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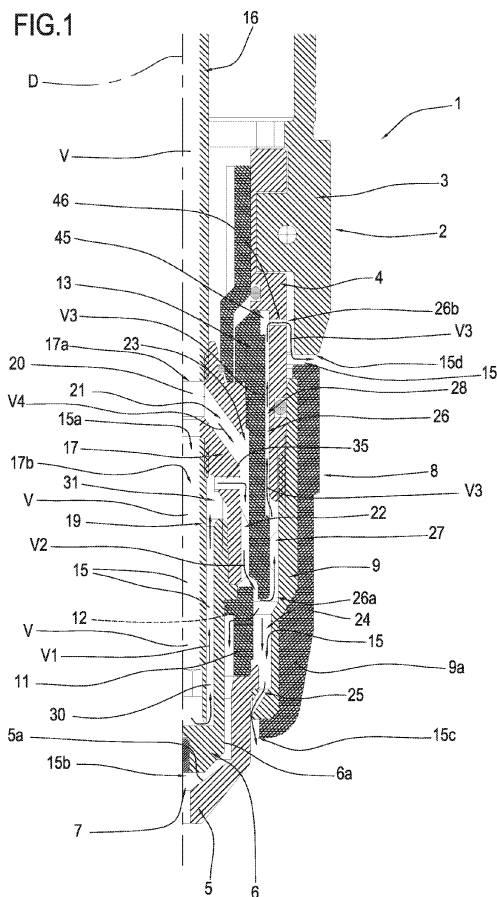
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(54) **Single-gas plasma cutting torch**

(57) A single-gas plasma cutting torch (1) comprises: a nozzle (5) from which the plasma issues; a hollow electrode (6) opposite in polarity to the nozzle (5), partly housed in the nozzle (5) and delimiting with the latter a plasma generating chamber (7); a torch body (2) extending principally along an axis (D); a nozzle holder (8) for supporting the nozzle (5) and mounted at one end of the torch body (2); the nozzle (5) and the electrode (6) are fed by respective supply systems (4, 9, 17, 16) which are isolated from each other; the torch (1) comprises a gas flow circuit (15) for cooling the electrode (6) and the nozzle holder (8) and for generating the plasma, the gas flow circuit having a vent between the nozzle holder and the torch body.



Description

[0001] This invention relates to a single-gas, transferred arc plasma cutting torch.

[0002] More specifically, this invention relates to a single-gas plasma cutting torch, that is to say, a torch that uses a single gas, in particular air, to generate the plasma arc and also to cool the torch.

[0003] Prior art single-gas plasma cutting torches extend longitudinally about a central axis and comprise:

- a nozzle from which the plasma issues;
- an electrode (cathode) opposite in polarity to the nozzle, substantially cylindrical in shape, partly housed in the nozzle and delimiting with the latter a plasma generating chamber;
- a main body or torch body;
- a nozzle holder which supports the nozzle and which is mounted at one end of the torch body; the nozzle holder also surrounds the electrode which is mounted centrally on the torch body.

[0004] The nozzle and the electrode are supplied by respective feed circuits which are suitably controlled to generate the plasma.

[0005] Generally speaking, the electrode is connected by a lead to the negative pole of a power generator (cathode).

[0006] The nozzle is electrically isolated from the electrode and can be connected by a lead to the positive pole of the power generator (anode).

[0007] This type of torch also comprises:

- at least one electrically insulating tubular element interposed between the nozzle and the electrode and between the respective supply circuits; and
- an air or gas supply circuit.

[0008] The air, to which express reference is made but without limiting the invention, has the twofold function of generating the arc plasma and of cooling the components of the torch.

[0009] Generally speaking, the air supplied by the feed circuit flows down the inside of the electrode, up along the outside of the electrode, down again and out near the nozzle holder.

[0010] It should be noted that a part of the air that flows out is channelled by suitable movement means into the plasma generating chamber to support the plasma.

[0011] These prior art torches have some disadvantages.

[0012] The use of cutting currents greater than 100A with prior art single-gas torches is particularly critical in terms of cooling the torch components and the consequent wear on the components.

[0013] When cutting operations are terminated because it is necessary to substitute some of the wear components of the torch, such as, for example, the nozzle or

the electrode, a certain amount of time must be allowed to pass because the nozzle holder is very hot and requires a relatively long period of time to cool down before the user can safely hold it in his hands in order to unscrew it.

[0014] In effect, in prior art cooling circuits such as the one described above, the air from the electrode which comes into contact with the nozzle holder is usually so hot that it is of little or no use to remove heat.

[0015] Other solutions, known for example from patent documents US4625094A, US528448A or US4777343A describe a single-gas plasma torch in which a passage-way directed towards the outside of the torch is provided for cooling purposes.

[0016] These solutions do not, however, allow the electrical leads that supply the nozzle to be effectively cooled along their full length.

[0017] This invention has for an aim to provide a single-gas plasma cutting torch which offers high-performance capabilities (cutting current higher than 100A) but which is less subject to wear than prior art torches.

[0018] Another aim of the invention is to provide a single-gas plasma cutting torch which is simple in construction and inexpensive and which at the same time allows rapid and effective cooling of all its components, including the nozzle holder, thereby facilitating the operations necessary for substituting the wear components when these reach their wear limit or to meet different working conditions.

[0019] According to the invention, this aim is achieved by a single-gas plasma cutting torch comprising the technical features described in one or more of the accompanying claims.

[0020] The technical features of the invention, with reference to the above aims, are clearly described in the claims below and its advantages are more apparent from the detailed description which follows, with reference to the accompanying drawings which illustrate a preferred, non-limiting example embodiment of the invention and in which:

- Figure 1 is a schematic longitudinal cross section of a plasma cutting torch according to this invention;
- Figure 2 is a schematic transversal cross section of a first embodiment of a plasma cutting torch according to this invention;
- Figure 3 is a schematic transversal cross section of a second embodiment of a plasma cutting torch according to this invention;
- Figure 4 is a schematic transversal cross section of a third embodiment of a plasma cutting torch according to this invention;
- Figure 5 is a schematic transversal cross section of a fourth embodiment of a plasma cutting torch according to this invention.

[0021] With reference in particular to Figure 1, the numeral 1 denotes in its entirety a single-gas, transferred

arc plasma cutting torch.

[0022] For convenience of illustration, the accompanying drawings show cross sections of only one half of the torch 1 since the latter is symmetrical about a plane comprising the axis D and perpendicular to the plane of Figure 1.

[0023] The torch 1 referred to is of the type with high-frequency ignition and its parts are described only insofar as is necessary to understand the invention.

[0024] In the description which follows, reference is made to the air as the fluid (or gas) used in the torch but without thereby limiting the scope of the invention.

[0025] Single-gas plasma torches are used for cutting metals and use a single gas, supplied by a single source, both to generate the plasma arc and to cool the torch.

[0026] The torch 1 comprises a torch body, labelled 2 in its entirety, extending along a substantially longitudinal principal axis or direction D of extension.

[0027] The torch body 2 comprises a shell 3 and a ring nut 4 engaged with the shell 3 to support the end components of the torch 1 specified below.

[0028] The torch 1 basically comprises a nozzle 5 from which the plasma issues and a hollow electrode 6 opposite in polarity to the nozzle 5 and partly housed in the nozzle 5.

[0029] The electrode 6 is connected by a lead to the negative pole of a power generator not illustrated (cathode).

[0030] The nozzle 5 is electrically isolated from the electrode 6 and can be connected by a lead to the positive pole of the power generator (anode).

[0031] The outside surface 6a of the electrode 6 delimits, with the inside surface 5a of the nozzle 5, a plasma generating chamber 7.

[0032] A nozzle holder 8 for supporting the nozzle 5 is mounted to the torch body 2 and keeps the nozzle 5 in alignment with the electrode 6.

[0033] Preferably, the nozzle holder 8 is screwed to the ring nut 4 and guarantees, through its internal conductive liner 9, a continuous flow of electricity between the ring nut 4 and the nozzle 5.

[0034] Advantageously, the nozzle holder 8 has an external insulating cover 9a which allows it to be handled safely by a user not illustrated.

[0035] The ring nut 4 preferably comprises a terminal, not illustrated since it is of a substantially known type, for connection to the positive pole of the aforementioned generator for powering the nozzle 5 through the ring nut 4 and the nozzle holder 8.

[0036] In practice, the ring nut 4 and the conductive liner 9 constitute power supply means of the nozzle 5.

[0037] Extending inside the torch body 2 and the nozzle holder 8 there are supply means, described in more detail below, for powering the electrode 6 and for channelling the gas.

[0038] The gas, as already mentioned, is used in this particular type of torch not only to generate and contain the plasma but also to cool the electrode 6 and, generally

speaking, all the components of the torch 1.

[0039] As illustrated, the electrode 6 and the nozzle 5 are electrically insulated through an interposed diffuser disc 11 or diffuser, of insulating material.

[0040] The diffuser 11 has tangential gas flow holes 12 and thus has the twofold function of electrically insulating the nozzle from the electrode and of channelling the gas into the chamber 7.

[0041] The torch 1 comprises a tubular insulating element or body 13 interposed between the power supply means of the electrode 6 and ring nut 4 and the nozzle holder 8.

[0042] Looking in more detail, it may be observed that the gas channelling means comprise a gas flow circuit 15 which is used to remove heat from the electrode 6, to feed the gas into the chamber 7 and to remove heat from the nozzle holder 8.

[0043] In the preferred embodiment illustrated, the electrode 6 is hollow and the interior of the electrode 6 forms part of the gas flow circuit 15.

[0044] The gas channelling means comprise a duct 16 for supplying the gas to the circuit 15 in which the gas flows in a direction V towards the nozzle 5.

[0045] More specifically, the supply duct 16 extends coaxially with the torch body 2 and is in fluid communication with the gas flow circuit 15.

[0046] The torch 1 comprises a connecting member or distributor 17 joining the duct 16 to the circuit 15, thus placing the duct 16 in fluid communication with the circuit 15.

[0047] Basically, the purpose of the duct 16 is to place the circuit 15 in fluid communication with the gas source.

[0048] To obtain the fluid communication, that is to say, to direct the gas supplied by the duct 16 into the circuit 15, use is made of the distributor 17, which is fitted along the supply duct 16, which is thus separated into two stretches, labelled 16 and 19, described in more detail below.

[0049] Advantageously, in the embodiment illustrated in Figure 1, the circuit 15 has an inlet 15a, which is in fluid communication with the duct 16, preferably by way of the connecting member 17.

[0050] Preferably, the circuit 15 has a first outlet 15b located substantially at the chamber 7. More specifically, the outlet 15b corresponds to the outlet through which the plasma issues from the nozzle 5.

[0051] The circuit 15 preferably has a second outlet 15c leading out of the nozzle holder 8.

[0052] The circuit 15 preferably has a third outlet 15d.

[0053] In the preferred embodiment illustrated by way of an example, the electrode 6 is plugged into the distributor 17, guaranteeing an uninterrupted flow of electricity between it and the supply duct 16, thereby defining the aforementioned power supply means of the electrode 6.

[0054] In effect, in the embodiment illustrated, the duct 16 can be connected to the negative pole of the aforementioned power generator.

[0055] Looking in more detail (at the circuit 15), it may

be observed that the circuit 15 includes the aforementioned second stretch or duct 19 which extends inside the electrode 6 and coaxially therewith: in short, when assembled, the second stretch or duct 19 is interpenetrated (at least partly) in the electrode 6 (both being considered as mechanical components).

[0056] In effect, as mentioned previously, the gas supply duct 16 comprises the first stretch 16 which can be associated with the gas source, and the second stretch 19 leading into the electrode 6.

[0057] The distributor 17 is preferably fitted between the first stretch 16 and the second stretch 19.

[0058] Thus, as mentioned previously, the second stretch 19 of the supply duct 16 also forms part of the gas flow circuit 15.

[0059] In the preferred embodiment illustrated, the distributor 17 is screwed at its inlet opening 17a to an outlet portion of the first stretch of the duct 16 whilst the second stretch 19 is in turn screwed to an outlet opening 17b of the selfsame distributor 17.

[0060] Advantageously, the distributor 17 is also supported by the insulating element 13 to which it is screwed.

[0061] As illustrated, the distributor 17 comprises a central channel 20 connecting the first stretch of the duct 16 and the second stretch 19 where the central channel 20 is coaxial with the supply duct 16.

[0062] The distributor 17 comprises a first set of ducts 21 which are in fluid communication with the channel 20 and in which the gas flows in a direction V4.

[0063] In the preferred embodiment illustrated, the first set comprises four ducts 21.

[0064] More in detail, the ducts 21 are distributed along a circumference round the side wall of the central channel 20.

[0065] In the preferred embodiment illustrated, the ducts 21 diverge from the central channel 20 to take at least part of the gas from the duct 16 towards the outside of the torch 1 where it can also cool all the peripheral components, as will become clearer as this description continues.

[0066] The duct stretch 19 is fitted coaxially in the electrode 6 in such a way as to form a gap 30 between the outside surface of the stretch 19 of the duct 16 and the inside surface of the electrode 6.

[0067] As mentioned above, the stretch 19 is interpenetrated deep inside the electrode 6 which is hollow except for a full head at the end of it whose outside surface faces the nozzle 5 (again considering the components after they have been assembled).

[0068] This architecture means that the end or outlet zone of the stretch 19 is arranged face to face with and very close to the annular inside surface of the end head of the electrode 6 defined by its hollow shape.

[0069] This particular arrangement optimizes the cooling effect of the gas (see direction V, Figure 1) since the plasma generating arc is struck at the head of the electrode 6 (that is on the surface of it which faces the nozzle 5).

[0070] When it leaves the duct 19, the gas flows up the electrode 6 in the direction V1 through the gap 30 which is thus in fluid communication with the stretch 19 of the supply duct 16.

[0071] Downstream of the gap 30 in the direction V1, the gas flow circuit 15 has an annular chamber 31.

[0072] The annular chamber 31 is preferably delimited by the connecting member 17 and by the outside surface of the electrode 6.

[0073] As illustrated, the torch 1 comprises a set of gas flow ducts 35 which are in fluid communication with the chamber 31.

[0074] Downstream of the ducts 35 in the direction V2, the torch comprises a channel or annulus 22, preferably substantially cylindrical.

[0075] In the preferred embodiment illustrated, the channel 22 is defined between the connecting member 17, and more specifically, between the outside surface of the connecting member 17, and the tubular insulating member 13.

[0076] More specifically, the ducts 35 place the annular chamber 31 in fluid communication with the channel 22.

[0077] The channel 22 is in fluid communication with the outlets of the ducts 21 and receives gas flowing out therefrom.

[0078] In practice, the distributor 17 provided with the channel 20 and with the ducts 21 defines a system for tapping the gas flowing in the duct 16.

[0079] A part of the "fresh" gas can therefore be tapped upstream of the electrode and directed to cool the nozzle holder 8, thanks to the distributor 17.

[0080] This part of "fresh" gas reaches the nozzle without coming into contact with the electrode and is more effective in cooling both the nozzle and the nozzle holder.

[0081] The "fresh" gas from the ducts 21 mixes with the gas from the chamber 31, cooling it and improving its effectiveness in cooling the nozzle holder 8.

[0082] To optimize the cooling effect of the gas circulating in the channel 22, the connecting member 17 comprises a plurality of fins 23 on its outside surface.

[0083] The fins 23 are therefore located inside the channel 22.

[0084] The fins 23 extend in the direction D and their height is preferably comparable to the width of the channel 22.

[0085] Downstream of the channel 22, in the direction V2, the circuit 15 comprises another channel or annulus 24, substantially cylindrical and in fluid communication with the channel 22.

[0086] The channel 24 is substantially defined between the aforementioned diffuser 11 and the nozzle holder 8, and more specifically, the outside surface of the diffuser 11 and the internal conductive liner 9 of the nozzle holder 8.

[0087] It should be noted that, as mentioned above, the plasma generating chamber 7 is supplied with gas through the holes 12 which place it in fluid communication with the channel 24.

[0088] The torch 1 comprises a set of holes 25 made in the nozzle holder 8 and which place the channel 24 in fluid communication with the outside environment so as to discharge part of the gas which, in use, removes heat from the nozzle holder 8.

[0089] The holes 25 thus constitute the aforementioned outlet 15c of the gas flow circuit 15 to the outside of the torch body 2.

[0090] With reference to Figure 1, it should be noted that the circuit 15 comprises a vent system or vent 26 with an inlet 26a and an outlet 26b. The inlet 26a is in fluid communication with the annulus 24, while the outlet 26b gives onto the outside atmosphere.

[0091] Preferably, the vent 26 runs in the principal direction D of extension of the torch 1.

[0092] More specifically, the inlet 26a of the vent 26 is at the nozzle 5 and the outlet 26b is substantially formed on the torch body 2 on the side opposite the nozzle 5 with respect to the nozzle holder 8.

[0093] Looking in more detail, it should be noted that the vent 26 has a first stretch or inlet stretch 27 defined by a corresponding annular chamber. The inlet stretch 27 is in fluid communication with the channel 24.

[0094] The vent 26 comprises a second, outlet stretch 28 which is in fluid communication with the inlet stretch 27.

[0095] Advantageously, the vent 26 extends at least partly between the insulating member 13 and the ring nut 4.

[0096] More specifically, the second stretch 28 of the vent 26 extends between the insulating member 13 and the ring nut 4.

[0097] Figures 2 to 5 show a first, a second, a third and a fourth preferred embodiment of the vent 26 and, more specifically, of the stretch 28.

[0098] In the embodiment illustrated in Figure 2, the second stretch 28 of the vent 26 is delimited between the insulating member 13 and the ring nut 4.

[0099] The member 13 has a flat section 40 on its substantially cylindrical outside surface.

[0100] In other words, the member 13 has a substantially flat face 40 directed towards the preferably cylindrical inside surface of the ring nut 4 and delimiting with the latter the vent 26 and, more specifically, the second stretch 28 of the vent 26.

[0101] In the embodiment illustrated in Figure 3, the vent 26 and, more specifically, the second stretch 28 of the vent 26 is defined by a groove 41.

[0102] Preferably, in the embodiment illustrated, the groove 41 is formed on the outside surface of the tubular member 13.

[0103] The groove 41 faces the substantially cylindrical inside surface of the ring nut 4 and delimits with the latter the second stretch 28 of the vent 26.

[0104] Preferably, the groove 41 runs in the direction D.

[0105] In the embodiment illustrated in Figure 4, the vent 26 and, more specifically, the second stretch 28 of

the vent 26 is defined by a groove 42.

[0106] Preferably, in the embodiment illustrated, the groove 42 is formed on the inside surface of the ring nut 4.

[0107] The groove 42 faces the substantially cylindrical outside surface of the member 13 and delimits with the latter the second stretch 28 of the vent 26.

[0108] Preferably, the groove 42 runs in the direction D.

[0109] In the embodiment illustrated in Figure 5, the vent 26 and, more specifically, the second stretch 28 of the vent 26 is defined by a first groove 43 and a second groove 44 which face each other.

[0110] Preferably, in the embodiment illustrated, the groove 43 is formed on the outside surface of the tubular member 13.

[0111] Preferably, in the embodiment illustrated, the groove 44 is formed on the inside surface of the ring nut 4.

[0112] Preferably, the groove 43 runs in the direction D.

[0113] Preferably, the groove 44 runs in the direction D.

[0114] As illustrated, the grooves 43 and 44 extend in a substantially symmetrical fashion to delimit the second stretch 28 of the vent 26.

[0115] In practice, the second stretch 28 is delimited between the groove 43 and the groove 44, or between the member 13 and the ring nut 4.

[0116] As illustrated in Figure 1, the gas flows up along the vent 26 in the direction V3.

[0117] The torch 1 comprises an annular chamber 45 located downstream of the second stretch 28 in the direction V3.

[0118] The chamber 45 forms part of the vent 26 and is in fluid communication with the second stretch 28 thereof.

[0119] In practice, the vent system 26 comprises the annular chambers 24 and 45 which are connected to each other by a plurality of channels defined by the second stretches 28 which extend in the direction D.

[0120] The gas is channelled from the chamber 24 to the chamber 45, from which it flows out, as described in more detail below, through the stretches 28.

[0121] The torch 1 comprises a plurality of holes 46 in fluid communication with the chamber 45.

[0122] The holes 46 extend from the chamber 45 to the outside of the torch 1 and preferably define the aforementioned third outlet 15d of the circuit 15.

[0123] Preferably, as illustrated, the holes 46 lead out substantially at the shell 3, that is to say, the vent 26 extends up along the entire nozzle holder 8 to remove heat from the latter.

[0124] Advantageously, the gas flow circuit 15 thus comprises a plurality of chambers and/or stretches connected in series to each other without any zones where still air can collect and which would reduce the cooling effect of the gas.

[0125] The air flows uninterruptedly along all the stretches and/or chambers, allowing effective cooling of

the torch components through which each of the stretches extends.

[0126] Advantageously, thanks to the design of the air supply circuit, it only takes a few seconds for the nozzle holder to cool down sufficiently for the user to screw it off safely in order to substitute the wear components when these reach their wear limit or when different working conditions must be met.

[0127] In this configuration, experimental tests have shown that even at cutting currents of 160A, all the wear components of the torch are effectively cooled and thus protected against unacceptably rapid wear and deterioration.

[0128] The torch as described above is susceptible of industrial application and may be modified and adapted in several ways without thereby departing from the scope of the inventive concept. Moreover, all the details may be substituted by technically equivalent elements.

Claims

1. A single-gas plasma cutting torch comprising:

- a nozzle (5) from which the plasma issues;
- a hollow electrode (6) opposite in polarity to the nozzle (5), partly housed in the nozzle (5) and delimiting with the latter a plasma generating chamber (7);
- a torch body (2) extending principally along an axis (D);
- a nozzle holder (8) for supporting the nozzle (5) and mounted at one end of the torch body (2);
- first electrical power supply means (4, 9) for powering the nozzle (5);
- second electrical power supply means (16, 17) for powering the electrode (6);
- electrical insulation means (11, 13) interposed between the electrode (6) and the nozzle (5) and between the first electrical power supply means (4, 9) and the second electrical power supply means (16, 17);
- gas conveying means (15, 16) for feeding the torch, these conveying means comprising
- a gas flow circuit (15) for channelling the gas towards the plasma generating chamber (7) and for channelling the gas in such a way as to cool at least the electrode (6) and the nozzle holder (8),

the gas flow circuit (15) comprising:

- a vent (26) having an inlet (26a) and an outlet (26b), the outlet (26b) giving onto the outside of the torch, the vent (26) extending between the electrical insulation means (11, 13) and the first electrical power supply means (4, 9);
- at least one annular channel (24) formed at

least partly between the electrical insulation means (11, 13) and the nozzle holder (8), the annular channel (24) being in fluid communication with the vent (26); the vent (26) comprising an inlet stretch (27) in fluid communication with the annular channel (24) and the inlet stretch (27) being delimited by the electrical insulation means (11, 13) and by the nozzle holder (8); the torch being **characterized in that** it comprises a ring nut (4) at least partly forming the first electrical power supply means (4, 9) and a tubular insulating element (13) at least partly forming the electrical insulation means (11, 13), the tubular insulating element (13) being at least partly inserted inside the ring nut (4), the vent (26) comprising at least one outlet stretch (28) formed at least partly between the tubular insulating element (13) and the ring nut (4).

2. The torch according to claim 1, wherein the vent (26) has its inlet (26a) at the nozzle (5) and its outlet (26b) from the torch body (2) on the side opposite the nozzle (5) with respect to the nozzle holder (8).

3. The torch according to claim 1 or 2, wherein the gas flow circuit (15) comprises a first stretch (19) coaxial with the torch body (2) and inserted in the electrode (6), a first gap (30) formed between the first stretch (19) and the electrode (6) and in fluid communication with the first stretch (19), pneumatic communication means (31, 35, 22, 24) operating between the first gap (30) and the vent (26) in order to put the first gap (30) in fluid communication with the vent (26).

4. The torch according to any of the preceding claims, **characterized in that** the plasma generating chamber (7) is in fluid communication with the annular channel (24), the annular channel (24) being in particular located at the nozzle (5).

5. The torch according to any of the preceding claims, wherein the inlet stretch (27) is formed by an annular channel.

6. The torch according to any of the preceding claims, wherein the tubular insulating element (13) has a planar section (40) on its outside surface forming a substantially flat face, the vent (26) being formed at least partly between this face and the inside surface of the ring nut (4).

7. The torch according to claim 6, wherein the face extends along the principal axis (D) of extension.

8. The torch according to any of the preceding claims, **characterized in that** the tubular insulating element (13) comprises a groove (41, 43) formed on its outside surface, the groove (41, 43) facing the ring nut

(4), the vent (26) being at least partly formed between the groove (41, 43) and the inside surface of the ring nut (4).

9. The torch according to any of the preceding claims, wherein the ring nut (4) comprises a groove (42, 44) formed on its inside surface, the groove (42, 44) in the ring nut (4) facing the tubular insulating element (13), the vent (26) being at least partly formed between the groove (42, 44) in the ring nut (4) and the tubular insulating element (13). 5
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10. The torch according to claim 9, wherein the tubular insulating element (13) comprises a groove (41, 43) formed on its outside surface, the groove (41, 43) facing the ring nut (4), the vent (26) being at least partly formed between the groove (41, 43) and the inside surface of the ring nut (4) and wherein the groove (41, 43) formed on the outside surface of the tubular insulating element (13) and the groove (42, 44) formed on the inside surface of the ring nut (4) face each other, the vent (26) being at least partly formed between the groove (42, 44) in the ring nut (4) and the groove (41, 42) in the tubular insulating element (13). 15
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11. The torch according to any of the claims from 8 to 10, wherein the groove (41, 43) in the tubular insulating element (13) extends along the principal axis (D) of extension. 30

12. The torch according to any of the claims from 8 to 11, wherein the groove (42, 44) in the ring nut (4) extends along the principal axis (D) of extension. 35

13. The torch according to any of the foregoing claims, wherein the vent (26) comprises an annular chamber (45) at the outlet (26b). 40

14. The torch according to claim 13, comprising at least one hole (46) extending from the annular chamber (45) at the outlet (26b) and forming the outlet (26b). 45

15. The torch according to any of the foregoing claims, comprising a tapping system (17, 20, 21) for tapping the gas from the conveying means (15, 16) in order to feed a gas portion to the vent (26). 50
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FIG. 1

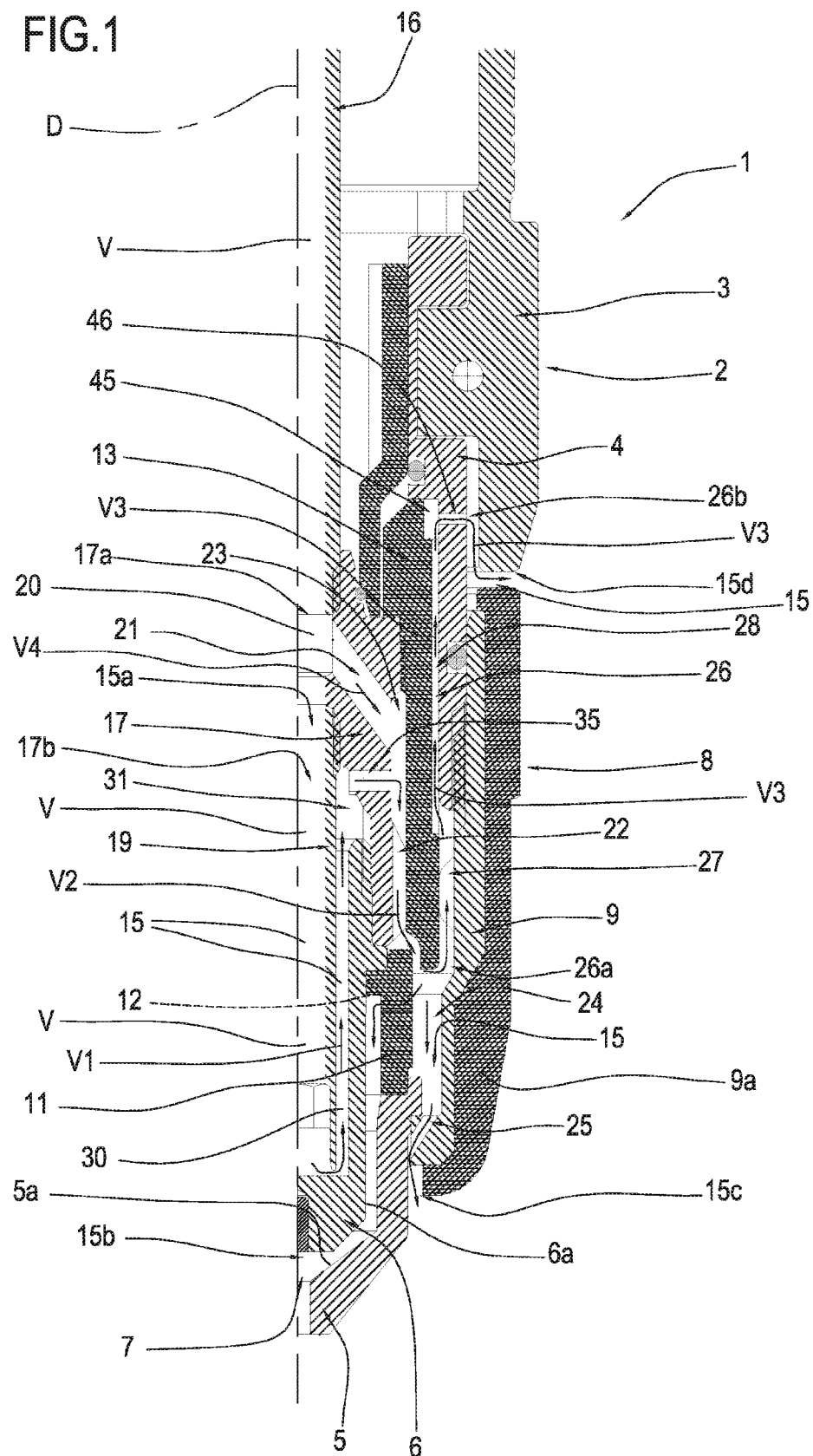


FIG.2

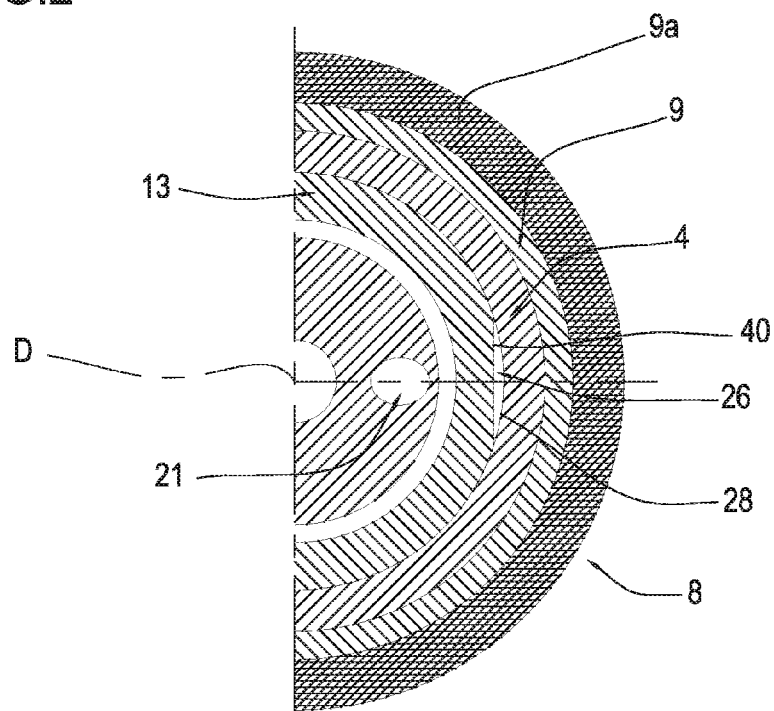


FIG.3

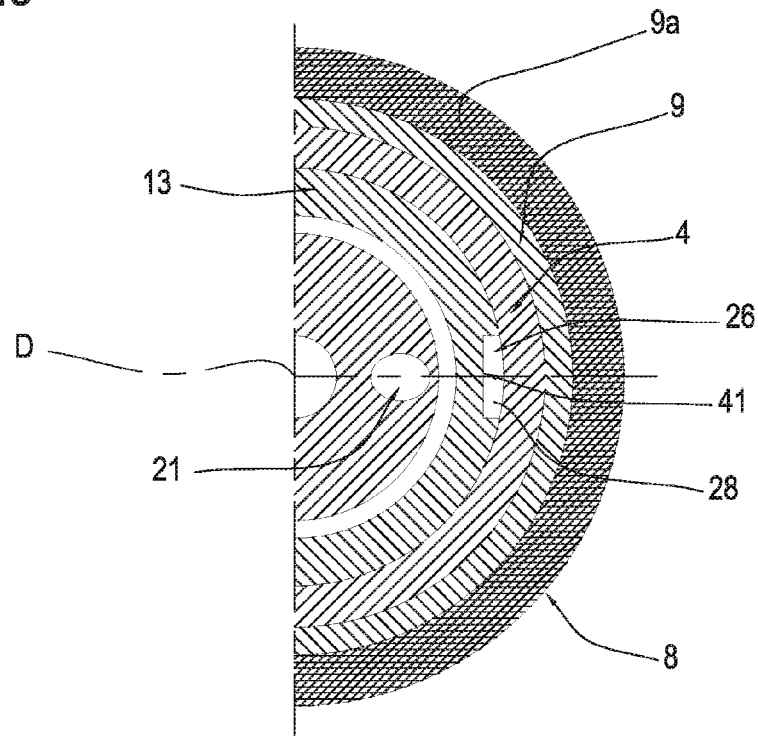


FIG.4

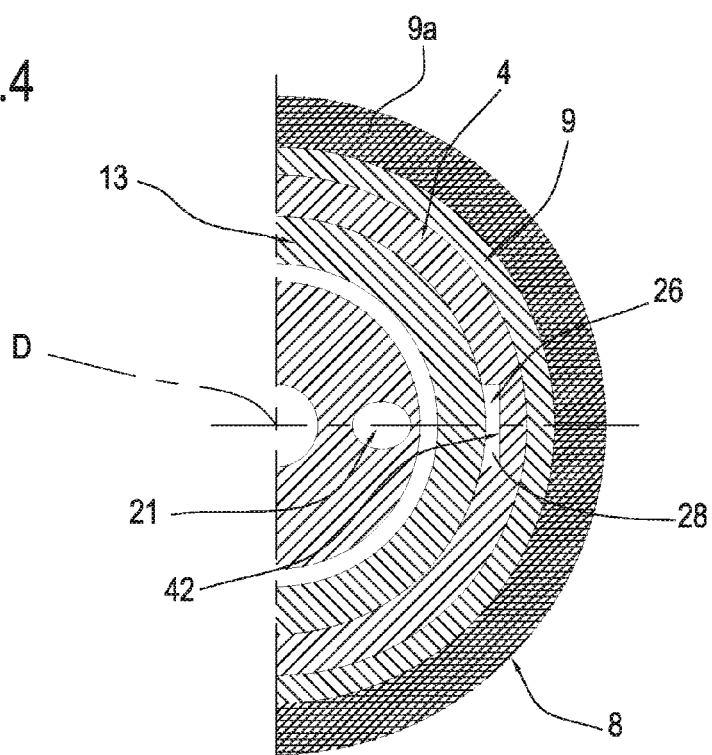
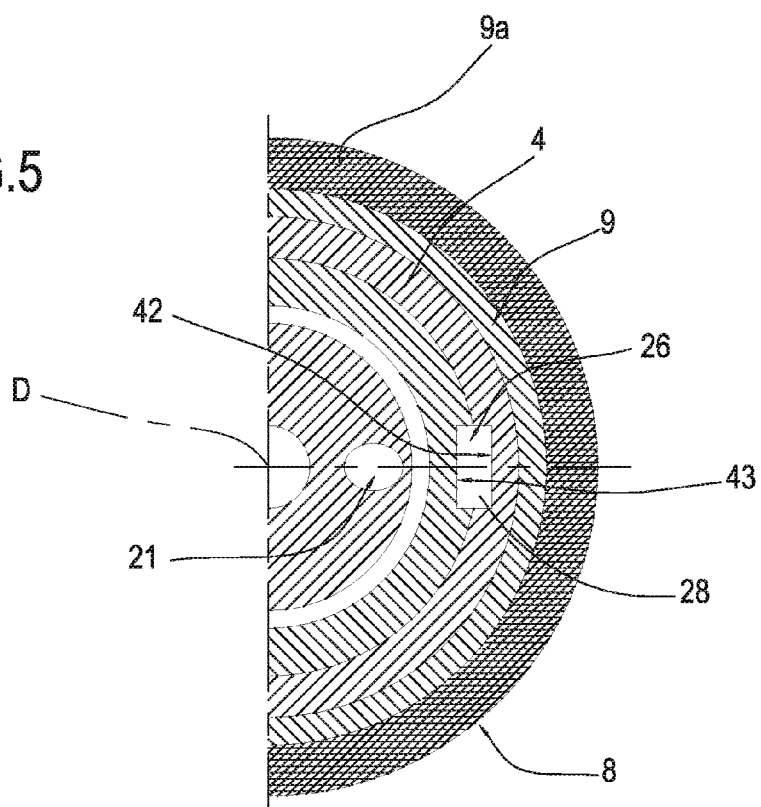


FIG.5





EUROPEAN SEARCH REPORT

Application Number
EP 11 17 4964

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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