generating element unit 23 is configured so as to vary with a speed controller, the rising/lowering speed of raising or lowering the heat generating element unit 22. This electrically operated cylinder for raising and lowering heat generating element unit 23 constitutes a relative shifting device that shifts the PET bottle 4 and the heat generating element 21 relatively to each other, and relatively shifts the PET bottle 4 and the heat generating element 21 so as to make the portion of the PET bottle 4 upon which a film is to be formed and the heat generating element 21 face each other. It should be understood that, in Figs. 1 and 2, the heat generating element 21 is shown in its elevated state.

[0031]

In the film formation apparatus having a structure like that shown in Figs. 1 and 2, the interior of the heat generating element protection chamber 2 is always kept in a vacuum state, so that the heat generating element 21 existing in the heat generating element protection chamber 2 is always kept in a vacuum state. At this moment, the gate valve 3 is in the closed state, so that communication between the heat generating element protection chamber 2 and the film deposition chamber 1 is intercepted.

[0032]

After the PET bottle 4 has been put into the film deposition chamber 1 and the PET bottle 4 has been set up on the bottle holding portion 11, the vacuumization of the interior of the film deposition chamber 1 starts. And, when the pressure in the interior of the film deposition chamber 1 has reached a predetermined vacuum pressure which is ~~lower~~ higher than the vacuum pressure within the heat generating element protection chamber 2, then the gate valve 3 is opened to establish the communication between the film deposition chamber 1 and the heat generating element protection chamber 2. Due to this, the vacuum pressure within the film deposition chamber 1 ~~rises~~ decreases and becomes equal to the vacuum pressure within the heat generating element protection chamber 2. Accordingly, it is possible to shorten the time period required for vacuumizing the film deposition chamber 1. And electrical power is supplied from a power supply not illustrated to the heat generating element unit 22, so that the heat generating element 21 produces heat. And, by operating the electrically operated cylinder for raising or lowering heat generating element unit 23, the heat generating element unit 22 is raised or lowered at a predetermined speed,

of the regulated pitch are inverted by the inversion device 57, so that they come to be in the inverted state. Then the plurality of PET bottles 4, now in the inverted state, are suctioned by the suction head 64 of the bottle handling device 60. At this time, the open/close gate 56 of the bottle in/out chamber 32 is opened. The bottle handling device 60 transfers a plurality of unprocessed PET bottles 4 and puts them into the bottle in/out chamber 32. In this embodiment, it is possible for the bottle handling device 60 to put eight of the PET bottles 4 into the bottle in/out chamber 32 simultaneously. When the plurality of PET bottles 4 put into the interior of the bottle in/out chamber 32 gets held by the bottle rising/lowering device 51, the open/close gate 56 is closed. And, the vacuum pump VP2 is operated to start vacuumization of the interior of the bottle in/out chamber 32 starts.

[0044]

When due to the operation of the vacuum pump VP2 the vacuum pressure within the bottle in/out chamber 32 reaches a predetermined vacuum pressure, which is still ~~lower~~ higher than the vacuum pressure of the interior of the film deposition dedicated chamber 31, the gate valve 33 is opened to establish the communication between the film deposition dedicated chamber 31 and the bottle in/out chamber 32. Due to this, the vacuum pressure of the interior of the bottle in/out chamber 32 ~~rises~~decreases, and becomes equivalent to the vacuum pressure of the interior of the film deposition dedicated chamber 31. Accordingly, it is possible to shorten the time period required for vacuumization of the bottle in/out chamber 32. Subsequently, the bottle rising/lowering device 51 within the bottle in/out chamber 32 is operated to supply the plurality of unprocessed PET bottles 4 into the interior of the film deposition dedicated chamber 31. These plurality of PET bottles 4 supplied into the interior of the film deposition dedicated chamber 31 are being held by the bottle rising/lowering device 51. The PET bottles 4 are raised and lowered at a speed that has been determined in advance while being held by the bottle rising/lowering device 51. Thereby, the heat generating elements 42 are inserted into, and taken out from, the PET bottles 4 respectively.

[0045]

Fig. 5 is a schematic sectional view showing one of the PET bottles 4 with one of the heat generating elements 42 that has been inserted into the interior of that PET bottle 4.

CLAIMS

1. An apparatus for forming thin film characterized by comprising:
a vacuum chamber in which film formation upon a surface of a container is performed in a vacuum state by using a heat generating element;
an vacuum evacuation ~~deveic~~ device that vacuumizes said vacuum chamber; and
a relative shifting device that, after vacuumization of said vacuum chamber has started, shifts the container and said heat generating element relatively to each other within the vacuum chamber,
wherein
said vacuum chamber is divided into a film deposition chamber in which film formation upon the container is performed, and a heat generating element protection chamber in which said heat generating element is held in a vacuum state; and
a vacuum isolation device is provided between said film deposition chamber and said heat generating element protection chamber.

2. The thin film formation apparatus according to Claim 1, wherein that said relative shifting device relatively shifts the container and said heat generating element at variable speed.

~~3. The apparatus for forming thin film according to Claim 1 or Claim 2, wherein~~
~~said vacuum chamber is divided into a film deposition chamber in which film formation upon the container is performed, and a heat generating element protection chamber in which said heat generating element is held in a vacuum state; and~~
~~a vacuum isolation device is provided between said film deposition chamber and said heat generating element protection chamber.~~

~~4~~3. The apparatus for forming thin film according to Claim ~~3~~1, wherein said relative shifting device shifts said heat generating element.

~~5~~4. The apparatus for forming thin film according to Claim ~~3~~1, wherein each of said film deposition chamber and said heat generating element protection chamber is linked to an individual vacuum evacuation devicedevcie~~devcie~~.

~~6~~5. The apparatus for forming thin film according to Claim ~~3~~1, wherein said film deposition chamber is vacuumized from atmospheric pressure to be brought to a vacuum state at a moment of film formation upon the container, and is returned to atmospheric pressure after the film formation has been completed.

~~7~~6. The apparatus for forming thin film according to Claim ~~3~~1, wherein said heat generating element protection chamber is always kept in a vacuum state.

~~8~~7. The apparatus for forming thin film according to Claim ~~3~~1, wherein said vacuum isolation device is opened when said film deposition chamber has been vacuumized, so as to communicate together said film deposition chamber and said heat generating element protection chamber.

~~9~~8. The apparatus for forming thin film according to Claim ~~8~~7, wherein said heat generating element is inserted into said film deposition chamber after said vacuum isolation device has been opened, and is returned to said heat generating element protection chamber after the film formation has been completed.

~~10~~9. The apparatus for forming thin film according to claim ~~9~~8, wherein, after the film formation has been completed and after said heat generating element has been returned to said heat generating element protection chamber, said vacuum isolation device is closed.

~~11~~10. ~~The apparatus for forming thin film according to Claim 1 or Claim 2~~ An apparatus for forming thin film characterized by comprising:
a vacuum chamber in which film formation upon a surface of a container is performed in a vacuum state by using a heat generating element;
an vacuum evacuation device that vacuumizes said vacuum chamber; and

a relative shifting device that, after vacuumization of said vacuum chamber has started, shifts the container and said heat generating element relatively to each other within the vacuum chamber, wherein

said vacuum chamber is divided into: a film deposition dedicated chamber for keeping said heat generating element in a vacuum state and performing film formation upon the container; and a container in/out chamber for taking out and inserting the container from and into said film deposition dedicated chamber, and

a vacuum isolation device is provided between said film deposition dedicated chamber and said container in/out chamber.

~~12~~11. The apparatus for forming thin film according to Claim ~~11~~10, wherein said relative shifting device shifts the container.

~~13~~12. The apparatus for forming thin film according to Claim ~~11~~10, wherein each of said film deposition dedicated chamber and said container in/out chamber is linked to an individual vacuum evacuation devicedeveic.

~~14~~13. The apparatus for forming thin film according to Claim ~~11~~10, wherein said film deposition dedicated chamber is always kept in a vacuum state.

~~15~~14. The apparatus for forming thin film according to Claim ~~11~~10, wherein said container in/out chamber is vacuumized from atmospheric pressure and is brought to the vacuum state at a moment of film formation upon the container, and is returned to atmospheric pressure at a moment of taking out the container after the film formation has been completed.

~~16~~15. The apparatus for forming thin film according to Claim ~~11~~10, wherein said vacuum isolation device is opened when said container in/out chamber has been brought to a vacuum state by vacuumization, so as to communicate together said film deposition dedicated chamber and said container in/out chamber.

~~17~~16. The apparatus for forming thin film according to Claim ~~11~~10, wherein said heat generating element is inserted

into the container when the container has been shifted into said film deposition dedicated chamber.

~~18~~17. The apparatus for forming thin film according to Claim ~~11~~10, wherein said container in/out chamber comprises an open/close gate for taking out and inserting the container from and into said container in/out chamber.

~~19~~18. The apparatus for forming thin film according to Claim ~~11~~10, further comprising a container transfer device that transfers an unprocessed container from a predetermined position into said container in/out chamber, and transfers a processed container from said bottle in/out chamber to a predetermined position.

~~20~~19. The apparatus for forming thin film according to Claim ~~19~~18, wherein said predetermined position is a position upon a conveyer.

20. The thin film formation apparatus according to Claim 10, wherein that said relative shifting device relatively shifts the container and said heat generating element at variable speed.

generating element unit 23 is configured so as to vary with a speed controller, the rising/lowering speed of raising or lowering the heat generating element unit 22. This electrically operated cylinder for raising and lowering heat generating element unit 23 constitutes a relative shifting device that shifts the PET bottle 4 and the heat generating element 21 relatively to each other, and relatively shifts the PET bottle 4 and the heat generating element 21 so as to make the portion of the PET bottle 4 upon which a film is to be formed and the heat generating element 21 face each other. It should be understood that, in Figs. 1 and 2, the heat generating element 21 is shown in its elevated state.

[0031]

In the film formation apparatus having a structure like that shown in Figs. 1 and 2, the interior of the heat generating element protection chamber 2 is always kept in a vacuum state, so that the heat generating element 21 existing in the heat generating element protection chamber 2 is always kept in a vacuum state. At this moment, the gate valve 3 is in the closed state, so that communication between the heat generating element protection chamber 2 and the film deposition chamber 1 is intercepted.

[0032]

After the PET bottle 4 has been put into the film deposition chamber 1 and the PET bottle 4 has been set up on the bottle holding portion 11, the vacuumization of the interior of the film deposition chamber 1 starts. And, when the pressure in the interior of the film deposition chamber 1 has reached a predetermined vacuum pressure which is higher than the vacuum pressure within the heat generating element protection chamber 2, then the gate valve 3 is opened to establish the communication between the film deposition chamber 1 and the heat generating element protection chamber 2. Due to this, the vacuum pressure within the film deposition chamber 1 decreases and becomes equal to the vacuum pressure within the heat generating element protection chamber 2. Accordingly, it is possible to shorten the time period required for vacuumizing the film deposition chamber 1. And electrical power is supplied from a power supply not illustrated to the heat generating element unit 22, so that the heat generating element 21 produces heat. And, by operating the electrically operated cylinder for raising or lowering heat generating element unit 23, the heat generating element unit 22 is raised or lowered at a predetermined speed,

of the regulated pitch are inverted by the inversion device 57, so that they come to be in the inverted state. Then the plurality of PET bottles 4, now in the inverted state, are suctioned by the suction head 64 of the bottle handling device 60. At this time, the open/close gate 56 of the bottle in/out chamber 32 is opened. The bottle handling device 60 transfers a plurality of unprocessed PET bottles 4 and puts them into the bottle in/out chamber 32. In this embodiment, it is possible for the bottle handling device 60 to put eight of the PET bottles 4 into the bottle in/out chamber 32 simultaneously. When the plurality of PET bottles 4 put into the interior of the bottle in/out chamber 32 gets held by the bottle rising/lowering device 51, the open/close gate 56 is closed. And, the vacuum pump VP2 is operated to start vacuumization of the interior of the bottle in/out chamber 32 starts.

[0044]

When due to the operation of the vacuum pump VP2 the vacuum pressure within the bottle in/out chamber 32 reaches a predetermined vacuum pressure, which is still higher than the vacuum pressure of the interior of the film deposition dedicated chamber 31, the gate valve 33 is opened to establish the communication between the film deposition dedicated chamber 31 and the bottle in/out chamber 32. Due to this, the vacuum pressure of the interior of the bottle in/out chamber 32 decreases, and becomes equivalent to the vacuum pressure of the interior of the film deposition dedicated chamber 31. Accordingly, it is possible to shorten the time period required for vacuumization of the bottle in/out chamber 32. Subsequently, the bottle rising/lowering device 51 within the bottle in/out chamber 32 is operated to supply the plurality of unprocessed PET bottles 4 into the interior of the film deposition dedicated chamber 31. These plurality of PET bottles 4 supplied into the interior of the film deposition dedicated chamber 31 are being held by the bottle rising/lowering device 51. The PET bottles 4 are raised and lowered at a speed that has been determined in advance while being held by the bottle rising/lowering device 51. Thereby, the heat generating elements 42 are inserted into, and taken out from, the PET bottles 4 respectively.

[0045]

Fig. 5 is a schematic sectional view showing one of the PET bottles 4 with one of the heat generating elements 42 that has been inserted into the interior of that PET bottle 4.

CLAIMS

1. An apparatus for forming thin film characterized by comprising:
a vacuum chamber in which film formation upon a surface of a container is performed in a vacuum state by using a heat generating element;
an vacuum evacuation device that vacuumizes said vacuum chamber; and
a relative shifting device that, after vacuumization of said vacuum chamber has started, shifts the container and said heat generating element relatively to each other within the vacuum chamber,
wherein
said vacuum chamber is divided into a film deposition chamber in which film formation upon the container is performed, and a heat generating element protection chamber in which said heat generating element is held in a vacuum state; and
a vacuum isolation device is provided between said film deposition chamber and said heat generating element protection chamber.

2. The thin film formation apparatus according to Claim 1, wherein that said relative shifting device relatively shifts the container and said heat generating element at variable speed.

3. The apparatus for forming thin film according to Claim 1, wherein said relative shifting device shifts said heat generating element.

4. The apparatus for forming thin film according to Claim 1, wherein each of said film deposition chamber and said heat generating element protection chamber is linked to an individual vacuum evacuation device.

5. The apparatus for forming thin film according to Claim 1, wherein said film deposition chamber is vacuumized from atmospheric pressure to be brought to a vacuum state at a moment of film formation upon the container, and is returned to atmospheric pressure after the film formation has been completed.

6. The apparatus for forming thin film according to Claim 1, wherein said heat generating element protection chamber is always kept in a vacuum state.

7. The apparatus for forming thin film according to Claim 1, wherein said vacuum isolation device is opened when said film deposition chamber has been vacuumized, so as to communicate together said film deposition chamber and said heat generating element protection chamber.

8. The apparatus for forming thin film according to Claim 7, wherein said heat generating element is inserted into said film deposition chamber after said vacuum isolation device has been opened, and is returned to said heat generating element protection chamber after the film formation has been completed.

9. The apparatus for forming thin film according to claim 8, wherein, after the film formation has been completed and after said heat generating element has been returned to said heat generating element protection chamber, said vacuum isolation device is closed.

10. An apparatus for forming thin film characterized by comprising:
a vacuum chamber in which film formation upon a surface of a container is performed in a vacuum state by using a heat generating element;
an vacuum evacuation device that vacuumizes said vacuum chamber; and
a relative shifting device that, after vacuumization of said vacuum chamber has started, shifts the container and said heat generating element relatively to each other within the vacuum chamber, wherein

said vacuum chamber is divided into: a film deposition dedicated chamber for keeping said heat generating element in a vacuum state and performing film formation upon the container; and a container in/out chamber for taking out and inserting the container from and into said film deposition dedicated chamber, and

a vacuum isolation device is provided between said film deposition dedicated chamber and said container in/out chamber.

11. The apparatus for forming thin film according to Claim 10, wherein said relative shifting device shifts the container.

12. The apparatus for forming thin film according to Claim 10, wherein each of said film deposition dedicated chamber and said container in/out chamber is linked to an individual vacuum evacuation device.

13. The apparatus for forming thin film according to Claim 10, wherein said film deposition dedicated chamber is always kept in a vacuum state.

14. The apparatus for forming thin film according to Claim 10, wherein said container in/out chamber is vacuumized from atmospheric pressure and is brought to the vacuum state at a moment of film formation upon the container, and is returned to atmospheric pressure at a moment of taking out the container after the film formation has been completed.

15. The apparatus for forming thin film according to Claim 10, wherein said vacuum isolation device is opened when said container in/out chamber has been brought to a vacuum state by vacuumization, so as to communicate together said film deposition dedicated chamber and said container in/out chamber.

16. The apparatus for forming thin film according to Claim 10, wherein said heat generating element is inserted into the container when the container has been shifted into said film deposition dedicated chamber.

17. The apparatus for forming thin film according to Claim 10, wherein said container in/out chamber comprises an open/close gate for taking out and inserting the container from and into said container in/out chamber.

18. The apparatus for forming thin film according to Claim 10, further comprising a container transfer device that transfers an unprocessed container from a predetermined position into said container in/out chamber, and transfers a processed container from said bottle in/out chamber to a predetermined position.

19. The apparatus for forming thin film according to Claim 18, wherein said predetermined position is a position upon a conveyer.

20. The thin film formation apparatus according to Claim 10, wherein that said relative shifting device relatively shifts the container and said heat generating element at variable speed.