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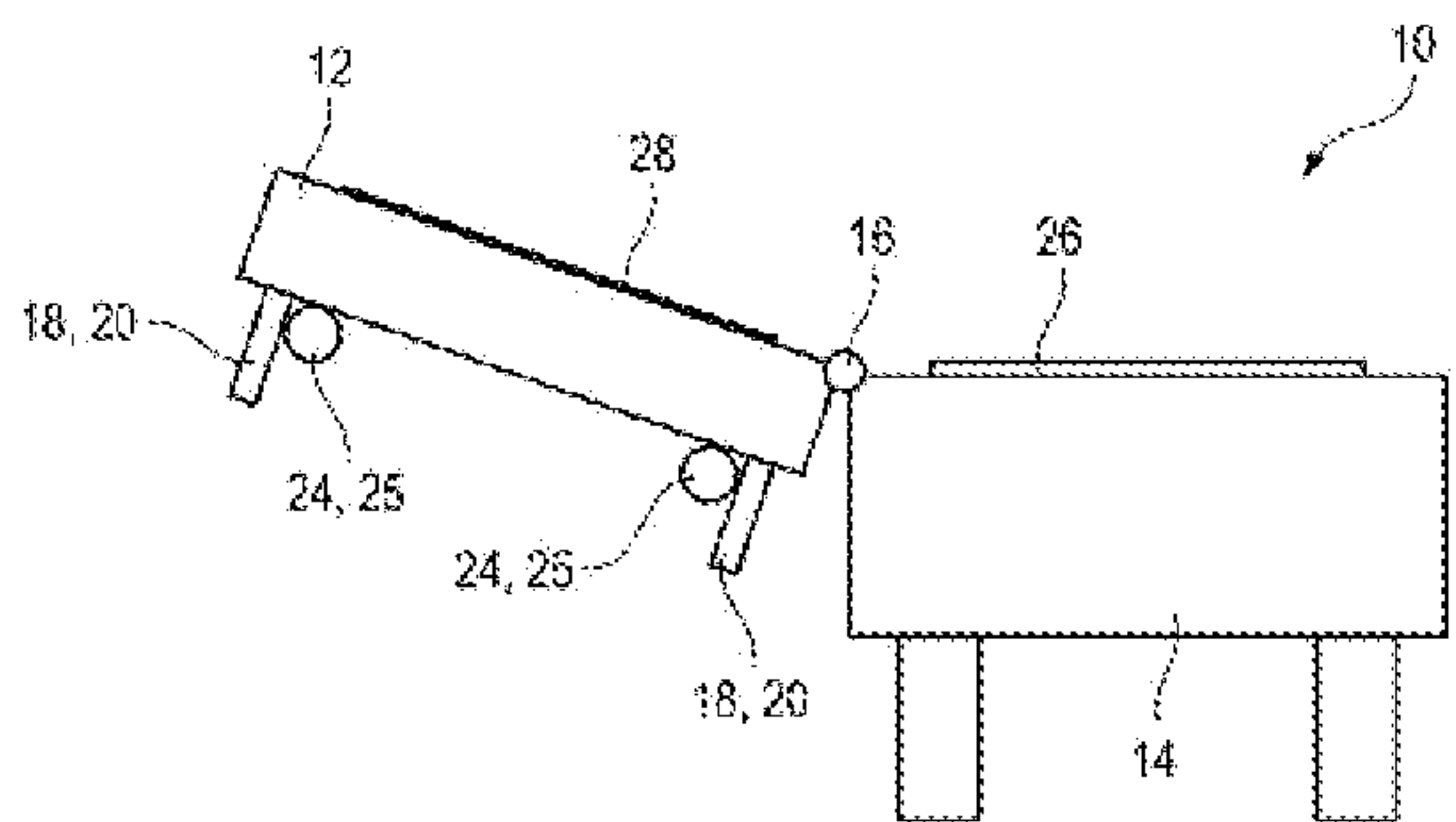
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Stamp replication device and method for producing a holding means for a stamp replication device as well as a stamp

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A stamp replication device (10) for producing stamps for the production of microstructured and/or nanostructured components comprising a platform (14), a cover (12) that is positionable on the platform (14) and a holding means (32) for a stamp carrier (28), wherein the holding means (32) is provided on the cover (12) or on the platform (14) and comprises a carrier (33) as well as a microstructured vacuum surface (34) on the carrier (33) for holding the stamp carrier (28). In addition, a method for producing a holding means (32) for a stamp replication device (10) as well as a method for producing a stamp are specified.



Stamp replication device and method for producing a holding means for a stamp replication device as well as a stamp

The present invention relates to a stamp replication device for producing stamps for the production of microstructured and/or nanostructured components
5 and a method for producing a holding means for a replication device as well as a method for producing a stamp for a replication device.

In the production of stamps for replication devices, a liquid or viscous stamp material is usually filled into a stamp replication device, given the desired form by means of a molding part and cured.

10 The curing can be achieved, for example, by heating the stamp replication device. To this end, heated water is led through channels in a cover of the stamp replication device. The stamp must remain in the stamp replication device until it is completely cured which may take a few days to a week. Therefore, it is necessary to use several stamp replication devices simultaneously in order to produce stamps
15 in sufficient quantities. As a result, high acquisition costs are incurred and the space requirement is also increased.

However, the demand for new stamps is relatively high as stamps for producing microstructured and/or nanostructured components have a relatively small service life and only about ten to a hundred stamping processes can be performed with
20 them. This is why there is the desire to reduce the cycle time in stamp production.

Another method of curing the stamp is curing by means of exposure to light, particularly to UV light. Curing can be achieved much more quickly through exposure to light than through heating. However, the desired quality cannot be maintained in the case of stamp production using this method.

25 The liquid stamp material is placed namely on a stamp carrier and bonded to it during curing. The stamp carrier, for example, of the completely cured stamp is held at least temporarily by means of a vacuum during production. For this purpose, vacuum channels lead from the stamp carrier and run at least in sections along a surface of the stamp carrier.

30 The problem is that light is scattered and reflected differently on the vacuum channels as on the smooth polished surfaces. This affects the uniformity of the

irradiation in the stamp material negatively and results in process variations. In this content, this is referred to as a shadow effect.

It is therefore an object of the invention to provide stamp replication device which enables the production of stamps within a short time with a consistently high
5 quality. In addition, it is an object of the invention to specify a method for producing a holding means for a stamp replication device as well as a method for producing a stamp.

This object is solved according to the invention by means of a stamp replication device for producing stamps for the production of microstructured and/or
10 nanostructured components comprising a platform, a cover that is placeable on the platform and a holding means for a stamp carrier, wherein the holding means is provided on the cover or on the platform and comprises a carrier as well as a microstructured vacuum surface on the carrier for holding the stamp carrier.

Within the scope of this invention, "microstructured" is understood to mean that
15 the size of structures or unevenness is in the micrometer range or below.

The advantage of a holder comprising a microstructured vacuum surface is that the vacuum structures are so small that they are not reproduced in the production of the stamp and there are therefore no shadow effects.

The stamp replication device according to the invention thus enables the curing
20 of stamps by exposure to light without compromising the quality of the stamp produced. The process times in the production of the stamp can be particularly brief by the use of exposure to light which positively impacts the production costs of the stamp.

The cover of the stamp replication device is preferably at least partially
25 transparent to light, in particular UV light, in order to allow the exposure to light of the stamp in the stamp replication device. Alternatively or additionally, the platform can also be at least transparent in some regions.

The carrier comprising the microstructured vacuum surface can also be integrated into the cover, in particular formed in a single piece with the cover. In
30 other words, the vacuum surface may be integrated into the cover directly.

In particular, a molding part that represents the form of the stamp to be produced as a negative is holdable on the cover or on the platform and the holding

means is provided on the other one of the cover and the platform. If the cover is located on the platform, the microstructured vacuum surface is preferably facing the molding part. In this state, a mold is formed for example, in which a stamp can be molded.

- 5 The cover is preferably mounted pivotably by means of hinges so that the cover can be placed on the platform by pivoting.

The stamp carrier can be a thin film, a glass plate or the like. The molding material, from which the stamp is molded, is distributed on the stamp carrier during production.

- 10 Vacuum grooves may also be provided for holding the molding part. However, these do not have to be microstructured.

- Typically, the molding part is more likely to be located on the platform as on the cover as the liquid stamp material is applied there. As the cover is pivoted when closing the stamp replication device, the liquid stamp material could namely flow
15 out of the stamp replication device.

- According to an embodiment, the individual structures of the microstructured vacuum surface have a feature size of no greater than 50 μm . The maximum feature size is based on, for example, a depth and/or a width of an individual structure. A particularly good uniformity of irradiation can be achieved with such
20 feature sizes.

- The microstructured vacuum surface can comprise a statistical structuring. A statistical structuring is produced, for example, through sand blasting, sanding, milling or etching. This means a statistical structuring has a random structure. Such statistically structured surfaces are also referred to as surface diffusers. Such
25 structuring can be produced particularly simply and economically.

- Alternatively or additionally, the microstructured vacuum surface can comprise micro-vacuum channels that extend over the surface of the holding means. Micro-vacuum channels have an advantage over statistical structuring as the individual structures can be dimensioned particularly exactly. In particular, only small
30 variations in thickness and depth occur in micro-vacuum channels. Another advantage is that the surface of the microstructured vacuum surface is not affected

by the structuring outside, thus between the individual micro-channels, and is particularly smooth.

Micro-vacuum channels can be produced by lithography, a removal method such as wet etching for example, by lasering or by micro-milling. Such methods
5 facilitate particularly precise structuring.

Preferably, the depth and/or the width of the micro-vacuum channels are smaller than 50 μm , in particular smaller than 10 μm . With a such channel size, the stamps can be produced with a particularly high quality.

According to an embodiment, the micro-vacuum channels run radially on the
10 holding means seen in top view. Alternatively or additionally, the micro-vacuum channels can be annular channels, in particular to connect straight micro-vacuum channels.

Alternatively, the micro-vacuum channels can run in a lattice shape on the holding means seen in top view. To this end, the micro-vacuum channels run
15 preferably evenly in two directions. The micro-vacuum channels that cross each other can run orthogonally or at an acute angle to each other.

By means of a micro-vacuum channels which run radially, annularly or in a lattice shape, a vacuum can be applied on the stamp carrier particularly uniformly.

According to an embodiment, the micro-vacuum channels are provided at
20 regular intervals, wherein a web is provided between two micro-vacuum channels in each case, in particular wherein the pitch of the microstructured vacuum surface as the width of one of said micro-vacuum channels and the adjacent web is less than or equal to 50 μm , preferably less than or equal to 10 μm . Together with the adjacent web, the channel forms an individual structure of the microstructuring in
25 each case, whose collective width is termed "pitch". A particularly good uniformity of illumination is achieved by means of such feature sizes.

The width of the micro-vacuum channels is preferably a maximum of 90% of the pitch, in particular exactly 90% of the pitch. A width of the micro-vacuum channels which is as wide as possible is advantageous with regards to the holding
30 force of the vacuum applied to the stamp carrier. A width up to a maximum of 90% ensures a reliable delimitation of individual micro-vacuum channels from each other by means of the web.

The depth of the micro-vacuum channels is for example no greater than ten times the width of the micro-vacuum channels. In this way, a vacuum can be generated along the microstructured vacuum surface uniformly so that a stamp carrier can be supported reliably.

5 The holding means can comprise a macroscopic vacuum channel, wherein the vacuum surface, in particular the micro-vacuum channels, is fluidly connected to the vacuum channel, in particular wherein the vacuum channel completely surrounds the microstructured vacuum surface. In this way, a vacuum can be generated on the microstructured vacuum surface via the macroscopic vacuum
10 channel. The macroscopic vacuum channel can be connected to a vacuum source for this purpose.

Alternatively, the macroscopic vacuum channel can also selectively supply the microstructured vacuum surface.

Within the scope of the invention, a “macroscopic” channel is understood to
15 mean a channel with structures in the micrometer range or above.

The cover of the stamp replication device has, for example, at least a fluid connection for applying the vacuum, in particular wherein the macroscopic vacuum channel extends in the cover from the fluid connection to the holder.

According to an embodiment, the stamp replication device comprises a spacing
20 adjustment device for adjusting the spacing between the cover and the platform and a measuring device for measuring the spacing between the cover and the platform, wherein the spacing adjustment device and the measuring device are provided separately from each other. As a result, an adjustment of the spacing and measurement of the spacing can occur independently of each other. In this way,
25 the spacing between the platform and the cover can be set particularly precisely.

The spacing adjustment device comprises, for example, micrometer screws and the measuring device comprises, for example, dial indicators. When operating the spacing adjustment device, the cover may end up namely inclining. If, for example, several micrometers screws are provided and one of said screws is
30 turned in order to increase the spacing between the cover and the platform, the spacing between the cover and the platform can be reduced at another point. As a result of the separately provided measuring device, such an inclination can be

detected and the spacing between the cover and the platform can be readjusted accordingly.

Three support regions are provided on the platform for supporting the cover, in particular wherein one of the support regions limits one degree of freedom, another
5 of the support regions limits two degrees of freedom and/or another of the support regions limits three degrees of freedom. In other words, one of the support regions provides five degrees of freedom, another of the support regions provides four degrees of freedom and a further support region provides three degrees of freedom. In this way, the support of the cover is statically not overdeterminate and
10 clearly defined. The cover is supported thus particularly stably.

A degree of freedom is understood to mean both translational and rotational degrees of freedom.

The micrometers screws have for example a semi-spherical end, each resting on one of the support regions when the cover is closed, said support regions being
15 configured in particular as a point, area or linear support. Preferably, three micrometer screws are provided in total.

According to an embodiment, the holding means, in particular the carrier, is made of glass or quartz, wherein the holding means is transparent to light, in particular UV light, in particular light with a wavelength of 250 nm to 450 nm.
20 Preferably, the holding means is transparent to light with a wavelength of 365 nm. Light with this wavelength is particularly suitable for curing stamps.

The holding means, in particular the carrier, is for example a plate that is installed in particular in the cover. Preferably, the holding means, in particular the carrier, is framed.

25 The stamp replication device comprises preferably an irradiation source for the purpose of exposing a liquid stamp material to light, in particular UV light, wherein the irradiation source comprises a flood lamp and/or a collimator. The stamp material can be irradiated particularly uniformly by means of such an irradiation source.

30 The lamps used in the irradiation source are for example LEDs or a mercury vapor lamp.

Furthermore, this object is solved according to the invention by a method for producing a holding means for a stamp replication device, in particular a stamp replication device designed as previously described. The method comprises the following steps:

- 5 - provision of a carrier of the holding means, and
- generation of a microstructured vacuum surface by applying a statistical structuring, in particular by means of sand blasting, sanding, milling or etching, and/or by introducing micro-vacuum channels, in particular through the use of a lithographic method, laser method or erosion method.
- 10 In particular, a structuring is applied to the microstructured vacuum surface with a feature size of the individual structures of no greater than 50 μm .

In addition, the object is solved according to the invention by a method for producing a stamp for a replication device for the production of microstructured and/or nanostructured components in a device as previously described. The method comprises the following steps:

- 15 - positioning the stamp carrier and a molding part in the stamp replication device,
- applying a vacuum on the microstructured vacuum surface for the purpose of holding the stamp carrier,
- 20 - applying the liquid stamp material on the molding part or the stamp carrier,
- positioning the cover on the platform, and
- curing the stamp material by exposing the stamp material to UV light.

The production time of stamps for a replication device can be reduced by such a method. Moreover, process variations in the production of stamps for replication devices can be reduced by such a method.

The aperture angle of the irradiation or a range of irradiation angles during the exposure of the stamp material is preferably selected in such a way that variations in the irradiance do not occur in the stamp material. An irradiation angle that is as large as possible positively affects the uniformity of the irradiation. For example,

30 the stamp material is irradiated at an angle of up to $\pm 90^\circ$.

Additional advantages and features of the invention can be found in the following description and in the attached drawings to which reference is made. In the drawings:

- 5 - Figure 1 shows a stamp replication device according to the invention schematically,
- Figure 2 shows the stamp replication device from Figure 1 in a top view,
- Figure 3 shows the stamp replication device from Figures 1 and 2 in a closed state,
- Figure 4 shows the cover for the stamp replication device,
- 10 - Figure 5 shows the cover according to a second embodiment of the stamp replication device,
- Figure 6 shows a section through the holding means for a stamp replication device comprising micro-vacuum channels,
- Figures 7a to 7c show various steps in the production of a holding means
15 for the stamp replication device,
- Figure 8 shows the cover according to a third embodiment of the stamp replication device, and
- Figure 9 shows the production of a holding means according to the third embodiment.

20 Figures 1, 2 and 3 show a stamp replication device 10 for producing stamps for the production of nanostructured and/or microstructured components schematically. The stamp replication device 10 comprises a cover 12 and a platform 14.

25 The cover is mounted on the platform 14 pivotably by means of hinges 16 and can be placed on the platform 14, as shown in Figure 3.

 The stamp replication device 10 comprises a spacing adjustment device 18 in order to set a defined spacing from the cover 12 to the platform 14 when the stamp replication device 10 is in a closed state. The spacing adjustment device 18 comprises, for example, three micrometer screws 20 that are preferably rounded
30 on their ends which are directed towards the platform 14.

Three support regions 22a, 22b, 22c are provided on the platform 14 for supporting the cover 12 accordingly, in particular in each case one support region 22a, 22b, 22c for one micrometer screw 20. Thus, one of the support regions 22a provides three degrees of freedom, another of the support regions 22b provides
5 four degrees of freedom and a further support region 22c provides five degrees of freedom.

The support regions are illustrated in Figure 2 by dotted lines. The support region 22a is formed by a conical depression. The support region 22b is formed by a V-shaped depression. The support region 22c is formed by an area.

10 In addition, the stamp replication device 10 comprises a measuring device 24 for measuring the spacing between the cover 12 and the platform 14. The measuring device 24 is provided separately from the spacing adjustment device 18. Thus, the amendments in the spacing between the cover 12 and the platform 14 can be detected which are not caused by the operation of the spacing
15 adjustment device 18. In this way, the spacing between the cover 12 and the platform 14 can be set particularly precisely.

The measuring device 24 comprises for example at least a dial indicator 25, preferably in each case one dial indicator 25 per micrometer screw 20. Each dial indicator 25 is assigned to one micrometer screw 20, but configured separately
20 from it.

Moreover, the stamp replication device 10 comprises an irradiation source 30 for exposing a liquid stamp material to light, in particular UV light. Such an irradiation source 30 is illustrated in Figure 3. A stamp material present in the stamp replication device 10 can be cured by exposure to light.

25 The irradiation source 30 can comprise a flood lamp and/or a collimator for this purpose. A stamp material can be irradiated particularly uniformly using a flood lamp and/or a collimator, which substantially impacts the quality of the finished stamp.

The cover 12 is, for example, at least partially transparent to light, in particular
30 UV light, in order to enable the irradiation of the stamp material.

A molding part 26 employed in the stamp replication device 10 is illustrated in Figures 1 and 2. The molding part 26 represents the form of the stamp to be

produced as a negative. The molding part 26 can be exchangeable so that different molding parts 26 can be employed for the production of different stamp geometries.

Moreover, a stamp carrier 28 employed in the stamp replication device 10 is illustrated in Figures 1 and 2, said stamp carrier 28 being connected to the stamp material permanently during the production of the stamp.

Both the molding part 26 and the stamp carrier 28 are held in place on the platform 14 and the cover 12 by means of a vacuum in the stamp production. This is necessary so that the stamp carrier 28 or the finished stamp do not fall out unintentionally when pivoting the cover 12 into position and so that the molding part 26 remains on the platform 14 when opening the cover 12 and does not remain stuck to the stamp.

In order to hold the stamp carrier in place, the stamp replication device 10 comprises a holding means 32 for holding the stamp carrier 28 that is provided on the cover 12 in the shown embodiment. This is shown in Figure 2. It is however conceivable that the holding means 32 is located on the platform 14.

The holding means 32 comprises in particular a carrier 33 and a microstructured vacuum surface configured on the carrier 33.

The holding means 32, in particular the carrier 33, is for example a plate 36 that can be installed in the cover 12. Alternatively, the carrier 33 can form the cover 12 or a part of the cover 12.

In the shown embodiment, the carrier 33 is enclosed by frame 38, as can be seen in Figure 2, wherein the frame 38 and the carrier 33 collectively form the cover 12. The frame 38 is optional, it imparts particularly good stability to the carrier 33 and the cover 12.

The carrier 33 can be made of glass or quartz, as a result of which the holding means 32 is transparent to light, in particular UV light, in particular light with a wavelength of 250 nm to 450 nm.

The holder of the molding part 26 can be carried out in a known manner, in particular also by means of a vacuum. However, no microstructured vacuum surface 34 is necessary for holding the molding part 26 as the holder of the molding part 24 does not or does not appreciably impact the quality of the stamp.

The holding means 32 comprising the microstructured vacuum surface 34 is shown in a top view in Figure 2. The vacuum surface 34 has, for example, the contour of the stamp carrier 28 so that the stamp carrier 28 completely covers the vacuum surface 34 if it is employed in the stamp replication device 10 as intended.

5 The stamp carrier 28 is not shown in Figure 2 in order to facilitate a view of the microstructured vacuum surface 34.

The individual structures of the microstructured vacuum surface 34 have, for example, a feature size of no greater than 50 μm , preferably no greater than 10 μm .

10 The holding means 32 comprises a macroscopic vacuum channel 40 in order to generate the vacuum on the microstructured vacuum surface 34. This macroscopic vacuum channel 40 is fluidly connected to the microstructured vacuum surface 34. In the shown embodiment, the macroscopic vacuum channel 40 completely surrounds the microstructured vacuum surface 34. It is however
15 conceivable that the microstructured vacuum surface 34 is only connected to the macroscopic vacuum channel 40 at certain points.

The macroscopic vacuum channel 40 is connected to a vacuum source 44 of the stamp replication device 10 via a channel 42.

20 A cover 12 comprising a holding means 32 according to the first embodiment is shown in Figure 4. For better illustrative purposes, a subregion of the microstructured vacuum surface 34 formed on the carrier 33 is shown enlarged.

The microstructured vacuum surface 34 shown in Figure 4 comprises a multitude of micro-vacuum channels 46 that extend over the surface of the holding means 32, in particular over the surface of the carrier 33.

25 In a top view on the holding means 32, the micro-vacuum channels 46 run in a lattice shape, wherein the micro-vacuum channels 46 are arranged at regular intervals to each other.

In Figure 5, a cover 12 comprising a holding means 32 according to the second embodiment is illustrated.

30 The microstructured vacuum surface 34 shown in Figure 5 comprises a multitude of micro-vacuum channels 46. In contrast to the microstructured vacuum

surface 34 shown in Figure 4, the micro-vacuum channels 46 according to this embodiment run radially on the holding means 32.

In addition, several annular micro-vacuum channels 48 are present which interconnect the radial micro-vacuum channels 46.

5 In Figure 6, the dimensions of the micro-vacuum channels 46 are illustrated by means of a section through the holding means 32 from Figure 4. The section view is extremely enlarged and not true to scale in order to improve the visibility of the micro-vacuum channels 46.

10 Preferably, the depth t and/or the width b of the micro-vacuum channels 46 are in each case smaller than $50\text{ }\mu\text{m}$, in particular smaller than $10\text{ }\mu\text{m}$.

A web 50 is provided in each case between two micro-vacuum channels 46, in particular wherein the pitch p of the microstructured vacuum surface 34 as the combined width b of one of the micro-vacuum channels 46 and the adjacent web 50 is smaller than or equal to $50\text{ }\mu\text{m}$, preferably smaller than or equal to $10\text{ }\mu\text{m}$.

15 To this end, the width b of the micro-vacuum channels 46 is a maximum of 90% of the pitch.

The depth t of the micro-vacuum channels 46 is no greater than ten times the width b of the micro-vacuum channels 46. In the shown embodiment, the depth t amounts to about one third of the width b .

20 The dimensions of the micro-vacuum channels 46 in the case of radial configuration can be accordingly as large as in the case of a lattice configuration except for the pitch. The pitch is not constant in the case of radial layout, but rather increases from the center of the micro-structured vacuum surface 34 towards the edge.

25 A possible method for producing a holding means 32 for stamp replication device 10 is shown in the Figures 7a to 7c, in particular a holding means 32 according to Figures 4 and 5. More specifically, the production of micro-vacuum channels 46 on a carrier 33 of the holding means 32 is shown. For simplicity, only a small section of the carrier 33 is shown in the Figures 7a to 7c.

30 Initially, a carrier 33 of the holding means 32 is provided, in particular a carrier 33 without a microstructured vacuum surface 34.

Subsequently, the microstructured vacuum surface 34 is created through the introduction of micro-vacuum channels 46. This can be carried out by a lithographic method, a laser method or an erosion method.

5 A lithographic method is shown in the Figures 7a to 7c exemplarily. To this end, a mask 51 is initially positioned on the carrier 33, as shown in Figure 7a.

Then, the surface 52 of the carrier 33 not covered by the mask 51 is exposed to an etching medium. As a result, the material of the carrier 33 is removed to a certain extent, thereby forming the micro-vacuum channels 46, as shown in the Figures 7b and 7c.

10 In Figure 8, a cover 12 comprising a holding means 32 according to a third embodiment is illustrated.

In the embodiment shown in Figure 8, the microstructured vacuum surface 34 comprises a statistical structuring, in particular a random structure. Even the statistical structuring only has structures in the micrometer range, in particular
15 smaller than 50 μm .

A method for producing such a holding means 32 for a stamp replication device 10 is shown in Figure 9.

Even in this case, the carrier 33 of the holding means 32 is initially provided without a microstructured vacuum surface 34.

20 Subsequently, the microstructured vacuum surface 34 is generated by applying a statistical structuring. This can be carried out by means of sand blasting, sanding, milling or etching.

In figure 9, the structuring is shown by means of sand blasting exemplarily. To this end, a region that is not to be structured is covered by a mask 51.

25 In the following, a method is explained for producing a stamp for a replication device for the production of microstructured and/or nanostructured components in a stamp replication device 10 according to the Figures 1 to 3.

Initially, a stamp carrier 28 and a molding part 26 are positioned in the stamp replication device 10. The molding part 26 is positioned on the platform 14 and the
30 stamp carrier 28 is positioned on the cover 12 in the stamp replication device 10 shown in Figures 1 to 3.

Subsequently, a vacuum is applied to the microstructured vacuum surface 34 for the purpose of holding the stamp carrier 28.

Before, during or after applying the vacuum, a liquid stamp material is applied to the molding part 26 or the stamp carrier 28. The stamp material is, for example,
5 polydimethylsiloxane (PDMS), in particular s-PDMS or x-PDMS or Sylgard 184.

Afterwards, the cover 12 is positioned on the platform 14, in particular as a result of pivoting it into position. When the cover 12 is positioned on the platform 14, the liquid stamp material is distributed on the molding part 26, for example, through the weight of the cover 12, wherein the form of the molding part 26 is
10 reproduced in the stamp material.

A fastening of the cover 12 is not necessary as the cover 12 is held in position by its own weight in the closed state of the stamp replication device 10.

Subsequently, the stamp material is cured by exposing the stamp material to UV light. The length of the curing is, for example, one to two minutes.

15 To this end, light emitted from the irradiation source 30 is broken and/or scattered in such a way on the microstructured vacuum surface 34 that the uniformity of the irradiation when exposing the stamp material is not affected negatively. In this way, stamps can be produced with a consistently high quality. In particular, what is referred to as the shadow effect can be avoided.

20 In contrast to previously conventional vacuum channels, a particularly uniform exposure of the stamp material can occur.

The irradiation angle in the exposure of the stamp material can thus be chosen depending on the pitch p of the microstructured vacuum area 34.

25 After the curing, the stamp material and the stamp carrier 28 are connected permanently to each other.

A stamp produced by means of a stamp replication device 10 as previously described has, for example, a thickness of 100 μm to 1 mm.

CONCLUSIES

1. Stempelreplicatie-inrichting (10) voor het vervaardigen van stempels voor het vervaardigen van componenten met een micro- en/of nanostructuur, met een platform (14), een deksel (12) dat op het platform (14) kan worden geplaatst en een vasthoudinrichting (32) voor een stempeldrager (28),
5
waarbij de vasthoudinrichting (32) op het deksel (12) of op het platform (14) is gevormd en zowel een drager (33) als een vacuümoppervlak (34) met een microstructuur op de drager (33) voor het vasthouden van de stempeldrager (28) omvat.
10
2. Stempelreplicatie-inrichting (10) volgens conclusie 1, **met het kenmerk**, dat de individuele structuren van het vacuümoppervlak (34) met microstructuur een structuurgrootte van maximaal 50 μm hebben.
- 15 3. Stempelreplicatie-inrichting (10) volgens conclusie 1 of 2, **met het kenmerk**, dat het vacuümoppervlak (34) met microstructuur een statistische structuur omvat.
4. Stempelreplicatie-inrichting (10) volgens een van de voorgaande conclusies, **met het kenmerk**, dat het vacuümoppervlak (34) met microstructuur microvacuümkanalen (46) omvat
20 die zich over het oppervlak van de vasthoudinrichting (32) uitstrekken.
5. Stempelreplicatie-inrichting (10) volgens conclusie 4, **met het kenmerk**, dat de diepte (t) en/of de breedte (b) van het microvacuümkanalen (46) kleiner dan 50 μm , in het bijzonder kleiner dan 10 μm is.
25
6. Stempelreplicatie-inrichting (10) volgens conclusie 4 of 5, **met het kenmerk**, dat de microvacuümkanalen (46) in een bovenaanzicht stervormig op de vasthoudinrichting (32) verlopen.
- 30 7. Stempelreplicatie-inrichting (10) volgens conclusie 4 of 5, **met het kenmerk**, dat de microvacuümkanalen (46) in een bovenaanzicht roostervormig op de vasthoudinrichting (32) verlopen.
8. Stempelreplicatie-inrichting (10) volgens een van de conclusies 4 tot en met 6, **met het kenmerk**, dat de microvacuümkanalen (46) op regelmatige afstanden zijn verschaft, waarbij
35 tussen twee microvacuümkanalen (46) telkens een tussenstuk (50) is gevormd, in het bijzonder waarbij de steek (p) van het vacuümoppervlak (34) met microstructuur als breedte

(b) van een van de microvacuümkanalen (46) en het aangrenzende tussenstuk (50) kleiner dan of gelijk aan 50 μm , bij voorkeur kleiner dan of gelijk aan 10 μm is.

5 9. Stempelreplicatie-inrichting (10) volgens conclusie 7, **met het kenmerk**, dat een breedte van de microvacuümkanalen (46) ten hoogste 90% van de steek (p) is.

10 10. Stempelreplicatie-inrichting (10) volgens een van de conclusies 4 tot en met 8, **met het kenmerk**, dat een diepte (t) van het microvacuümkanalen (46) ten hoogste tien maal de breedte (b) van het microvacuümkanalen (46) is.

15 11. Stempelreplicatie-inrichting (10) volgens een van de voorgaande conclusies, **met het kenmerk**, dat de vasthoudinrichting (32) een macroscopisch vacuümkanaal (40) omvat, waarbij het vacuümoppervlak, in het bijzonder de microvacuümkanalen (46), met het vacuümkanaal (40) in fluïdumverbinding is, in het bijzonder waarbij het vacuümkanaal (40) het vacuümoppervlak (43) met microstructuur volledig omgeeft.

20 12. Stempelreplicatie-inrichting (10) volgens een van de voorgaande conclusies, **met het kenmerk**, dat het stempelreplicatie-inrichting (10) een afstandinstelinrichting (18) voor het instellen van een afstand tussen het deksel (12) en het platform (14) en een meetinrichting (24) voor het meten van de afstand tussen deksel (12) en platform (14) omvat, waarbij de afstandinstelinrichting (18) en de meetinrichting (24) gescheiden van elkaar zijn gevormd.

25 13. Stempelreplicatie-inrichting (10) volgens een van de voorgaande conclusies, **met het kenmerk**, dat op het platform (14) drie opleggebieden (22a, 22b, 22c) voor het opslaan van het deksel (12) zijn verschaft, in het bijzonder waarbij een van de opleggebieden (22a) drie vrijheidsgraden verschaft, een andere van de opleggebieden (22b) vier vrijheidsgraden verschaft en/of een verdere van de opleggebieden (22c) vijf vrijheidsgraden verschaft.

30 14. Stempelreplicatie-inrichting (10) volgens een van de voorgaande conclusies, **met het kenmerk**, dat de vasthoudinrichting (32), in het bijzonder de drager (33) van glas of kwarts is, waarbij de vasthoudinrichting (32) doorlaatbaar is voor licht, in het bijzonder UV-licht, in het bijzonder voor licht met een golflengte van 250 nm tot en met 450 nm.

35 15. Stempelreplicatie-inrichting (10) volgens een van de voorgaande conclusies, **met het kenmerk**, dat de vasthoudinrichting (32), in het bijzonder de drager (33), een plaat is die in het bijzonder in het deksel (12) is gezet.

16. Stempelreplicatie-inrichting (10) volgens een van de voorgaande conclusies, **met het kenmerk**, dat het stempelreplicatie-inrichting (10) een bestralingsbron (30) voor het bestralen van een vloeibaar stempelmateriaal met licht, in het bijzonder UV-licht, omvat, waarbij de stralingsbron (30) een oppervlakstraler en/of een collimator omvat.

5

17. Werkwijze ter vervaardiging van een vasthoudinrichting (32) voor een stempelreplicatie-inrichting (10), in het bijzonder een stempelreplicatie-inrichting (10) volgens een van de voorgaande conclusies, met de volgende stappen:

- het verschaffen van een drager (33) van de vasthoudinrichting (32), en
- 10 - het opwekken van een vacuümoppervlak (34) met microstructuur door het inbrengen van een statistische structuur, in het bijzonder door zandstralen, slijpen, frezen of etsen en/of door het inbrengen van microvacuümkanalen (46), in het bijzonder middels een lithografiemerkwijze, laserwerkwijze of erodeerwerkwijze.

15 18. Werkwijze voor het vervaardigen van een stempel voor een replicatie-inrichting voor het vervaardigen van componenten met micro- en/of nanostructuur in een stempelreplicatie-inrichting (10) volgens een van de voorgaande conclusies, omvattende de volgende stappen:

- het plaatsen van een stempeldrager (28) en een vormdeel (26) in de stempelreplicatie-inrichting (10),
- 20 - het creëren van een vacuüm op het vacuümoppervlak (34) met microstructuur voor het vasthouden van de stempeldrager (28),
- het aanbrengen van vloeibaar stempelmateriaal op het vormdeel (26) of op de stempelhouder (28),
- het plaatsen van het deksel (12) op het platform (14), en
- 25 - het uitharden van het stempelmateriaal door het bestralen van het stempelmateriaal met UV-licht.

Fig. 1

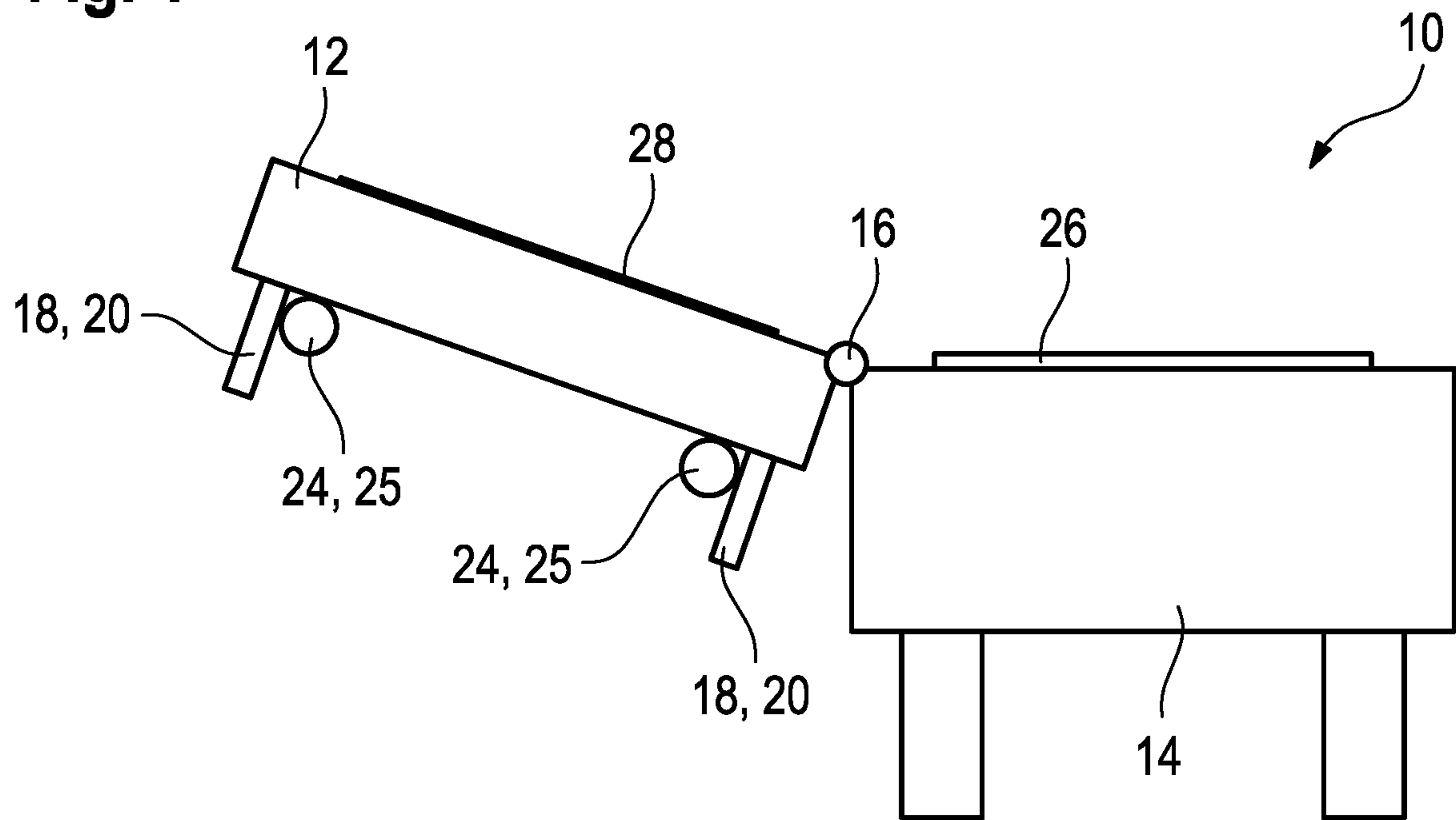


Fig. 2

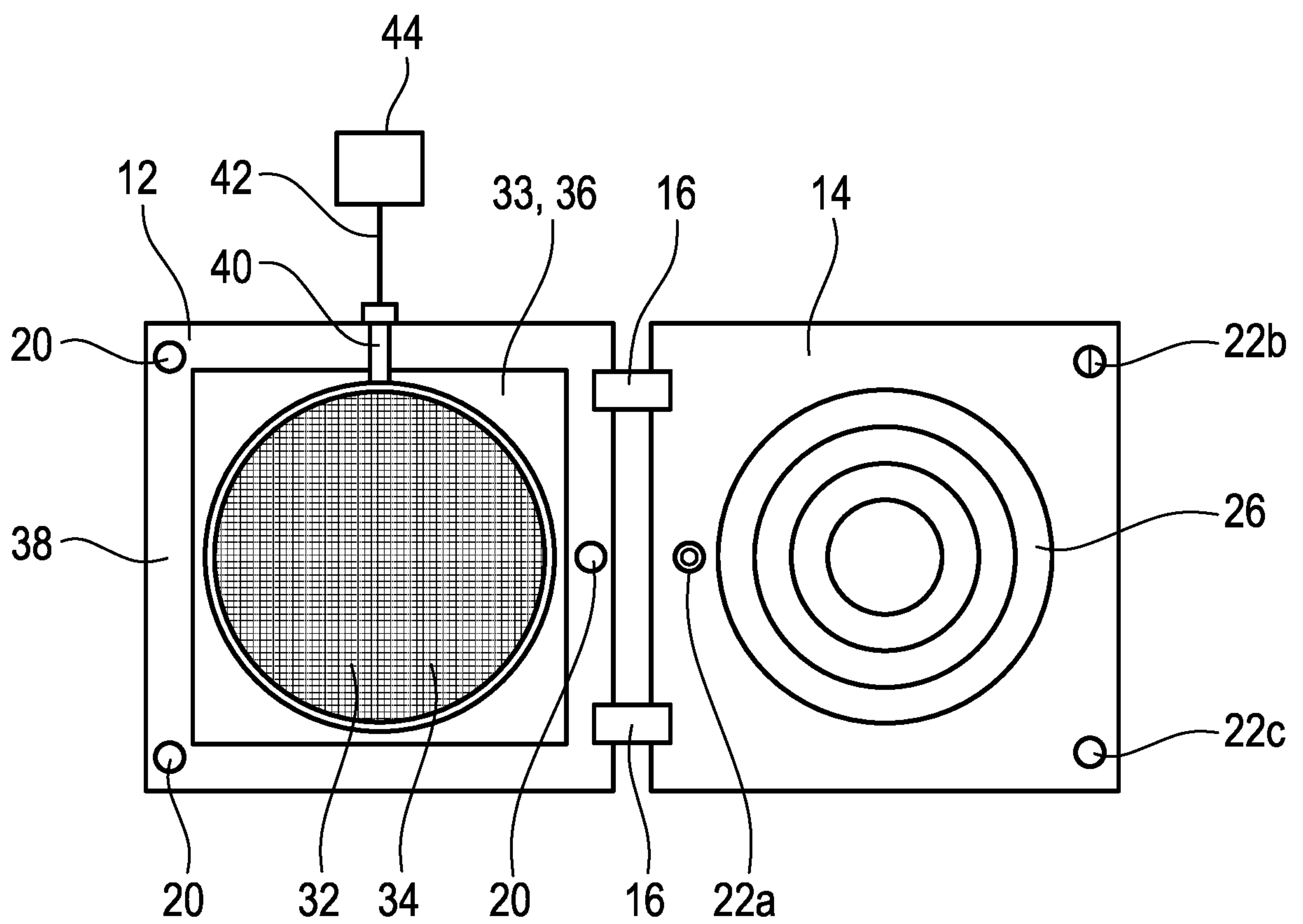


Fig. 3

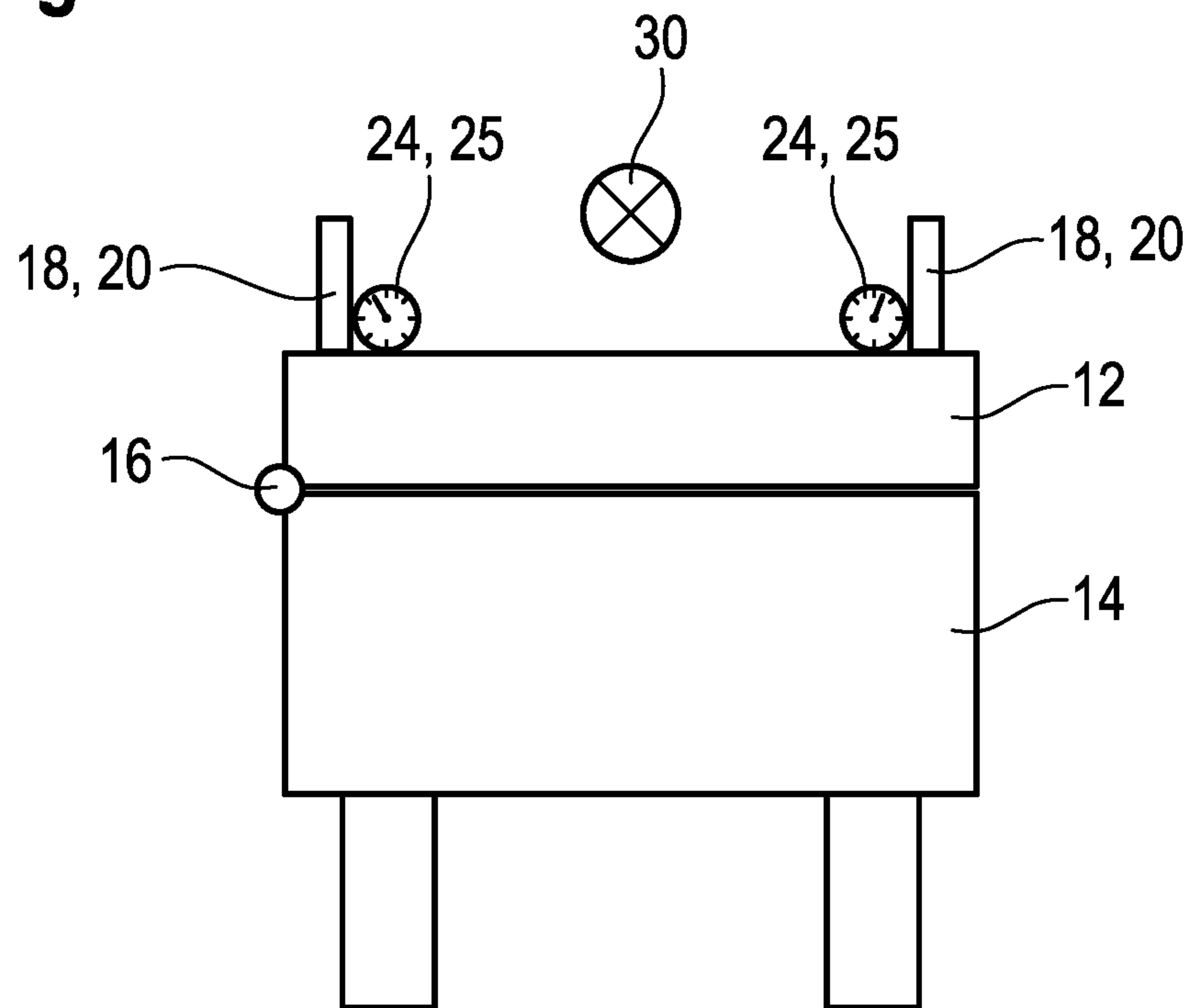


Fig. 4

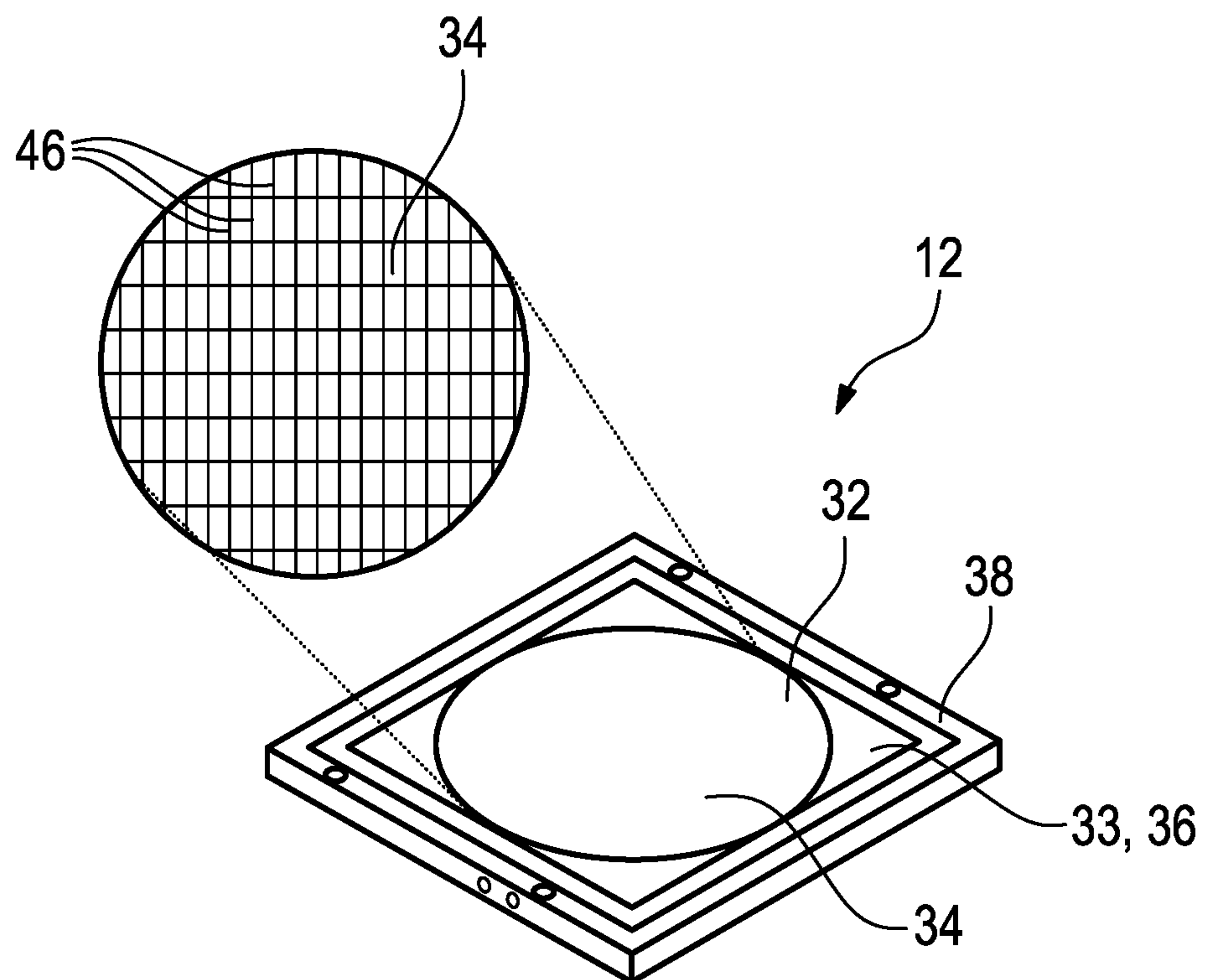


Fig. 5

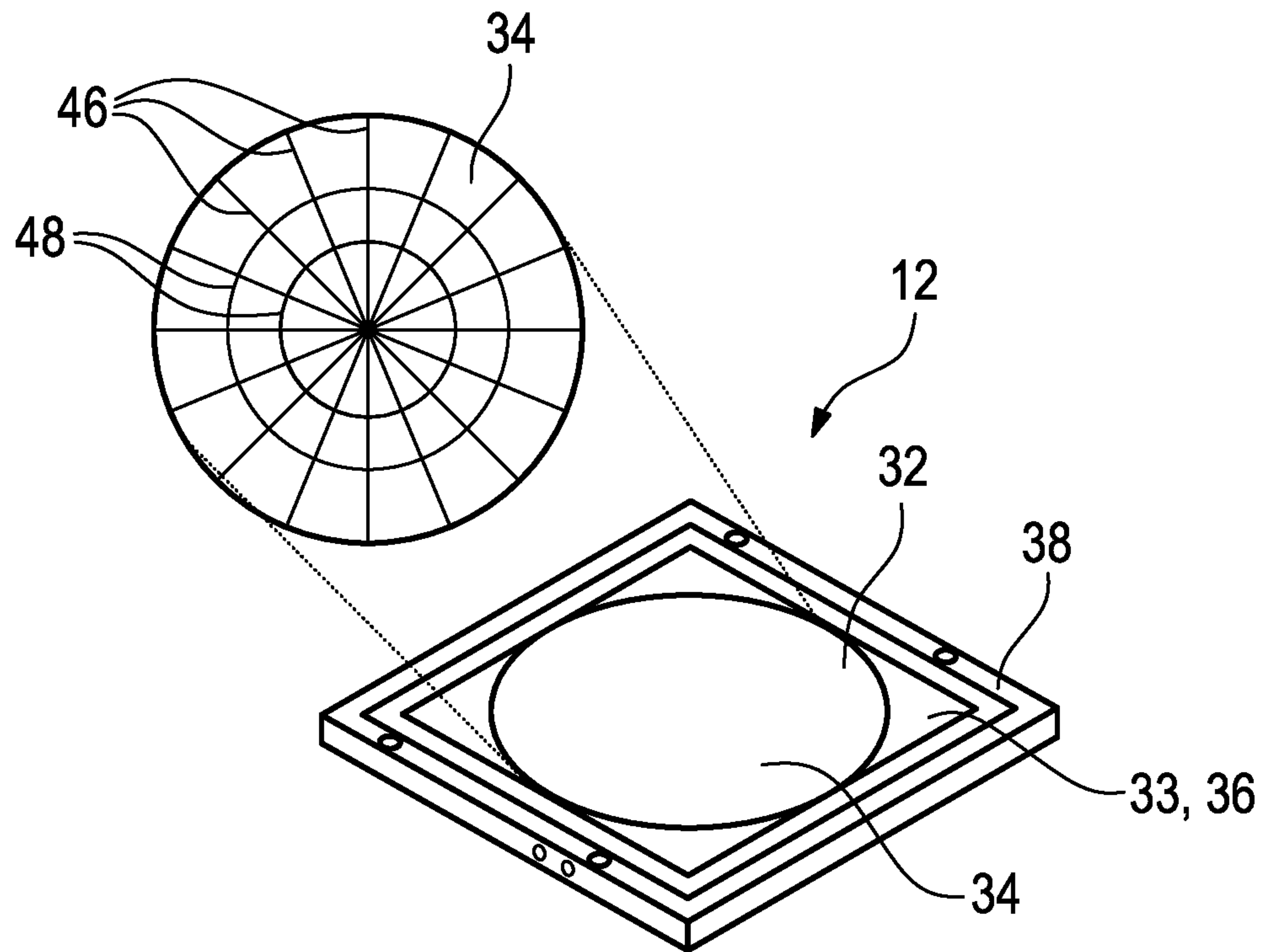


Fig. 6

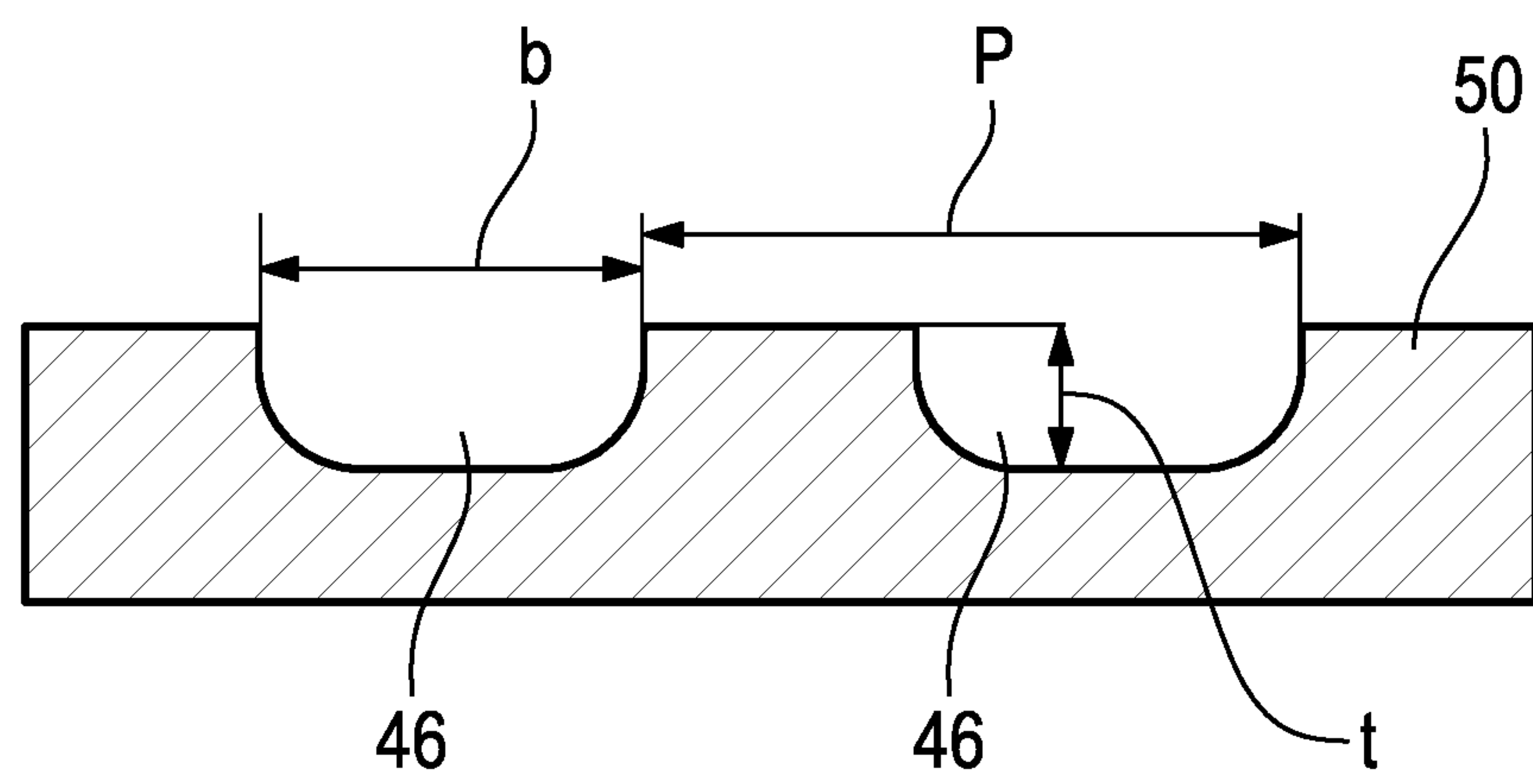


Fig. 7a

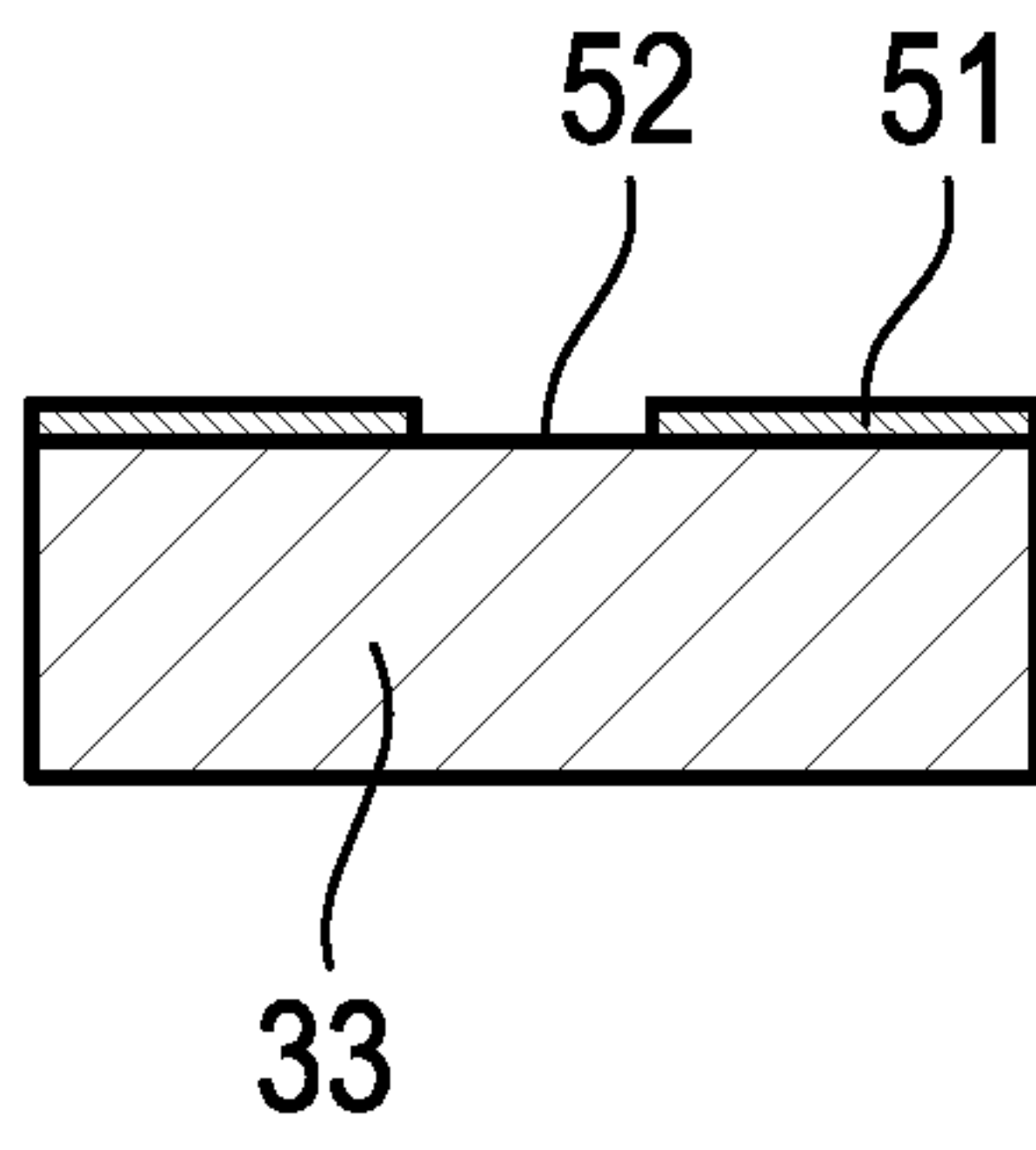


Fig. 7b

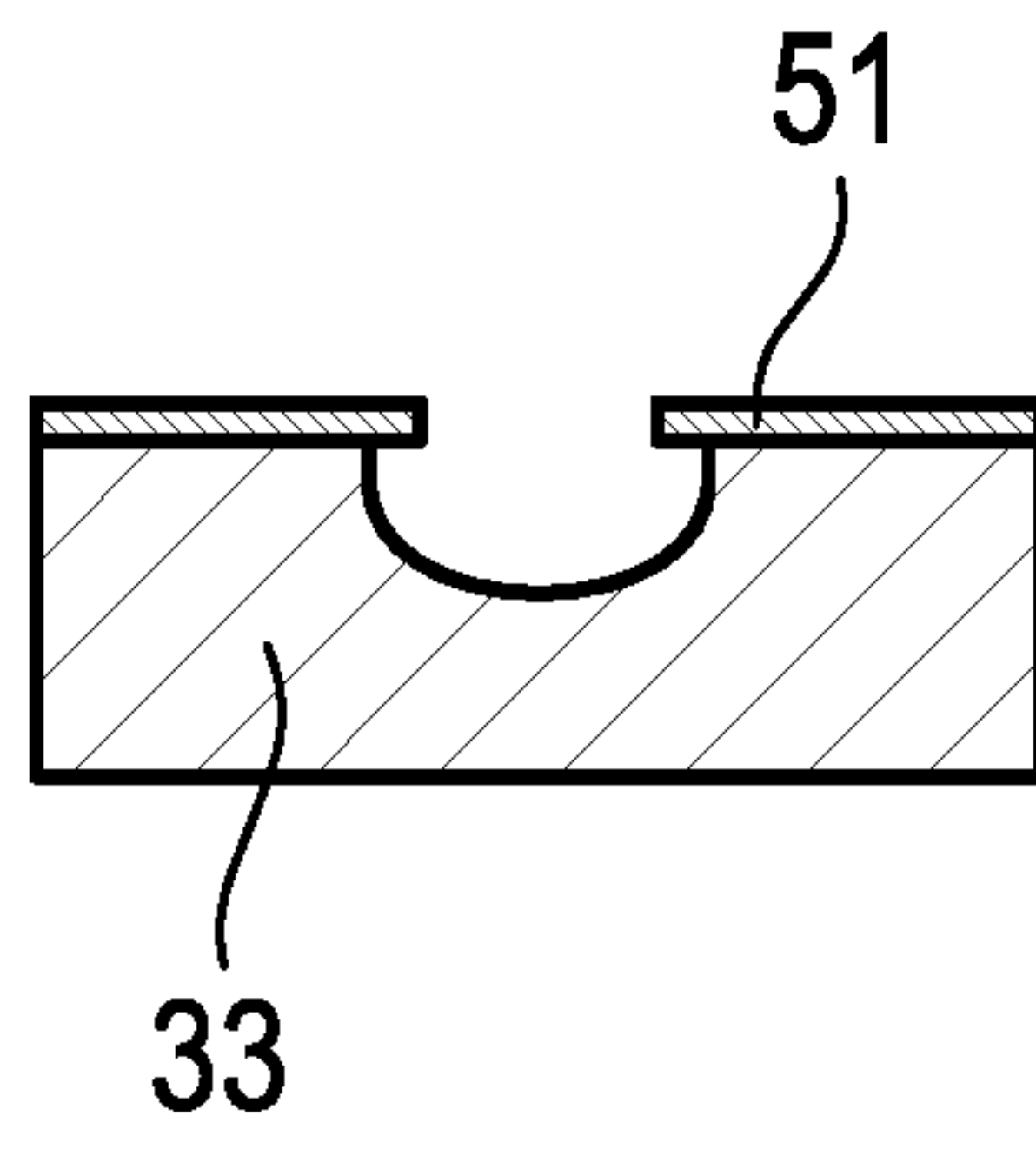


Fig. 7c

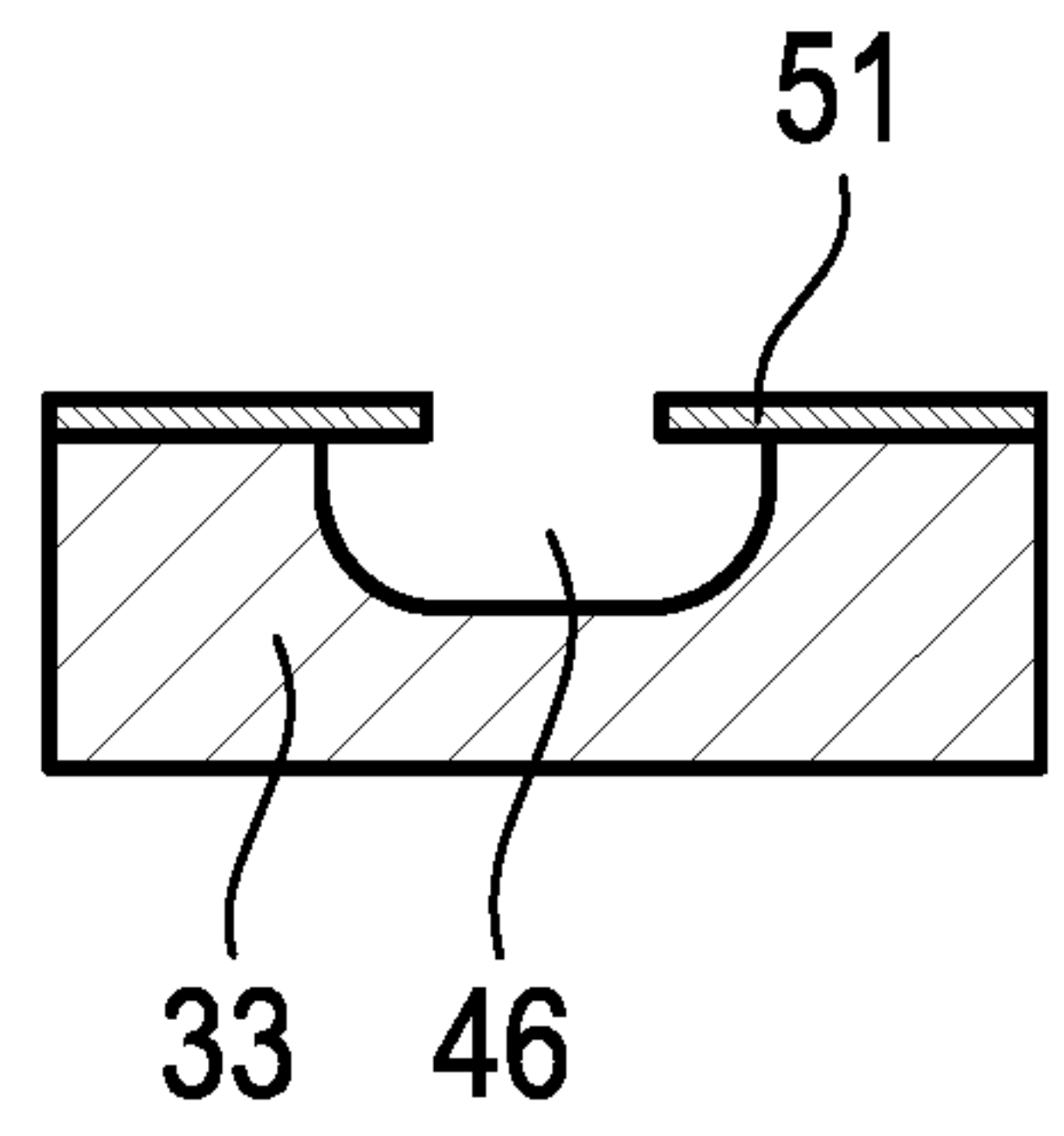


Fig. 8

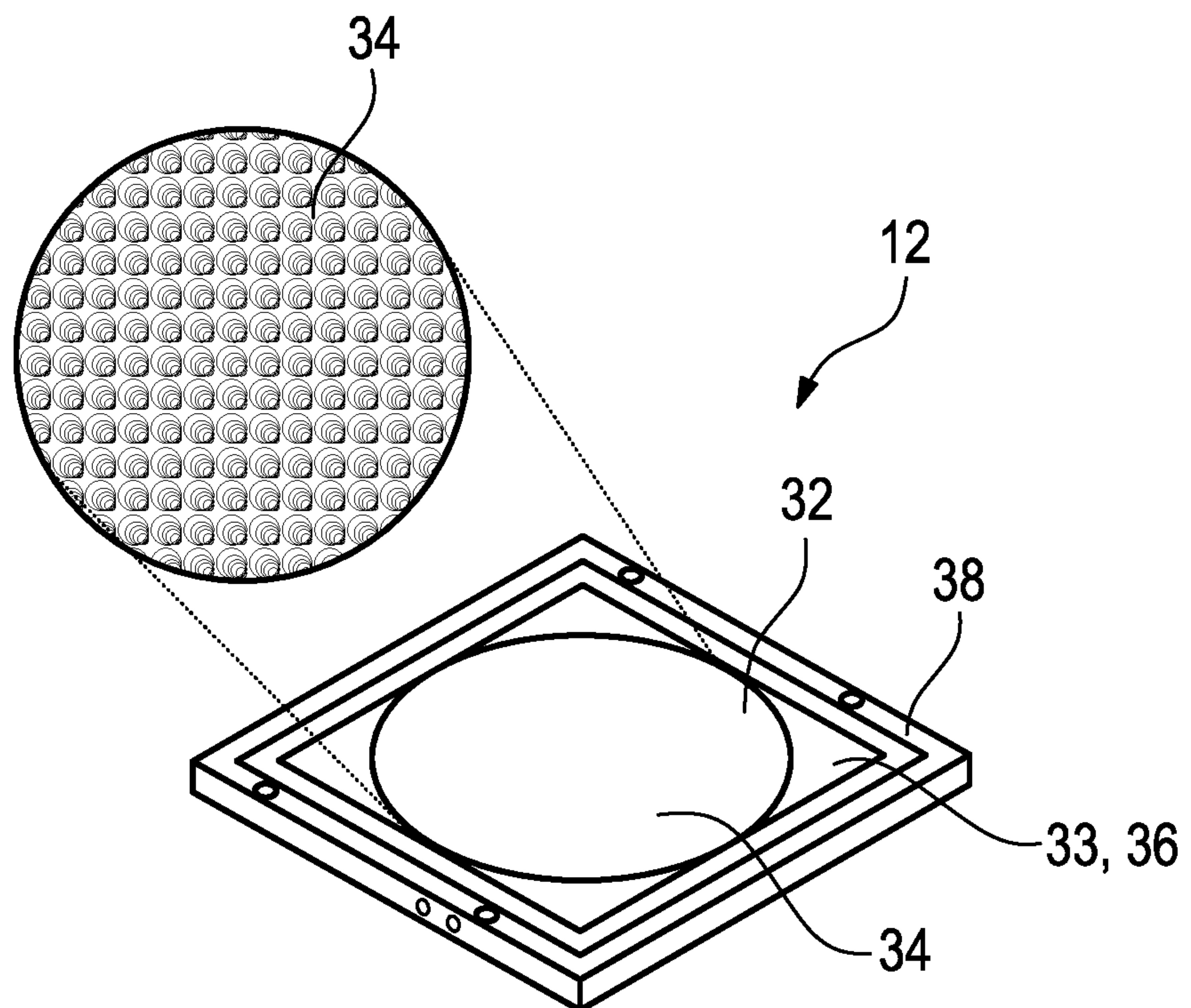
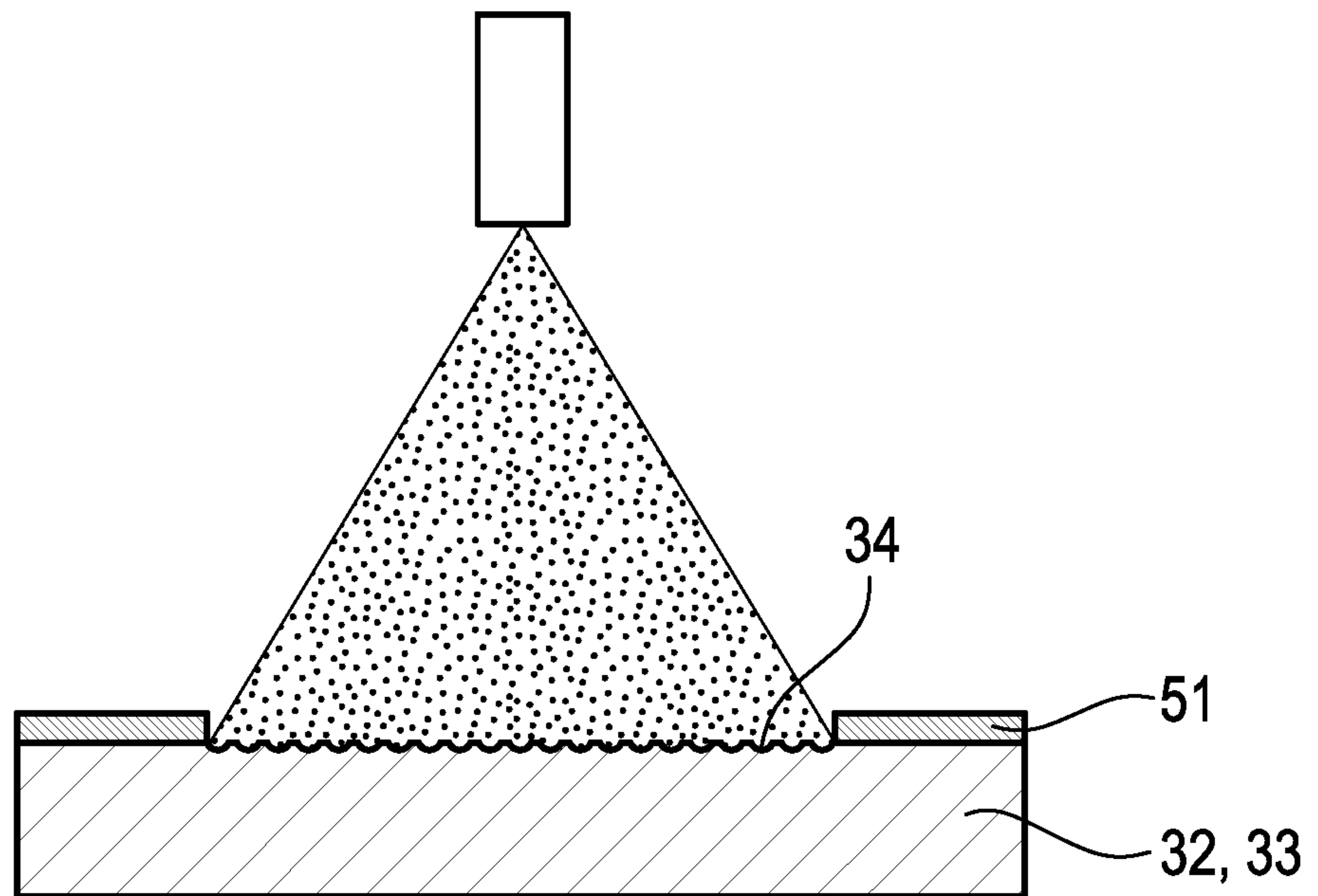


Fig. 9





ONDERZOEKSRAPPORT

BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK

RELEVANTE LITERATUUR			
Categorie ¹	Literatuur met, voor zover nodig, aanduiding van speciaal van belang zijnde tekstgedeelten of figuren.	Van belang voor conclusie(s) nr:	Classificatie (IPC)
X	US 2007/205524 A1 (BEST MARGARET E [US] ET AL) 6 september 2007 (2007-09-06) * alinea [0042] - alinea [0075]; figuren 2b,3 *	1-4,6-18	INV. G03F7/00
X	US 2005/266587 A1 (NIMMAKAYALA PAWAN K [US] ET AL) 1 december 2005 (2005-12-01) * alineas [0037] - [0041], [0045], [0046]; figuren 1,6,10,11,15-17 *	1,2,4-18	
A	US 2009/158947 A1 (THALLNER ERICH [AT]) 25 juni 2009 (2009-06-25) * alineas [0015], [0040], [0041]; conclusies 11,16; figuren 1-4 *	1-18	
A	US 2004/141163 A1 (BAILEY TODD [US] ET AL) 22 juli 2004 (2004-07-22) * alineas [0175], [0209] - [0213]; figuren 47,48,51 *	1-18	
A	US 2004/104326 A1 (DEMEL WALTER [DE] ET AL) 3 juni 2004 (2004-06-03) * conclusies 1-3,5; figuren 2,3 *	1-18	Onderzochte gebieden van de techniek G03F B81C B29C
Indien gewijzigde conclusies zijn ingediend, heeft dit rapport betrekking op de conclusies ingediend op:			
Plaats van onderzoek: München		Datum waarop het onderzoek werd voltooid: 10 februari 2020	Bevoegd ambtenaar: Angioni, Catherine

¹ CATEGORIE VAN DE VERMELDE LITERATUUR

X: de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur
Y: de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht
A: niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft
O: niet-schriftelijke stand van de techniek
P: tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

T: na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvraag, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding
E: eerdere octrooi(aanvraag), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven
D: in de octrooiaanvraag vermeld
L: om andere redenen vermelde literatuur
&: lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

**AANHANGSEL BEHORENDE BIJ HET RAPPORT BETREFFENDE
HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK,
UITGEVOERD IN DE OCTROOIAANVRAGE NR.**

NO 140426
NL 2023097

Het aanhangsel bevat een opgave van elders gepubliceerde octrooiaanvragen of octrooien (zogenaamde leden van dezelfde octrooifamilie), die overeenkomen met octrooischriften genoemd in het rapport.

De opgave is samengesteld aan de hand van gegevens uit het computerbestand van het Europees Octrooibureau per
De juistheid en volledigheid van deze opgave wordt noch door het Europees Octrooibureau, noch door het Bureau voor de Industriële eigendom gegarandeerd; de gegevens worden verstrekt voor informatiedoeleinden.

10-02-2020

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
US 2007205524 A1	06-09-2007	CN 101030034 A EP 1830351 A1 JP 2007230235 A KR 20070090086 A US 2007205524 A1	05-09-2007 05-09-2007 13-09-2007 05-09-2007 06-09-2007
US 2005266587 A1	01-12-2005	CN 101426957 A EP 1769102 A2 JP 2008501244 A KR 20070032664 A TW 200603362 A US 2005263249 A1 US 2005266587 A1 US 2008204693 A1 WO 2005118914 A2	06-05-2009 04-04-2007 17-01-2008 22-03-2007 16-01-2006 01-12-2005 01-12-2005 28-08-2008 15-12-2005
US 2009158947 A1	25-06-2009	EP 1764648 A1 EP 1927028 A2 US 2009158947 A1 WO 2007031205 A2	21-03-2007 04-06-2008 25-06-2009 22-03-2007
US 2004141163 A1	22-07-2004	AU 2001297642 A1 CN 1531668 A EP 1352295 A2 EP 2306242 A2 JP 2004523906 A KR 20040004401 A US 2002115002 A1 US 2004141163 A1 US 2004168586 A1 US 2004170771 A1 US 2008095878 A1 US 2010173033 A1 WO 02067055 A2	04-09-2002 22-09-2004 15-10-2003 06-04-2011 05-08-2004 13-01-2004 22-08-2002 22-07-2004 02-09-2004 02-09-2004 24-04-2008 08-07-2010 29-08-2002
US 2004104326 A1	03-06-2004	DE 10235482 B3 JP 2004072108 A TW I244156 B US 2004104326 A1	22-01-2004 04-03-2004 21-11-2005 03-06-2004

SCHRIFTELIJKE OPINIE

DOSSIER NUMMER NO140426	INDIENINGSDATUM 09.05.2019	VOORRANGSDATUM	AANVRAAGNUMMER NL2023097
CLASSIFICATIE INV. G03F7/00			
AANVRAGER SUSS MicroTec Lithography GmbH			

Deze schriftelijke opinie bevat een toelichting op de volgende onderdelen:

- ☒ Onderdeel I Basis van de schriftelijke opinie
- ☐ Onderdeel II Voorrang
- ☐ Onderdeel III Vaststelling nieuwheid, inventiviteit en industriële toepasbaarheid niet mogelijk
- ☐ Onderdeel IV De aanvraag heeft betrekking op meer dan één uitvinding
- ☒ Onderdeel V Gemotiveerde verklaring ten aanzien van nieuwheid, inventiviteit en industriële toepasbaarheid
- ☐ Onderdeel VI Andere geciteerde documenten
- ☐ Onderdeel VII Overige gebreken
- ☐ Onderdeel VIII Overige opmerkingen

	DE BEVOEGDE AMBTENAAR Angioni, Catherine
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SCHRIFTELIJKE OPINIE

Aanvraag nr.:
NL2023097

Onderdeel I Basis van de Schriftelijke Opinie

1. Deze schriftelijke opinie is opgesteld op basis van de meest recente conclusies ingediend voor aanvang van het onderzoek.
2. Met betrekking tot **nucleotide en/of aminozuur sequenties** die genoemd worden in de aanvraag en relevant zijn voor de uitvinding zoals beschreven in de conclusies, is dit onderzoek gedaan op basis van:
 - a. type materiaal:
 - ☐ sequentie opsomming
 - ☐ tabel met betrekking tot de sequentie lijst
 - b. vorm van het materiaal:
 - ☐ op papier
 - ☐ in elektronische vorm
 - c. moment van indiening/aanlevering:
 - ☐ opgenomen in de aanvraag zoals ingediend
 - ☐ samen met de aanvraag elektronisch ingediend
 - ☐ later aangeleverd voor het onderzoek
3. ☐ In geval er meer dan één versie of kopie van een sequentie opsomming of tabel met betrekking op een sequentie is ingediend of aangeleverd, zijn de benodigde verklaringen ingediend dat de informatie in de latere of additionele kopieën identiek is aan de aanvraag zoals ingediend of niet meer informatie bevatten dan de aanvraag zoals oorspronkelijk werd ingediend.
4. Overige opmerkingen:

Onderdeel V Gemotiveerde verklaring ten aanzien van nieuwheid, inventiviteit en industriële toepasbaarheid

1. Verklaring

Nieuwheid	Ja:	Conclusies	5-16
	Nee:	Conclusies	1-4, 17, 18
Inventiviteit	Ja:	Conclusies	
	Nee:	Conclusies	1-18
Industriële toepasbaarheid	Ja:	Conclusies	1-18
	Nee:	Conclusies	

2. Citaties en toelichting:

Zie aparte bladzijde

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

D1: US 2007/205524 A1

D2: US 2005/266587 A1

D3: US 2009/158947 A1

D4: US 2004/141163 A1

D5: US 2004/104326 A1

2. The present application does not meet the criteria of patentability, because the subject-matter of claims 1, 17 and 18 is not new.

2.1. In the wording of present claim 1, D1 discloses a stamp replication device (fig. 3) suitable for producing stamps ([0054], fig. 2B: the substrate 310 may include a UV curable imprintable resist layer 256 for transferring the formed pattern of the stamper 300 to the UV transparent substrate 310) for the production of micro and / or nanostructured components comprising:

a platform (**light grey dotted part of 320**),

a cover (**stamper 300**) that can be placed on the platform and

a holding means (**substrate guide 328, surface support 324**) for a stamp carrier (**310**),

wherein the holding means is provided on the platform and comprises a carrier (**surface support 324**) as well as a microstructured vacuum surface ([0057]: **the surface support 324 comprises a porous metal**) on the carrier for holding the stamp carrier.

2.2. In the wording of present claim 1, D2 discloses a stamp replication device (fig. 1) suitable for producing stamps for the production of micro and / or nanostructured components comprising:

a platform (**110: cf. fig. 10, 11**),

a cover (**imprint head 18: cf. fig. 1**) that can be placed on the platform and

a holding means (**device layer 200: cf. fig. 10**) for a stamp carrier (**substrate 32: substrate 32 is covered with imprinting layer 34**),

wherein the holding means is provided on the platform and comprises a carrier (**pin layer 114: cf. figs. 6, 10, 11, 15-17**) as well as a microstructured vacuum surface (**fig. 15, [0045], [0046]: width 171 of cross member 70 = 0.3 mm; width and depth of base portion 161 = 0.1 mm; "vacuum channels 128 and void 125 are in fluid communication with throughways 160, 157 and 166 and throughway 120"**) on the carrier for holding the stamp carrier.

2.3. The reasoning made under items 2.1. and 2.2. supra applies mutatis mutandis to the subject-matter of claim 17.

2.4. The stamp material in D1 (cf. [0046] and [0052]) is cured with UV light. The reasoning made under items 2.1. and 2.2. supra applies hence mutatis mutandis to the subject-matter of claim 18.

Furthermore, while the wavelength of the actinic source for cross-linking the stamp material is not explicitly mentioned in D2, a UV-range may be considered to be implicitly disclosed since UV curing is standardly used in imprint lithography.

2.5. For the sake of completeness, D3-D5 are briefly discussed:

2.5.1. In the wording of claim 1, D3 discloses (figs. 1, 2) a stamp replication device (1)

for producing stamps (2) for the production of micro and / or nanostructured components (**claim 11**) comprising:

a platform **(5)**,

a cover **(4)** that can be placed on the platform and

a holding means **(annular adjustment master stamp 9, cavity 24)**
for a stamp carrier **(support 7)**,

wherein the holding means is provided on the platform and
comprises a carrier **(annular adjustment master stamp 9)**.

D3 discloses a microstructured vacuum surface **([0015]: porous material and/or material penetrated by channels, with pore size between 10 and 100 μm)**. However, the microstructured vacuum surface is not on the carrier but on the stamp carrier.

2.5.2. D4 discloses a substrate pin-type vacuum chuck 540 (fig. 48A) and substrate a groove-type vacuum chuck 460 (fig. 48B), the space and size of each groove being as small as hundreds of microns. Vacuum flow is provided through fine vacuum channels across multiple grooves that run in parallel with respect to the chuck surface. D3 discloses also a template support system (fig. 51) comprising a vacuum supporting plate 5101 that is transparent to the curing agent. A set of mirrors is provided to divert eventually obstructed curing light in order to ensure uniform curing (cf. [0175]).

2.5.3. D5 discloses a vacuum chuck for fixing thin and/or flexible substrates comprising a bearing surface in which notches/holes and microgrooves, communicating with each other are formed, the microgrooves having a width of 80 to 160 μm and a depth of 30 to 70 μm .

3. Dependent claims 2-4 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of novelty in view of D1: claims 2-4 (cf. D1: material of carrier is porous).

Dependent claims 2, 4 and 5 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of inventive step in view of D2: claims 2, 4, 5 (cf. D2: width and depth of 0.1 mm).

Dependent claims 6-16 do not appear to provide any supplementary feature which would not be within an obvious modification of the demonstrated prior art documents.