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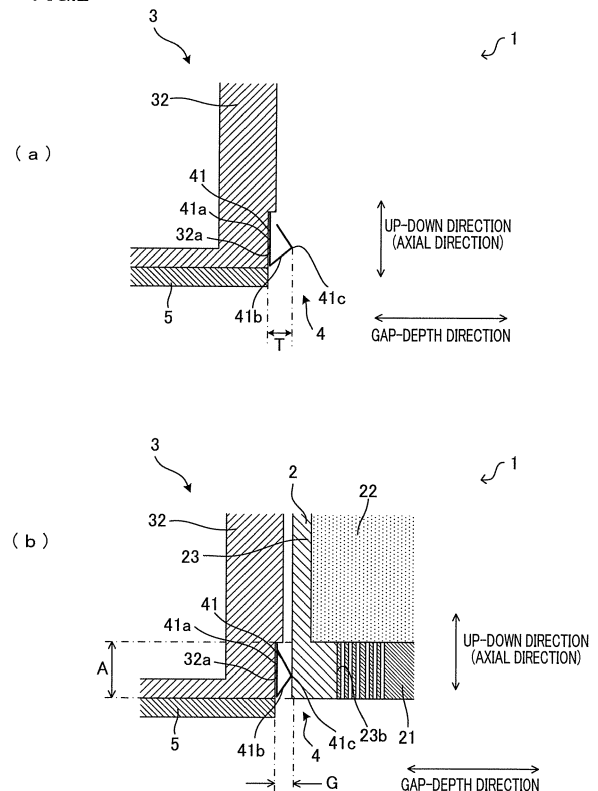
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(54) **MELT SPINNING DEVICE**

(57) An object of the present invention is to improve the efficiency in transferring heat from a heated box to a spinning pack, regardless of the size of a gap between the heated box and the spinning pack.

A melt spinning device 1 includes: a cylindrical spinning pack 2 including a spinneret 21; a heated box 3 including a concave portion 32 having the internal space into which the spinning pack 2 is inserted; and a heat-transmission mechanism 4 which is positioned at a gap between the wall surface defining the concave portion 32 and the surface of the spinning pack 2 when the spinning pack 2 is inserted into the concave portion 32. The concave portion 32 is open downward. The heat-transmission mechanism 4 includes plate springs 41 in each of which the shape is elastically valuable in accordance with the size of the gap. When the spinning pack 2 is inserted into the concave portion 32, each plate spring 41 forms a heat conduction path which reaches the surface of the spinning pack 2 from the wall surface defining the concave portion 32 in the heated box 3.

FIG.2



## Description

### BACKGROUND OF THE INVENTION

**[0001]** The present invention relates to a melt spinning device for producing a yarn from polymer.

**[0002]** Typically, a melt spinning device includes (i) a heated box which is heated so that the temperature of the box is equal to or higher than a melting point of polymer and (ii) a spinning pack which is detachably attached to the heated box. In the melt spinning device, molten polymer supplied to the spinning pack via a polymer path is spun out from a spinneret of the spinning pack. The polymer path is formed inside the heated box.

**[0003]** For example, Patent Literature 1 (Japanese Laid-Open Patent Publication No. 2012-102435) discloses a heated box having a concave portion into which a spinning pack is inserted and which is open downward. In the concave portion, a pack attaching portion to which the spinning pack is attached is provided. To the spinning pack attached to the pack attaching portion, heat from the heated box is supplied.

### SUMMARY OF THE INVENTION

**[0004]** There is a gap which is approximately 1 mm in width between a heated box and a spinning pack, i.e., between (i) a wall surface defining a concave portion in which a pack attaching portion of the heated box is provided and (ii) the spinning pack attached to the heated box. With this arrangement, heat from the heated box is transferred to the spinning pack via an air layer at this gap between the heated box and the spinning pack. Because heat resistance of the air layer is relatively high, the heat from the heated box may not be sufficiently transferred to the spinning pack.

**[0005]** In addition to that, the size of the gap between the heated box and the spinning pack is uneven because of errors in production of members, etc. Therefore, the heat is unevenly transferred from the heated box to the spinning pack. As a result, unevenness in temperature occurs in the spinning pack. Furthermore, because the size of the gap is uneven, it is difficult to fill the gap between the heated box and the spinning pack by using a member with a fixed size.

**[0006]** An object of the present invention is to provide a melt spinning device capable of improving the efficiency in transferring heat from a heated box to a spinning pack, regardless of the size of a gap between the heated box and the spinning pack.

#### [Solution to Problem]

**[0007]** According to the first aspect of the invention, a melt spinning device includes: a spinning pack including a spinneret; a heated box including a concave portion having an internal space into which the spinning pack is inserted, the concave portion being open downward; and

a heat-transmission mechanism which is positioned at a gap between a wall surface defining the concave portion and a surface of the spinning pack when the spinning pack is inserted into the concave portion, the heat-transmission mechanism including a deformation member the shape of which is elastically variable in accordance with the size of the gap, the heat-transmission mechanism further including one or more members which include at least the deformation member, and the one or more members forming a heat conduction path from the wall surface defining the concave portion in the heated box to the surface of the spinning pack when the spinning pack is inserted into the concave portion.

**[0008]** According to this aspect, by means of the heat conduction path formed by the one or more members included in the heat-transmission mechanism, heat from the heated box can be transferred to the spinning pack. Because of this, as compared to cases where the heat from the heated box is transferred to the spinning pack via an air layer, the efficiency in transferring the heat from the heated box to the spinning pack is improved. In addition to that, the occurrence of unevenness in temperature is suppressed in the spinning pack. Furthermore, because the heat-transmission mechanism includes the deformation member the shape of which is elastically variable in accordance with the size of the gap between the heated box and the spinning pack, the efficiency in transferring heat from the heated box to the spinning pack is improved regardless of the size of the gap.

**[0009]** According to the second aspect of the invention, the melt spinning device is arranged such that the heat-transmission mechanism is attached to the wall surface defining the concave portion in the heated box.

**[0010]** The spinning pack is often detached from the heated box, and maintenance such as cleaning is performed for the spinning pack. When the heat-transmission mechanism is attached to the spinning pack, removal of the heat-transmission mechanism from the spinning pack is required at the time of maintenance of the spinning pack. This makes the maintenance complicated. According to this aspect, because the heat-transmission mechanism is provided in the heated box, the complexity of maintenance of the spinning pack is avoided.

**[0011]** According to the third aspect of the invention, the melt spinning device is arranged such that the heat-transmission mechanism is detachably attached to the wall surface defining the concave portion in the heated box.

**[0012]** According to this aspect, when polymer adheres to the wall surface defining the concave portion, the heat-transmission mechanism, etc., cleaning can be performed by detaching the heat-transmission mechanism.

**[0013]** According to the fourth aspect of the invention, the melt spinning device is arranged such that the heat-transmission mechanism further includes a contact portion which makes contact with an area, the area being a part of the surface of the spinning pack which is inserted

into the concave portion, the spinneret being formed in an up-down direction in the area.

**[0014]** According to this aspect, the contact portion of the heat-transmission mechanism makes contact with the area where the spinneret is formed in the up-down direction. The area is a part of the surface of the spinning pack which is inserted into the concave portion. Therefore, by the heat-transmission mechanism, heat from the heated box is easily transferred to the part where the spinneret is provided in the spinning pack. This suppresses the decrease in quality of yarns due to the low temperature of the spinneret.

**[0015]** According to the fifth aspect of the invention, the melt spinning device is arranged such that a recess is formed in the wall surface defining the concave portion in the heated box, and a part of the heat-transmission mechanism is provided in the recess.

**[0016]** According to this aspect, by using the recess, it is possible to secure a sufficient space for providing the heat-transmission mechanism. In the present specification, a part of the wall surface defining the concave portion is defined as a wall surface defining the "recess".

**[0017]** According to the sixth aspect of the invention, the melt spinning device is arranged such that the deformation member is a spring which is fixed to one of the wall surface defining the concave portion and the surface of the spinning pack and, as the spinning pack is inserted into the concave portion, the shape of the spring elastically varies by making contact with the other of the wall surface defining the concave portion and the surface of the spinning pack.

**[0018]** According to this aspect, the biasing force of the spring increases a contact pressure between the deformation member and the other of the wall surface defining the concave portion and the surface of the spinning pack. It is therefore possible to further improve the efficiency in transferring heat from the heated box to the spinning pack.

**[0019]** According to the seventh aspect of the invention, the melt spinning device is arranged such that the deformation member is a wire-shaped member, one end portion of the wire-shaped member being fixed to one of the wall surface defining the concave portion and the surface of the spinning pack, and, as the spinning pack is inserted into the concave portion, the shape of the wire-shaped member elastically varying in such a way that the other end portion of the wire-shaped member makes contact with the other of the wall surface defining the concave portion and the surface of the spinning pack.

**[0020]** According to this aspect, it is unnecessary to finely design the size of the heat-transmission mechanism and, members of the mechanism are not required to have high precision. Therefore, the design and production of the heat-transmission mechanism are relatively easy.

**[0021]** According to the eighth aspect of the invention, the melt spinning device is arranged such that the heat-transmission mechanism further includes a separated

member which is divided into plural parts with respect to a circumferential direction of the spinning pack, and the deformation member is a spring which is fixed to one of the wall surface defining the concave portion and the surface of the spinning pack and, when the spinning pack is inserted into the concave portion, the spring applies biasing force to the separated member in a direction toward the other of the wall surface defining the concave portion and the surface of the spinning pack.

**[0022]** According to this aspect, the biasing force of the spring increases a contact pressure between the separated member and the other of the wall surface defining the concave portion and the surface of the spinning pack. It is therefore possible to further improve the efficiency in transferring heat from the heated box to the spinning pack.

**[0023]** According to the ninth aspect of the invention, the melt spinning device is arranged such that a gradually-narrowing portion which gradually narrows from one side toward the other side in the up-down direction is formed between a bottom surface of the recess and the surface of the spinning pack, the heat-transmission mechanism further includes a separated member which is divided into plural parts with respect to a circumferential direction of the spinning pack and which forms the heat conduction path, the separated member is provided at the gradually-narrowing portion between the bottom surface of the recess and the surface of the spinning pack, and the separated member is in surface-contact with the bottom surface of the recess and the surface of the spinning pack, and the deformation member is a spring which applies biasing force to the separated member in a direction from the one side to the other side in the up-down direction when the spinning pack is inserted into the concave portion.

**[0024]** According to this aspect, the separated member forming the heat conduction path is in surface-contact with the bottom surface of the recess and the surface of the spinning pack. The heat conduction path formed by the separated member is the shortest path among paths from the wall surface defining the concave portion to the surface of the spinning pack. It is therefore possible to further improve the efficiency in transferring heat from the heated box to the spinning pack.

## BRIEF DESCRIPTION OF THE DRAWINGS

### **[0025]**

FIG. 1 is a cross section of a melt spinning device related to a first embodiment of the present invention. FIG. 2(a) is an enlarged view of a lower end portion and its surroundings of a concave portion in a heated box of the melt spinning device of FIG. 1 in a state in which a spinning pack is not inserted into the concave portion, and FIG. 2(b) is an enlarged view of the lower end portion and its surroundings in a state in which the spinning pack is inserted into the con-

cave portion.

FIG. 3 shows a spring attached to a wall surface defining the concave portion in the heated box of the melt spinning device of FIG. 1.

FIG. 4 is a graph showing (i) the change in temperature of a spinneret in the melt spinning device of the first embodiment and (ii) the change in temperature of a spinneret in a melt spinning device of a comparative example.

FIG. 5 is a cross section of a concave portion in a heated box of a melt spinning device related to a second embodiment of the present invention.

FIG. 6(a) is a cross section of a lower end portion and its surroundings of a concave portion in a heated box of a melt spinning device related to a third embodiment of the present invention in a state in which a spinning pack is being inserted into the concave portion, and FIG. 6(b) is a cross section of the lower end portion and its surroundings in a state in which the spinning pack has been inserted into the concave portion.

FIG. 7 is a perspective view of a transferring block shown in FIG. 6.

FIG. 8(a) is a cross section of a lower end portion and its surroundings of a concave portion in a heated box of a melt spinning device related to a fourth embodiment of the present invention in a state in which a spinning pack is being inserted into the concave portion, and FIG. 8(b) is a cross section of the lower end portion and its surroundings in a state in which the spinning pack has been inserted into the concave portion.

FIG. 9 is a cross section of a concave portion in a heated box of a melt spinning device related to a modification of the second embodiment of the present invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

### <First Embodiment>

**[0026]** To begin with, the following will describe the overall structure of a melt spinning device 1 of a first embodiment of the present invention with reference to FIG. 1. The melt spinning device 1 includes a cylindrical spinning pack 2 having a spinneret 21, a heated box 3 having concave portions 32 open downward, a heat-transmission mechanism 4, and a cooling box 6.

**[0027]** In each concave portion 32 of the heated box 3, a pack attaching portion 31 to which the spinning pack 2 is detachably attached is provided. The spinning pack 2, which is configured to be attached to the pack attaching portion 31, is inserted into the internal space of the concave portion 32 so that the axial direction of the spinning pack 2 is in an up-down direction of FIG. 1. Each concave portion 32 has a circular shape in plan view. The concave portions 32 are staggered along the direction orthogonal to the plane of FIG. 1. At a lower end portion of a wall

surface defining each concave portion 32, recesses 32a are provided. A part of this wall surface defining the concave portion 32 is defined as a wall surface defining each recess 32a. The recesses 32a are provided at regular intervals along the circumferential direction of each concave portion 32 (see FIG. 3). Each recess 32a is open downward. A part of the heat-transmission mechanism 4 is provided in this recess 32a. There is a gap which is approximately 1mm in width between (i) a part of the wall surface defining the concave portion 32 except a part where the recesses 32a are provided and (ii) the outer circumferential surface of the spinning pack 2 inserted into the concave portion 32.

**[0028]** In the heated box 3, polymer paths 33 are provided. Each polymer path 33 reaches the spinning pack 2, which is attached to the corresponding pack attaching portion 31 provided in the concave portion 32, from an unillustrated spin pump. The pack attaching portion 31 is fixed to the bottom surface of the concave portion 32 by an unillustrated screw. The pack attaching portion 31 includes a connecting portion 31a which protrudes downward and which has an outer circumferential surface on which a male screw is formed. In the pack attaching portion 31, a through hole 31b is formed as an end of the polymer path 33.

**[0029]** In an internal space 3a of the heated box 3, heat medium vapor supplied from an unillustrated heat medium boiler is sealed. The outer side surfaces of the heated box 3 are covered by a heat insulation member 5 such as ceramic felt.

**[0030]** The spinning pack 2 includes a pack member 23 in which there is an internal space 2a. When the spinning pack 2 is attached to the pack attaching portion 31, the internal space 2a is connected with the polymer path 33. In the internal space 2a of the pack member 23, a filtrating member 22 is provided. In the pack member 23, a threaded-connection portion 23a the top surface of which is concave is formed. On the inner circumferential surface of the threaded-connection portion 23a, a female screw corresponding to the male screw of the connecting portion 31a of the pack attaching portion 31 is formed. The threaded-connection portion 23a can be joined to the connecting portion 31a. At the lower end of the pack member 23, an opening 23b which is open in the up-down direction is formed to allow the internal space 2a to be communicated with the external space. To this opening 23b, the spinneret 21 is fitted.

**[0031]** The cooling box 6 is provided below the heated box 3. On the top surface of the cooling box 6, a packing 7 is provided. The cooling box 6 is movable in the up-down direction by means of an unillustrated driving mechanism, and switchable between a state in which the cooling box 6 is in contact with the lower surface of the heated box 3 via the packing 7 (this state is shown in FIG. 1) and a state in which the cooling box 6 is separated from the lower surface of the heated box 3.

**[0032]** An opening 71 is formed at a part of the packing 7, which opposes the concave portion 32 of the heated

box 3. A part of the upper wall of the cooling box 6 and a part of the lower wall of the cooling box 6 oppose the concave portion 32 of the heated box 3, and openings 61 and 62 are respectively formed on these parts of the upper and lower walls of the cooling box 6. The space at a part which opposes the concave portion 32 of the heated box 3 in the cooling box 6 is a yarn running space 6a through which molten polymer spun out from the spinneret 21 passes. The space in the cooling box 6 is partitioned into the yarn running space 6a and other space by a filter 63. To the cooling box 6, cooling air is supplied through an unillustrated duct. The cooling air supplied to the cooling box 6 is sent to the yarn running space 6a through the filter 63.

**[0033]** In the melt spinning device 1 configured as described above, the heat medium vapor is supplied to the internal space 3a of the heated box 3 from the heat medium boiler (not illustrated). The heat medium vapor supplied to the internal space 3a of the heated box 3 heats the heated box 3 so that the temperature of the box is increased to a predetermined spinning temperature which is equal to or higher than the melting point of polymer. After that, each spinning pack 2 is inserted to the corresponding concave portion 32 of the heated box 3 and attached to the pack attaching portion 31. In this regard, each spinning pack 2 is preliminarily heated by a heating unit (not illustrated), etc. so that the temperature of the spinning pack 2 is substantially identical with the spinning temperature. To the spinning pack 2 attached to the pack attaching portion 31, heat from the heated box 3 is transferred by the heat-transmission mechanism 4.

**[0034]** High-temperature molten polymer such as nylon and polyester, which is supplied from the spin pump (not illustrated), is sent to the internal space 2a of the spinning pack 2 through the polymer path 33. The molten polymer sent to the internal space 2a of the spinning pack 2 is filtered by the filtrating member 22, and then spun out from the spinneret 21. The molten polymer spun out from the spinneret 21 passes through the yarn running space 6a in the cooling box 6. At this time, the molten polymer passing the yarn running space 6a is cooled by the cooling air supplied to the yarn running space 6a.

**[0035]** The following will describe the heat-transmission mechanism 4 with reference to FIGs. 2(a) and 2(b) and FIG. 3. The heat-transmission mechanism 4 is provided at the gap between (i) the wall surface defining the concave portion 32 formed in the heated box 3 (to be more specific, the bottom surface of each recess 32a) and (ii) the spinning pack 2 inserted into the concave portion 32. The direction of the gap between the wall surface defining the concave portion 32 and the outer circumferential surface of the spinning pack 2 (i.e., left-right direction for a viewer of FIGs. 2(a) and 2(b)) is simply referred to as the "gap-depth direction" in the present specification. The heat-transmission mechanism 4 is formed of plate springs 41. The material of each plate spring 41 is preferably high in heat conductivity. Exam-

ples of this material include aluminum alloy, copper alloy, common steel, alloy steel, special steel, carbon fiber composite, and silicone rubber. The material of each plate spring 41 may be any material as long as the heat conductivity in the material is higher at least than the heat conductivity in the static air layer.

**[0036]** Each plate spring 41 is detachably fitted to the corresponding recess 32a formed at the lower end portion of the wall surface defining the concave portion 32. The plate spring 41 is formed in such a way that a plate-shaped member is bent at its one end portion, and includes a plate-shaped base portion 41a and a bent portion 41b. The bent portion 41b is connected to a lower end portion of the base portion 41a, and bent toward one surface of the base portion 41a. The bent portion 41b is bent so that a central portion 41c in the up-down direction of the bent portion 41b is the farthest portion from the base portion 41a as compared to other portions of the bent portion 41b. The plate spring 41 is attached to the heated box 3 so that the back side (i.e., the other surface opposite to one surface toward which the bent portion 41b is bent) of the base portion 41a is in contact with the wall surface (to be more specific, the bottom surface of each recess 32a) defining the concave portion 32 in the heated box 3.

**[0037]** The base portion 41a of the plate spring 41 is provided in the recess 32a. The central portion 41c in the bent portion 41b of the plate spring 41 is provided outside the recess 32a. In other words, the position of the central portion 41c in the gap-depth direction of the plate spring 41 is on the spinning pack 2 side of a part of the wall surface defining the concave portion 32, in which part the recesses 32a are not formed. In the gap-depth direction, a thickness T (see FIG. 2(a)) of the plate spring 41 to which no external force is applied is larger than the size of a gap G (see FIG. 2(b)) between the wall surface defining the concave portion 32 in each recess 32a and the outer circumferential surface of the spinning pack 2.

**[0038]** As the spinning pack 2 is inserted into the concave portion 32 as shown in FIG. 2(b), the central portion 41c in the bent portion 41b of the plate spring 41 makes contact with a surface of the spinning pack 2. To be more specific, the central portion 41c of the plate spring 41 makes contact with an area A (see FIG. 2(b)) which is a part of the outer circumferential surface of the spinning pack 2 inserted into the concave portion 32 and where the spinneret 21 is formed in the up-down direction. The central portion 41c of the plate spring 41 corresponds to a contact portion of the present invention. As the central portion 41c of the plate spring 41 makes contact with the surface of the spinning pack 2, the shape of the plate spring 41 elastically varies in accordance with the size of the gap between the wall surface defining the concave portion 32 and the outer circumferential surface of the spinning pack 2. As shown in FIG. 2(b), when the shape of the plate spring 41 elastically varies, the upper end of the bent portion 41b makes contact with the base portion 41a.

**[0039]** When the central portion 41c of the plate spring 41 is in contact with the outer circumferential surface of the spinning pack 2, the plate spring 41 forms a heat conduction path from the wall surface (to be more specific, the bottom surface of each recess 32a) defining the concave portion 32 in the heated box 3 to the outer circumferential surface of the spinning pack 2. With this arrangement, to begin with, heat from the heated box 3 is transferred to the base portion 41a in contact with the heated box 3. Subsequently, the heat transferred to the base portion 41a is transferred to the bent portion 41b. In this regard, a lower end portion of the bent portion 41b is connected to the base portion 41a and an upper end portion of the bent portion 41b is in contact with the base portion 41a. Because of this, the heat from the base portion 41a is transferred to both the lower end portion and upper end portion of the bent portion 41b. The heat transferred to the bent portion 41b is finally transferred to the spinning pack 2 in contact with the central portion 41c of the bent portion 41b.

**[0040]** In the melt spinning device 1, cleaning of surfaces is required for regularly removing contaminants adhered to the surface of the spinneret 21. When molten polymer is spun out from the spinneret 21 during the cleaning of surfaces, the molten polymer is discarded. Therefore, in order not to wastefully consume molten polymer, the cleaning of surfaces may be performed while molten polymer is not spun out from the spinneret 21. During the cleaning of surfaces, the cooling box 6 is moved downward so that the cooling box 6 is switched from the state in which the cooling box 6 is in contact with the lower surface of the heated box 3 via the packing 7 to the state in which the cooling box 6 is separated from the lower surface of the heated box 3. After the cleaning of surfaces, the cooling box 6 is moved upward so that the cooling box 6 is switched from the state in which the cooling box 6 is separated from the lower surface of the heated box 3 to the state in which the cooling box 6 is in contact with the lower surface of the heated box 3 via the packing 7. Before being attached to the heated box 3, the spinning pack 2 is preliminary heated so that the temperature of the spinning pack 2 is increased to a predetermined temperature. However, the spinneret 21 is exposed to the outside air until the cooling box 6 makes contact with the lower surface of the heated box 3. As a result, the temperature of the spinneret 21 is decreased. When the temperature of the spinneret 21 is decreased, the quality of spun-out yarns is deteriorated after the cleaning of the surfaces is performed and the spinning of the molten polymer from the spinneret 21 is resumed. It is therefore required to increase the temperature of the spinneret 21 as soon as the cleaning of surfaces finishes.

**[0041]** The graph of FIG. 4 shows (i) the change in temperature of a spinneret 21 in a melt spinning device of an example and (ii) the change in temperature of a spinneret 21 in a melt spinning device of a comparative example. To be more specific, the graph of FIG. 4 shows the change in temperature of each spinneret 21 since

the attachment of the spinning packs 2 to the heated boxes 3.

**[0042]** The example uses the melt spinning device 1 of the first embodiment described above, and stainless is the material of each plate spring 41. The melt spinning device of the comparative example does not include the heat-transmission mechanism 4, and the recesses 32a are not formed in each concave portion 32 of the heated box 3. Except these differences, the structure of the melt spinning device is the same as that of the melt spinning device 1 of the present embodiment described above. In the melt spinning device of the comparative example, there is a gap which is approximately 1.0 mm in width between the wall surface defining the concave portion 32 and the outer circumferential surface of the spinning pack 2 which is inserted into the concave portion 32. In the melt spinning device of the comparative example, heat from the heated box 3 is transferred to the spinning pack 2 via the air layer at this gap which is approximately 1.0 mm in width.

**[0043]** In the graph of FIG. 4, the vertical axis indicates the temperature (°C) of the spinnerets 21 and the horizontal axis indicates the elapsed time (minutes) since the attachment of the spinning packs 2 to the heated boxes 3. In addition to that, the dashed line indicates the temperature measured at the central portion of the lower surface of the spinneret 21 of the example, and the solid line indicates the temperature measured at the central portion of the lower surface of the spinneret 21 of the comparative example.

**[0044]** As shown in FIG. 4, after the spinning packs 2 are attached to the heated boxes 3, decrease in temperature at the central portion of the lower surface of the spinneret 21 of the example is gradual as compared to decrease in temperature at the central portion of the spinneret 21 of the comparative example. After the cooling boxes 6 are moved to make contact with the lower surfaces of the heated boxes 3 via the packings 7 after approximately ten minutes elapse since the start of measuring the temperatures, the temperature at the central portion of the lower surface of the spinneret 21 of the example reaches 260°C after approximately 80 minutes elapse. Meanwhile, it takes approximately 110 minutes until the temperature at the central portion of the lower surface of the spinneret 21 of the comparative example reaches 260°C.

(Effects of First Embodiment)

**[0045]** As described above, the melt spinning device 1 of the present embodiment includes: the cylindrical spinning pack 2 including the spinneret 21; the heated box 3 including the concave portion 32 having the internal space into which the spinning pack 2 is inserted; and the heat-transmission mechanism 4 which is positioned at the gap between the wall surface defining the concave portion 32 and the surface of the spinning pack 2 as the spinning pack 2 is inserted into the concave portion 32.

The concave portion 32 is open downward. The heat-transmission mechanism 4 includes the plate springs 41 in each of which the shape is elastically variable in accordance with the size of the gap. In this regard, when the spinning pack 2 is inserted into the concave portion 32, each plate spring 41 forms the heat conduction path which reaches the surface of the spinning pack 2 from the wall surface defining the concave portion 32 in the heated box 3.

**[0046]** With this arrangement, by means of the heat conduction path formed by the plate spring 41 included in the heat-transmission mechanism 4, heat from the heated box 3 can be transferred to the spinning pack 2. Because of this, as compared to cases where the heat from the heated box 3 is transferred to the spinning pack 2 via the air layer, the efficiency in transferring the heat from the heated box 3 to the spinning pack 2 is improved. In addition to that, the occurrence of unevenness in temperature is suppressed in the spinning pack 2. Furthermore, because the shape of each plate spring 41 is elastically variable in accordance with the size of the gap between the heated box 3 and the spinning pack 2, the efficiency in transferring heat from the heated box 3 to the spinning pack 2 is improved regardless of the size of the gap.

**[0047]** In the melt spinning device 1 of the present embodiment, the plate spring 41 is attached to the wall surface defining the concave portion 32 in the heated box 3. The spinning pack 2 is often detached from the heated box 3, and maintenance such as cleaning is performed for the spinning pack 2. When the plate spring 41 is attached to the spinning pack 2, removal of the plate spring 41 from the spinning pack 2 is required at the time of maintenance of the spinning pack 2. This makes the maintenance complicated. In the present embodiment, because the plate spring 41 is provided in the heated box 3, the complexity of maintenance of the spinning pack 2 is avoided.

**[0048]** In the melt spinning device 1 of the present embodiment, the plate spring 41 is detachably attached to the wall surface defining the concave portion 32 in the heated box 3. Therefore, when polymer adheres to the wall surface defining the concave portion 32, the plate spring 41, etc., cleaning can be performed by detaching the plate spring 41.

**[0049]** In the melt spinning device 1 of the present embodiment, the recesses 32a are formed on the wall surface defining the concave portion 32 in the heated box 3. The base portion 41a of the plate spring 41 is provided at each recess 32a. It is therefore possible to secure a sufficient space for providing the plate spring 41 by using each recess 32a.

**[0050]** In the melt spinning device 1 of the present embodiment, the central portion 41c of the bent portion 41b in the plate spring 41 makes contact with the area A which is a part of the surface of the spinning pack 2 inserted into the concave portion 32 and where the spinneret 21 is formed in the up-down direction. Therefore, by the plate

spring 41, heat from the heated box 3 is easily transferred to the part where the spinneret 21 is provided in the spinning pack 2. This suppresses the decrease in quality of the yarns due to the low temperature of the spinneret 21.

**[0051]** In the melt spinning device 1 of the present embodiment, the plate spring 41 is fixed to the wall surface (to be more specific, the bottom surface of each recess 32a) defining the concave portion 32. As the spinning pack 2 is inserted into the concave portion 32, the shape of the plate spring 41 elastically varies by making contact with the outer circumferential surface of the spinning pack 2. With this arrangement, the biasing force of the plate spring 41 increases the contact pressure between the outer circumferential surface of the spinning pack 2 and the plate spring 41. It is therefore possible to further improve the efficiency in transferring heat from the heated box 3 to the spinning pack 2.

<Second Embodiment>

**[0052]** The following will describe a melt spinning device 101 of a second embodiment of the present invention with reference to FIG. 5. The structure of the melt spinning device 101 of the present embodiment is substantially identical with that of the melt spinning device 1 of the first embodiment, except a heat-transmission mechanism 104. In the descriptions below, members identical with those in the first embodiment will be denoted by the same reference numerals as in the first embodiment, and the explanations thereof may not be repeated.

**[0053]** In the first embodiment, the recesses 32a which are formed at the lower end portion of the wall surface defining the concave portion 32 of the heated box 3 are provided at regular intervals along the circumferential direction of each concave portion 32. Meanwhile, a recess 132a of the present embodiment is formed across the whole circumference of the concave portion 32.

**[0054]** The heat-transmission mechanism 104 of the present embodiment is brush-shaped, and includes a band base member 141 and a large number of brush bristles 142 which are attached to one surface of the band base member 141. The materials of the base member 141 and the brush bristles 142 are preferably high in heat conductivity. Examples of these materials include aluminum alloy, copper alloy, common steel, alloy steel, special steel, carbon fiber composite, and silicone rubber. The materials of the base member 141 and the brush bristles 142 may be any materials as long as the heat conductivities in these materials are higher at least than the heat conductivity in the static air layer.

**[0055]** The heat-transmission mechanism 104 is detachably attached to the wall surface (to be more specific, the bottom surface of the recess 132a) defining the concave portion 32 in the heated box 3 by bolts (not illustrated). The heat-transmission mechanism 104 is attached to the heated box 3 so that the surface of the base member 141, i.e., the other surface opposite to one surface to which the brush bristles 142 are attached, is in

contact with the wall surface defining the concave portion 32 of the heated box 3. In other words, one end portions of the brush bristles 142 attached to the base member 141 are fixed to the wall surface defining the concave portion 32 via the base member 141. The heat-transmission mechanism 104 is provided to surround the whole circumference of the spinning pack 2 which is inserted into the concave portion 32.

**[0056]** The base member 141 of the heat-transmission mechanism 104 is provided in the recess 132a formed at the lower end portion of the wall surface defining the concave portion 32 of the heated box 3. Leading end portions 142a (i.e., the other end portions opposite to one end portions attached to the base member 141) of the brush bristles 142 are provided outside the recess 132a. In other words, the position of the leading end portion 142a in the gap-depth direction of each brush bristle 142 is on the spinning pack 2 side of a part of the wall surface defining the concave portion 32, in which part the recess 132a is not formed. In the gap-depth direction, when no external force is applied to the brush bristles 142, the length of the heat-transmission mechanism 104 is longer than the size of a gap G between the wall surface defining the concave portion 32 in the recess 132a and the outer circumferential surface of the spinning pack 2.

**[0057]** As the spinning pack 2 is inserted into the concave portion 32, the leading end portion 142a of each brush bristle 142 makes contact with the surface of the spinning pack 2. To be more specific, the leading end portion 142a of the brush bristle 142 makes contact with the area A which is a part of the outer circumferential surface of the spinning pack 2 inserted into the concave portion 32 and where the spinneret 21 is formed in the up-down direction. In the present embodiment, the leading end portions 142a of all brush bristles 142 make contact with the area A of the outer circumferential surface of the spinning pack 2. The leading end portion 142a of each brush bristle 142 corresponds to the contact portion of the present invention. As the leading end portions 142a make contact with the surface of the spinning pack 2, the shapes of the brush bristles 142 elastically vary in accordance with the size of the gap between the wall surface defining the concave portion 32 and the outer circumferential surface of the spinning pack 2.

**[0058]** When the leading end portion 142a of each brush bristle 142 is in contact with the outer circumferential surface of the spinning pack 2, the base member 141 and the brush bristle 142 make a heat conduction path from the wall surface (to be more specific, the bottom surface of the recess 132a) defining the concave portion 32 in the heated box 3 to the outer circumferential surface of the spinning pack 2. With this arrangement, to begin with, heat from the heated box 3 is transferred to the base member 141 in contact with the heated box 3. The heat transferred to the base member 141 is then transferred to the brush bristles 142 attached to the base member 141. The heat transferred to the brush bristles 142 is finally transferred to the spinning pack 2 in contact with

the brush bristles 142.

(Effects of Second Embodiment)

**[0059]** In the present embodiment, the following effects are obtained in addition to the effects based on the structure identical with that in the first embodiment. In the melt spinning device 101 of the present embodiment, it is unnecessary to finely design the size of the heat-transmission mechanism 104, and members of the mechanism are not required to have high precision. Therefore, the design and production of the heat-transmission mechanism 104 are relatively easy.

<Third Embodiment>

**[0060]** The following will describe a melt spinning device 201 of a third embodiment of the present invention with reference to FIGs. 6(a) and 6(b) and FIG. 7. The structure of the melt spinning device 201 of the present embodiment is substantially identical with that of the melt spinning device 1 of the first embodiment, except a heat-transmission mechanism 204. In the descriptions below, members identical with those in the first embodiment will be denoted by the same reference numerals as in the first embodiment, and the explanations thereof may not be repeated.

**[0061]** In the first embodiment, the recesses 32a which are formed at the lower end portion of the wall surface defining the concave portion 32 of the heated box 3 are provided at regular intervals along the circumferential direction of each concave portion 32. Each recess 32a is open downward. Meanwhile, a recess 232a of the present embodiment is formed across the whole circumference of the concave portion 32. In addition to that, a wall surface defining the recess 232a is formed of (i) a bottom surface which opposes the outer circumferential surface of the spinning pack 2 inserted into the concave portion 32 and (ii) side surfaces which are provided at the respective ends of the bottom surface in the up-down direction. In other words, the recess 232a is not open downward.

**[0062]** The heat-transmission mechanism 204 of the present embodiment includes (i) a separated member 241 which is separated into plural transferring blocks 242 with respect to the circumferential direction of the spinning pack 2 and (ii) springs 243 which are provided to correspond to the respective transferring blocks 242 of the separated member 241. The materials of the separated member 241 and the springs 243 are preferably high in heat conductivity. Examples of these materials include aluminum alloy, copper alloy, common steel, alloy steel, special steel, carbon fiber composite, and silicone rubber. The materials of separated member 241 and the springs 243 may be any materials as long as the heat conductivities in these materials are higher at least than the heat conductivity in the static air layer.

**[0063]** As shown in FIG. 7, the transferring blocks 242

forming the separated member 241 are circular-arc-shaped members. The separated member 241 is provided around the spinning pack 2 which is inserted into the concave portion 32. Each spring 243 is a compression coil spring which elongates or contracts in the gap-depth direction, and one end portion of the spring 243 is attached to a surface of the corresponding transferring block 242. This surface of the transferring block 242 opposes the heated box 3. The spring 243 is detachably attached to the heated box 3 so that the other end portion opposite to one end portion attached to the transferring block 242 is in contact with the wall surface (to be more specific, the bottom surface of the recess 232a) defining the concave portion 32 in the heated box 3.

**[0064]** The spring 243 of the heat-transmission mechanism 204 is provided in the recess 232a formed at the lower end portion of the wall surface defining the concave portion 32 of the heated box 3. In the gap-depth direction (i.e., left-right direction for a viewer of FIGs. 6(a) and 6(b)), a leading end surface 242a (i.e., surface opposite to the surface to which the spring 243 is attached) of the transferring block 242 is provided outside the recess 232a. In other words, the position of the leading end surface 242a in the gap-depth direction of the transferring block 242 is on the spinning pack 2 side of a part of the wall surface defining the concave portion 32, in which part the recess 232a is not formed. In the gap-depth direction, when no external force is applied to the transferring block 242, the length of the heat-transmission mechanism 204 is longer than the size of a gap G (see FIG. 6(b)) between the wall surface defining the concave portion 32 in the recess 232a and the outer circumferential surface of the spinning pack 2. The upper and lower surfaces of the transferring block 242 are in contact with both side surfaces of the recess 232a. In other words, the length of the transferring block 242 in the up-down direction is substantially equal to the length of the recess 232a in the up-down direction.

**[0065]** Each transferring block 242 has an inclined surface 242b. In the gap-depth direction (i.e., left-right direction for a viewer of FIGs. 6(a) and 6(b)), the inclined surface 242b is formed on the lower surface of the transferring block 242 so that the inclined surface 242b and the spring 243 are on the opposite sides of the transferring block 242. The inclined surface 242b is inclined with respect to the gap-depth direction so that the lower end is positioned to be close to the heated box 3 as compared to the upper end.

**[0066]** As the spinning pack 2 is moved upward and inserted into the concave portion 32 as shown in FIG. 6(a), the upper end of the spinning pack 2 makes contact with the inclined surface 242b of the transferring block 242. As the spinning pack 2 is further moved upward while the upper end of the spinning pack 2 is in contact with the inclined surface 242b of the transferring block 242, the transferring block 242 moves toward the heated box 3. As a result, the spring 243 contracts.

**[0067]** As shown in FIG. 6(b), when the spinning pack 2 is entirely inserted into the concave portion 32, the lead-

ing end surface 242a of the transferring block 242 is in contact with the surface of the spinning pack 2. To be more specific, the leading end surface 242a of the transferring block 242 is in contact with an area A (see FIG. 6(b)) which is a part of the outer circumferential surface of the spinning pack 2 inserted into the concave portion 32 and where the spinneret 21 is formed in the up-down direction. In the present embodiment, the entire leading end surface 242a of the transferring block 242 is in contact with the area A of the outer circumferential surface of the spinning pack 2. The leading end surface 242a of the transferring block 242 corresponds to the contact portion of the present invention. The spring 243 contracts in accordance with the size of the gap between the wall surface defining the concave portion 32 and the outer circumferential surface of the spinning pack 2. The spring 243 applies the biasing force to transferring block 242, in a direction toward the surface of the spinning pack 2.

**[0068]** When the leading end surface 242a of the transferring block 242 is in contact with the outer circumferential surface of the spinning pack 2, the transferring block 242 and the spring 243 form a heat conduction path from the wall surface defining the concave portion 32 in the heated box 3 to the outer circumferential surface of the spinning pack 2. Because of this, heat from the heated box 3 is transferred to the transferring block 242 from both side surfaces of the recess 232a in contact with the upper and lower surfaces of the transferring block 242. In addition to that, heat from the heated box 3 is transferred to the transferring block 242 via the spring 243. The heat transferred to the transferring block 242 is finally transferred to the spinning pack 2 in contact with the transferring block 242.

**[0069]** The leading end surface 242a of each of the transferring blocks 242 forming the separated member 241 is designed so that the curvature of the leading end surface 242a is the same as that of the outer circumferential surface of the spinning pack 2. However, the leading end surface 242a and the outer circumferential surface of the spinning pack 2 may be different in curvature from each other because of, e.g., errors in production. It is therefore difficult to cause the entire leading end surface 242a of the transferring block 242 to make contact with the outer circumferential surface of the spinning pack 2. In this regard, as a contact area between the leading end surface 242a of each transferring block 242 and the outer circumferential surface of the spinning pack 2 increases, the efficiency in transferring heat from the heated box 3 to the spinning pack 2 improves. From the perspective of increasing the contact area between the leading end surface 242a of each transferring block 242 and the outer circumferential surface of the spinning pack 2, in order to secure the contact area as large as possible even when the leading end surface 242a of each transferring block 242 and the outer circumferential surface of the spinning pack 2 are different in curvature from each other, the separated member 241 is preferably formed of as many members as possible. In other words, for

example, the separated member 241 is separated into eight transferring blocks 242.

**[0070]** As the number of the springs 243 increases, the number of heat conduction paths also increases. Because of this, the efficiency in transferring heat from the heated box 3 to the spinning pack 2 is improved. For example, two springs 243 are provided at each of eight transferring blocks 242. In other words, the number of the provided springs 243 is sixteen in total.

(Advantageous Effects of Third Embodiment)

**[0071]** In the present embodiment, the following effects are obtained in addition to the effects obtained based on the structure identical with that in the first embodiment. In the melt spinning device 201 of the present embodiment, the biasing force of the springs 243 increases the contact pressure between the surface of the spinning pack 2 and the separated member 241 (i.e., transferring blocks 242). It is therefore possible to further improve the efficiency in transferring heat from the heated box 3 to the spinning pack 2.

<Fourth Embodiment>

**[0072]** The following will describe a melt spinning device 301 of a fourth embodiment of the present invention with reference to FIGs. 8(a) and 8(b). The structure of the melt spinning device 301 of the present embodiment is substantially identical with that of the melt spinning device 1 of the first embodiment, except a heat-transmission mechanism 304. In the descriptions below, members identical with those in the first embodiment will be denoted by the same reference numerals as in the first embodiment, and the explanations thereof may not be repeated.

**[0073]** In the first embodiment, the recesses 32a which are formed at the lower end portion of the wall surface defining the concave portion 32 of the heated box 3 are provided at regular intervals along the circumferential direction of each concave portion 32. Each recess 32a is open downward. Meanwhile, a recess 332a of the present embodiment is formed across the whole circumference of the concave portion 32. In addition to that, a wall surface defining the recess 332a is formed of (i) a bottom surface which opposes the outer circumferential surface of the spinning pack 2 inserted into the concave portion 32 and (ii) side surfaces which are provided at the respective ends of the bottom surface in the up-down direction. In other words, the recess 332a is not open downward. The bottom surface of the recess 332a is inclined with respect to the gap-depth direction so that the lower end is positioned to be close to the spinning pack 2, which is inserted into the concave portion 32, as compared to the upper end. Because of this, as the spinning pack 2 is inserted into the concave portion 32, a gradually-narrowing portion 308 which gradually narrows from the upper side toward the lower side in the up-down di-

rection is formed between the bottom surface of the recess 332a and the outer circumferential surface of the spinning pack 2.

**[0074]** The heat-transmission mechanism 304 of the present embodiment includes (i) a separated member 341 which is separated into plural transferring blocks 342 with respect to the circumferential direction of the spinning pack 2 and (ii) springs 343 which are provided to correspond to the respective transferring blocks 342 of the separated member 341. The materials of the separated member 341 and the springs 343 are preferably high in heat conductivity. Examples of these materials include aluminum alloy, copper alloy, common steel, alloy steel, special steel, carbon fiber composite, and silicone rubber. The materials of the separated member 341 and the springs 343 may be any materials as long as the heat conductivities in these materials are higher at least than the heat conductivity in the static air layer.

**[0075]** The transferring blocks 342 forming the separated member 341 are circular-arc-shaped members. The separated member 341 is provided around the spinning pack 2 which is inserted into the concave portion 32. Each spring 343 is provided between a surface which is a part of the wall surface defining the recess 332a and faces downward and the upper surface of the corresponding transferring block 342. One end of the spring 343 is attached to the upper surface of the transferring block 342, and the other end of the spring 343 is detachably attached to the wall surface defining the concave portion 32. The spring 343 is, e.g., a disc spring, and elongates and contracts in the up-down direction (i.e., axial direction of the spinning pack 2).

**[0076]** The spring 343 of the heat-transmission mechanism 304 is provided in the recess 332a formed at the lower end portion of the wall surface defining the concave portion 32 of the heated box 3. A leading end surface 342a (i.e., surface which opposes the outer circumferential surface of the spinning pack 2 which is inserted into the concave portion 32) of the transferring block 342 is provided outside the recess 332a. In other words, the position of the leading end surface 342a in the gap-depth direction of the transferring block 342 is on the spinning pack 2 side of a part of the wall surface defining the concave portion 32, in which part the recess 332a is not formed. As shown in FIG. 8(a), in the gap-depth direction, when no external force is applied to the transferring block 342, a length L2 of a part of the transferring block 342 which is provided outside the recess 332a is longer than a length L1 of a gap between (i) a part of the wall surface defining the concave portion 32 and (ii) the outer circumferential surface of the spinning pack 2 which is inserted into the concave portion 32. In the part of the wall surface defining the concave portion 32, the recess 332a is not formed.

**[0077]** Each transferring block 342 has an inclined surface 342b. The inclined surface 342b is connected to the lower end of the leading end surface 342a. The inclined surface 342b is inclined with respect to the gap-depth

direction so that the lower end is positioned to be close to the heated box 3 as compared to the upper end.

**[0078]** A surface of the transferring block 342 opposes the bottom surface of the recess 332, and this surface is an inclined surface 342c the inclination angle of which is the same as that of the bottom surface of the recess 332a. In other words, the inclined surface 342c is inclined with respect to the gap-depth direction so that the lower end is positioned to be close to the spinning pack 2 which is inserted into the concave portion 32 as compared to the upper end.

**[0079]** As the spinning pack 2 is moved upward and inserted into the concave portion 32 as shown in FIG. 8(a), the upper end of the spinning pack 2 makes contact with the inclined surface 342b of the transferring block 342. As the spinning pack 2 is further moved upward while the upper end of the spinning pack 2 is in contact with the inclined surface 342b of the transferring block 342, the transferring block 342 moves upward. As a result, the spring 343 contracts. At this time, the transferring block 342 moves upward while the inclined surface 342c of the transferring block 342 is in contact with the bottom surface of the recess 332a. As the transferring block 342 moves upward on account of the inclination of the bottom surface of the recess 332a, the center of the transferring block 342 also moves away from the spinning pack 2 which is inserted into the concave portion 32 (i.e., the direction toward the heated box 3).

**[0080]** As shown in FIG. 8(b), when the spinning pack 2 is entirely inserted into the concave portion 32, the transferring block 342 is positioned at the gradually-narrowing portion 308. In addition to that, the leading end surface 342a of the transferring block 342 is in contact with the surface of the spinning pack 2. To be more specific, the leading end surface 342a of the transferring block 342 is in contact with an area A (see FIG. 8(b)) which is a part of the outer circumferential surface of the spinning pack 2 inserted into the concave portion 32 and where the spinneret 21 is formed in the up-down direction. In the present embodiment, the entire leading end surface 342a of the transferring block 342 makes contact with the area A of the outer circumferential surface of the spinning pack 2. The leading end surface 342a of the transferring block 342 corresponds to the contact portion of the present invention. The spring 343 contracts in accordance with the size of the gap between the wall surface defining the concave portion 32 and the outer circumferential surface of the spinning pack 2. The spring 343 applies downward biasing force to the transferring block 342.

**[0081]** When the leading end surface 342a of the transferring block 342 is in contact with the outer circumferential surface of the spinning pack 2, the transferring block 342 and the spring 343 form a heat conduction path from the wall surface (to be more specific, the bottom surface of the recess 332a) defining the concave portion 32 in the heated box 3 to the outer circumferential surface of the spinning pack 2. With this arrangement, to begin

with, heat from the heated box 3 is transferred to the transferring block 342 and the spring 343 which are in contact with the heated box 3. The heat transferred to the spring 343 is then transferred to the transferring block 342. The heat transferred to the transferring block 342 is finally transferred to the spinning pack 2 in contact with the transferring block 342.

**[0082]** The leading end surface 342a of each of the transferring blocks 342 forming the separated member 341 is designed so that the curvature of the leading end surface 342a is the same as that of the outer circumferential surface of the spinning pack 2. However, the leading end surface 342a and the outer circumferential surface of the spinning pack 2 may be different in curvature from each other because of, e.g., errors in production. It is therefore difficult to cause the entire leading end surface 342a of the transferring block 342 to make contact with the outer circumferential surface of the spinning pack 2. In this regard, as a contact area between the leading end surface 342a of each transferring block 342 and the outer circumferential surface of the spinning pack 2 increases, the efficiency in transferring heat from the heated box 3 to the spinning pack 2 improves. From the perspective of increasing the contact area between the leading end surface 342a of each transferring block 342 and the outer circumferential surface of the spinning pack 2, in order to secure the contact area as large as possible even when the leading end surface 342a of each transferring block 342 and the outer circumferential surface of the spinning pack 2 are different in curvature from each other, the separated member 341 is preferably separated into the large number of members. In other words, for example, the separated member 341 is separated into eight transferring blocks 342.

(Advantageous Effects of Fourth Embodiment)

**[0083]** In the present embodiment, the following effects are obtained in addition to the effects obtained based on the structure identical with that in the first embodiment. In the melt spinning device 301 of the present embodiment, the transferring block 342 forming the heat conduction path is in surface-contact with the wall surface (to be more specific, the bottom surface of the recess 332a) defining the concave portion 32 of the heated box 3 and the outer circumferential surface of the spinning pack 2. The heat conduction path formed in the transferring block 342 is the shortest path among paths from the wall surface defining the concave portion 32 in the heated box 3 to the outer circumferential surface of the spinning pack 2. It is therefore possible to further improve the efficiency in transferring heat from the heated box 3 to the spinning pack 2.

(Modifications)

**[0084]** The embodiments of the present invention are described hereinabove. However, the specific structure

of the present invention shall not be interpreted as to be limited to the above described embodiments. The scope of the present invention is defined not by the above embodiments but by claims set forth below, and shall encompass the equivalents in the meaning of the claims and every modification within the scope of the claims.

**[0085]** In the above-described embodiments, the heat-transmission mechanism 4 (104, 204, 304) is attached to the bottom surfaces of the recesses 32a (i.e., to the bottom surface of the recess 132a, 232a, 332a) formed on the wall surface defining the concave portion 32 in the heated box 3. However, the disclosure is not limited to this. In a melt spinning device 401 of a modification of the second embodiment as shown in FIG. 9, a heat-transmission mechanism 404 including (i) a band base member 441 and (ii) a large number of brush bristles 442 attached to one surface of the band base member 441 is attached to the outer circumferential surface of the spinning pack 2.

**[0086]** In the above-described embodiments, the heat-transmission mechanism 4 (104, 204, 304) is detachably attached to the wall surface defining the concave portion 32 in the heated box 3. However, the disclosure is not limited to this. That is, the heat-transmission mechanism 4 (104, 204, 304) may be configured not to be detached from the wall surface defining the concave portion 32 in the heated box 3.

**[0087]** In the embodiments above, a part of the heat-transmission mechanism 4 (104, 204, 304) is provided at each recess 32a (the recess 132a, 232a, 332a) formed on the wall surface defining the concave portion 32 in the heated box 3. However, each recess 32a (the recess 132a, 232a, and 332a) may not be formed. The heat-transmission mechanism 4 (104, 204, 304) may be provided on a wall surface defining a concave portion in which any recess is not formed.

**[0088]** In the embodiments above, the area A which is a part of the surface of the spinning pack 2 inserted into the concave portion 32 and where the spinneret 21 is formed in the up-down direction makes contact with the following member: the central portion 41c of each plate spring 41 in the first embodiment; the leading end portion 142a of each brush bristle 142 in the second embodiment; the leading end surface 242a of each transferring block 242 in the third embodiment; or the leading end surface 342a of each transferring block 342 in the fourth embodiment. However, the disclosure is not limited to this. These members, i.e., the central portion 41c of each plate spring 41, the leading end portion 142a of each brush bristle 142, and the leading end surfaces 242a and 342a of the transferring blocks 242 and 342 may make contact with other parts of the surface of the spinning pack 2 except the area A. In the second embodiment above, the leading end portions 142a of all brush bristles 142 make contact with the area A. In the third embodiment above, the entire leading end surface 242a of each transferring block 242 makes contact with the area A. In the fourth embodiment above, the entire leading end sur-

face 342a of each transferring block 342 makes contact with the area A. However, the leading end portions 142a of some brush bristles 142, a part of the leading end surface 242a of each transferring block 242, and a part of the leading end surface 342a of each transferring block 342 may make contact with the area A.

**[0089]** In the first embodiment above, when the shape of each plate spring 41 elastically varies, the upper end of the bent portion 41b makes contact with the base portion 41a. However, the upper end of the bent portion 41b may not make contact with the base portion 41a.

**[0090]** In the second embodiment above, the heat-transmission mechanism 104 is brush-shaped and includes the band base member 141 and a large number of the brush bristles 142 attached to one surface of the band base member 141. Alternatively, a heat-transmission mechanism may be a scrubbing brush in shape. In other words, the heat-transmission mechanism may include a band member and a large number of wire-shaped members attached to one surface of the band member.

**[0091]** In the third embodiment above, the upper and lower surfaces of each transferring block 242 are in contact with both side surfaces of the recess 232a. However, the disclosure is not limited to this. The length of each transferring block 242 in the up-down direction may be sufficiently shorter than the length of the recess 232a in the up-down direction, with the result that the upper and lower surfaces of each transferring block 242 may be separated from both side surfaces of the recess 232a.

**[0092]** In the fourth embodiment above, the gradually-narrowing portion 308 which gradually narrows from the upper side toward the lower side in the up-down direction is formed between the wall surface defining the concave portion 32 and the outer circumferential surface of the spinning pack 2, and each spring 343 applies the downward biasing force to the corresponding transferring block 342. However, the disclosure is not limited to this. For example, a gradually-narrowing portion which gradually narrows from the lower side toward the upper side in the up-down direction may be formed and each spring may apply upward biasing force to the corresponding transferring block 342.

**[0093]** In the fourth embodiment above, the recess 332a formed on the wall surface defining the concave portion 32 is not open downward. However, the recess 332a may be open downward.

## Claims

1. A melt spinning device (1, 101, 201, 301, 401) comprising: a spinning pack (2) including a spinneret (21);  
a heated box (3) including a concave portion (32) having an internal space into which the spinning pack (2) is inserted, the concave portion (32) being open downward; and

- a heat-transmission mechanism (4, 104, 204, 304, 404) which is positioned at a gap between a wall surface defining the concave portion (32) and a surface of the spinning pack (2) when the spinning pack (2) is inserted into the concave portion (32), the heat-transmission mechanism (4, 104, 204, 304, 404) including a deformation member (41, 142, 243, 343, 442) the shape of which is elastically variable in accordance with the size of the gap, the heat-transmission mechanism (4, 104, 204, 304, 404) further including one or more members which include at least include the deformation member (41, 142, 243, 343, 442), and the one or more members forming a heat conduction path from the wall surface defining the concave portion (32) in the heated box (3) to the surface of the spinning pack (2) when the spinning pack (2) is inserted into the concave portion (32).
2. The melt spinning device (1, 101, 201, 301) according to claim 1, wherein, the heat-transmission mechanism (4, 104, 204, 304) is attached to the wall surface defining the concave portion (32) in the heated box (3).
  3. The melt spinning device (1, 101, 201, 301) according to claim 2, wherein, the heat-transmission mechanism (4, 104, 204, 304) is detachably attached to the wall surface defining the concave portion (32) in the heated box (3).
  4. The melt spinning device (1, 101, 201, 301) according to any one of claims 1 to 3, wherein, the heat-transmission mechanism (4, 104, 204, 304) further includes a contact portion (41c, 142a, 242a, 342a) which makes contact with an area, the area being a part of the surface of the spinning pack (2) which is inserted into the concave portion (32), the spinneret (21) being formed in the area in an up-down direction.
  5. The melt spinning device (1, 101, 201, 301, 401) according to any one of claims 1 to 4, wherein, a recess (32a, 132a, 232a, 332a) is formed in the wall surface defining the concave portion (32) in the heated box (3), and a part of the heat-transmission mechanism (4, 104, 204, 304, 404) is provided in the recess (32a, 132a, 232a, 332a).
  6. The melt spinning device (1) according to any one of claims 1 to 5, wherein, the deformation member (41) is a spring which is fixed to one of the wall surface defining the concave portion (32) and the surface of the spinning pack (2) and, as the spinning pack (2) is inserted into the concave portion (32), the shape of the spring elastically varies by making contact with the other of the wall surface defining the concave portion (32) and the surface of the spinning pack (2).
  7. The melt spinning device (101, 401) according to any one of claims 1 to 5, wherein, the deformation member (142, 442) is a wire-shaped member, one end portion of the wire-shaped member being fixed to one of the wall surface defining the concave portion (32) and the surface of the spinning pack (2), and, as the spinning pack (2) is inserted into the concave portion (32), the shape of the wire-shaped member elastically varying in such a way that the other end portion of the wire-shaped member makes contact with the other of the wall surface defining the concave portion (32) and the surface of the spinning pack (2).
  8. The melt spinning device (201) according to any one of claims 1 to 5, wherein, the heat-transmission mechanism (204, 304) further includes a separated member (241, 341) which is divided into plural parts with respect to a circumferential direction of the spinning pack (2), and the deformation member (243) is a spring which is fixed to one of the wall surface defining the concave portion (32) and the surface of the spinning pack (2) and, when the spinning pack (2) is inserted into the concave portion (32), the spring applies biasing force to the separated member (241) in a direction toward the other of the wall surface defining the concave portion (32) and the surface of the spinning pack (2).
  9. The melt spinning device (301) according to claim 5, wherein, a gradually-narrowing portion (308) which gradually narrows from one side toward the other side in the up-down direction is formed between a bottom surface of the recess (332a) and the surface of the spinning pack (2), the heat-transmission mechanism (304) further includes a separated member (341) which is divided into plural parts with respect to a circumferential direction of the spinning pack (2) and which forms the heat conduction path, the separated member (341) is provided at the gradually-narrowing portion (308) between the bottom surface of the recess (332a) and the surface of the spinning pack (2), and the separated member (341) is in surface-contact with the bottom surface of the recess (332a) and the surface of the spinning pack (2), and the deformation member (343) is a spring which applies biasing force to the separated member (341) in a direction from the one side to the other side in the up-down direction, when the spinning pack (2) is inserted into the concave portion (32).

FIG. 1

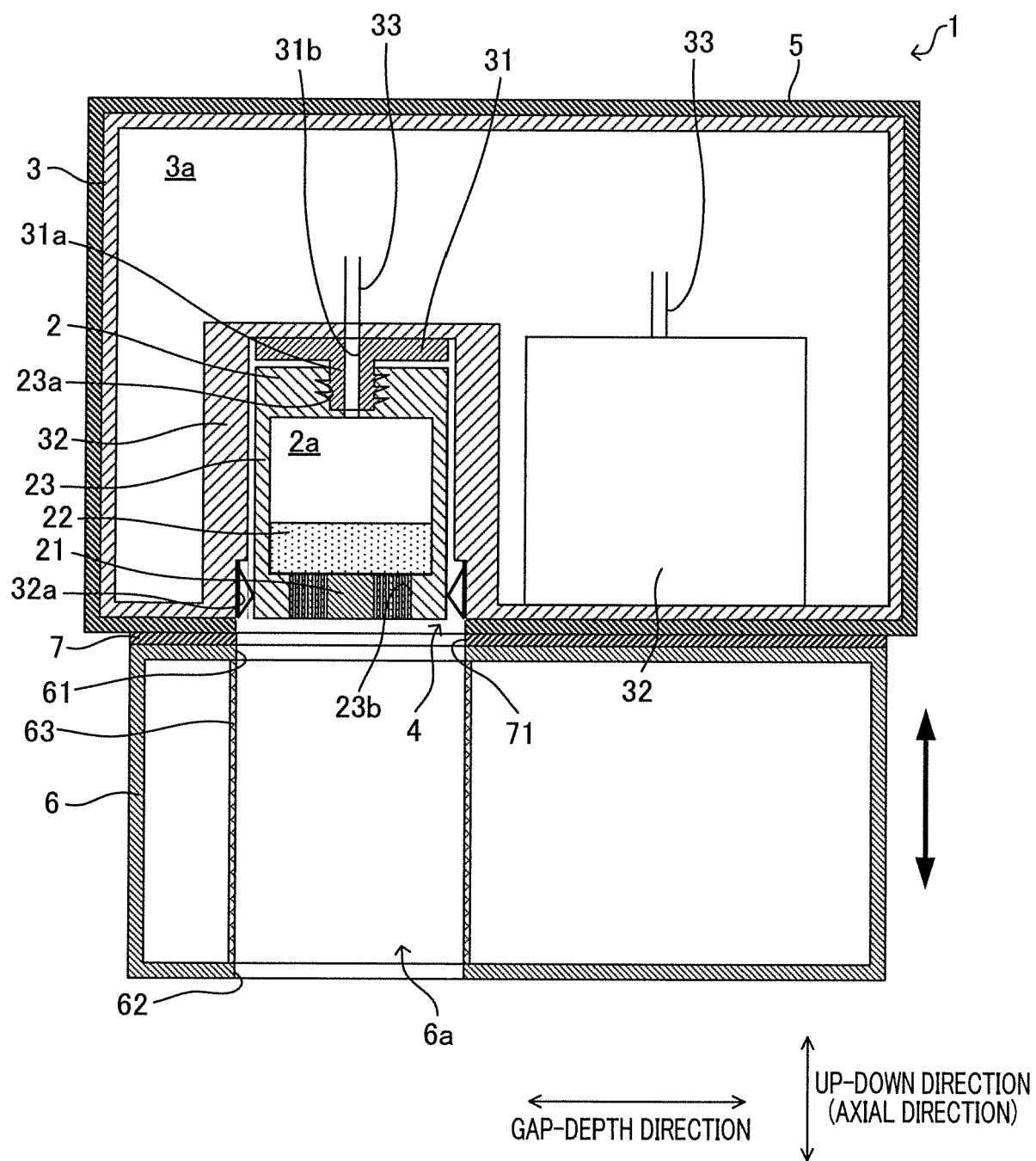


FIG.2

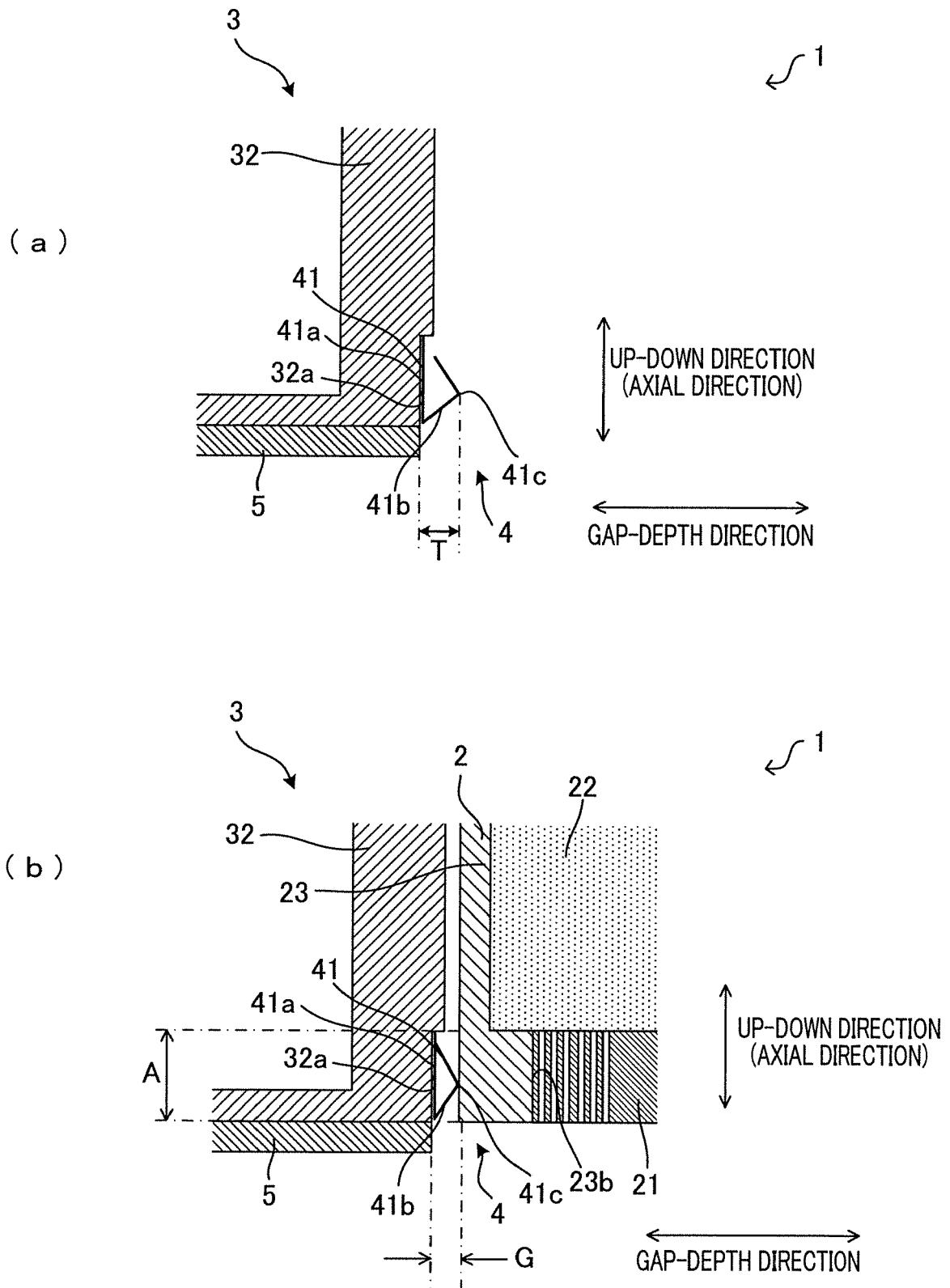


FIG.3

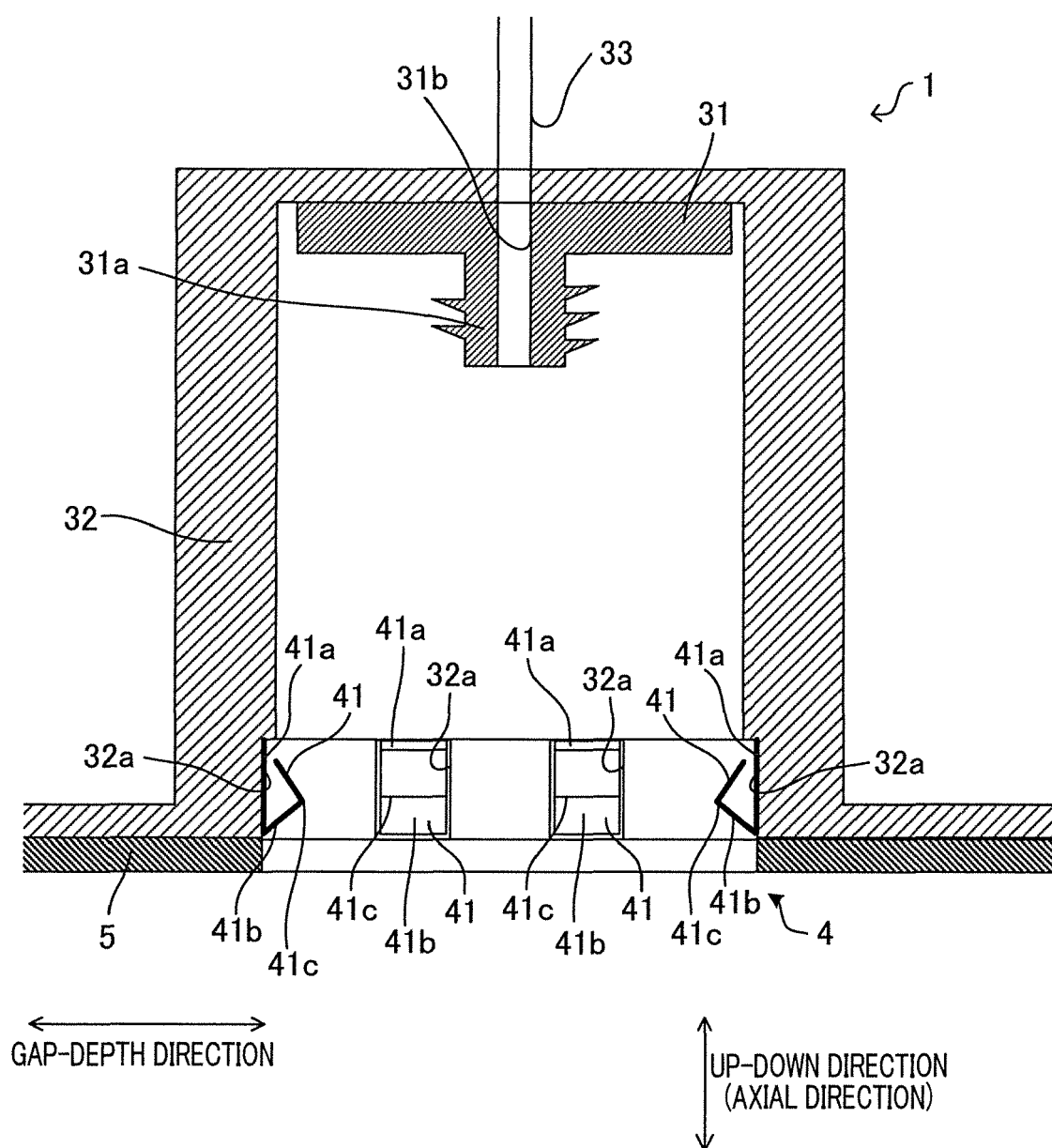


FIG.4

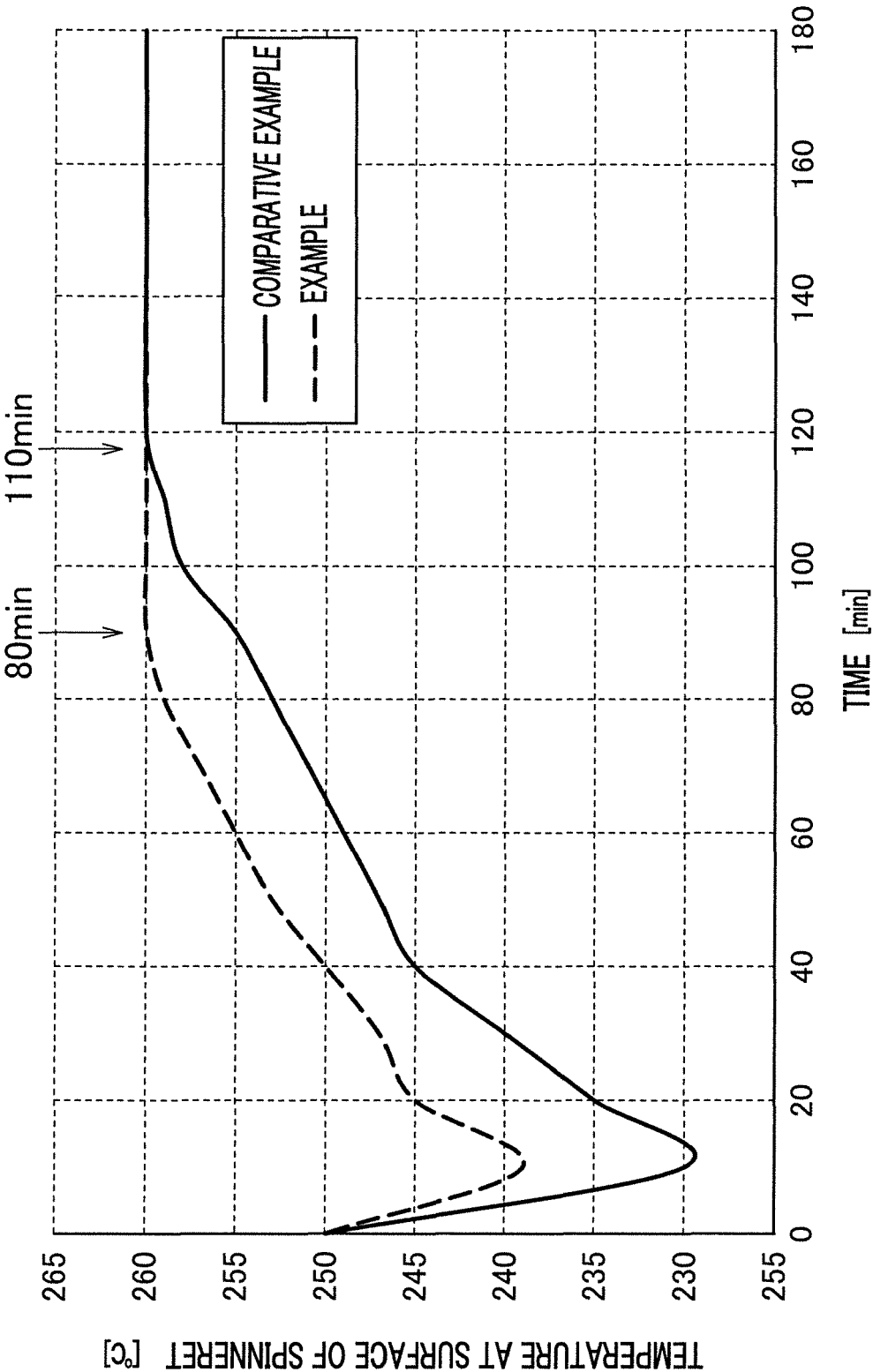


FIG.5

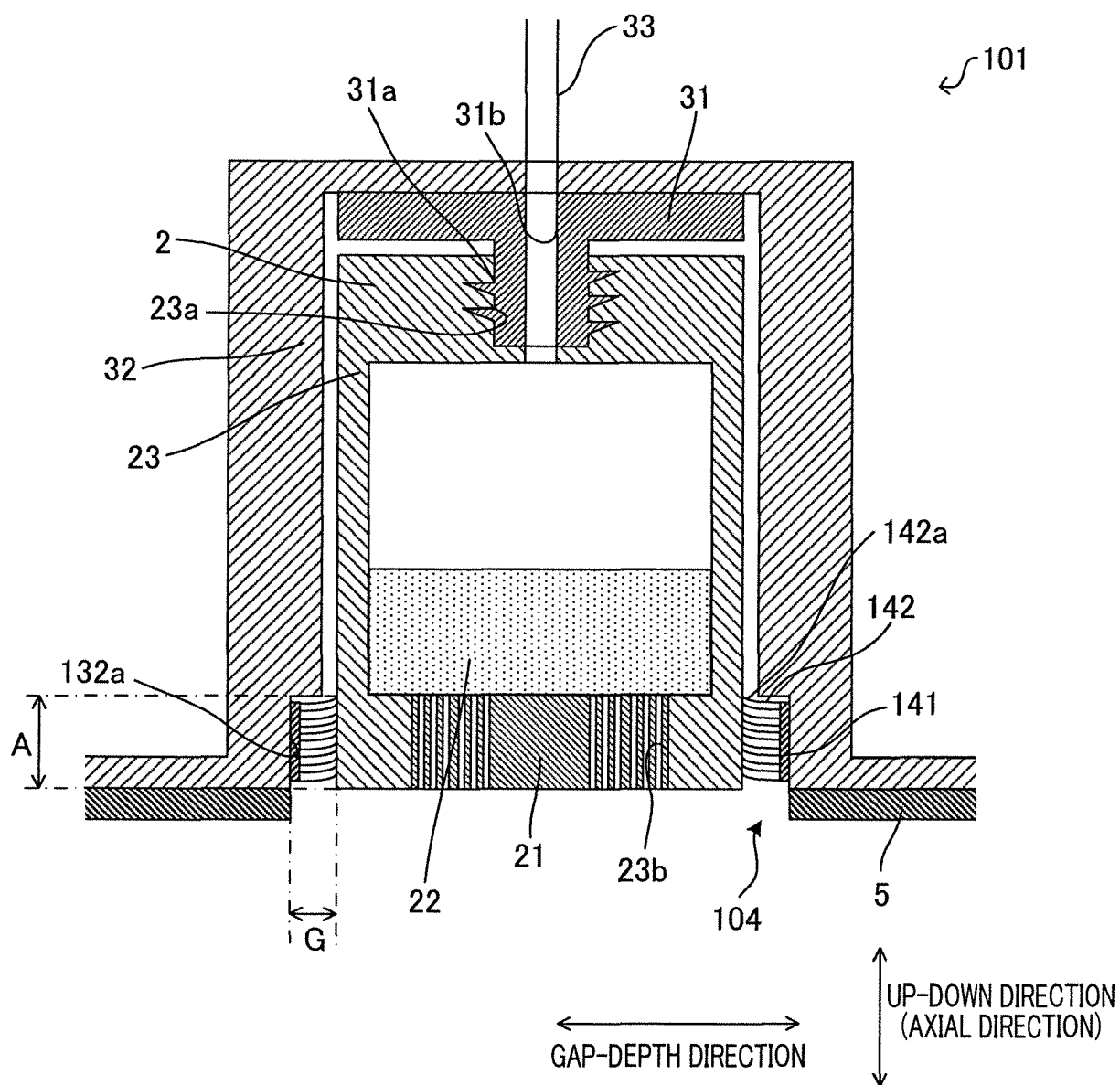


FIG.6

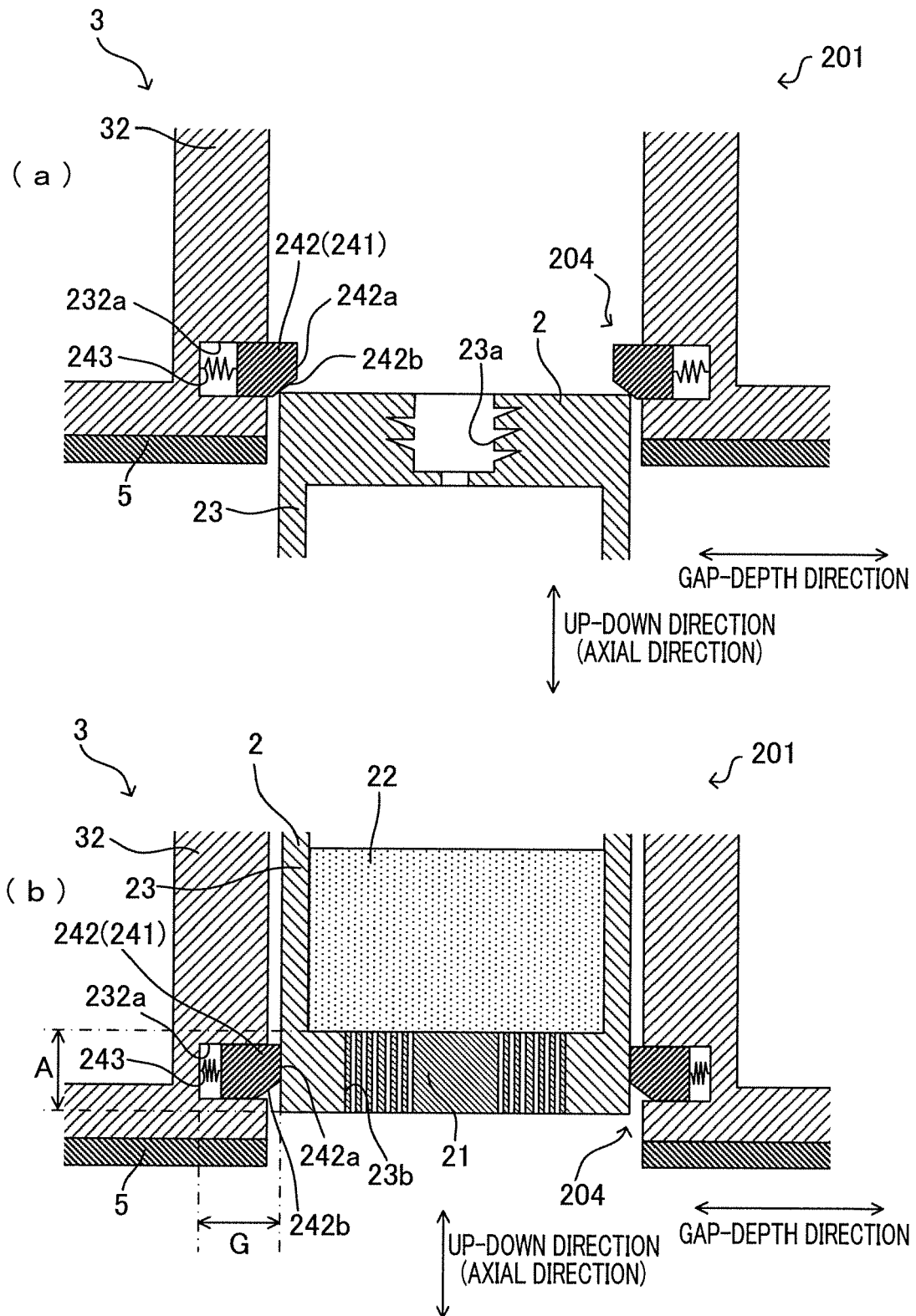


FIG.7

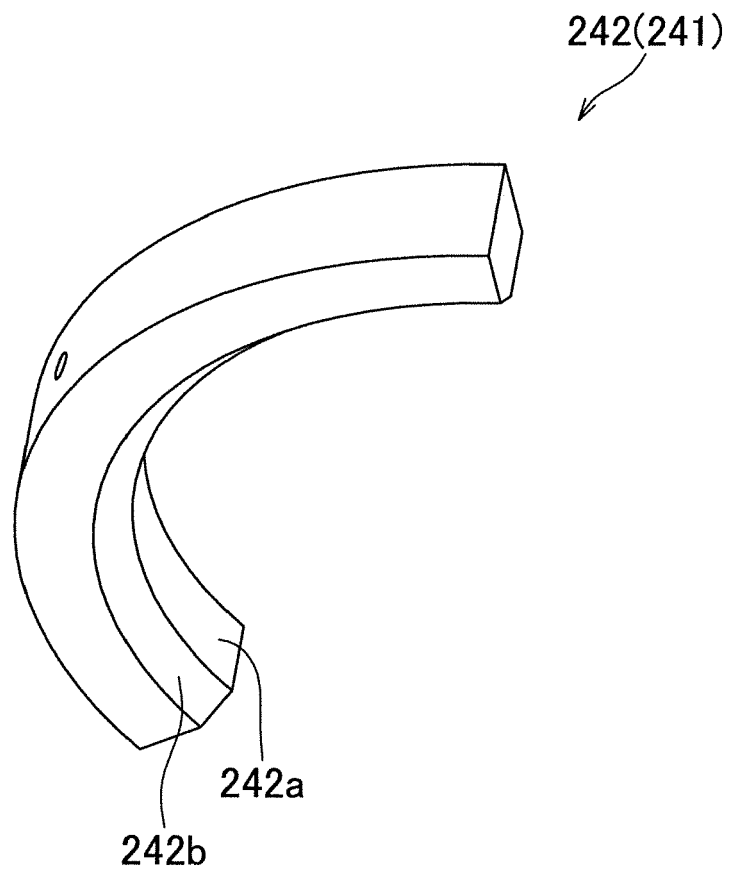


FIG.8

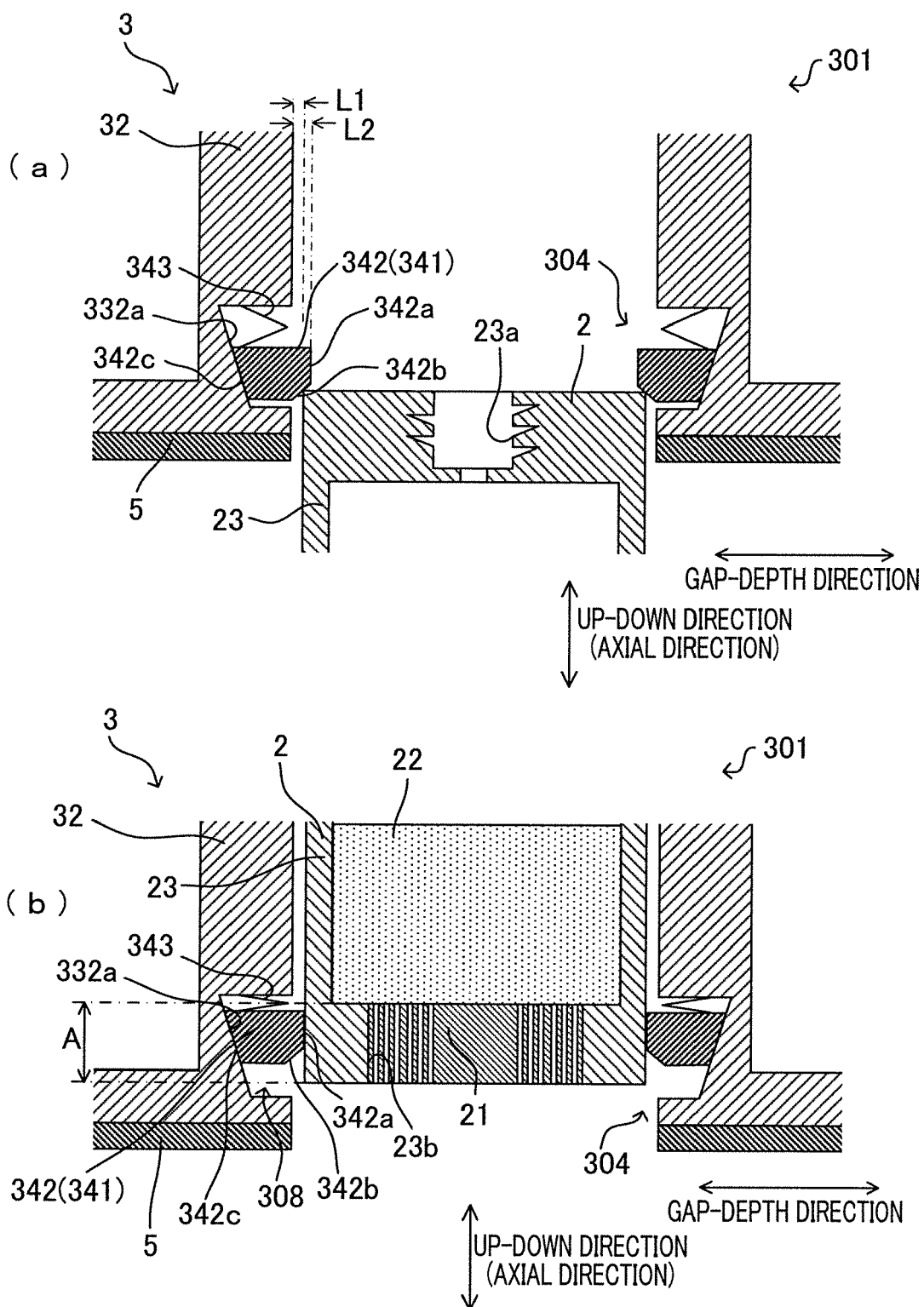
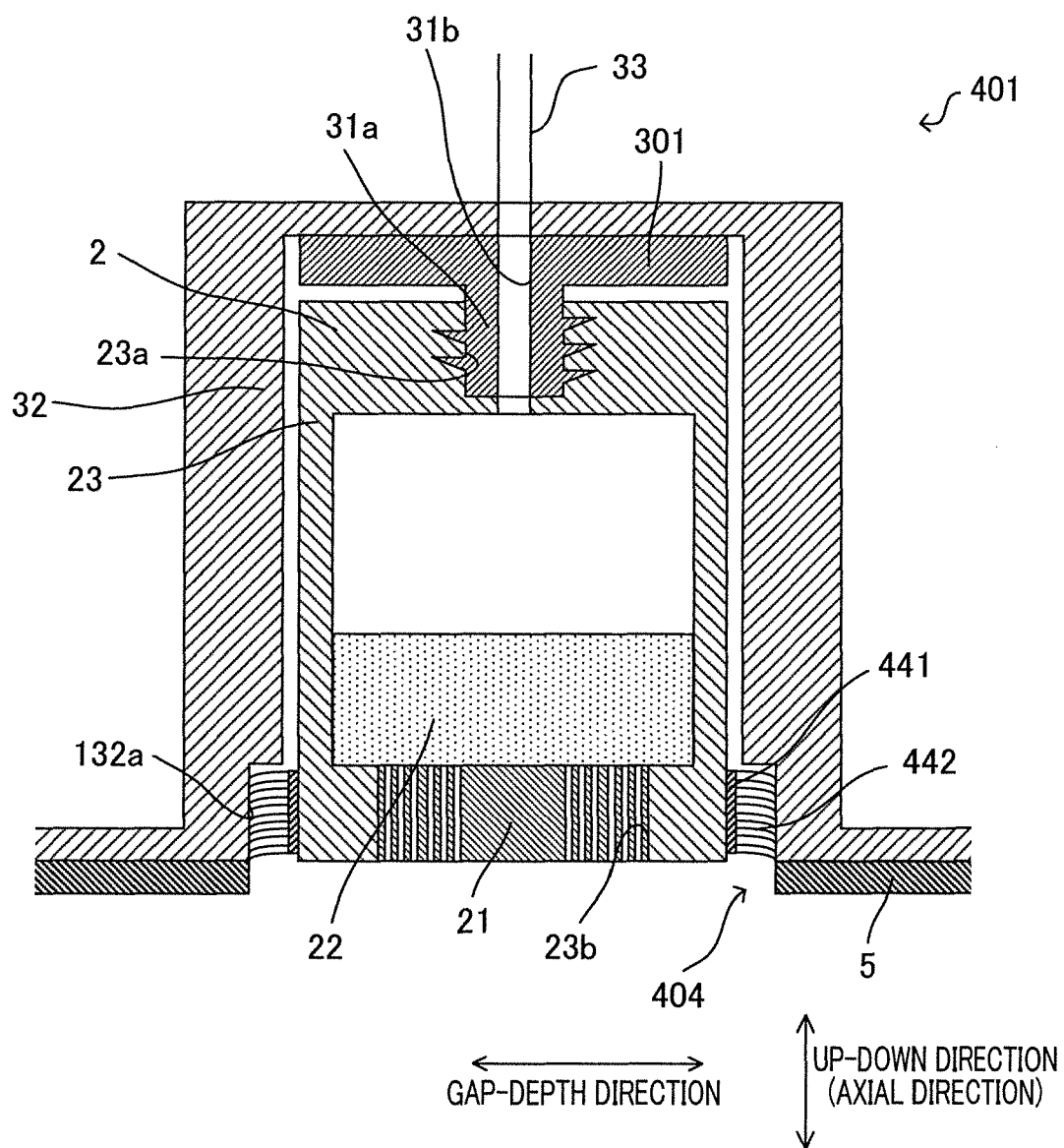


FIG.9





## EUROPEAN SEARCH REPORT

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