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(54) ACTIVE HEATING AND DRYING FIXTURE FOR LITHIUM BATTERY, AND VACUUM CONNECTION SYSTEM FOR PRODUCTION LINE

(57) An active heating and drying fixture for lithium battery includes a fixture body, a heating device, a circuit assembly and an upper cover. The fixture body is provided with a cavity for receiving lithium batteries, the heating device is configured on the fixture body, the circuit assembly is configured on an outer wall of the fixture body and electrically connected with the heating device, and the upper cover is detachably covered on the cavity to seal the cavity. The fixture can heat and dry the lithium battery directly, without using a large drying oven and a heating module, thereby simplifying the manufacturing process and reducing the manufacturing cost.

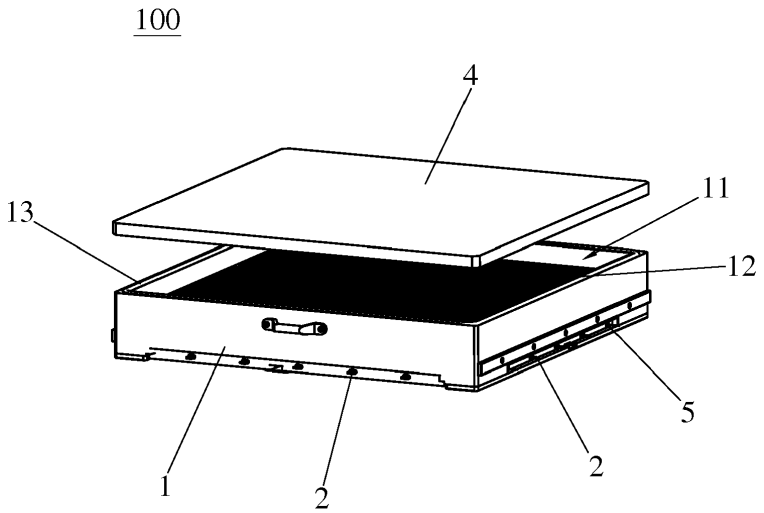

Fig.1

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Description

RELATED APPLICATIONS

[0001] This application claims the benefit of priority to Chinese Patent Applications No. 201810354607.8, filed on April 19, 2018, and No. 201811013445.8, filed on August, 2018, which are hereby incorporated by reference in its entirety.

FIELD OF THE INVENTION

[0002] The invention relates to a fixture, and more particularly to an active heating and drying fixture for lithium battery and a vacuum connection system for production line.

BACKGROUND OF THE INVENTION

[0003] Moisture has a very important influence on the performance of lithium batteries. In the production process of lithium batteries, the humidity of the environment and the water content of the batteries must be strictly controlled. Under the current process conditions, baking equipment is typically used to control the water content of the battery prior to battery injection. For example, the battery is dried by a drying oven under a baking mode. The basic baking step is: putting the battery into a fixture by using a clamping machine, placing the fixture filled with the batteries into the drying oven by a clamp, and drying the batteries by vacuuming and heating the drying oven.

[0004] By this token, the conventional fixture for lithium battery has a simple function only for loading batteries. In order to dry the batteries, it is necessary to increase accessorial equipments such as a large drying oven and a heating module, which complicates the operation process and increases the cost.

SUMMARY OF THE INVENTION

[0005] One objective of the present invention is to provide an active heating and drying fixture for lithium battery, which can heat and dry the lithium battery directly, without using a large drying oven and a heating module, thereby simplifying the manufacturing process and reducing the manufacturing cost.

[0006] Another objective of the present invention is to provide a vacuum connection system for production line for lifting the active heating and drying fixture for lithium battery and intercommunicating with the fixture and the vacuum pipeline, which can heat and dry the lithium battery directly and simplify the process.

[0007] To achieve the above-mentioned objectives, an active heating and drying fixture for lithium battery includes a fixture body, a heating device, a circuit assembly and an upper cover, the fixture body being provided with a cavity that has a top with an opening and a bottom with multiple receiving slots for receiving lithium batteries, the heating device being configured on the fixture body, the circuit assembly being configured on an outer wall of the fixture body and electrically connected with the heating device, and the upper cover being detachably covered on the cavity to seal the cavity.

[0008] In comparison with the prior art, the fixture body of the present invention is provided with the cavity in which multiple receiving slots are configured to receive a plurality of lithium batteries. Further, the heating device is configured outside the cavity to transfer the heat to the cavity through the fixture body, thereby the lithium batteries in the cavity can be heated. In addition, by means of the upper cover, the cavity can be sealed; accordingly, the cavity can be evacuated by the automatic valve, so that the lithium battery can be dried in a vacuum environment, thereby effectively improving the drying effect. By this token, the fixture according to the present invention not only has the function of loading the battery, but also has the function of active heating. During the drying process of the battery, the heating and drying can be directly performed on the fixture, and the large drying oven and the heating module are omitted, thereby simplifying the process and reducing the manufacturing cost. Before drying the lithium battery, pumping vacuum to the cavity, so that the lithium battery is located in the vacuum environment, which is beneficial to discharge the water and bubble to improve the drying effect.

[0009] Preferably, a gasket ring is configured between the upper cover and an upper edge of the fixture body.

[0010] Preferably, a cross section of the receiving slot is round or square.

[0011] Preferably, the heating device is inserted into the fixture body and located between two receiving slots.

[0012] Preferably, the fixture further includes a temperature sensor electrically connected with the circuit assembly for detecting temperature in the cavity

[0013] Preferably, a thermal barrier layer is surrounded on the fixture body.

[0014] Preferably, the circuit assembly is provided with pinholes through which probes of a control system are inserted to achieve electrical connections.

[0015] Preferably, the circuit assembly is configured at the outer wall of a bottom of the fixture body.

[0016] Preferably, the fixture further includes an automatic valve intercommunicated with the cavity.

[0017] Preferably, the automatic valve includes an upper valve body, a lower valve body, an elastic element, and a gasket ring, the upper valve body is provided with a first channel running through an outer side of the upper valve body and a second channel axially configured and intercommunicated with the first channel, the lower valve body is provided with a third channel in which the upper valve body is slidably configured; the elastic element is configured between the upper valve body and the lower valve body to make the upper and the lower valve body stay in a normal-closed state; the gasket ring is configured between the upper valve body and the lower valve

body to seal the first channel when the upper and the lower valve body are turned off; and the third channel is provided with an entry to intercommunicate with the first channel when the upper and the lower valve body are turned on.

[0018] Preferably, the entry is a fourth channel which is coaxial with the third channel, and a diameter of the fourth channel is larger than that of the third channel.

[0019] Preferably, one end, connected with the third channel, of the fourth channel is tapered.

[0020] Preferably, two gasket rings are configured at an upper end and a lower end of an opening of the first channel.

[0021] Accordingly, a vacuum connection system for production line includes a transport line, a vacuum pipeline, a lifting device and the active heating and drying fixture for lithium battery mentioned above. The active heating and drying fixture for lithium battery is configured on the transport line and moved along with the transport line, the automatic vale is configured on a bottom of the active heating and drying fixture for lithium battery, the pipeline is configured on an output end of the lifting device, and the lifting device is configured below the transport line to lift the vacuum pipeline which is connected with the automatic valve to turn on the automatic valve.

[0022] Preferably, the system further includes a control system which comprises probes configured at the output end of the lifting device to electrically connected with the pinholes of the active heating and drying fixture for lithium battery.

[0023] Preferably, a positioning mechanism which has a positioning sleeve and a positioning post, wherein one of the positioning sleeve and the positioning post is arranged on the bottom of the active heating and drying fixture for lithium battery, and the other of the positioning sleeve and the positioning post is arranged on the output end of the lifting device.

[0024] Preferably, the output end of the lifting device is provided with a carrier platform on which the vacuum pipeline is configured.

[0025] Preferably, an output end of the vacuum pipeline is provided with a base on which a sealing ring is arranged, and the sealing ring is pressed against the lower valve of the automatic valve when the vacuum pipeline is connected to the automatic valve.

[0026] Preferably, the system further includes a limiting device for limiting the active heating and drying fixture for lithium battery so as to make the automatic valve align with the vacuum pipeline.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The accompanying drawings facilitate an understanding of the various embodiments of this invention. In such drawings:

Fig. 1 is a partial exploded perspective view of an active heating and drying fixture for lithium battery according to a first embodiment of the present invention;

Fig. 2 is a perspective view of a fixture body of the active heating and drying fixture for lithium battery according to a first embodiment of the present invention;

Fig. 3 is a perspective view of a bottom of the active heating and drying fixture for lithium battery according to a first embodiment of the present invention;

Fig. 4 is a perspective view of a fixture body of the active heating and drying fixture for lithium battery according to a second embodiment of the present invention;

Fig. 5 is a perspective view of a bottom of the active heating and drying fixture for lithium battery according to a second embodiment of the present invention;

Fig. 6 is a cross sectional view of an automatic valve connected to the active heating and drying fixture for lithium battery according to the present invention;

Fig. 7 is a cross sectional view of the automatic valve which is turned on;

Fig. 8 is a cross sectional view of the automatic valve which is turned off;

Fig. 9 is a cross sectional view of a vacuum connection system for production line according to one embodiment of the present invention; and

Fig. 10 is a cross sectional view of a vacuum connection system for production line when it's connected according to one embodiment of the present invention.

DETAILED DESCRIPTION OF ILLUSTRATED EMBODIMENTS

[0028] Referring to Figs. 1 to 3, an active heating and drying fixture for lithium battery 100 according to one embodiment of the present invention includes a fixture body 1, a heating device 2, and a circuit assembly 3. The fixture body 1 is provided with a cavity 11 that has a top with an opening and a bottom with multiple receiving slots 12 for receiving lithium battery. The heating device 2 is configured on the fixture body 1, specifically is located outside the cavity 11 and embedded in the bottom of the fixture body 1. The circuit assembly 3 is configured on an outer wall of the fixture body 1 and electrically connected with the heating device 2.

[0029] Specifically, as shown in Fig. 1, the active heating and drying fixture for lithium battery 100 further includes an upper cover 4 detachably covering on the cavity 11 to seal the cavity 11. A gasket ring 13 is configured between the upper cover 14 and an upper edge of the fixture body 1, so as to ensure the airtightness of the cavity, along with the upper cover 4. Before drying the lithium battery, pumping vacuum to the cavity 11, so that the lithium battery is located in the vacuum environment, which is beneficial to discharge the water and bubble to improve the drying effect.

[0030] Referring to Figs. 2 and 3, the bottom of the

fixture body 1 is provided with a circuit slot 14 in which the connection leads between the circuit assembly 3 and the heating device 12 are hidden, thereby preventing the leads exposure to improve safety. Specifically, the cross section of the receiving slot 12 round which is suitable to small electric battery cores. The receiving slots 12 are arranged in an array, and the heating device 2 is inserted into the fixture body 1 from the outside of the fixture body 1 along a bottom parallel to the fixture body 1, so that the heating device 2 is located between two receiving slots 12. The active heating and drying fixture for lithium battery 100 further includes a temperature sensor 5 electrically connected with the circuit assembly 3 for detecting temperature in the cavity 11, which is a thermocouple or thermistor. Due to the temperature sensor 5, the heating temperature in the cavity 11 can be monitored in real time, to achieve full automation for battery drying. The circuit assembly 3 is configured at the bottom of the fixture body 1, specifically at the middle of the bottom of the fixture body 1. The circuit slots 14 are extended around the circuit assembly 3 to reach each edge of the fixture body 1, so as to guide the leads to the heater. The circuit assembly 3 is provided with pinholes 31 through which probes of a control system are inserted to achieve electrical connections. For example, after the probes of the control system are inserted into the pinholes 31, with a signal outputted by the control system, the heating power of the heating device 2 can be controlled by means of the circuit assembly 3 and the leads, thereby controlling the temperature of the cavity automatically.

[0031] Preferably, a thermal barrier layer (not shown) is surrounded on the fixture body 1, thereby preventing heat from being dissipated to the outside, and accordingly reducing energy loss during battery baking.

[0032] Referring to Figs. 6-9, the active heating and drying fixture for lithium battery 100 further includes automatic valve 6 intercommunicated with the cavity 11 and the cavity pipeline 202. Alternatively, the automatic valve 6 can be configured at the bottom of the fixture body 1, or on the upper cover 4. In this embodiment, the automatic valve 6 is configured at the bottom of the fixture body 1. The automatic valve 6 includes an upper valve body 61, a lower valve body 62, an elastic element 63, and a gasket ring 64.

[0033] Referring to Figs. 7 and 8 again, the entry is a fourth channel 62b which is coaxial with the third channel 62a, and a diameter of the fourth channel 62b is larger than that of the third channel 62a. Preferably, one end, connected with the third channel 62s, of the fourth channel 62b is tapered. By setting the fourth channel 62b coaxially with the third channel 62a, the connections among the channels and the vacuum pipeline 3 are convenient.

[0034] Two gasket rings 64 are configured at the upper end and the lower end of an opening of the first channel 61a, so as to ensure the airtightness.

[0035] By comparison with the prior art, the fixture body 1 of the present invention is provided with the cavity 11 in which multiple receiving slots 12 are configured to receive a plurality of lithium batteries. Further the heating device 2 is configured outside the cavity 11 to transfer the heat to the cavity through the fixture body 1, thereby the lithium batteries in the cavity 11 can be heated. In addition, by means of the upper cover 4, the cavity 11 can be sealed; accordingly, the cavity 11 can be evacuated by the automatic valve 6, so that the lithium battery can be dried in a vacuum environment, thereby effectively improving the drying effect. By this token, the fixture according to the present invention not only has the function of loading the battery, but also has the function of actively heating. During the drying process of the battery, the heating and drying can be directly performed on the fixture, and the large drying oven and the heating module are omitted, thereby simplifying the process and reducing the manufacturing cost.

[0036] Referring to Figs. 4 and 5, an active heating and drying fixture for lithium battery 100' according to a second embodiment of the present invention is shown. The basic structure in this embodiment is the same with that of the first embodiment, except that, the cross section of the receiving slot 12' is square to suit for square power lithium battery and soft lithium battery, and a wall 1a is arranged between two adjacent receiving slots 12'. The heating device 2' is inserted into the fixture body 1' from the outside of the fixture body 1' along a direction parallel to a bottom of the fixture body 1', so that the heating device 2' is located between two receiving slots 12'. Alternatively, the heating device 2' can be inserted into the fixture body 1' along a direction perpendicular to the bottom of the fixture body 1'. The circuit assembly 3' is configured at the outer wall of the fixture body 1', and the circuit slot is arranged in a cross. The effect of the active heating and drying fixture of the lithium battery of the embodiment is the same as that of the fixture of the first embodiment, and will not be repeated here.

[0037] In addition to the above two embodiments, the specific shape of the receiving slots of the fixture body of the present invention can be arranged according to the type, shape and size of the battery, thereby improving the adaptability of the fixture.

[0038] Referring to Figs. 9 and 10, a system 200 includes the active heating and drying fixture for lithium battery 100, a transport line 201, a vacuum pipeline 202 and a lifting device 203. The active heating and drying fixture for lithium battery 100 is arranged on the transport line 201 to move along with the transport line 201, the automatic valve 6 is arranged on the bottom of the fixture 100 through the gasket ring, and intercommunicated with the inside of fixture 100. The vacuum pipeline 202 is arranged at the output end of the lifting device 203 and connected with a vacuum-pumping system, and the lifting device 203 is arranged below the transport line 201 to lift the vacuum pipeline 202, causing the vacuum pipeline 202 to turn on the automatic valve 6 and connect with the automatic valve 6.

[0039] Referring to Figs. 9 and 10, the system 200 further includes a control system (not shown) which has

probes 204 configured on the output end of the lifting device 203 and inserted in the pinholes 31 of the active heating and drying fixture for lithium battery 100 to achieve electrical connection. Specifically, the pinholes 31 are arranged on the bottom of the fixture 100. By the arrangement and the cooperation of the probes 204 and the pinholes 31, under the lifting power of the lifting device 203 in the transport line 201, the connection between the control system and the fixture 100 can be achieved, thereby ensuring the normal working of components in the fixture 100, and the structure is simple and convenient. As illustrated, the system 200 further includes a positioning mechanism which has a positioning sleeve 205 and a positioning post 206, one of the positioning sleeve 205 and the positioning post 206 is arranged on the bottom of the fixture 100, and the other of the positioning sleeve 205 and the positioning post 206 is arranged on the output end of the lifting device 203. Specifically, in this embodiment, the positioning post 206 is arranged on the output end of the lifting device 203, and the positioning sleeve 205 is arranged on the bottom of the fixture 100, so as to prevent a shift of the fixture 100 to ensure the smooth turn-on of the automatic valve 6.

[0040] The output end of the vacuum pipeline 202 is provided with a base 2021 on which a sealing ring (not shown) is arranged. After the vacuum pipeline 202 is connected to the automatic valve 6, the sealing ring is pressed against the lower valve body 62 of the automatic valve 6.

[0041] The output end of the lifting device 203 is provided with a carrier platform 2031 on which the base 2021 of the vacuum pipeline 202, the probes 204 and the positioning post 206 are arranged.

[0042] The system 200 further includes a limiting device 210 for limiting the fixture 100 so as to make the automatic valve 6 align with the vacuum pipeline 202.

[0043] Preferably, the system 200 further includes a guiding bulge 207 and a guiding sleeve 208. The guiding bulge 207 is arranged on the bottom of the carrier platform 2031, the guiding sleeve 208 is arranged on the transport line 201, and the guiding bulge 207 is movably sleeved on the guiding sleeve 208. A limiter 209 is formed below the carrier platform 2031, for detecting the descent height of the carrier platform 2031, thereby controlling the movement of the lifting device 203.

[0044] By combining with the Figs. 9 and 10, the working principle of the system 200 is as follows.

[0045] The active heating and drying fixtures for lithium battery 100 are carried at two sides of the transport line 201, and moved along with the transport line 201. When limited by the limiting device 210, the fixtures 100 are stayed in the current position and aligned with the carrier platform 2031. At this time, the lower valve body 62 is aligned with the base 2021 of the vacuum pipeline 202, the probes 204 are aligned with the pinholes 31, and the positioning post 206 is aligned with the positioning sleeve 205. And then, the carrier platform 2031 is lifted by the output end of the lifting device 203, the positioning post 206 is inserted into the positioning sleeve 205, the pinholes 31 are electrically connected to the probes 204, and the base 2021 is pressed against the lower valve body 62. In such a way, the fixtures 100 are lifted by the carrier platform 2031. Meanwhile, the lower valve body 62 slides upwards to compress the elastic element 63, causing the opening of the first channel 61a to be located in the fourth channel 62b, thereby the fourth channel 62b is intercommunicated with the second channel 61b. As a result, the vacuum pipeline 202 is intercommunicated with the cavity 11 of the fixture 100, so that the cavity 11 of the fixture 100 can be pumped by the vacuum pumping device connected with the vacuum pipeline 202.

[0046] After the drying process of the fixture 100 is completed, the carrier platform 2031 descends under the action of the output end of the lifting device 203, causing the fixture to be supported on the carrier platform 2031 again. At this time, the positioning post 206 is withdrawn from the positioning sleeve 205, the probes 204 leaves the pinhole 31, and the base 2021 leaves the lower valve body 62. Meanwhile, the lower valve body 62 slides downwards relative to the lower valve body 61, under the spring action of the elastic element 63, which causes the opening of the first channel 61a slide into the third channel 62a, and the opening of the first channel 61a disconnect with the fourth channel 62b, so that the vacuum pipeline disconnects with the cavity 11 of the fixture 100, that is, the cavity 11 of the fixture 100 is in a sealed status. Finally, the fixture 100 is released from the limiting device 210 and is transported by the transport line 201 continually.

[0047] Since the automatic valve 6 is arranged on the bottom of the fixture 100, and the automatic valve 6 can be turned on or turned off automatically by means of the lifting power of the lifting device 203 on the transport line 201; further, the connection between the probes 204 and the pinholes 31 is achieved, thereby ensuring the normal working of the components inside the fixture 100. In addition, the structure of the present invention is quite simple, which reduces the arrangement of electromagnetic valves on one hand, and achieves automatic control one the other hand.

[0048] While the invention has been described in connection with what are presently considered to be the most practical and preferred embodiments, it is to be understood that the invention is not to be limited to the disclosed embodiments, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the invention.

Claims

1. An active heating and drying fixture for lithium battery, comprising a fixture body, a heating device, a circuit assembly and an upper cover, the fixture body being provided with a cavity that has a top with an opening and a bottom with multiple receiving slots

for receiving lithium batteries, the heating device being configured on the fixture body, the circuit assembly being configured on an outer wall of the fixture body and electrically connected with the heating device, and the upper cover being detachably covered on the cavity to seal the cavity.

2. The active heating and drying fixture for lithium battery according to claim 1, wherein a gasket ring is configured between the upper cover and an upper edge of the fixture body.

3. The active heating and drying fixture for lithium battery according to claim 1, wherein a cross section of the receiving slot is round or square.

4. The active heating and drying fixture for lithium battery according to claim 3, wherein the heating device is inserted into the fixture body and located between two receiving slots.

5. The active heating and drying fixture for lithium battery according to claim 1, further comprising a temperature sensor electrically connected with the circuit assembly for detecting temperature in the cavity.

6. The active heating and drying fixture for lithium battery according to claim 1, wherein a thermal barrier layer is surrounded on the fixture body.

7. The active heating and drying fixture for lithium battery according to claim 1, wherein the circuit assembly is provided with pinholes through which probes of a control system are inserted to achieve electrical connections.

8. The active heating and drying fixture for lithium battery according to claim 1, wherein the circuit assembly is configured at the outer wall of a bottom of the fixture body.

9. The active heating and drying fixture for lithium battery according to claim 1, further comprising an automatic valve intercommunicated with the cavity.

10. The active heating and drying fixture for lithium battery according to claim 9, wherein the automatic valve includes an upper valve body, a lower valve body, an elastic element, and a gasket ring, the upper valve body is provided with a first channel running through an outer side of the upper valve body and a second channel axially configured and intercommunicated with the first channel, the lower valve body is provided with a third channel in which the upper valve body is slidably configured; the elastic element is configured between the upper valve body and the lower valve body to make the upper and the lower valve body stay in a normal-closed state; the gasket ring is configured between the upper valve body and the lower valve body to seal the first channel when the upper and the lower valve body are turned off; and the third channel is provided with an entry to intercommunicate with the first channel when the upper and the lower valve body are turned on.

11. The active heating and drying fixture for lithium battery according to claim 10, wherein the entry is a fourth channel which is coaxial with the third channel, and a diameter of the fourth channel is larger than that of the third channel.

12. The active heating and drying fixture for lithium battery according to claim 11, wherein one end, connected with the third channel, of the fourth channel is tapered.

13. The active heating and drying fixture for lithium battery according to claim 10, wherein two gasket rings are configured at an upper end and a lower end of an opening of the first channel.

14. A vacuum connection system for production line, comprising a transport line, a vacuum pipeline, a lifting device and the active heating and drying fixture for lithium battery according to any one of claims 9-13, wherein the active heating and drying fixture for lithium battery is configured on the transport line and moved along with the transport line, the automatic vale is configured on a bottom of the active heating and drying fixture for lithium battery, the pipeline is configured on an output end of the lifting device, and the lifting device is configured below the transport line to lift the vacuum pipeline which is connected with the automatic valve to turn on the automatic valve.

15. The vacuum connection system for production line according to claim 14, further comprising a control system which comprises probes configured at the output end of the lifting device to electrically connected with the pinholes of the active heating and drying fixture for lithium battery.

16. The vacuum connection system for production line according to claim 14, further comprising a positioning mechanism which has a positioning sleeve and a positioning post, wherein one of the positioning sleeve and the positioning post is arranged on the bottom of the active heating and drying fixture for lithium battery, and the other of the positioning sleeve and the positioning post is arranged on the output end of the lifting device.

17. The vacuum connection system for production line according to any one of claims 14-16, wherein the output end of the lifting device is provided with a car-

rier platform on which the vacuum pipeline is configured.

18. The vacuum connection system for production line according to claim 14, wherein an output end of the vacuum pipeline is provided with a base on which a sealing ring is arranged, and the sealing ring is pressed against the lower valve of the automatic valve when the vacuum pipeline is connected to the automatic valve.

19. The vacuum connection system for production line according to claim 14, further comprising a limiting device for limiting the active heating and drying fixture for lithium battery so as to make the automatic valve align with the vacuum pipeline.

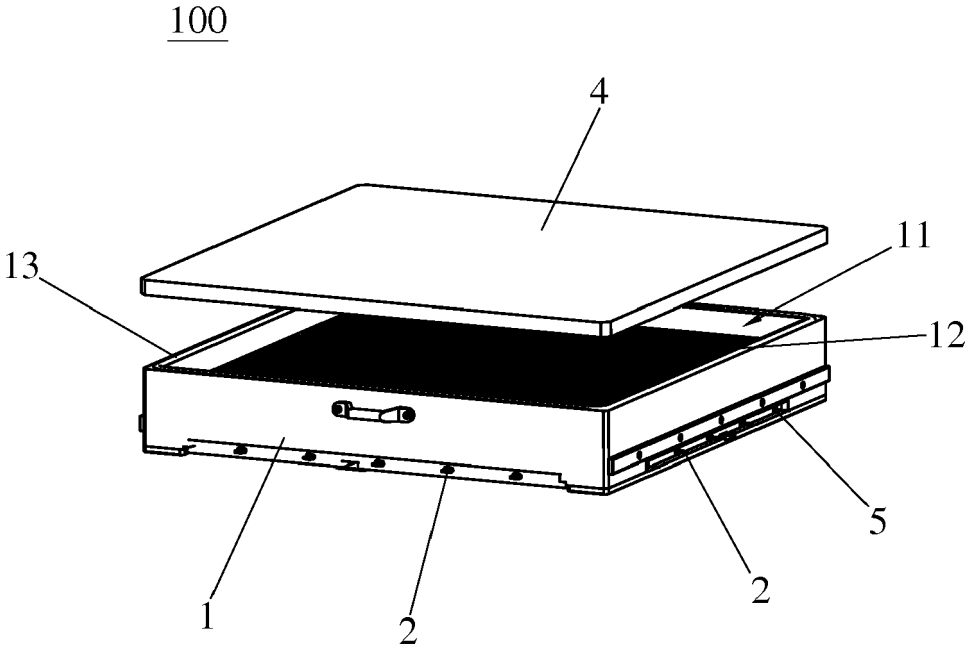

Fig.1

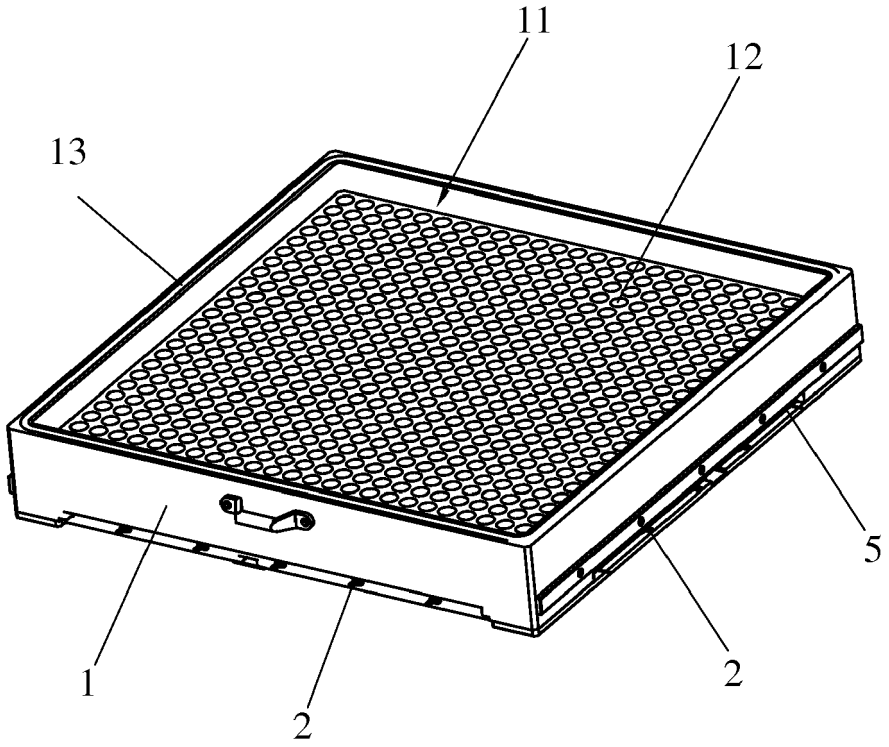

Fig.2

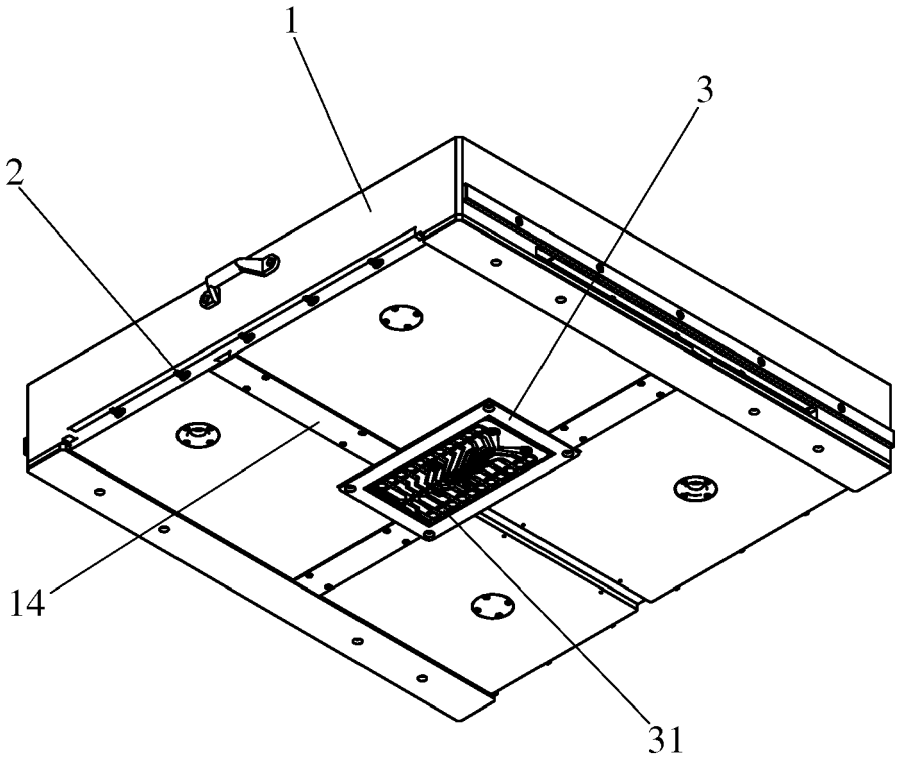

Fig.3

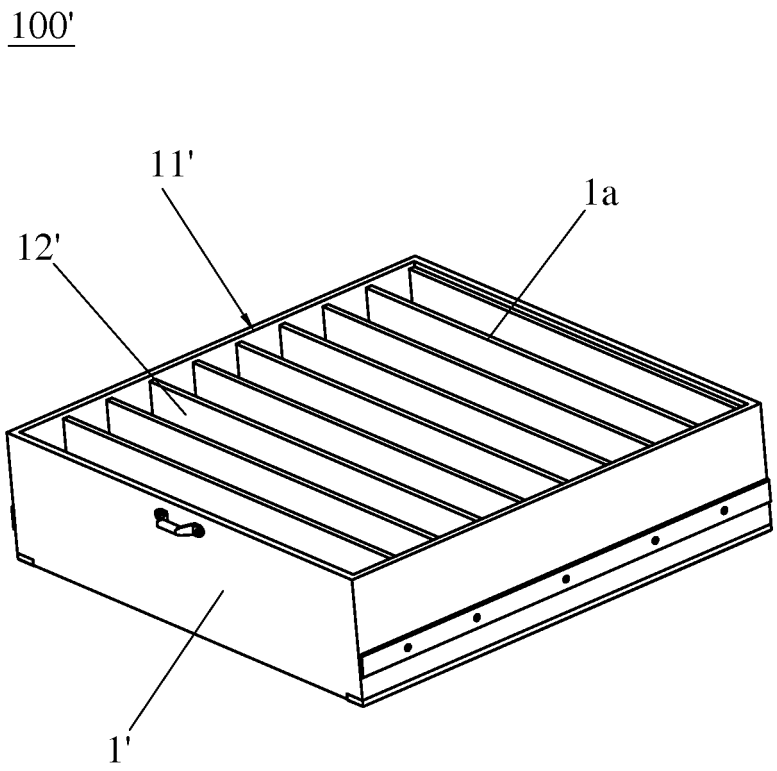

Fig.4

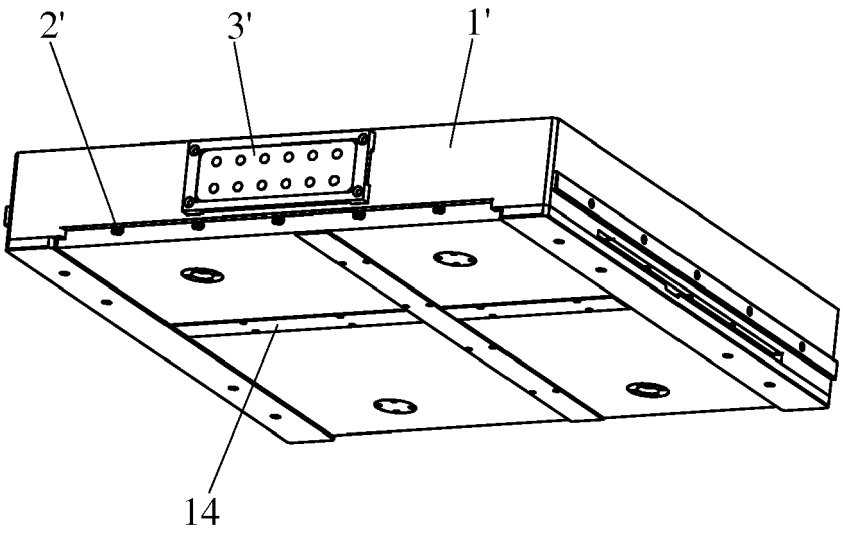

Fig.5

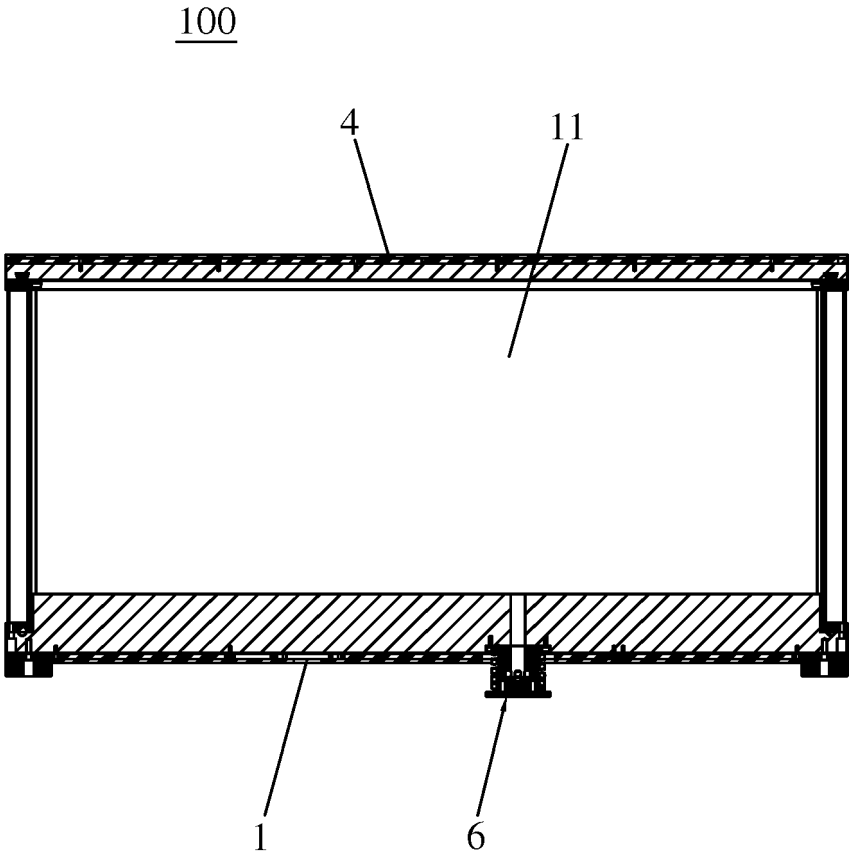

Fig.6

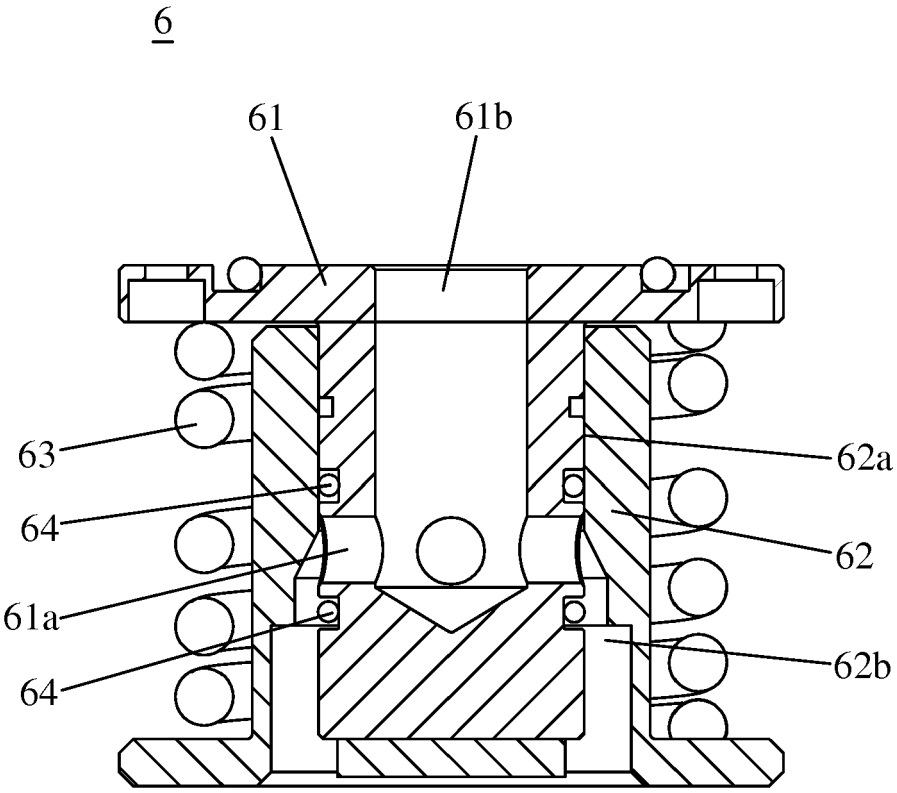

Fig.7

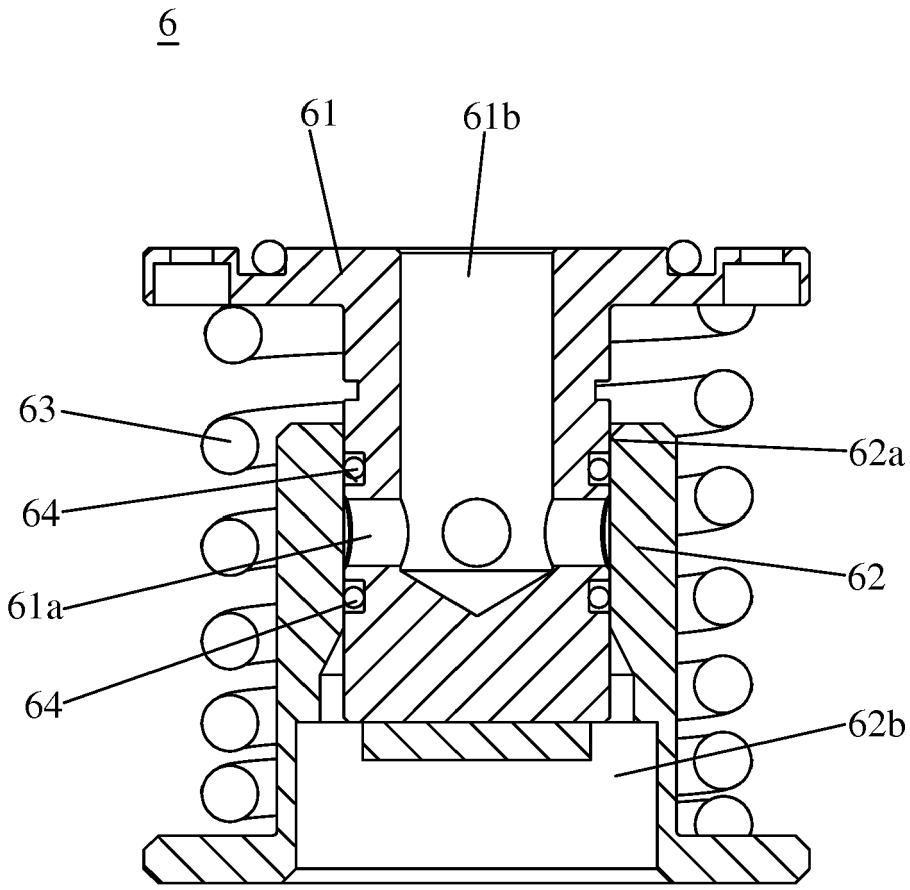

Fig.8

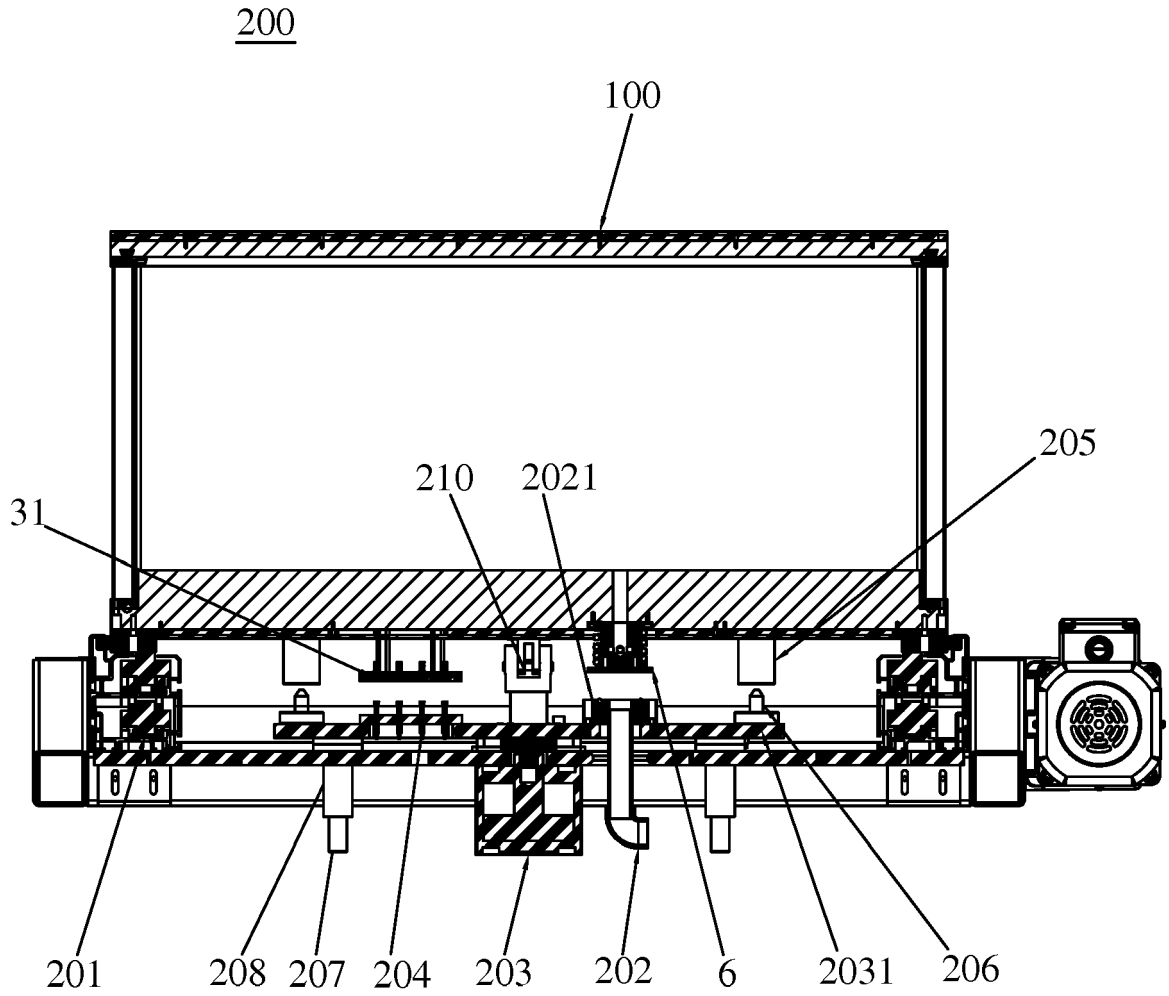

Fig.9

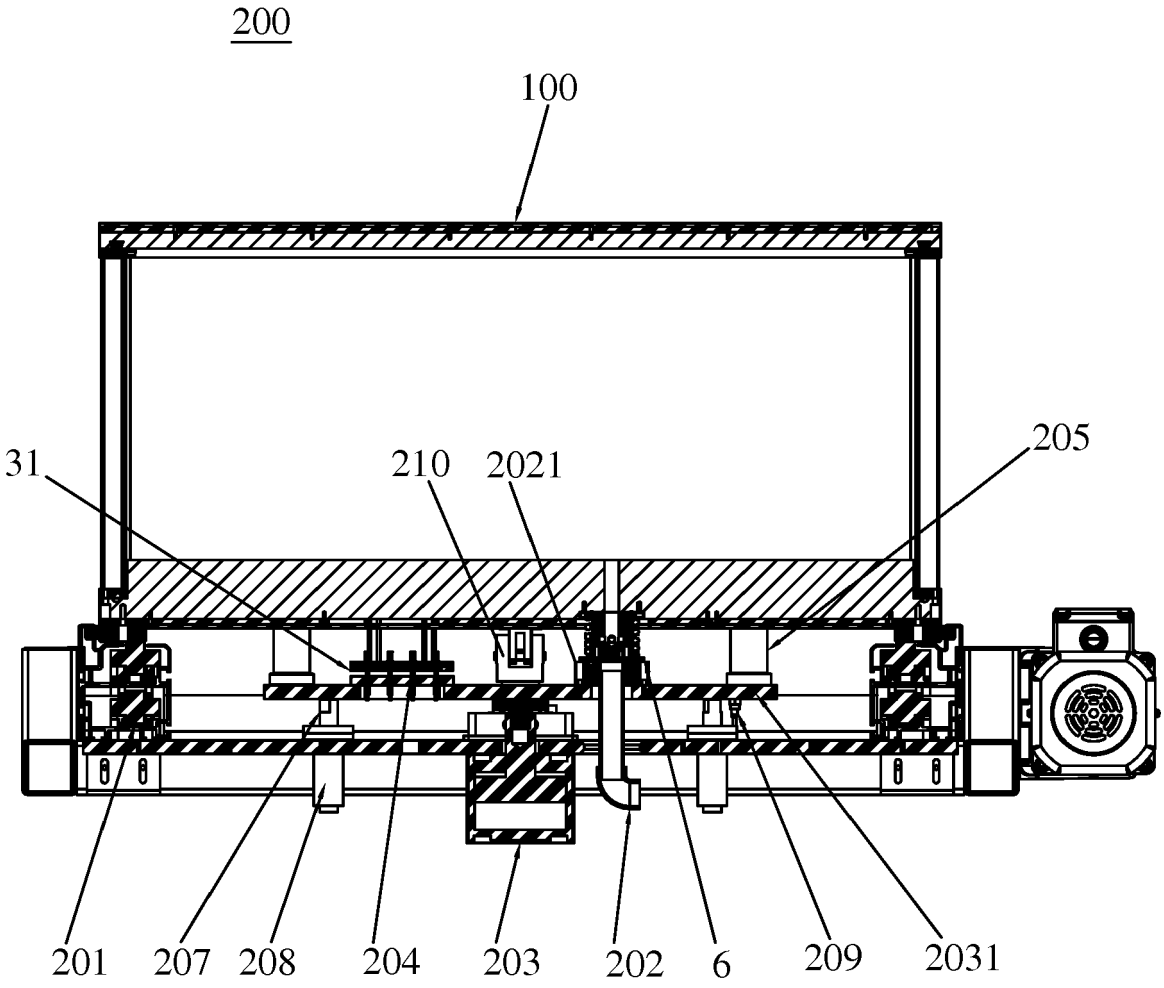

Fig.10

Europäisches Patentamt
European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 19 02 0296

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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