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(54) **Üzemeltetési eljárás besugárzókészülékhez**

EP2907527

OPERATING METHOD FOR AN IRRADIATION DEVICE

DESCRIPTION

SZTNH-100042892

Technical field

The present invention relates to an irradiation device for irradiating a substrate by means of an UV emitter, comprising the process steps of:

(a) Operating the UV emitter at a nominal operating radiation power that is a function of a nominal operating temperature,

(b) continuously feeding the substrate, at a feed rate, into an irradiation area that is defined by the UV emitter,

(c) irradiating the substrate in the irradiation area.

Such operating processes are frequently used for the operation of irradiation devices in flow production, for example, for disinfection, water treatment or for curing lacquers, adhesives or plastics.

Prior art

In the case of known irradiation devices one or several UV emitters are provided as a radiating source. UV emitters in this sense are, for example, mercury vapor- low pressure emitters, -medium pressure emitters and high pressure emitters. In these irradiation devices the UV emitter or emitters are arranged in such a way that they define the irradiation area, within which an irradiation of the substrate occurs at a predetermined minimum irradiation intensity. The substrate is fed to the irradiation area by a transport device, wherein it passes through the irradiation area if possible at a constant speed.

An irradiation device of this type is known, for example, from JP 2008-265830 A, wherein foil bags continuously pass through a UV irradiation device and are thereby sterilized before they are subsequently filled with a sterilizing liquid.

At a given radiation power of the UV lamp the dwell time of the substrate within the irradiation area defines the irradiation energy impacting the substrate. By means of a control of the transport speed of the substrate the irradiation energy impacting the substrate can be adjusted to the irradiation process occurring in each case.

To achieve a good energy efficiency in principle an as continuous an operation of the irradiation device as possible, that is, an operation without interruptions, is desirable. If a failure in the production process occurs it must be ensured, that a substrate remaining in the irradiation area is not damaged by excessive irradiation.

In order to prevent damage to the substrate, the UV emitters can indeed be switched off if there is an interruption of the production process. However, they need a certain time each time they are switched on, in order to reach their nominal radiation power again. The radiation power of the UV emitters depends thereby in particular on their temperature.

In the case of a cold start of the UV emitter the latter warms up after being switched on continuously until it reaches its operating temperature. Only when the operating temperature has been reached is a constant radiation power attained. The time until the operating temperature is reached is referred to as the warm-up time. As a rule, it is several minutes. A new start of the UV lamp therefore is regularly accompanied by a delay of the production process.

In order to guarantee an as short a warm-up time as possible after an interruption, in the prior art a switching off of the UV emitter is therefore dispensed with. Instead, the use of a shielding element is proposed for the interruption of the beam path between the UV emitter and substrate, so that the UV emitter can also continue to operate in the event of a stoppage of the production process, without it immediately having an impact on the substrate.

Such an irradiation device is known from JP 08 056 132 A. The irradiation device comprises a germicidal lamp, which defines an irradiation area, as well as a transport device, which transports the substrate through the irradiation area. In order to prevent an excessive irradiation of a substrate remaining in the irradiation area during a stoppage of the transport device, it is proposed, to arrange a shutter between the UV germicidal lamp and the substrate, which shutter interrupts the beam path between UV germicidal lamp and substrate during a stoppage of the production process.

The shutter, however, has the disadvantage, that it partially absorbs, partially reflects, radiation emitted by the UV emitter, so that this on its part can contribute to a strong local heating of the environment of the UV emitter and thus to a heating of the UV emitter. A too strong heating of the UV emitter can, on the one hand, impair its radiation power; in addition, it contributes to an aging of the emitter, wherein its emission declines in the UV range and the service life of the emitter is reduced.

In addition, a continuous operation of the UV emitter during a longer stoppage, is accompanied by a consumption of energy and frequently also by damage to the substrate to be treated.

Furthermore, the use of a shutter requires the presence of a certain installation space, therefore, a sufficient distance of the emitter to the substrate. However, this distance reduces the irradiation intensity. Basically, it is the case, that as great an irradiation intensity as possible is achieved, when the distance between the emitter and substrate is a small as possible.

Finally, a shutter is a movable component, which must be activated and has a certain susceptibility to error.

Technical problem

Therefore, the problem addressed by the invention is to indicate a simple and cost-effective operating process for an irradiation device, which prevents the above-mentioned disadvantages and at the same time makes possible a short warm-up time after an interruption of the production process.

General description of the invention

This problem is solved based on an operating process of the type mentioned at the outset according to the present invention, in that the UV emitter is switched off if there is an interruption of the continuous substrate feed, wherein the emitter temperature of the switched off UV emitter is measured and provisions for heating are made as a counter-measure to counteract a decrease of the emitter temperature by more than 10° C below the nominal operating temperature.

In the case of the operating process according to the invention a continuous operation of the UV emitter and the use of a shutter are dispensed with. Instead, it is proposed according to the invention to switch off the emitter if there is an interruption of the substrate feed. As a result of the fact, that the operating process according to the invention dispenses with a continuous operation of the UV emitter with operating radiation power, if there is a stoppage of the production process the energy consumption is reduced. Because of this, on the one hand, a particularly energy-efficient operating process is made possible and, on the other hand, the service life of the emitter is extended.

The disadvantage of the excessive heating off the UV emitter associated with the shielding element if there is a stoppage of the production process and the accompanying impairment of the initial radiation power does not occur in the process according to the present invention

In order nevertheless to make possible a rapid start of the UV emitter and an efficient operation of the device after a stoppage, further modifications of the operating process are proposed, one of which relates to the monitoring of the emitter temperature after an interim switching off of the UV emitter and the other relates to the provision of counter-measures, in order to counteract a decrease of the emitter temperature in the switched-off state.

The UV emitter is in principle designed for a specified operating temperature and an operating radiation power, which can be reached during an optimized production process of the UV emitter. The operating temperature of the UV emitter in particular thereby has substantial influence on the achievable radiation power of the UV emitter. Both an operating temperature of the UV emitter which is too high as well as one which is too low is accompanied by a reduced radiation power. A particularly reproducible adjustment of the desired radiation power is obtained, if the UV emitter has nearly the same temperature along its surface.

In order also to make possible a rapid new start in the case of a switched off UV emitter, a heating is provided according the present invention as a counter-measure, in order to counteract a decrease of the emitter temperature by more than 10° C below the nominal operating temperature. To this end initially the emitter actual temperature is detected and subsequently compared with the nominal operating temperature.

Since the UV emitter is kept at a temperature close to its nominal operating temperature, a short warm-up time is made possible. As a result of the fact that during the operation the UV emitter temperature deviates at most by maximally 10° C from the operating temperature, the UV emitter can attain its operating radiation power in less than 5 seconds.

The operating parameters of the irradiation device are adjusted to the operating radiation power of the UV emitter. In the simplest case, the irradiation device is operated with a feed rate optimized to the nominal operating radiation power. Thus, the substrate, on the one hand, is irradiated with sufficient radiation energy and, on the other hand, an as high speed of the production process as possible is guaranteed.

In a preferred design of the operating process according to the present invention it is provided, that a heating of the UV emitter is provided as a counter-measure by means of a heating element.

In the simplest case, in the vicinity of the UV emitter a tempering unit is provided with a heating element, for example, in the form of an infrared emitter or a heating coil, with which the emitter temperature can be kept in the temperature range around the operating temperature. Thus, it is made possible, that the UV emitter can develop its maximal radiation power within a few seconds.

In an alternative, also preferred design of the operating process according to the present invention it is provided, that the emitter temperature is influenced by means of an air flow generated by an air cooling, and that heating of the air flow by means of a heating element is provided as a counter-measure.

In order to operate the UV emitter at its specified nominal operating temperature, in which the UV emitter has an optimized radiation power, an air cooling is provided for the UV emitter. The air cooling generates an air flow, which flows by the surface of the UV emitter or around the surface of the UV emitter and thus influences the emitter temperature in the direction of the nominal operating temperature, therefore, if possible reduces or increases the current emitter temperature. It has thereby proven to be beneficial, if the air flow flows around the surface of the UV emitter.

The emitter temperature can also be influenced by adjustment of the air cooling. Depending on the temperature of the ambient air drawn in from the air cooling, heating or a cooling of the emitter surface is made possible with the air cooling; the air flow can bring about both an increase as well as a reduction of the emitter temperature. An air flow, which flows by the UV emitter or flows around the latter, contributes to the UV emitter being heated or cooled as uniformly as possible, and to an excessive local heating of the UV emitter being prevented.

As a result of the fact that the heating element heats the air flow, the temperature of the UV emitter can be increased by the air flow and thus be kept in the desired temperature range. The heated air flow contributes, furthermore, to a uniform heating of the emitter.

Preferably, the heating element is an electrical heating element with a current-carrying heating coil. Such a heating element can be produced simply and cost-effectively and, in addition, it has a low inertia, so that the heat output can be comparatively simply set and adjusted. Finally, an electrical heating element can be simply activated. Preferably, the heating element is a short-wave infrared emitter. In the case of a short-wave emitter the heat output is very rapidly available, so that rapid temperature changes and a rapid heating of the UV emitter are made possible.

In a further advantageous design of the operating process according to the present invention it is provided, that the emitter temperature is influenced by means of an air flow generated by an air cooling, and that a change of the mass flow of the air flow is provided as a counter-measure.

As a result of the fact that the air flow is variable, an influence of the emitter temperature is made possible by a change of the mass flow of the air flow. If, for example, the temperature of the air flow is higher than the emitter temperature, a heating of the emitter is attained by an increase of the mass flow. However, if the temperature of the air flow is lower than the emitter temperature, a reduction of the mass flow contributes to keeping the UV emitter warm as long as possible.

The air flow of the air cooling makes possible an exact setting of the emitter temperature also during the operation of the irradiation device and contributes to a uniform emitter temperature.

It has proven successful, if the continuous substrate feed is interrupted

(aa) the UV emitter is switched off, and

(bb) the heating element is switched on,

and when the interruption of the continuous substrate feed is no longer present

(cc) the UV emitter is switched on, and

(dd) the heating element is switched off.

By switching off the emitter and switching on the heating element when there is an interruption of the production process, the emitter temperature is kept in a temperature range around the operating temperature during the interruption. When the production process is restarted the emitter therefore immediately reaches a high radiation power. In this connection, it has therefore proven to be b4eneficial, if the UV emitter is switched on and at the same time the heating element is switched off. The simultaneous switching off of the heating element contributes to preventing an excessive heating of the UV emitter under operating conditions.

It has proven to be beneficial, if the heating of the air flow occurs in an air feed channel of the air cooling.

A heating element arranged in an air feed channel has the advantage, that the air can be heated in spatial proximity to the UV emitter, so that an especially energy efficient operating process is made possible. At the same time, a non-uniform heating of the UV emitter is counteracted.

In the case of a preferred design of the process according to the present invention it is provided, that the irradiation device has a reflector having a side facing the UV emitter and a side facing away from the UV emitter, and that the heating of the air flow takes place by a heating element arranged on the side of the reflector facing away.

The reflector is firmly connected with the UV emitter or it is a reflector component arranged separately from it; it has a side facing the UV emitter and a side facing away from the UV emitter.

As a result of the fact that the heating element is arranged behind the reflector, therefore on the side facing away from the UV emitter, only the reflector is directly heated by the latter. As a result of the fact that the UV emitter is exposed to no direct heating by the heating element and at most is indirectly heated via the reflector, a non-uniform and local heating of the UV emitter is prevented. Such an arrangement therefore contributes to a uniform heating of the UV emitter.

Preferably, the air flow flows around the UV emitter in the direction perpendicular to the longitudinal direction of the emitter.

Thus, a uniform tempering of the UV emitter is made possible.

It has proven successful, if the feed rate is detected consecutively by a sensor.

An effective adjustment of the radiation power of the UV emitter to the feed rate is made possible, if the feed rate is detected consecutively – that is, continuously or from time to time. The sensor provided for the detection of the feed rate can detect the feed rate, for example, by detecting an electrical or optical measured value. Preferably, the measurement of the feed rate occurs without contact by using an optical correlation measuring system, for example, by means of a camera.

It has proven to be beneficial, if the temperature of the UV emitter is detected consecutively by a sensor.

The temperature sensor converts the temperature into an electrical measured value. It detects the temperature of the UV emitter consecutively, that is, continuously or from time to time. In particular, in the case of simultaneous use of several UV emitters, each of the emitters can be provided with a temperature sensor. Alternatively, only the temperature at a single emitter or at individual emitters can also be detected. The detection of the temperature takes place preferably on the surface of the emitter tube. Through the consecutive detection of the emitter temperature it is possible, to identify deviations of the emitter temperature from a preset nominal value as rapidly as possible. Thus, an especially dynamic operating process is guaranteed.

<u>Embodiment</u>

The invention is described in detail below by means of an embodiment and several drawings. In schematic representation

Figure 1 shows an embodiment of an irradiation device operating according to the operating process according to the present invention for the irradiation of a substrate,

Figure 2 shows a first emitter module for use in the irradiation device according to Figure 1, in which a heat coil is arranged in an air feed channel,

Figure 3 shows an emitter module according to Figure 2 in a rear view,

Figure 4 shows a second emitter module for use in the irradiation device according to Figure 1, in which a heating element running perpendicular to the longitudinal direction of the emitter module is arranged behind a reflector,

Figure 5 shows a third emitter module for use in the irradiation device according to Figure 1, in which a heating element running in the longitudinal direction of the emitter model is arranged behind a reflector, and

Figure 6 shows a diagram, in which the relative UV emission of an UV emitter operating according to the process according to the present invention is depicted depending on the time after the start of the emitter for variously strongly pre-tempered emitters.

Figure 1 shows schematically an embodiment of an irradiation device operating according to the operating process according to the present invention, to which the reference sign 1 is assigned overall. The irradiation device 1 is used for the curing and hardening of a coating 3 on the work pieces 2 in the form of plastic foils.

The irradiation device 1 comprises an emitter unit 5 for the irradiation of the work pieces 2 and a transport device 4, which continuously feeds the work pieces 2 in the transport direction 7 of the irradiation through the emitter unit 5.

The emitter unit 5 has three emitter modules 6a, 6b, 6c arranged in a row, as well as a control unit 13, for the emitter modules 6a, 6b, 6c. The emitter modules 6a, 6b, 6c are designed identically. Therefore, only the emitter module 6a is described in detail below.

The emitter module 6a comprises an UV emitter 9a, to which a heating element 10a is assigned for heating the UV emitter 9a. The UV emitter 9a has a cylindrical emitter tube made of quartz glass with an emitter tube longitudinal axis. It is characterized by a nominal power of 300 W and a length of the emitter tube of 1,000 mm.

The emitter modules 6a, 6b, 6c are arranged within the emitter unit 5 relative to the transport device 4 in such a way that the emitter tube longitudinal axes of the UV emitter run perpendicular to the transport direction 7. The emitter unit 5 defines an irradiation field on the surface of the transport device 4 for the irradiation of the work pieces 2. The extension of the irradiation field in the transport direction 7 is drawn in in Figure 1 by dashed lines 8a, 8b.

The transport device 4 moves the work pieces 2 relative to the emitter unit 5, so that the latter runs slowly through the irradiation field. The distance of the emitter unit 5 to the surface of the work piece 2 is 20 mm and can be set via a device for setting the distance (not depicted).

The irradiation device 1 is based on the operating process according to the present invention. Before the work pieces 2 are fed to the irradiation field of the emitter unit 5, the UV emitters 9a, 9b, 9c are first switched off, so that the latter reach their operating temperature. In an alternative design of the operating process it is provided, that the UV emitters are initially in each case kept by the associated heating element 10a, 10b, 10c preheated or permanently at the operating temperature and are subsequently started.

If the UV emitters 9a, 9b, 9c have reached their preset operating temperature and operating radiation power, the work pieces 2 are fed by the transport device 4 at predetermined transport speed to the irradiation area. In order to make possible an efficient operation of the irradiation device 1, the transport speed is adjusted to the average operating radiation power of the UV emitters 9a, 9b, 9c. The work pieces run through the irradiation area thereby with as constant transport speed as possible. The transport speed is detected continuously via an optical sensor 11, which detects the distance traveled of a work piece 2 in a preset time interval. The sensor 11 transmits the transport speed continuously to the control unit 13 of the emitter unit 5.

If a stoppage in the production process occurs during the process, the danger exists, that the work pieces 2 located in the irradiation area are exposed too long to an UV irradiation, so that these can be damaged. In order to prevent this, it is provided, that the operating parameters of the emitter modules 6a, 6b, 6c are controlled by the control unit 13 depending on the transport speed. If there is a stoppage of the production the emitter modules 6a, 6b, 7c are switched off.

In order to be able to guarantee an irradiation of the work pieces with a high irradiation power as immediately as possible when restarting the production, the temperature of the UV emitters 9a, 9b, 9c is measured at the same time. To detect the emitter temperature a temperature sensor 12 is arranged on the emitter tube of the UV emitter 9c of the emitter module 6c, which temperature sensor detects the actual temperature of the emitter tube. In an alternative embodiment (not depicted) each emitter module 6a, 6b, 6c is provided with a temperature sensor 12. If the temperature of the UV emitter 9a, 9b, 9c drops by more than 10 °C below its operating temperature, the respective heating element 10a, 10b, 10c is switched off by the control unit 13, so that the air flow with which the UV emitter is bathed in the direction perpendicular to the emitter longitudinal direction, is heated. The UV emitters 9a, 9b, 9c are thus kept at a temperature in the range of their operating temperature during the stoppage of the production.

As a result of the fact that the UV emitter 9a, 9b, 9c is kept at the operating temperature, the time is reduced, which the UV emitter 9a, 9b, 9c requires when restarting, in order to attain its operating radiation power. Thus, an immediate start of the irradiation device 1 after a stoppage is possible with high transport speed. When restarting the production, the heating filament 10a, 10b, 10c is switched off simultaneously with the switching on again of the UV emitter 9a, 9b, 9c.

Figure 2 shows schematically a front view of an emitter module 200, which can be inserted in the irradiation device according to Figure 1.

The emitter module 200 comprises a housing 201 with eight UV emitters 205a-205h arranged therein. The housing 201 is made from stainless steel. It has a length L of 1,030 mm, a width B of 434 mm and a height H of 171 mm. On the rear side of the housing 201 ventilation ducts 202, 203 are arranged.

The UV emitters 205a-205h have in each case a cylindrical emitter tube closed on both ends made of quartz glass with an emitter tube longitudinal axis. The UV emitters 205a-205h are characterized by a nominal power of 300 W (in the case of a nominal lamp current of 4 A), an emitter tube length of 100 m, an emitter tube outer diameter of 28 mm and by a power density of 3 W/cm; they are arranged within the housing in such a way that their emitter rube longitudinal axes run parallel to each other.

Figure 3 shows schematically a rear view of the emitter module 200 for use in the irradiation device according to Figure 1. The emitter module 200 comprises a housing 201 with eight UV emitters 205a-205h arranged therein (not discernible in the drawing). On the rear side 201a of the housing 201 ventilation ducts 202, 203 are arranged, through which the UV emitter can be cooled during the operation via an air flow, which flows in a direction perpendicular to the emitter longitudinal direction. The ventilation duct 202 is an air supply duct; the ventilation duct 203 is used as an exhaust duct. In the ventilation duct 202 a heating coil 204 is arranged.

If the emitter module 200 is operated with nominal power, a heating takes place of the UV emitters 205a-205h installed in the emitter module 200. In order to prevent an excessive heating of the UV emitters 205a-205h and of the housing 201 and in order to be able to operate the UV emitters 205a-205h with optimized radiation power, the emitters 205a-205h can be bathed via the ventilation duct 202 with cooling airflow and thereby cooled. The cooling air, heated by the emitters 205a-205h, is led away through the exhaust air duct. The air flow is variable; in particular, the mass flow of the air flow can be adjusted to adjust the cooling capacity.

In order to prevent a cooling down of the switched- off UV emitters 205a-205h, a heating element 204 is arranged in the supply air channel 202, which heating element can be switched on as required. The heating element 204 is used for heating the air fed through the supply air channel 202, which in turn contributes to a heating of the UV emitters 205a-205h. Through a control of the supply air temperature the UV emitters 205a-305h can be kept at the operating temperature.

In **Figure 4** a second embodiment of the emitter module for use in the irradiation device is depicted schematically in a cross-sectional depiction according to Figure 1. The reference number 400 is assigned overall to the emitter module. The dimensioning of the emitter module 400 is indicated in Figure 1 in mm. The emitter module 400 comprises a housing 401 with eight UV emitters 405a-405h arranged therein and a housing window 403 made of quartz glass. In addition, a reflector 402 made of aluminum is attached on the inside of the emitter module 400. In contrast to the radiation module 200 from Figures 2 and 3 the emitter module 400 has no air cooling. In addition, a heating element 404 is arranged behind the reflector 402, which heating element heats the reflector 402 and thus indirectly also the UV emitters 405a-405h. The heating element 404 runs thereby perpendicular to the longitudinal axis of the emitter module 400. Viewed in the direction of the longitudinal axis four heating elements (not depicted) are arranged running parallel to each other.

Figure 5 shows schematically a third embodiment of the emitter module, to which the reference number 500 is assigned overall. The emitter module 500 comprises a housing 501 with four UV emitters 503 arranged therein, on the rear side of which an air cooling system 504 is attached for cooling the UV emitter 503. A window 502 permeable for ultraviolet radiation is embedded in the front side of the housing 501. A heating element is arranged between the rear wall of the housing 501 and the UV emitter 503, which heating element runs parallel to the longitudinal axis of the UV emitter 503.

The diagram in **Figure 6** shows the UV emission of an UV emitter at the wavelength 254 nm depending on the time after the start of the UV emitter for various emitter starting temperatures.

A low pressure emitter with an emitter tube made of quartz glass was used as UV emitter, which is closed on both ends via pinches. The emitter tube of the low pressure emitter surrounds a discharge chamber filled with argon, in which an amalgam depot and two electrodes are arranged.

The low pressure emitter is characterized by a nominal power of 300 W (in the case of a nominal lamp current of 4 A), an emitter tube length of 100 cm, an emitter tube outer diameter of 28 mm and by a power density of 3 W/cm

The low pressure emitter was heated before the start initially to a starting temperature. For this purpose, the temperature of the low pressure emitter in the middle of the emitter tube was determined with a temperature sensor attached on the outside of the emitter tube. 20 °C, 50 °C, 75°C and 100°C were selected as starting temperatures. Subsequently the low pressure emitter was started at the point in time t=0. In Figure 6, for each of these starting temperatures a course of the UV emission is depicted depending on the time after the start. On the x-axis the time since the start of the emitter is plotted in seconds. The y-axis reflects the ultraviolet radiation emission in relative units.

For a good UV emission performance the low pressure emitter must have a certain temperature. Since the low pressure emitter warms up during the operation, this temperature is achieved after a certain operating time. As the curve progression 604 shows, in the case of an emitter, which was preheated at a temperature of 20°C, an acceptable UV emission is attained after approximately 135 seconds. The time until achievement of an acceptable UV emission can be reached by a preheating of the emitter tube. A starting temperature of 50 °C leads according to the curve progression 603 to a starting time of approximately 65 seconds. In the case of a starting temperature of 75 °C the starting time is shortened to approximately 23 seconds and in particular in the case of a starting temperature of 100 °C the starting time of less than 5 seconds can be achieved (curve progressions 601, 602).

<u>List of reference signs</u>

Irradiation device	1
Work piece	2
Coating	3
Transport device	4
Emitter unit	5
Emitter modules	6a, 6b, 6c
Transport direction	7
Irradiation field (lines)	8a, 8b
UV emitter	9a
Heating elements	10a, 10b, 10c
Optical sensor	11
Temperature sensor	12
Control unit	13
Emitter module	200
Housing	201
Housing-rear side	201a
Ventilation ducts	202, 203
Heating coil	204
UV emitters	205a-205h
Emitter module	400
Housing	401
Reflector	402
Housing window	403
Heating element	404
UV emitters	405a-405h
Emitter module	500
Housing	501
Window	502
UV emitter	503
Air cooling system	504
Curve progressions	601-604

EP2907527

ÜZEMELTETÉSI ELJÁRÁS BESUGÁRZÓKÉSZÜLÉKHEZ

SZABADALMI IGÉNYPONTOK

1. Üzemeltetési eljárás besugárzókészülékhez, réteg (2) besugárzásához UV-sugárzóval (9a; 205a-205h; 405a-405h; 503), amely a következő lépéseket foglalja magába:

a) az UV sugárzó (9a; 205a-205h; 405a-405h; 503) működtetése egy előírt hőmérséklettől függő előírt üzemeltetési sugárzás-teljesítménnyel,

b) a réteg (2) folyamatos bevezetése az UV-sugárzó (9a; 205a-205h; 405a-405h; 503) által meghatározott besugárzási tartományba, adott hozzávezetési sebességgel,

c) a réteg (2) besugárzása a besugárzási tartományban,

azzal jellemezve, hogy a folyamatos rétegvezetés megszakadása esetén az UV-sugárzót (9a; 205a-205h; 405a-405h; 503) kikapcsoljuk, ahol a kikapcsolt UV-sugárzó (9a; 205a-205h; 405a-405h; 503) sugárzó-hőmérsékletét megmérjük, és ellenhatásként melegítést hajtunk végre, hogy a sugárzó- hőmérsékletnek az előírt üzemi hőmérsékletnél több mint 10°C-kal történő süllyedése ellen hassunk.

2. Az 1. igénypont szerinti üzemeltetési eljárás, **azzal jellemezve, hogy** ellenhatásként az UV-sugárzó (9a; 205a-205h; 405a-405h; 503) melegítését fűtőelem (10a, 10b, 10c, 404) segítségével végezzük.

3. Az 1. igénypont szerinti üzemeltetési eljárás, **azzal jellemezve, hogy** a sugárzó-hőmérsékletet egy léghűtő (202; 203) által előállított léghűtés segítségével befolyásoljuk, és **hogy** ellenhatásként a légáramlat melegítését fűtőelemmel (204) látjuk el.

4. Az előző igénypontok egyike szerinti üzemeltetési eljárás, **azzal jellemezve, hogy** sugárzó-hőmérsékletet léghűtés által képzett légárammal befolyásoljuk, és **hogy** ellenintézkedésként a légáramlat beömlő tömegének változtatását hajthatjuk végre.

5. A 2. vagy 3. igénypont szerinti üzemeltetési eljárás, **azzal jellemezve, hogy** a folyamatos rétegvezetés megszakadása esetén

(aa) az UV-sugárzót (9a; 205a-205h; 405a-405h) kikapcsoljuk, és

(bb) a fűtőelemet (10a, 10b, 10c, 404) bekapcsoljuk, és **hogy** a folyamatos rétegvezetés megszakadása esetén

(cc) bekapcsoljuk az UV-sugárzót (9a; 205a-205h; 405a-405h; 503), és

(dd) kikapcsoljuk a fűtőelemet (10a, 10b, 10c, 404).

6. Az 1. igénypont szerinti üzemeltetési eljárás, **azzal jellemezve, hogy** a légáramlat melegítését a léghűtés (202; 203) egy levegő bevezető csatornájában (202) hajtjuk végre.

7. Az előző 3. vagy 6. igénypontok egyike szerinti üzemeltetési eljárás, **azzal jellemezve, hogy** a besugárzó készüléknek reflektora (402) van, egy, az UV-sugárzó (405a-405h) felőli, és egy, az UV-sugárzóval (405a-405h) ellentétes oldalon, és **hogy** a légáramlat melegítését a reflektorral (202) ellentétes oldalon elrendezett fűtőelemmel (404) végezzük.

8. Az előző 3. 4. 6. vagy 7. igénypontok egyike szerinti üzemeltetési eljárás, **azzal jellemezve, hogy** a légáramlat az UV-sugárzót (9a; 205a-205h) a sugárzó-hossziranyhoz képest merőlegesen körüláramolja.

9. Az előző igénypontok egyike szerinti üzemeltetési eljárás, **azzal jellemezve, hogy** a bevezetési sebességet egy érzékelővel (11) folyamatosan regisztráljuk.

10. Az előző igénypontok egyike szerinti üzemeltetési eljárás, **azzal jellemezve, hogy** az UV-sugárzó (9a; 205a-205h; 405a-405h; 503) hőmérsékletét egy érzékelővel folyamatosan (12) regisztráljuk.

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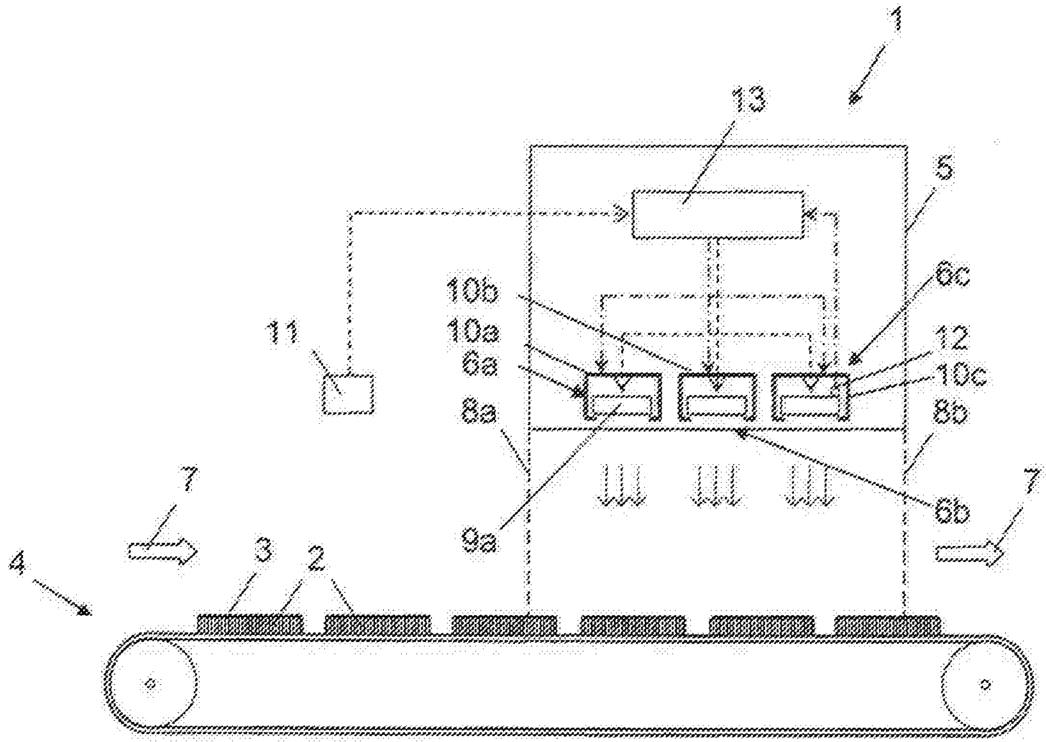
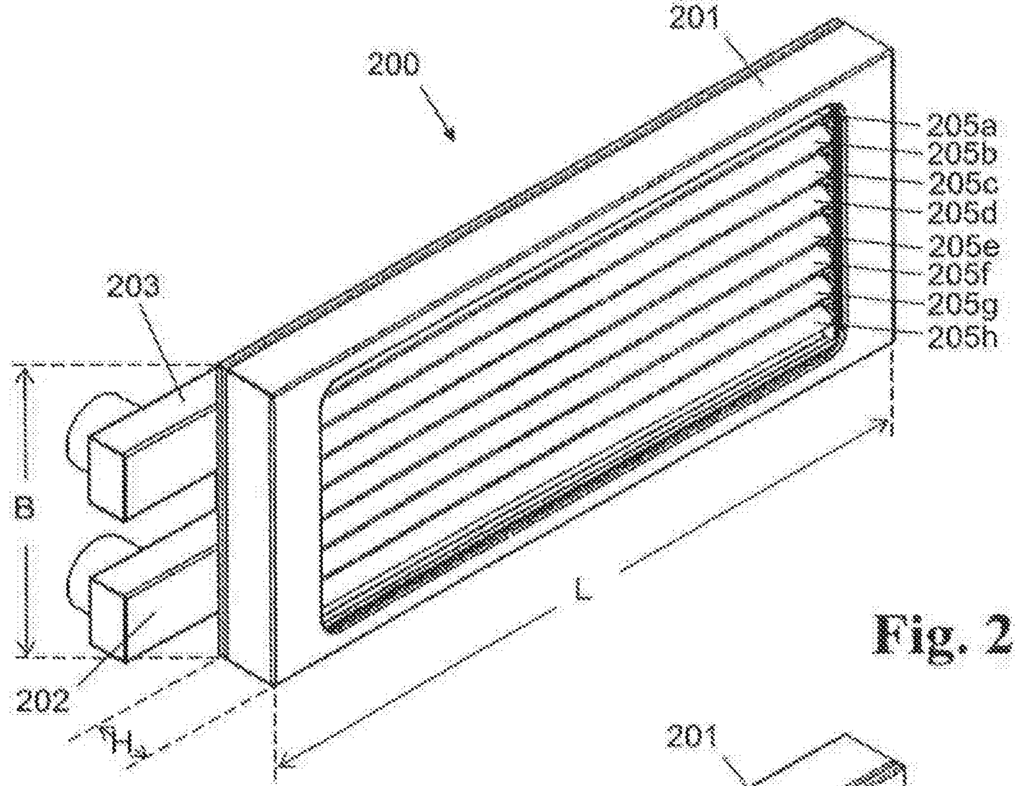
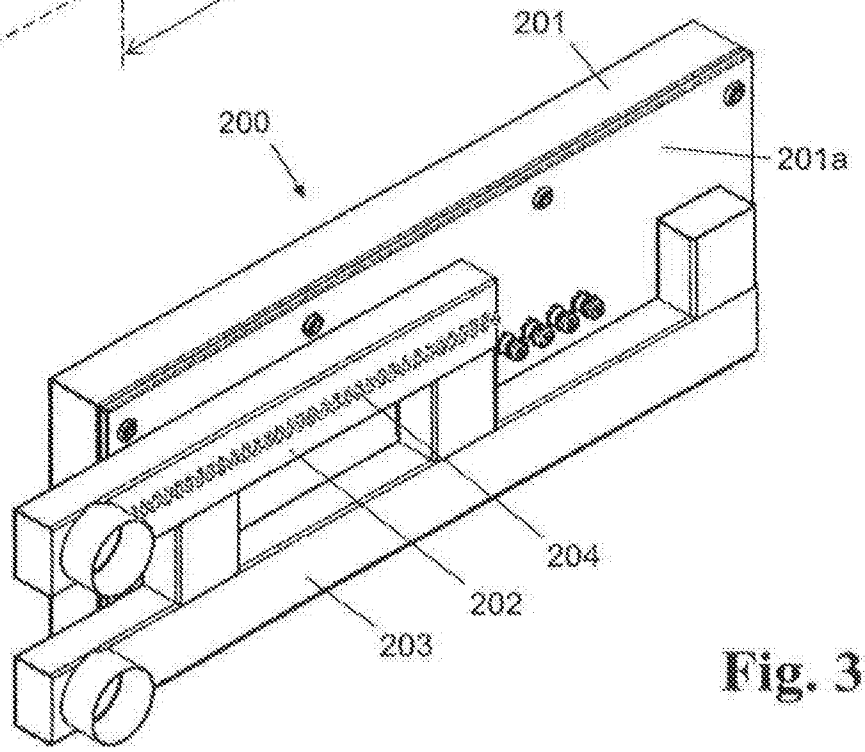


Fig. 1



200
201
205a
205b
205c
205d
205e
205f
205g
205h
203
B
L
202
H

Fig. 2



201
200
201a
204
202
203

Fig. 3

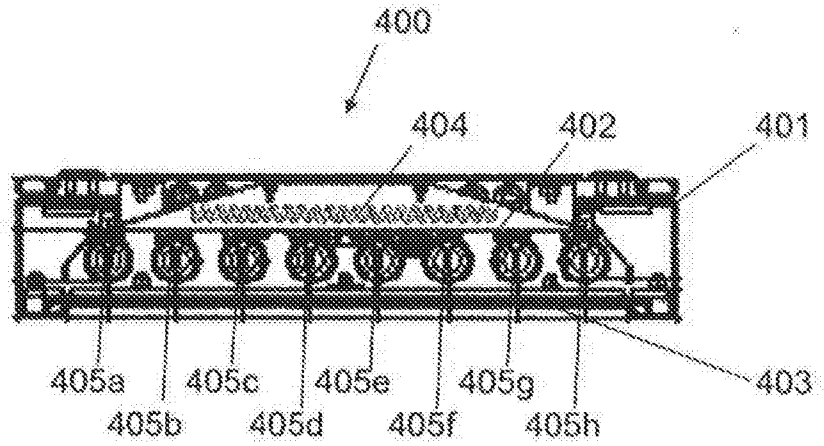

400
404
402
401
405a
405b
405c
405d
405e
405f
405g
405h
403

Fig. 4

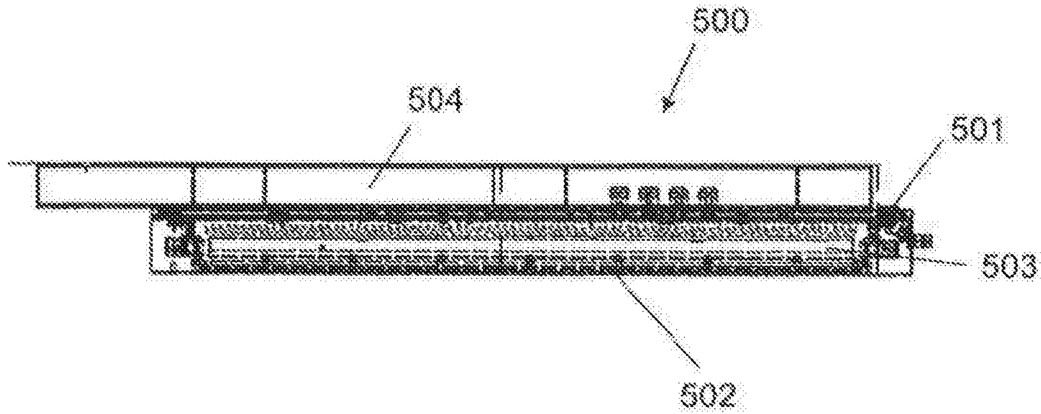

500
504
501
503
502

Fig. 5

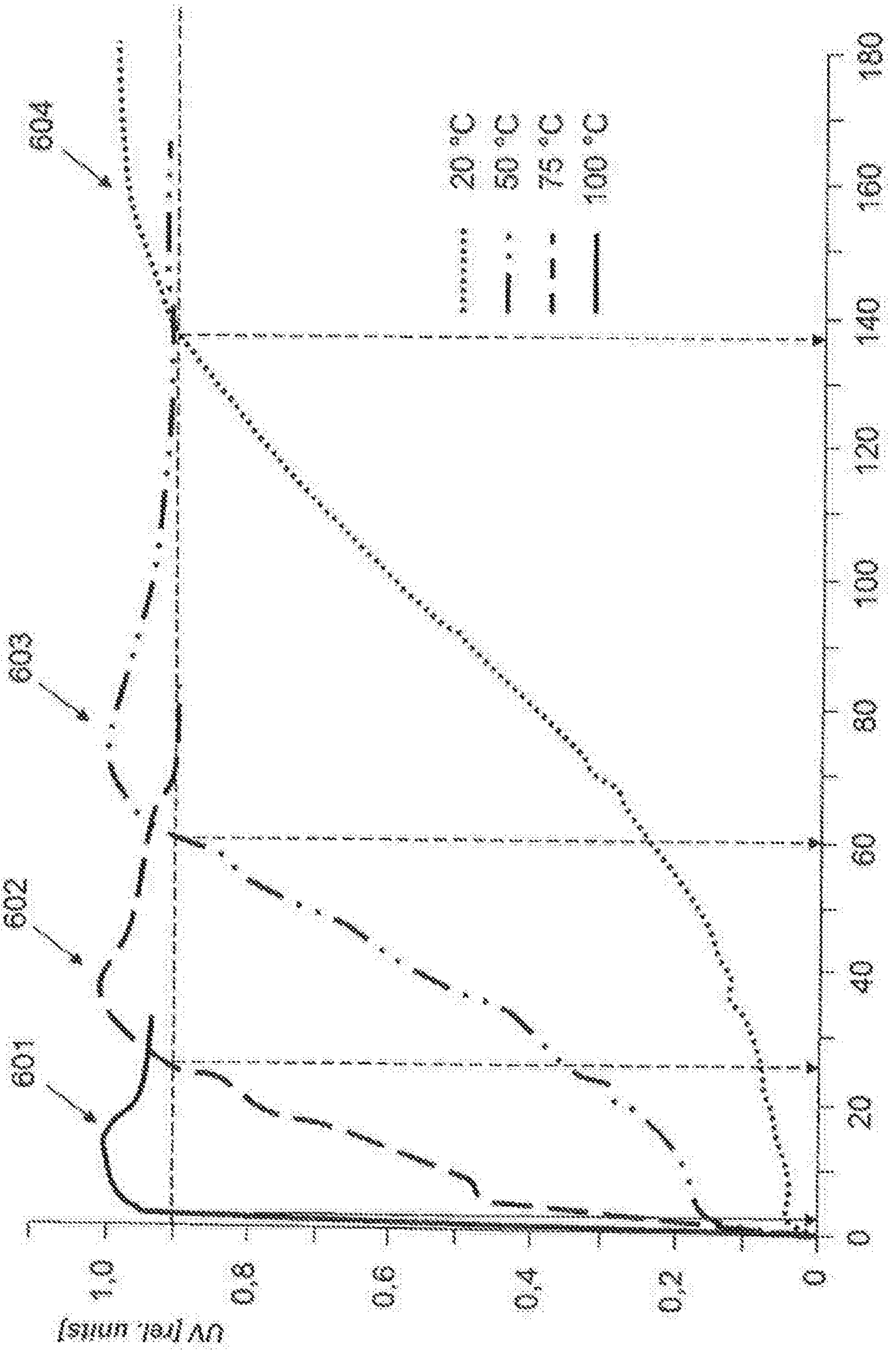

UV [rel. units]
1,0
0,8
0,6
0,4
0,2
0
0
20
40
60
80
100
120
140
160
180
t [s]
601
602
603
604
20 °C
50 °C
75 °C
100 °C

Fig. 6