PLASMA TORCH

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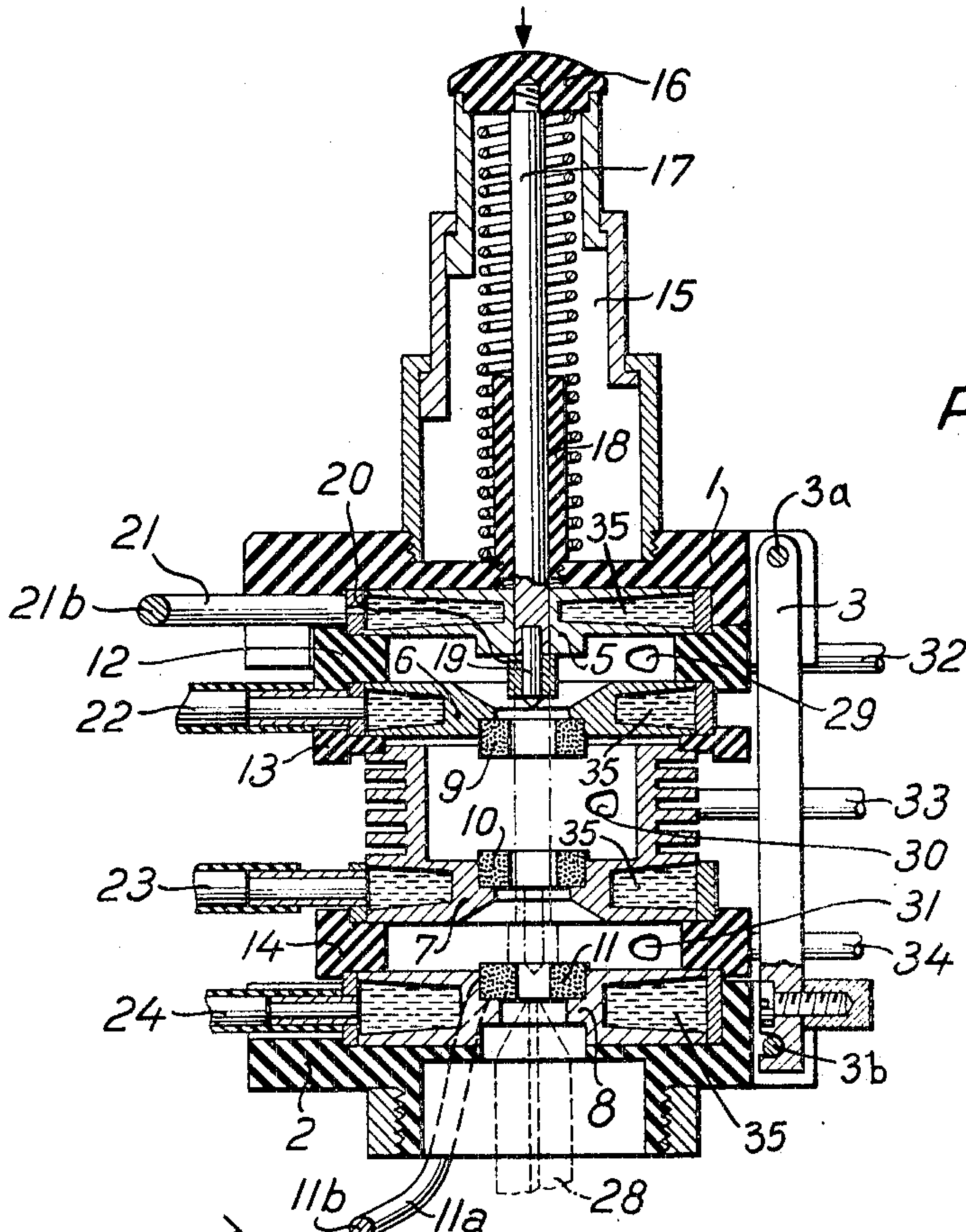

Fig. 1

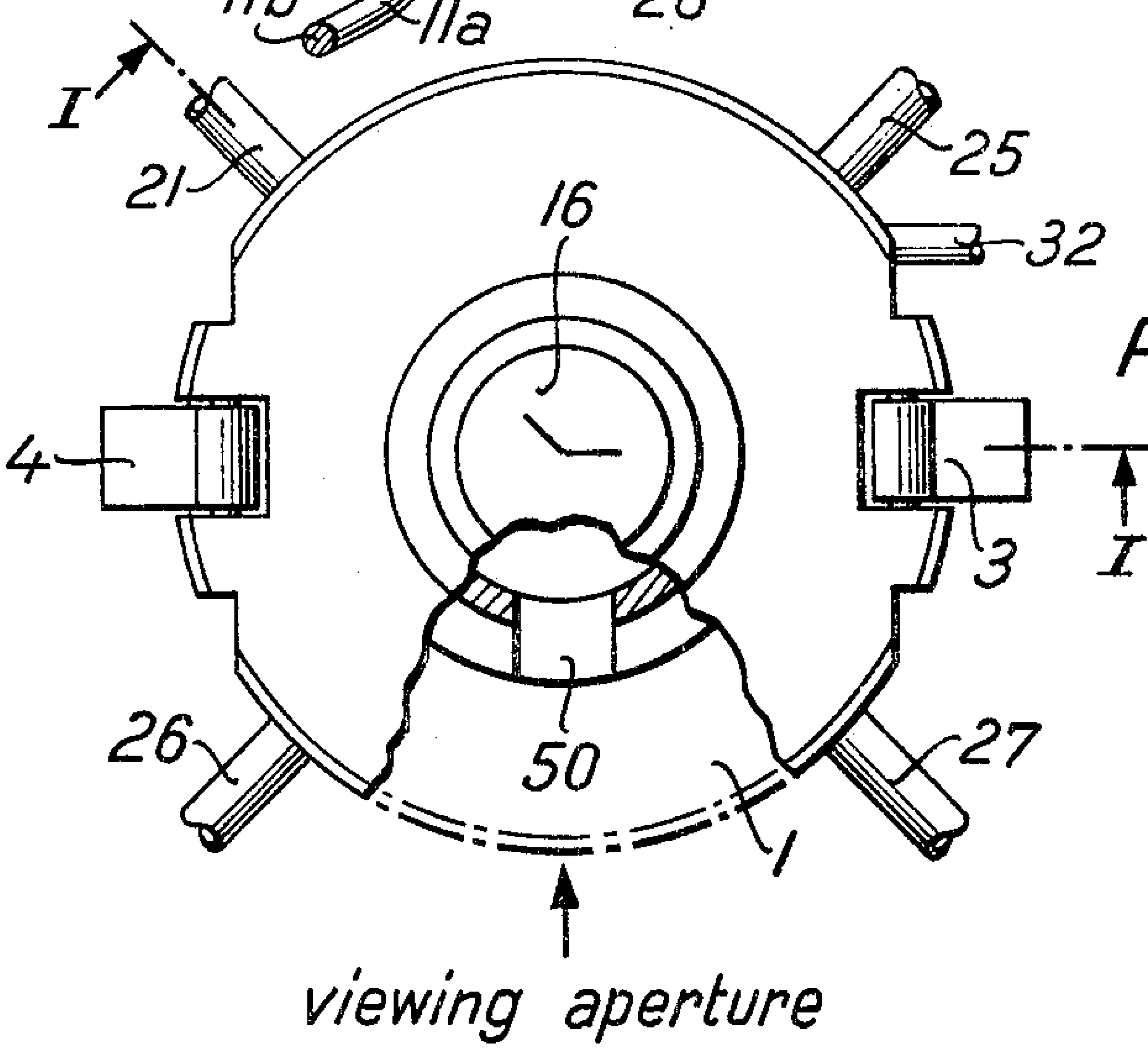

Fig. 2

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PLASMA TORCH

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ABSTRACT OF THE DISCLOSURE

In a plasma torch for spectrum analysis examination processes a bar-shaped cathode and an annular anode are disposed in a casing which is subdivided by two disc-shaped apertured arc stabilizers into three chambers. At least the two outer chambers are provided with tangential inlet apertures for a protective gas, while the central chamber has a viewing aperture in front of which a spectrum analysis examination device is arranged.

The disc-shaped arc stabilizers are disclosed to be made of graphite and to be mounted in discs having cavities through which a cooling medium flows. The protective gas may, for example, be argon.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to a plasma torch for spectrum analysis examination processes.

Description of the prior art

During recent years plasma torches for spectrum analysis examination have been disclosed in which the substance to be analyzed is introduced into an electric arc. With an electric arc considerably higher temperatures can be obtained than with chemical flames as previously used for such examination purposes. The use of higher temperatures, however, is advantageous because by these temperatures more energy is provided for dissociation and stimulation of the substances to be analyzed. As a result considerably more substances as before may be examined by spectrum analysis processes.

A number of different types of plasma torches are already known to those skilled in the art. Of these torches those have proven to be particularly suitable wherein the plasma of the electric arc is stabilized by diaphragms disposed between the arc cathode and anode. Said diaphragms, therefore, serve as arc stabilizers.

By applying slight pressure above the atmospheric a plasma jet is forced in perpendicular direction to the axis of the electric arc through an aperture in the chamber wall wherein the electric arc burns. Examination is then performed in this plasma jet. In the axis of the jet temperatures of up to 6,500° K. can be obtained. However, with these prior art devices major difficulties are encountered in introducing the substances to be analyzed into the center of the jet.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a novel plasma torch which overcomes the above mentioned disadvantage. It is another object to provide a plasma torch wherein still higher temperatures can be obtained than with the known devices. It is a further object to provide a plasma torch which can be easily dismounted and thus allows ready access to all its parts.

These objects are attained by arranging the cathode and the annular anode in a casing that is subdivided by two disc-shaped apertured arc stabilizers into three chambers, of which at least the two outer chambers are provided with tangential inlet apertures for a protective gas. The central chamber has a viewing aperture in front of which a spectrum analysis examination device of known design is positioned.

The annular arc stabilizers consist of graphite rings mounted in brass or copper discs. The latter are provided with cavities through which a cooling liquid passes.

The annular anode preferably consists of spectrally pure carbon and may also be disposed in a disc-shaped holder through which a cooling medium flows. The cathode may consist of a throiated tungsten pencil which is fastened in a bar-shaped metal holder. The latter may be mounted axially slidably in an extensible spring housing.

Preferably at least part of the guide for the bar-shaped holder of the cathode consists of a hollow metallic disc through which also a cooling medium flows and which at the same time serves to provide electrical connection of the cathode to a cable connected to a D.C. source.

In order to ensure easy dismantling of the torch and simple interchangeability of all parts the torch is constructed of disc-shaped and annular individual components which are held together by means of two clamp connectors.

DESCRIPTION OF THE DRAWINGS

The objects and advantages of a plasma torch according to the invention will be more fully comprehended from the following description when taken in conjunction with the appending drawings, wherein—

FIG. 1 is a cross-sectional view of the plasma torch along line I—I in FIG. 2, and

FIG. 2 is a plan view of the plasma torch.

Referring to the drawings, a plasma torch in accordance with the inevention comprises two discs **1** and **2**, each of which has a central bore and which are made of electrically non-conductive, thermal insulating material. The two discs are held together by means of two clamp connectors **3** and **4**. The clamp connectors **3** and **4** swivel around pin **3***a* and are hooked behind locking pins **3***b*. Four hollow discs **5**, **6**, **7** and **8** through which a cooling medium flows are positioned between the discs **1** and **2**. They are separated from one another by insulating rings **12**, **13**, **14**, made of a material capable of withstanding heat, for example asbestos cement. The discs **6**, **7** and **8** are provided with central bores, in each of which carbon rings **9**, **10** and **11** are respectively mounted. The carbon rings **9** and **10** serve as apertured stabilizers, while the carbon ringe **11** serves as an anode and is connected electrically by means of a cable **11***a* to a terminal **11***b* for the current supply.

In the interior of an extensible spring housing, a bar-shaped cathode holder **17** is mounted in a cover **16** which closes the housing **15** and which is made of electrically non-conductive material, said cathode holder being guided in a tube **18** of insulating material which is inserted in the disc **1** and further guided by metal disc **5**. The cathode holder **17** extends through a central bore in the metal disc **5** and at its inner end carries a thoriated tungsten pencil **19**, which in addition is surrounded up to the height of its conical tip by a brass ring **20**. The metal disc **5** is connected by means of a cable **21** to the other pole **21***b* of the direct current supply. The brass ring **20** serves on the one hand to improve the electrical connection of cathode pencil **19** to the disc **5** and on the other hand provides better transfer of heat.

The cavities containing coolant **35** in the discs **5**, **6**, **7** and **8** are connected serially together through hose connections **22**, **23**, **24**, **25**, **26** and **27** with a source of coolant, for example tap water. The electrical conductivity of water is so slight that it does not impair the arc current which may be between 30 and 60 amperes. It is advantageous for the coolant to be allowed to flow first through the cavity in the cathode disc **5** and then through the other cavities, since the cathode is subjected to the greatest thermal load. The coolant is fed into the disc **5** by the hose connection **25** and led out the opposite side by connection **26**. Connection **26** is now connected with hose connection **22**. Water enters the hollow area of disc **6** through connection **22** and leaves through connection **27**. Connection **27** is now connected by a hose to **23** so that the coolant now flows into the hollow area of disc **7** from which it flows out through another connection which is under hose connectin **27**. This lower hose connection is finally connected by a flexible hose with connection **24** of the hollow area of disc **8**. From disc **8** the water is finally led off through a pipe connection underneath hose connection **27**. This completes the circulation beginning with inlet connection **25**, passing through four hollow areas to the outlet from the hollow areas of disc **8**.

Beneath the annular anode **11** there is disposed, concentrically to its bore, an atomiser **28** (shown in broken lines) for the introduction of the analysis material into the plasma of the arc burning between the cathode **19** and anode **11**. Bores having tangential inlet apertures **29** and **31** are provided in the annular insulating discs **12** and **14** and are in communication with gas admission connections **32** and **34** respectively. During operation a protective gas, for example argon, is injected through these bores into the chambers containing the cathode or anode. The tubular extension of the disc **7** is provided with cooling ribs and likewise has a bore having a tangential inlet aperture, which is in communication with a gas inlet connection **33**. In the tubular extension of the disc **7** there is in addition provided a viewing aperture **50** through which it is possible to view the central chamber of the burner. The direction of viewing is indicated in FIGURE 2.

The arc in the plasma torch is ignited by moving the cathode holder axially in the direction of the anode against the pressure of the spring of the extensible housing **15** until the brass ring **20** surrounding the cathode **19** makes contact with the annular anode **11**. The spring then brings the cathode **19** back into the operative position, while the electric arc is formed between the cathode **19** and the anode **11**.

It is advantageous to provide an adjustable apertured plate in the spectrophotometric viewing device, in order thereby to permit a selection of the viewing point inside the plasma.

The above described plasma torch will permit observations in the plasma core at temperatures of up to 17,000° K.

What is claimed is:

1. A plasma torch for spectrum analysis examination processes comprising in combination

a casing;
a bar-shaped cathode and an annular anode disposed in said casing along a common axis;
a cathode holder;
an anode holder;
electrically conductive means adapted to connect said cathode to one pole of a D.C. source;
electrically conductive means adapted to connect said anode to the other pole of said D.C. source;

two disc-shaped apertured arc stabilizers subdividing said casing into three chambers;
a holder for each of said arc stabilizers;
means adapted to cool said holders;
inlet apertures for a protective gas being provided in the outer two of said chambers; and
a viewing aperture being provided in the central chamber in front of which a spectrum analysis examination device can be disposed.

2. A plasma torch for spectrum analysis examination processes comprising in combination and along a common axis

a bar-shaped cathode and an annular anode;
an electrically conductive disc-shaped holder whereon said annular anode is mounted, said disc being provided with cavities through which a cooling medium flows;
electrically conductive means adapted to connect said anode holder to one pole of a D.C. source;
a bar-shaped holder whereto the cathode is fastened, said holder being axially displaceable;
means adapted to guide said bar-shaped cathode holder, said guide means comprising an electrically conductive disc provided with cavities through which a cooling medium flows;
electrically conductive means adapted to connect said disc to the other pole of a D.C. source;
two disc-shaped apertured arc stabilizers;
two metallic discs wherein said arc stabilizers are secured, said discs being provided with cavities through which a cooling medium flows;
three insulating rings inserted between said discs and two insulating apertured discs being positioned in front and to the rear of said discs and rings;
clamping means adapted to press said discs and rings together so as to form a solid block, the latter constituting a casing which is subdivided by said arc stabilizers into three chambers;
an electrically non-conductive hose connection adapted to connect serially said cavities in said discs;
tangential inlet apertures for a protective gas being provided in the outer two of said chambers; and
a viewing aperture in the central chamber through which the substance to be analyzed may be observed.

3. A plasma torch according to claim **2**, wherein said protective gas is argon.

4. A plasma torch according to claim **2**, wherein said apertured arc stabilizers comprise graphite rings.

5. A plasma torch according to claim **2**, wherein said annular anode consists of spectrally pure carbon.

6. A plasma torch according to claim **2**, wherein said cathode consists of a thoriated tungsten pencil.

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U.S. Cl. X.R.

313—231; 315—111