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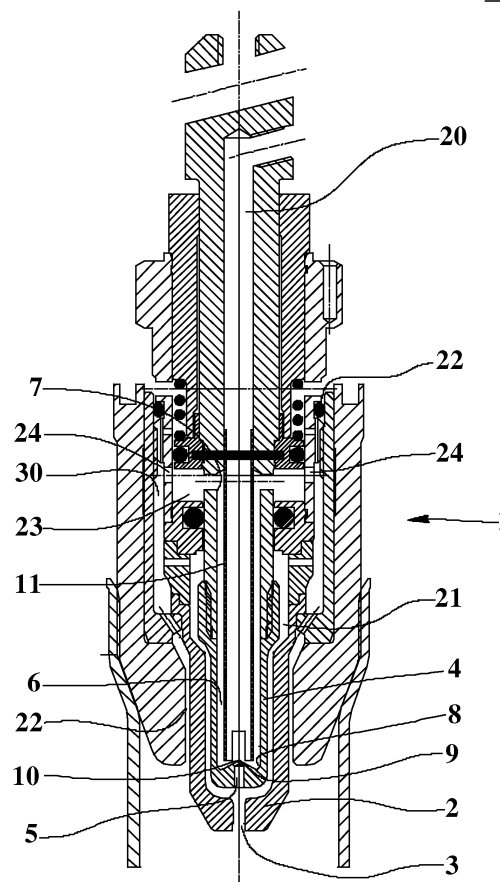
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(54) **Plasma torch device and method for carrying out an electrode thereof**

(57) Plasma torch device comprising at least a nozzle (2) provided with a plasma outlet (3) and containing an electrode (4) whose terminal portion turned towards the plasma outlet (3) has a housing in which an insert (5) is blocked. Said electrode is also provided with an inner longitudinal cavity (6) having an opened end (7) and a closed end (8) towards the end portion having the insert (5).

The closed end (8) of the electrode has a shaped portion (9) having shape almost conical protruding inside the longitudinal cavity (6) and with the vertex (10) turned towards the opened end (7) of said cavity (6).

FIG.1



Description

[0001] The present invention refers to cutting devices and in particular it refers to a plasma torch device and a method for carrying out an electrode thereof.

[0002] There are known torch devices provided with an electrode made of copper alloy and inside provided with a cavity for the air-passage or for other cooling fluid passage and/or fit to form a plasma jet, whose top portion has an insert made of a proper material, as hafnium, having an elongated cylinder shape.

[0003] In the producing step of the electrode, the insert may be inserted into a top blind hole of the electrode, having a diameter and a length respectively greater and lower than the diameter and the length of the insert.

[0004] A successive pressure onto the end of the insert protruding from the hole, deforms the inset blocking it in the hole.

[0005] A drawback of said known hollow electrodes, consists in that they may be damaged and deformed by the high deforming pressure of the insert also in presence of a match inside the cavity because the pressure forces may be deflected towards the side surface of said electrode by the match.

[0006] Another drawback consists in that the known ends, having flat circular shape or conical extension, of the cavities of the electrode may reduce the cooling of the electrode top, probably due to stagnations of the cooling fluid adduced into the cavity of the electrode by a nozzle.

[0007] In the known torches, the cooling may be un-homogeneous, for instance excessive in some zones and insufficient in others, in particular in the zones nearer to the primer zone.

[0008] An object of the present invention is to propose a plasma torch device with an electrode whose inner terminal end, of the respective cavity, has a special shape for matching with a respective and complementary match in such a way to avoid deformations of the electrode during the deformation of the insert.

[0009] Further object is to propose a torch in which a terminal end of the cavity of the electrode has a special shape suitable to improve the cooling of the top portion of the electrode.

[0010] A further object is to propose a method for carrying out the electrode of said torch.

[0011] Further object is to propose a torch provided with an homogeneous cooling.

[0012] The characteristics of the present invention are highlighted in the following with particular reference to the attached figures, where:

- figure 1 shows a longitudinal section view of the plasma torch device object of the present invention, in an operating condition;
- figure 2 shows a partial and enlarged view of the section of figure 1.

[0013] In figures 1-2 the numeral 1 indicates a plasma torch device object of the present invention.

[0014] The plasma torch device 1 comprises a nozzle 2 provided with an outlet for the plasma 3 and containing an electrode 4 with which defines an interspace 21 interposed between them.

[0015] The end portion of the electrode turned towards the outlet for the plasma 3 of the nozzle, has a housing into which is blocked the insert 5 for instance made of hafnium or its alloys, tungsten or its alloys or other alloys.

[0016] The electrode is carried out in copper or its alloys, for instance in tellurium-copper, or in silver or its alloys or in other alloys, and is also provided with a longitudinal inner cavity 6 having a closed end 8 corresponding to the end portion having the insert 5 and the opposite opened end 7.

[0017] The plasma device comprises a lip means 11, duct shaped, having an end portion flowing into the longitudinal inner cavity 6 of the electrode 4 near a shaped portion 9 of the closed end 8 and fit to adduce a fluid for the cooling and for the plasma along said cavity 6.

[0018] The outlet end for the fluid or the end portion of the lip means 11 which flows into the cavity 6 of the electrode, has optionally a set of grooves or recesses 12.

[0019] The lip end portion 11 opposite to the portion which flows into the cavity 6 is connected to a supply duct 20 connected to an outer source of the fluid for supplying the lip 11 and, against the stream, the cavity 6 with a cooling fluid flow and partially fit to form the fluid.

[0020] The open end 7 of the cavity 6, opposite to the end portion of the lip flowing therein, flows, through a toroidal chamber 23 and radial holes 24 of the chamber, in a sort of collector 30 almost shaped like a cylindrical wall, from which the fluid flow splits continuing towards the interspace 21, for cooling at least the nozzle and forming the plasma, and in upper and lower cooling ducts 22 flowing outside the device 1.

[0021] The closed end 8 of the electrode 4 has, opposite and aligned to the housing for the insert 5, a shaped portion 9 having shape almost conical and protruding inwardly the longitudinal cavity 6 and with the vertex 10 turned towards the open end 7 of said cavity 6.

[0022] The side wall 13 of the longitudinal inner cavity 6 is almost cylindrical and the base of the closed end 8 of the shaped portion 9 is linked to said cylindrical wall 13 by means of a connection surface 14 having annular torus portion that is an outer annular sector of a ring having circular or oval section.

[0023] The shaped portion 9 of the closed end 8 is fit at least to match with a concave end housing, having shape almost complementary to said shaped portion, of a match during the blocking by pressure deformation of the insert 5 in the respective housing.

[0024] In addition the shaped portion 9 of the closed end 8 is fit to at least drive the fluid flow near the closed end 8 in order to improve the cooling of the closed end portion of the electrode avoiding the formation of fluid stagnations.

[0025] The useful section, met by the fluid in passing in sequence the supply duct 20, the lip means 11, the outer portion to the latter in the cavity 6 of the electrode 4 and in passing in parallel the interspace 21 and the cooling ducts 22 up to the outside of the device 1, is almost constant or slightly increasing outward the device 1.

[0026] In this manner the velocity of the fluid respectively constant or decreasing towards the several outlets of the fluid from the device is obtained.

[0027] The invention further provides that in possible zone of possible overheating or immediately upstream them, the passage section of the fluid may be locally reduced for augmenting the velocity of the fluid in said zones or upstream them.

[0028] The method of the present invention for carrying out the hollow electrode 4 provides:

- to carry out in the end portion of the hollow electrode 4 a blind housing having depth and diameter respectively lower and greater than the length and the diameter of the cylindrical insert 5;
- to carry out in the opposite closed end 8 of the longitudinal inner cavity 6 of the electrode a shaped portion 9 having shape almost conical protruding inside the longitudinal cavity 6 and with the vertex 10 turned toward the opposite in respect to the housing;
- to put the shaped portion 9 having a shape almost conical matching an end concave housing, having shape almost complementary to said shaped portion 9, of a match placed into the cavity and placed as a stop against a fixed force point;
- to insert the insert 5 in the respective housing and make onto it an axial deforming pressure up to deform the insert blocking it in the housing;
- to extract the match from the cavity 6.

[0029] The operation of the device 1 provides that during the pressure blocking of the insert, thanks to the shape of the shaped portion 9 matching with the match having complementary shape, pressure forces discharge almost totally onto said match without deforming the cylindrical wall of the hollow electrode which, being made of copper or silver alloys, otherwise would be easy to be deformed.

[0030] During the working, the operating provides that the shape of the shaped portion 9 in cooperation with the connection surface 14, allows to the fluid flow to lap on the inner surface of the closed end portion of the cavity avoiding stationary vortexes and stagnations and thus improving the electrical exchange and the cooling of the hottest portion of the electrode.

[0031] An advantage of the present invention is to provide a plasma torch device with an electrode whose inner terminal end, of the respective cavity, has a special shape for matching with a respective and complementary match in such a way to avoid deformations of the electrode during the deformation of the insert.

[0032] Further advantage is to provide a torch in which a terminal end of the cavity of the electrode has a special shape suitable to improve the cooling of the top portion of the electrode.

[0033] A further advantage of the present invention is to guarantee a perfect fixing of the insert and to guarantee the maximum possible thermal conduction and best thermal exchange between the insert and the electrode.

[0034] A further advantage is to provide a method for carrying out the electrode of said torch.

[0035] Further advantage is to provide a torch provided with an homogeneous cooling.

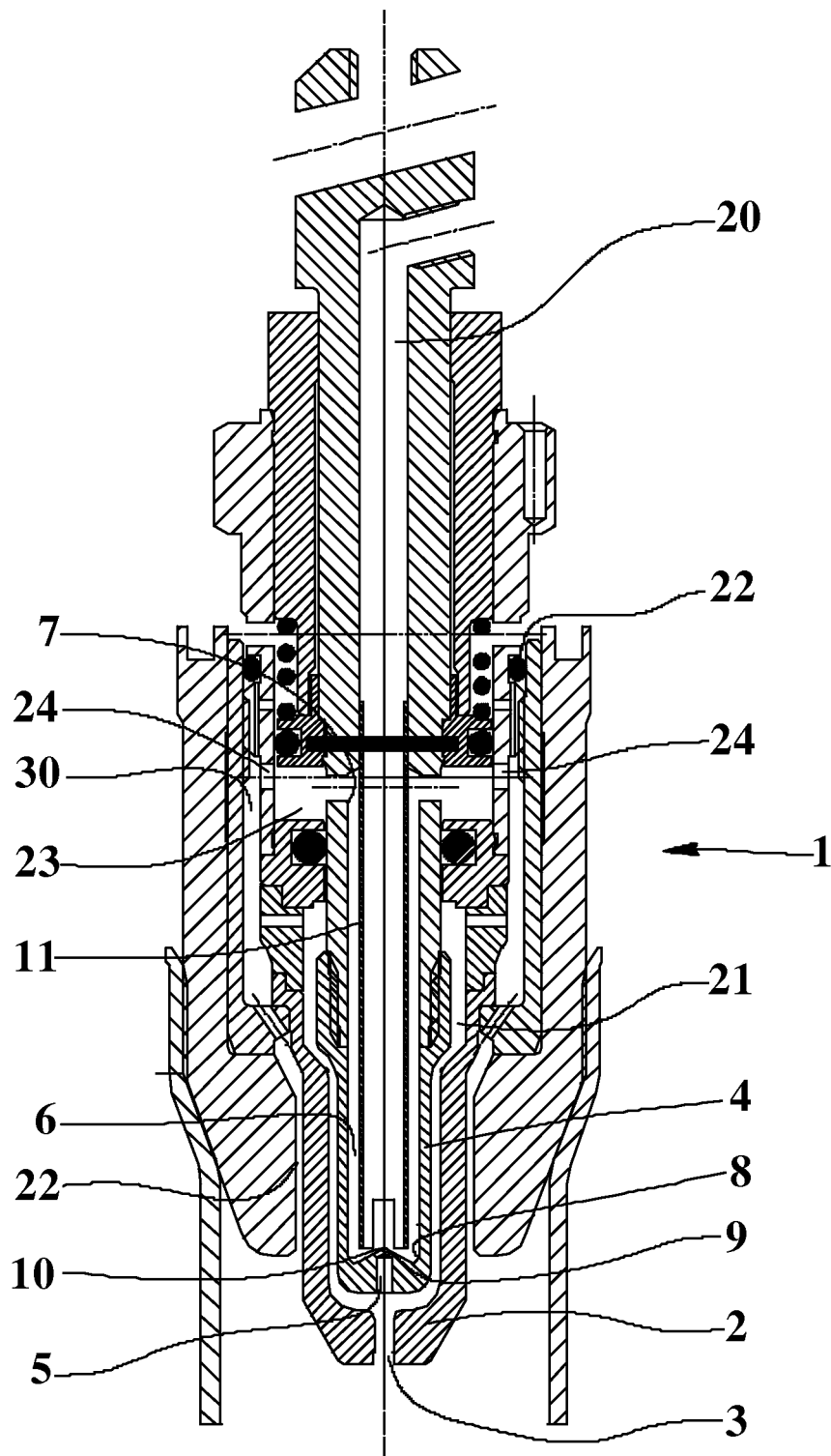
15 Claims

1. Plasma torch device comprising at least a nozzle (2) provided with an plasma outlet (3) and containing an electrode (4) whose end portion turned towards the plasma outlet (3) has a housing in which an insert (5) is blocked and provided with an inner longitudinal cavity (6) having an opened end (7) and a closed end (8) towards the end portion having the insert (5); the device (1) being **characterized in that** the closed end (8) has a shaped portion (9) having almost conical shape protruding inside the longitudinal cavity (6) and with the vertex (10) turned towards the opened end (7) of said cavity (6).
2. Device according to claim 1 **characterized in that** the shaped portion (9) of the closed end (8) is fit to at least match with an end concave housing, shaped almost complementary to said shaped portion (9), of a match during blocking by pressure deformation of the insert (5) in the respective housing.
3. Device according to claim 1 or 2 **characterized in that** it comprises a lip means (11) flowing into the inner longitudinal cavity (6) of the electrode (4) near the shaped portion (9) of the closed end (8) and fit to adduce a fluid at least for cooling.
4. Device according to claim 3 **characterized in that** the shaped portion (9) of the closed end (8) is fit at least to guide the fluid flow near the closed end (8) in order to improve the cooling of the closed end portion of the electrode.
5. Device according to the claim 3 **characterized in that** the outlet end for the fluid of the lip means (11) has a set of grooves or recesses (12).
6. Device according to any of the previous claims **characterized in that** the side wall (13) of the longitudinal inner cavity (6) is almost cylindrical and the base of the closed end (8) of the shaped portion (9) is linked to said cylindrical wall (13) by means of a connection surface (14) having torus annular portion shape.

7. Device according to any of the previous claims **characterized in that** the electrode (4) is made of copper or its alloys, silver or its alloys or in other alloys and the insert (5) is made of hafnium or its alloys, tungsten or its alloys or other alloys. 5
8. Plasma torch device comprising at least a nozzle (2) provided with a plasma outlet (3) and containing an electrode (4) provided with a longitudinal inner cavity (6) having an opened end (7) and a closed end (8) towards the plasma outlet (3), said longitudinal inner cavity (6) houses a lip means (11) supplied with a fluid flow at least for cooling by a supply duct (20) and flowing near the shaped portion (9) of the cavity (6) which flows into an interspace (21) between electrode and nozzle and into cooling ducts (22) flowing outside the device (1); said device being **characterized in that** the useful section, met by the fluid passing sequentially through the supply duct (20, the lip means (11), the outer portion of the latter in the cavity (6) of the electrode (4) and in passing parallelly the interspace (21) and the cooling ducts (22) up to the outside of the device (1), is almost constant or slightly increasing towards the outside of the device (1). 10
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9. Method for carrying out the hollow electrode (4) of any of the claims 1-7 **characterized in:**
- carrying out in the end portion of the hollow electrode (4) a blind housing having depth and diameter respectively lower and greater than the length and the diameter of the cylindrical insert (5); 30
 - carrying out in the opposite closed end (8) of the longitudinal inner cavity (6) of the electrode a shaped portion (9) having shape almost conical protruding inside the longitudinal cavity (6) and with the vertex (10) turned toward the opposite in respect to the housing; 35
 - putting the shaped portion (9), having a shape almost conical, so matching a concave end housing, having shape almost complementary to said shaped portion (9), of a match placed into the cavity and placed as a stop against a fixed force point; 40
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 - inserting the insert (5) in the respective housing and make onto it an axial deforming pressure up to deform the insert blocking it in the housing;
 - extracting the match from the cavity (6). 50

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FIG.1



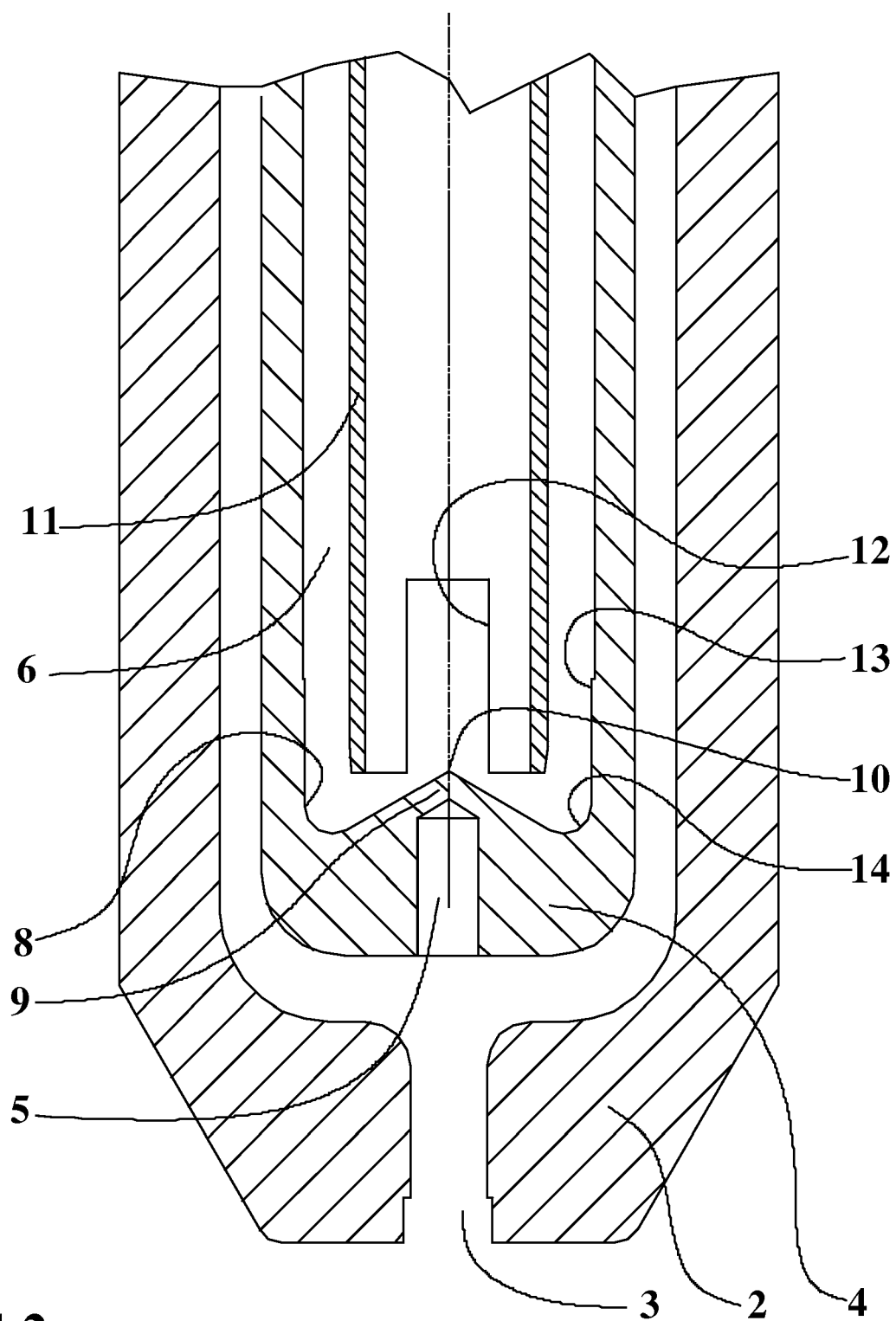


FIG. 2