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Blowoff nozzle

Abstract

A blower nozzle is a blower nozzle that blows out the air to a film being conveyed, and that includes an internally installed portion that is provided near a position where the air is blown out, inside the blower nozzle, and that has inclined surfaces inclined with respect to a virtual plane passing through an opening surface of an opening of the blower nozzle, the opening surface being a surface from which the air is blown out, the inclined surfaces being inclined in a manner being closer to each other toward the virtual plane.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS
(1) This application is the U.S. National Phase application of PCT/JP2020/037654 filed Oct. 2, 2020, which claims priority to Japanese Patent Application No. 2019-190269, filed Oct. 17, 2019, the disclosures of these applications being incorporated herein by reference in their entireties for all purposes.
FIELD OF THE INVENTION
(2) The present invention relates to a blowoff nozzle.
BACKGROUND OF THE INVENTION
(3) As methods for producing stretched films made of thermoplastic resin, sequential biaxial stretching, and simultaneous biaxial stretching have been known. With the sequential biaxial stretching, an unstretched film made of thermoplastic resin is stretched in its longitudinal direction to obtain a uniaxially stretched film, and then the obtained uniaxially stretched film is put into a tenter oven and stretched in its width direction. With the simultaneous biaxial stretching, an unstretched film made of thermoplastic resin is put into a tenter oven and stretched inside the oven in its longitudinal direction and the width direction simultaneously.
(4) Stretched films made of thermoplastic resin are widely used for various industrial material applications, such as those for packaging. Among such films, sequential biaxially stretched films made of polyester, polyolefin, or polyamide resin are widely used due to their excellent properties such as mechanical, thermal, and electrical properties, in applications where unstretched films are not usable, and the demand for the sequential biaxially stretched films has been increasing.
(5) A problem with a tenter oven used in manufacturing a stretched film made of thermoplastic

resin is that circulation of the air does not complete within the chamber that makes up the tenter oven. For example, the tenter oven experiences phenomena in which the air flows into an adjacent chamber with a different temperature setting, in which the air from the outside of the tenter oven flows into the oven, and in which the air inside the chamber blows out of the oven. All of these phenomena are phenomena in which the air flows along the direction in which the film is conveyed, and this kind of the air flow is referred to as a machine-direction (MD) flow. Such an MD flow is caused by, for example, an airflow that accompanies the film as the film is conveyed, and a discrepancy between the amount of heated air supplied into the tenter oven and the amount of the air exhausted from the tenter oven.

(6) When an MD flow is generated, because the incoming air with a different temperature from the outside of the chamber becomes mixed with the heated air inside the chamber, as the incoming air flows near the film, the film heating efficiency becomes inconsistent, and the film is subjected to extensive temperature unevenness. In the tenter oven, at least one of the following processes is performed: a preheating process for heating the film to a desired temperature; a stretching process for extending the film into a desired width; a thermal fixing process for applying a thermal treatment to the film at a desired temperature; and a cooling process for cooling the film to a desired temperature. If the temperature of the film becomes uneven during any of these processes, the film thickness may become uneven and the characteristics may become varied, and result in a deterioration of the product quality. In addition to the deterioration of the product quality, the film may become torn inside the tenter oven, and productivity may decline.

(7) Known as a technology for preventing an MD flow from drawing the external air into the tenter oven, or from carrying the air inside the chamber to the outside of the tenter oven is a technology for causing a blowoff nozzle installed at a prior stage of the oven, being prior in the film conveying direction, to blow out the air to the film surface, so as to block such an airflow air (see Patent Literature 1, for example).

PATENT LITERATURE

(8) Patent Literature 1: International Publication No. 2017/115654

SUMMARY OF THE INVENTION

(9) In a stretched film manufacturing apparatus, it is preferable to keep the blowoff nozzle away from the film, from the viewpoint of the configuration of the apparatus. However, if the distance between the film and the blowoff nozzle is increased, the air pressure of the air blowing out of the blowoff nozzle drops, and becomes incapable of blocking the MD flow. The MD flow may then draw the external air into the tenter oven or carry the inside air to the outside of the tenter oven, and may increase the temperature unevenness near the film and inside the tenter oven.

(10) The present invention was made in consideration of the above problem, and an object of the present invention is to provide a blowoff nozzle capable of suppressing temperature unevenness even when the distance between the nozzle and the film is increased.

(11) To solve the above problem, a blowoff nozzle according to the present invention is a blowoff nozzle that blows out air to a film being conveyed. The blowoff nozzle includes an internally installed portion that is provided near a position where the air is blown out, inside the blowoff nozzle, and that has inclined surfaces inclined with respect to a virtual plane passing through an opening surface of an opening of the blowoff nozzle, the opening surface being a surface from which the air is blown out, the inclined surfaces being inclined in a manner being close to each other toward the virtual plane.

(12) The blowoff nozzle according to the present invention further includes a protruding portion protruding from the internally installed portion to outside of the opening, the protruding portion having an inclined surface inclined with respect to the virtual plane.

(13) In the blowoff nozzle according to the present invention, the opening includes first to third openings that are independent from one another, and the internally installed portion includes: a first internally installed portion provided between the first opening and the second opening, the first

internally installed portion having an inclined surface that is inclined with respect to the virtual plane; and a second internally installed portion provided between the second opening and the third opening, the second internally installed portion having an inclined surface that is inclined with respect to the virtual plane.
(14) The blowoff nozzle according to the present invention further includes a protruding portion protruding from the internally installed portion to outside of the opening, the protruding portion having an inclined surface that is inclined with respect to the virtual plane. The protruding portion includes: a first protrusion provided between the first opening and the second opening, the first protrusion having an inclined surface inclined with respect to the virtual plane; and a second protrusion provided between the second opening and the third opening, the second protrusion having an inclined surface inclined with respect to the virtual plane.
(15) According to the present invention, it is possible to suppress temperature unevenness even when the distance between the film and the apparatus is increased.

Description

BRIEF DESCRIPTION OF DRAWINGS
(1) FIG. **1** is a schematic illustrating a configuration of a film manufacturing apparatus provided with a blowoff nozzle according to one embodiment of the present invention.
(2) FIG. **2** is a cross-sectional view of the film manufacturing apparatus corresponding to a cross section across the line A-A illustrated in FIG. **1**.
(3) FIG. **3** is a cross-sectional view of the blowoff nozzle corresponding to a cross section across the line B-B illustrated in FIG. **2**.
(4) FIG. **4** is a schematic illustrating a configuration of a blowoff nozzle according to a first modification of the present invention.
(5) FIG. **5** is a schematic illustrating a configuration of a blowoff nozzle according to a second modification of the present invention.
(6) FIG. **6** is a schematic illustrating a configuration of the blowoff nozzle according to a third modification of the present invention.
(7) FIG. **7** is a schematic illustrating a configuration of a blowoff nozzle according to a comparative example.
(8) FIG. **8** is a schematic for explaining a numerical analysis model used in a second analysis example.
DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION
(9) Some embodiments for implementing the present invention will now be explained with reverence to some drawings. The embodiments, however, are not intended to limit the scope of the present invention in any way. Furthermore, the drawings referred in the following description merely give schematic representations of the shapes, the sizes, and the positional relations according to the present invention to an extent allowing understanding of the present invention. In other words, the present invention is not limited only to the shapes, the sizes, and positional relations illustrated in the drawings. Furthermore, in the description of the drawings, the same parts are given the same reference signs.
(10) FIG. **1** is a schematic illustrating a configuration of a film manufacturing apparatus provided with a blowoff nozzle according to one embodiment of the present invention. FIG. **2** is a cross-sectional view of the film manufacturing apparatus corresponding to a cross section across the line A-A illustrated in FIG. **1**. This film manufacturing apparatus **1** illustrated in FIGS. **1** and **2** is provided with an airflow controller **2** and a tenter oven **3**. The film manufacturing apparatus **1** is a stretched film manufacturing apparatus that uses the sequential biaxial stretching or the simultaneous biaxial stretching, and feeds an unstretched film made of thermoplastic resin into the

tenter oven **3** and stretches an unstretched film **100** inside the tenter oven **3** in at least one of the longitudinal and width directions. In FIG. **1**, the longitudinal direction of the film **100** is the film conveying direction FR, and corresponds to the left-to-right direction in the drawing. The width direction of the film **100** (film width direction) is a direction perpendicular to the longitudinal direction and the thickness direction of the film (the up-and-down direction on the paper surface), and corresponds to a direction perpendicular to the paper surface.
(11) The airflow controller **2** is installed at a prior stage of the tenter oven **3**, in the conveying direction of the film **100**. After passing through the airflow controller, the film **100** to be stretched is carried into the tenter oven **3**. The airflow controller **2** is connected to the tenter oven **3** via a connector **4**.
(12) The film to which the airflow controller **2** according to the present invention is applied is not limited to a particular film, and any known thermoplastic film heated and stretched inside the tenter oven **3** may be applied.
(13) The inside of the tenter oven **3** is heated to a set temperature when the film **100** is to be stretched. The tenter oven **3** has one end connected to the connector **4**, and has the other end provided with an opening through which the film **100** is discharged to the outside.
(14) The airflow controller **2** includes a first blowoff nozzle **21** facing one surface of the film **100** (the top surface in FIG. **1**) and a second blowoff nozzle **22** facing the other surface of the film **100** (the bottom surface in FIG. **1**). Hereinafter, the "first blowoff nozzle **21**" will be simply referred to as a "blowoff nozzle **21**". The "second blowoff nozzle **22**" will be simply referred to as a "blowoff nozzle **22**". The blowoff nozzles **21** and **22** blow out the air to the respective surfaces of the film **100**, the surfaces being surfaces facing the blowoff nozzles **21** and **22**. The blowoff nozzles **21** and **22** are housed in a box-shaped body **20**. The box-shaped body **20** has one end connected to the connector **4** in the conveying direction of the film **100**, and has the other end provided with an opening through which the film **100** is fed from the outside. Although a pair of blowoff nozzles facing each other is effective, the effectiveness can be improved further by providing the blowoff nozzles in a plurality of pairs.
(15) The airflow controller **2** is provided with blowers B**1** and B**2**, as air supply sources to the blowoff nozzles **21** and **22**, respectively, heat exchangers H**1** and H**2**, and exhaust mechanisms E**1** and E**2**. The blower B**1** sucks the external air, and blows out the airs. The heat exchanger H**1** heats the air blown out of the blower B**1**. The exhaust mechanism E**1** stores the air heated by the heat exchanger H**1**, and sends the air to the blower B**1**. The blower B**2**, the heat exchanger H**2**, and the exhaust mechanism E**2** have the same functions as those of the blower B**1**, the heat exchanger H**1**, and the exhaust mechanism E**1**, respectively, as described above.
(16) The blower B**1** and the exhaust mechanism E**1** are connected via a duct D**11**. The blower B**1** and the heat exchanger H**1** are connected via a duct D**12**. The heat exchanger H**1** and the blowoff nozzle **21** are connected via a duct D**13**. In the airflow controller **2**, the air blown out of the blower B**1** is heated in the heat exchanger H**1**, and the heated air is sent to the blowoff nozzle **21** via the duct D**13**. The blowoff nozzle **21** blows out the air fed via the duct D**13**. The exhaust mechanism E**1** has exhaust units E**11** and E**12** that suck the air blown out of the blowoff nozzle **21**, and the air carried by the MD flow. The exhaust units E**11** and E**12** are provided with openings, respectively, through which the air is sucked into the exhaust mechanism E**1**. These openings are provided as holes or slits. In this embodiment, the exhaust unit E**11** is provided at the prior stage, and the exhaust unit E**12** is provided at the subsequent stage of the blowoff nozzle **21**, in the longitudinal direction (conveying direction FR) of the film **100**.
(17) The blower B**2** and the exhaust mechanism E**2** are connected via a duct D**21**. The blower B**2** and the heat exchanger H**2** are connected via a duct D**22**. The heat exchanger H**2** and the blowoff nozzle **22** are connected via a duct D**23**. In the airflow controller **2**, the air blown out of the blower B**2** is heated in the heat exchanger H**2**, and the heated air is sent to the blowoff nozzle **22** via the duct D**23**. The blowoff nozzle **22** blows out the air fed via the duct D**23**. The exhaust mechanism

E**2** includes exhaust units E**21** and E**22** that suck the air blown out of the blowoff nozzle **22** and carried by the MD flow. The exhaust units E**21** and E**22** are provided with openings, respectively, through which the air is sucked into the exhaust mechanism E**2**, and the openings are provided as holes or slits. In this embodiment, in the longitudinal direction (conveying direction FR) of the film **100**, the exhaust unit E**21** is provided at the prior stage, and the exhaust unit E**22** is provided at the subsequent stage of the blowoff nozzle **22**.

(18) Air supply dampers (not illustrated) may be installed in the ducts D**13** and D**23**, respectively, and the amount of the blown-out air may be adjusted by changing the degree by which this air supply damper is opened. The air supply damper may be replaced with a valve, a valve, or an orifice. By adjusting the amount of the air blown out of the blowoff nozzles **21** and **22**, it is possible to reduce the amount of energy used for heating the air.

(19) Exhaust dampers (not illustrated) may be installed in the ducts D**11** and D**21**, respectively, and the amount of the air sucked into the exhaust units E**11**, E**12**, E**21**, and E**22** may be adjusted by changing the degree by which this air supply damper is opened. The exhaust damper may be replaced with a valve, a valve, or an orifice. By adjusting the amount of the air sucked by the exhaust units E**11**, E**12**, E**21**, and E**22**, it is possible to reduce a thermal loss.

(20) In general, in order to use the film **100** to be conveyed having a different width based on the type of the film **100** to be manufactured, the distance between rail covers **51** and **52** covering clips and clip rails (not illustrated) for holding the respective ends of the film **100** in the tenter oven **3** is increased or decreased in the width direction. The rail covers **51** and **52** and the blowoff nozzles **21** and **22** are provided at positions not interfering each other. For example, if the distance between the blowoff nozzles **21** and **22** disposed facing each other with the film **100** therebetween is smaller than the height of the rail covers **51** and **52** (the distance in the thickness direction of the film **100**), it is preferable to provide a mechanism that can increase or decrease the width of the blowoff nozzles **21** and **22**, in accordance with the width of the film **100** so that the rail covers **51** and **52** do not interfere with the blowoff nozzles **21** and **22**. When the width of the film **100** is increased, it is possible to form an air curtain that extends in the film width direction by extending the length of the blowoff nozzles **21** and **22** in the film width direction, while avoiding contact or interference with the rail covers **51** and **52**.

(21) A configuration of the blowoff nozzle will now be explained. FIG. **3** is a cross-sectional view of the blowoff nozzle corresponding to the cross section across the line B-B illustrated in FIG. **2**. In the explanation of FIG. **3**, a configuration of the blowoff nozzle **22** will be used as an example, but the blowoff nozzle **21** has the same configuration. The blowoff nozzle **22** includes a pressure equalizing chamber **221** to which the air is supplied via the duct D**23**, a blowoff unit **222** that extends from the pressure equalizing chamber **221** and blows out the air, and a flow divider unit **223** that is provided inside the blowoff unit **222** and divides the flow path of the air blown out of the blowoff unit **222**.

(22) The blowoff unit **222** has an opening **222***a* for blowing out the air toward a side opposite to the side connected to the pressure equalizing chamber **221**. The opening **222***a* is provided as a slit extending in the film width direction (see FIG. **2**). The air blowing opening **222***a* may also be a plurality of holes lined up in the film width direction, instead of being a slit. An end face of the blowoff unit **222**, the end face being provided with the opening **222***a*, is laid in parallel with the conveying direction FR of the film **100**. A part of each side surface of the blowoff unit **222**, the part being that on the side of the opening **222***a*, is provided with inclined surfaces **222***b* and **222***c* inclined with respect to the conveying direction FR of the film **100**. The inclined surfaces **222***b* and **222***c* are inclined in a manner being closer to each other toward the opening surface of the opening **222***a*. The blowoff unit **222** may also be a hollow prism-like shape without the inclined surfaces **222***b* and **222***c*.

(23) The flow divider unit **223** has inclined surfaces having inclined ends on the side of opening **222***a*, being inclined with respect to each other toward the opening **222***a*. Specifically, the flow

divider unit **223** has a base portion **223***a* that extends in a prism-like shape from the pressure equalizing chamber **221**, and an internally installed portion **223***b* that is provided inside the blowoff unit **222** near the position where the air is blown out and that extends from the base portion **223***a* toward the opening **222***a*. The internally installed portion **223***b* has inclined surfaces **223***c* and **223***d* inclined with respect to a virtual plane S that passes through the opening surface of the opening **222***a* and that extends in parallel with the opening surface. The inclined surfaces **223***c* and **223***d* are inclined in a manner being closer to each other toward the opening **222***a*. The flow divider unit **223** has a pentagonal contour in the cross section illustrated in FIG. **3**. The virtual plane S extends in parallel with the conveying direction FR. In this embodiment, the inclined surface **223***c* extends in parallel with the inclined surface **222***b*, and the inclined surface **223***d* extends in parallel with the inclined surface **222***c*, but it is not always necessary for the inclined surfaces of the blowoff unit **222** to be in parallel with the inclined surfaces of the flow divider unit **223**, respectively.
(24) It is assumed herein that L denotes the distance between the tip of the blowoff unit **222** and the film **100**, θ**1** denotes the angle between the inclined surface of the flow divider unit **223** (inclined surface **223***d* in FIG. **3**) and the virtual plane S (where θ**1**>0), and t denotes the distance between the opening **222***a* and the flow divider unit **223** on the virtual plane S, in the film conveying direction FR. The distance L, the angle θ**1**, and the distance t are determined based on a pressure setting for an air stagnation point P**1**. The pressure setting is set to 60 Pa, for example, but may be set to any pressure higher than that by which the MD flow can be blocked, without limitation to 60 Pa. The stagnation point P**1** corresponds to a position of stagnation formed on the film **100** by the air blown out of the blowoff unit **222**.
(25) The ways in which the air blown out of the blowoff nozzles **21** and **22** flows will now be explained, using the blowoff nozzle **22** as an example. The air (hot air) supplied into the blowoff nozzle **22** via the duct D**23** is blown out of the opening **222***a* toward the film **100**. The flow divider unit **223** controls the blowing direction of the air blown out of the opening **222***a*. The flow divider unit **223** causes the air blown out from the upstream side of the conveying direction FR to blow toward the downstream with respect to the film **100**. The flow divider unit **223** causes the air blown out from the downstream side of the conveying direction FR to blow toward the upstream with respect to the film **100**. The air blown out on the upstream side and the air blown out on the downstream side travel in directions crossing each other, and become merged with each other between the blowoff nozzle **22** and the film **100**. Through this merging of the air, the air pressure is increased, and the air volume per unit time is increased. After being merged, the air travels in a direction perpendicular to the conveying direction FR of the film **100**, and hits the film **100**. The air then changes its flowing direction to the upstream and the downstream sides in the conveying direction of the film **100**, and collide with the incoming air flowing into the box-shaped body **20** and is turned into return air. The return air is then sucked into the exhaust units E**21** and E**22** (see FIG. **1**), respectively. The air blown out of the blowoff nozzle **21** is also sucked into the exhaust units E**11** and E**12** in the same manner.
(26) At this time, as the incoming air from the outside of the apparatus along the bottom surface of the film **100** as well as the accompanying flow generated in the film conveying direction flow into the box-shaped body **20** through the film feeding opening of the airflow controller **2**, the incoming air is blocked by the air blown out of the blowoff nozzle **22**, has its flowing direction changed, and is sucked into the exhaust unit E**21**, together with the return air. In the manner described above, because the exhaust unit E**21** sucks the incoming air from the outside of the apparatus, the incoming air from the outside of the airflow controller **2** is prevented from flowing into the tenter oven **3** and from resulting in temperature unevenness in the tenter oven **3**. The same applies to the incoming air arriving from the outside the apparatus along the top surface of the film **100** and flowing into the box-shaped body **20** through the film feeding opening.
(27) When the incoming air from the tenter oven **3** passes through a discharge opening of the airflow controller **2** (through the connector **4**) along the bottom side of the film **100** and flows into

the box-shaped body **20**, the incoming air is blocked by the air curtain formed by the air blown out of the blowoff nozzle **22**, has its flowing direction changed, and is sucked into the exhaust unit E**22**, together with the return air. In this manner, by causing the exhaust unit E**22** to suck the incoming air from the tenter oven **3**, it is possible to prevent the air heated in the chamber of the tenter oven **3** from being blown out of the tenter oven **3**, and raising the temperature of the working area around the tenter oven **3** and deteriorating the work environment around the tenter oven **3**. It is also possible to prevent sublimates from the film **100** from depositing and adhering to the surface of the film **100** outside the chamber of the tenter oven **3**, and to prevent defects resultant of such foreign substances from reducing the productivity. The same applies to the incoming air from the tenter oven **3** passing along the top surface of the film **100** and flowing into the box-shaped body **20**.

(28) As explained above, the blowoff nozzles **21** and **22** are disposed in a manner facing the surfaces of the film **100**, respectively. If the blowoff nozzle is installed only on one side of the film **100**, the MD flow is allowed to flow more easily on the side on which the blowoff nozzle is not installed, and the airflow blocking effect will be reduced. Thermoplastic films do not allow the air to pass there through, unlike a material such as a fabric. Therefore, when the air is blown to the film **100** from only one side, the wind pressure of the air causes the film **100** to be blown up or down, and causes the film **100** to flap more.

(29) To prevent the film **100** from flapping, the blowoff nozzles are installed on one side and the other side of the film **100**, respectively, and the opening of the blowoff nozzle on the one side and the opening of the blowoff nozzle on the other side are configured to face each other with the film **100** therebetween. Because the openings face each other, the airflows therefrom exert the effect of pressing the same position of the film **100** from the one side and the other side, and prevent the film from flapping. The openings facing each other herein means that a projection of the opening of the blowoff nozzle on one side onto the film **100** overlaps at least partially with a projection of the opening of the blowoff nozzle on the other side onto the film **100**. At this time, it is more preferable for both of these projections to overlap with each other completely when these openings have the same size.

(30) The airflow controller **2** is an apparatus for decoupling and controlling the airflows between an opening for feeding the film **100** into the tenter oven **3** and the outside of the tenter oven **3**. Therefore, when the airflow controller **2** is installed adjacently to the tenter oven **3** on the upstream side of the conveying direction of the film **100**, the temperature of the air blown out of the blowoff nozzle is preferably set equal to or higher than that of the air outside the chamber of the tenter oven **3**, near the feeding opening of the tenter oven **3**. In this manner, excessive cooling of the film **100** is prevented so that the preheating process in the tenter oven is prevented from being adversely affected. Furthermore, when the airflow controller **2** is installed adjacently to the tenter oven **3** on the downstream side of the conveying direction FR of the film **100**, the air temperature blown out of the blowoff nozzle is preferably set equal to or higher than the air temperature outside the chamber of the tenter oven **3** near the discharging opening of the tenter oven **3**. In this manner, excessive cooling of the film **100** is prevented so that a process downstream to the tenter oven **3** is prevented from being adversely affected. The temperature of the air blown out of the blowoff nozzle is preferably set equal to or lower than the glass transition point of the film **100**. In this manner, changes in the crystal structure of the film **100** made of thermoplastic resin are suppressed.

(31) In the embodiment described above, the flow divider unit having inclined surfaces is provided inside the blowoff nozzles **21** and **22**, and the air blown out of the blowoff unit is divided and then merged between the blowoff unit and the film **100** before the air hits the film **100**. The air blown out of the blowoff nozzles **21** and **22** has its air pressure increased by being merged, and forms the air curtain for blocking the MD flow. According to this embodiment, because the air having its air pressure increased by being merged is blown to the film **100**, even if the distance between the film **100** and the blowoff nozzle is increased, it is possible to suppress the temperature unevenness.

(32) In the embodiment described above, the flow divider unit **223** may be configured not to have the base portion **223***a*. In such a configuration, the flow divider unit (internally installed portion **223***b*) is fixed to an inner wall of the blowoff nozzle **22**, the inner wall intersecting with the film width direction.
(33) (First Modification)
(34) A first modification of the embodiment will now be explained with reference to FIG. **4**. FIG. **4** is a schematic illustrating a configuration of the blowoff nozzle according to a first modification of the embodiment of the present invention. The configuration of the film manufacturing apparatus according to the first modification is the same as that of the film manufacturing apparatus **1** described above, except that the configuration of the blowoff nozzle is changed. The elements that are the same as those explained above will be given the same reference numerals. A configuration of a blowoff nozzle **22**A replacing the blowoff nozzle **22** will now be explained, but the blowoff nozzle replacing the blowoff nozzle **21** also has the same configuration.
(35) A blowoff nozzle **22**A includes a pressure equalizing chamber **221** to which the air is supplied from the duct D**23**, a blowoff unit **222** that extends from the pressure equalizing chamber **221** and blows out the air to the outside, and a flow divider unit **224** that is provided inside the blowoff unit **222** and divides the flow path of the air blown out of the blowoff unit **222**.
(36) The flow divider unit **224** has inclined surfaces having inclined ends on the side of opening **222***a*, being inclined with respect to each other toward the opening **222***a*. Specifically, the flow divider unit **224** has a base portion **224***a* extending in a prism-like shape from the pressure equalizing chamber **221**, and an internally installed portion **224***b* provided in the blowoff unit **222** and extending from the base portion **224***a* toward the opening **222***a*. The internally installed portion **224***b* has inclined surfaces **224***c* and **224***d* that are inclined with respect to the conveying direction of the film **100**, and a flat part **224***e* that has one end connected to the inclined surface **224***c* and the other end connected to the inclined surface **224***d*, in the conveying direction FR. The inclined surfaces **224***c* and **224***d* are inclined in a manner being closer to each other toward the opening **222***a*. The flat part **224***e* extends in parallel with the conveying direction FR, and is positioned on a virtual plane S passing through the opening **222***a*. The flow divider unit **224** has a trapezoidal contour in the cross section illustrated in FIG. **4**. It is preferable for the flat part **224***e* to be a surface extending in parallel with the virtual plane S, but may also a curved surface extending from the inclined surfaces **224***c* and **224***d*, and connecting the inclined surfaces **224***c* and **224***d*.
(37) It is assumed herein that W denotes the distance of the flat part **224***e* in the conveying direction FR. The distance L, the angle θ**1**, the distance t, and the distance W are determined based on the pressure setting at the air stagnation point P**1** (see FIG. **3**).
(38) In first modification described above, too, a flow divider unit **224** with inclined surfaces is provided to divide the air blown out of the blowoff unit **222**, to merge the air between the blowoff nozzle **22**A and the film **100**, to apply the merged air to the film **100**. According to the first modification, because the air having its air pressure increased by being merged is blown to the film **100**, even if the distance between the film **100** and the blowoff nozzle is increased, it is possible to suppress the temperature unevenness.
(39) In the first modification described above, the flow divider unit **224** may be configured not to have the base portion **224***a*. In such a configuration, the flow divider unit (internally installed portion **224***b*) may be fixed to an inner wall that intersects with the film width direction in the blowoff nozzle **22**A.
(40) (Second Modification)
(41) A second modification of the embodiment will now be explained with reference to FIG. **5**. FIG. **5** is a schematic illustrating a configuration of the blowoff nozzle according to a second modification of the embodiment of the present invention. The configuration of the film manufacturing apparatus according to the second modification is the same as that of the film manufacturing apparatus **1** described above, except that the configuration of the blowoff nozzle is

changed. The elements that are the same as those explained above will be given the same reference numerals. A configuration of a blowoff nozzle **22**B replacing the blowoff nozzle **22** will now be explained, but the blowoff nozzle replacing the blowoff nozzle **21** also has the same configuration.
(42) The blowoff nozzle **22**B includes a pressure equalizing chamber **221** to which the air is supplied from the duct D**23**, a blowoff unit **222** that extends from the pressure equalizing chamber **221** and blows out the air to the outside, and a flow divider unit **225** that divides the flow path of the air blown out of the blowoff unit **222**.
(43) The flow divider unit **225** has a part protruding from the inside of the blowoff unit **222**, and having inclined surfaces inclined with respect to each other toward the side opposite to the pressure equalizing chamber **221**. Specifically, the flow divider unit **225** has an internal flow divider unit **225***a* provided inside of the blowoff unit **222** and dividing the air flow, and an external flow divider unit **225***b* protruding from the blowoff unit **222** and dividing the air flow. The flow divider unit **225** has a pentagonal contour in the cross section illustrated in FIG. **5**.
(44) The internal flow divider unit **225***a* has a base portion **225***c* extending from the pressure equalizing chamber **221**, and an internally installed portion **225***d* installed inside the blowoff unit **222** and extending from the base portion **225***c* toward the opening **222***a*. The internally installed portion **225***d* has inclined surfaces **225***e* and **225***f* that are inclined with respect to the virtual plane S, and a connected portion **225***g* that has one end being continuous to the inclined surface **225***e* and the other end being continuous to the inclined surface **225***f*, and that is connected to the external flow divider unit **225***b*, in the conveying direction FR. The inclined surfaces **225***e* and **225***f* are inclined in a manner being closer to each other toward the opening **222***a*. The connected portion **225***g* extends in parallel with the conveying direction FR, and is positioned on the virtual plane S passing through the opening **222***a*.
(45) The external flow divider unit **225***b* has a triangular prism shape extending in the film width direction, and has two inclined surfaces that are inclined with respect to the virtual plane S. The tip of the external flow divider unit **225***b* may have a flat surface extending in parallel with the virtual plane S, or a curved surface. In FIG. **5**, the inclined surfaces of the external flow divider unit **225***b* are inclined with respect to the virtual plane S at the same angle as that at which the inclined surfaces **225***e* and **225***f* are inclined, but may be inclined at a different angle. The external flow divider unit **225***b* corresponds to a protruding portion.
(46) It is assumed herein that W denotes the distance of the connected portion **225***g* in the conveying direction FR, θ**1** denotes the angle between the inclined surface of the internal flow divider unit **225***a* (the inclined surface **225***f* in FIG. **5**) and the virtual surface S (where θ**1**>0), and **02** denotes the angle between the inclined surface of the external flow divider unit **225***b* and the virtual surface S (where θ**2**>0). The distance L, the angles θ**1** and θ**2**, the distance t, and the distance W are determined based on the pressure setting at the air stagnation point P**1** (see FIG. **3**). The distance L in the second modification is the distance between the tip of the external flow divider unit **225***b* and the film **100**.
(47) In the second modification described above, too, the flow divider unit **225** having the inclined surfaces is provided to divide the air blown out of the blowoff unit **222**, to merge the divided air between the blowoff nozzle and the film **100**, and to apply the merged air to the film **100**. According to the second modification, because the air having its air pressure increased by being merged is blown to the film **100**, even if the distance between the film **100** and the blowoff nozzle is increased, it is possible to suppress the temperature unevenness.
(48) Explained in the second modification is an example in which the external flow divider unit **225***b* is continuous to the connected portion **225***g*, but the blowoff unit **222** may be provided with two openings extending in the film width direction, and external flow divider unit **225***b* may be supported on the outer surface of the blowoff unit **222** between these openings. Furthermore, the internal flow divider unit **225***a* may also be supported by the inner wall of the blowoff unit **222** between the openings.

(49) In the second modification, the internal flow divider unit **225***a* and the external flow divider unit **225***b* may be integrally formed.
(50) (Third Modification)
(51) A third modification of the embodiment will now be explained with reference to FIG. **6**. FIG. **6** is a schematic illustrating a configuration of the blowoff nozzle according to the third modification of the embodiment of the present invention. The configuration of the film manufacturing apparatus according to the third modification is the same as that of the film manufacturing apparatus **1** described above, except that the configuration of the blowoff nozzle is changed. The elements that are the same as those explained above will be given the same reference numerals. A configuration of a blowoff nozzle **22**C replacing the blowoff nozzle **22** will now be explained, but the blowoff nozzle replacing the blowoff nozzle **21** also has the same configuration.
(52) The blowoff nozzle **22**C includes a pressure equalizing chamber **221** to which the air is supplied from the duct D**23**, a blowoff unit **222** that extends from the pressure equalizing chamber **221** and blows out the air, and a flow divider unit **226** that divides the flow path of the air blown out of the blowoff unit **222**.
(53) The blowoff unit **222** in the blowoff nozzle **22**C is provided with three openings (openings **222***d* to **222***f*). The openings **222***d* to **222***f* all have a hole shape extending in the film width direction. The openings **222***d* to **222***f* are lined up sequentially in the order of the openings **222***d*, **222***e*, **222***f* from the upstream side in the conveying direction FR.
(54) The flow divider unit **226** has a part protruding from the inside of the blowoff unit **222**, and having inclined surfaces inclined with respect to each other toward the side opposite to the pressure equalizing chamber **221**. Specifically, the flow divider unit **226** has internally installed portions **226***a* provided inside the blowoff unit **222** and protruding portions **226***b* protruding from the blowoff unit **222**. The internally installed portions **226***a* are supported on inner walls of the blowoff unit **222**, between the openings **222***d* and **222***e* and between the openings **222***e* and **222***f*, respectively. The protruding portions **226***b* are supported on outer surfaces of the blowoff unit **222**, between the openings **222***d* and **222***e* and between the openings **222***e* and **222***f*, respectively.
(55) The internally installed portions **226***a* include a first internally installed portion **226***c* provided upstream and a second internally installed portion **226***d* provided downstream, in the conveying direction FR.
(56) The protruding portions **226***b* include a first protruding portion **226***e* provided upstream and a second protruding portion **226***f* provided downstream, in the conveying direction FR.
(57) The first internally installed portion **226***c* has an inclined surface **226***g* on the side of the opening **222***d*.
(58) The second internally installed portion **226***d* has an inclined surface **226***h* on the side of the opening **222***f*.
(59) The inclined surfaces **226***g* and **226***h* are both inclined with respect to the virtual plane S, and inclined in a manner being closer to each other toward the opening **222***a*.
(60) The first protruding portion **226***e* has an inclined surface **226***i* that is continuous to the inclined surface **226***g*.
(61) The second protruding portion **226***f* has an inclined surface **226***j* that is continuous to the inclined surface **226***h*.
(62) The inclined surfaces **226***i* and **226***j* are both inclined with respect to the virtual plane S, with the inclined surface **226***i* inclined toward the opening **222***d* and the inclined surface **226***j* inclined toward the opening **222***f*, in a manner being away from each other. In other words, the inclined surfaces **226***i* and **226***j* are inclined in a manner being closer to each other toward the end (tip) on the opposite side of the internally installed portion **226***a*. The tip of each of the first protruding portion **226***e* and the second protruding portion **226***f* may be in parallel with the virtual plane S, or have a curved surface. In FIG. **6**, the inclined surface **226***i* forms an angle different from that formed by the inclined surface **226***g* with the virtual plane S, but these angles may also be the

same. The same applies to the inclination angles of inclined surface 226j and the inclined surface 226h.

(63) The internally installed portion 226a and the protruding portion 226b have wall surfaces that are perpendicular to the conveying direction FR, on the side of the opening 222e disposed at the center in the conveying direction FR, among the openings 222d to 222f. These walls may also be inclined with respect to the conveying direction FR, and the walls of the internally installed portions 226a may be inclined at an angle different from that at which the walls of the protruding portions 226b are inclined.

(64) It is assumed herein that t1 to t3 denote the distances of the openings 222d to 222f in the conveying direction FR, respectively, W1 denotes the distance between the opening 222d and the opening 222e, W2 denotes the distance between the opening 222e and the opening 222f, θ1 denotes the angle formed by the inclined surface of the internally installed portion 226a (inclined surface 226h in FIG. 6) and the virtual plane S (where θ1>0), and θ2 denotes the angle formed by the inclined surface of the protruding portion 226b (inclined surface 226j in FIG. 6) and the virtual plane S (where θ2>0). The distance L, the angles θ1 and θ2, the distances t1 to t3, and the distances W1 and W2 are determined based on the pressure setting at the air stagnation point P1 (see FIG. 3). The distance L in the third modification is the distance between the tips of the protruding portions 226b and the film 100. The distances t1 to t3 may all be the same length or different lengths, but the distances t1 and t3 are preferably the same length.

(65) In the third modification described above, too, the flow divider unit 226 having the inclined surfaces is provided, to divide the air blown out of the blowoff unit 222, to merge the divided air between the blowoff nozzle and the film 100, and to apply the merged air to the film 100. According to the third modification, because the air having its air pressure increased by being merged is blown to the film 100, even if the distance between the film 100 and the blowoff nozzle is increased, it is possible to suppress the temperature unevenness.

(66) In the third modification described above, a configuration not having the protruding portion 226b is also possible. In this case, the flow divider unit 226 only includes the internally installed portion 226a (the first internally installed portion 226c and the second internally installed portion 226d).

(67) In the embodiment and the first to the third modifications described above, the inclined surfaces provided to the flow divider unit are explained to be flat surfaces, but without limitation thereto, the inclined surfaces may also be curved or waved surfaces.

EXAMPLES

(68) With examples below, the present invention will be explained in further detail. However, these examples are not intended to limit the interpretations of the present invention in any way.

(69) [Analysis 1]

(70) In the following examples, for each of the exemplary configurations described above, the parameters of the blowoff nozzle were set and the air pressure (air volume) was analyzed. In the analyses, the air volume at the stagnation point described above at the time when the air pressure reached 60 Pa was obtained. In the example, when the obtained air volume was smaller than that of a comparison target, it was determined that the result was good if the effect of increasing air volume was observed, as a blowoff nozzle, and it was determined that the result was not good if not.

Example 1

(71) For the blowoff nozzle 22 illustrated in FIG. 3, an analysis was carried out by setting the distance t to 12 mm, the distance L to 150 mm, and the angle θ1 to 70 degrees. The parameters and the analysis result are indicated in Table 1.

(72) TABLE-US-00001 TABLE 1 t L W θ1 θ2 Air Volume [mm] [mm] [mm] [deg] [deg] Q [m.sup.3/min/m] Determination Example 1 12 150 0 70 None 12.0 Good Example 2 5 150 2 70 None 8.5 Good Example 3 12 150 2 70 None 17.2 Good Example 4 12 150 5 70 65 13.5 Good

Example 5 12 150 10 70 65 14.2 Good Comparative 5 150 2 90 None 9.0 — Example 1 Comparative 12 150 2 90 None 19.2 — Example 2 Comparative 12 50 2 90 None 13.5 No Good Example 3 (Pressure at stagnation point <60 Pa)

Example 2

(73) For the blowoff nozzle **22**A illustrated in FIG. **4**, an analysis was carried out by setting the distance t to 5 mm, the distance L to 150 mm, the distance W to 2 mm, and angle θ**1** to 70 degrees. The parameters and the analysis result are indicated in Table 1.

Example 3

(74) An analysis was carried out using the same parameters as those used in Example 2, except that the distance t was set to 12 mm. The parameters and the analysis result are indicated in Table 1.

Example 4

(75) For the blowoff nozzle **22**B illustrated in FIG. **5**, an analysis was carried out by setting the distance t to 12 mm, the distance L to 150 mm, the distance W to 5 mm, the angle θ**1** to 70 degrees, and the angle θ**2** to 65 degrees. The parameters and the analysis result are indicated in Table 1.

Example 5

(76) An analysis was carried out using the same parameters as those used in Example 4, except that the distance W was set to 10 mm. The parameters and the analysis result are indicated in Table 1.

Comparative Example 1

(77) An analysis was carried out using a blowoff nozzle **300** illustrated in FIG. **7**. FIG. **7** is a schematic illustrating a configuration of the blowoff nozzle according to a comparative example. The blowoff nozzle **300** includes a pressure equalizing chamber **301** to which air is supplied from the duct D**23**, a blowoff unit **302** that extends from the pressure equalizing chamber **301** and blows out the air from an opening **302***a*, and a flow divider unit **303** that is provided inside the blowoff unit **302** and divides the flow path of the air blown out of the blowoff unit **302**. The flow divider unit **303** extends in a prism-like shape. In the blowoff nozzle **300**, L denotes the distance between the tip of the blowoff unit **302** and the film **100**, S.sub.300 denotes the plane passing through the opening surface (end surface) of the blowoff unit **302** in parallel with the opening surface, θ**1** denotes the angle formed between the flow divider unit **303** and the virtual plane S.sub.300 (where θ**1**>0), and t**1** denotes the distance between the opening **302***a* and the flow divider unit **303** on the virtual plane S.sub.300, in the film conveying direction FR.

(78) In Comparative Example 1, an analysis was carried out for the blowoff nozzle **300** by setting the distance t to 5 mm, the distance L to 150 mm, the distance W to 2 mm, and the angle θ**1** to 90 degrees. The parameters and the analysis result are indicated in Table 1.

Comparative Example 2

(79) The same parameters as those used in Comparative Example 1 were used for the analysis, except that the distance t was set to 12 mm. The parameters and the analysis result are indicated in Table 1.

Comparative Example 3

(80) The same parameters as those used in Comparative Example 2 were used for the analysis, except that the distance L was set to 50 mm. The parameters and the analysis result are indicated in Table 1.

(81) In Comparative Example 1, an air volume of 9.0 m.sup.3/min/m was required to bring the air pressure at the stagnation point to 60 Pa. By contrast, in Example 2 where the same distances t and L were used, the air volume was 8.5 m.sup.3/min/m.

(82) In Comparative Example 2, an air volume of 19.2 m.sup.3/min/m was required to bring the air pressure at the stagnation point to 60 Pa. By contrast, in Examples 1, 3 to 5 where the same distances t and L were used, the air volumes were smaller than 19.2 m.sup.3/min/m. The analysis result for Comparative Example 3 indicated that the wind pressure at the stagnation point did not reach 60 Pa.

Example 6

(83) For the blowoff nozzle **22**C illustrated in FIG. **6**, an analysis was carried out by setting the distances t**1** and t**3** to 8 mm, the distance t**2** to 8 mm, the distance L to 150 mm, the angle θ**1** to 62 degrees, and the angle θ**2** to 45 degrees. The parameters and the analysis result are indicated in Table 2.

(84) TABLE-US-00002 TABLE 2 t1 and t3 t2 L W θ1 θ2 Air Volume [mm] [mm] [mm] [mm] [deg] [deg] Q [m.sup.3/min/m] Determination Example 6 8 8 150 2 62 45 14.8 Good Example 7 8 8 150 15 62 45 14.4 Good Example 8 8 8 150 15 45 45 12.3 Good Example 9 8 8 150 15 30 45 10.3 Good Example 10 8 8 150 15 80 45 17.2 Good Example 11 8 8 150 15 62 30 16.1 Good Example 12 8 8 150 15 62 80 15.7 Good Example 13 8 8 150 2 80 10 15.5 Good Comparative 8 8 150 2 None None Not No Good Example 4 Measurable (Unstable air volume) Comparative 8 8 150 15 None None Not No Good Example 5 Measurable (Unstable air volume) Comparative 8 8 150 2 None 45 19.7 No Good Example 6

Example 7

(85) An analysis was carried out using the same parameters as those used in Example 6, except that the distance W was set to 15 mm. The parameters and the analysis result are indicated in Table 2.

Example 8

(86) An analysis was carried out using the same parameters as those used in Example 7, except that the angle θ**1** was set to 45 degrees. The parameters and the analysis result are indicated in Table 2.

Example 9

(87) An analysis was carried out using the same parameters as those used in Example 7, except that the angle θ**1** was set to 30 degrees. The parameters and the analysis result are indicated in Table 2.

Example 10

(88) An analysis was carried out using the same parameters as those used in Example 7, except that the angle θ**1** was set to 80 degrees. The parameters and the analysis result are indicated in Table 2.

Example 11

(89) An analysis was carried out using the same parameters as those used in Example 7, except that the angle θ**2** was set to 30 degrees. The parameters and the analysis result are indicated in Table 2.

Example 12

(90) An analysis was carried out using the same parameters as those used in Example 7, except that the angle θ**2** was set to 80 degrees. The parameters and the analysis result are indicated in Table 2.

Example 13

(91) An analysis was carried out using the same parameters as those used in Example 6, except that the angle θ**1** was set to 80 degrees, and the angle θ**2** was set to 10 degrees. The parameters and the analysis result are indicated in Table 2.

Comparative Example 4

(92) An analysis was carried out using the same parameters as those used in Example 6, except that the configuration was not provided with the flow divider unit **226**. The parameters and the analysis result are indicated in Table 2.

Comparative Example 5

(93) The same parameters as those used in Comparative Example 4 were used for the analysis, except that the distance W was set to 15 mm. The parameters and the analysis result are indicated in Table 2.

Comparative Example 6

(94) An analysis was carried out using the same parameters as those used in Example 4, except that the protruding Portion **226***b* of the flow divider unit **226** was provided, and the angle θ**2** was set to 45 degrees. The parameters and the analysis result are indicated in Table 2.

(95) In Examples 6 to 13, air volumes ranging from 10.3 to 17.2 m.sup.3/min/m were required to bring the air pressure at the stagnation point to 60 Pa. By contrast, the analysis results of Comparative Examples 4 and 5 indicated the instability of the air volume, so that the determinations of the air volume were not possible. Comparative Example 6 also required an

airflow rate of 19.7 m.sup.3/min/m.
(96) [Analysis 2]
(97) In Analysis 2, a numerical analysis model different from that used in Analysis 1 was created, and a numerical analysis was performed with this model to evaluate the MD flow blocking performance.
(98) FIG. **8** illustrates the numerical analysis model used in this analysis. An apparatus model **200** illustrated in FIG. **8** is a model of the chamber including the airflow controller **2** provided with the blowoff nozzle **22** (see FIG. **1**, for example), and illustrates a longitudinal section that is in parallel with the film conveying direction FR. In order to save computational resources required in analyzing the internal space of the airflow controller **2**, it was assumed that the apparatus model **200** and an outer space **61** were symmetrical in the up-and-down direction with the film **100** therebetween, and the numerical analysis was carried out only for the lower half. In order to evaluate the MD flow blocking performance, it is sufficient to examine the way in which the air flows across a vertical cross section extending in parallel with the film conveying direction FR. Therefore, a numerical analysis was performed using a two-dimensional model across this plane.
(99) The dimensions of the structures were established as follows. A length X of the apparatus model **200** in the film conveying direction FR was set to 1000 mm, and a height H was set to 500 mm. The blowoff nozzle **22** and the exhaust mechanism E**2** were installed inside this model. The size W**3** of the blowoff nozzle **22** in the film conveying direction FR was set to 200 mm, and the distance L between the film **100** and the blowoff nozzle **22** was set to 150 mm. An outer space **61** was set up on the upstream side of the apparatus model **200** in the film conveying direction, and the connector **4** connected to the tenter oven **3** was set up on the downstream in the film conveying direction. A distance Y**1** between the bottom end of the outer space **61** and the film **100** was set to 50 mm, and a distance Y**2** between the bottom end of the connector **4** and the film **100** was set to 50 mm.
(100) The outer boundary **62** of the outer space **61** and the inner boundary **63** of the connector **4** were established as pressure boundaries, and atmospheric pressure (0.1 MPa) was set to the outer boundary **62**, and −5 Pa was set to the inner boundary **63**, as boundary conditions. In addition, the temperature of the outer space **61** was set to 25° C., and the temperature of the tenter oven connected to the connector **4** was set to 125° C. The physical properties of the air were assumed to be those of the dry air at the atmospheric pressure. Boundary conditions under which the air volume at an air pressure of 60 Pa flowed into the stagnation point were set to the blowoff nozzle **22**, and the blowout temperature was set to 60° C. Boundary conditions under which the same volume of the air was exhausted as that blown out of the blowoff nozzle were set to the exhaust units E**21** and E**22**.
(101) An average temperature on an evaluation surface **64** between the apparatus model **200** and the outer space **61**, and an average temperature on an evaluation surface **65** between the apparatus model **200** and the connector **4**, both of which are illustrated in FIG. **8**, were used as the indices of the effectiveness of the airflow controller **2**.
(102) Under these conditions, when the air supply into and exhaust from the apparatus model **200** were stopped, the air flowed from the outer space **61**, passed through the apparatus model **200**, and into the connector **4** at an average velocity of 2.0 m/s, and the tenter oven **3** was filled with the cool air at the temperature of 25° C., and caused temperature unevenness in the tenter oven **3**.
Example 14
(103) For an analysis, the blowoff nozzle **22** used in Example 1 was placed as the blowoff nozzle **22** of the apparatus model **200**. This blowoff nozzle **22** had the distance t of 12 mm and the angle θ**1** of 70 degrees. As a result of the analysis, the average temperature on the evaluation surface **64** was 25° C., and the average temperature on the evaluation surface **65** was 125° C. In other words, it was possible to prevent a leakage of the hot air from the apparatus model **200** into the outer space **61**, and flowing of the cold air into the tenter oven **3** via the connector **4**. Therefore, it can be

assumed that the airflow controller **2** succeeded in suppressing the temperature unevenness in the tenter oven **3**.

Example 15

(104) For an analysis, the blowoff nozzle **22**C used in Example 8 was placed as the blowoff nozzle **22** of the apparatus model **200**. In this blowoff nozzle **22**, the distances t**1** to t**3** were set to 8 mm, the angle θ**1** was set to 45 degrees, and the angle θ**2** was set to 45 degrees. As a result of the analysis, the average temperature on the evaluation surface **64** was 25° C., and the average temperature on the evaluation surface **65** was 125° C. In other words, it was possible to prevent a leakage of the hot air from the apparatus model **200** into the outer space **61**, and flowing of the cold air into the tenter oven **3** via the connector **4**. Therefore, it can be assumed that the airflow controller **2** succeeded in suppressing the temperature unevenness in the tenter oven **3**.

INDUSTRIAL APPLICABILITY

(105) The blowoff nozzle according to the present invention can be applied preferably to the heating and stretching processes in a tenter oven provided to a film manufacturing facility, but the scope of applications is not limited thereto.

REFERENCE SIGNS LIST

(106) **1** film manufacturing apparatus **2** airflow controller **3** tenter oven **4** connector **21** first blowoff nozzle (blowoff nozzle) **22**, **22**A, **22**B, **22**C second blowoff nozzle (blowoff nozzle) **51**, **52** rail cover **61** outer space **62** outer boundary **63** inner boundary **64** evaluation surface on outer space side **65** evaluation surface on connector side **100** film **221** pressure equalizing chamber **222** blowoff unit **223**, **224**, **225**, **226** flow divider unit **223***a*, **224***a*, **225***c* base portion **223***b*, **224***b*, **225***d*, **226***a* internally installed portion **223***c*, **223***d*, **224***c*, **224***d*, **225***e*, **225***f*, **226***g*, **226***h*, **226***i*, **226***j* inclined surface **224***e* flat surface **225***a* internal flow divider unit **225***b* external flow divider unit **225***g* connector **226***b* protrusion **226***c* first internally installed portion **226***d* second internally installed portion **226***e* first protrusion **226***f* second protrusion B**1**, B**2** blower D**11**, D**12**, D**13**, D**21**, D**22**, D**23** duct E**1**, E**2** exhaust mechanism E**11**, E**12**, E**21**, E**22** exhaust unit H**1**, H**2** heat exchanger S virtual plane

Claims

1. A blowoff nozzle that blows out air to a film being conveyed, the blowoff nozzle comprising: an internally installed portion that is provided near a position where the air is blown out, inside the blowoff nozzle, and that has inclined surfaces inclined with respect to a virtual plane passing through an opening surface of an opening of the blowoff nozzle, the opening surface being a surface from which the air is blown out, the inclined surfaces being inclined in a manner being close to each other toward the virtual plane, and a protruding portion protruding from the internally installed portion to outside of the opening, the protruding portion having an inclined surface inclined with respect to the virtual plane, wherein: the opening of the blowoff nozzle has a slit shape extending in a film width direction, the internally installed portion extends in the film width direction, and the protruding portion has a triangular prism shape extending in the film width direction.