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CA 2384211 C 2010/01/12

(11)(21) **2 384 211**

(12) **BREVET CANADIEN**
CANADIAN PATENT

(13) **C**

(22) Date de dépôt/Filing Date: 2002/04/30

(41) Mise à la disp. pub./Open to Public Insp.: 2003/01/10

(45) Date de délivrance/Issue Date: 2010/01/12

(30) Priorité/Priority: 2001/07/10 (DE101 32 575.4)

(51) Cl.Int./Int.Cl. *B22D 41/54* (2006.01), *B22D 41/50* (2006.01), *B22D 41/60* (2006.01)

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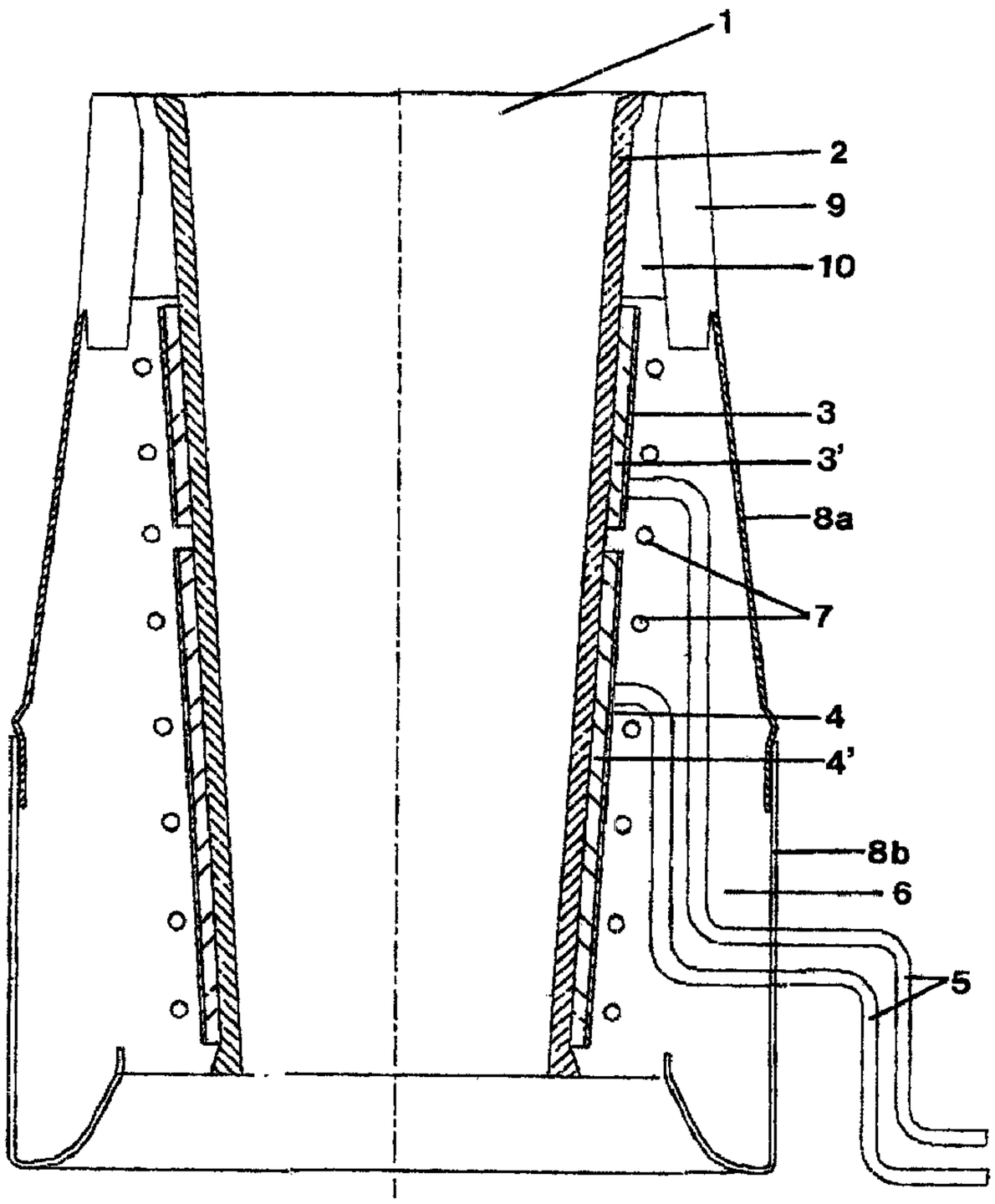
(54) Titre : TUBE REFRACTAIRE
(54) Title: REFRACTORY NOZZLE



(57) Abrégé/Abstract:
The invention refers to a refractory nozzle for arrangement in the wall of metallurgic vessels, especially for steel meltings, comprising a passage opening having an upper and a bottom end, an inside wall of a solid electrolyte material enclosing the sides

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(57) Abrégé(suite)/Abstract(continued):
of the passage opening, with at least one electrode having connecting lines arranged electroconductively at the outer side of the solid electrolyte material facing away from the passage opening, and with thermal insulating material enclosing at least partially the outside of the solid electrolyte material and the electrode, and is characterized in that the at least one electrode is essentially made of a metal which has a melting point of at least 1400 °C and/or of at least one of its oxides.

Abstract

The invention refers to a refractory nozzle for arrangement in the wall of metallurgic vessels, especially for steel meltings, comprising a passage opening having an upper and a bottom end, an inside wall of a solid electrolyte material enclosing the sides of the passage opening, with at least one electrode having connecting lines arranged electroconductively at the outer side of the solid electrolyte material facing away from the passage opening, and with thermal insulating material enclosing at least partially the outside of the solid electrolyte material and the electrode, and is characterized in that the at least one electrode is essentially made of a metal which has a melting point of at least 1400 °C and/or of at least one of its oxides.

Refractory Nozzle

The invention concerns a refractory nozzle for arrangement in the wall of metallurgic vessels, specially for steel melts, comprising a passage opening having an upper and a bottom end, an inside wall of a solid electrolyte material enclosing the sides of the passageway opening, with at least one electrode having connecting lines arranged electroconductively at the outer side of the solid electrolyte material facing away from the passage opening, and with thermally insulating material enclosing at least partially the outside of the solid electrolyte material and the electrode.

Such a nozzle is known from US 4,850,572. This patent describes an electrochemical method to prevent the deposition of material flowing through the nozzle to the surface of the inside wall of the nozzle.

From JP 62104655A another nozzle arrangenment is known, whereby the inner wall of the opening passage comprises a solid electrolyte layer, which is contacted by an outer electrode made of graphite. This is surrounded by an insulating material.

A similar nozzle is known from JP 57085659 A.

Furthermore it is known to heat refractory nozzles for molten metal. In US 3,722,821 it is disclosed, that a resistance heater is arranged around the inner wall of a nozzle with the purpose to counteract against thermomechanical tensions and to prevent the solidification of material flowing through onto the walls of the nozzle.

It is the problem of this invention to make a refractory nozzle, that is an improvement over known solutions and provides a highly reliable nozzle.

According to the invention, the problem is solved by having the at least one electrode made essentially of a metal and/or of an oxide thereof and having a melting point of at least 1400 °C. Such electrodes are stable, so that a nozzle with such an arrangement is very reliable and stable and has a low price. It is especially advantageous, that the at least one electrode is made substantially from steel, chromium or Cr_2O.

It is advantageous to have a chromium layer at least partially arranged in between the solid electrolyte material and the electrode, whereby this layer preferably has a thickness of approximately 50 µm. One oxide of the metal of the electrode should have a conductivity of at least $10^{-2}\ \Omega^{-1}\,cm^{-1}$ at a temperature of 1400 °C. It is difficult to use the known copper electrodes to contact the appropriate solid electrolyte material, the known graphite electrode material is easily oxidized to carbon monoxide or carbon dioxide, which could result in detoriation of the nozzle. Moreover, this is solved through the use of chromium, because the oxidation of this material is harmless, since Cr_20_3 is also electrically conductive. The arrangement has a low electrical resistance over a long time. Cr_20_3 can be mixed with zirconia.

It is also useful to have a metal inlay, especially a wire mesh, arranged to the side of the electrode facing away from the solid electrolyte material. It isprefered that at least two electrodes are provided one after the other in direction of the passage opening and that the electrodes surround the solid electrolyte material in annular, tubular or spiral form. It is another advantage, to have an electrically insulating material arranged between the ends of the opening passage and the at least one electrode. The insulating material of the refractory nozzle can for instance be one or more materials of the group consisting ofalumina, zirconia or mullite, particularly zirconia mullite having approximately 37 weight % zirconia and 63 weight % mullite.

The insulating material is bordered at its upper side by a preferably sintered ring of zirconia mullite, which encloses the solid electrolyte material, whereby the ring of zirconia mullite can be arranged at the top end of the opening passage and a cement can be arranged between the ring of zirconia mullite and the solid electrolyte material. The cement can for example be based on aluminium oxide. It is advantageous to use a cement with a higher heat expansion as the ring of zirconia mullite and/or the solid electrolyte material, in order to create a tension in the direction of the center of the nozzle during the heating, and thus improving the strength of the device. In this case, the cement act as a fastener ring, that increases the strength of the device.

According to one aspect of the present invention there is provided a refractory nozzle for arrangement in a wall of a metallurgical vessel, especially for steel melts, comprising a passage opening having an upper end and a lower end, an inside wall of solid electrolyte material surrounding the passage opening, at least one electrode arranged on an outer side of the solid electrolyte material facing away from the passage opening, the at least one electrode having connecting lines leading electro-conductively therefrom, a chromium layer provided at least partially on the solid electrolyte material between the inside wall and the at least one electrode, and a thermal insulating material at least partially enclosing the outer side of the solid electrolyte material and the at least one electrode, wherein the at least one electrode substantially comprises a metal and/or a metal oxide having a melting point of at least about 1400° C.

It is advantageous to have a heater, preferably a resistance heater, at least partially surrounding the outside of the solid electrolyte material, enclosing the electrodes. The heater enables the preheating of the nozzle, to prevent tensions and deterioration of the material because of rapid temperature change. The heater is preferably formed in an annular, tubular or spiral manner to the outside of the solid electrolyte material, preferably within the thermal insulation material. The heater can be made of carbon or graphite, from a high melting point metal, especially molybdenum, from a carbide, especially silicon carbide or from an oxide, especially Cr_2O_3. Zirconia is preferably used as a solid electrolyte material. It is of advantage that this solid electrolyte material of the inner wall has a density of more than 5,2 g/cm^3 and a content of silica of less than 1,5 weight % and that it is preferably sintered.

An example is explained according to the drawing. The drawing shows a section through the refractory nozzle.

The nozzle has an opening passage 1, having an inside wall 2 made of zirconia. The diameter of the opening passage 1 is increasing continuously towards the top opening of the passage 1. Two annular electrodes 3; 4 are arranged on top of each other on the outside of the zirconia, whereby between inside wall 2 and the electrodes 3;4, there is provided at least partially a chromium layer 3';4' on the solid electrolyte material having a thickness of approximately 50µm. The electrodes 3;4 or the chromium layer 3';4' can be made of chromium powder. The electrodes 3;4 can also be made of steel, the material of chromium layer 3';4' can be mixed with zirconia and should be compressed. From electrodes 3;4 connecting lines or contacting electrodes 5 are extending outwards. The electrodes are surrounded by an electrically insulating material 6, namely, by zirconia mullite, in which a heater 7 is embedded. The outer surface of the nozzle is surrounded by a metal casing. This is made from a top part 8a and a bottom part 8b. A ring 9 of zirconia mullite on the top region of the top part 8a functions as an outer closure of the nozzle. A cement 10 based on aluminium oxide is arranged in between the ring 9 of zirconia mullite and the inside wall 2 of zirconia.

WHAT IS CLAIMED IS:

1. A refractory nozzle for arrangement in a wall of a metallurgical vessel, especially for steel melts, comprising a passage opening having an upper end and a lower end, an inside wall of solid electrolyte material surrounding the passage opening, at least one electrode arranged on an outer side of the solid electrolyte material facing away from the passage opening, the at least one electrode having connecting lines leading electro-conductively therefrom, a chromium layer provided at least partially on the solid electrolyte material between the inside wall and the at least one electrode, and a thermal insulating material at least partially enclosing the outer side of the solid electrolyte material and the at least one electrode, wherein the at least one electrode substantially comprises a metal and/or a metal oxide having a melting point of at least about 1400° C.

2. The refractory nozzle according to claim 1, wherein the at least one electrode substantially comprises a material selected from the group consisting of steel, chromium and a chromium oxide.

3. The refractory nozzle according to claim 1 or 2, wherein the chromium layer has a thickness of approximately 50 μm.

4. The refractory nozzle according to claim 1, 2 or 3, wherein a metallic enclosure is provided on a side of the electrode facing away from the solid electrolyte material.

5. The refractory nozzle according to claim 4, wherein the metallic enclosure comprises a wire mesh.

6. The refractory nozzle according to any one of claims 1 to 5, wherein at least two electrodes are provided one above the other in an axial direction of the passage opening.

7. The refractory nozzle according to any one of claims 1 to 6, wherein the at least one electrode surrounds the solid electrolyte material in annular, tubular or spiral form.

8. The refractory nozzle according to any one of claims 1 to 7, wherein at least one electrically insulating material is arranged between the ends of the passage opening and the at least one electrode.

9. The refractory nozzle according to claim 8, wherein the insulating material is selected from the group consisting of alumina, zirconia and mullite.

10. The refractory nozzle according to claim 9, wherein the insulating material composes a mixture of zirconium dioxide mullite comprising about 37 weight % of zirconium dioxide and about 63 weight % of mullite.

11. The refractory nozzle according to any one of claims 1 to 10, wherein the outer side of the solid electrolyte material is at least partially surrounded by a heater.

12. The refractory nozzle according to claim 11, wherein the heater is a resistance heater which surrounds the electrodes.

13. The refractory nozzle according to claim 11, wherein the heater is arranged around the outer side of the solid electrolyte material in an annular, tubular or spiral form.

14. The refractory nozzle according to claim 11, wherein the heater is arranged in the thermal insulating material.

15. The refractory nozzle according to claim 11, wherein the heater comprises a material selected from the group consisting of carbon, a high-melting metal, a carbide, an oxide, and mixtures and alloys of at least two of these materials.

16. The refractory nozzle according to claim 15, wherein the heater comprises a material selected from the group consisting of graphite, molybdenum, silicone carbide, Cr_2O_3, and mixtures and alloys of at least two of these materials.

17. The refractory nozzle according to any one of claims 1 to 16, wherein the solid electrolyte material comprises zirconium dioxide.

18. The refractory nozzle according to claim 17, wherein the solid electrolyte material

has a density of more than about 5.2 g/cm^3, a silica content of less than about 1.5 weight %, and the material is sintered.

19. Use of the refractory nozzle according to any one of claims 1 to 18 for steel melts.

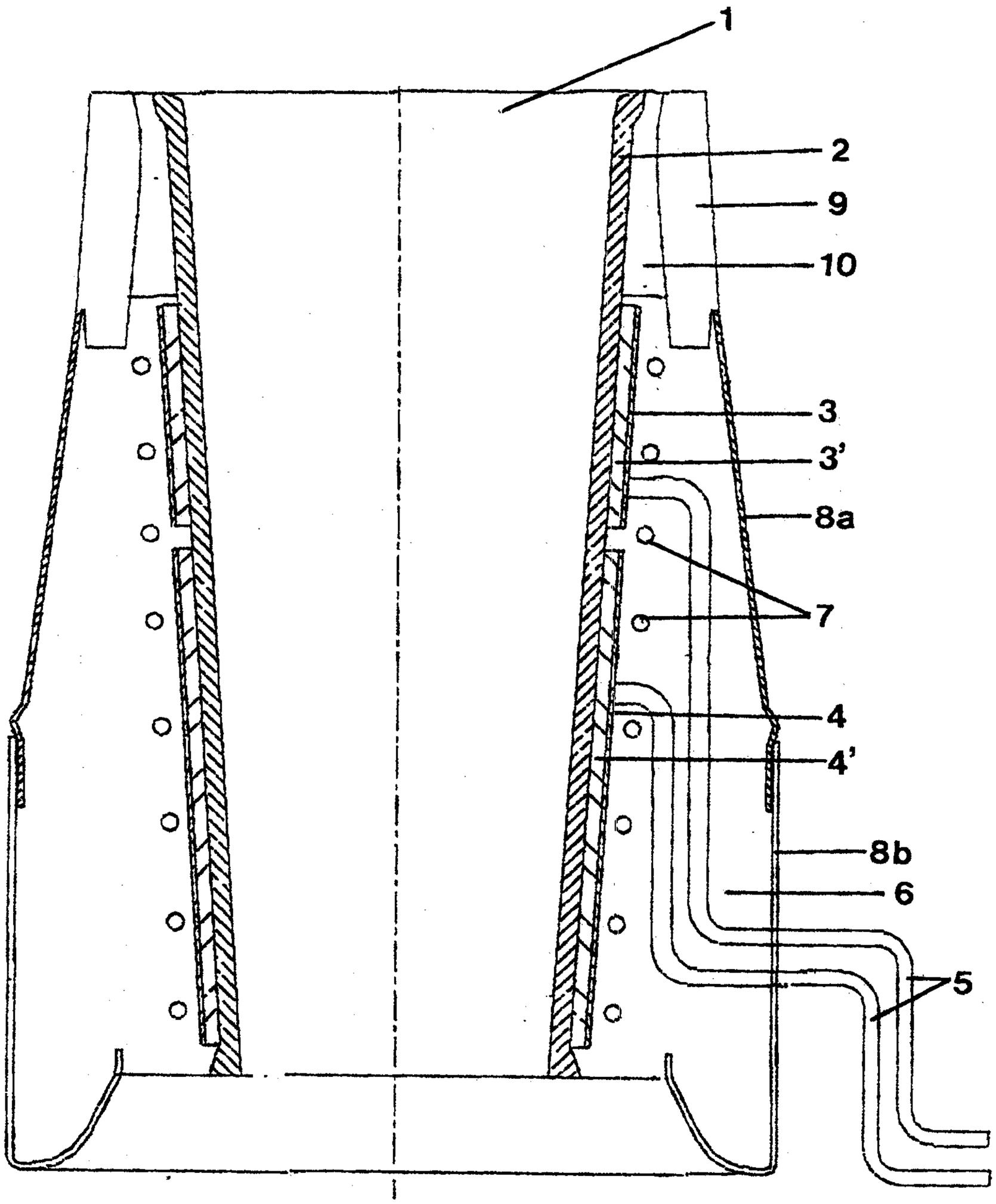
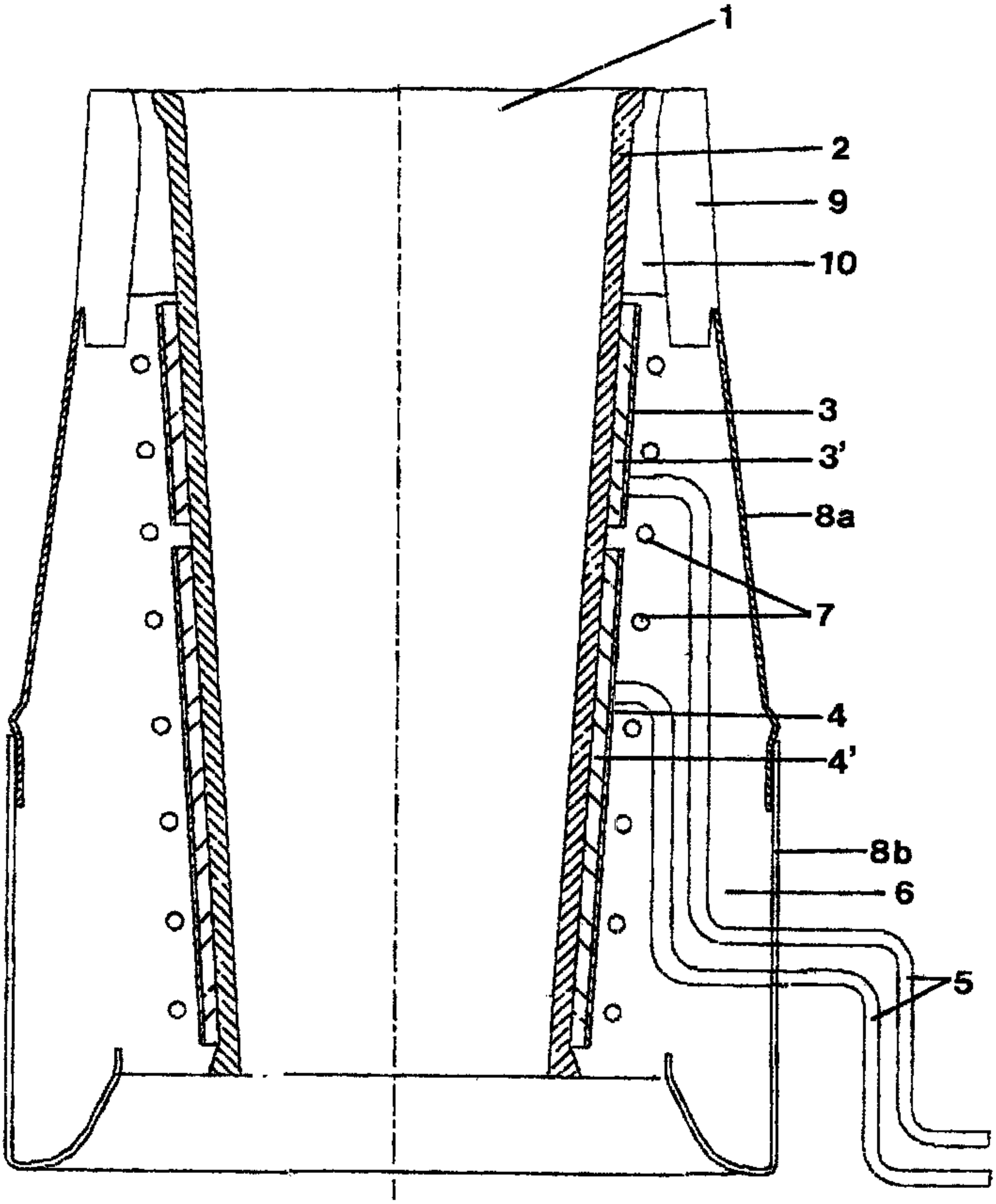


FIG. 1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