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(54) **DISPENSER CATHODE**

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Description

Field of the invention

[0001] The present invention relates to thermionic cathodes, in particular for use in a lithography system, in particular a multi-beam lithography system.

Prior art

[0002] Thermionic cathodes, more specific controlled porosity dispenser-type thermionic cathodes, are well known in the art. These dispenser cathodes are commonly used in for instance televisions, computer monitors and microwave ovens. Such a dispenser cathode usually comprises a cathode body with a reservoir comprising a cavity filled with work-function-lowering material and with an emission surface, and a heating element for generating the heat needed to cause work function lowering particles to diffuse from the reservoir to an emission area on the emission surface and to create the thermionic emission. In general, the entire emission surface is used as emission area.

[0003] There are several types of reservoirs known in the art. In a first type of reservoir, the cavity is filled with a porous matrix and the pores of this matrix are filled with the work-function-lowering particles, e.g. compounds of alkaline earth metals like Ba, Ca and Sr. In these dispenser cathodes, usually one surface of the porous matrix functions as emission surface. Heating the cathode will release work function lowering particles from the porous matrix to the emission surface and will cause thermionic emission.

[0004] In a second type of reservoir, work function lowering material is present in a space behind the porous matrix. During operation work-function-lowering particles, e.g. Ba or BaO, are generated or released within the pores and are supplied from the space behind the porous matrix and then migrate through the pores of the porous matrix and are supplied to the emission surface in sufficient quantities to maintain good emission surface coverage which assures adequate emission from the emission surface.

[0005] In order to increase brightness of these type of cathodes, a coating is deposited on top of the porous matrix, usually on the entire surface of the metal matrix. Thus, the entire emission surface becomes an emission area. The coating usually has several layers, at least one of which comprising a work-function-lowering material. Nowadays the most widely used work-function-lowering material for this coating layer comprises a scandate compound. Appropriate fabrication techniques and components of these scandate dispenser cathodes are for instance disclosed in US-patents 4.007.393, 4.350.920, 4.594.220, 5.064.397, 5.261.845, 5.264.757, 5.314.364, 5.407.633 and 6.348.756.

[0006] In these known cathodes, the connections between the pores are randomly generated. An inherent consequence is that the path length that the active materials must travel to reach the emission surface can be much larger than the thickness of the matrix layer. This limits the lifetime and emission of these conventional dispenser cathodes. Furthermore, these pores debouche in the emission surface, which forms a relatively large emission area in its entirety.

[0007] US-A-4.101.800 discloses a controlled-porosity dispenser cathode provided with a thin perforated foil on top of the matrix layer. The foil is made of a refractory metal. The active materials migrate through the holes in the perforated foil to coat the surface of the foil. The foil thus serves as the emission surface of the cathode. In this cathode again, the entire emission surface is emission area

[0008] A further improvement of this concept is disclosed in US-A-4.310.G03. The dispenser cathode disclosed in this document comprises a cathode body comprising a reservoir with work function lowering material and a heating element located in the cathode body on one side of the reservoir. The opposite side of the reservoir defines an emission side surface. The emission side surface of the reservoir is provided with a foil with holes covering the reservoir, welded to the cathode body and preferably made of tungsten or molybdenum. Parts of the foil are provided with a coating comprising work function lowering material defining emission areas, and parts of the foil are provided with non-emitting material defining a shadow grid. The work function lowering coating establishes a lower work function Φ and thus an enhanced emissivity of the emission areas. In this cathode, all the holes are located in the large emission areas.

[0009] In these controlled-porosity dispenser cathodes described above, the dimensions of the pitch between the holes define the path length of the active materials. However, the holes in the emission surface also induce a severe inhomogenity in the radiation from the cathode. Furthermore, almost the entire emission surface acts as emission area.

[0010] The invention further relates to the use of a dispenser-type cathode in electron beam exposure apparatus like lithography systems, electron microscopes, inspection systems. In these electron beam apparatus generally a LaB_6-source, a field emitter or a Schotky-type emitter is used. Most of these apparatus a relatively low current is required, as these apparatus require a homogeneous electron source with a relatively small dimension. The use of a dispenser cathode with a high brightness in an electron beam apparatus is therefore not trivial. The diameter of a prior-art dispenser cathode, for instance, is 100-10,000 times larger than the diameter of a LaB_6-source or field emitter source. Thus, the emission current is too high for the electron beam apparatus. Furthermore, since more electrons are emitted in the same period of time, Coulomb interactions reduce the resolution of an apparatus when using the known dispenser cathodes.

[0011] This problem is especially relevant in single

source multi-electron beam systems. In an attempt to overcome this problem, especially in single source multi-electron beam systems, a diverging electron beam with a limited emission area is used. Examples of such systems are disclosed in for example US-patents 5.834.783, 5.905.267 and 5.981.954 by Canon and US provisional application 60/422.758 by the present applicant. A so-called triode setup is most often used to accomplish the diverging electron beam. The electric field lines produced by two electrodes, oppositely charged and in close proximity of the emissive cathode surface, create an expanding electron beam using only a fraction of the emitted electrons. However, before the electrons diverge, their individual trajectories first converge and go through a crossover. This results in stronger Coulomb interactions and consequently in an increase of the energy spread. This extraction approach thus poses a problem, especially in high-resolution systems, like electron beam lithography systems.

Summary of the invention

[0012] It is an object of the present invention to provide an electron source which provides a homogeneous electron beam, homogeneous both in time and in space.

[0013] It is furthermore an object of the present invention to provide an electron source with a relatively small emission area.

[0014] It furthermore is an object of the present invention to provide an electron source with a narrow energy distribution.

[0015] The present invention to that end provides a dispenser cathode which comprises:

- an emission surface comprising at least one emission area for emitting electrons and at least one non-emission area covered with emission-suppressing material and surrounding each emission area;
- a reservoir for material releasing, when heated, work-function-lowering particles, and
- at least one passage connecting said reservoir and said emission surface for allowing diffusion of work-function-lowering particles from said reservoir to said emission surface, said at least one passage debouching in said non-emission area and within a diffusion length distance from an emission area for allowing diffusion of work-function-lowering particles from said reservoir to said emission area.

[0016] By applying the emission area having clear boundaries, and passages debouching outside the emission area, it has proven possible to obtain a dispenser cathode which is both spatially homogeneous as well as suitable for application in high-resolution electron beam systems.

[0017] In an embodiment, the emission area comprises a blocking layer for blocking work-function-lowering particles. This blocking layer prevents work function lowering particles not coming through a passage from reaching the emission area. In this way, the emission area is not disrupted and remains homogenous. This in tum results in a spatially homogeneous electron beam.

[0018] In a further embodiment, the dispenser cathode comprises a membrane covering the emission side of said reservoir, said membrane being substantially impermeable to work-function-lowering particles. In this way a well-defined emission area and a well defined non-emission area can be created.

[0019] In another embodiment, the membrane has an emission side surface and a cathode side surface (i.e., the side directed towards the reservoir), said emission side surface having at least one emission area and at least one non-emission area surrounding said at least one emission area, wherein said emission area is coated with work-function-lowering material and said non-emission area is coated with emission-suppressing material.

[0020] In an embodiment of the dispenser cathode with the membrane, the membrane is a metal membrane covering the emission surface side of said reservoir and is provided with perforations in said non-emission area providing passages for said work function lowering particles.

[0021] In an embodiment, the passages debouch next to said emission area. Preferably, in this embodiment, the passages debouche adjacent the emission area. This makes it easy for the work function lowering particles to reach the emission area, and makes the diffusion easily controllable.

[0022] In an embodiment of the dispenser cathode of the present invention, the dispenser cathode comprises a plurality of passages, all passages debouching in said non-emission area.

[0023] In another embodiment of the dispenser cathode of the present invention, the emission surface has at least one convex surface. This helps producing a diverging beam. In a further embodiment, the emission surface is convex at the location of an emission area. When the dispenser cathode is used in high-resolution electron beam systems, it is preferred to use a diverging electron beam, in order to avoid cross-overs in the electron beam, which causes a broadening of the energy distribution function in the electron beam.

[0024] In another embodiment of the dispenser cathode of the present invention, it is furthermore provided with a support structure for supporting said emission area. In this way, the emission area remains well defined during operation. In an embodiment, the support structure comprises a pillar at the location of the emission area, reaching through said reservoir. The pillar provides an easy way of providing a well-defined emission area.

[0025] In a further embodiment thereof, the pillar has a top, the top forming part of said emission surface. In a further embodiment, the top of said pillar forms an emission area.

[0026] In still a further embodiment of the dispenser cathode with the pillar, a passage runs along a side of said pillar. In this embodiment, an easy way of making

this is by providing a free-standing or substantially free-standing pillar in the reservoir. In this way, the sidewall of the pillar provides a wall of a passage. This way, the pillar has two functions: the first function is defining the emission area. Its second function is defining a boundary to a passage for the work function lowering particles.

[0027] In an embodiment of the dispenser cathode described above, it further comprises a wall, substantially surrounding the emission surface. This wall is added to increase uniformity of the electron beam. In an embodiment, this wall surrounds both the emission surface and said passage or passages which are within a diffusion length distance from said emission area. In an embodiment, said wall runs from said emission area at about 20-25 degrees, preferably at about the Pierce angle. An advantage of this wall, in particular at the specific angles, is an improvement in emission uniformity due to a more uniform E-field. In fact, the emission area merges into the wall as continuously as possible, in order to create a smooth E-field. In this wall, in an embodiment at a location where the wall goes over in the emission area, one or more passages of channels are provided.

[0028] In an embodiment of the dispenser cathode, the emission surface is situated below the level of the surface of the dispenser cathode in a recess in said surface. In an embodiment thereof, the wall of said recess is at about 20-25 degrees, preferably at about the Pierce angle, with respect to the emission surface.

[0029] In an embodiment of the invention, the dispenser cathode further comprises at least one heater for heating said emission area.

[0030] In another or in such an embodiment, the dispenser further comprises at least one heater for heating said work-function-lowering particles.

[0031] The invention further relates to a cathode comprising an emission area for emitting electrons, said emission area merging into a wall surrounding said emission area, said wall being electrically conductive. In an embodiment, said wall is covered with an emission-suppressing, electrically conducting material. In a further embodiment, the wall is an electric conductor, or is covered with an electric conductor.

[0032] In an embodiment of this cathode, said wall substantially runs at an angle of about 20-25 degrees with respect to the emission area.

[0033] In a further embodiment thereof, said cathode further comprises at least one reservoir comprising work-function-lowering particles, and at least one passage or channel having an inlet for allowing work-function-lowering particles in said reservoir to enter said passage, and an outlet in said wall at a diffusion length distance of said emission area.

[0034] The invention further relates to a lithography system comprising a dispenser cathode of the current invention.

[0035] In an embodiment the lithography system further comprises beam splitter means for splitting the electron beam generated by the dispense cathode up into a plurality of electron beamlets, modulator means for individually modulating substantially each electron beamlet, and control means for controlling said modulator means for modulating the beamlets according to a predetermined pattern.

Brief description of the drawings

[0036] The invention will now be explained with reference to the following drawings which are only intended to illustrate preferred embodiments of the invention and not to limit its scope of protection.

Figure 1	shows a cross section of a cathode of the current invention;
figures 2a, 2b	shows top views of the cathode of figure 1, of the emission surface indicating different aspects of the current invention;
figure 3	shows a cross section of a cathode of the current invention with a support structure supporting the emission area;
figure 4	shows a top view of the cathode of figure 3;
figure 5	shows a cross section of the emission part of a cathode of the current invention with a porous metal reservoir;
figure 6	shows a cross section view of another embodiment of a cathode of the present invention;
figure 7	shows a cross section of a cathode with a convex emission surface;
figure 8	shows a cross section of another embodiment of a cathode with a curved emission surface;
figure 9	shows an embodiment of a cathode of the present invention with surrounding walls in a Pierce angle P;
figure 10	shows another embodiment of a cathode of figure 9 with a pillar.

Description of preferred embodiments

[0037] In the figures, entities with the same reference numbers relate to the same or corresponding features.

[0038] Figure 1 shows a first embodiment of a dispenser cathode of the present invention. The dispenser cathode has a cathode body **1**, the upper part of which forming a reservoir filled with compounds **2** that dispense, when heated by a heating element **3**, at least one kind of work-function-lowering particles towards the emission side surface **4** of the reservoir **2.** The emission side surface **4** of the reservoir **1** is divided into two types of areas as shown in Figures 2a and 2b, showing a top view of the dispenser cathode of figure 1.

[0039] The first type of area of the emission side surface **4** is the emission area **9** which is responsible for the emission of electrons. The emission area is usually coat-

ed with work function lowering material, like iridium, osmium or other platinum-group metals, or scandate. These materials or compositions are known to a man skilled in the art.

[0040] The second type of area of the emission surface **4** is the non-emission area **8** which surrounds each emission area **9.** The non-emission area is coated with emission supressing material, like zirconium or graphite.

[0041] The non-emission areas surrounding each emission area are provided to limit the area of the emission areas. In this way, it is possible to provide a cathode having sources having a limited size. In practical applications the emission areas will be about 100 micron x 100 micron in size or less.

[0042] The dispenser cathode is provided with a membrane **6**, preferably a metal membrane, on the emission side surface of the reservoir **1.** This membrane ensures the homogenity of the electron emission. There is no direct connection between both sides of the membrane **6** in the emission area **9.** At the location of the emission area **9**, the membrane is substantially impermeable to work-function-lowering particles from the reservoir. This can for instance be accomplished by making the membrane of a metal which is substantially impermeable to the work function lowering material. Another embodiment provides the membrane with a substantially impermeable layer at the location of the emission area.

[0043] The membrane **6** has one or more passages **7**, preferably holes, through the membrane **6**, connecting reservoir **1** and the emission surface side **4** of the membrane **6.** The passages **7** allow work-function-lowering particles from the reservoir to diffuse from the reservoir **2** to the emission area **9**, to enhance the emission of electrons.

[0044] On the emission side, the membrane **6** is provided with a layer of work function lowering material **9** defining the emission area, and a layer of emission-suppressing material **8**, defining the non-emission area.

[0045] A top view of this configuration is depicted in FIGURE 2a. Additionally, choosing the right distance between at least one passage **7** and any position residing in the emission area **9** ensures the continuous supply of work-function-lowering material **2.** This distance should be smaller than the largest diffusion length of the work-function-lowering particles coming form the reservoir **2.** A further enhancement of the emission is established by coating the first area with at least one layer 9 of work-function-lowering material.

[0046] Figure 2b shows a top view of membrane **6**. The membrane **6** has through holes at a diffusion length distance from the emission area, and is preferably a metal membrane. Suitable metals include refractory metals like tungsten and molybdenum. Work function lowering particles diffusing from the reservoir towards the emission surface can only pass the membrane via the holes **7.**

[0047] Using the heater, the work function lowering particles are released from the reservoir. These particles diffuse through the holes in the membrane to the emission area. At the emission area, electrons are released. Using an extraction electrode, the electrons are accellerated.

[0048] FIGURE 3 shows a second embodiment of the present invention. Again the dispenser cathode comprises a cathode body **1**, the upper part of which forms a reservoir **2**, and a heating element **3.** The emission surface **4** of the dispenser cathode comprises an emission area **9** and a non-emission area **8** with the same working principle as the dispenser cathode in the first embodiment of the present invention, i.e. electrons are emitted from the emission area **9**, while work-function-lowering particles are supplied to the emission area **9** via the non-emission area **8** surrounding the emission area **9.** In this particular embodiment, however, instead of a membrane **6**, the non-porosity of the emission area for work function lowering particles is established by a support structure **10** directly underneath the emission surface **4.** The support structure **10** is preferably pillar-shaped, and extends through the reservoir. In this embodiment, the passages debouch adjacent to the emission area.

[0049] In this embodiment the reservoir **2** is filled with a porous material containing the work function lowering material in its pores. This enhances the dispension of work-function lowering particles towards the surface. The non-emission area **8** is coated with at least one layer **8** of emission suppressing material, herewith dramatically reducing the electron emission from this area. To enhance the electron emission even further, a coating layer **9** of work-function-lowering material is provided on top of the emission pillar **10.** A top view of this embodiment is depicted in FIGURE 4.

[0050] The pillar **10** is a substantially free standing structure, thus providing a passage around the pillar. In the top view of figure **4** it can clearly be seen that the passage **7** surrounds the entire pillar **10** and thus the entire emission area **9.**

[0051] The support structure **10** preferably comprises a metal. Potential candidates are refractory metals like molybdenum and tungsten.

[0052] Figure 5 shows an embodiment of the dispenser cathode of the present invention, showing porous material containing the work function lowering material **1.** In this embodiment, porous tungsten is used for containing the work function lowering material. At the emission side of the reservoir, a membrane **6** is provided having holes or perforations **7.** The membrane comprises a non-emission area coated with emission suppressing material **8**, and an emission area **9** coated with work function lowering material. In this embodiment, the holes **7** forming the passages for work function lowering particles, are provided directly adjacent the emission area. Furthermore, the extractor electrode **11** is shown located close to the emission surface, thus providing a source radiating a diverging beam of electrons. The entire area shown is about 1 mm wide, while the emission area **9** is about 40 μm wide.

[0053] Figure 6 shows another embodiment of the dis-

penser cathode of the current invention. In this embodiment, the emission surface is a curved surface which is convex. The reservoir comprises porous tungsten with work function lowering material **1** in its pores. The porous tungsten is provided with a tungsten membrane **6** which is substantially impermeable to work function lowering particles. The membrane is provided with holes **7** providing passages for the work function lowering particles. Again, the emission area **9** is coated with a work function lowering material, e.g. a scandate composition. The remaining area **8** of membrane **6** is coated with emission suppressing material. Using the convex surface, the dispenser cathode emits an almost perfectly diverging beam of electrons having one virtual origin.

[0054] Figure 7 shows an embodiment of a dispenser cathode according to the present invention having a free-standing tungsten pillar **10** in a reservoir filled with porous tungsten provided with work function lowering material in its pores **1.** As the pillar **10** is free-standing, work function lowering particles can pass along the sides **7** of the pillar **10** , which thus provides a passage **7** for allowing the particles to diffuse to the emission area **9.**

[0055] Figure 8 shows another embodiment of a dispenser cathode according to the present invention. In this embodiment, a cone-shaped cathode is provided with a free-standing tungsten pillar **10.** Around this free-standing pillar, the reservoir is provided with porous tungsten **1.** Again, the pores contain the work function lowering material which is released using the heater which is not shown. Because of the cone shape, providing a convex surface, and because of the small size of the emission area **9,** this source provides a diverging electron beam. The pillar **10** preferably has a circle cylinder shape. The emission area side top **9** is coated with work function lowering material, for instance a scandate composition. The remaining area **8** is coated with emission suppressing material.

[0056] Figure 9 shows an embodiment of the cathode of the current invention, having an emission area **9,** coated with work function lowering material and surrounded by a passage **7** for allowing further work-function-lowering material to reach the emission area **9.** In this specific embodiment, the cathode has a concave or cone-shaped wall **8** surrounding the emission area and which is coated with, or made of, emission suppressing material described above. Preferably, the wall is coated or made of conducting material. In this way, an electric E-field runs as shown in figure 9, providing a lens effect which results in a narrower beam.

[0057] The angle P of the wall preferably equals the Pierce angle. In most cases, the angle P will be between 20-25 degrees, more preferably 22-23 degrees. In a preferred embodiment, angle P is about 22.5 degrees.

[0058] Figure 10 shows another embodiment of the cathode, where the emission area, here on a pillar **9,** is below the general surface **12** of the cathode. The emission area is surrounded by a cone-shaped wall at about a Pierce angle P with respect to the emission area **9.** Again, an applied E-field will run as depicted, resulting in a lens effect. Preferably, the wall has an electrically conducting surface and is emission suppressing.

[0059] The wall 8 in this embodiment merges into the emission area almost continuously. The passage or channel for the work-function-lowering particles preferably interfere as little as possible with the E-field (electric field). In fact, in a contemplated embodiment, the emission area smoothly merges into the wall. In this wall, where the emission area goes over or emerges into the wall, some small holes are made all the way to a reservoir with the work-function-lowering particles.

[0060] A plurality of the cathodes described above may be combined, resulting in a multi-beam cathode.

[0061] It is to be understood that the above description is included to illustrate the operation of the preferred embodiments and is not meant to limit the scope of the invention. The scope of the invention is to be limited only by the following claims. From the above discussion, many variations will be apparent to one skilled in the art that would yet be encompassed by the scope of the present invention as claimed.

Claims

1. A dispenser cathode which comprises:

- an emission surface (4) comprising at least one emission area for emitting electrons and at least one non-emission area covered with emission-suppressing material and surrounding each emission area;
- a reservoir (1) for material releasing (2), when heated, work-function-lowering particles, and
- at least one passage (7) connecting said reservoir and said emission surface, **characterized in that** said at least one passage debouches in said non-emission area (8) and within a diffusion length distance from an emission area (2) thereby allowing diffusion of work-function-lowering particles from said reservoir to said emission area.

2. The dispenser cathode of claim 1, wherein the emission area comprises a blocking layer for blocking work-function-lowering particles and extending below the at least one emission area (9), and comprising a membrane (6) covering the emission side (4) of said reservoir, said membrane being substantially impermeable to work-function-lowering particles.

3. The dispenser cathode of claim 2, wherein said membrane (6) has an emission side surface and a cathode side surface, said emission side surface having at least one emission area and at least one non-emission area surrounding said at least one emission area, wherein said emission area is coated

with work-function-lowering material and said non-emission area is coated with emission-suppressing material (8), and wherein said membrane is a metal membrane covering the emission surface side of said reservoir and is provided with perforations in said non-emission area providing passages for said work function lowering particles.

4. The dispenser cathode of any one of the preceding claims, wherein said passages debouch next to said emission area (9).

5. The dispenser cathode of any one of the preceding claims, comprising a plurality of passages (7), substantially all passages debouching in said non-emission area, and wherein said emission surface has at least one convex surface, at the location of an emission area (9).

6. The dispenser cathode of any one of the preceding claims, furthermore provided with a support structure for supporting said emission area, comprising a pillar (10) at the location of emission area and reaching through said reservoir, and has a top forming part of said emission surface (9), which top of said pillar forms an emission area, wherein said passage runs along a side of said pillar, and wherein said pillar has a sidewall, said sidewall providing a wall of a passage (7).

7. The dispenser cathode according to any one of the preceding claims, further comprising an extractor electrode (11) provided above the emission area, the extractor electrode provided to provide, in operation, an electrostatic field functioning as a negative lens to emitted electrons.

8. The dispenser cathode according to any one of the preceding claims, further comprising a wall substantially surrounding the emission area (9), said emission area merges into said wall, and wherein said wall surrounds the emission surface and said passage or passages (7) which are within a diffusion length distance from said emission area.

9. A dispenser cathode according to claim 1 wherein said emission area (9) merges into a wall surrounding said emission area, said wall being electrically conductive and being coated with, or made of, emission suppressing material, which wall substantially runs at an angle of about 20-25 degrees with respect to the emission area, and wherein said cathode comprises at least one reservoir (1) comprising work-function-lowering particles (2), and passages (7) having an inlet for allowing work-function-lowering particles in said reservoir to enter said passage, and an outlet in said wall at a diffusion length distance of said emission area.

10. A lithography system comprising at least one dispenser cathode of any one of the preceding claims, in particular a lithography system comprising beam splitter means for splitting the electron beam generated by the dispense cathode up into a plurality of electron beamlets, modulator means for individually modulating substantially each electron beamlet, and control means for controlling said modulator means for modulating the beamlets according to a predetermined pattern.

Patentansprüche

1. Vorratskathode, die aufweist:

- eine Emissionsfläche (4), die mindestens einen Emissionsbereich zum Emittieren von Elektronen und mindestens einen Nicht-Emissionsbereich aufweist, der mit einem Emissionsunterdrückungsmaterial bedeckt ist und jeden Emissionsbereich umgibt;
- einen Vorrat (1) für Material (2), das, wenn es erwärmt wird, austrittsarbeitsenkende Teilchen freisetzt, und
- mindestens einen Durchgang (7), der den Vorrat und die Emissionsfläche verbindet, **dadurch gekennzeichnet, daß** der mindestens eine Durchgang in den Nicht-Emissionsbereich (8) und in einem Diffusionslängenabstand von einem Emissionsbereich (9) einmündet, wodurch eine Diffusion von austrittsarbeitsenkenden Teilchen aus dem Vorrat zum Emissionsbereich ermöglicht wird.

2. Vorratskathode nach Anspruch 1, wobei der Emissionsbereich eine Sperrschicht zum Sperren austrittsarbeitsenkender Teilchen aufweist, die sich unter den mindestens einen Emissionsbereich (9) erstreckt und eine Membran (6) aufweist, die die Emissionsseite (4) des Vorrats bedeckt, wobei die Membran für austrittsarbeitsenkende Teilchen im wesentlichen undurchlässig ist.

3. Vorratskathode nach Anspruch 2, wobei die Membran (6) eine Emissionsseitenfläche und eine Kathodenseitenfläche aufweist, wobei die Emissionsseitenfläche mindestens einen Emissionsbereich und mindestens einen Nicht-Emissionsbereich aufweist, der den mindestens einen Emissionsbereich umgibt, wobei der Emissionsbereich mit einem austrittsarbeitsenkenden Material überzogen ist und der Nicht-Emissionsbereich mit einem Emissionsunterdrükkungsmaterial (8) überzogen ist und wobei die Membran eine Metallmembran ist, die die Emissionsseitenfläche des Vorrats bedeckt und im Nicht-Emissionsbereich mit Perforationen versehen ist, die Durchgänge für die austrittsarbeitsenkende Teil-

chen bilden.

4. Vorratskathode nach einem der vorhergehenden Ansprüche, wobei die Durchgänge nahe des Emissionsbereichs (9) einmünden.

5. Vorratskathode nach einem der vorhergehenden Ansprüche, die mehrere Durchgänge (7) aufweist, wobei im wesentlichen alle Durchgänge in den Nicht-Emissionsbereich einmünden, und wobei die Emissionsfläche am Ort eines Emissionsbereichs (9) mindestens eine konvexe Oberfläche aufweist.

6. Vorratskathode nach einem der vorhergehenden Ansprüche, die ferner mit einer Haltestruktur zum Halten des Emissionsbereichs versehen ist, die eine Säule (10) am Ort des Emissionsbereichs aufweist und durch den Vorrat reicht, und ein oberes Ende aufweist, das einen Teil der Emissionsfläche (9) bildet, wobei das obere Ende der Säule einen Emissionsbereich bildet, wobei der Durchgang längs einer Seite der Säule verläuft, und wobei die Säule eine Seitenwand aufweist, wobei die Seitenwand eine Wand eines Durchgangs (7) bildet.

7. Vorratskathode nach einem der vorhergehenden Ansprüche, die ferner eine Extraktorelektrode (11) aufweist, die über dem Emissionsbereich vorgesehen ist, wobei die Extraktorelektrode vorgesehen ist, um im Betrieb ein elektrostatisches Feld bereitzustellen, das als eine Zerstreuungslinse auf die emittieren Elektronen wirkt.

8. Vorratskathode nach einem der vorhergehenden Ansprüche, die ferner eine Wand aufweist, die im wesentlichen den Emissionsbereich (9) umgibt, wobei der Emissionsbereich in die Wand übergeht, und wobei die Wand die Emissionsfläche und den Durchgang oder die Durchgänge (7) umgibt, die sich in einem Diffusionslängenabstand vom Emissionsbereich befinden.

9. Vorratskathode nach Anspruch 1, wobei der Emissionsbereich (9) in eine Wand übergeht, die den Emissionsbereich umgibt, wobei die Wand elektrisch leitfähig ist und mit einem Emissionsunterdrükkungsmaterial überzogen ist oder daraus besteht, wobei die Wand im wesentlichen unter einem -Winkel von etwa 20-25 Grad bezüglich des Emissionsbereichs verläuft, und wobei die Kathode mindestens einen Vorrat (1), der austrittsarbeitsenkende Teilchen (2) aufweist, und Durchgänge (7) aufweist, die einen Einlaß, um es zu ermöglichen, daß austrittsarbeitsenkende Teilchen im Vorrat in den Durchgang eintreten, und einen Auslaß in der Wand in einem Diffusionslängenabstand vom Emissionsbereich aufweisen.

10. Lithographiesystem, das mindestens eine Vorratskathode nach einem der vorhergehenden Ansprüche aufweist, insbesondere ein Lithographiesystem, das eine Strahlteilereinrichtung zur Teilung des Elektronenstrahls, der durch die Vorratskathode erzeugt wird, in mehrere Mikroelektronenstrahlen, eine Modulatoreinrichtung zum individuellen Modulieren im wesentlichen jedes Mikroelektronenstrahls, und eine Steuereinrichtung zum Steuern der Modulatoreinrichtung zum Modulieren der Mikrostrahlen gemäß eines vorgegebenen Musters aufweist.

Revendications

1. Cathode dispensatrice qui comprend :

   - une surface d'émission (4) comprenant au moins une région d'émission pour émettre des électrons et au moins une région de non émission recouverte d'un matériau de suppression d'émission et entourant chaque région d'émission ;
   - un réservoir (1) de matériau libérant (2), lorsqu'il est chauffé, des particules d'abaissement du travail d'extraction, et
   - au moins un passage (7) reliant ledit réservoir et ladite surface d'émission, **caractérisée en ce que** ledit au moins un passage débouche dans ladite région de non émission (8) et à une distance d'une région d'émission (9) inférieure à une longueur de diffusion permettant de ce fait la diffusion de particules d'abaissement du travail d'extraction dudit réservoir vers ladite région d'émission.

2. Cathode dispensatrice selon la revendication 1, dans laquelle la région d'émission comprend une couche de blocage pour bloquer les particules d'abaissement du travail d'extraction et s'étendant au-dessous de ladite au moins une région d'émission (9), et comprenant une membrane (6) recouvrant le côté d'émission (4) dudit réservoir, ladite membrane étant sensiblement imperméable aux particules d'abaissement du travail d'extraction.

3. Cathode dispensatrice selon la revendication 2, dans lequel ladite membrane (6) comporte une surface de côté d'émission et une surface de côté de cathode, ladite surface de côté d'émission comportant au moins une région d'émission et au moins une région de non émission entourant ladite au moins une région d'émission, dans laquelle ladite région d'émission est revêtue d'un matériau d'abaissement du travail d'extraction et ladite région de non émission est revêtue d'un matériau de suppression d'émission (8), et dans laquelle ladite membrane est une membrane métallique recouvrant le côté de sur-

face d'émission dudit réservoir et est pourvue de perforations dans ladite région de non émission réalisant des passages pour lesdites particules d'abaissement du travail d'extraction.

4. Cathode dispensatrice selon l'une quelconque des revendications précédentes, dans laquelle lesdits passages débouchent à côté de ladite région d'émission (9).

5. Cathode dispensatrice selon l'une quelconque des revendications précédentes, comprenant une pluralité de passages (7), sensiblement tous les passages débouchant dans ladite région de non émission, et dans laquelle ladite surface d'émission a au moins une surface convexe, à l'emplacement d'une région d'émission (9).

6. Cathode dispensatrice selon l'une quelconque des revendications précédentes, pourvue en outre d'une structure de support pour supporter ladite région d'émission, comprenant une colonne (10) à l'emplacement de la région d'émission et traversant ledit réservoir, et comportant une partie formant un dessus de ladite surface d'émission (9), lequel dessus de ladite colonne forme une région d'émission, dans laquelle ledit passage s'étend le long d'un côté de ladite colonne, et dans laquelle ladite colonne comporte une paroi latérale, ladite paroi latérale réalisant une paroi d'un passage (7).

7. Cathode dispensatrice selon l'une quelconque des revendications précédentes, comprenant en outre une électrode d'extraction (11) prévue au-dessus de la région d'émission, l'électrode d'extraction étant prévue pour générer, en fonctionnement, un champ électrostatique fonctionnant en tant que lentille négative pour les électrons émis.

8. Cathode dispensatrice selon l'une quelconque des revendications précédentes, comprenant en outre une paroi entourant sensiblement la région d'émission (9), ladite région d'émission se fondant dans ladite paroi, et dans laquelle ladite paroi entoure la surface d'émission et ledit passage ou lesdits passages (7) qui sont à moins d'une distance de longueur de diffusion de ladite région d'émission.

9. Cathode dispensatrice selon la revendication 1, dans laquelle ladite région d'émission (9) se fond dans une paroi entourant ladite région d'émission, ladite paroi étant électriquement conductrice et étant revêtue d'un matériau de suppression d'émission, ou réalisée en celui-ci, laquelle paroi s'étend sensiblement selon un angle d'environ 20 à 25 degrés par rapport à la région d'émission, et dans laquelle ladite cathode comprend au moins un réservoir (1) comprenant des particules d'abaissement de travail d'extraction (2), et des passages (7) comportant un orifice d'entrée pour permettre aux particules d'abaissement du travail d'extraction dans ledit réservoir d'entrer dans ledit passage, et un orifice de sortie dans ladite paroi à une distance de longueur de diffusion de ladite région d'émission.

10. Système de lithographie comprenant au moins une cathode dispensatrice selon l'une quelconque des revendications précédentes, en particulier un système de lithographie comprenant des moyens de division de faisceau pour diviser le faisceau d'électrons généré par la cathode dispensatrice en une pluralité de petits faisceaux d'électrons, des moyens de modulation pour moduler individuellement sensiblement chaque petit faisceau d'électrons, et des moyens de commande pour commander lesdits moyens de modulation pour moduler les petits faisceaux selon un motif prédéterminé.

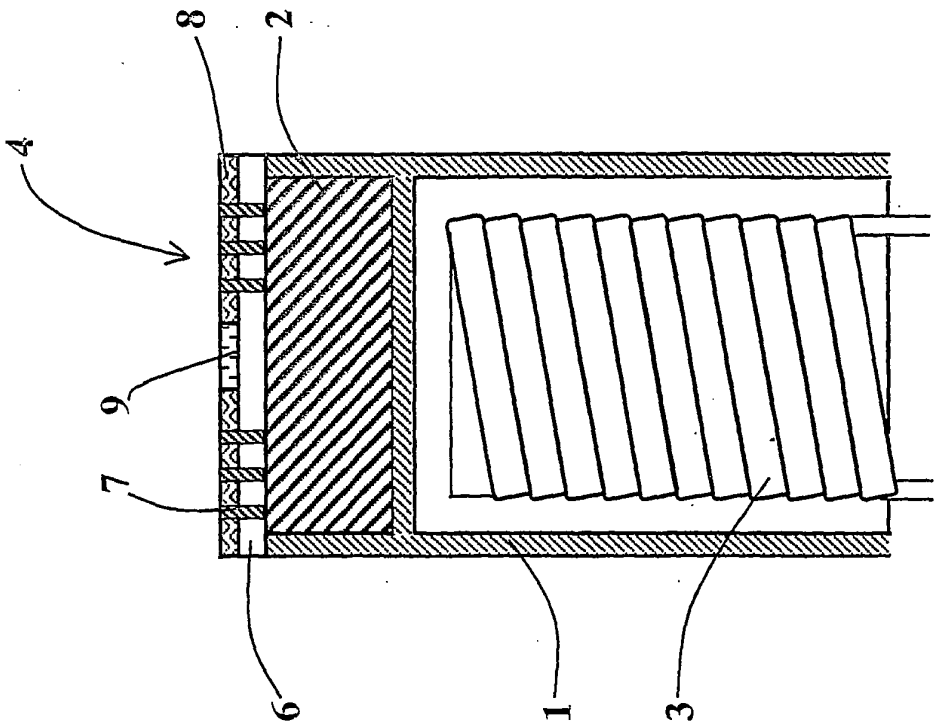


Fig. 1

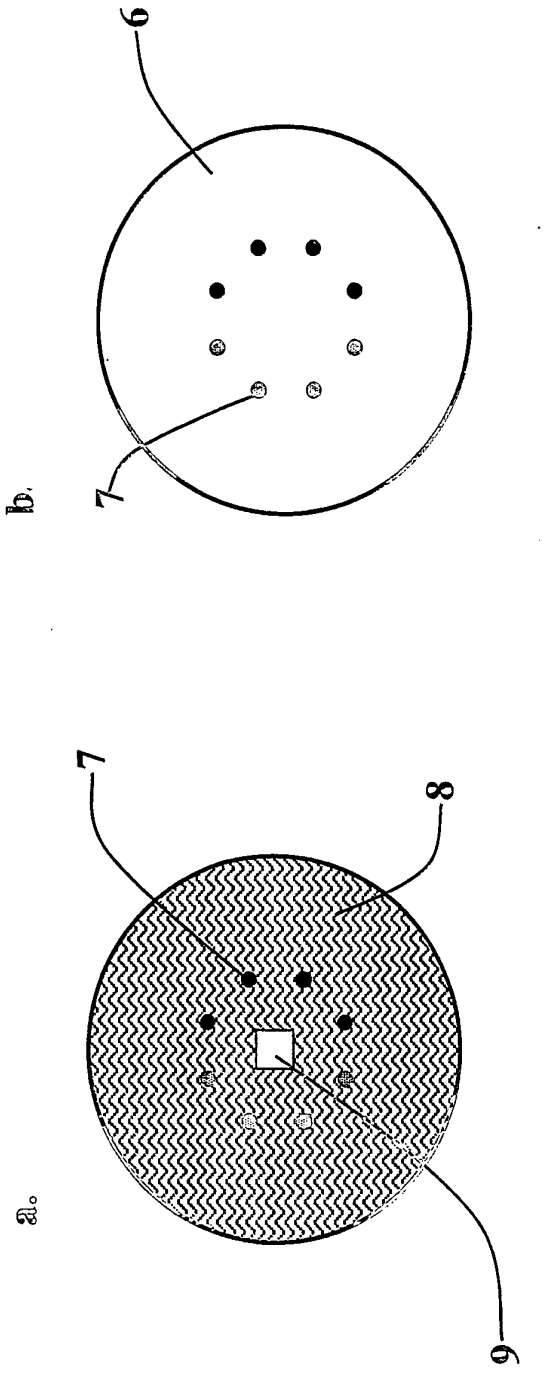


Fig. 2

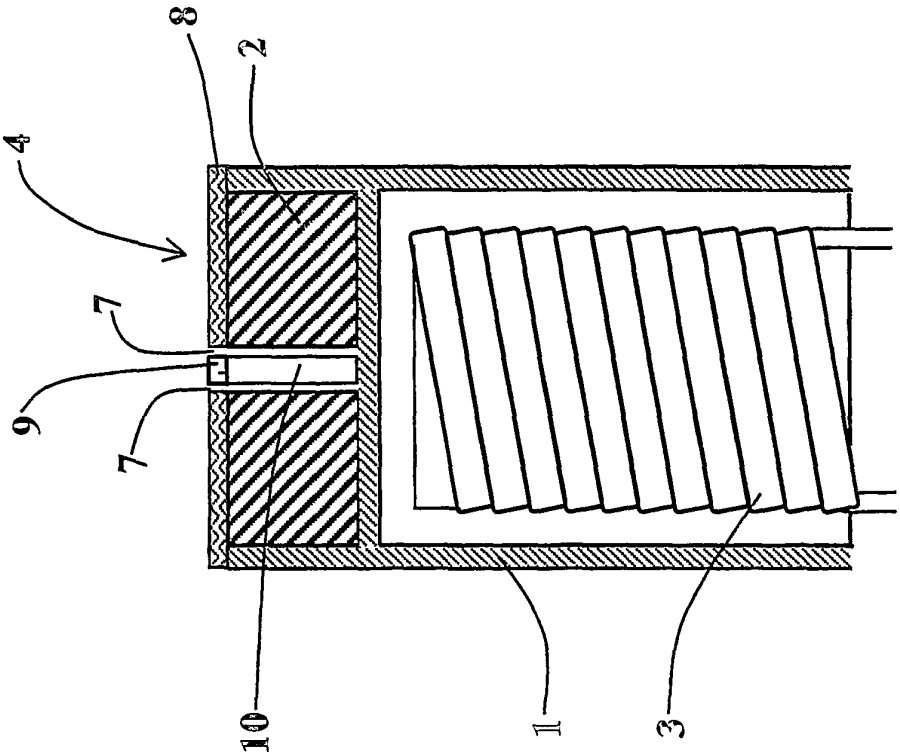


Fig. 3

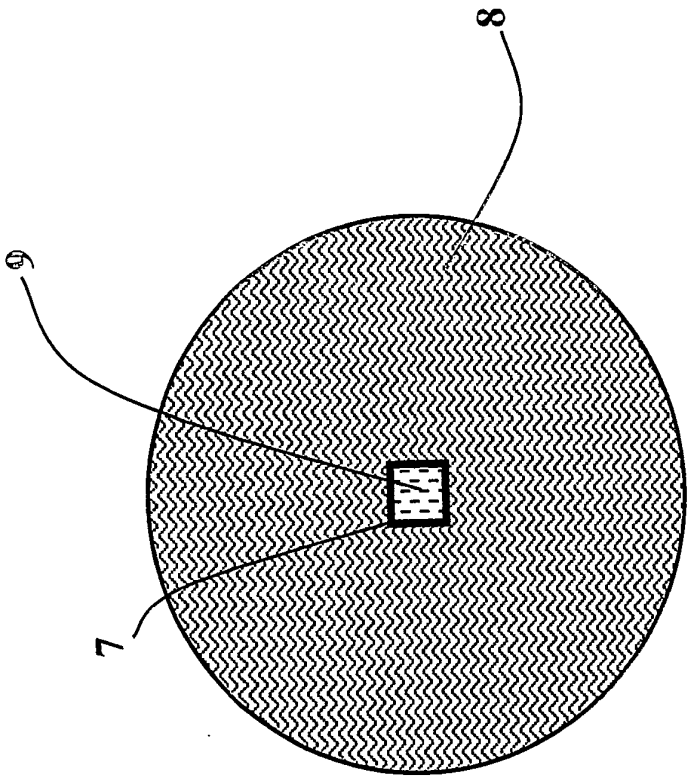


Fig. 4

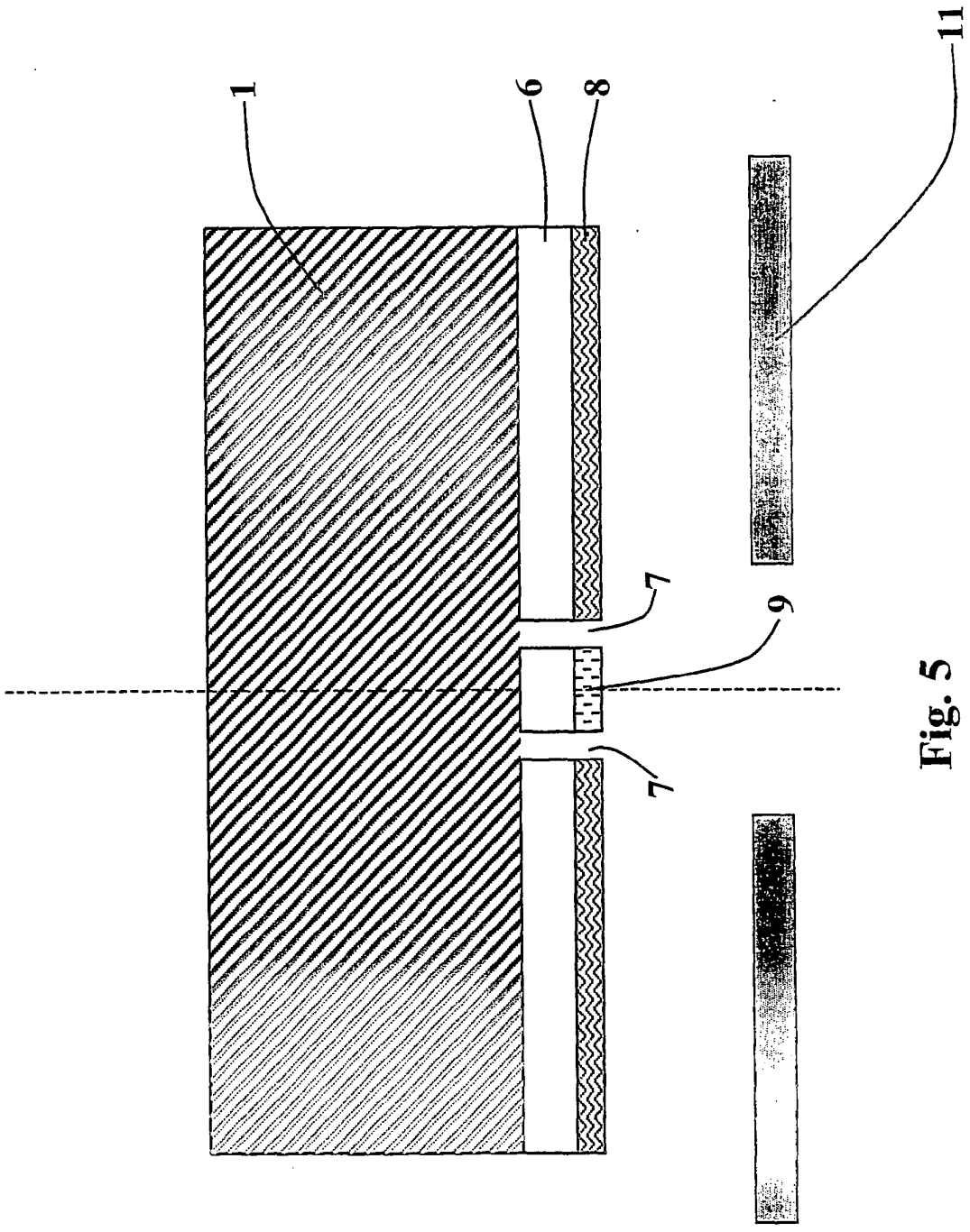


Fig. 5

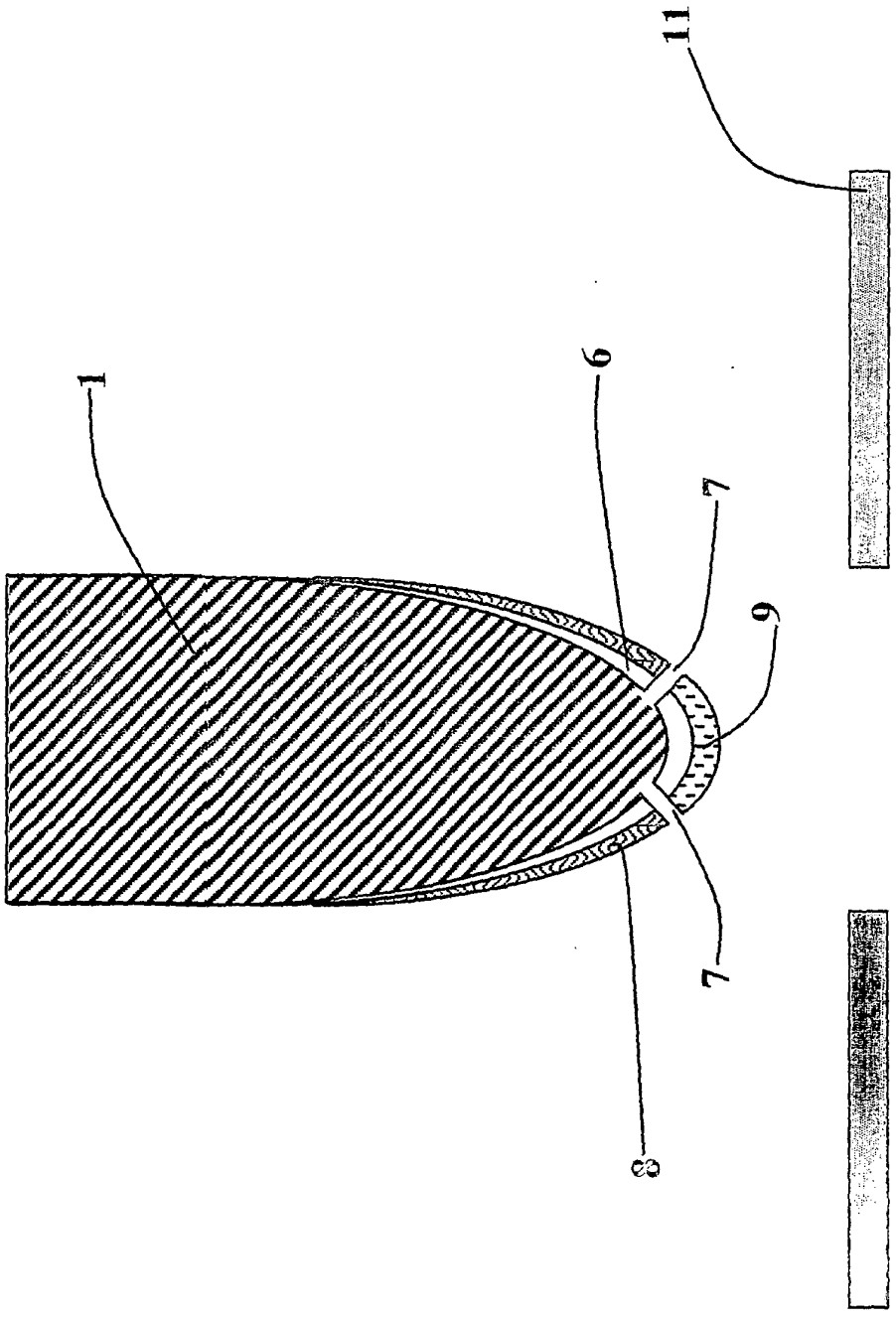


Fig. 6

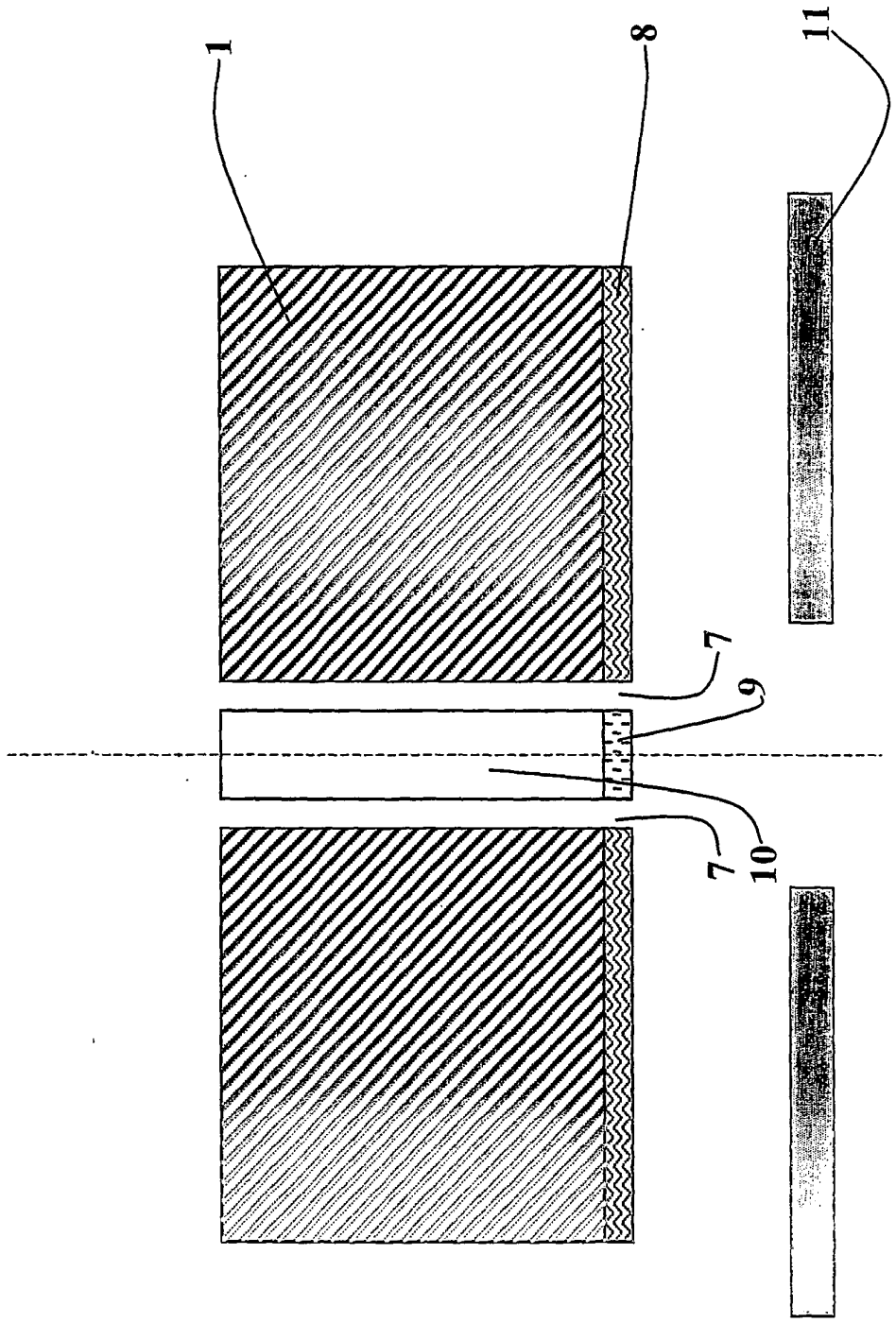


Fig. 7

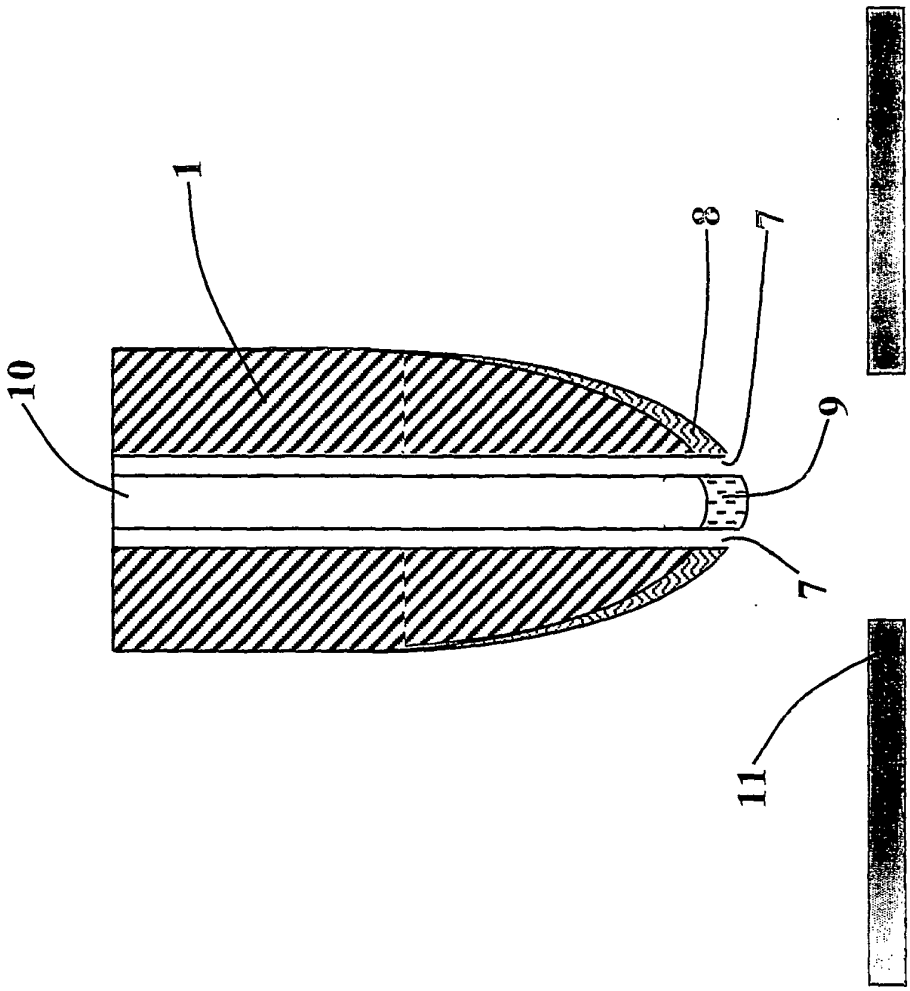


Fig. 8

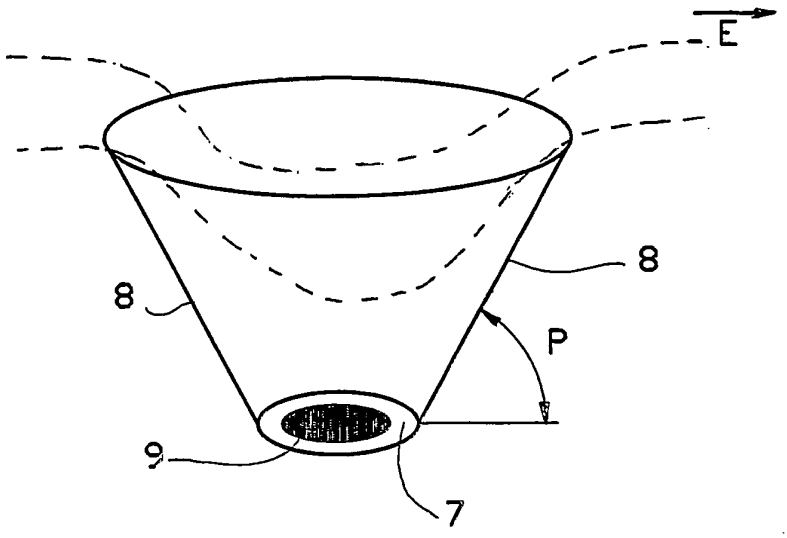


FIG. 9

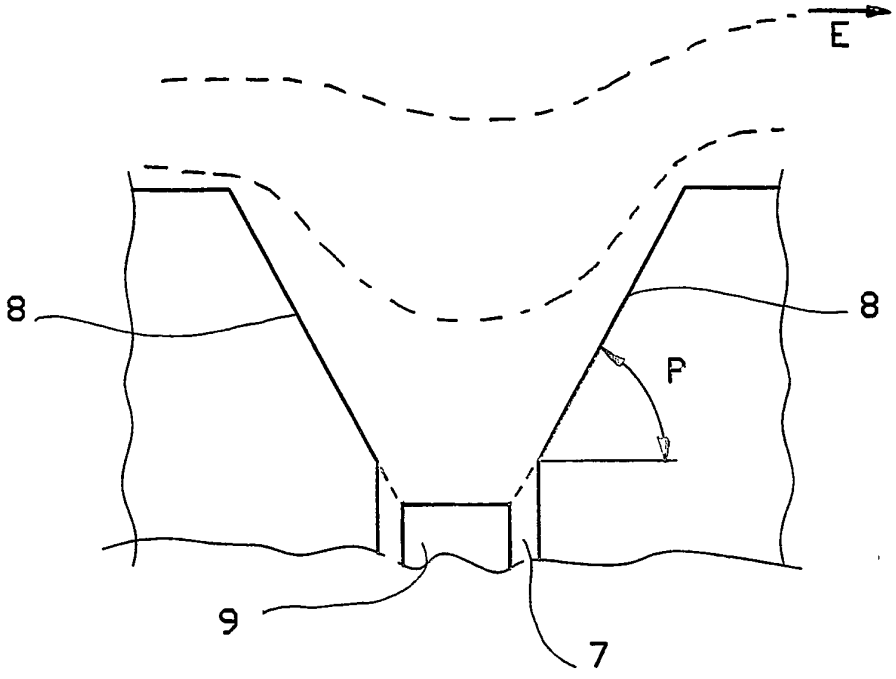


FIG. 10

REFERENCES CITED IN THE DESCRIPTION

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