applicant is the assignee of the said inventors for the said invention.

DECLARED at Paris, France this 22nd day of April 19 88



Jacques Balazard

Jacques BALAZARD

This form may be completed and filed after the filing of a patent application but the form must not be signed until after it has been completely filled in as indicated by the marginal notes. The place and date of signing must be filled in. Company stamps or seals should not be used.

No legalisation is necessary

(12) PATENT ABRIDGMENT (11) Document No. AU-B-15287/88
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 604880

(54) Title
TUBULAR ELECTRODE FOR PLASMA TORCH AND PLASMA TORCH PROVIDED WITH
SUCH ELECTRODES

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(56) Prior Art Documents
AU 584141 50592/85 H05H 1/42, 1/38 H05B 7/20
AU 568419 36233/84 H05H 1/34, B23K 9/00, 9/24
AU 74687/74 B23K 15/00, H01J 37/30, H05H 1/26

(57) Claim

1. An electrode for use in a plasma torch comprising:
a tubular intermediate part intended for catching arc
feet;

end parts adapted to connect said electrode to other
parts of said torch, said end parts connected to said
intermediate part of said electrode at each end of said
intermediate part of said electrode;

an enclosed fluid circulation chamber within which a
cooling fluid circulates, said intermediate part and said
end parts forming part of said enclosed fluid circulation
chamber;

said intermediate and said end parts of said electrodes
being formed of individual parts whose thickness is at least
equal to ten millimetres;

mechanical assembly means for connecting said
intermediate and said end parts of said electrodes together,
said mechanical assembly means being disassemblable and

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(10) 604880

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moisture-impervious, and comprising for each part of said electrode to be assembled:

a peripheral shoulder which is disposed adjacent said enclosed fluid circulation chamber, said peripheral shoulder disposed at right angles to the axis of said tubular intermediate part of said electrode;

a thread coaxial to said tubular intermediate part of said electrode;

a centering cylindrical surface coaxial to said tubular intermediate part of said electrode and extending in a direction coplanar to said thread and perpendicular to said peripheral shoulder; and

a seal disposed between the cooperating mechanical assembly means of two assembled parts of said electrode.

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COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

Form 10

COMPLETE SPECIFICATION

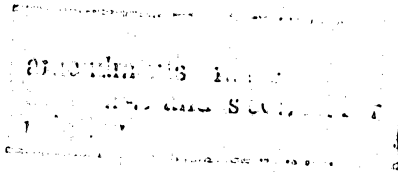
FOR OFFICE USE

Short Title:

Int. Cl:

Application Number:
Lodged:

Complete Specification—Lodged:
Accepted:
Lapsed:
Published:



Priority:

Related Art:

TO BE COMPLETED BY APPLICANT

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Complete Specification for the invention entitled:

TUBULAR ELECTRODE FOR PLASMA TORCH AND
PLASMA TORCH PROVIDED WITH SUCH
ELECTRODES

The following statement is a full description of this invention,
including the best method of performing it known to me/us:—
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The present invention relates to tubular electrodes for plasma torches and to plasma torches provided with such electrodes.

French Patent No. 2 473 248 for example discloses plasma torches in which each of the electrodes, generally made of metal, is in one piece and is shaped as a tubular intermediate part extended by end parts intended for connection to other pieces of the torch, said electrodes being disposed respectively in tight chambers in which a cooling fluid circulates.

In electrodes of this type, the tubular intermediate part is of simple shape and serves to catch the arc feet, whilst the end parts are complex in shape but are not attained by the arc. These electrodes are thus expendable pieces of which only the tubular intermediate part erodes.

Two methods are essentially known for making such one-piece electrodes:

- the first method consists in making, then in machining, a monolithic electrode blank. This method makes it possible to obtain thin electrodes with a thickness of some millimetres. Consequently, these electrodes wear rapidly and must be replaced frequently, this involving high costs of use and limitations of the performances of the torches;
- the second method consists in producing and machining blanks of electrode parts, then in welding said pieces by electron bombardment. This second method makes it possible to obtain thicker electrodes than those obtained by the first. However, owing to the mode of welding, it is hardly possible to obtain an electrode thickness greater than ten millimetres, with the result that the electrodes thus produced must also be frequently replaced. In addition to the fact that welding by electron bombardment does

not allow connection of thick pieces, it risks causing surface irregularities and differences in the welding zone, leading to rapid breakdown of said electrodes. Furthermore, if, in such an electrode obtained by electron bombardment welding, only the eroded tubular part is replaced by a new tubular part which is welded to the end parts previously welded to the eroded tubular part, an electrode cannot be obtained whose geometry is identical to that of a new electrode. This results in deterioration in the performances of the torch.

In addition, whatever the known method of making the electrodes, taking into account the fact that an electrode of appropriate metal must be associated with the plasmagenic gas used, the electrodes must be entirely replaced if it is desired to employ the torch with different plasmagenic gases.

It is an aim of the present invention to overcome the drawbacks of these known electrodes for plasma torches.

Therefore, the present invention provides an electrode for use in a plasma torch comprising:

a tubular intermediate part intended for catching arc feet;

end parts adapted to connect said electrode to other parts of said torch, said end parts connected to said intermediate part of said electrode at each end of said intermediate part of said electrode;

an enclosed fluid circulation chamber within which a cooling fluid circulates, said end part and intermediate parts forming part of said enclosed fluid circulation chamber;

said intermediate and said end parts of said electrodes being formed of individual parts whose thickness is at least equal to ten millimetres;

mechanical assembly means for connecting said intermediate and said end parts of said electrodes together, said mechanical assembly means being disassemblable and moisture-impervious, and comprising for each part of said electrode to be assembled:



a peripheral shoulder which is disposed adjacent said enclosed fluid circulation chamber, said peripheral shoulder disposed at right angles to the axis of said tubular intermediate part of said electrode;

5 a thread coaxial to said tubular intermediate part of said electrode;

a centering cylindrical surface coaxial to said tubular intermediate part of said electrode and extending in a direction coplanar to said thread and perpendicular to said peripheral shoulder; and

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a seal disposed between the cooperating mechanical assembly means of two assembled parts of said electrode.

Thanks to the invention, thick electrodes are thus obtained whose life duration is long and which do not need to be replaced frequently. Moreover, thanks to the considerable thickness of the electrodes of the invention, a mechanical assembly of the individual pieces may be effected, with the result that it becomes easy to interchange just the eroded tubular part of an electrode, and immediately to adapt the nature of this tubular part of electrode to the nature of the plasmagenic gas used.

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It is surprising to have been able to obtain satisfactory electrodes by mechanical assembly of parts which, up to the present time, it was thought had to be assembled together by electron bombardment welding, which limited their thickness. In fact, these electrodes must not only present an excellent electrical conduction at the connections of their constituent parts, but they must be perfectly tight at the level of these connections, so that the cooling fluid circulating in the tight chambers cannot pass inside said electrodes.

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Applicants have observed that such an assembly presented a contact resistance of the order of 0.1 to 1 milliohm, which is perfectly admissible for the overall conduction of the electrode. Moreover, due to the considerable thickness of the parts of the electrode and to the proximity of the peripheral shoulders to the tight chamber, the seals, on the one hand, are not subjected

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directly to the high temperature of the arc, and, on the other hand, are subjected to an efficient cooling. They may be made in known manner of elastomers withstanding temperatures of the order of 100°C to 200°C.

5 In a variant embodiment, said mechanical assembly comprises:

- for each part to be assembled, a peripheral shoulder which is disposed near said tight chamber and of which the plane is at right angles to the axis of said tubular
- 10 intermediate part, a cylindrical surface coaxial to said tubular intermediate part and disposed posterior to said shoulder, and a thread likewise coaxial to said tubular intermediate part extending said cylindrical surface; and
- a seal disposed between said cooperating cylindrical
- 15 surfaces of the two assembled parts.

Said mechanical assembly preferably further comprises centering means formed by cooperating cylindrical surfaces of said electrode parts to be assembled, said cylindrical surfaces being coaxial to said tubular part and extending

20 said thread opposite the corresponding shoulder. In this way, assembly of the parts of the electrode is rendered easier.

Said thread of each part to be assembled is advantageously made at least substantially half way through

25 the thickness of said piece.

A plasma torch comprising a cathode and an anode wherein at least the cathode comprises: a tubular intermediate part arranged for catching arc feet; end parts connecting said cathode to other parts of the torch and an enclosed fluid circulation chamber within which a cooling fluid circulates, said intermediate part and said end parts

30 of said cathode forming part of said enclosed fluid circulation chamber and being formed of individual parts whose thickness is at least equal to 10 mm, and said

35 individual parts of said cathode being connected together by mechanical assembly means comprising for each part of said

cathode to be assembled; a peripheral shoulder which is disposed near said enclosed fluid circulation chamber, said peripheral shoulder disposed at right angles to the axis of said tubular intermediate part of said cathode; a thread
5 coaxial to said tubular intermediate part of said cathode; a centering cylindrical surface coaxial to said tubular intermediate part of said cathode and extending in a direction coplanar to said thread and perpendicular to said peripheral shoulder, and a seal disposed between the
10 cooperating mechanical assembly means of two assembled parts of said cathode, whereby said intermediate and end parts of said cathode are assembled together to form a tight dismantlable moisture impervious electrode.

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cal assembly may of course present the additional particular features mentioned hereinabove.

In the particular case of said torch comprising a first electrode and a second electrode, which are coaxial, disposed one after the other, and of the end part of the second electrode opposite the first electrode forming a flare of the tubular intermediate part of said second electrode, it is advantageous if said cooperating cylindrical centering surfaces borne by the end part and the intermediate part of said second electrode, extend up to in the flare, with the result that the end of the tubular intermediate part of said second electrode forms the central part of said flare. In this way, this central curved part of the second electrode, subjected to considerable erosion, is easily replaceable with the tubular intermediate wearing part of the second electrode, whilst the flared end part, of complex shape, virtually does not suffer erosion.

The invention will be more readily understood on reading the following description with reference to the accompanying drawings, in which:

Fig. 1 is a schematic section, half in longitudinal section, half in outside view, of a plasma torch according to the present invention.

Fig. 2 is an enlarged, partial view in longitudinal section of the cathode of the plasma torch of Fig. 1.

Fig. 3 is an enlarged view in section, illustrating the assembly of the different parts of the cathode of Fig. 2, as well as certain parts of the anode of said plasma torch.

Fig. 4 is an enlarged view in longitudinal section of the anode of the plasma torch of Fig. 1.

Figs. 5 and 6 illustrate two variant embodiments of the assembly of certain parts of the anode of Fig. 4.

Referring now to the drawings, the plasma torch 1 according to the present invention and shown in Fig. 1, comprises a body 2 incorporating two envelopes 3 and 4. Inside envelope 3 is mounted a cathode 5, whilst, inside envelope 4, there is mounted an anode 6. A coil 7 is provided around envelope 3.

Cathode 5 and anode 6 are of extended tubular form and they are mounted coaxially, one after the other. Inside the body 2 and envelopes 3 and 4, there is provided a network for circulation of cooling fluid, connected outside the torch to means for circulating such a fluid (not shown) via connections 8, of which only one has been shown in Fig. 1. This cooling fluid network comprises tight cylindrical chambers 9 and 10, in which are respectively disposed cathode 5 and anode 6. Cylindrical walls 11 and 12, disposed in said tight chambers 9 and 10 and coaxially surrounding said cathode and anode 5 and 6 respectively, make it possible to form around the latter laminar cylindrical spaces 13 and 14 respectively, through which said cooling fluid flows.

An arcing device 15 is provided in the vicinity of the two opposite ends of the cathode 5 and anode 6.

The torch 1 will not be described in greater detail, as it is of known type and simply a description of the particular features of its electrodes is sufficient to understand the present invention.

As shown in Fig. 1, the cathode 5 is constituted by a tubular intermediate part 5 I, extended by end parts 5 E1 and 5 E2. The intermediate part 5 I is of simple cylindrical form and it is intended for

catching the arc feet; it is therefore subject to erosion, as illustrated schematically at 16 in Fig. 1. On the other hand, the end parts 5 E1 and 5 E2 are intended for connection to other parts of the torch 1 (not described in detail) and are complex in shape, all the more so as they form at least in part the circuit for circulation of cooling fluid.

According to the invention (cf. also Fig. 3), the three parts 5 I, 5 E1 and 5 E2 of cathode 5 have a wall thickness e_5 at least equal to ten millimetres, and preferably of the order of twenty five millimetres, and their ends are machined to allow tight mechanical assembly by screwing.

To that end, there is machined at the two ends of the tubular intermediate part 5 I, a peripheral shoulder 17 of which the plane is at right angles to the axis 18 of the cathode 5, a thread 19 half way through the thickness and coaxial to the axis 18 and a male cylindrical surface 20 for centering, likewise coaxial to axis 18. Furthermore, in each of the ends of the end parts 5 E1 and 5 E2 disposed opposite the intermediate part 5 I, there is machined a peripheral shoulder 21 of which the plane is at right angles to axis 18, a thread 22 coaxial to axis 18 and a female cylindrical surface 23 for centering, likewise coaxial to axis 18.

Tight mechanical assembly of the tubular intermediate part 5 I and of the end parts 5 E1 and 5 E2 is thus obtained by the cooperation of the threads 19 and 22 and of shoulders 17 and 21, at least one seal 24 being disposed between the cooperating shoulders of said parts. The housings of seals 24 are preferably machined in the shoulders 17 of the tubular intermediate part 5 I.

Furthermore, as shown on a larger scale in Fig. 4, the anode 6 is constituted by a tubular inter-

mediate part 6 I, extended by end parts 6 E1 and 6 E2. The intermediate part 6 I is of simple cylindrical shape and subject to erosion, as indicated for part 5 I of cathode 5. Like parts 5 E1 and 5 E2, the end parts 6 E1 and 6 E2 are complex in shape. In particular, the end part 6 E1, disposed opposite cathode 5, forms a flare 25.

The three parts 6 I, 6 E1 and 6 E2 of anode 6 likewise have a wall thickness e6 at least equal to ten millimetres, and preferably of the order of twenty five millimetres, and their ends are machined to allow tight mechanical assembly by screwing.

As also shown Fig. 5, at the two ends of the tubular part 6 I, there is machined a peripheral shoulder 26 whose plane is at right angles to axis 27 of the anode 6, a thread 28 half way through the thickness and coaxial to axis 27 and a male cylindrical centering surface 29, likewise coaxial to the axis 27. Furthermore, in each of the ends of the end parts 6 E1 and 6 E2 disposed opposite the intermediate part 6 I, there is machined a peripheral shoulder 30 whose plane is at right angles to axis 27, a thread 31 coaxial to axis 27 and a female cylindrical centering part 32, likewise coaxial to axis 27. It will be noted that the female cylindrical centering part 32 of part 6 E1 opens out into flare 25.

Tight mechanical assembly of the tubular intermediate part 6 I and of end parts 6 E1 and 6 E2 is thus obtained by the cooperation of the threads 28 and 31 and of shoulders 26 and 30, at least one seal 33 being disposed between the cooperating parts of said shoulders. The housings of seals 33 are preferably inserted in the shoulders 26 of the tubular part 6 I.

It will be noted that, near part 6 E1, the

end 34 of the tubular intermediate part 6 I, defined by the female centering part 32, forms the central, erodable part of the flare 25.

5 The variant embodiment of Fig. 6 also incorporates the shoulders 26 and 30, the threads 28 and 31 and the centering surfaces 29 and 32. However, in this case, between said threads and said shoulders, there are provided cylindrical surfaces 35 (on part 10 6 I) and 36 (on parts 6 E1 and 6 E2) coaxial to axis 27 and a seal 37 is disposed between these surfaces 35 and 36.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An electrode for use in a plasma torch comprising:
a tubular intermediate part intended for catching arc
5 feet;

end parts adapted to connect said electrode to other
parts of said torch, said end parts connected to said
intermediate part of said electrode at each end of said
intermediate part of said electrode;

10 an enclosed fluid circulation chamber within which a
cooling fluid circulates, said intermediate part and said
end parts forming part of said enclosed fluid circulation
chamber;

said intermediate and said end parts of said electrodes
15 being formed of individual parts whose thickness is at least
equal to ten millimetres;

mechanical assembly means for connecting said
intermediate and said end parts of said electrodes together,
said mechanical assembly means being disassemblable and
20 moisture-impervious, and comprising for each part of said
electrode to be assembled:

a peripheral shoulder which is disposed adjacent said
enclosed fluid circulation chamber, said peripheral shoulder
disposed at right angles to the axis of said tubular
25 intermediate part of said electrode;

a thread coaxial to said tubular intermediate part of
said electrode;

a centering cylindrical surface coaxial to said tubular
intermediate part of said electrode and extending in a
30 direction coplanar to said thread and perpendicular to said
peripheral shoulder; and

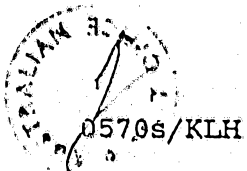
a seal disposed between the cooperating mechanical
assembly means of two assembled parts of said electrode.

35 2. The electrode of claim 1, wherein said seal is disposed
between the cooperating peripheral shoulders of two
assembled parts of said electrode.

3. The electrode of claim 1 or 2 wherein, for each part of said electrode to be assembled, said mechanical assembly means further comprises an additional cylindrical surface coaxial to said tubular intermediate part of said electrode and disposed further away from said enclosed fluid circulation chamber than said peripheral shoulder, said thread extending along said additional cylindrical surface and said seal being disposed between the cooperating additional cylindrical surfaces of two assembled parts of said electrode.

4. The electrode of claim 1, wherein for each part of said electrode to be assembled, said thread of each part to be assembled is disposed at least substantially half way through the thickness of said part.

5. A plasma torch comprising a cathode and an anode wherein at least the cathode comprises: a tubular intermediate part arranged for catching arc feet; end parts connecting said cathode to other parts of the torch and an enclosed fluid circulation chamber within which a cooling fluid circulates, said intermediate part and said end parts of said cathode forming part of said enclosed fluid circulation chamber and being formed of individual parts whose thickness is at least equal to 10 mm, and said individual parts of said cathode being connected together by mechanical assembly means comprising for each part of said cathode to be assembled; a peripheral shoulder which is disposed near said enclosed fluid circulation chamber, said peripheral shoulder disposed at right angles to the axis of said tubular intermediate part of said cathode; a thread coaxial to said tubular intermediate part of said cathode; a centering cylindrical surface coaxial to said tubular intermediate part of said cathode and extending in a direction coplanar to said thread and perpendicular to said peripheral shoulder, and a seal disposed between the



cooperating mechanical assembly means of two assembled parts of said cathode, whereby said intermediate and end parts of said cathode are assembled together to form a tight dismantlable moisture impervious electrode.

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6. The plasma torch as disclosed in claim 5, wherein the cathode and the anode are coaxial and disposed one after the other and the anode incorporates a tubular intermediate part, end parts and fluid circulation chamber having an
10 relationship the same as the relationship of corresponding parts of the cathode as claimed in claim 5.

7. the plasma torch as disclosed in claim 6, wherein the end part of the anode is disposed opposite to the end part
15 of the cathode and forms a flare in relation to the intermediate part of the anode, wherein said anode further comprises centering means, said centering means formed by cooperating cylindrical surfaces, one of said cooperating cylindrical surface being disposed on each of the anode
20 parts to be assembled, said cylindrical surfaces being coaxial to said intermediate tubular part of said anode and extending in a direction coplanar to said thread and perpendicular to said peripheral shoulder, wherein said cooperating cylindrical surfaces, borne by the end part of
25 said anode disposed proximal to said cathode and the intermediate part of the anode extend up to and comprise a portion of said flare, with the result that the end of the tubular intermediate part of the anode forms the central part of said flare and forms a major portion of the area of
30 said flare which is exposed within the interior of the anode.

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8. An electrode for use in a plasma torch substantially as herein described with reference to the accompanying drawings.

9. A plasma torch substantially as herein described with reference to the accompanying drawings.

DATED this 11th day of September, 1990

AEROSPATIALE SOCIETE NATIONALE INDUSTRIELLE

By their Patent Attorneys

GRIFFITH HACK & CO



0570s/KLH

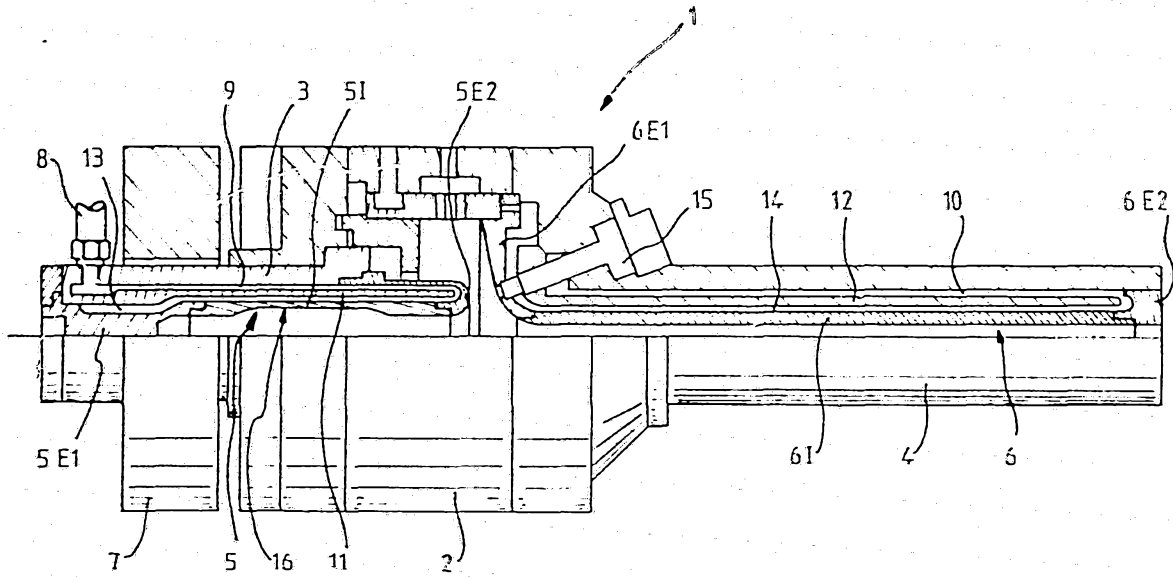


FIG. 1

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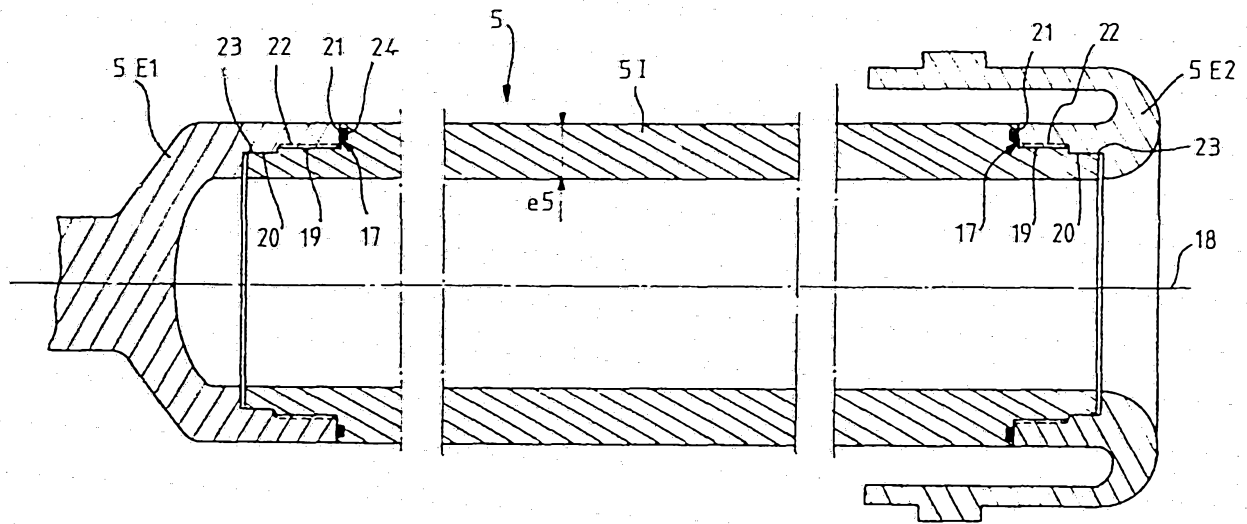


FIG. 2

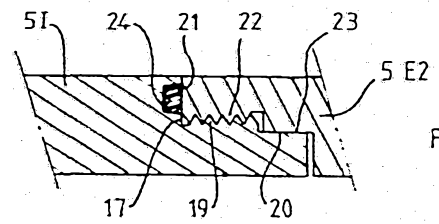
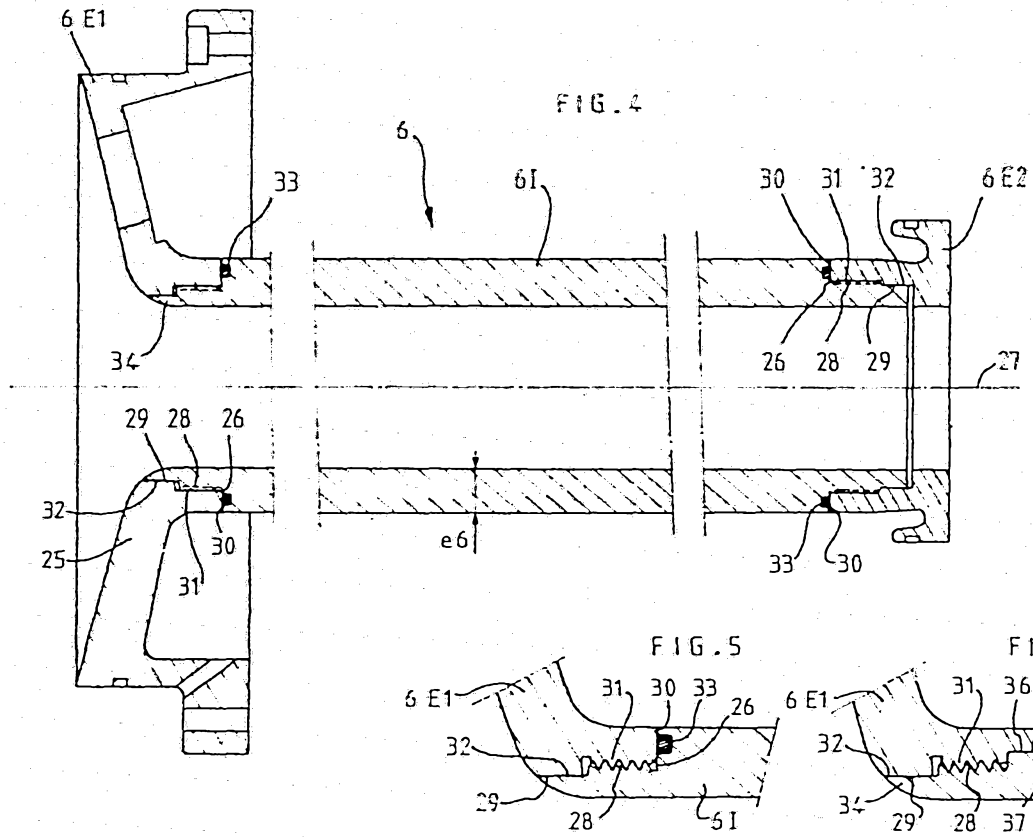


FIG. 3

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