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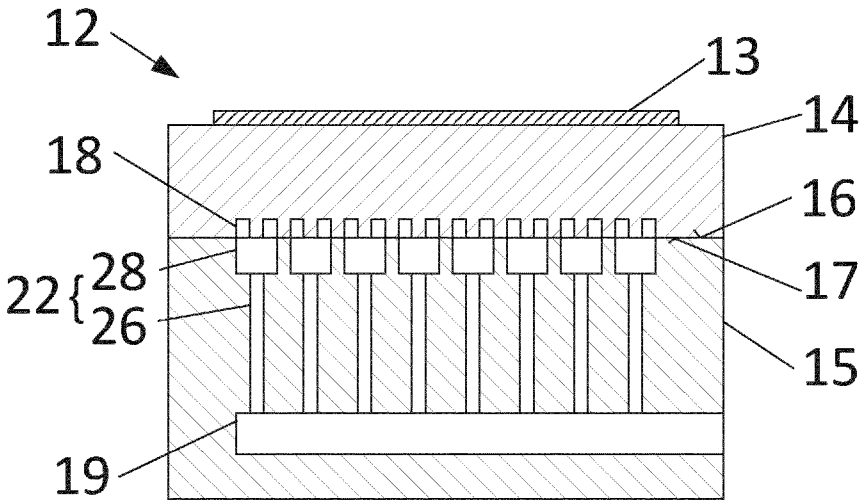


Fig.16

(57) Abstract: The invention relates to a mirror for a lithography system. The mirror has a mirror body (12), which comprises a first mirror part (14), a second mirror part (15), an optical surface (13) for the reflection of light and a plurality of cooling channels (18). The first mirror part (14) and/or the second mirror part (15) are made from a glass material, a glass ceramic material or a ceramic material. The first mirror part (14) and the second mirror part (15) are rigidly connected to one another. The cooling channels (18) are arranged in the first mirror part (14), are formed to be open towards a first outer surface (16) of the first mirror part (14) that adjoins the second mirror part (15), are fluidically connected to one another and are formed separately from one another in the region of the first outer surface (16) of the first mirror part (14) and surrounded in each case entirely by the material of the first mirror part (14).

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Mirror for a lithography system

The invention relates to a mirror for a lithography system. The invention furthermore relates to an illumination system, to a projection lens and to a lithography system having such a mirror.

Lithography systems are used in particular in the production of semiconductors and generally have an illumination system and a projection lens. The illumination system generates a desired light distribution for illuminating a mask from the light from a light source. The projection lens is used to image the mask onto a light-sensitive material, which has been applied, for example, on a wafer or on another substrate, in particular made from a semiconductor material. In this way, the light-sensitive material is exposed in a structured manner to a pattern prescribed by the mask. Since the mask has tiny structure elements that are intended to be transferred to the substrate with high precision, the illumination system, needs to generate a desired light distribution precisely and reproducibly and the imaging by the projection lens needs to take place precisely and reproducibly.

In addition to further optical elements, the illumination system and the projection lens may have in the light path at least one mirror, which deflects the light in a specified way by reflection at its optical surface. How the light deflection specifically takes place depends on the shape of the optical surface. Since the mirror does not reflect completely but absorbs a small portion of the light and converts it into heat, the mirror heats up during operation. This increase in temperature results in a deformation of the optical surface of the mirror and thereby influences the light deflection at the optical surface. If the mirror is an integral part of the illumination system, the light distribution generated by the illumination system deviates from the specification. If the mirror is an integral part of the projection lens, imaging aberrations will occur during the imaging using the projection lens.

With increasing miniaturization in semiconductor manufacturing, the illumination and the imaging of the mask must be carried out with ever increasing precision. The result is that an increasing number of influencing factors must be taken into account, which have so far been able to be tolerated, or that already existing measures for compensating the influencing factors must be improved or be substituted by better measures.

It is already known to counteract the heating of a mirror of a lithography system by way of cooling the mirror. For example, US 7591561 B2 discloses an internally cooled mirror, in which at least one microchannel, which is supplied with a fluid by at least one port, is arranged under an optical surface. The known mirror has an upper part and a lower part, wherein the microchannels can be formed, for example, in the region of the surface of the lower part and can be connected to the ports by feed grooves, which are likewise at least partially formed in said surface.

In the known embodiment of the cooling structure in the mirror, isolated ribs are formed between the cooling channels and the feed grooves. Said ribs may cause problems during manufacturing to the extent that there is a risk of the material breaking away in particular in the end regions of said ribs. In addition, an interferometric measurement of the surface is made more difficult if the surface has isolated regions.

Further problems in an internally cooled mirror can consist in the optical surface deforming owing to the fluid pressure in the cooling structure of the mirror.

The invention is based on the object of simplifying the manufacturability of a cooled mirror. In particular the risk of mechanical damage occurring during manufacturing is intended to be reduced and the manufacturing precision is intended to be increased.

This object is achieved by means of the combinations of features of the coordinate claims.

The mirror according to the invention for a lithography system has a mirror body, which comprises a first mirror part, a second mirror part, an optical surface for the reflection of light and a plurality of cooling channels. The first mirror part and/or the second mirror part are preferably made from a glass material, a glass ceramic material or a ceramic material. The first mirror part and the second mirror part are rigidly connected to one another. The cooling channels are arranged in the first mirror part, are formed to be open towards a first outer surface of the first mirror part that adjoins the second mirror part, are fluidically connected to one another and are formed separately from one another in the region of the first outer surface of the first mirror part and are surrounded in each case entirely by the material of the first mirror part.

The invention has the advantage that the mirror is designed such that it is relatively easy to produce. In particular, there are no isolated ribs between the cooling channels of which parts may break away during manufacturing. In addition, dispensing with isolated ribs simplifies an interferometric measurement of the first outer surface of the first mirror part.

The cooling channels can have in the region of the first outer surface of the first mirror part in each case one boundary curve that is closed in itself for each cooling channel. Furthermore, the according channels can be fluidically connected to one another inside the mirror body. In particular, the cooling channels inside the first mirror part and/or the second mirror part can be fluidically connected to one another.

The first mirror part and the second mirror part can be connected to one another by way of bonding. Bonding permits a very strong and permanent connection that can be established with acceptable outlay. Using bonding, the material of the first mirror part can be directly connected to the material of the second mirror part. In this way, the disadvantages occurring when using adhesives can be avoided. In particular, bonding can be used to form covalent connections between the material of the first mirror part and the material of the second mirror part.

The second mirror part may have a greater thickness than the first mirror part. This allows efficient cooling of the optical surface if the latter is arranged on the first mirror part and the cooling channels are formed in the vicinity of the boundary region between the first mirror part and the second mirror part.

The cooling channels can be formed in the manner of recesses, arranged one next to the other, in the first outer surface of the first mirror part. Cooling channels that are thus formed are relatively easy to produce. The cooling channels can in particular be formed in the manner of recesses, arranged parallel to one another, in the first outer surface of the first mirror part. Less fluid pressure is required for parallel flows to pass through a plurality of short cooling channels than for a serial flow to pass through a long cooling channel. A lower fluid pressure entails a reduced risk of pressure-induced deformation of the mirror part and thus of the optical surface.

The cooling channels can have a depth that is greater than their widths. In other words, the lateral dimensions of the cooling channels can have greater values in a direction perpendicular to the first outer surface of the first mirror part than in a direction parallel to the first outer surface of the first mirror part. As a result, with the same flow cross section, there is a smaller risk of the optical surface deforming, since the proportion of the surface area of the cavities formed by the cooling channels parallel to the optical surface area is smaller than in the case of wide cooling channels that have a small depth.

The cooling channels can be fluidically connected to at least one fluid distributor and/or at least one fluid collector. The fluid distributor and/or the fluid collector can have a greater flow area than an individual cooling channel. This makes the setting of beneficial flow conditions possible. The fluid distributor and/or the fluid collector can be arranged at a greater distance from the optical surface than the cooling channels. The distance can be ascertained as the respectively smallest separation from the optical surface. A thicker material layer of the mirror body can be arranged between the fluid distributor and/or the fluid collector and the optical surface than between the cooling channels and the optical surface. The thickness of the material layer can here be considered to be the minimum thickness that is continuously kept in the region between the fluid distributor and/or the fluid collector and the optical surface, or in the region between the cooling channels and the optical surface. With these measures, the deformation of the optical surface owing to the fluid pressure in the fluid distributor and/or in the fluid collector, which generally have cavities with a greater surface area than the cooling channels, can be kept within acceptable limits.

The fluid distributor and/or the fluid collector can be arranged in the second mirror part. This makes it easier to avoid ribs and other isolated surfaces in the region of the first outer surface of the first mirror part. In addition, sufficient space is available there because the cooling channels are arranged in the first mirror part. The fluid distributor and/or the fluid collector can also be arranged in a third mirror part.

The fluid distributor and/or the fluid collector can have a flow area that increases in the direction of the cooling channels. In this way, it is possible to establish beneficial flow conditions in the fluid distributor and/or the fluid collector.

The fluid distributor and/or the fluid collector can be at least regionally arranged laterally outside the optical surface. Whether this condition has been met can be ascertained using a projection of the optical surface and also of the fluid distributor and/or fluid collector into the same plane, for example into the plane of the first outer surface of the first mirror part. In particular, the fluid distributor and/or the fluid collector can be arranged to at least 10%, preferably at least 25%, with particular preference at least 50%, of their volume, or even entirely, laterally outside the optical surface.

The fluid distributor and/or the fluid collector can have a main surface that encloses a non-zero angle with the optical surface. If the optical surface is embodied as a planar surface, the angle can be determined without difficulty as the angle between the plane of the main surface and the plane of the optical surface. If the optical surface is embodied as a curved surface, the angle can be determined as the angle between the plane of the main surface and a plane that is tangential to the optical surface in the region of the centre of the optical surface. The angle can be, in particular, at least 15°, preferably at least 30°. The arrangement of the fluid distributor and/or the fluid collector, which is tilted relative to the optical surface, means that the proportion of the surface that is parallel to the optical surface is smaller than in the case of an angle of 0°. Accordingly, the fluid pressure in the fluid distributor and/or fluid collector has a less pronounced effect on the optical surface, resulting in less deformation of the optical surface than without said measure. A further effect of the inclined arrangement consists in the fact that a partial region of the fluid distributor and/or of the fluid collector is arranged at a greater distance from the optical surface, which likewise reduces the influence on the optical surface.

The fluid distributor and/or the fluid collector can be arranged with a separation from the cooling channels. It is thus possible to arrange the cooling channels at a relatively small distance from the optical surface, with the result that a good cooling effect is obtained, and also to arrange the fluid distributor and/or the fluid collector at a large distance from the optical surface, with the result that any deformations of the optical surface that occur will be small.

The fluid distributor can be fluidically connected to the cooling channels via distributor channels and/or the fluid collector can be fluidically connected to the cooling channels via collector channels. In this way it is possible, despite the separation between the fluid

distributor and/or the fluid collector and the cooling channels, to establish a fluidic connection between the fluid distributor and/or the fluid collector and the cooling channels.

The distributor channels and/or the collector channels can extend perpendicular to the first outer surface of the first mirror part along their entire lengths. This orientation is beneficial with regards to achieving the lowest possible deformation of the optical surface.

In particular, the fluid distributor can be fluidically connected in each case via one distributor channel to a plurality of cooling channels and/or the fluid collector can be fluidically connected in each case via one collector channel to a plurality of cooling channels. In this way, the numbers of the distributor channels and of the collector channels can be kept small. In addition, more material of the mirror body remains between the distributor channels and between the collector channels, resulting in an increase in stability of the mirror body and a decrease of the risk of an inadmissible deformation of the optical surface.

The distributor channels and/or the collector channels can have a flow area that increases in the direction of the cooling channels. It is thus possible to fluidically connect a plurality of cooling channels to the same distributor channel or collector channel and to still keep the flow area of the distributor channel or collector channel relatively small over the majority of its length.

The fluid distributor and/or the fluid collector and/or the distributor channels and/or the collector channels can be embodied in the form of holes in the mirror body. This has advantages from a manufacturing standpoint because holes can be created with relatively little outlay and high precision. In particular, the distributor channels and/or the collector channels can be embodied in the form of stepped holes or as holes that regionally expand conically.

The optical surface can be arranged on the first mirror part. Since the cooling channels are likewise embodied in the first mirror part, this variant is characterized by a relatively small distance between the cooling channels and the optical surface and thus by efficient cooling.

The invention furthermore relates to an illumination system having a mirror according to the invention. The invention likewise relates to a projection lens having a mirror according to the invention.

In addition, the invention relates to a lithography system having an illumination system according to the invention and/or a projection lens according to the invention.

The previously described configurations are not limited to an embodiment of the mirror in which the cooling channels are embodied separately from one another in the region of the first outer surface of the first mirror part and are surrounded in each case completely by the material of the first mirror part. Accordingly, the invention also relates to a mirror for a lithography system, having a mirror body comprising a first mirror part, a second mirror part, an optical surface for the reflection of light and a plurality of cooling channels, wherein the first mirror part and the second mirror part are rigidly connected to one another and the cooling channels are arranged in the first mirror part, are formed to be open towards a first outer surface of the first mirror part that adjoins the second mirror part, are fluidically connected to one another and wherein in addition at least one of the previously described configurations is provided.

The invention is explained in more detail below on the basis of the exemplary embodiments that are represented in the drawing,

in which:

Fig. 1 shows a schematic illustration of an exemplary embodiment of a lithography system embodied according to the invention,

Fig. 2 shows a schematic illustration of a further exemplary embodiment of a lithography system embodied according to the invention,

Fig. 3 shows a schematic sectional illustration of a first exemplary embodiment of a mirror body according to the invention,

Fig. 4 shows a further schematic sectional illustration of the first exemplary embodiment of the mirror body illustrated in Figure 3,

Fig. 5 shows a schematic plan view of the first mirror part of the first exemplary embodiment of the mirror body,

Fig. 6 shows a schematic plan view of the second mirror part of the first exemplary embodiment of the mirror body,

Fig. 7 shows a second exemplary embodiment of the mirror body in an illustration corresponding to Figure 3,

Fig. 8 shows the second exemplary embodiment of the mirror body in an illustration corresponding to Figure 4,

Fig. 9 shows a third exemplary embodiment of the mirror body in an illustration corresponding to Figure 3,

Fig. 10 shows the third exemplary embodiment of the mirror body in an illustration corresponding to Figure 4,

Fig. 11 shows a fourth exemplary embodiment of the mirror body in an illustration corresponding to Figure 3,

Fig. 12 shows the fourth exemplary embodiment of the mirror body in an illustration corresponding to Figure 4,

Fig. 13 shows a fifth exemplary embodiment of the mirror body in an illustration corresponding to Figure 3,

Fig. 14 shows the fifth exemplary embodiment of the mirror body in an illustration corresponding to Figure 4,

Fig. 15 shows a sixth exemplary embodiment of the mirror body in an illustration corresponding to Figure 3, and

Fig. 16 shows the sixth exemplary embodiment of the mirror body in an illustration corresponding to Figure 4.

Figure 1 shows a schematic illustration of an exemplary embodiment of a lithography system embodied according to the invention. The lithography system illustrated is designed for operation with light in the DUV range. DUV denotes here "deep ultraviolet". In particular, the lithography system may be designed for operation with light at the wavelength of 193 nm.

The lithography system has an illumination system 1 and a projection lens 2. The internal structure of the illumination system 1 and the internal structure of the projection lens 2, which may in each case comprise for example optical components, sensors, manipulators etc., are not shown in detail. In the case of the projection lens 2, a mirror M is indicated as a representative of its optical components. The mirror M may be cooled with the aid of a cooling medium, which is provided by a cooling device 3. The cooling medium is a fluid, for example water. In addition or alternatively, the illumination system 1 may have a cooled mirror M and an associated cooling device 3. The projection lens 2 and/or the illumination system 1 may also have a plurality of cooled mirrors M and cooling devices 3. In the case of the illumination system 1 and in the case of the projection lens 2, lens elements and further mirrors - cooled or uncooled - may for example be present as further optical components.

The light required for the operation of the lithography system is generated by a light source 4. The light source 4 may be in particular an excimer laser, for example an argon fluoride laser, which generates light of the wavelength 193 nm.

Arranged between the illumination system 1 and the projection lens 2 is a reticle stage 5, fixed on which is a mask 6, also referred to as a reticle. The reticle stage 5 has a drive 7. Arranged downstream of the projection lens 2, seen in the direction of light, is a substrate stage 8, which carries a substrate 9, for example a wafer, and has a drive 10.

Also shown furthermore in Figure 1 is a control device 11, which is connected to the illumination system 1, the projection lens 2, the cooling device 3, the light source 4, the reticle stage 5 or the drive 7 thereof and the substrate stage 8 or the drive 10 thereof.

The lithography system serves to image the mask 6 onto the substrate 9 with great precision. For this purpose, the mask 6 is illuminated with the aid of the illumination system 1 and the illuminated mask 6 is imaged onto the substrate 9 with the aid of the projection lens 2. Specifically, the following procedure is adopted:

The illumination system 1 transforms the light generated by the light source 4 in an exactly defined way by means of its optical components and guides it onto the mask 6. Depending on the embodiment, the illumination system 1 may be formed in such a way that it illuminates the entire mask 6 or only a partial region of the mask 6. The illumination system 1 is capable of illuminating the mask 6 in such a way that there are almost identical light conditions at each illuminated point of the mask 6. In particular, the light intensity and the angular distribution of the incident light are almost identical for each illuminated point of the mask 6.

The illumination system 1 is capable of illuminating the mask 6 optionally with light of a multiplicity of different angular distributions. These angular distributions of the light are also referred to as illumination settings. The desired illumination setting is generally selected in dependence on the structure elements formed on the mask 6. Used relatively often for example are dipole or quadrupole illumination settings, in the case of which the light is incident on each illuminated point of the mask 6 from two or from four different directions, respectively. Depending on the form of the illumination system 1, the different illumination settings may be produced for example by means of different diffractive optical elements in combination with a zoom axicon optical unit or by means of mirror arrays, which have in each case a multiplicity of small mirrors that are arranged next to one another and are individually adjustable with respect to their angular positions.

The mask 6 may be formed for example as a glass plate, which is transparent to the light supplied by the illumination system 1 and applied to which are opaque structures, for example in the form of a chromium coating.

The lithography system may be formed in such a way that the entire mask 6 is illuminated at the same time by the illumination system 1 and is imaged completely onto the substrate 9 by the projection lens 2 in a single exposure step.

Alternatively, the lithography system may also be formed in such a way that only a partial region of the mask 6 is illuminated at the same time by the illumination system 1 and the drive 7 of the reticle stage 5 is controlled by the control device 11 in such a way that, during the exposure of the substrate 9, the mask 6 is moved relative to the illumination system 1 and, as a result, the illuminated partial region migrates over the mask 6 as a whole. The substrate 9 is moved synchronously by a suitably adjusted control operation of the drive 10 of the substrate stage 8, in which the imaging properties of the projection lens 2 are also taken into account, and the respectively illuminated partial region of the mask 6 is thus imaged onto a partial region of the substrate 9 that is provided for it. This movement of the mask 6 and of the substrate 9 is also referred to as scanning.

In order to be able to transfer the latent image produced by the exposure of the substrate 9 in both embodiment variants of the lithography system into a physical structure, a light-sensitive layer is applied to the substrate 9. The image of the mask 6 is formed in this light-sensitive layer by exposure and a permanent structure can be produced from it on the substrate 9 with the aid of subsequent chemical processes.

The mask 6 is generally imaged onto the substrate 9 not only once, but multiple times one next to the other. For this purpose, after each imaging of the mask 6 onto the substrate 9, the substrate stage 8 is displaced laterally in a way corresponding to the size of the image of the mask 6 on the substrate 9. The imaging of the mask 6 may be performed here in each case as a whole or sequentially by scanning. The chemical treatment of the substrate 9 is started only when the desired number of imagings of the mask 6 onto the substrate 9 have been carried out.

Figure 2 shows a schematic illustration of a further exemplary embodiment of a lithography system embodied according to the invention. The lithography system according to Figure 2 is designed for operation with light in the EUV range. EUV denotes “extreme ultraviolet". In particular, the lithography system may be designed for operation with light at the wavelength 13.5 nm.

Analogously to the lithography system in Figure 1, the lithography system illustrated in Figure 2 has an illumination system 1, a projection lens 2, a light source 4, a reticle stage 5 including drive 7, and a substrate stage 8 including drive 10. The light source 4 can be

embodied in particular as a plasma light source. A mask 6 is arranged on the reticle stage 5. A substrate 9 is arranged on the substrate stage 8. The illumination system 1 has mirrors M1, M2, M3, M4, M5 and M6, which are arranged in this order in the beam path from the light source 4 to the mask 6. The projection lens 2 has in the beam path from the mask 6 to the substrate 9, in this order, mirrors M7, M8, M9, M10, M11 and M12. The mirror M8 can be cooled with the aid of a cooling medium provided by a cooling device 3. The cooling medium is again a fluid, for example water. In addition or alternatively to the mirror M8, it is also possible for another mirror of the projection lens 2 and/or of the illumination system 1 to be cooled or for a plurality of mirrors of the projection lens 2 and/or of the illumination system 1 to be cooled.

In the exemplary embodiment of Figure 2, neither the illumination system 1 nor the projection lens 2 has lens elements, because there are no materials that exhibit a transmission or other optical properties that is or are suitable for a lithography system at a wavelength of 13.5 nm. The mask 6 is also not operated in transmission but in reflection.

Although this is not illustrated in Figure 2, a control device 11 may be provided in the exemplary embodiment of Figure 2, similar to the exemplary embodiment of Figure 1.

The exposure operation is effected in the exemplary embodiment of Figure 2 in a similar manner as described for the exemplary embodiment of Figure 1, wherein a scanning operation is generally performed.

Fig. 3 shows a schematic sectional illustration of a first exemplary embodiment of a mirror body 12 according to the invention. Figure 4 shows a further schematic sectional illustration of the same exemplary embodiment of the mirror body 12, wherein a sectional plane selected is one that is rotated about 90° with respect to the sectional plane of Figure 3.

The mirror body 12 can be, for example, an integral part of the mirror M according to Figure 1 or of the mirror M8 according to Figure 2 and can be made from a material having a very low coefficient of thermal expansion. Suitable materials are, for example, special glasses, in particular quartz glass doped with titanium oxide, or special glass ceramics.

The mirror body 12 has a reflective optical surface 13. Depending on the desired optical properties, the optical surface 13 can be of a planar design or have a curvature. In the first exemplary embodiment of the mirror body 12, the optical surface 13 is formed as a coating that has been applied to the mirror body 12. The formation of the coating depends on the wavelength at which the optical surface 13 is intended to produce its reflective effect. In the case of a desired reflection in the DUV range, i.e. in the case of the mirror M of Figure 1, the coating may be formed as an aluminium layer. By contrast, if a reflection in the EUV range is intended, as in the case of the mirror M8 of Figure 2, the coating can be formed in particular from layers of silicon and molybdenum in an alternating sequence.

The mirror body 12 contains a first mirror part 14 and a second mirror part 15, which adjoin one another in the region of a first outer surface 16 of the first mirror part 14 and of a second outer surface 17 of the second mirror part 15 and are connected rigidly to one another. The first mirror part 14 and/or the second mirror part 15 can be made from a glass material, a glass ceramic material or a ceramic material. In particular, the first mirror part 14 and second mirror part 15 are made from the materials listed above for the mirror body 12. The connection between the mirror parts 14, 15 can be brought about for example by a bonding technique. For this purpose, the first outer surface 16 of the first mirror part 14 and the second outer surface 17 of the second mirror part 15 are formed to be planar with great precision and polished to a low roughness. Subsequently, the first outer surface 16 of the first mirror part 14 and the second outer surface 17 of the second mirror part 15 are moved towards each other, possibly with the supply of heat, until mechanical contact is made, and they are possibly additionally pressed against each other. In the process, covalent bonds are formed between the material of the first mirror part 14 and that of the second mirror part 15. The mirror parts 14, 15 then permanently adhere to one another, even once the contact pressure is no longer maintained.

In the first exemplary embodiment, the optical surface 13 is arranged on the first mirror part 14, to be precise on its side facing away from the second mirror part 15. The first mirror part 14 has, in the region of its first outer surface 16, a plurality of cooling channels 18 that run parallel to one another and are formed to be open in the direction of the first outer surface 16. This is also evident from Figure 5.

Figure 5 shows a schematic plan view of the first mirror part 14 of the first exemplary embodiment of the mirror body 12, It is evident from Figure 5 that the cooling channels 18

run parallel to one another and are formed separately from one another in the region of the first outer surface 16 of the first mirror part 14 and are surrounded in each case entirely by the material of the first mirror part 14. Each cooling channel 18 has, in the region of the first outer surface 16 of the first mirror part 14, a closed boundary curve, which touches no boundary curve of another cooling channel 18, and no common issuing region is formed with another cooling channel 18.

This geometry of the cooling channels 18 has the result that, even in an arrangement of the cooling channels 18 with a small separation from one another, the ribs that remain between adjacent cooling channels 18 have no free end regions that possess only a light mechanical stability and could easily break away during mechanical processing of the first outer surface 16 of the first mirror part 14. Rather, the ribs transition in their end regions into the surrounding material without interruption, that is to say there are no isolated ribs and thus no free end regions.

A further consequence of the geometry of the cooling channels 18 illustrated in Figure 5 is that the entire first outer surface 16 of the first mirror part 14 is formed as a single contiguous surface despite the multiplicity of cooling channels 18 and there is no isolated surface region. If the first outer surface 16 is to be measured by interferometry during the production of the first mirror part 14 for the purposes of checking the machining state, the measurement result is thus clear for the entire first outer surface 16, that is to say there are no regions of the first outer surface 16 for which the interferometric measurement leaves open the question of whether said regions have a height difference that causes a path difference in the size of an integer multiple of the measurement wavelength and is thus not discernible.

It is evident from Figures 3 and 4 that the second mirror part 15 has, in the region of its second outer surface 17, a fluid distributor 19 and a fluid collector 20, which are designed to be open in each case in the direction of the second outer surface 17 and lie opposite one another in a manner such that they overlap with the opposing end regions of the cooling channels 18. In other words, the fluid distributor 19 overlaps with the end regions of the cooling channels 18 that are illustrated in Figure 3 on the left, and the fluid collector 20 overlaps with the end regions of the cooling channels 18 that are illustrated in Figure 3 on the right. In the illustration of Figure 4, the sectional plane extends through the overlap region

between the fluid distributor 19 and the end regions of the cooling channels 18 that are illustrated in Figure 3 on the left.

The described arrangement of the cooling channels 18 and of the fluid distributor 19 and the fluid collector 20 has a positive effect on the interferometric measurement of the optical surface 13, since the first outer surface 16 of the first mirror part 14 has, in the lateral region of the optical surface 13, that is to say within the projection region of the optical surface 13 onto the first outer surface 16, at most a very small proportion of polished surfaces that are directly adjoined by a cavity of the second mirror part 15, with the result that a jump in refractive index occurs. Such a jump in refractive index at a polished surface - the first outer surface 16 of the first mirror part 14 is polished for the purposes of bonding - can result in a back reflection of the measurement radiation and thus to disturbing additional reflections during the interferometric measurement of the optical surface 13.

Further details regarding the embodiment of the fluid distributor 19 and of the fluid collector 20 are evident from Figure 6.

Figure 6 shows a schematic plan view of the second mirror part 15 of the first exemplary embodiment of the mirror body 12. The fluid distributor 19 extends from the periphery of the second outer surface 17 of the second mirror part 15, which is illustrated in Figure 6 on the left, by a small amount in the direction of the periphery lying opposite it, that is to say in Figure 6 towards the right. The dimensions of the fluid distributor 19 transversely to the direction of said extent here increase fast, that is to say the fluid distributor 19 becomes wider as the distance from the periphery increases. The fluid collector 20 is formed to be mirror-symmetrical to the fluid distributor 19 with respect to a plane that extends centrally between the left periphery and the opposite right periphery. Accordingly, the fluid collector 20 extends from the periphery of the second outer surface 17 of the second mirror part 15, illustrated in Figure 6 on the right, by a short amount in the direction of the periphery that lies opposite it, that is to say in Figure 6 to the left. The dimensions of the fluid collector 20 transversely to the direction of this extent increase here fast, that is to say the fluid collector 20 becomes wider as the distance from the periphery increases. Specifically, the shapes of the fluid distributor 19 and of the fluid collector 20 can be selected such that the flow behaviour of the fluid is optimized. For example, it is possible to strive for a flow that is as laminar as possible with few turbulences.

It is evident from a combination of Figures 3, 4, 5 and 6 that the fluid distributor 19 illustrated in Figure 6 on the left is fluidically connected to the end regions of the cooling channels 18 that are illustrated in Figures 3 and 5 on the left and fluidically connects said end regions of the cooling channels 18 to one another. It is furthermore evident that the fluid collector 20 illustrated in Figure 6 on the right is fluidically connected to the end regions of the cooling channels 18 that are illustrated in Figures 3 and 5 on the right and fluidically connects said end regions of the cooling channels 18 to one another. It is thus possible to supply a fluid to the cooling channels 18 through the fluid distributor 19. The fluid flows through the cooling channels 18 and then flows on into the fluid collector 20, via which it can be removed. The supply of the fluid to the fluid distributor 19 and the removal of the fluid from the fluid collector 20 can take place with the aid of the cooling device 3, which for this purpose can be connected to the fluid distributor 19 and the fluid collector 20. Adjusting the temperature of the supplied fluid to a temperature below the temperature of the first mirror part 14 can achieve the effect that the fluid extracts heat from the first mirror part 14 as it flows through the cooling channels 18. This extraction of heat is intended in particular to compensate for the input of heat due to the light that is incident on the optical surface 13 during the operation of the lithography system. Since the optical surface 13 does not completely reflect the incident light, a small proportion of the light is absorbed by the optical surface 13 and, depending on the formation of the optical surface 13, also absorbed by the first mirror part 14 and converted into heat. Since the optical surface 13 and the first mirror part 14 have a certain thermal conductivity, part of this heat is directed to the cooling channels 18 and can be taken up there by the fluid and transported away. In this way, the rise in temperature of the mirror body 12 caused by the light can be reduced and the deformation of the optical surface 13 caused by effects of thermal expansion can be reduced in comparison with an uncooled mirror. As a consequence, the imaging aberrations caused by the deformation are also reduced.

In one modification of the first exemplary embodiment of the mirror body 12, it is also possible to form the cooling channels 18 in the second mirror part 15, and to form the fluid distributor 19 and the fluid collector 20 in the first mirror part 14. However, this modification is generally less preferred than the first exemplary embodiment of the mirror body 12 because, for example, the cooling is less efficient due to the greater distance of the cooling channels 18 from the optical surface 13.

Independently of the details of their arrangement, the cooling channels 18, the fluid distributor 19 and the fluid collector 20 counteract deformation of the optical surface 13 by cooling the optical surface 13. However, the cavities required for forming the cooling channels 18, the fluid distributor 19 and the fluid collector 20 represent a weakening of the material of the mirror body 12, which itself can result in deformation of the optical surface 13. The deformation of the optical surface 13 caused by said material weakening can be kept at acceptable levels due to several measures that can be applied individually or in various combinations in different exemplary embodiments of the mirror body 12.

Two general guiding principles that may apply individually or together in the individual exemplary embodiments are, first, to keep the material weakening caused by the cavities itself as low as possible and, second, to keep the effects of the material weakening on the site of the optical surface 13 as low as possible.

Regarding the first point, it is useful if the supporting width of the cavities is in each case as small as possible. In order to estimate the supporting width of a cavity, it is possible to ascertain for each side wall of the cavity the distance over which said side wall is at least self-supported so as to design the given geometry of the cavity. The largest of all the distances thus ascertained can then be used as the supporting width. Owing to the comparatively large-area formation of their cavities, the fluid distributor 19 and the fluid collector 20 have a comparatively large supporting width and consequently are the cause of a comparatively great material weakening, the effect of which on the optical surface 13 should be mitigated using measures according to the second point.

With respect to the second point, several aspects play a role, in particular the distance, the positioning and the orientation of the cavities relative to the optical surface 13. The effect of the material weakening due to the cavities on the optical surface 13 is here reduced if the cavities are arranged at a large distance from the optical surface 13 and/or laterally outside the region of the optical surface 13 and/or are oriented by way of their side wall that is relevant for the supporting width of the respective cavity at a non-zero angle with respect to the optical surface 13. If the optical surface 13 is embodied to be curved, the angle relative to a plane that is tangential to the optical surface 13 in the region of the centre of the optical surface 13 can be ascertained. In other words, the angle between the plane of the relevant side wall and the plane that is tangential to the optical surface 13 in the centre thereof can be used. The relevant

side wall is generally a main surface of the cavity. Depending on the formation of the curvature of the optical surface 13, the angle can alternatively also be ascertained relative to the first outer surface 16 of the first mirror part 14. If the relevant side wall of the cavity is not planar, it is alternatively possible to use a plane the normal of which extends parallel to the direction of the maximum effect of the weakening caused by the cavity.

As one measure for limiting the deformation of the optical surface 13, the cooling channels 18 can be narrow and deep, i.e. the lateral dimensions of the cooling channels 18 can be smaller in a direction parallel to the first outer surface 16 of the first mirror part 14 than in a direction perpendicular to the first outer surface 16 of the first mirror part 14. This measure is also provided in the first exemplary embodiment of the mirror body 12.

Furthermore, the fluid distributor 19 and the fluid collector 20 can be embodied such that they taper as the distance from their point of connection to the cooling channels 18 increases, and their cavities are thus not unnecessarily large. This measure is also provided in the first exemplary embodiment of the mirror body 12.

In addition, the fluid distributor 19 and the fluid collector 20 can be arranged at least partially laterally outside the region of the optical surface 13. The fluid distributor 19 and the fluid collector 20 will in this case generally be arranged in a different plane from the optical surface 13. It is then possible to ascertain the lateral relationship on the basis of the projection of the optical surface 13 into said different plane. This measure is also provided in the first exemplary embodiment of the mirror body 12.

As a further measure, the fluid distributor 19 and the fluid collector 20 can be arranged in the second mirror part 15, which is located at a greater distance from the optical surface 13 than the first mirror part 14. This measure is also provided in the first exemplary embodiment of the mirror body 12. This measure has a particularly great effect if the fluid distributor 19 and the fluid collector 20 are arranged within the second mirror part 15 at a distance from the second outer surface 17, because this increases the distance from the optical surface 13 even further. Exemplary embodiments in this regard will be explained in more detail below.

In addition, it is possible to arrange the fluid distributor 19 and the fluid collector 20 with their main surfaces perpendicularly or in another, non-parallel orientation with respect to the

second outer surface 17 of the second mirror part 15 and consequently also to the first outer surface 16 of the first mirror part 14 and to thereby keep the proportion of the surface area parallel to the first outer surface 16 of the first mirror part 14 and also to the optical surface 13 small. Exemplary embodiments in this regard will be explained in more detail below.

A deformation of the optical surface 13 can also be caused by the fluid pressure that is necessary for a flow to pass through the cooling channels 18. Arranging the cooling channels 18 in parallel makes possible a strong fluid flow and thus a high cooling power at a low fluid pressure. The shape of the fluid distributor 19 and of the fluid collector 20 is likewise aimed at achieving a fluid flow that is as great as possible at a fluid pressure that is as low as possible. However, the effect of the shape on the static of the mirror body 12 and thus on a potential deformation of the optical surface 13 in this case needs to be taken into account as a further influencing variable.

Figure 7 shows a second exemplary embodiment of the mirror body 12 in an illustration corresponding to Figure 3. Figure 8 shows the second exemplary embodiment of the mirror body 12 in an illustration corresponding to Figure 4.

The second exemplary embodiment of the mirror body 12 has, analogously to the first exemplary embodiment of the mirror body 12, an optical surface 13, a first mirror part 14 and a second mirror part 15. The optical surface 13 and the first mirror part 14 can have the same embodiments as in the first exemplary embodiment of the mirror body 12 and will therefore not be described again. The second mirror part 15 differs from the first exemplary embodiment of the mirror body 12 in terms of the embodiments of the fluid distributor 19 and the fluid collector 20. Unlike in the case of the first exemplary embodiment of the mirror body 12, the main surfaces of the fluid distributor 19 and of the fluid collector 20 are not arranged parallel but perpendicularly to the second outer surface 17 of the second mirror part 15. In this way, the proportions of the surface area parallel to the second outer surface 17 of the second mirror part 15 and consequently also parallel to the first outer surface 16 of the first mirror part 14 for the fluid distributor 19 and the fluid collector 20 are kept small, and the extent of the deformation of the optical surface 13 caused by the fluid pressure within the fluid distributor 19 and the fluid collector 20 is thus limited. In one modification, the main surfaces of the fluid distributor 19 and of the fluid collector 20 are arranged in a different, non-parallel orientation to the second outer surface 17 of the second mirror part 15 and consequently also

to the first outer surface 16 of the first mirror part 14. This likewise reduces the deformation of the optical surface 13 as compared to a parallel orientation, albeit not as much as a perpendicular orientation.

Figure 9 shows a third exemplary embodiment of the mirror body 12 in an illustration corresponding to Figure 3. Figure 10 shows the third exemplary embodiment of the mirror body 12 in an illustration corresponding to Figure 4.

The third exemplary embodiment of the mirror body 12 has an optical surface 13, a first mirror part 14, a second mirror part 15 and a third mirror part 21. The optical surface 13 and the first mirror part 14 can have the same embodiments as in the first exemplary embodiment of the mirror body 12 and will therefore not be described again. The second mirror part 15 has a plurality of distributor channels 22 and a plurality of collector channels 23, which can each be embodied in the form of holes. The distributor journals 22 and the collector channels 23 each extend starting from the second outer surface 17 of the second mirror part 15 through the entire second mirror part 15 up to a third outer surface 24 of the second mirror part 15. The third outer surface 24 is arranged on the side of the second mirror part 15 that lies opposite the second outer surface 17. The distributor channels 22 and the collector channels 23 are arranged such that in each case one distributor channel 22 issues in each case into one end region of a cooling channel 18 and in each case one collector channel 23 issues in each case into the end region of the cooling channel 18 that lies respectively opposite thereof.

The third mirror part 21 is connected, for example by bonding, to the third outer surface 24 of the second mirror part 15 in the region of a fourth outer surface 25. The third mirror part 21 has a fluid distributor 19 and a fluid collector 20, which may be identical or similar to the fluid distributor 19 and the fluid collector 20 of the first exemplary embodiment of the mirror body 12. Accordingly, the fluid distributor 19 and the fluid collector 20 are embodied to be open in the direction of the fourth outer surface 25 of the third mirror part 21. The distributor channels 22 issue into the fluid distributor 19 and the collector channels 23 issue into the fluid collector 20. The fluid distributor 19 laterally overlaps with the end regions of the cooling channels 18, and the fluid collector 20 laterally overlaps with the opposite end regions of the cooling channels 18. The fluid distributor 19 and the fluid collector 20 extend from these overlap regions to the respectively adjacent periphery of the fourth outer surface 25 of the third mirror part 21 and taper in the process.

The fluid is supplied to the fluid distributor 19 in the third mirror part 21 by the cooling device 3 and is distributed by said distributor over the distributor channels 22 in the second mirror part 15. The fluid flows through the distributor channels 22 to the cooling channels 18 in the first mirror part 14. After the fluid flow has passed through the cooling channels 18, it flows into the collector channels 23 in the second mirror part 15 and, after passing through the collector channels 23, reaches the fluid collector 20 in the third mirror part 21. The fluid collector 20 guides the fluid back to the cooling device 3.

In the third exemplary embodiment of the mirror body 12, the fluid distributor 19 and the fluid collector 20 in the illustration of Figures 9 and 10 are arranged with an offset vertically with respect to the cooling channels 18, which means that the fluid distributor 19 and the fluid collector 20 are arranged at a greater distance from the optical surface 13 and the cooling channels 18 and that a thicker material layer of the mirror body 12 is formed between the fluid distributor 19 and also the fluid collector 20 and the optical surface 13 than between the cooling channels 18 and the optical surface 13. This is also the case in the exemplary embodiments of the mirror body 12, which are described below. The thicker material layer means that the fluid pressure prevailing in the fluid distributor 19 and in the fluid collector 20 has barely any effect on the optical surface 13, even though the fluid distributor 19 and the fluid collector 20 form relatively large-area cavities. Owing to their smaller cross-sectional areas, the fluid pressure in the distributor channels 22 and in the collector channels 23 likewise has barely any effect on the optical surface 13.

Figure 11 shows a fourth exemplary embodiment of the mirror body 12 in an illustration corresponding to Figure 3. Figure 12 shows the fourth exemplary embodiment of the mirror body 12 in an illustration corresponding to Figure 4.

The fourth exemplary embodiment of the mirror body 12 has, analogously to the first exemplary embodiment, an optical surface 13, a first mirror part 14 and a second mirror part 15. The optical surface 13 and the first mirror part 14 can have the same embodiments as in the first exemplary embodiment of the mirror body 12 and will therefore not be described again.

The second mirror part 15 has a plurality of distributor channels 22 and a plurality of collector channels 23, which are arranged such that, in the region of the second outer surface 17 of the second mirror part 15, in each case one distributor channel 22 issues in each case into one end region of a cooling channel 18 and in each case one collector channel 23 issues in each case into the end region of the cooling channel 18 that lies respectively opposite thereof. The distributor channels 22 and the collector channels 23 extend starting from the second outer surface 17 of the second mirror part 15 into the interior of the second mirror part 15 and there issue into a fluid distributor 19 and a fluid collector 20. The fluid distributor 19 in the fourth exemplary embodiment of the mirror body 12 is embodied in the form of a hole that extends transversely to the longitudinal direction of the distributor channels 22 and emerges on the outside on a side of the second mirror part 15. Here, a connection to the cooling device 3 can be established. Holes can be produced with comparatively little outlay, even if they extend deep into the interior of a material block. The fluid distributor 19 has a diameter that is greater in the fourth exemplary embodiment of the mirror body 12 than the diameter of an individual distributor channel 22. However, it is for example also possible for the fluid distributor 19 to have the same diameter as an individual distributor channel 22. The fluid distributor 20 in the fourth exemplary embodiment of the mirror body 12 is embodied in the form of a hole that extends transversely to the longitudinal direction of the collector channels 23 and emerges on the outside on a side of the second mirror part 15. Here, a connection to the cooling device 3 can be established. The fluid collector 20 in the fourth exemplary embodiment of the mirror body 12 has a diameter that is greater than the diameter of an individual collector channel 23. However, it is also possible for example for the fluid collector 20 to have the same diameter as an individual collector channel 23.

The fluid is supplied to the fluid distributor 19 in the second mirror part 15 by the cooling device 3 and is distributed by said distributor over the distributor channels 22. The fluid flows through the distributor channels 22 to the cooling channels 18 in the first mirror part 14. After the fluid flow has passed through the cooling channels 18, it flows into the collector channels 23 in the second mirror part 15 and, after passing through the collector channels 23, reaches the fluid collector 20. The fluid collector 20 guides the fluid back to the cooling device 3.

As a consequence of the large distances of the fluid distributor 19 and of the fluid collector 20 from the optical surface 13, the fluid pressure prevailing therein has hardly any effect on the optical surface 13. Owing to their smaller cross-sectional areas, the fluid pressure in the

distributor channels 22 and in the collector channels 23 likewise has barely any effect on the optical surface 13.

Figure 13 shows a fifth exemplary embodiment of the mirror body 12 in an illustration corresponding to Figure 3. Figure 14 shows the fifth exemplary embodiment of the mirror body 12 in an illustration corresponding to Figure 4.

The fifth exemplary embodiment of the mirror body 12 has, analogously to the first exemplary embodiment, an optical surface 13, a first mirror part 14 and a second mirror part 15. The optical surface 13 and the first mirror part 14 can have the same embodiments as in the first exemplary embodiment of the mirror body 12 and will therefore not be described again.

In the fifth exemplary embodiment of the mirror body 12, the second mirror part 15 has a similar structure to that in the fourth exemplary embodiment. A difference lies merely in the fact that the diameter of the distributor channels 22 and the diameter of the collector channels 23 in the fifth exemplary embodiment of the mirror body 12 are significantly greater than in the fourth exemplary embodiment. It is thereby possible that in the fifth exemplary embodiment, in each case two cooling channels 18 are fluidically connected to the same distributor channel 22 and the same collector channel 23. In the fifth exemplary embodiment, only half as many distributor channels 22 and collector channels 23 as in the fourth exemplary embodiment are thus present overall. A few large holes are generally easier to produce than many small ones.

The fluid flow in the fifth exemplary embodiment of the mirror body 12 is analogous to that in the fourth exemplary embodiment. The only differences are that, in the fifth exemplary embodiment, in each case two adjacent cooling channels 18 are supplied with fluid by the same distributor channel 22 and that the fluid flows from in each case two adjacent cooling channels 18 into the same collector channel 23.

Figure 15 shows a sixth exemplary embodiment of the mirror body 12 in an illustration corresponding to Figure 3. Figure 16 shows the sixth exemplary embodiment of the mirror body 12 in an illustration corresponding to Figure 4.

The sixth exemplary embodiment of the mirror body 12 largely corresponds to the fifth exemplary embodiment. The only differences lie in the configuration of the distributor channels 22 and of the collector channels 23. In the sixth exemplary embodiment of the mirror body 12, the distributor channels 22 and the collector channels 23 have a stepped design with respect to their diameters and are divided into a first hole section 26, 27, which has a small diameter, and a second hole section 28, 29, which has a large diameter. The distributor channels 22 issue by way of their first hole sections 26 into the fluid distributor 19 and are fluidically connected to in each case two cooling channels 18 in the region of their second hole sections 28. The collector channels 23 issue by way of their first hole sections 27 into the fluid collector 20 and are fluidically connected to in each case two cooling channels 18 in the region of their second hole sections 29.

The small diameter of the first hole sections 26, 27 ensures that a comparatively large amount of material remains between adjacent distributor channels 22 and adjacent collector channels 23 and that the mechanical stability of the second mirror part 15 is comparatively speaking only slightly lowered by the distributor channels 22 and the collector channels 23. The large diameter of the second hole sections 28, 29 permits a fluidic connection between in each case one distributor channel 22 or collector channel 23 and two cooling channels 18. This results in a reduction of the number of supply channels 22 and removal channels 23 and thus in a lower manufacturing outlay.

With the stepped formation of the distributor channels 22 and of the collector channels 23 it is thus possible to keep the number of the distributor channels 22 and collector channels 23 small and thus to keep the manufacturing outlay small and, in addition, to achieve a high mechanical stability. The greater the ratio of the longitudinal extent of the first hole sections 26, 27 and the longitudinal extent of the second hole sections 28, 29 is, the greater will be the mechanical stability. Generally, the first hole sections 26, 27 will have a greater longitudinal extent, even one that is multiple times greater, than the second hole sections 28, 29.

It is also possible to make the transition between the first hole sections 26, 27 and the second hole sections 28, 29 not stepped but continuous, for example in the form of a cone. The transition can in this case also extend in each case over the entire second hole section 28, 29, with the result that a conic second hole section 28, 29 can follow for example in each case a cylindrical first hole section 26, 27.

The fluid flow in all variants of the sixth exemplary embodiment of the mirror body 12 is analogous to that in the fifth exemplary embodiment.

Reference signs

1	Illumination system
2	Projection lens
3	Cooling device
4	Light source
5	Reticle stage
6	Mask
7	Drive
8	Substrate stage
9	Substrate
10	Drive
11	Control device
12	Mirror body
13	Optical surface
14	First mirror part
15	Second mirror part
16	First outer surface
17	Second outer surface
18	Cooling channel
19	Fluid distributor
20	Fluid collector
21	Third mirror part
22	Distributor channel
23	Collector channel
24	Third outer surface
25	Fourth outer surface
26	First hole section of the distributor channel
27	First hole section of the collector channel
28	Second hole section of the distributor channel
29	Second hole section of the collector channel

M	Mirror
M1	Mirror
M2	Mirror
M3	Mirror
M4	Mirror
M5	Mirror
M6	Mirror
M7	Mirror
M8	Mirror
M9	Mirror
M10	Mirror
M11	Mirror
M12	Mirror

Patent claims

1. Mirror for a lithography system, wherein the mirror has a mirror body (12), comprising
- a first mirror part (14),
- a second mirror part (15),
- an optical surface (13) for the reflection of light and
- a plurality of cooling channels (18),
wherein
- the first mirror part (14) and/or the second mirror part (15) are made from a glass material, a glass ceramic material or a ceramic material,
- the first mirror part (14) and the second mirror part (15) are rigidly connected to one another,
- the cooling channels (18) are arranged in the first mirror part (14),
- the cooling channels (18) are embodied to be open in the direction of a first outer surface (16) of the first mirror part (14) adjoining the second mirror part (15),
- the cooling channels (18) are fluidically connected to one another and
- the cooling channels (18) are formed separately from one another in the region of the first outer surface (16) of the first mirror part (14) and are surrounded in each case entirely by the material of the first mirror part (14).

2. Mirror according to Claim 1, wherein the cooling channels (18) are formed in the manner of recesses, arranged one next to the other, in the first outer surface (16) of the first mirror part (14).

3. Mirror according to either of the preceding claims, wherein the cooling channels (18) are fluidically connected to at least one fluid distributor (19) and/or at least one fluid collector (20).

4. Mirror according to Claim 3, wherein the fluid distributor (19) and/or the fluid collector (20) have a greater flow area than an individual cooling channel (18).

5. Mirror according to either of Claims 3 and 4, wherein the fluid distributor (19) and/or the fluid collector (20) are arranged at a greater distance from the optical surface (13) than the cooling channels (18).

6. Mirror according to one of Claims 3 to 5, wherein a thicker material layer of the mirror body (12) is arranged between the fluid distributor (19) and/or the fluid collector (20) and the optical surface (13) than between the cooling channels (18) and the optical surface (13).

7. Mirror according to one of Claims 3 to 6, wherein the fluid distributor (19) and/or the fluid collector (20) are arranged in the second mirror part (15).

8. Mirror according to one of Claims 3 to 7, wherein the fluid distributor (19) and/or the fluid collector (20) have a flow area that increases in the direction of the cooling channels (18).

9. Mirror according to one of Claims 3 to 8, wherein the fluid distributor (19) and/or the fluid collector (20) are at least regionally arranged laterally outside the optical surface (13).

10. Mirror according to one of Claims 3 to 9, wherein the fluid distributor (19) and/or the fluid collector (20) have a main surface that encloses a non-zero angle with the optical surface (13).

11. Mirror according to one of Claims 3 to 10, wherein the fluid distributor (19) and/or the fluid collector (20) are arranged at a distance from the cooling channels (18).

12. Mirror according to Claim 11, wherein the fluid distributor (19) is fluidically connected to the cooling channels (18) via distributor channels (22) and/or the fluid collector (20) is fluidically connected to the cooling channels (18) via collector channels (23).

13. Mirror according to Claim 12, wherein the fluid distributor (19) is connected to a plurality of cooling channels (18) in each case via one distributor channel (22) and/or the fluid collector (20) is connected to a plurality of cooling channels (18) in each case via one collector channel (23).

14. Mirror according to one of Claims 3 to 13, wherein the fluid distributor (19) and/or the fluid collector (20) and/or the distributor channels (22) and/or the collector channels (23) are embodied in the form of holes in the mirror body (12).

15. Mirror according to one of the preceding claims, wherein the optical surface (13) is arranged on the first mirror part (14).

16. Illumination system having a mirror according to one of the preceding claims.

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17. Projection lens having a mirror according to one of Claims 1 to 15.

18. Lithography system having an illumination system (1) according to Claim 16 and/or a projection lens (2) according to Claim 17.

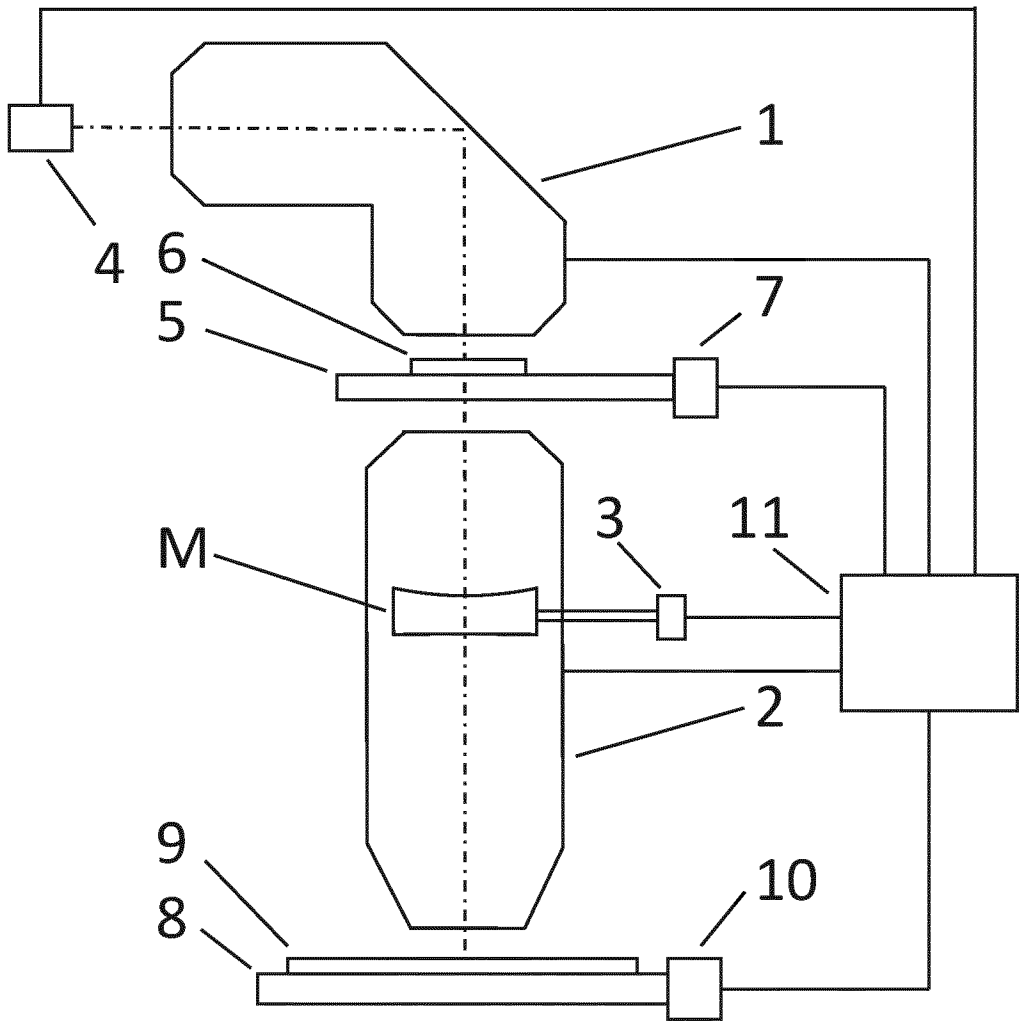


Fig. 1

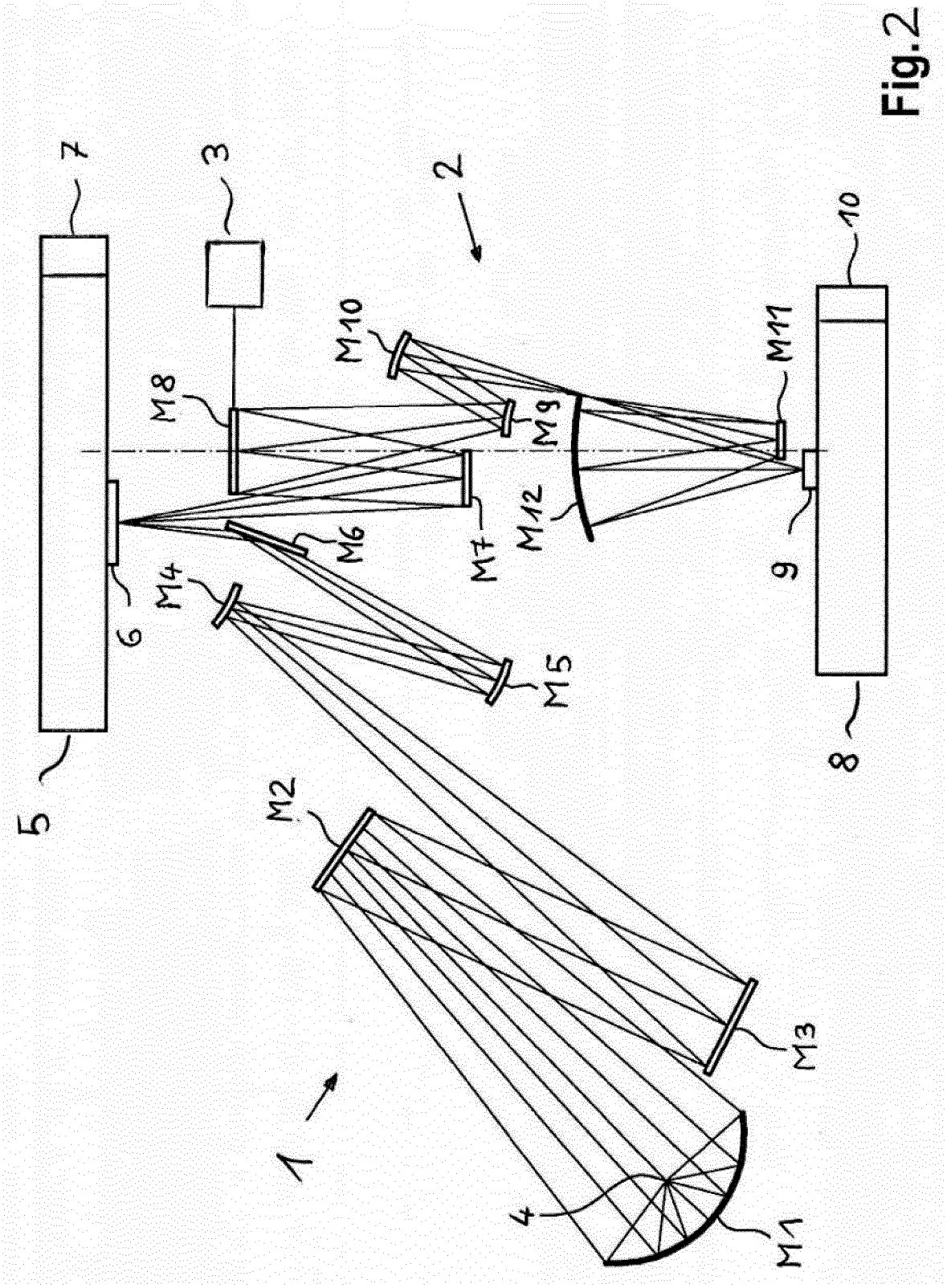


Fig.2

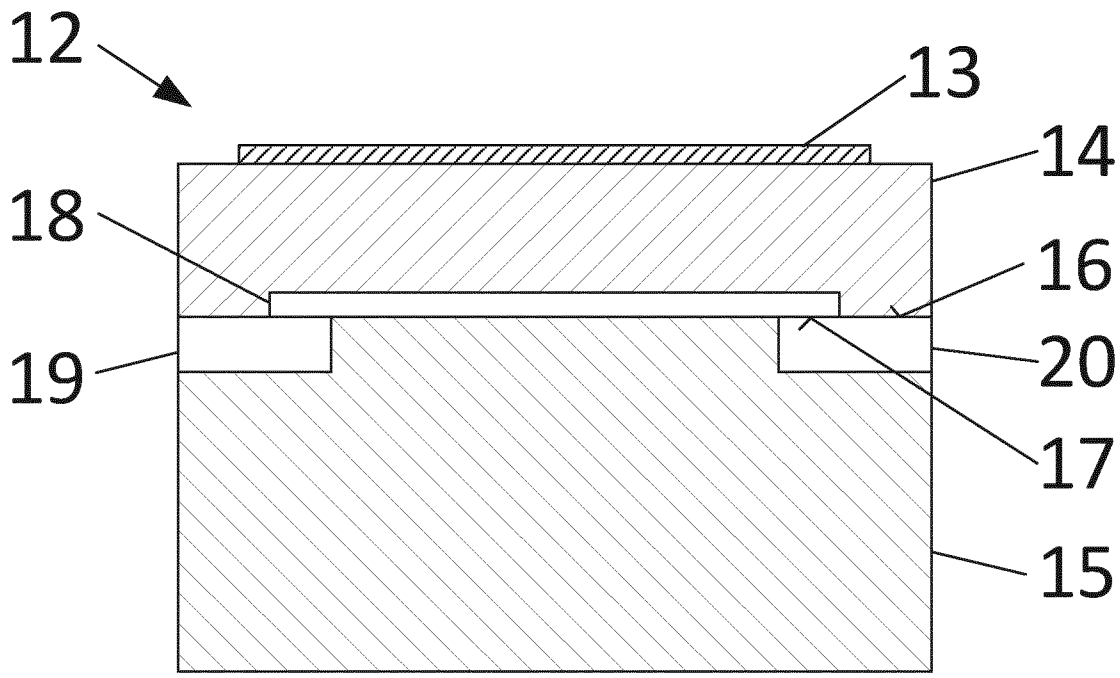


Fig.3

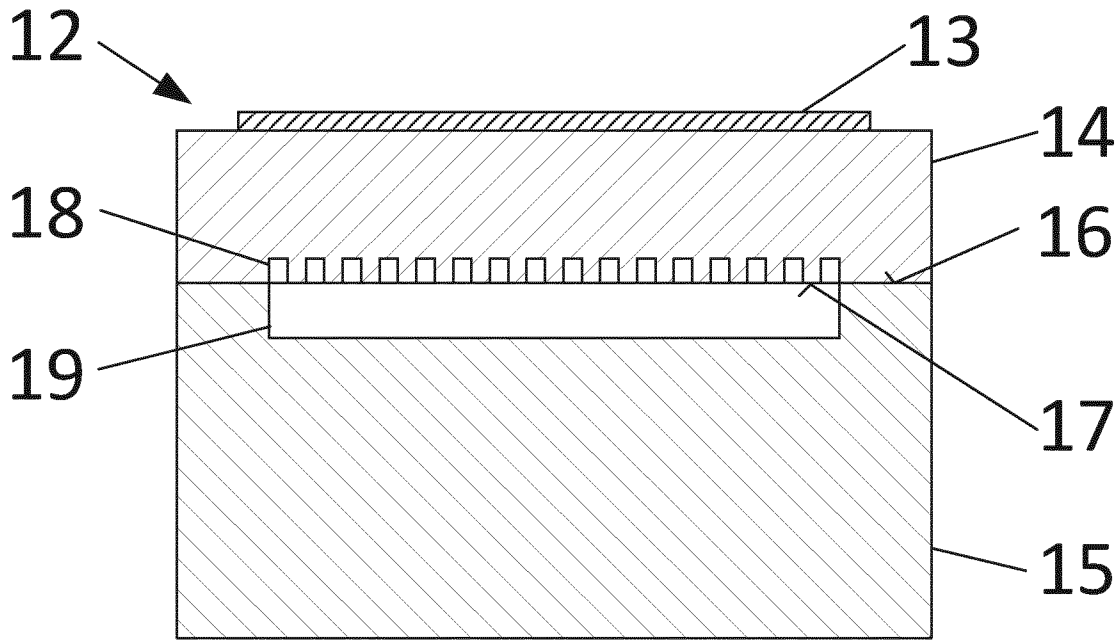


Fig.4

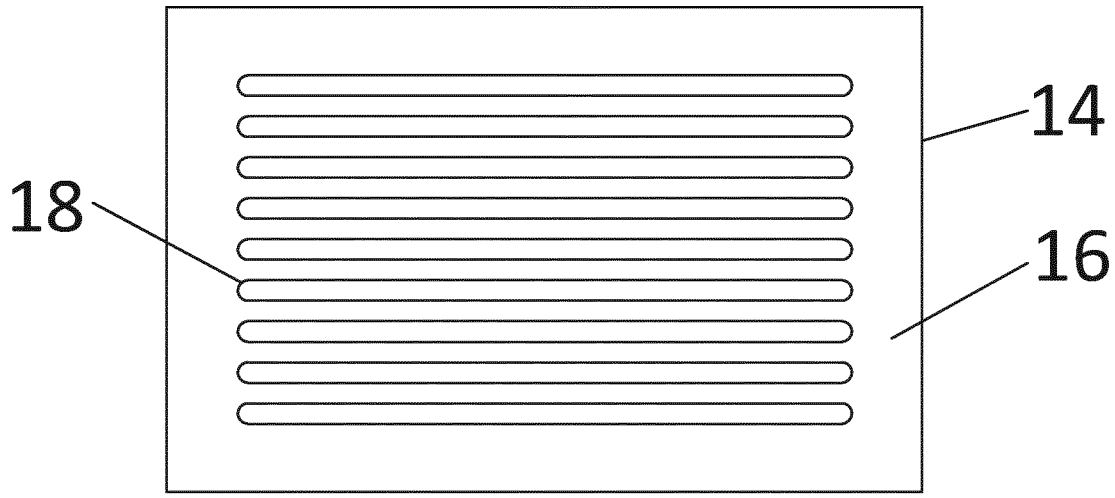


Fig.5

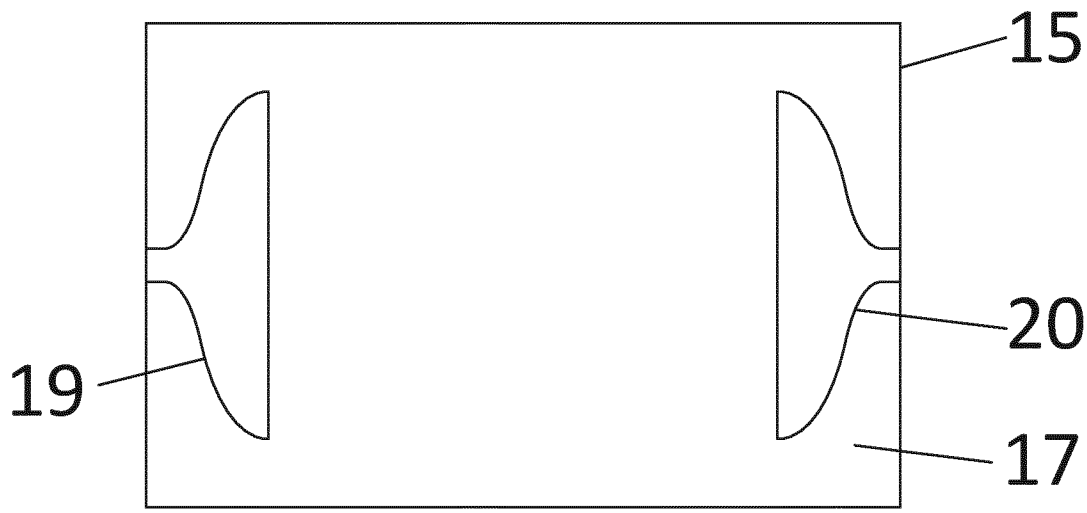


Fig.6

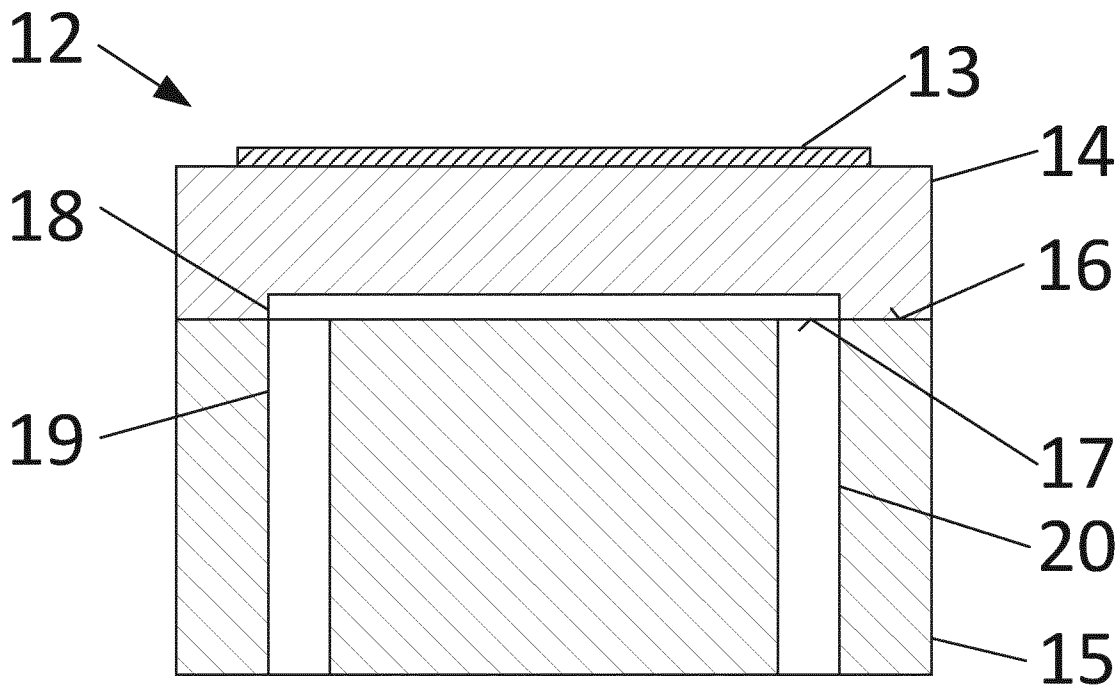


Fig.7

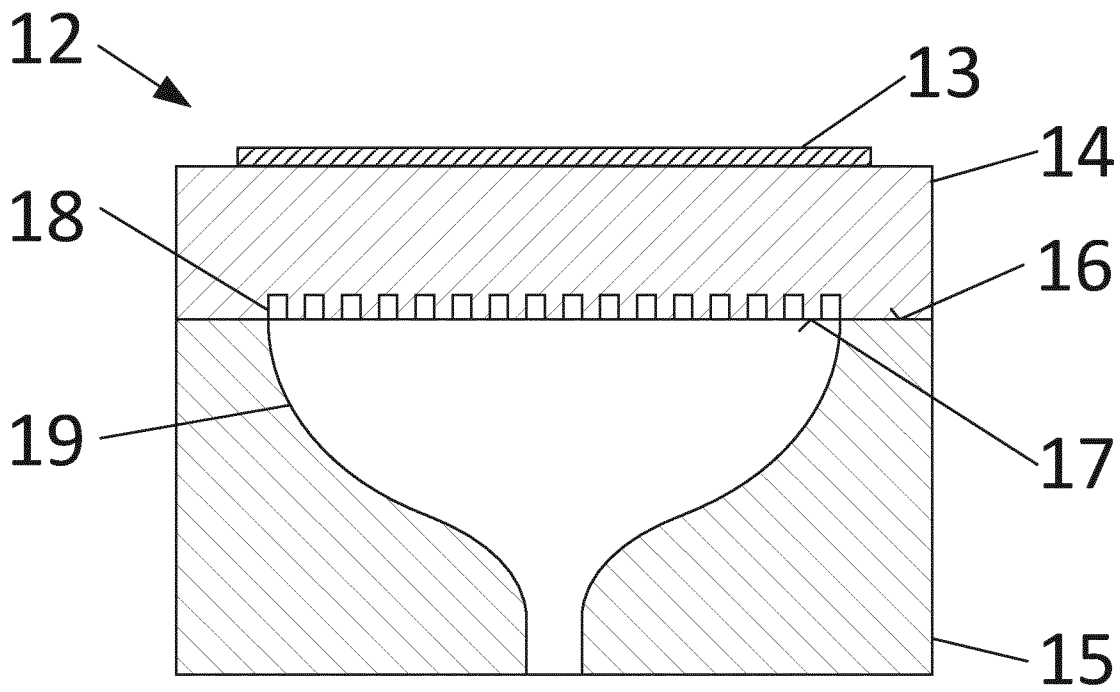


Fig.8

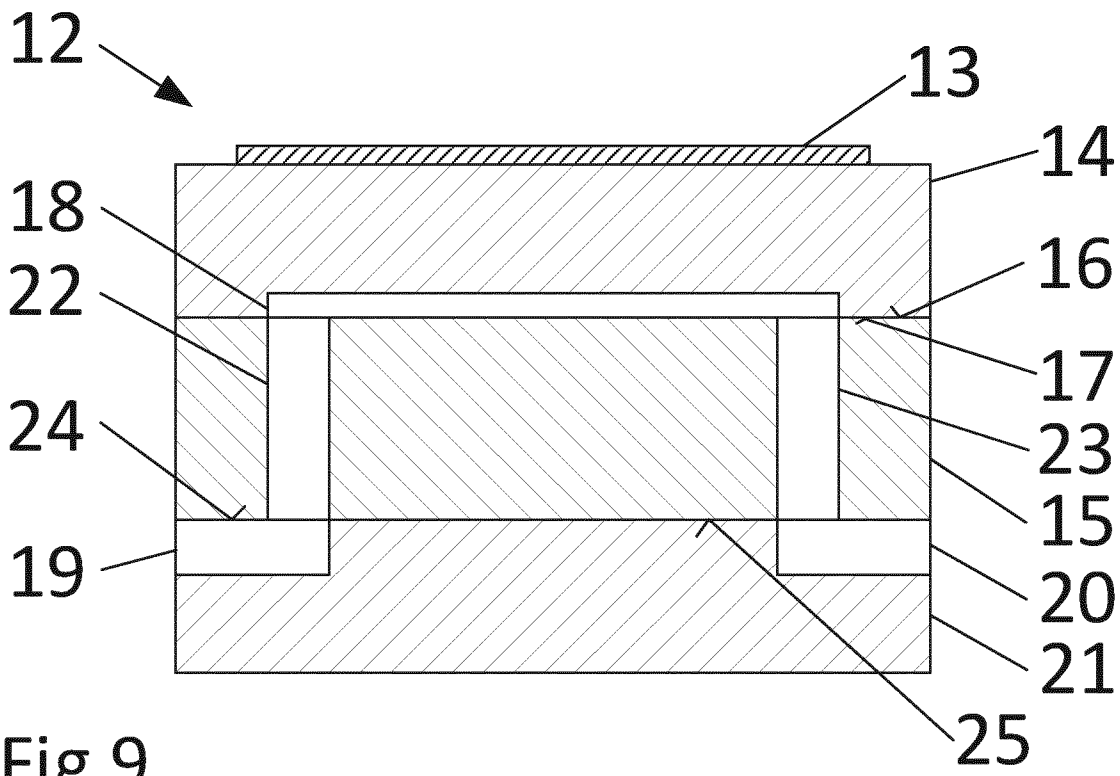

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Fig.9

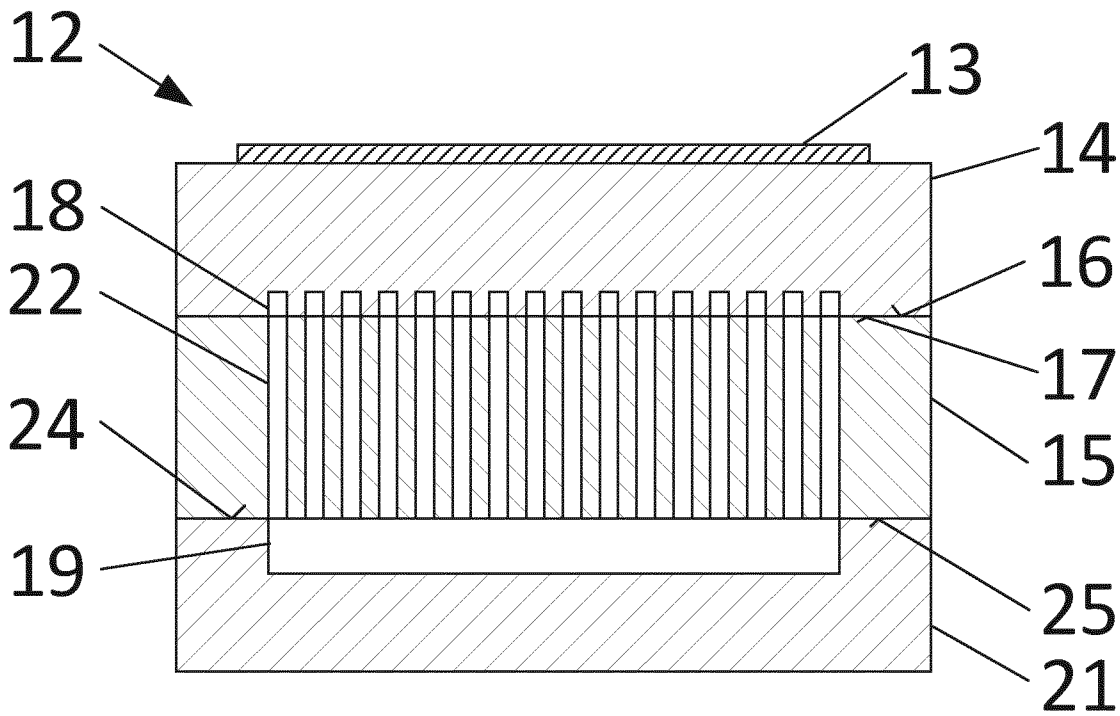

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Fig.10

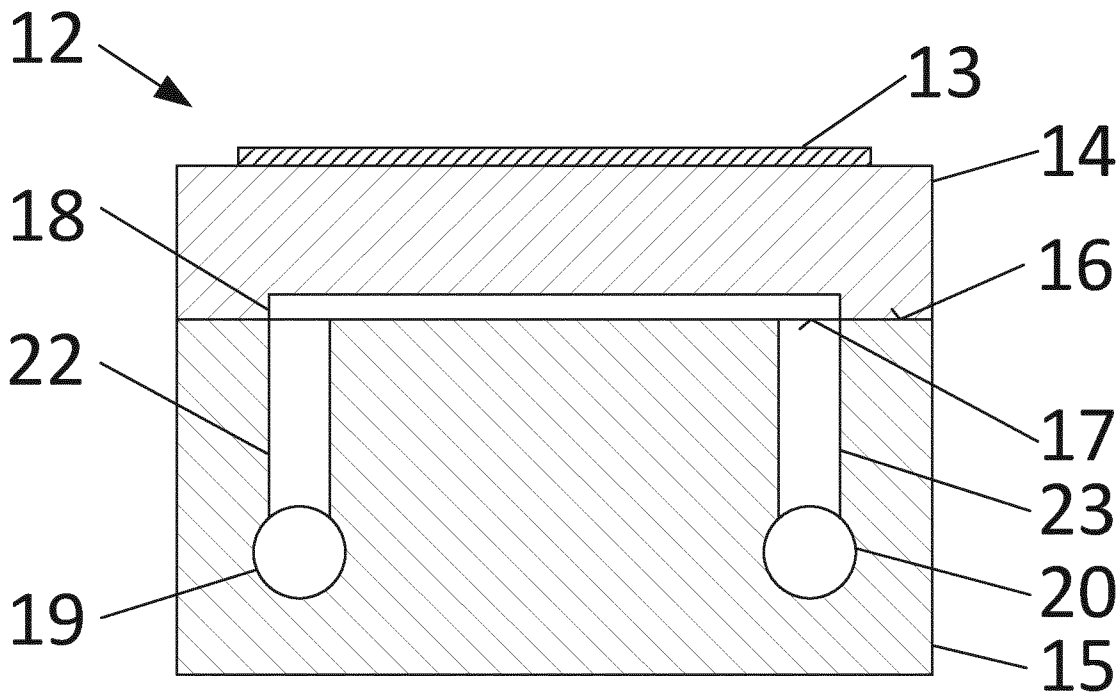


Fig.11

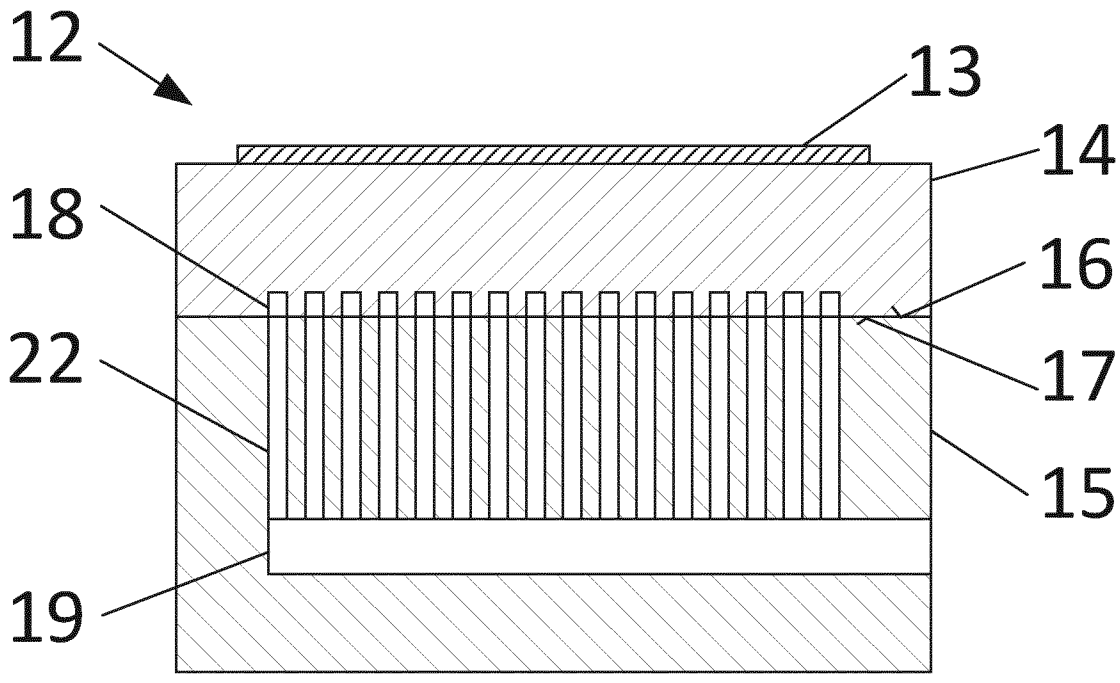


Fig.12

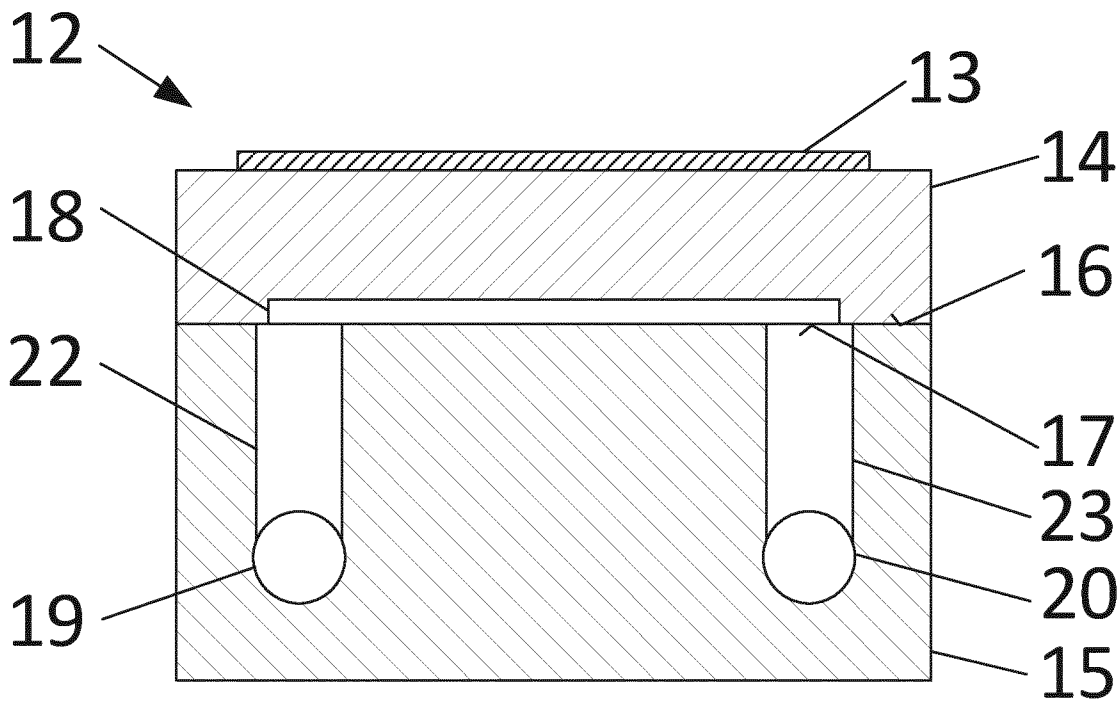


Fig.13

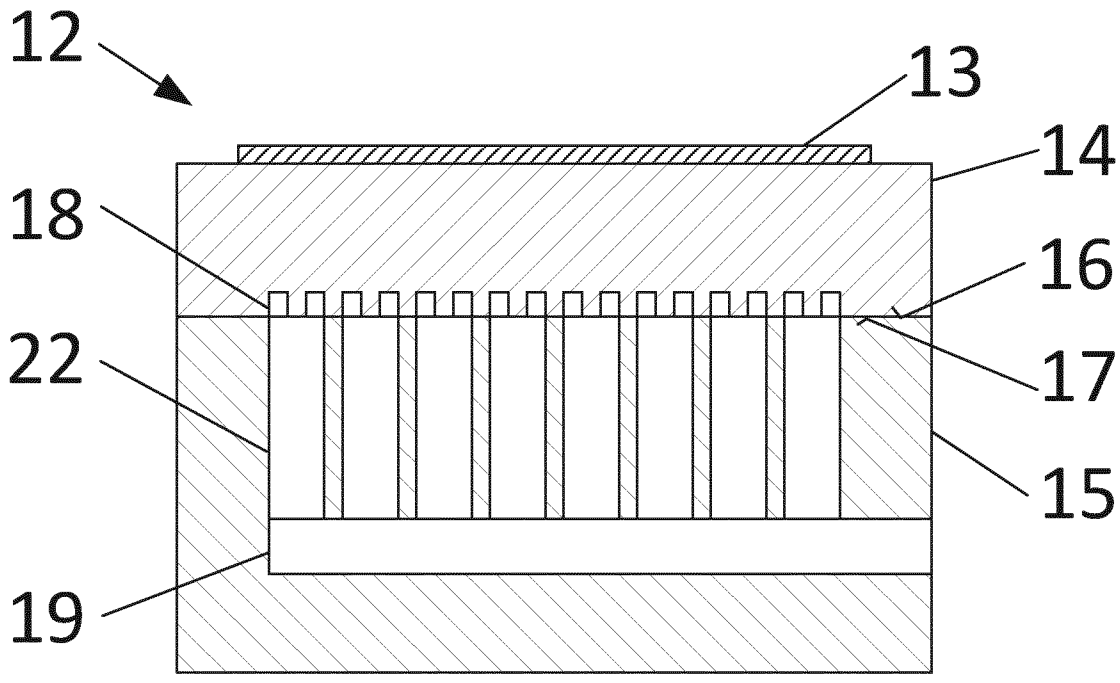


Fig.14

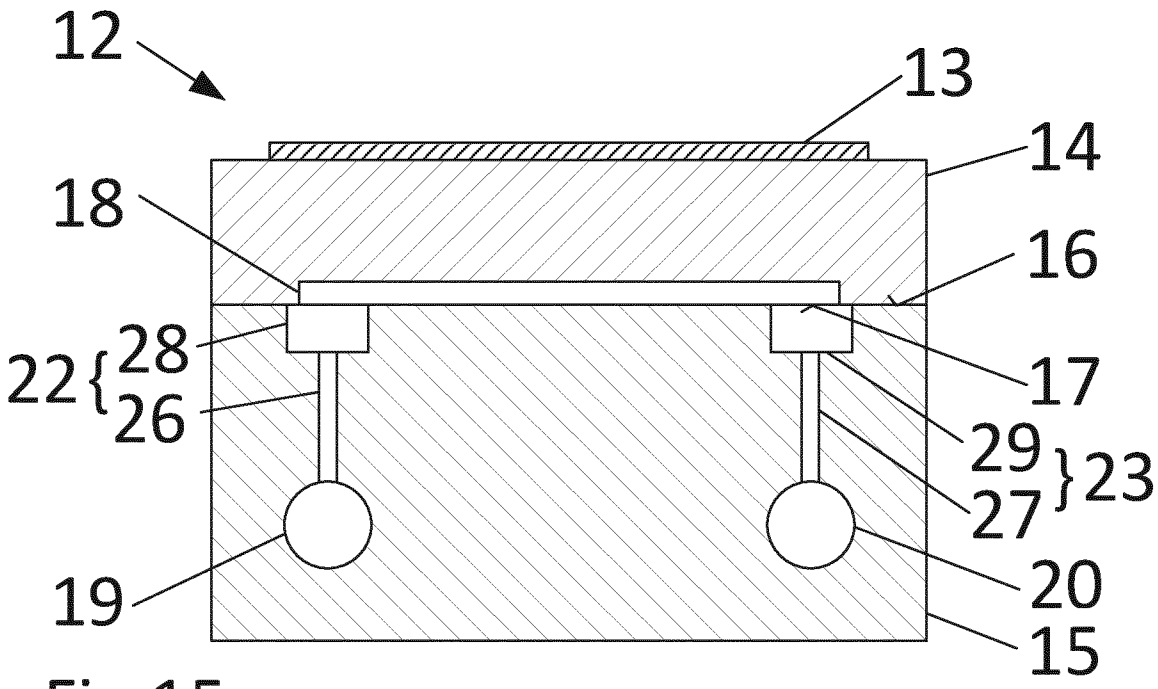

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Fig.15

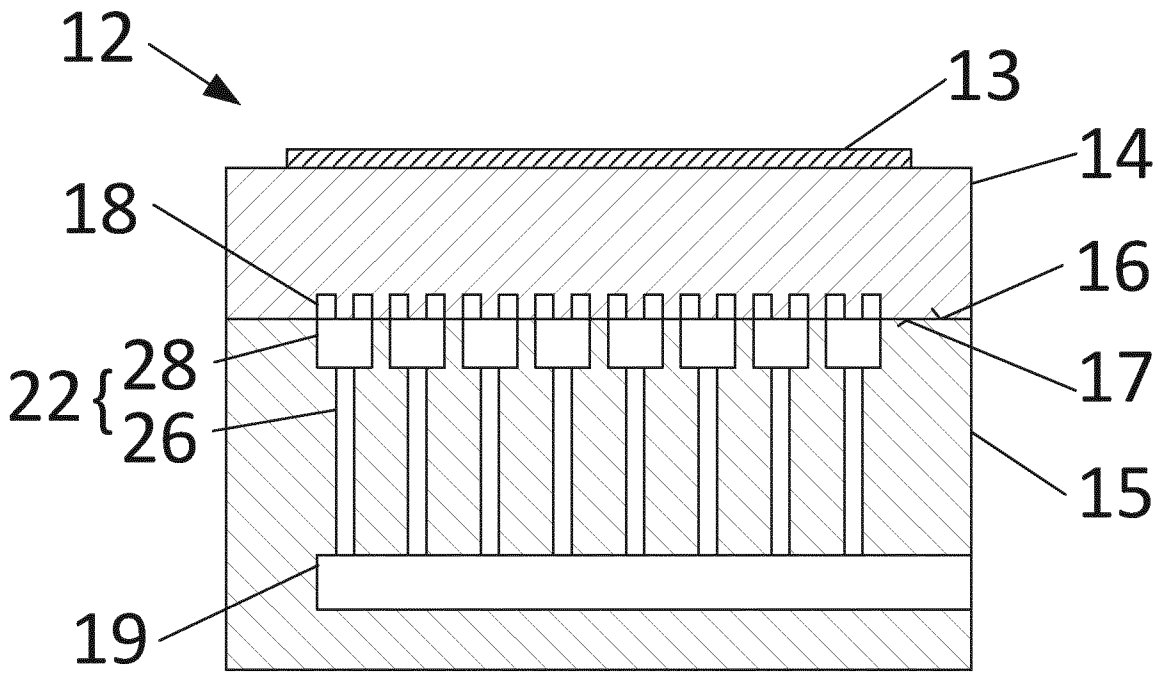

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Fig.16

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2021/065448

A. CLASSIFICATION OF SUBJECT MATTER
INV. G03F7/20 G02B7/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G03F G02B H05G G21K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/091485 A1 (PHILLIPS ALTON H [US] ET AL) 26 April 2007 (2007-04-26) paragraphs [0007] - [0012], [0051] - [0060], [0070] - [0073]; figures 3A-9C	1-18
X	US 2019/033499 A1 (VAN BERKEL KOOS [NL] ET AL) 31 January 2019 (2019-01-31) paragraphs [0008] - [0011], [0031] - [0043], [0048], [0049], [0051], [0062] - [0064]; figures 3-6	1-4, 16-18
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 September 2021	24/09/2021

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Roesch, Guillaume

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2021/065448

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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