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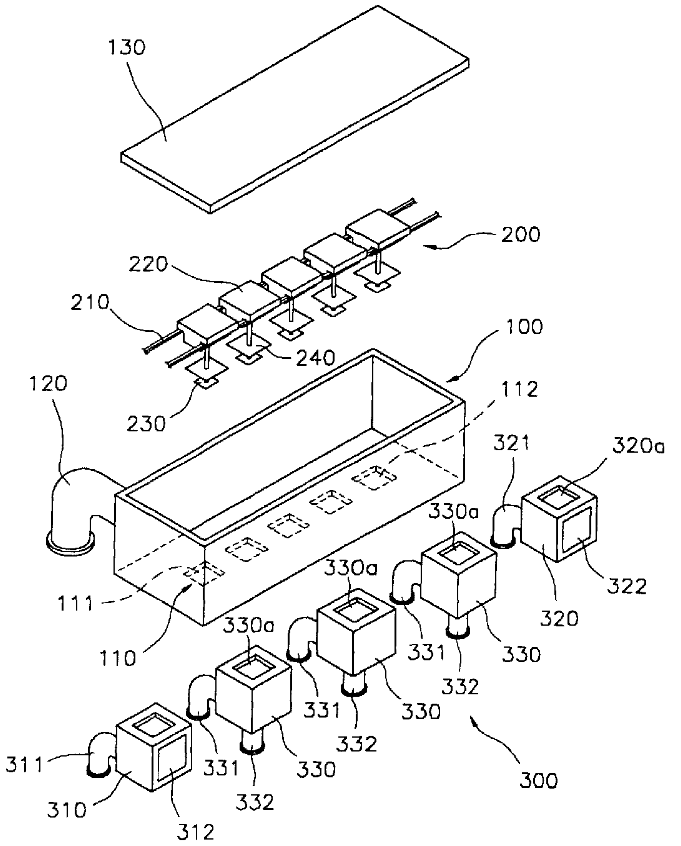
(54) **Title:** APPARATUS FOR MANUFACTURING ORGANIC ELECTRO-LUMINESCENT LIGHT EMITTING DEVICES FOR MASS PRODUCTION



(57) Abstract: The present invention relates to an apparatus for manufacturing an organic electro-luminescent device, and more particularly, to an apparatus for manufacturing an organic electro-luminescent device including a thin film with at least one player. The apparatus for manufacturing the organic electro-luminescent device according to the present invention comprises a substrate carrying chamber 100 in which a plurality of openings 110 for installation of processing chambers are formed and a pump port 120 is installed, a substrate carrying means 200 installed in the substrate carrying chamber 100 for carrying substrates processed in the plurality of openings to next openings within the substrate carrying chamber 100, and a plurality of chambers 300 attached to the openings 100 of the substrate carrying chamber 100, respectively. Accordingly, the substrates can be carried within the substrate carrying chamber and relevant processes such as substrate cleaning, mask alignment and cleaning, and vapor deposition can be simultaneously performed within the plurality of chambers.

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APPARATUS FOR MANUFACTURING ORGANIC ELECTRO-LUMINESCENT LIGHT EMITTING DEVICES FOR MASS PRODUCTION

Technical Field

The present invention relates to an apparatus for manufacturing an organic electro-luminescent light emitting device for mass production, and more particularly, to an apparatus for manufacturing a multi-layer thin film of an organic electro-luminescent light emitting device by causing a substrate or an assembly with the substrate and a mask integrated with each other to be carried within a substrate carrying chamber, and allowing processes of substrate loading and cleaning, mask aligning and aligning, vapor deposition and substrate unloading to be simultaneously performed in several processing chambers.

Background Art

In a case where semiconductor devices or light emitting devices are manufactured, processes composed of numerous manufacturing stages are generally needed. In order to perform multistage manufacturing processes, chambers for respective processes are usually constructed and substrates are carried into the chambers to go through various processes different from one another.

Heretofore, the chambers have been disposed in a circular fashion, and the substrates can be carried into the respective chambers by installing a magnetic bar at the center of the chambers or using a robot arm. That is, each of the substrates has been subjected to a specific process within one chamber, carried from the chamber and into the other chamber, and then subjected to another process within the other chamber. By repeating these processes, the devices have been manufactured.

However, in a case where the substrates are carried using the magnetic bar as described above, the length of the magnetic bar is limited and the substrates can also be carried between only two chambers. Thus, there is a problem in that it is difficult to perform successive processes through the plurality of vacuum chambers.

Further, the robot arm can be generally used when processing small substrates.

Thus, if the robot arm is applied to large substrates, an additional carrying means is needed.

In a case where the substrates are carried using the robot arm in a vacuum condition, the robot arm cannot hold the substrates using a method such as vacuum lifting. Thus, the substrates should be positioned onto the robot arm owing to only their own weights and their positions may be shifted when acceleration of motion of the robot arm is increased. Therefore, there is a problem in that it is not easy to keep the substrates at their correct positions in next mask aligning and vacuum deposition processes.

Accordingly, if the substrates are carried using such a robot arm, the robot arm should be used at a reduced acceleration of motion thereof while carrying the substrates. Consequently, there is another problem in that transport time required for carrying the substrates is increased.

Furthermore, if the size of the substrate is increased, the transport time is more increased and the size of a carrying chamber positioned in the middle of a transport system is also increased. Thus, a transport path of the substrate is lengthened and a burden on a vacuum pump is also increased.

Moreover, the transport system using such a robot arm should be configured in such a manner that a substrate located within one chamber is transported into the other chamber and is then transported and positioned into another empty chamber. Thus, there are problems in that the substrate should be transported twice to complete the transport works and the two transport works should be made in the same manner within each of the chambers.

In addition, if a vapor deposition source is depleted during a vapor deposition process, the process should be ceased and a vacuum state in the chamber should be changed to an atmospheric pressure state. Then, a new vapor deposition source should be supplied. In such a case, there is a disadvantage in that it takes much time to manufacture a thin film.

On the other hand, in a case where a process of manufacturing a multi-layer thin film is performed in one chamber in which a plurality of vapor deposition cells are installed, there is a risk of contamination of respective layers of the thin film between the manufacturing processes of the layers. Thus, an additional device for avoiding the contamination risk is needed. In particular, there is a great need for the device in an organic thin film.

Disclosure of Invention

The present invention is contemplated to solve the above problems. An object of the present invention is to provide an apparatus for manufacturing an organic electro-luminescent device for mass production, wherein when an organic or inorganic multi-layer thin film is formed to manufacture the organic electro-luminescent device onto a substrate, manufacturing time can be shortened by efficiently carrying the substrate and a thin film can be caused to effectively grow on the substrate in a state where they are not mutually contaminated.

Another object of the present invention is to provide a rotary vapor deposition cell exchange apparatus capable of exchanging a vapor deposition cell without destroying a vacuum state within a vapor deposition chamber of an apparatus for manufacturing an organic electro-luminescent device for mass production.

In order to achieve the above objects of the present invention, there is provided an apparatus for manufacturing an organic electro-luminescent device for mass production, comprising a linear substrate carrying chamber in which a plurality of openings are formed and a pump port is installed so that chambers for performing substrate loading, substrate cleaning, mask alignment, substrate unloading and a plurality of vapor deposition processes can be installed therein; a substrate carrying means installed in the substrate carrying chamber for carrying substrates processed in the plurality of openings to next openings within the substrate carrying chamber; and a plurality of chambers attached to the openings of the substrate carrying chamber, respectively.

Brief Description of Drawings

FIG. 1 is an exploded perspective view of an apparatus for manufacturing an organic electro-luminescent device for mass production according to a preferred embodiment of the present invention;

FIG. 2 is a front sectional view of the apparatus for manufacturing the organic electro-luminescent device for mass production according to the preferred embodiment of the present invention;

FIG. 3 is a side sectional view of the apparatus for manufacturing the organic electro-luminescent device for mass production according to the preferred embodiment of the present invention;

FIG. 4 is a perspective view of a unit structure which constructs the apparatus for manufacturing the organic electro-luminescent device for mass production according to the present invention;

FIG. 5 is a sectional view showing a state where a plurality of unit structures are connected with one another;

FIG. 6 is a schematic view of a substrate carrying means of the apparatus for manufacturing the organic electro-luminescent device for mass production according to the present invention;

FIG. 7 is a schematic view of the substrate carrying means as viewed in a direction of an arrow a of FIG. 6;

FIG. 8 is a plan view of an apparatus for manufacturing an organic electro-luminescent device for mass production according to another preferred embodiment of the present invention;

FIG. 9 is a side sectional view of the apparatus for manufacturing the organic electro-luminescent device for mass production according to the another preferred embodiment of the present invention;

FIG. 10 is an exploded perspective view of an apparatus for manufacturing an organic electro-luminescent device for mass production according to a further preferred embodiment of the present invention;

FIG. 11 is a bottom view of the apparatus for manufacturing the organic electro-luminescent device for mass production according to the further preferred embodiment of the present invention;

FIG. 12 is a sectional view of the apparatus for manufacturing the organic electro-luminescent device for mass production according to the further preferred embodiment of the present invention;

FIG. 13 is a sectional view of a rotary vapor deposition cell exchange means for use in the apparatus for manufacturing the organic electro-luminescent device for mass production according to the present invention; and

FIG. 14 is a perspective view showing the interior of the rotary vapor deposition cell exchange means for use in the apparatus for manufacturing the organic electro-luminescent device for mass production according to the present invention.

Best Mode for Carrying Out the Invention

Hereinafter, preferred embodiments of the present invention will be explained in detail with reference to the accompanying drawings.

FIG. 1 is an exploded perspective view of an apparatus for manufacturing an organic electro-luminescent device for mass production according to a preferred embodiment of the present invention, FIG. 2 is a front sectional view of the apparatus for manufacturing the organic electro-luminescent device for mass production according to the preferred embodiment of the present invention, and FIG. 3 is a side sectional view of the apparatus for manufacturing the organic electro-luminescent device for mass production according to the preferred embodiment of the present invention. As shown in these figures, the present invention comprises a substrate carrying chamber 100 on which a plurality of openings 110 for installation of processing chambers are formed and a pump port 120 is installed; a substrate carrying means 200 installed in the substrate carrying chamber 100 for carrying the substrate, which relevant process has gone through one of the plurality of openings 110, to the next opening 110 within the substrate carrying chamber 100; and a plurality of chambers 300 attached to the openings of the substrate chamber 100, respectively.

The substrate carrying chamber 100 is manufactured in the form of an elongated box, and is formed with the plurality of openings 110 to which the chambers for performing processes of substrate cleaning, mask attachment and alignment, vapor deposition, substrate loading, substrate unloading and the like can be installed. Further, a lid 130 may be installed to the substrate carrying chamber 100 so that the substrate carrying means 200 can be easily mounted thereto.

The plurality of chambers 300 generally comprises a loading chamber 310, processing chambers 330 for vapor deposition and other processes, and an unloading chamber 320. The loading chamber 310 is installed to an opening 111 formed at one longitudinal end of the substrate carrying chamber 100 and includes a pump port 311 and a door 312.

The unloading chamber 320 is installed to an opening 112 formed at the other longitudinal end of the substrate carrying chamber 100, and includes a pump port 321 and a door 322. The plurality of processing chambers 330 are installed to the openings 110 of the substrate carrying chamber 100 between the loading and unloading chambers, and each of the processing chambers includes a pump port 331 and a vapor deposition cell port 332.

The processing chambers 330 are installed to the openings 110 of the substrate carrying chamber 100 so as to perform the processes of substrate cleaning, mask attachment and alignment, vapor deposition, and the like. The processing chambers are classified into a substrate cleaning chamber which includes the pump port and a door, a mask alignment chamber which is attached to the opening of the substrate carrying chamber and includes the pump port and a door, and a plurality of vapor deposition chambers each of which includes the pump port and the vapor deposition cell port, according to their respective functions.

Each of the processing chambers is configured in such a manner that an inlet 330a is formed at the top thereof; a vapor deposition port 332 for installation of a substrate cleaning apparatus, a mask alignment apparatus or the vapor deposition cell in case of the vapor deposition process is formed at the bottom thereof; and the pump port 331 for a vacuum pump is installed to a rear end thereof.

The numbers of openings 110 and processing chambers 330 formed on the substrate carrying chamber 100 may vary according to the number of relevant devices to be manufactured. For example, in case of the organic electro-luminescent device, however, the numbers of openings and chambers amount to about 20, respectively. In a case where the numbers of openings and chambers are increased as such, the length of the substrate carrying chamber 100 is lengthened. Thus, it is preferred in view of effective use of space that the substrate carrying chamber be made in the form of a straight line, a doughnut, or a U character.

In addition, the substrate carrying means 200 comprises rails 210, moving parts 220 which move on the rails 210 in a one-way direction, and substrate holders 230 attached to the moving parts 220 for holding the substrates thereon. In such a case, it is preferred that the substrates be carried in a state where they are attached to a conveyor belt type moving means.

The plurality of moving parts 220 are used so that they can be sequentially moved along above the respective processing chambers 330 after the respective processes are completed therein. The moving parts 220 with the finished substrates attached thereto may be sequentially accumulated or collected at one side of the substrate carrying chamber (although not shown).

In some cases, each of the moving parts 21 may further include a cover valve 240 for closing the opening 110 of the substrate carrying chamber 100 so that the opening 110 located at the bottom of the substrate carrying chamber 100 can be closed up with the cover valve via a sealing means 10 when the substrate holder 230 is lowered into the processing chamber 330.

It is preferred that a generally used O-ring be used as the sealing means.

As described above, since the substrate carrying chamber 100 is isolated from the processing chambers 330 upon the vapor deposition of the substrates, the contamination due to evaporated gas from the processing chambers can be prevented and a high degree of vacuum can be maintained.

As another example, the substrate carrying means 200 may comprise a pair of chains and a plurality of substrate holders attached to the chains at a predetermined interval, so that the same advantageous effects can be obtained (although not shown).

As described above, the substrate carrying chamber 100 and the plurality of chambers 300 may be constructed as such by attaching the plurality of chambers 300 to the substrate carrying chamber 100. However, even when a plurality of unit structures 150 with a single chamber and the substrate carrying chamber integrated with each other are repeatedly coupled with one another as shown in FIGS. 4 and 5, the configuration shown in FIG. 2 can be obtained as a whole.

That is, after the unit structures 150 in which the one chamber and a portion of the substrate carrying chamber are integrally formed with each other as a bottom portion 152 and a top portion 151, respectively, are repeatedly bonded to one another, the top portions 151 of the adjacent unit structures 150 are in communication with each other through open communication portions 151a so that the substrate carrying chamber 100 for accommodating the substrate carrying means 200 therein is defined, whereas the bottom portions 152 of the adjacent unit structures 150 are coupled with each other via walls so that the respective chambers 300 for performing the vapor deposition, substrate loading and substrate unloading functions are defined.

Further, as shown in FIG. 6, the unit structure 150 may be configured such that separate top and bottom portions 151, 152 are coupled with each other.

A substrate carrying means 200 with a two-story structure is proposed in FIG. 6. FIG. 7 is a schematic view as viewed in a direction of an arrow a of FIG. 6. As shown in the figure, the substrate carrying means 200 is constructed in the form of the two-story structure within the top portion 151 of the unit structure 150, and comprises the pair of rails 210 composed of an upper rail 211 and a lower rail 212, and moving parts 220 moving along the rails 210.

In the preferred embodiment of the present invention, the moving parts 220 move along the lower rail 212 in a one-way direction and the vapor deposition is performed within the chambers defined by the successive unit structures 150. If a series of vapor deposition processes are completed when the moving parts arrive at a longitudinal end of the successive unit structures, the moving parts 210 are conveyed to the upper rail 211 in an additional chamber and then return in an opposite direction.

In addition, as shown in FIG. 7, a substrate 221 and a mask 222 for use in vapor deposition are integrally attached onto each of the moving parts 220 and the vapor deposition is performed while moving together with the relevant moving part 210. It is apparent that the mask 222 can be exchanged in a separate chamber depending on the respective processes.

In the meantime, when manufacturing the organic electro-luminescent device composed of a hole injection layer, a hole transport layer, a light-emitting layer, an electron transport layer, electrodes, and the like, processing pressures needed for manufacturing respective organic thin films of the device are identical with one another. Thus, it is unnecessary to isolate the respective unit processing chambers from one another using valves. Accordingly, as shown in FIG. 7, it is preferred that the respective processing chambers be sealed with a concavo-convex baffle 153 formed between the top and bottom portions 151, 152 instead of using the cover valve 240 and the sealing means 10 as in the previous preferred embodiment. At the same time, it is also preferred that substantial flow of particles be prevented by complicating a path through which the particles produced from the rails 210, the moving parts 220, inner walls of the unit structures 150, and the like can move toward the substrate 221 and the mask 222 to be vapor deposited (refer to a dotted arrow in FIG. 7).

Furthermore, the aforementioned processes of causing the moving parts 220 to be conveyed to the upper rail 211 and to be returned and exchanging the mask 222 within the separate chamber can be performed by using a vertical transport chamber 160 and mask exchange chambers 170, as shown in FIGS. 8 and 9.

That is, the vertical transport chamber 160 includes a vertical transport panel 161 movable in a vertical direction and exchange rails 213 disposed vertically above the rails 210 with a predetermined height difference. The exchange rails 213 are configured to be connected to the mask exchange chambers 170.

The mask exchange chambers 170 are disposed at both lateral sides of the vertical transport chamber 160 with respect to a direction in which the successive unit structures 150 are coupled with one another (i.e., lateral sides perpendicular to the direction) such that used masks are positioned at one side while new masks are positioned at the other side.

FIG. 10 is an exploded perspective view of an apparatus for manufacturing an organic electro-luminescent device for mass production according to a further preferred embodiment of the present invention, FIG. 11 is a bottom view of the apparatus for manufacturing the organic electro-luminescent device for mass production according to the preferred embodiment of the present invention, and FIG. 12 is a sectional view of the apparatus for manufacturing the organic electro-luminescent device for mass production according to the preferred embodiment of the present invention. The preferred embodiment of the present invention shown in the figures has a technical feature in that a pump port is installed at one side of the substrate carrying chamber 100, the substrate carrying chamber 100 is formed to take the shape of a cylindrical or polygonal box, and a plurality of openings 110 are formed on a bottom surface of the substrate carrying chamber 100 at an equidistance from a central axis of the box.

Further, the substrate carrying means 200 according to the present embodiment comprises a central shaft 250 installed at the center of the substrate carrying chamber 100 taking the shape of the cylindrical or polygonal box, a plurality of rods 260 branched from the central shaft 250, and a plurality of substrate holders 230 installed to the plurality of rods 260, respectively, so that respective substrates can be carried by causing the central shaft 250 to rotate.

At this time, the substrate carrying chamber 100 may also be provided with a lid 140. In such a case, it is preferred that the lid 140 be provided with a main lid portion 141 in which the central shaft 250 can be positioned.

Thus, after a relevant vapor deposition process has been completed, the central shaft 250 is caused to rotate at a predetermined angle by using a rotating means (not shown) so that the vapor deposition on the substrate can be performed in the next processing chamber 330.

In the meantime, if a vapor deposition source of a vapor deposition cell is depleted when mass producing a multi-layer thin film substrate, it is necessary to exchange the depleted vapor deposition source for a new one. FIGS. 13 and 14 show a rotary vapor deposition cell exchange means 400 capable of continuously inserting vapor deposition cells A into the processing chambers 330 without destroying its vacuum state within the apparatus for manufacturing the organic electro-luminescent device for mass production according to the present invention.

Such a rotary vapor deposition cell exchange means 400 comprises an upper chamber 410 which includes a connection port 411 connected to the vapor deposition cell port 332 of the processing chamber 330, a lower chamber 420 which is rotatably coupled with the upper chamber 410 and on which a plurality of vapor deposition cells A are placed, and a rotating means (not shown) for causing the lower chamber 420 to rotate. Thus, even though the vapor deposition source has been depleted during the respective vapor deposition processes, the vapor deposition cells A can be efficiently exchanged without destroying the vacuum state within the respective chambers 300.

As shown in FIG. 14, since the plurality of vapor deposition cells A are disposed on a floor of the lower chamber 420 along its circumference, the process can be continued until all the vapor deposition cells A are completely consumed.

Next, an operation and effect of the present invention will be explained in detail with reference to FIGS. 1 to 14.

The substrate to be subjected to thin film processing is attached to the substrate holder 230 in the loading chamber 310. The substrate attached to the substrate holder 230 is carried to the next processing chamber 330 in which the substrate cleaning and mask alignment process in turn is performed. Then, due to various vapor deposition processes in the processing chambers, the multi-layer thin film is formed on an assembly with the substrate and mask integrated with each other. Further, the next substrate to be subjected to the thin film processing will be simultaneously attached to the substrate holder 230 in the loading chamber 310.

At this time, the loading chamber 310 is caused to be isolated from the substrate carrying chamber 100 in a vacuum state by means of the cover valve 240 or an additional valve so that only the loading chamber can be exposed to the atmosphere without destroying the vacuum state in the substrate carrying chamber 100.

In the same manner as the loading chamber, the unloading chamber 320 can be isolated from the substrate carrying chamber 100 by means of the valve, and the finished substrate can be taken out from the unloading chamber 320 without destroying the vacuum state in the substrate carrying chamber 100 and the processing chambers 330.

Since substrate loading and unloading processes and several vapor deposition processes can be simultaneously performed in such a manner, the multi-layer thin film substrate can be mass produced and thus manufacturing time can also be shortened.

In the meantime, a process of manufacturing the organic electro-luminescent device composed of the hole injection layer, the hole transport layer, the light-emitting layer, the electron transport layer, the electrodes, and the like will be discussed as follows.

The manufacture of the organic electro-luminescent device is done by performing the substrate cleaning, UV-ozone or plasma processing, alignment of the substrate and the mask for use in the organic thin film, manufacture of the thin film composed of the hole injection layer, hole transport layer, the light-emitting layer and the electron transport layer, alignment of the substrate and the mask for the electrodes, the thin film processing for the electrodes, a sealing process of protecting the manufactured device from moisture and oxygen, and the like.

Since the process of performing the UV-ozone or plasma processing for the cleaned substrate is made under a pressure different from that of the process of manufacturing the organic thin film, an additional valve should be installed to perform the process. A stage where the substrate and the mask are aligned with each other is out of a region where the vapor deposition is performed.

The aligned substrate and mask manufactures the thin film by using an organic material evaporated from an evaporation source. In a case where a single furnace is used, the substrate is rotated to improve uniformity of the thin film. In a case where a linear evaporation source is used, the substrate, the mask or the linear evaporation source is linearly scanned to manufacture the film. The subsequent processes of manufacturing the organic thin film are repeated in the same way.

After the process of manufacturing the organic thin film as described above has been completed, the mask for the organic thin film is removed and the mask for electrodes is aligned with the substrate. Then, the substrate is carried to a stage for the process of manufacturing the electrodes.

In the process of manufacturing the electrodes, the electrodes such as transparent and metal electrodes are manufactured by using vapor deposition and sputtering methods.

If the electrode manufacture is completed, the substrate is carried to a stage for the process of manufacturing protective layers in which a multi-layer structure is manufactured with the organic thin film, oxide thin film, nitride thin film and combination thereof for allowing the device to be protected from a degradation source such the moisture or oxygen.

The above processes are simultaneously performed for the plurality of substrates 221 in the apparatus for manufacturing the organic electro-luminescent device for mass production according to the present invention and also performed to the substrates carried to the respective chambers 300 by the substrate carrying means 200.

In a case where the process for manufacturing such an organic electro-luminescent device is applied to the manufacture of multicolored or natural color devices, the organic thin films composed of the hole injection layer, the hole transport layer, the light-emitting layer, the electron transport layer, and the like are arranged in accordance with their respective colors and then repeatedly processed, after the substrate processing.

When such an organic electro-luminescent device is manufactured, the processing pressures needed for manufacturing the respective organic thin films are identical with one another. Thus, it is not necessary to isolate the unit processing chambers from one another with valves. Since the length of the whole equipment can be excessively increased, it is preferred, as shown in FIGS. 6 to 9, that the same unit structures 150 be successively connected to one another, the two-story rails 210 and the vertical transport chamber 160 be configured such that the moving parts 220 can be collected, and the mask exchange chamber 170 be configured such that the masks 222 discharged after the respective vapor deposition processes can be returned to their original positions.

With such a configuration, a procedure of the vapor deposition process is as follows.

That is, while the substrate 221 and the mask 222 are moved along the respective chambers 300 in a state where they are attached to the moving parts 220 of the substrate carrying means 200, the respective vapor deposition processes are performed.

Then, if one unit process has been completed, the moving parts 220 with the substrate 221 and the mask 222 attached thereto reach the vertical transport chamber 160.

At this time, different kinds of masks 222 for the next process are positioned at the mask exchange chamber 170 located at one side (e.g., an upper side of FIG. 8) of the vertical transport chamber 160. First, the moving parts 220 transfer to the exchange rails 213 through the vertical transport chamber 160 and move to the mask exchange chamber 170 located at the other side (e.g., a lower side of FIG. 8) of the vertical transport chamber so that the mask 222 already used in the previous process is separated and collected.

Then, the moving parts 220 are moved to the mask exchange chamber 170 located at the one side of the vertical transport chamber so that the different kinds of masks 222 can be attached thereto. Thereafter, the moving parts 220 are moved to the vertical transport chamber 160 via the exchange rail 213 and enter the next vapor deposition process.

If the aforementioned vapor deposition processes have been completed, the moving parts 220 and the masks 222 are collected in reverse order to the above mask exchange order.

That is, the moving parts 220 transfer to the upper rail 211 from the vertical transport panel 161 of the vertical transport chamber 16 and then move along the upper rail 211 in a direction opposite to a moving direction of the moving parts during the vapor deposition process.

At this time, the masks 222 attached to the moving parts 220 are returned to and collected at their original positions. That is, the collection of the masks is performed in the reverse order to the mask exchange order.

First, each of the moving parts 220 is moved to the mask exchange chamber 170 located at the other side (the lower side of FIG. 8) so as to separate the used mask 222 from the moving part 220. Then, the moving part 220 is moved to the mask exchange chamber 170 located at the one side (the upper side of FIG. 8) so as to attach the mask 222 separated in the previous vapor deposition process to the moving part 220. Thereafter, the moving part 220 is moved to its original position. Such a procedure will be repeated as many times as the number of masks 222.

The basic functions of the loading chamber 310, the unloading chamber 320 and the processing chambers 330 in the preferred embodiment shown in FIGS. 10 to 12 are the same as in the previous preferred embodiments. Further, the number of the processing chambers 330 can be adjusted.

According to this embodiment, since the thin film manufacturing apparatus is particularly simple and the pump port is attached to the rear end (i.e., the interior) of the processing chamber 330, the space needed for installation of the apparatus can be reduced.

Further, the rotary vapor deposition cell exchange means 400 is configured to perform the vapor deposition with the relevant vapor deposition cell using the lower chamber 420 onto which the plurality of vapor deposition cells are disposed and to cause the lower chamber 420 to rotate at a predetermined angle when the vapor deposition source has been depleted.

Then, since a new vapor deposition cell A will be positioned at a location near the connection port 411, the vapor deposition process can be continuously performed using the new vapor deposition cell A.

At this time, the upper and lower chambers 410, 420 can be rotated with respect to each other as described above, but the O-ring is interposed between the two chambers so that spaces defined by the two chambers can be sealed. Accordingly, the vapor deposition cells can be exchanged without any influences on the vacuum state of and the vapor deposition processes in the processing chambers.

Industrial Applicability

According to the present invention, there are advantages in that the substrates can be successively carried to the respective processing chambers in a vacuum state and the multi-layer thin films can be mass produced by simultaneously performing the substrate loading, the substrate cleaning, the mask attachment and alignment, the substrate unloading, and the plurality of vapor deposition processes.

Further, since the vapor deposition cells containing different kinds of the vapor deposition sources are installed in the respective vapor deposition chambers, the multi-layer thin films can be manufactured without being mutually contaminated.

In addition, since the rotary vapor deposition cell exchange means is used in the present invention, the vapor deposition cells can be exchanged without destroying the vacuum state of the vapor deposition chambers. Accordingly, there is a further advantage in that the manufacturing time can be shortened.

CLAIMS

1. An apparatus for manufacturing an organic electro-luminescent device for mass production, comprising:

a linear substrate carrying chamber in which a plurality of openings are formed and a pump port is installed so that chambers for performing substrate loading, substrate cleaning, mask alignment, substrate unloading and a plurality of vapor deposition processes can be installed therein;

a substrate carrying means installed in the substrate carrying chamber for carrying substrates or assemblies with the substrate and a mask integrated with each other, which are processed in the plurality of openings, to next openings in the substrate carrying chamber; and

a plurality of chambers attached to the openings of the substrate carrying chamber, respectively.

2. The apparatus as claimed in claim 1, wherein the substrate carrying chamber and the plurality of chambers are configured by repeatedly coupling unit structures in which one chamber is integrated with the substrate carrying chamber with each other such that the substrate carrying chamber of one of the unit structures is connected with a substrate carrying chamber of an adjacent unit structure via an open communication portion and the chamber of one of the unit structures is connected with a chamber of an adjacent unit structure via walls.

3. The apparatus as claimed in claim 1, wherein the substrate carrying chamber is manufactured to be an elongated box taking the shape of a straight line, a polygon, a doughnut or a curved line as a whole.

4. The apparatus as claimed in claim 1, wherein the plurality of chambers comprises:

a loading chamber which is installed at one longitudinal end of the substrate carrying chamber and includes a pump port and a door;

an unloading chamber which is installed at the other longitudinal end of the substrate carrying chamber and includes a pump port and a door; and

processing chambers including a substrate cleaning chamber which is installed at the opening and has a pump port and a door, a mask alignment chamber which is installed at the opening and has a pump port and a door, and a plurality of vapor deposition chambers which are installed at the openings and have a pump port and a vapor deposition cell port, respectively.

5. The apparatus as claimed in claim 4, wherein each of the vapor deposition chambers further comprises a rotary vapor deposition cell exchange means including an upper chamber which has a connection port connected to the vapor deposition cell port of the vapor deposition chamber and a pump port, a lower chamber which is rotatably connected to the upper chamber and on which a plurality of vapor deposition cells are disposed, and a rotating means for causing the lower chamber to rotate.

6. The apparatus as claimed in claim 4, wherein the processing chambers comprises a plurality of chambers attached to the openings of the substrate carrying chamber, and the chambers for performing processes of substrate loading, substrate cleaning, mask attachment, mask cleaning, substrate unloading, and the like, which require vacuum and atmospheric environments to be alternately applied, are configured to be separately attached to the vapor deposition chambers linearly or side by side.

7. The apparatus as claimed in claim 1, wherein the substrate carrying means comprises rails, moving parts moving along the rails, and substrate holders attached to the moving parts for holding substrates, respectively, whereby the substrates can be carried in a state where they is attached to a conveyor belt type moving means.

8. The apparatus as claimed in claim 1, wherein the substrate carrying means comprises a pair of rails which has a two-story structure with an upper rail and a lower rail, and moving parts which move along the rails and to which substrates and masks are

attached at lower sides thereof, whereby vapor deposition is performed while the moving parts move along one of the upper and lower rails and the moving parts are then returned along the other of the rails.

9. The apparatus as claimed in claim 8, wherein a concavo-convex baffle for causing only a vapor deposition face of the substrate to be exposed to the vapor deposition chamber and preventing particles from occurring due to friction of the rails is further provided between the substrate carrying chamber and the vapor deposition chambers.

10. The apparatus as claimed in claim 6 or 8, wherein a vertical transport chamber including a vertical transport panel for transporting the moving parts up and down is further provided between the processing chambers for performing a series of unit processes.

11. The apparatus as claimed in claim 10, wherein a mask exchange chamber in which a mask is positioned or a mask attached to the moving part is separated therefrom and stored, and a mask cleaning chamber for cleaning a mask subjected to a predetermined vapor deposition process are disposed respectively at both sides of the vertical transport chamber, and the vertical transport chamber and the mask exchange chamber are connected with each other through exchange rails.

12. The apparatus as claimed in claim 1, wherein a cover valve is further provided to close up the opening between the substrate carrying chamber and each of the vapor deposition chambers.

13. The apparatus as claimed in claim 1, wherein the substrate carrying chamber is configured such that a pump port is installed at one side thereof, and the substrate carrying chamber is formed to take the shape of a cylindrical or polygonal box and has the plurality of openings formed on a bottom surface thereof at an equidistance from a central axis of the box.

14. The apparatus as claimed in claim 13, wherein the substrate carrying means comprises a central shaft installed at the center of the substrate carrying chamber (taking the shape of the cylindrical or polygonal box), and a plurality of substrate holders branched from and installed to the central shaft, whereby substrates can be carried by causing the central shaft to rotate.

FIG. 1

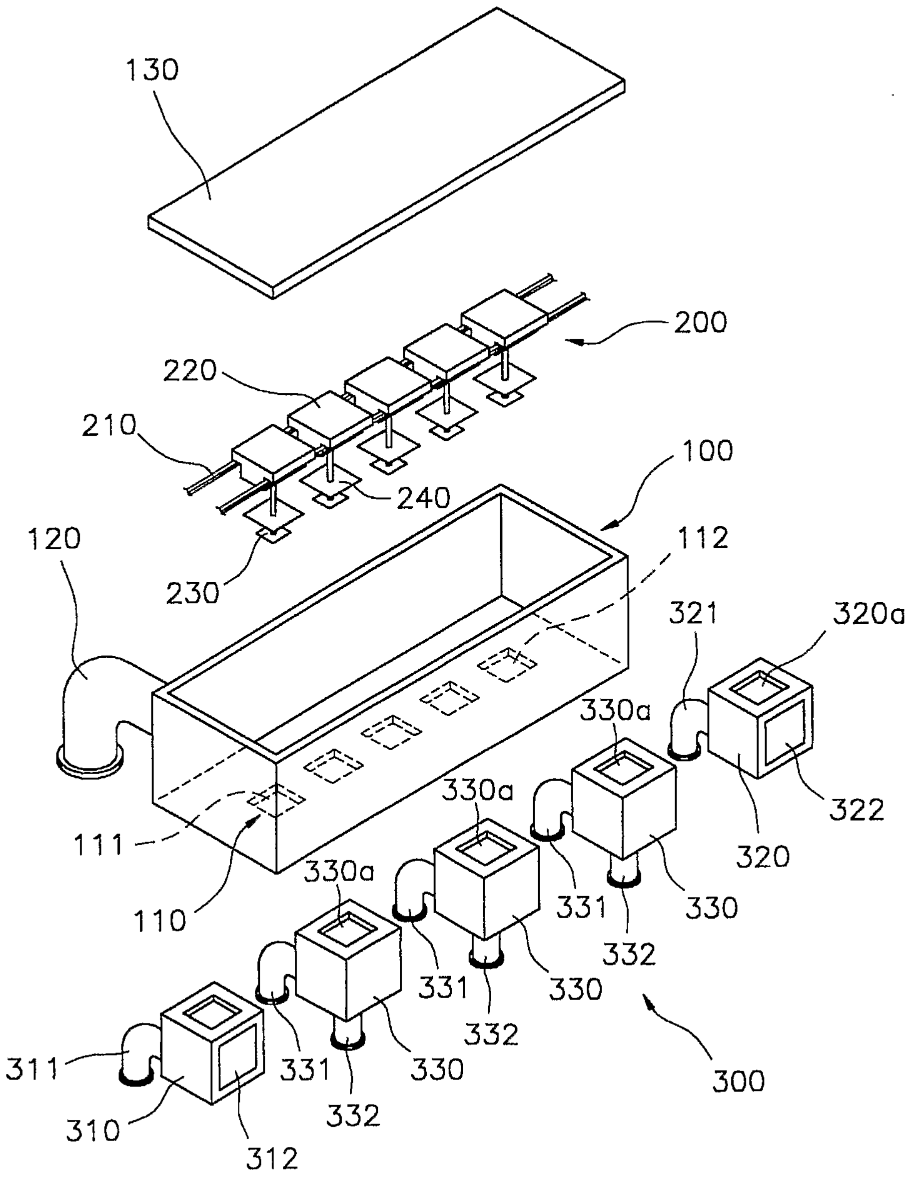
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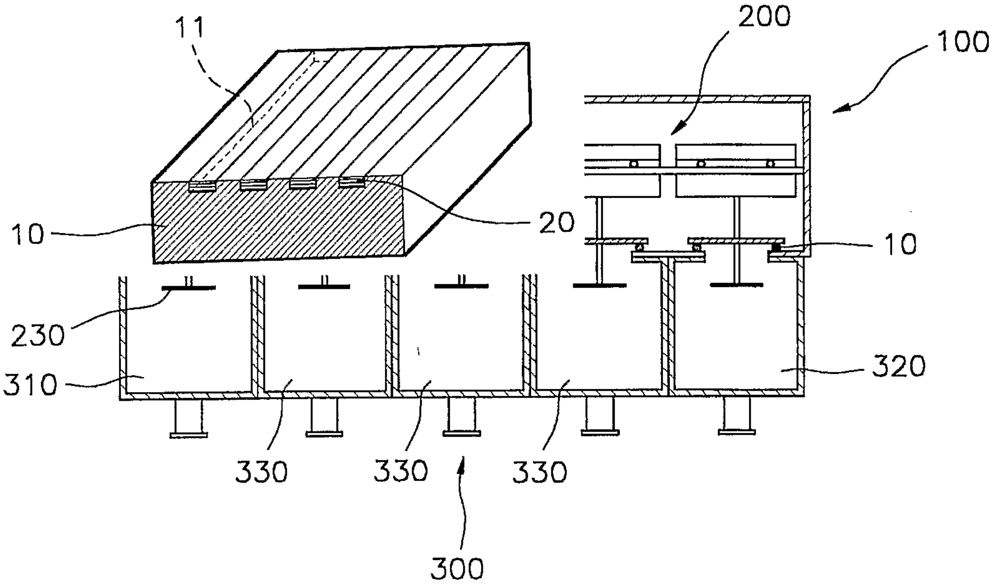
FIG. 2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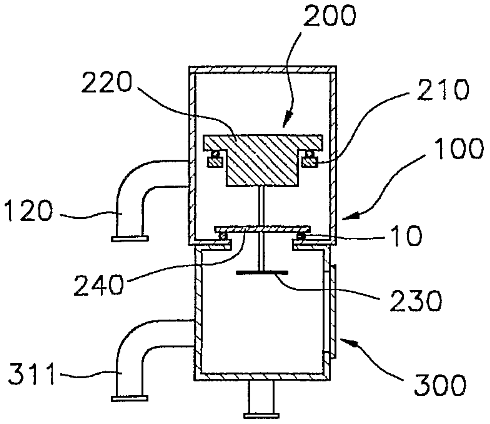
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FIG. 4

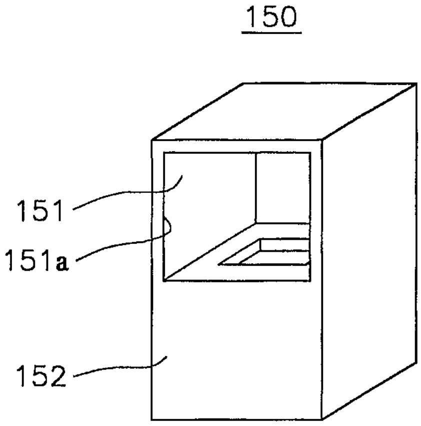
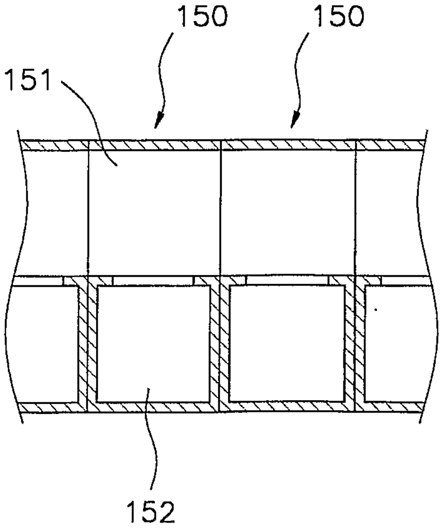


FIG. 5



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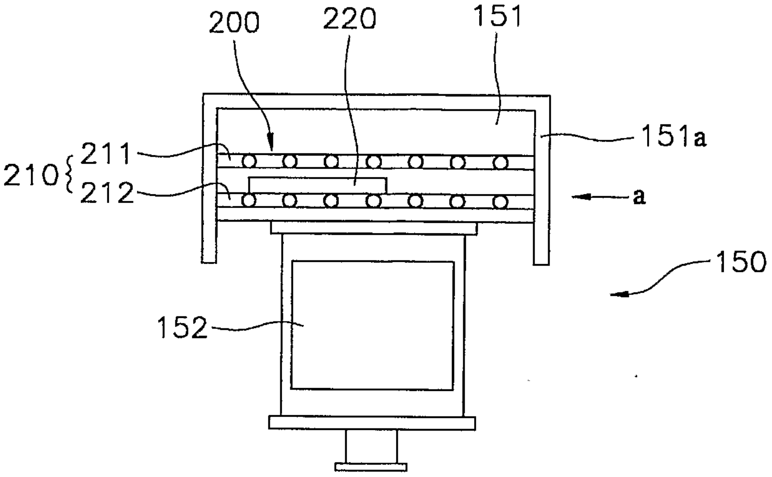
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FIG. 7

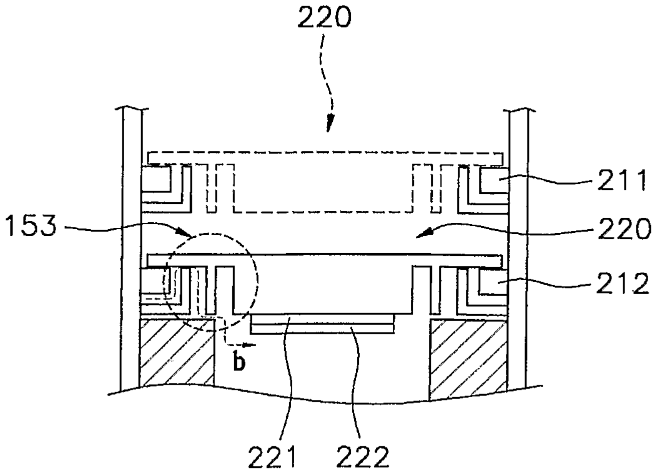
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FIG. 8

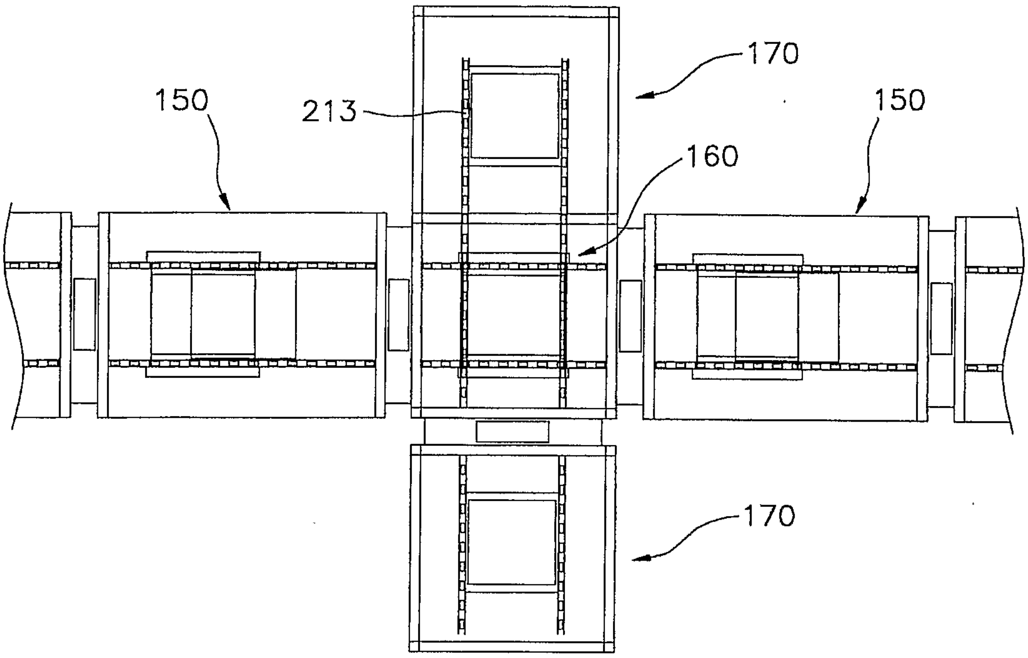

FIG. 9

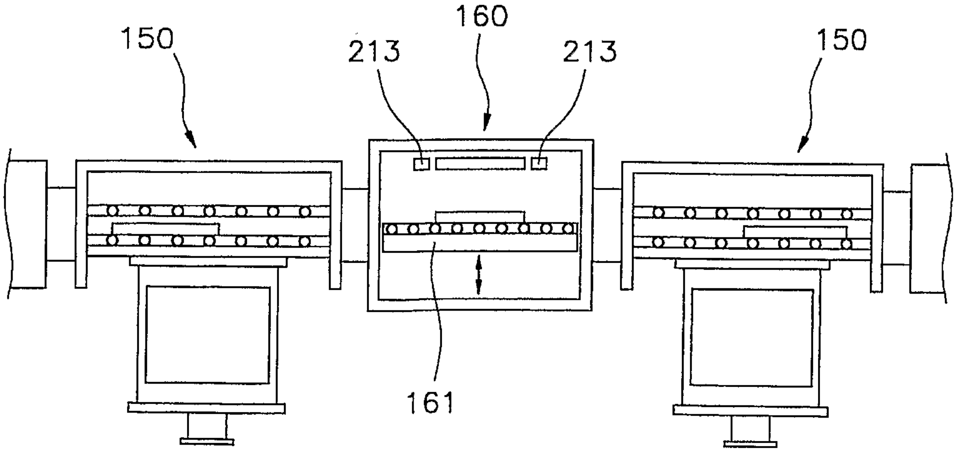

FIG. 10

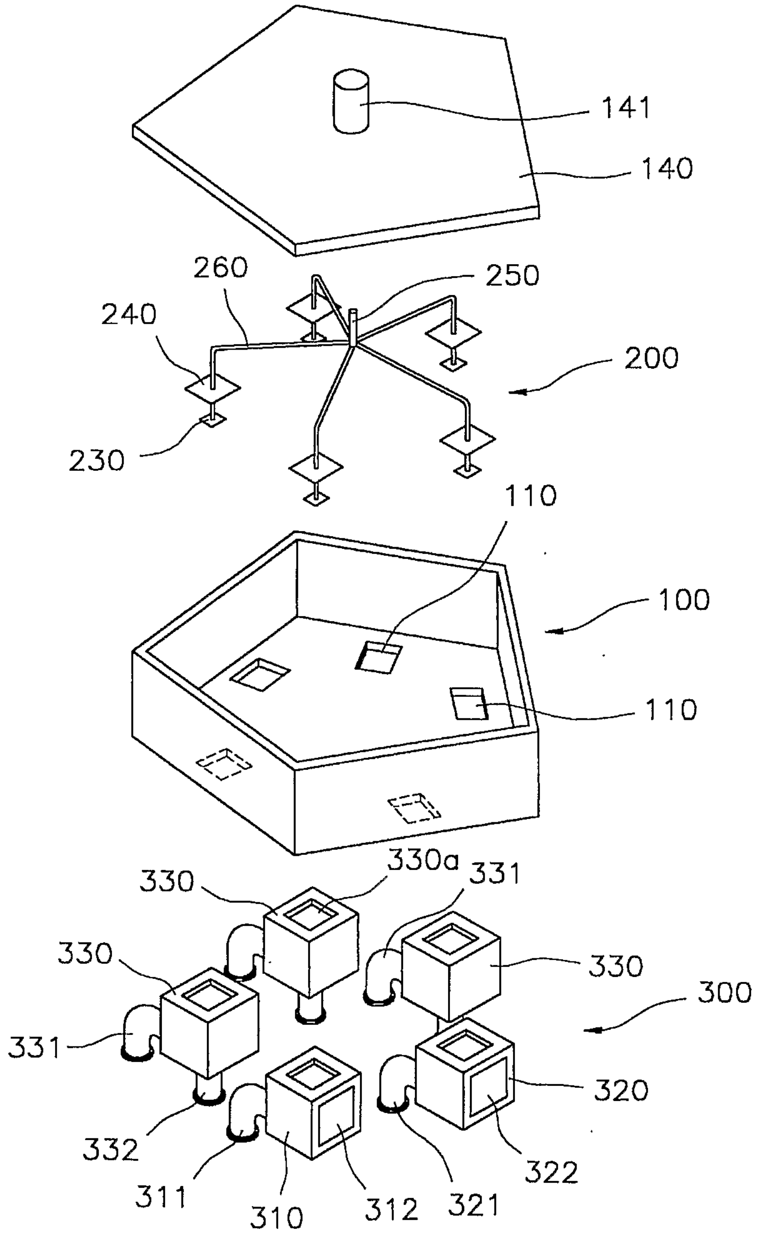
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FIG. 11

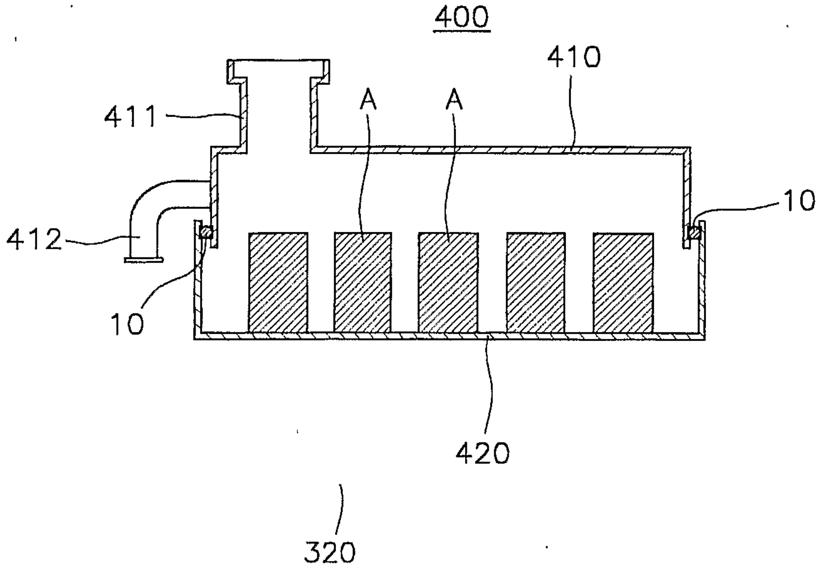


FIG. 12

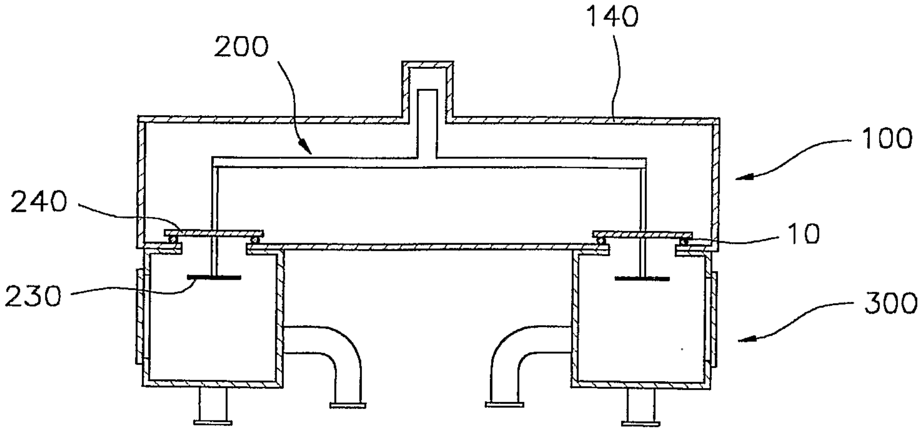


FIG. 13

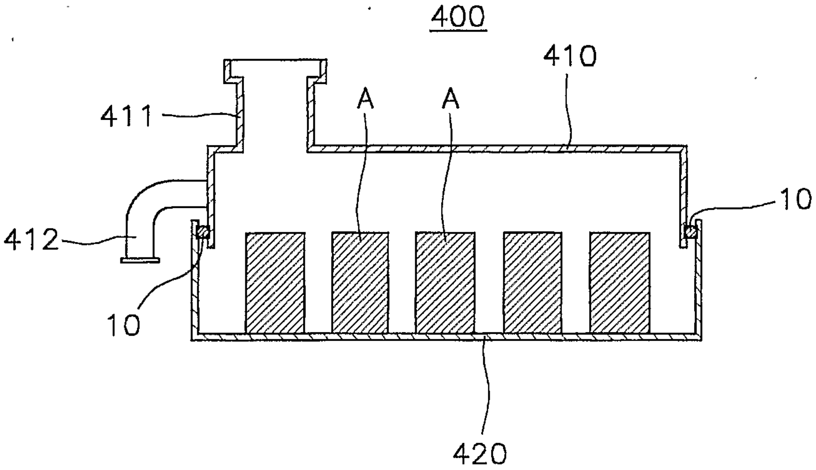
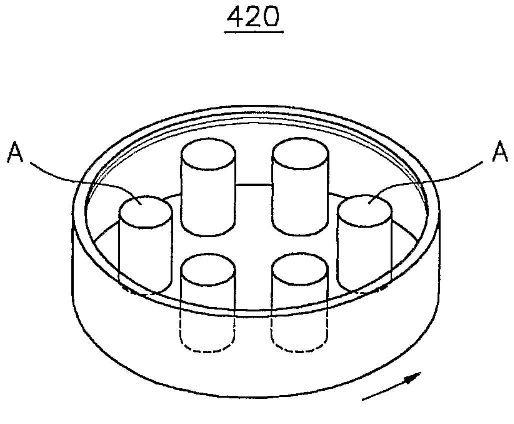


FIG. 13



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR02/02135

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H01L 21/20

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)
IPC7 H01L21, H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
KOREAN PATENTS AND APPLICATIONS FOR INVENTIONS SINCE 1975

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	KR02-72362A(JEONG,KWANG-HO) 14 SEPTEMBER 2002 SEE THE WHOLE DOCUMENT	1-3, 12, 13
PA	KR02-356A(SAMSUNG SDI CORP.) 05 JANUARY 2002 SEE THE WHOLE DOCUMENT	1
PA	KR02-44833A(PLASMATRON CO.,LTD.) 19 JUNE 2002 SEE THE WHOLE DOCUMENT	1
A	JP62-119941A(NEC CORP.) 01 JUNE 1987 SEE THE WHOLE DOCUMENT	1

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"&" document member of the same patent family

Date of the actual completion of the international search 17 MARCH 2003 (17.03.2003)	Date of mailing of the international search report 18 MARCH 2003 (18.03.2003)
Name and mailing address of the ISA/KR Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer LEE, Son Taek Telephone No. 82-42-481-5980