- a tubular baffle 17 the upper end of which is screwed
(a) Convention

AUSTRALIA
Patents Act

(b) STANDARD/PETTY PATENT

(c) Insert FULL name(s) of applicant(s)

I/We (c) L’AIR LIQUIDE, SOCIÉTÉ ANONYME POUR L’ÉTUDE ET L’EXPLOITATION DES PRODUCES GEORGES CLAUDE

(d) Insert FULL address(es) of applicant(s)
of (d) 75, Quai d’Orsay - 75007 PARIS (FRANCE)

(e) Delete one

hereby apply for the grant of a (e) Standard Patent for an invention entitled

(f) "PLASMA TORCHES"

which is described in the accompanying (g) complete specification.

(Note: The following applies only to Convention applications)

Details of basic application(s)

<table>
<thead>
<tr>
<th>Application No.</th>
<th>Country</th>
<th>Filing Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>82.16.512</td>
<td>FRANCE</td>
<td>October 1, 1982</td>
</tr>
</tbody>
</table>

(h) Insert number, country and filing date for the basic application

(i) Signature of applicant(s)

For body corporate see headnote*

(k) Corporate seal if any

Note: No legalization or other witness required

PHILLIPS ORMONDE AND FITZPATRICK
Patent and Trade Mark Attorneys
367 Collins Street
Melbourne, Australia 3000

Dated (i) September 6, 1983

Marcel MIGAUD
Directeur des Service de Propriété Industrielle.

PHILLIPS ORMONDE AND FITZPATRICK
Patent and Trade Mark Attorneys
367 Collins Street
Melbourne, Australia
In support of the (a) *convention* application made by (b) L'AIR LIQUIDE, SOCIETE ANONYME POUR L'ETUDE ET L'EXPLOITATION DES PROCEDES GEORGES CLAUDE

(hereinafter called "applicant(s) for a patent") for an invention entitled (c) "PLASMA TORCHES"

I, (d) Marcel MICHAUD of L'AIR LIQUIDE, SOCIETE ANONYME POUR L'ETUDE ET L'EXPLOITATION DES PROCEDES GEORGES CLAUDE - 75, Quai d'Orsay - 75007 PARIS (FRANCE),

do solemnly and sincerely declare as follows:

1. I am the applicant(s),

   (or, in the case of an application by a body corporate)

2. I am/We are authorized to make this declaration on behalf of the applicant(s).

3. The basic application(s) for patent or similar protection on which the application is based is/are identified by country, filing date, and number as follows:

   FRANCE, filed on October 1, 1982 under No. 82.16.512 by LA Soudure Autogène Française of 75, Quai d'Orsay - 75007 PARIS (FRANCE) who are the assignees of the inventor(s).

(Note: Paragraphs 3 and 4 apply only to Convention applications)

4. The basic application(s) referred to in paragraph 3 hereof was/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

Declared at (a) PARIS

Dated (e) September 6, 1983

Marcel MICHAUD

Directeur des Services de Propriété

Inustriales.

PHILLIPS ORMONE & FITZPATRICK
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367 Collins Street
Melbourne, Australia
The handle 1 contains a single tube 3 for feed of gas and of cutting current surrounded by an insulating sheath 4, and an electric cable 5. The head 2 contains a first metal assembly 6 connected electrically to the tube 3, a second metal assembly 7 connected electrically to the cable 5, and an insulator 8 interposed between these assemblies 6 and 7.

The assembly 6 comprises three hollow elements:
- an electrode carrier 9 which has a blind axial bore 10 open at its lower extremity and the other end of which is in communication with the tube 3 via a radial gas inlet 11,
- a non-consumable electrode 12 formed by a cut 13 whose upper edge is screwed to the lower extremity of the electrode holder 9 and the bottom of which is an upwardly directed projection 14. This projection is provided with a blind seat 15 open at the bottom which receives an insert 16, for example of zirconium, and
- a tubular baffle 17 the upper end of which is screwed into the pipe 10 of the electrode carrier 9, just below the gas inlet 11, and the lower end of which is enlarged to fit over the projection 14 of the electrode at a small distance from the same.

Claim

1. A plasma torch, of the kind comprising a single gas feed pipe opening into metal electrode carrier means, metal nozzle carrier means and dividing means for dividing the gas flow into a first flow of plasmagenic gas and a second flow of cooling gas, wherein the dividing means comprise two series of orifices formed in the electrode carrier means or in said metal nozzle carrier means.
AUSTRALIA

Patents Act

COMPLETE SPECIFICATION

(ORIGINAL)

Application Number: 1933281

Lodged:

Complete Specification Lodged:

Accepted:

Published:

Priority:

Related Art:

APPLICANT'S REF.: Série 2.567 - A.L. - CJ/CN

Code: 422

Name(s) of Applicant(s): L'Air Liquide, Société Anonyme pour L'étude et l'exploitation des Procédés Georges Claude

Address(es) of Applicant(s): 75, Quai D'Orsay - 75007 Paris, France.

Actual Inventor(s): Gerard Marhic Didier Schaff Francis Remy

Address for Service is: PHILLIPS, ORMONDE & FITZPATRICK Patent and Trade Mark Attorneys 367 Collins Street Melbourne, Australia, 3000

Complete Specification for the invention entitled:

"PLASMA TORCHES"

The following statement is a full description of this invention, including the best method of performing it known to applicant(s):

P 18/11/77
The present invention relates to plasma torches of the kind comprising a single gas supply pipe leading into metal electrode carrier means, metal nozzle carrier means and dividing means for dividing the gas flow into a first flow of plasmagenic gas and a second flow of cooling gas. Torches of this kind will hereinafter be referred to as "monogas plasma torches".

It will be understood that the utilisation of a single circuit for supplying the plasmagenic gas and for cooling the main elements of the torch: electrode, nozzle, insulator, etc. . . . , is attractive because of the resulting uncomplicated structure.

However, the need for controlling the ratio between the two flows in precise manner despite substantial temperature variations occurring during operation, raises serious design difficulties. This is probably the reason why, to the Applicants' knowledge, no monogas plasma torch of any kind has been produced industrially, although their principle had been disclosed many years ago (see the specification of French patent No. 2,275,270).

It is an object of the invention to provide a monogas plasma torch intended to be capable of operating in a satisfactory manner under actual conditions of utilisation.

To achieve this and other objects the invention consists in a plasma torch of the aforesaid kind, wherein said dividing means comprise two series of orifices formed in the electrode carrier means or in said metal nozzle carrier means.
In an embodiment which assures particularly effective cooling of the electrode, a tubular baffle is provided within the electrode carrier means, which firstly directs the entering gas on to the active part of the electrode and then towards the two series of orifices. In this case, in order to lower the temperature of the cooling gas, this latter may be guided between a nozzle support and an annular skirt provided with at least one drilling for intake of ambient air, and/or a complementary passage may connect the gas inlet to a point of the cooling circuit situated down-flow of the said baffle.

One embodiment of the invention will now be described with reference to the accompanying drawings by way of example, in which:

Figure 1 is a view in axial section of a manual plasma cutting torch in accordance with the invention, and

Figures 2 and 3 are cross-sections of the electrode carrier means taken, respectively, along the lines II-II and III-III of Figure 1.

The plasma cutting torch illustrated in the drawings comprises a handle 1 and, at its end, a cutting head 2 which altogether forms a body of revolution around an axis X-X. To simplify the description, the axis XX will be assumed to be vertical and the head 2 to be downwardly directed.

The handle 1 contains a single tube 3 for feed
of gas and of cutting current surrounded by an insulating sheath 4, and an electric cable 5. The head 2 contains a first metal assembly 6 connected electrically to the tube 3, a second metal assembly 7 connected electrically to the cable 5, and an insulator 8 interposed between these assemblies 6 and 7.

The assembly 6 comprises three hollow elements:
- an electrode carrier 9 which has a blind axial bore open at its lower extremity and the other end of which is in communication with the tube 3 via a radial gas inlet 11,
- a non-consumable electrode 12 formed by a cut whose upper edge is screwed to the lower extremity of the electrode holder 9 and the bottom of which has an upwardly directed projection 14. This projection is provided with a blind seat 15 open at the bottom which receives an insert 16, for example of zirconium, and
- a tubular baffle 17 the upper end of which is screwed into the pipe 10 of the electrode carrier 9, just below the gas inlet 11, and the lower end of which is enlarged to fit over the projection 14 of the electrode at a small distance from the same.

The electrode carrier 9 has a stepped external shape in the area of the gas inlet 11, its upper portion terminates in a horizontal shoulder 18 and is followed by an intermediate portion of slightly smaller diameter; a second horizontal shoulder 19 connects the latter to a lower portion of distinctly smaller diameter, approximately equal to the external diameter.
of the cut 13. Four radial orifices 20 situated at 90° from each other, pass through the electrode carrier 9 just below the shoulder 19, and two orifices 21 of smaller diameter, which are also radial, pass through this electrode carrier just above the upper edge of the cup 13.

The second metal assembly 7 comprises two elements, being a tubular nozzle carrier 22 and a nozzle 23 in the form of a cup the top edge of which is screwed to the lower end of the nozzle carrier and the bottom of which is transpierced by an axial orifice 24.

The insulator 8 formed from an appropriate insulating material, has three parts: an upper part engaged on the intermediate portion of the electrode carrier 9 and impinging against the shoulder 18, an intermediate part of greater thickness which delimits an annular chamber 25 with the shoulder 19 and is transpierced by a series of longitudinal passages 26, and a lower part which with an annular gap surrounds the electrode carrier in the area of the orifices 21. The chamber 25 is also connected directly to the upper end of the passage 10 of the electrode carrier by one or more complementary passages 27.

The nozzle carrier 22 comprises an upper part engaged over the intermediate and upper parts of the insulator 8, a thicker intermediate part engaged over the lower part of this insulator, and a lower part receiving the nozzle. The intermediate part of the nozzle carrier delimits an annular chamber 28 with that of the insulator, and is also transpierced by
a series of longitudinal passages 29. These latter open into a final annular chamber 30 delimited internally by the lower portion of the nozzle carrier 22 and by the nozzle, and externally by an insulating skirt screwed or secured by another means to the upper portion of the nozzle carrier. The skirt 31 is transpierced by several venting holes 32 sloping inwards and downwards. The torch is completed by an insulating covering 33 of plastics material which forms the outer part of the handle 1 and of the head 2 up to the level of the top edge of the skirt 31.

In operation, the assembly 6 is raised to an appropriate potential compared to the piece which is to be cut (not illustrated) by means of the tube 3, the assembly 7 is raised to an intermediate potential by means of the cable 5, and an appropriate gas, for example compressed air, is directed into the tube 3.

In essence, the gas enters the passage 10 via the inlet 11, descends through the baffle 17, passes over the projection 14 of the electrode and rises again in the annular space 34 present between the cup 13 and the baffle 17, and then between the latter and the wall of the passage 10.

A comparatively low proportion (for example 10%) of the gas emerges from the annular space 34 through the two holes 21 to produce an injection of plasmagenic gas into the annular gap provided at this level between the electrode holder 9 and the insulator 8, then into the annular chamber left free under this latter between the nozzle 23 and the cup 13. This plasmagenic gas issues from the head 2 via the central orifice 24.
The residue of the gas which had reached the annular space 34 is utilised to cool the head 2 and in particular the nozzle 23. This gas emerges from the electrode holder via the orifices 20 and passes consecutively into the annular chamber, the passages 26, the annular chamber 28, the passages 29 and the annular chamber 30 from which it is discharged downwards into the surrounding atmosphere. A particular flow of gas passes direct from the inlet 11 to the chamber 25 via the passages 27 of the electrode carrier, and the flow of the cooling gas into the chamber 30 draws in a substantial volume of ambient air through the holes 32 of the skirt 31.

It is thus apparent that the gas allowed to enter via the tube 3 substantially has the initial function of cooling the electrode 12. A part of this gas heated by the electrode, and determined by the ratio between the total cross-sections of the orifices 20 on the one hand and of the orifices 21 on the other hand, is derived to form the plasmagenic gas. During operation, this latter thus has a high temperature unaffected by the possible variations of the temperature of the gas entering through the tube 3. This is advantageous, since it is known that the temperature of the plasmagenic gas affects the cutting performance of the torch, by improving the same when it increases. The fraction of the flow emerging via the orifices 21 may be controlled in a precise manner since all the orifices 20 and 21 are drilled in one and the same component, which expands in a uniform manner. This
would remain valid moreover if the electrode carrier
were formed by several elements having expansion coefficients
close to each other. Furthermore, these orifices and
in particular the orifices 21, may easily be made with
a very small diameter since they are drilled into a
metal element. By contrast, the passages 26 of the
insulator 8 which merely serve the purpose of guiding
the cooling gas, may have a distinctly greater diameter
than that of the orifices 20, since their diame-

The fresh gas entering the cooling circuit
downstream of the orifices 20 via the passages 27 and
the fresh air drawn in via the holes 32, render it
possible to obtain a cooling gas at sufficiently low
temperature at every level to play its part in effective
manner. In particular, the gas emerging from the passages
27 renders it possible to keep the insulator 8 at a
lower temperature than the softening point of particular
plastics materials, which is highly advantageous for
quantity production. Again, the fact that passages
27 are drilled in the same metal element as the orifices
20 and 21 allows of satisfactory control over the gas
fraction diverted in this manner.

As a modification, and although this actually
appears to be less advantageous, the two series of
orifices forming the flow divider could be formed in
one or two metal elements forming the nozzle carrier
means. In this case, the electrode holder would no
longer comprise the orifices 21 and the whole of the
gas contained in the annular space 34 would emerge
through the orifices 20 for partial re-injection into
the plasmagenic gas chamber. The principle of this
modification has been sketched in Figure 1, in which
dash-dotted lines have been used to show passages 21A
connecting the chamber 28 to the plasmagenic gas chamber
and drilled into the nozzle carrier 22. The lower
part of the insulator 8 being omitted to allow of this
connection. In this modification, the overall gas
flow is divided by the passages 29 and 21A which are
all formed in the same metal element 22.

It should be observed that the design of the
torch in accordance with the invention renders it
possible to impart any desirable orientation to the
orifices 20 and 21.
The

1. A gas f of metal gas. There is then a third means

2. A corresponding part of a tube to pass on to the two sides

3. A guiding situation for the tub

4. A point where a tube is located on the top of a core. There is then a parting and an opening for dr

5. A cooling point for a core said by RECS or

6. A corresponding point

DATED:
L'AIR DES PP
By its PHILLI
The claims defining the invention are as follows:

1. A plasma torch, of the kind comprising a single gas feed pipe opening into metal electrode carrier means, metal nozzle carrier means and dividing means for dividing the gas flow into a first flow of plasmagenic gas and a second flow of cooling gas, wherein the dividing means comprise two series of orifices formed in the electrode carrier means or in said metal nozzle carrier means.

2. A torch as claimed in claim 1, wherein the orifices corresponding to the cooling gas open at the inlet of a guiding passage formed in an insulator which surrounds the electrode carrier means.

3. A plasma torch as claimed in claim 2, wherein the guiding passage is formed by a series of axial drillings situated in the insulator.

4. A plasma torch as claimed in claim 1, 2 or 3, wherein within the electrode carrier means is situated a tubular baffle which directs the incoming gas firstly on to the active part of the electrode and then towards the two series of orifices.

5. A plasma torch as claimed in claim 4, wherein the cooling gas is guided between said nozzle carrier means and an annular skirt provided with at least one drilling for drawing in ambient air.

6. A plasma torch as claimed in claim 4 or 5, wherein a complementary passage connects the gas feed pipe to a point of the cooling circuit situated downflow of the said baffle.

7. A plasma torch substantially as hereinbefore described with reference to the accompanying drawings.

DATED: 21 September, 1983

L' AIR LIQUIDE, SOCIETE ANONYME POUR L'ETUDE ET L'EXPLOITATION DES PROCEDES GEORGES CLAUDE
By its Patent Attorneys:
PHILLIPS ORMONDE AND FITZPATRICK