

(19)



(11)

EP 2 260 955 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
18.01.2012 Bulletin 2012/03

(51) Int Cl.:
B21C 47/34 (2006.01) **B21B 39/02** (2006.01)
B65H 20/10 (2006.01) **B21D 43/18** (2006.01)

(21) Application number: **10164843.4**

(22) Date of filing: **03.06.2010**

(54) **Apparatus for and method of transporting sheet material**

Vorrichtung und Verfahren zum Transportieren von Bandmaterial

Dispositif et méthode de transport d'un matériau en bande

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO SE SI SK SM TR**

(30) Priority: **09.06.2009 GB 0909873**

(43) Date of publication of application:
15.12.2010 Bulletin 2010/50

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EP 2 260 955 B1

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Description

[0001] The invention relates generally to industrial processes where thin sheet material needs to be transported without damage. The invention is especially applicable in the field of aluminium foil and thin strip rolling mills and describes a new device capable of picking up and transporting foil in the range approximately 12 - 50 microns thickness. The device can be combined with existing systems which pick up foil and strip of greater thickness to produce a new combination device which is able to pick up and transport foil and strip in the range approximately 12 - 300 microns. The new device is suitable for use as part of the mill foil feeding system which enables foil or thin strip to be brought from the coil to the mill roll bite automatically.

[0002] The ingoing side of an aluminium foil rolling mill consist of an uncoiling machine, a piece of equipment known as the "entry bridle", and the mill stand itself which contains the "work rolls" which reduce the foil in thickness. In order to start rolling, the free end of the foil coil must be picked up and transported to the mill bite through the entry bridle equipment, a distance of approximately 3 metres.

[0003] Aluminium foil of the lower thickness range (down to 12 micron thickness) is extremely fragile and has almost no inherent stiffness. Picking up such a material automatically, and transporting over and through equipment, without damaging it is therefore challenging. Traditionally this has been done manually with a typical procedure being as follows:

- Manually lift the foil end from the coil
- Fold the foil to create an arrowhead and fit over the end of a wooden pole
- Rotate the coil to allow slack foil
- Push the pole through the bridle until the foil is caught and pulled by the work roll nip

[0004] A skilled operator can perform such a function, but the procedure involves the operator standing close to moving machinery and risks damage to the bridle or mill stand equipment if the pole is mis-handled. For personnel and equipment safety it is therefore desirable that the foil is lifted from the coil and carried to the mill bite automatically. Additionally, aluminium foil / strip of the higher thickness range (up to 300 micron thickness) is quite stiff which means that a different method has been required to feed up this material. Again a manual procedure has traditionally been followed which this time involves the operator supporting the front end of the strip underneath with the wooden pole whilst the strip is wound off the coil. The same safety and damage implications are present as for foil feeding. Therefore it is even more desirable to have one system which can automatically lift and carry foil or strip with a wide range of thicknesses.

[0005] Several systems are in existence which attempt to carry out the foil feeding function, however, each has

only met with limited success:

Patent GB2185927 describes a method and equipment for feeding foil or strip from a coil to the entry bridle. However, this method still requires the operator to separate the foil from the coil and manually attach it to the carrier mechanism.

Patent application JP56001216 describes a method and apparatus for feeding foil or strip all the way to the mill bite. However, the described method requires the operator to perform a separate action to separate the foil and to attach it to the feeding mechanism. In addition, the operator is required to fold the foil into a special shape around the feeding mechanism in order to provide a leading edge to protrude beyond the feeding mechanism.

Patent US4520645 describes a method and equipment for the automatic threading of a foil mill. A foil pick up head is described where vacuum suckers are used to grip the foil and air jets are used to lift the front end of the foil to facilitate threading into the mill bite. Two different mechanisms are described for carrying the foil pick up head from the coil to near the mill bite.

Patent EP1518615 describes essentially the same method using vacuum suckers for picking up the foil from the coil and transporting it towards the mill, except in this case the foil is put down before the entry bridle and further transported using air floatation tables.

[0006] It has been found in practise that using vacuum suckers to lift foil and strip has certain limitations. The method can work well for thicker foil and strip above approximately 50 microns in thickness. In this case, on contact between the sucker and strip, whilst applying a suction action through the hole in the centre of the sucker, the flexible lip of the sucker (typically rubber-like material) deflects as low pressure is created between sucker and strip, whilst the stiffer aluminium strip stays rigid. Hence a good grip is created and the strip is not damaged. However, when attempting to lift thin foils of approximately 50 microns thickness and below, the foil has much less stiffness. Therefore when the sucker lip and foil is placed in contact, whilst applying a suction action through the hole in the centre of the sucker, the foil deflects instead of, or as well as the sucker lip. It is difficult to create an effective seal between 2 flexible objects and so poor grip will result between sucker and foil. If the suction action is increased within the central hole of the sucker, the higher pressure difference created may break a hole through thin foil or cause it to buckle and be partially pulled up inside the sucker hole itself.

[0007] Therefore in order to pick up and transport thin foils it is necessary to devise an alternative head design

and it is to this end that the new invention is presented hereto. It is considered that the mechanisms necessary for transportation of the pick up head from the coil to the mill bite are well established by prior art and are therefore not discussed beyond that which is necessary to understand the invention.

[0008] According to the invention, apparatus for transporting sheet material comprises the features set out in claim 1 attached hereto.

[0009] In one embodiment, the means for providing a pressure differential comprises a vacuum source and a nozzle arranged to extract air from a region above the plate. Preferably, the plate is arranged to form the base of the enclosure with the nozzle/vacuum source arranged to evacuate the enclosure.

[0010] In an alternative embodiment, the pressure differential is achieved by directing a flow of gas over the upper surface of the plate. This is conveniently achieved using a source of pressurised gas and a nozzle arranged to direct the gas over the upper surface of the plate. Preferably, a flat jet compressed air nozzle is used. Moreover the effectiveness of the flowing gas is preferably improved by arranging the plate to form the base of a conduit which bounds the flow of gas.

[0011] Preferably, the effect of the flowing gas is further enhanced where by incorporating at the holes, a streamlined hood having a tapered, closed end arranged towards the flowing gas (at the upstream side of the hole) and an open end arranged at the downstream side.

[0012] Preferred embodiments of the invention further comprise means for directing a flow of gas from an edge of the plate in a direction substantially parallel to, and above, the plane of the plate. In some embodiments a continuous flow of gas is directed over the upper surface of the plate and in a direction substantially parallel to, and above, the plane of the plate after the gas passes over said upper surface.

[0013] Preferably, the holes on the grid are staggered.

[0014] In at least one embodiment, the apparatus includes a number of plates, each having an associated plurality of holes and associated means for providing a pressure differential between the upper surface and lower surface of the plate. Each plate may be attached to adjacent plates with the nozzles being in fluid communication.

[0015] In some embodiments, the apparatus includes conventional suckers attached to a vacuum source for lifting sheet material. These may conveniently be arranged in sections which alternate with the plates of the invention. In a preferred embodiment, the suckers are moveable by, for example, a linear actuator so that they may be raised above or below the level of the plates.

[0016] In a preferred embodiment, the invention is used for the transport of metal foil.

[0017] According to a second aspect of the invention there is provided a method for transporting sheet material as recited in the independent method claim.

[0018] In order to grip foil with a thickness of less than

50 microns without damaging it and therefore to overcome the main limitation of previous pick up head designs, the new invention has a "suction grid" consisting of numerous small holes in a stiff plate. This replaces the conventional rubber suckers as the mechanism by which the foil is gripped. Although the thin foil is flexible, the contrasting stiffness of the suction plate allows a good seal, and hence good grip to form between the foil and the head. Additionally, the small size of the suction holes prevents the foil from deflecting into the holes excessively which in turn prevents damage or holes forming through the foil.

[0019] The suction pressure through the grid holes is provided by the passage of a stream of high speed air over the upper surface of the holes. The high speed air stream is provided by a flat slot type nozzle connected to a compressed air supply. The suction pressure occurs due to the so called "Bernoulli effect" where moving air on the upper surface of the holes is at lower pressure than the still air below the grid or foil. Although the effect can work with simple straight drilled holes, the suction effect can be enhanced by ensuring that the high speed air stream passes smoothly over the holes with no tendency to blow through them rather than produce suction. This can be done by using holes which have streamlined hoods over their leading edges (see figure 3). A further benefit to smooth air flow and hence maintained air velocity is also achieved by arranging the holes in a staggered pattern.

[0020] Alternatively, the suction pressure could be provided by a vacuum pump means, but this would not allow the following additional advantage over patent US4520645 to be realised.

[0021] The high velocity air flow used to create the suction effect loses little of its velocity over the grid. After leaving the grid the air flow can be directed over the front of the foil. As described in US4520645, again via the Bernoulli Effect, this gives a lifting action to the front end of the foil, allowing easy feeding of the foil into the mill bite without the pick up head touching the rolls. However, whereas in US4520645 two separate actions of sucking and blowing are required to produce the foil gripping and the lifting of the foil front end, the new invention allows both actions to be performed by the same air stream with associated reductions in equipment complexity and cost.

[0022] The invention will now be described, by non-limiting example, with reference to figures 1, 2 & 3 which show a preferred embodiment of the invention.

[0023] Figure 1 shows a cross section of the pick up head gripping a piece of thin foil. Figure 2 shows a plan view of a pick up head for narrow foils, or one section of a pick up head for wider foils. The foil is picked up and held in the position shown on the pick up head by the following system: A pressurised header 1 supplies compressed air to one or more flat jet nozzles 2. A high velocity jet of air (indicated by the large arrows) passes out of the nozzle(s) and travels along a tunnel 6, created by top cover 3, grid 4, and side plates 5. As the jet of air

passes along the tunnel 6, it lowers the pressure on the upper side of the holes 7, initially causing air (indicated by the small arrows) to be drawn in through the holes 7.

[0024] When the suction head is placed in close proximity to a foil strip 8, a suction force is produced between the foil 8 and the grid 4 due to the pressure differential between the air in the tunnel 6 and the air below the foil. Additionally, any foil which is protruding in front of the head 9 is subject to a lifting force caused by the high velocity air travelling over its upper surface.

[0025] Thereby the front of a foil strip can be lifted and held by the pick up head with the foil taking up a shape similar to that shown in figure 1.

[0026] Figure 3 shows a plan view and cross section through an optimised hole design. The hole 10 has a streamlined hood 11 which serves to increase the suction pressure created through the hole and prevent too much velocity being lost by the main air stream 12 as it passes over the hole 10.

[0027] Figures 4 & 5 show views of a combined pick up head for picking up and transporting foils or thin strip in the thickness range of approximately 12 - 300 microns. The head assembly 13 consists of alternate sections of two types separated by partitions 14. One type of section 15 consists of a suction grid assembly as described above. Each suction grid section is supplied with air from a pressurised header 16 running the width of the head. The other sections 17 consist of two conventional sucker arrangements 18. The suckers 18 are connected to a vacuum pump means (not illustrated) as is well known in the art. When operating, the sucker assemblies can be lowered below the level of grids 4 via a linear motion means 19 such as a small pneumatic cylinder. When not operating, the suckers 18 can be raised above the level of the grids 4 by the same linear motion means 19.

[0028] The number of each type of section and hence the width of the head is matched to the width of the foil and/or strip to be picked up.

[0029] In use, such a head would have 3 usual modes of operation, depending on the thickness of the foil or strip to be picked up. For thin foil in the range 12 to approximately 50 microns, only the suction grids 4 would be used, the suckers 18 would be retracted and their vacuum means turned off. For thin strip in the range 100 to 300 microns, the suckers 18 would be extended and the vacuum pump means turned on. Good grip would then be achieved between the suckers 18 and the relatively stiff strip. Therefore the air supply to the suction grids 4 can be turned off in this case. Between 50 and 100 microns thick there is an intermediate case where it is advantageous to have the suckers 18 extended and both the suckers 18 and the grids 4 in operation simultaneously.

[0030] Figure 6 shows an alternative design of pick up head where the suction grid and blowing action are separated. The foil is picked up and held in the position shown on the pick up head by the following system: A vacuum pump means (not illustrated) applies reduced pressure

via header or pipe 20 to a sealed box 21. The bottom of the box consists of a suction grid 22. The vacuum pump means lowers the pressure on the upper side of the holes 23, initially causing air to be drawn in through the holes 23. A pressurised header 24 supplies compressed air to one or more flat jet nozzles 25. A high velocity jet of air (indicated by the large arrow) passes out of the nozzle (s) 25 and travels over the top of the leading edge of the foil 27.

[0031] When the suction head is placed in close proximity to a foil strip 26, a suction force is produced between the foil 26 and the grid 22 due to the pressure differential between the air in the box 21 and the air below the foil. Additionally, any foil which is protruding in front of the head 27 is subject to a lifting force caused by the high velocity air travelling over its upper surface.

[0032] Thereby the front of a foil strip can be lifted and held by the pick up head with the foil taking up a shape similar to that shown in figure 6.

Claims

1. Apparatus for transporting sheet material (8; 26) comprising:

a plate having a plurality of holes (7) arranged to form a grid (4; 22);

means for providing a pressure differential between an upper surface and a lower surface of the plate and

means for directing a flow of gas from an edge of the plate in a direction substantially parallel to, and above, the plane of the plate;

motor means for transporting the plate.

2. Apparatus according to claim 1, where the means for providing a pressure differential comprises a vacuum source and a nozzle (25) arranged to extract air from a region above the plate.

3. Apparatus according to claim 2, where the plate forms the base of an enclosure, the vacuum source and nozzle being arranged to evacuate the enclosure.

4. Apparatus according to claim 1, where the means for providing a pressure differential comprises means (2) for directing a flow of gas over the upper surface of the plate.

5. Apparatus according to claim 4, wherein the means (2) for directing a flow of gas comprises a source (1) of pressurized gas and a nozzle (2) arranged to direct a flow of said gas across the upper surface.

6. Apparatus according to claim 5, where the nozzle (2) comprises a flat jet compressed air nozzle.

7. Apparatus according to any of claims 4 - 6 wherein the plate forms the base of a conduit (6), said conduit bounding the flow of gas over the plate.
8. Apparatus according to any of claims 4 - 7, wherein the holes (10) each comprise a streamlined hood (11) located in the flowing gas and having a closed, tapered upstream end and an open downstream end.
9. Apparatus according to any preceding claim, wherein the means for directing a flow of gas from an edge of the plate in a direction substantially parallel to, and above, the plane of the plate and the means for providing the pressure differential between the upper surface and a lower surface of the plate comprises the same flow of gas.
10. Apparatus according to any preceding claim, wherein the holes (7) are arranged in a staggered pattern.
11. Apparatus according to any preceding claim, comprising a plurality of plates, wherein each plate has an associated plurality of holes arranged to form a grid and each plate has associated means (16) for providing a pressure differential between an upper surface and a lower surface of the plate.
12. Apparatus according to claim 11, wherein each plate is physically attached to adjacent plates and the associated means (16) for providing a pressure differential are in fluid communication.
13. Apparatus according to claim 12, further comprising a plurality of suckers (18) and a vacuum source, the apparatus being operable to pick up sheet material by contacting the suckers (18) with the sheet material and application of vacuum to the suckers.
14. Apparatus according to claim 13, comprising a plurality of sections wherein:
 - a first type of section (15) comprises a plate having a plurality of holes arranged to form a grid and means for providing a pressure differential between an upper surface and a lower surface of the plate and
 - a second type of section (17) comprises a plurality of suckers (18) connected to a vacuum source.
15. Apparatus according to claim 14, further comprising a plurality of linear actuators (19) operable to adjust the height of the suckers (18) in relation to the plates.
16. Apparatus according to any preceding claim, adapted for transporting metal foil.
17. A method of transporting sheet material (8; 26) comprising the steps of:
 - locating a plate, having a plurality of holes (7) arranged to form a grid, (4; 22) such that a lower surface of the plate is proximal to the sheet material;
 - directing a flow of gas from an edge of the plate in a direction substantially parallel to, and above, the plane of the plate;
 - inducing a reduced pressure in a region above the plate, relative to a region below the plate and transporting the plate.
18. A method according to claim 17, where a reduced pressure is induced in the region above the plate by applying a vacuum thereto.
19. A method according to claim 18, comprising the steps of forming an enclosure (6) having one boundary defined by the plate and evacuating said enclosure.
20. A method according to claim 17, where a reduced pressure is induced in the region above the plate by directing a flow of gas over the upper surface of the plate.
21. A method according to claim 20, where the flow of gas is directed from a source (1) of pressurized gas using a nozzle (2).
22. A method according to claim 21, where a flat jet compressed air nozzle (2) is used to direct the flow of gas.
23. A method according to any of claims 17 - 22, comprising the steps of completing a conduit (6) having one boundary defined by the plate and directing the flow of gas through the conduit (6).
24. A method of using the apparatus of any of claims 14 to 16 when dependent on claim 13 comprising the step of determining a thickness of the sheet material to be transported and in the event of the determined sheet thickness being in the range of 12 to 50 microns operating the apparatus in a first mode, in the event of the determined sheet thickness being in the range of 100 to 300 microns operating the apparatus in a second mode and in the event of determined thickness being in the range of 50 to 100 microns operating the apparatus in a third mode wherein, in the first mode, the suckers (18) do not have a vacuum applied to them and are retracted away from the sheet; in the second mode the suckers (18) are extended to a position proximal the sheet and a vacuum is applied to them to enable gripping of the sheet with the sucker sections having no vacuum applied, and, in the third mode, the suckers (18) are extended

to a position proximal the sheet and a vacuum is applied both to the suckers and sucker sections to enable gripping of the sheet both by the suckers and the sucker sections.

25. A method as claimed in any of claims 17 to 24 wherein the sheet material transported is wider strip material.

Patentansprüche

1. Vorrichtung zum Transportieren von Blattmaterial (8; 26), welche umfasst:

eine Platte mit einer Vielzahl von Löchern (7), die so angeordnet sind, dass sie ein Gitter (4; 22) bilden;
Mittel zum Bereitstellen einer Druckdifferenz zwischen einer Oberseite und einer Unterseite der Platte; und
Mittel zum Lenken eines Gasstroms von einem Rand der Platte in eine Richtung, die im Wesentlichen parallel zur Ebene der Platte ist und über dieser verläuft;
Motormittel zum Transportieren der Platte.

2. Vorrichtung nach Anspruch 1, wobei die Mittel zum Bereitstellen einer Druckdifferenz eine Vakuumquelle und eine Düse (25) umfassen, die dafür eingerichtet sind, Luft aus einem Bereich über der Platte abzusaugen.

3. Vorrichtung nach Anspruch 2, wobei die Platte den Boden einer Hülle bildet, wobei die Vakuumquelle und die Düse dafür eingerichtet sind, die Hülle zu evakuieren.

4. Vorrichtung nach Anspruch 1, wobei die Mittel zum Bereitstellen einer Druckdifferenz Mittel (2) zum Lenken eines Gasstroms über die Oberseite der Platte umfassen.

5. Vorrichtung nach Anspruch 4, wobei die Mittel (2) zum Lenken eines Gasstroms eine Quelle (1) von druckbeaufschlagtem Gas und eine Düse (2), die dafür eingerichtet ist, einen Strom des besagten Gases über die Oberseite zu lenken, umfassen.

6. Vorrichtung nach Anspruch 5, wobei die Düse (2) eine Flachstrahl-Druckluftdüse umfasst.

7. Vorrichtung nach einem der Ansprüche 4 - 6, wobei die Platte den Boden eines Kanals (6) bildet, wobei der besagte Kanal den Gasstrom über der Platte begrenzt.

8. Vorrichtung nach einem der Ansprüche 4 - 7, wobei

die Löcher (10) jeweils eine stromlinienförmige Haube (11) umfassen, die sich in dem strömenden Gas befindet und ein geschlossenes, konisch zulaufendes stromaufwärtiges Ende und ein offenes stromabwärtiges Ende aufweist.

9. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die Mittel zum Lenken eines Gasstroms von einem Rand der Platte in eine Richtung, die im Wesentlichen parallel zur Ebene der Platte ist und über dieser verläuft, und die Mittel zum Bereitstellen der Druckdifferenz zwischen der Oberseite und einer Unterseite der Platte denselben Gasstrom umfassen.

10. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die Löcher (7) zueinander versetzt angeordnet sind.

11. Vorrichtung nach einem der vorhergehenden Ansprüche, die eine Vielzahl von Platten umfasst, wobei jede Platte eine zugeordnete Vielzahl von Löchern aufweist, die so angeordnet sind, dass sie ein Gitter bilden, und jede Platte zugeordnete Mittel (16) zum Bereitstellen einer Druckdifferenz zwischen einer Oberseite und einer Unterseite der Platte aufweist.

12. Vorrichtung nach Anspruch 11, wobei jede Platte physisch an benachbarten Platten angebracht ist und die zugeordneten Mittel (16) zum Bereitstellen einer Druckdifferenz in Fluidverbindung stehen.

13. Vorrichtung nach Anspruch 12, welche ferner eine Vielzahl von Saugnäpfen (18) und eine Vakuumquelle umfasst, wobei die Vorrichtung in der Lage ist, Blattmaterial durch Inkontaktbringen der Saugnäpfe (18) mit dem Blattmaterial und Anlegen von Vakuum an die Saugnäpfe aufzunehmen.

14. Vorrichtung nach Anspruch 13, welche eine Vielzahl von Abschnitten umfasst, wobei:

ein erster Abschnittstyp (15) eine Platte mit einer Vielzahl von Löchern, die so angeordnet sind, dass sie ein Gitter bilden, und Mittel zum Bereitstellen einer Druckdifferenz zwischen einer Oberseite und einer Unterseite der Platte umfasst; und

ein zweiter Abschnittstyp (17) eine Vielzahl von Saugnäpfen (18), die an eine Vakuumquelle angeschlossen sind, umfasst.

15. Vorrichtung nach Anspruch 14, welche ferner eine Vielzahl von Linearaktoren (19) umfasst, die in der Lage sind, die Höhe der Saugnäpfe (18) in Bezug auf die Platten einzustellen.

16. Vorrichtung nach einem der vorhergehenden Ansprüche, die für das Transportieren von Metallfolie geeignet ist.
17. Verfahren zum Transportieren von Blattmaterial (8; 26), welches die folgenden Schritte umfasst:
- Positionieren einer Platte mit einer Vielzahl von Löchern (7), die so angeordnet sind, dass sie ein Gitter (4; 22) bilden, derart, dass eine Unterseite der Platte sich nahe dem Blattmaterial befindet; 10
- Lenken eines Gasstroms von einem Rand der Platte in eine Richtung, die im Wesentlichen parallel zur Ebene der Platte ist und über dieser verläuft; 15
- Hervorrufen eines verminderten Druckes in einem Bereich über der Platte, bezogen auf einen Bereich unter der Platte; und 20
- Transportieren der Platte.
18. Verfahren nach Anspruch 17, wobei ein verminderter Druck in dem Bereich über der Platte durch Anlegen eines Vakuums an diese hervorgerufen wird. 25
19. Verfahren nach Anspruch 18, welches die Schritte des Bildens einer Hülle (6), die eine durch die Platte definierte Begrenzung aufweist, und des Evakuierens der besagten Hülle umfasst. 30
20. Verfahren nach Anspruch 17, wobei ein verminderter Druck in dem Bereich über der Platte durch Lenken eines Gasstroms über die Oberseite der Platte hervorgerufen wird. 35
21. Verfahren nach Anspruch 20, wobei der Gasstrom aus einer Quelle (1) von druckbeaufschlagtem Gas unter Verwendung einer Düse (2) gelenkt wird. 40
22. Verfahren nach Anspruch 21, wobei eine Flachstrahl-Druckluftdüse (2) verwendet wird, um den Gasstrom zu lenken. 45
23. Verfahren nach einem der Ansprüche 17 - 22, welches die Schritte des Ausbildens eines Kanals (6), welcher eine durch die Platte definierte Grenze aufweist, und des Lenkens des Gasstroms durch den Kanal (6) umfasst. 50
24. Verfahren zur Verwendung der Vorrichtung nach einem der Ansprüche 14 - 16, wenn abhängig von Anspruch 13, welches den Schritt des Bestimmens einer Dicke des zu transportierenden Blattmaterials und, falls die bestimmte Blattdicke im Bereich von 12 bis 50 Mikrometern liegt, das Betreiben der Vorrichtung in einer ersten Betriebsart, falls die bestimmte Blattdicke im Bereich von 100 bis 300 Mikrometern liegt, das Betreiben der Vorrichtung in ei-

ner zweiten Betriebsart und, falls die bestimmte Blattdicke im Bereich von 50 bis 100 Mikrometern liegt, das Betreiben der Vorrichtung in einer dritten Betriebsart umfasst, wobei in der ersten Betriebsart an die Saugnäpfe (18) kein Vakuum angelegt wird und sie von dem Blatt weg zurückgezogen sind; in der zweiten Betriebsart die Saugnäpfe (18) in eine Position nahe dem Blatt ausgefahren sind und ein Vakuum an sie angelegt wird, um ein Greifen des Blattes zu ermöglichen, wobei an die Saugabschnitte kein Vakuum angelegt wird; und in der dritten Betriebsart die Saugnäpfe (18) in eine Position nahe dem Blatt ausgefahren sind und ein Vakuum sowohl an die Saugnäpfe als auch an die Saugabschnitte angelegt wird, um ein Greifen des Blattes mittels sowohl der Saugnäpfe als auch der Saugabschnitte zu ermöglichen.

25. Verfahren nach einem der Ansprüche 17 - 24, wobei das transportierte Blattmaterial breiteres Bandmaterial ist.

Revendications

1. Dispositif de transport d'un matériau en bande (8 ; 26) comprenant :
 - une plaque comportant une pluralité de trous (7) agencés pour former une grille (4 ; 22) ;
 - un moyen pour produire une différence de pression entre une surface supérieure et une surface inférieure de la plaque, et
 - un moyen pour diriger un flux de gaz depuis un bord de la plaque dans une direction sensiblement parallèle au, et passant au-dessus du, plan de la plaque,
 - un moyen formant moteur pour transporter la plaque.
2. Dispositif selon la revendication 1, dans lequel le moyen de production d'une différence de pression comprend une source de vide et une buse (25) agencées pour extraire l'air d'une zone au-dessus de la plaque.
3. Dispositif selon la revendication 2, dans lequel la plaque forme la base d'une enceinte, la source de vide et la buse étant agencées pour faire le vide dans l'enceinte.
4. Dispositif selon la revendication 1, dans lequel le moyen de production d'une différence de pression comprend un moyen (2) pour diriger un flux de gaz sur la surface supérieure de la plaque.
5. Dispositif selon la revendication 4, dans lequel le moyen (2) pour diriger un flux de gaz comprend une

source (1) de gaz sous pression et une buse (2) agencée pour diriger un flux dudit gaz d'un côté à l'autre de la surface supérieure.

6. Dispositif selon la revendication 5, dans lequel la buse (2) est constituée par une buse à jet d'air comprimé plat. 5
7. Dispositif selon l'une quelconque des revendications 4-6 dans lequel la plaque forme la base d'un conduit (6), ledit conduit bornant l'écoulement de gaz au-dessus de la plaque. 10
8. Dispositif selon l'une quelconque des revendications 4-7, dans lequel les trous (10) comprennent chacun un capot aérodynamique (11) situé dans l'écoulement de gaz et comportant une extrémité amont effilée, fermée, et une extrémité aval ouverte. 15
9. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le moyen pour diriger un flux de gaz depuis un bord de la plaque dans une direction sensiblement parallèle au, et passant au-dessus du, plan de la plaque et le moyen de production de la différence de pression entre la surface supérieure et une surface inférieure de la plaque comprennent le même flux de gaz. 20 25
10. Dispositif selon l'une quelconque des revendications précédentes, dans lequel les trous (7) sont agencés selon un motif en quinconce. 30
11. Dispositif selon l'une quelconque des revendications précédentes, comprenant une pluralité de plaques, dans lequel chaque plaque comporte une pluralité associée de trous agencés pour former une grille et chaque plaque comporte un moyen associé (16) de production d'une différence de pression entre une surface supérieure et une surface inférieure de la plaque. 35 40
12. Dispositif selon la revendication 11, dans lequel chaque plaque est physiquement attachée à des plaques adjacentes et les moyens associés (16) de production d'une différence de pression sont en communication fluïdique. 45
13. Dispositif selon la revendication 12, comprenant par ailleurs une pluralité de ventouses (18) et une source de vide, le dispositif étant utilisable pour soulever un matériau en bande par mise en contact des ventouses (18) avec le matériau en bande et application d'un vide aux ventouses. 50
14. Dispositif selon la revendication 13, comprenant une pluralité de sections parmi lesquelles : 55

un premier type de section (15) comprend une

plaque comportant une pluralité de trous agencés pour former une grille et un moyen de production d'une différence de pression entre une surface supérieure et une surface inférieure de la plaque, et un second type de section (17) comprend une pluralité de ventouses (18) reliées à une source de vide.

15. Dispositif selon la revendication 14, comprenant par ailleurs une pluralité d'actionneurs linéaires (19) utilisables pour ajuster la hauteur des ventouses (18) par rapport aux plaques. 10
16. Dispositif selon l'une quelconque des revendications précédentes, adapté pour transporter une feuille métallique. 15
17. Procédé de transport de matériau en bande (8 ; 26) comprenant les étapes consistant : 20
 - à placer une plaque, comportant une pluralité de trous (7) agencés pour former une grille (4 ; 22), de telle sorte qu'une surface inférieure de la plaque est à proximité du matériau en bande ;
 - à diriger un flux de gaz depuis un bord de la plaque dans une direction sensiblement parallèle au, et passant au-dessus du, plan de la plaque ;
 - à induire une pression réduite dans une zone au-dessus de la plaque, par rapport à une zone sous la plaque, et
 - à transporter la plaque.
18. Procédé selon la revendication 17, dans lequel on induit une pression réduite dans la zone au-dessus de la plaque en y appliquant un vide. 35
19. Procédé selon la revendication 18, comprenant les étapes consistant à former une enceinte (6) comportant une limite définie par la plaque et à faire le vide dans ladite enceinte. 40
20. Procédé selon la revendication 17, dans lequel on induit une pression réduite dans la zone au-dessus de la plaque en dirigeant un flux de gaz au-dessus de la surface supérieure de la plaque. 45
21. Procédé selon la revendication 20, dans lequel le flux de gaz est dirigé depuis une source (1) de gaz sous pression au moyen d'une buse (2). 50
22. Procédé selon la revendication 21, dans lequel on utilise une buse à jet d'air comprimé plat (2) pour diriger le flux de gaz. 55
23. Procédé selon l'une quelconque des revendications 17-22, comprenant les étapes consistant à réaliser

un conduit (6) comportant une limite définie par la plaque et à diriger le flux de gaz dans le conduit.

- 24.** Procédé d'utilisation du dispositif selon l'une quelconque des revendications 14 à 16 quand elles dépendent de la revendication 13, comprenant l'étape consistant à déterminer une épaisseur du matériau en bande à transporter et, dans l'éventualité où l'épaisseur de bande déterminée est dans la fourchette de 12 à 50 microns, à utiliser le dispositif dans un premier mode, dans l'éventualité où l'épaisseur de bande déterminée est dans la fourchette de 100 à 300 microns, à utiliser le dispositif dans un deuxième mode et, dans l'éventualité où l'épaisseur de bande déterminée est dans la fourchette de 50 à 100 microns, à utiliser le dispositif dans un troisième mode, étant entendu que, dans le premier mode, les ventouses (18) ne sont pas soumises à un vide et sont rétractées par rapport à la bande, que, dans le deuxième mode, les ventouses (18) sont sorties jusqu'à une position à proximité de la bande et qu'un vide leur est appliqué pour permettre la saisie de la bande par les sections de ventouse auxquelles aucun vide n'est appliqué, et que, dans le troisième mode, les ventouses (18) sont sorties jusqu'à une position à proximité de la bande et qu'un vide est appliqué à la fois aux ventouses et aux sections de ventouse pour permettre la saisie de la bande à la fois par les ventouses et par les sections de ventouse.
- 25.** Procédé selon l'une quelconque des revendications 17 à 24, dans lequel le matériau en bande transporté est un matériau en bande élargie.

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FIG 1

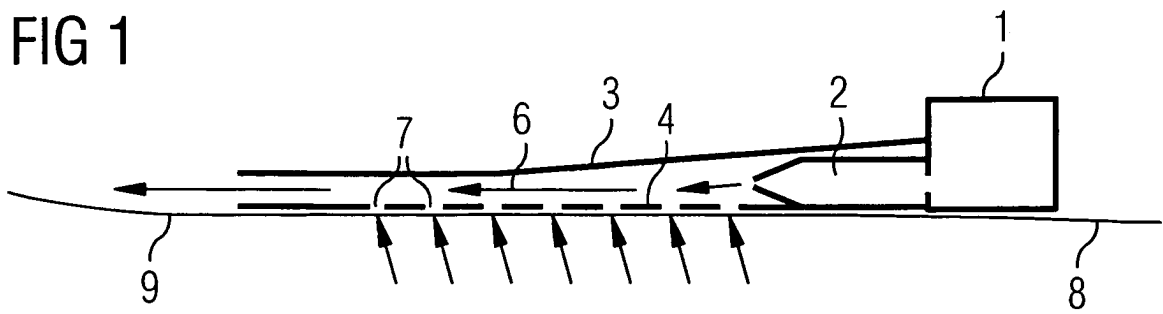


FIG 2

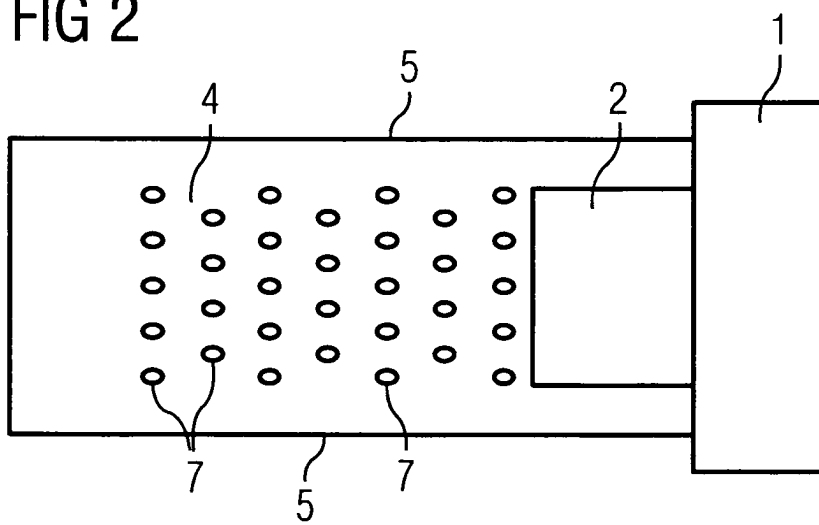


FIG 3

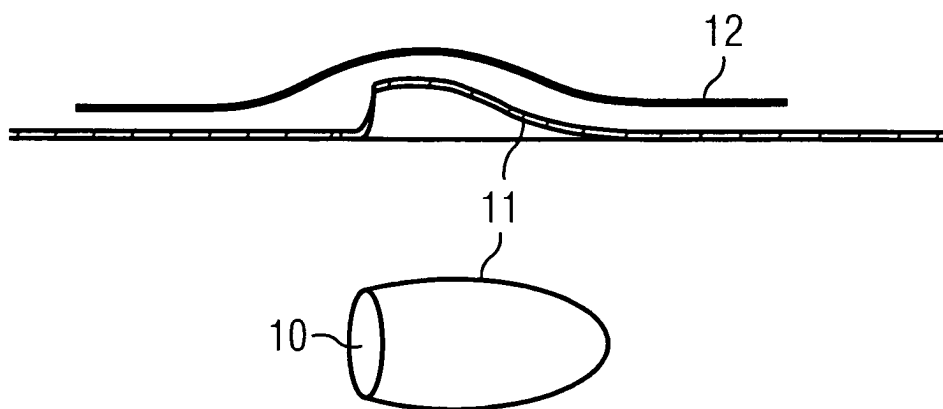


FIG 4

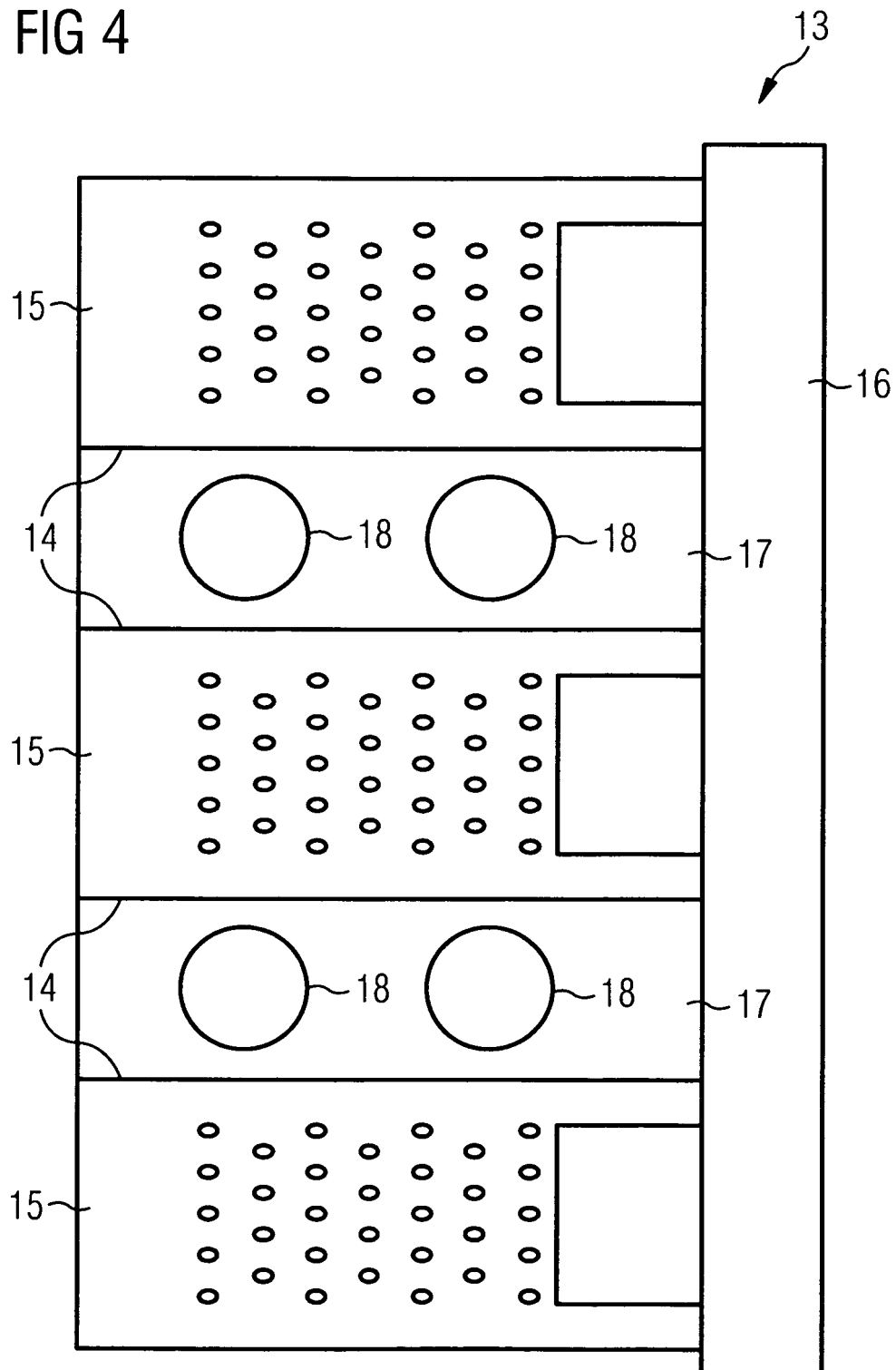


FIG 5

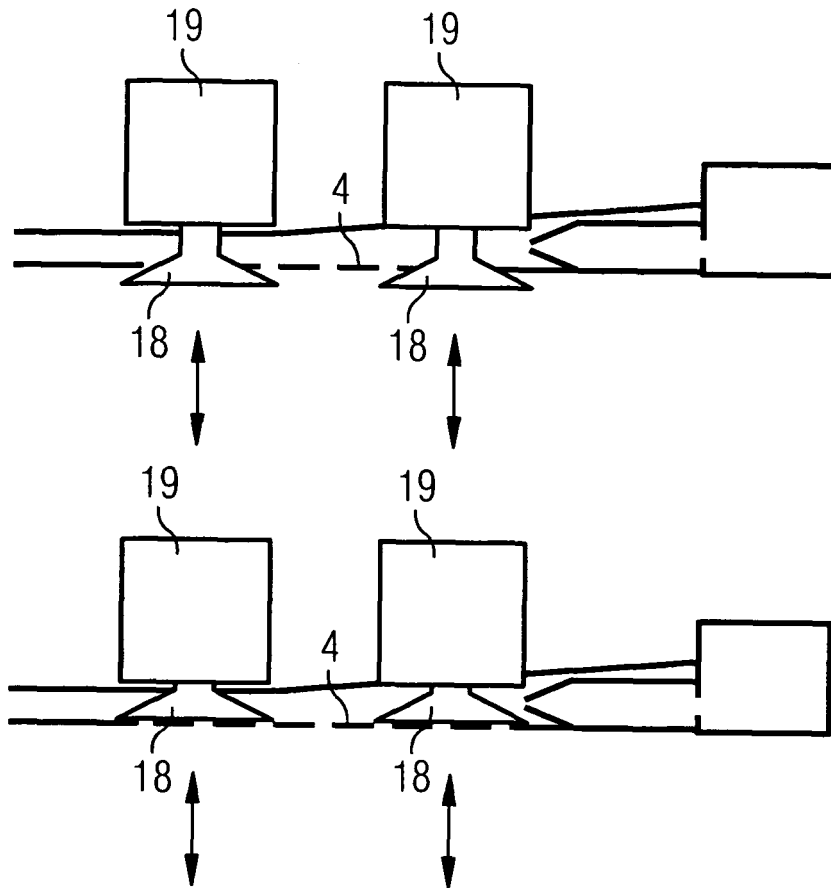
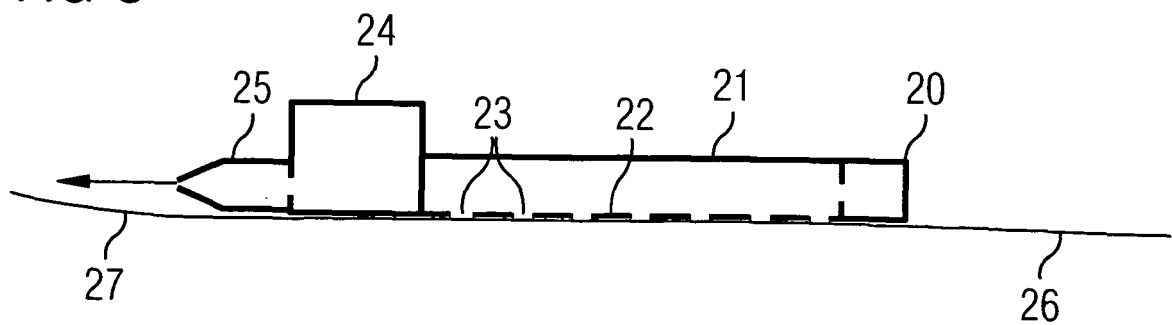


FIG 6



REFERENCES CITED IN THE DESCRIPTION

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