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(54) **Support device for the knife of a machine for the production of paper band-like material**

Schaberhalter für eine Papierbanderzeugende Maschine

Support pour lame d'une machine de production d'une bande de matériau de type papier

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Description

[0001] The present invention refers to a support device for the knife of a machine for the production of paper band-like material.

[0002] As known, in the productive process of crepe paper, intended in particular for the transformation into toilet paper, all-purpose absorbent paper, napkins, tissues, industrial rolls and yet more, it is necessary to carry out a drying and desiccation step of the product being processed, normally made of a pulp of paper which is diluted with water. The drying and desiccation step is usually carried out with a drying device comprising a so-called "Yankee" cylinder. This is a cylinder that is heated with steam, having a diameter that can vary from about 1.5 m to about 6 m, consisting of a pressurised container that contains process steam up to about 10 bar G and beyond, inside it. The paper is made to dynamically adhere to the Yankee cylinder so as to make the water in excess evaporate thus completing the desiccation process.

[0003] The machinery for the production of crepe paper is normally equipped with three distinct knives which operate on the Yankee cylinder. A first knife, or creping knife, removes the paper from the Yankee cylinder, giving the paper itself the crepe characteristics. A second knife, called removal or cutting knife, is used for removing the paper from the Yankee cylinder while changing the blade of the creping knife. A third knife, or cleaning knife, finally has the task of cleaning the surface of the Yankee cylinder from residues left by the creping knife.

[0004] Irrespective of the type, each knife is normally made up of a blade, which acts directly upon the surface of the Yankee cylinder, and a cutter block mounted on a support crossbar. The support crossbar is capable of swinging around an axis that is substantially parallel to the rotation axis of the Yankee cylinder and rests on a pair of opposing pins, one for each side of the support crossbar itself. Two support bearings, or brasses, support the crossbar and allow them to swing.

[0005] The support crossbar is usually moved, with respect to the fixed structure of the machinery for producing paper, through levers and pneumatic cylinders. The pneumatic cylinders allow the crossbar to rotate so as to remove the knife from the surface of the Yankee cylinder, for example for operations of replacing the blade or for other maintenance operations. In the case of rigid knives, i.e. that are not elastically connected to the support crossbar, the pneumatic cylinders also provide the torque necessary to press the blade against the surface of the Yankee cylinder.

[0006] The contact pressure of the blade against the surface of the Yankee cylinder must be calibrated in the best way possible in order to effectively remove the paper and to simultaneously avoid damage to such a surface or the paper itself. This type of damage however, can occur quite frequently in known types of machines for producing paper, requiring the working process to be in-

terrupted which is onerous both in terms of costs, and in terms of time to restore the functionality of the machinery itself.

[0007] The document DE 44 24 032 C1 describes a creping machine for paper band-like material, in which a plurality of creping knives is mounted on a support device provided with many constraint means with respect to the frame of the machine. The support device is moved through levers and pneumatic cylinders. The support device can thus undergo swinging in a crosswise direction with respect to the rotation axis of the cylinder of the creping machine.

[0008] The document WO 93/06300 describes another creping machine for paper band-like material, in which the creping knife is mounted on a support device that is provided with a crossbar and with an adjustment slide. Even in this case, the support device can undergo swinging in a crosswise direction with respect to the rotation axis of the cylinder of the creping machine.

[0009] The purpose of the present invention is therefore that of making a support device for the knife of a machine for the production of paper band-like material that is capable to solve the aforementioned drawbacks of the prior art in an extremely simple, cost effective and particularly functional manner.

[0010] In particular, one purpose of the present invention is that of making a support device for the knife of a machine for the production of paper band-like material which makes it possible for the support device itself to have high functional stability.

[0011] Another purpose of the invention is that of making a support device for the knife of a machine for the production of paper band-like material that is capable of removing paper from the surface of the Yankee cylinder in a particularly effective manner.

[0012] Yet another purpose of the invention is that of making a support device for the knife of a machine for the production of paper band-like material that is capable of minimising the possibility of damage of the surface of the Yankee cylinder and of the paper being processed.

[0013] These purposes according to the present invention are achieved by making a support device for the knife of a machine for the production of paper band-like material as outlined in claim 1.

[0014] Further characteristics of the invention are highlighted in the dependent claims, which are an integrating part of the present description.

[0015] The characteristics and the advantages of a support device for the knife of a machine for the production of paper band-like material according to the present invention shall become clearer from the following description, given as an example and not for limiting purposes, with reference to the attached schematic drawings, in which:

figure 1 is a side view of a series of support devices of the known type for knives of a machine for the production of paper band-like material;

figure 2 is a detailed view of a support device of the known type and of the relative movement mechanism;

figure 3 is a front view of a first embodiment of a support device according to the invention;

figure 4 is a side view of the support device of figure 3, to which a knife of the flexible type is applied;

figure 5 is a side view of the support device of figure 3, to which a knife of the rigid type is applied;

figure 6 is a side view of the support device of figure 3, to which another knife of the rigid type is applied; and

figure 7 is a side view of a second embodiment of a support device according to the invention.

[0016] With reference in particular to figures 1 and 2, a detail of a machine for the production of paper band-like material is shown, of the type comprising a so called "Yankee" cylinder, which is able to rotate around its own axis with respect to the fixed structure or frame 12 of the machine itself. On the circumferential surface 10 of the cylinder, suitably heated through steam in a per se known manner, the belt of paper is made to dynamically adhere so as to make it dry.

[0017] One or more knives or cutter blocks 14÷18, each carrying a respective blade 20÷24, are placed in contact with the surface 10 of the cylinder. More precisely, it can be foreseen for there to be a creping knife 14, that is capable of removing the paper from the surface 10 of the cylinder so as to give the paper itself the crepe characteristic, a so-called removal or cutting knife 16, to remove the paper from the surface 10 of the cylinder while changing the blade 20 of the creping knife 14, and a cleaning knife 18, which has the task of cleaning the surface 10 of the cylinder from paper residue left by the creping knife 14.

[0018] Each knife or cutter block 14÷18 is provided with a respective support device 26÷30 made of a crossbar which extends according to a direction that is substantially parallel to the rotation axis of the surface 10 of the cylinder. Each crossbar 26÷30 preferably has a substantially prismatic shape in cross-section and is connected to the frame 12 of the machine in a mobile or fixed manner. When present, the moving means of each crossbar 26÷30 with respect to the frame 12 of the machine can for example consist of levers 32÷36 and pneumatic cylinders 38÷42. The moving means 32÷36 and 38÷42 can operate both so as to make each crossbar 26÷30 rotate and/or translate, so as to remove the relative knife 14÷18 from the surface 10 of the cylinder when, for example, it is necessary for there to be replacement operations of the blade 20÷24 or other maintenance operations, and to provide the torque necessary to press the blade 20÷24 against the surface 10 of the cylinder.

[0019] According to the invention, each support device or crossbar 26÷30 is provided with constraint means with respect to the frame 12 of the machine which extend along at least two distinct axes A-A and B-B, parallel to

each other and to the rotation axis of the cylinder. Such constraint means are each mounted on respective support bearings 50, 52 that are fixedly attached to the frame 12 of the machine. The support bearings 50, 52 prevent swinging, in a crosswise direction, with reference to the rotation axis of the cylinder, of the constraint means which extend along such axes A-A and B-B parallel to each other. Such support bearings 50, 52, which differentiate the invention from all of the known embodiments, have the purpose of dividing the entire reaction to the stress between themselves, at the same time widening the support and reaction base.

[0020] With reference to figures 3 and 4, which show a first embodiment of the support device according to the invention, the crossbar 26 that supports a creping knife 14 is shown. The creping knife 14 is that which requires the greatest rigidity possible with respect to the cylinder, compatibly with the possibility of rotation of the respective crossbar 26. The constraint means of such a crossbar 26 with respect to the frame 12 are thus made of, for each side of the crossbar 26 itself, a pair of pins 44 and 46 which extend along respective axes A-A and B-B parallel to each other, as highlighted in figure 3.

[0021] The two pins 44 and 46, suitably fixed in a manner that may or may not be able to rotate with respect to the frame 12 of the machine through respective support bearings 50 and 52, can provide a reaction torque that is sufficient for the purpose required by the creping process. With respect to conventional crossbars, provided with a single pin on each side, the two pins 44 and 46 indeed make it possible to widen the reaction base of the effort of the creping, as well as to provide the reaction torque that is normally transmitted by the levers 32÷36. The crossbar 26 can thus be equipped with any type of moving means with respect to the frame 12 of the machine, not necessarily provided with such levers 32÷36.

[0022] Figures 5 and 6 respectively show the crossbar 26 that supports a creping knife 14 of the rigid type and the crossbar 30 that supports a cleaning knife 18, also of the rigid type. The load on the blade 20 of the creping knife 14 is generated by applying a predetermined force through the moving means, made up of, for example, a pneumatic cylinder, a hydraulic cylinder or a mechanical actuator, of the crossbar 26. The predetermined force can be applied on one of the two pins of the crossbar 26, for example on the pin 44, along an arc of circumference C having centre in the rotation axis of the second pin 46.

[0023] In this case the crossbar 26 is able to rotate around the axis defined by the second pin 46, whereas the first pin 44, mobile with circular motion along the arc C, is in any case supported by a constraint in the form of a bracket that is compatible with the required movement. The same type of circular movement is of course possible for the second pin 46 with respect to the rotation axis of the first pin 44, as shown for example in figure 6.

[0024] The movement directions indicated by the arrows of figures 5 and 6 are only given as an example, and can also be taken as directions to apply the blade

load or to adjust the position of the cutter block 14 or 18 with respect to the surface 10 of the cylinder. It is important to underline that both the pins 44 and 46 are always supported, so as to provide a stable constraint extended to the crossbar 26÷30.

[0025] With reference to figure 7 a second embodiment of the support device is shown according to the invention, applied as an example to the crossbar 30 that supports a cleaning knife 18. The constraint means of such a crossbar 30 with respect to the frame 12 are in this case made up of, for each side of the crossbar 26 itself, a single pin 48 being elongated-shaped in section, that is not circular, so as to extend longitudinally between a pair of axes A-A and B-B that are parallel to each other.

[0026] The pin 48, suitably actuated by the moving means, can carry out the same movements, in terms of translation and/or rotation, as the system with two pins 44 and 46 previously described. Even in this case the pin 48 is provided with a respective support bearing (not shown) that is fixedly attached to the frame 12 of the machine. The supports and the brackets of the pin 48 are made so as to carry out the displacements foreseen for the respective cutter block 14÷18. The pin 48 can have, for example, an elliptical section, rectangular section, or a section with any other shape obtained by the meeting of the two distinct pins which extend along respective axes A-A and B-B that are parallel to each other.

[0027] In the case in which there are two distinct pins 44 and 46 for each side of the crossbar 26÷30, such pins 44 and 46 can both be mobile with respect to the fixed structure 12 of the machine, or both be fixed, or furthermore one mobile and one fixed. The single pin 48 with an elongated shape can in turn be mobile or fixed with respect to the frame 12 of the machine. The translation direction of the constraint pins 44, 46 and 48 with respect to the machine can be any (circular, linear, elliptical, following a plurality of different directions, etc.).

[0028] The constraint pins 44, 46 and 48 can be mobile both during assembly and during adjustment of the machine, both for reasons related to the operation of the machine itself, that is to say mobile during the normal functionality and without limitations with respect to the operation step, during which they can be rotated and/or translated. The constraint pins 44, 46 and 48 can also be mobile along the direction of the axes A-A and B-B, so as to make the support devices 26÷30 able to swing in an axial direction with respect to the surface 10 of the cylinder. The swinging system can be independent, or integrated into the moving means (translation and/or rotation) of the constraint pins 44, 46 and 48. Moreover, it can also be foreseen for there to be, also made in an independent form or integrated in the moving means of the constraint pins 44, 46 and 48, a kinematic mechanism that is suitable for modifying the angle of incidence of the blades 20÷24 on the surface 10 of the cylinder.

[0029] The support bearings 50, 52 which constrain the pins 44, 46 and 48 to the frame 12 of the machine can be of any type, like for example, ball bearings, roller

bearings, bushings or bushes of any type and form. The pins 44, 46 and 48 can be fixed to the respective crossbar 26÷30 in an irremovable manner, through for example welding or fitting with interference created by heating or cooling of a part, or in a removable manner, through for example screws or another system of reversible mechanical connection. The control of the moving means of the pins 44, 46 and 48 can be of any type and origin, like for example mechanical, hydraulic, electrical, electronic, etc.

[0030] It has thus been seen that the support device for the knife of a machine for the production of paper band-like material according to the present invention achieves the purposes previously highlighted, making it possible for there to be better functional stability with respect to the embodiments according to the prior art.

[0031] The support device for the knife of a machine for the production of paper band-like material of the present invention thus conceived can in any case undergo numerous modifications and variants, all covered by the same inventive concept; moreover, all the details can be replaced by technically equivalent elements. In practice the materials used, as well as the shapes and sizes, can be any according to the technical requirements.

[0032] The scope of protection of the invention is thus defined by the attached claims.

Claims

1. Support device (26; 28; 30) for the knife (14; 16; 18) of a machine for the production of paper band-like material of the type comprising a cylindrical surface (10) able to rotate with respect to a fixed structure (12) of the machine, said knife (14; 16; 18) being placed in contact with said cylindrical surface (10) for interacting with the paper band-like material, the support device (26; 28; 30) being made of a crossbar which extends according to a direction substantially parallel to the rotation axis of said cylindrical surface (10) and which is connected to the fixed structure (12) of the machine, wherein said crossbar (26; 28; 30) is provided with constraint means with respect to the fixed structure (12) of the machine which extend along at least two distinct axes (A-A, B-B), parallel to each other and to the rotation axis of said cylindrical surface (10), **characterised in that** each of said constraint means is mounted on respective support bearings (50, 52) fixedly attached to the fixed structure (12) of the machine, said support bearings (50, 52) preventing swinging in a crosswise direction, with reference to the rotation axis of said cylindrical surface (10), of the constraint means which extend along said distinct axes (A-A, B-B) that are parallel to each other, wherein said constraint means of each crossbar (26; 28; 30) with respect to the fixed structure (12) of the machine are made of two pins (44, 46) for each side of said crossbar (26; 28; 30), said

two pins (44, 46) extending respectively along said two distinct axes (A-A, B-B) parallel to each other.

2. Support device (26; 28; 30) according to claim 1, **characterised in that** at least one of said pins (44, 46; 48) is mobile with respect to the fixed structure (12) of the machine for moving the crossbar (26; 28; 30) with respect to the cylindrical surface (10). 5
3. Support device (26; 28; 30) according to claim 2, **characterised in that** the movement of said pins (44, 46; 48) is realized through moving means (32; 34; 36) also able to provide the torque necessary to press the knife (14; 16; 18) against the cylindrical surface (10). 10
4. Support device (26; 28; 30) according to claim 3, **characterised in that** said pins (44, 46; 48) are mobile along the direction of said axes (A-A, B-B) parallel to each other, so as to make the support device (26; 28; 30) swinging axially with respect to the cylindrical surface (10). 15
5. Support device (26; 28; 30) according to claim 4, **characterised in that** the swinging system of said pins (44, 46; 48) is integrated into the moving means (32; 34; 36). 20
6. Support device (26; 28; 30) according to any one of claims from 3 to 5, **characterised in that** it comprises a kinematic mechanism suitable for modifying the incidence angle of the knife (14; 16; 18) on the cylindrical surface (10). 25
7. Support device (26; 28; 30) according to claim 6, **characterised in that** said kinematic mechanism is integrated into the moving means (32; 34; 36). 30
8. Support device (26; 28; 30) according to any one of claims from 1 to 7, **characterised in that** the pins (44, 46; 48) are constrained to the fixed structure (12) of the machine in a rigid manner. 35
9. Support device (26; 28; 30) according to any one of claims from 1 to 8, **characterised in that** the pins (44, 46; 48) are fixed to said support device (26; 28; 30) in an irremovable manner. 40
10. Support device (26; 28; 30) according to any one of claims from 1 to 8, **characterised in that** the pins (44, 46; 48) are fixed to said support device (26; 28; 30) in a removable manner. 45

Patentansprüche 55

1. Haltevorrichtung (26; 28; 30) für die Klinge (14; 16; 18) einer Maschine für die Herstellung von papier-

bandartigem Material des Typs, der eine zylindrische Oberfläche (10) umfasst, die sich in Bezug auf eine feste Konstruktion (12) der Maschine drehen kann, wobei die Klinge (14; 16; 18) in Kontakt mit der zylindrischen Oberfläche (10) angeordnet ist, um mit dem papierbandartigen Material zu interagieren, wobei die Haltevorrichtung (26; 28; 30) aus einem Querbalken besteht, der sich in einer im Wesentlichen zur Drehachse der zylindrischen Oberfläche (10) parallelen Richtung erstreckt und mit der festen Konstruktion (12) der Maschine verbunden ist, wobei dieser Querbalken (26; 28; 30) mit Befestigungsmitteln in Bezug auf die feste Konstruktion (12) der Maschine versehen ist, die sich entlang von mindestens zwei verschiedenen Achsen (A-A, B-B) erstrecken, die zueinander und zur Drehachse der zylindrischen Oberfläche (10) parallel sind, **dadurch gekennzeichnet, dass** jedes dieser Befestigungsmittel auf jeweilige Stützlager (50, 52) montiert ist, die starr an der festen Konstruktion (12) der Maschine befestigt sind, wobei diese Stützlager (50, 52) ein Schwingen in einer Querrichtung zur Drehachse der zylindrischen Oberfläche (10) der Befestigungsmittel verhindern, die sich entlang der verschiedenen Achsen (A-A, B-B) erstrecken, die parallel zueinander sind, wobei die Befestigungsmittel jedes Querbalkens (26; 28; 30) mit Bezug auf die feste Konstruktion (12) der Maschine aus zwei Bolzen (44, 46) für jede Seite des Querbalkens (26; 28; 30) bestehen, wobei sich diese zwei Bolzen (44, 46) jeweils entlang zweier verschiedener Achsen (A-A, B-B) erstrecken, die parallel zueinander sind.

2. Haltevorrichtung (26; 28; 30) nach Anspruch 1, **dadurch gekennzeichnet, dass** mindestens einer der Bolzen (44, 46; 48) gegenüber der festen Konstruktion (12) der Maschine beweglich ist, um den Querbalken (26; 28; 30) gegenüber der zylindrischen Oberfläche (10) zu bewegen.
3. Haltevorrichtung (26; 28; 30) nach Anspruch 2, **dadurch gekennzeichnet, dass** die Bewegung der Bolzen (44, 46; 48) durch Bewegungsmittel (32; 34; 36) ins Werk gesetzt wird, die auch das erforderliche Drehmoment bereitstellen können, um die Klinge (14; 16; 18) gegen die zylindrische Oberfläche (10) zu pressen.
4. Haltevorrichtung (26; 28; 30) nach Anspruch 3, **dadurch gekennzeichnet, dass** die Bolzen (44, 46; 48) entlang der Richtung der zueinander parallelen Achsen (A-A, B-B) beweglich sind, um die Haltevorrichtung (26; 28; 30) axial zur zylindrischen Oberfläche (10) schwingen zu lassen.
5. Haltevorrichtung (26; 28; 30) nach Anspruch 4, **dadurch gekennzeichnet, dass** das Schwingensystem der Bolzen (44, 46; 48) in die Bewegungsmittel (32;

34; 36) intégré est.

6. Haltevorrichtung (26; 28; 30) nach einem der Ansprüche von 3 bis 5, **dadurch gekennzeichnet, dass** sie einen kinematischen Mechanismus umfasst, der geeignet ist, um den Anstellwinkel der Klinge (14; 16; 18) auf der zylindrischen Oberfläche (10) zu verändern.
7. Haltevorrichtung (26; 28; 30) nach Anspruch 6, **dadurch gekennzeichnet, dass** der kinematische Mechanismus in die Bewegungsmittel (32; 34; 36) integriert ist.
8. Haltevorrichtung (26; 28; 30) nach einem der Ansprüche von 1 bis 7, **dadurch gekennzeichnet, dass** die Bolzen (44, 46; 48) starr an der festen Konstruktion (12) der Maschine befestigt sind.
9. Haltevorrichtung (26; 28; 30) nach einem der Ansprüche von 1 bis 8, **dadurch gekennzeichnet, dass** die Bolzen (44, 46; 48) unlösbar an der Haltevorrichtung (26; 28; 30) befestigt sind.
10. Haltevorrichtung (26; 28; 30) nach einem der Ansprüche von 1 bis 8, **dadurch gekennzeichnet, dass** die Bolzen (44, 46; 48) lösbar an der Haltevorrichtung (26; 28; 30) befestigt sind.

Revendications

1. Dispositif de support (26 ; 28 ; 30) pour la lame (14 ; 16 ; 18) d'une machine pour la production de matériau de type bande de papier du type comprenant une surface cylindrique (10) capable de tourner par rapport à une structure fixe (12) de la machine, ladite lame (14 ; 16 ; 18) étant placée en contact avec ladite surface cylindrique (10) pour interagir avec le matériau de type bande de papier, le dispositif de support (26 ; 28 ; 30) étant constitué par une barre transversale qui s'étend suivant une direction sensiblement parallèle à l'axe de rotation de ladite surface cylindrique (10) et qui est connectée à la structure fixe (12) de la machine, dans lequel ladite barre transversale (26 ; 28 ; 30) est munie de moyens de fixation par rapport à la structure fixe (12) de la machine qui s'étendent suivant au moins deux axes distincts (A-A, B-B), parallèles entre eux et à l'axe de rotation de ladite surface cylindrique (10), **caractérisé en ce que** chacun desdits moyens de fixation est monté sur des paliers de support respectifs (50, 52) attachés de manière fixe à la structure fixe (12) de la machine, lesdits paliers de support (50, 52) empêchant le pivotement dans une direction transversale, en référence à l'axe de rotation de ladite surface cylindrique (10), des moyens de fixation qui s'étendent suivant lesdits axes distincts (A-A, B-B) qui sont

parallèles entre eux, dans lequel lesdits moyens de fixation de chaque barre transversale (26 ; 28 ; 30) par rapport à la structure fixe (12) de la machine sont constitués par deux broches (44, 46) pour chaque côté de ladite barre transversale (26 ; 28 ; 30), lesdites deux broches (44, 46) s'étendant respectivement suivant lesdits deux axes distincts (A-A, B-B) parallèles entre eux.

2. Dispositif de support (26 ; 28 ; 30) selon la revendication 1, **caractérisé en ce qu'**au moins une desdites broches (44, 46 ; 48) est mobile par rapport à la structure fixe (12) de la machine pour déplacer la barre transversale (26 ; 28 ; 30) par rapport à la surface cylindrique (10).
3. Dispositif de support (26 ; 28 ; 30) selon la revendication 2, **caractérisé en ce que** le mouvement desdites broches (44, 46 ; 48) est réalisé par l'intermédiaire de moyens de déplacement (32 ; 34 ; 36) également capable de fournir le couple nécessaire pour presser la lame (14 ; 16 ; 18) contre la surface cylindrique (10).
4. Dispositif de support (26 ; 28 ; 30) selon la revendication 3, **caractérisé en ce que** lesdites broches (44, 46 ; 48) sont mobiles suivant la direction desdits axes (A-A, B-B) parallèles entre eux, de manière à rendre le dispositif de support (26 ; 28 ; 30) pivotant axialement par rapport à la surface cylindrique (10).
5. Dispositif de support (26 ; 28 ; 30) selon la revendication 4, **caractérisé en ce que** le système de pivotement desdites broches (44, 46 ; 48) est intégré dans les moyens de déplacement (32 ; 34 ; 36).
6. Dispositif de support (26 ; 28 ; 30) selon l'une quelconque des revendications 3 à 5, **caractérisé en ce qu'**il comprend un mécanisme cinématique adapté pour modifier l'angle d'incidence de la lame (14 ; 16 ; 18) sur la surface cylindrique (10).
7. Dispositif de support (26 ; 28 ; 30) selon la revendication 6, **caractérisé en ce que** ledit mécanisme cinématique est intégré dans les moyens de déplacement (32 ; 34 ; 36).
8. Dispositif de support (26 ; 28 ; 30) selon l'une quelconque des revendications 1 à 7, **caractérisé en ce que** les broches (44, 46 ; 48) sont assujetties à la structure fixe (12) de la machine d'une manière rigide.
9. Dispositif de support (26 ; 28 ; 30) selon l'une quelconque des revendications 1 à 8, **caractérisé en ce que** les broches (44, 46 ; 48) sont fixées audit dispositif de support (26 ; 28 ; 30) d'une manière inamovible.

10. Dispositif de support (26 ; 28 ; 30) selon l'une quelconque des revendications 1 à 8, **caractérisé en ce que** les broches (44, 46 ; 48) sont fixées audit dispositif de support (26 ; 28 ; 30) d'une manière amovible.

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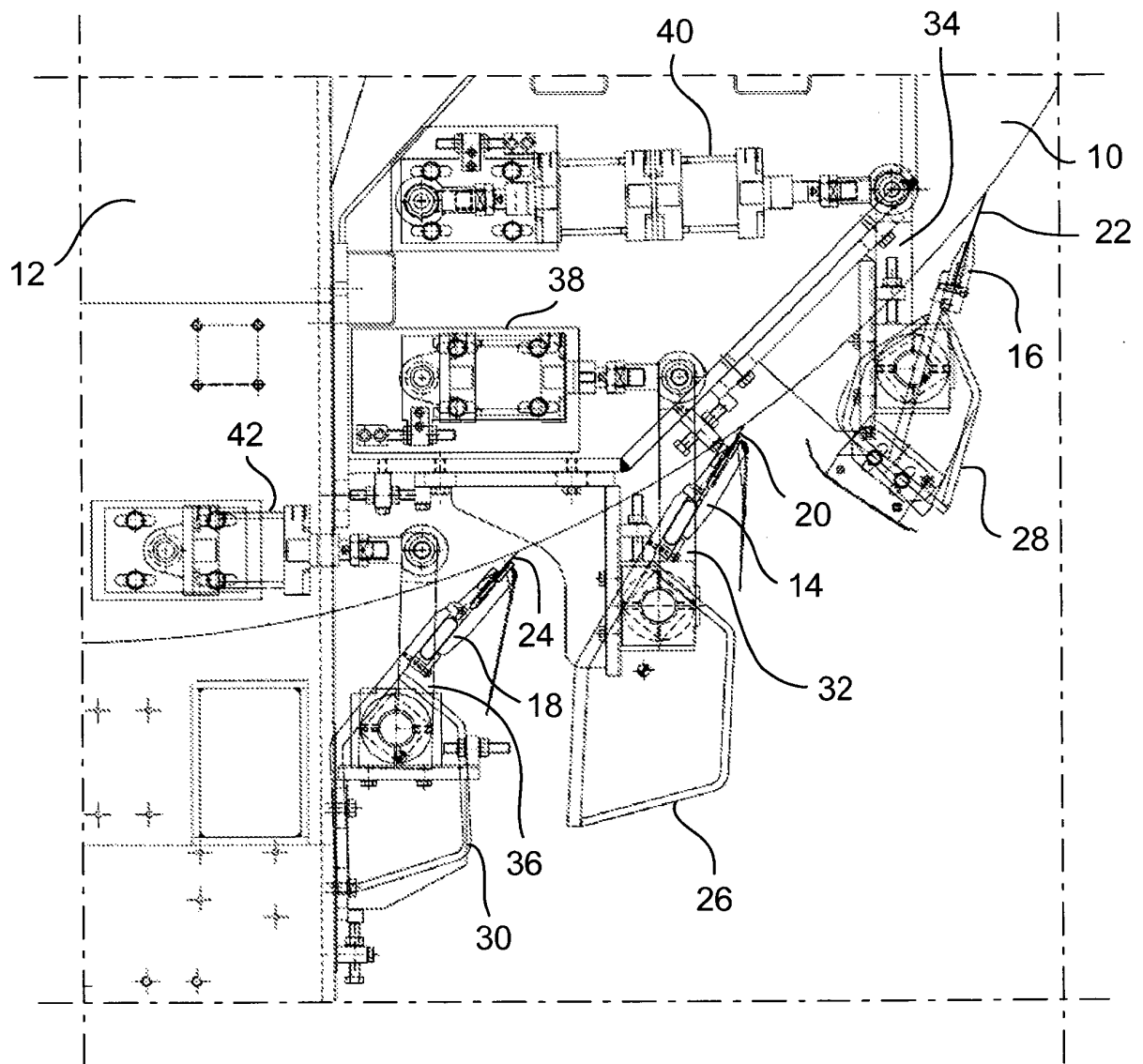


Fig. 1

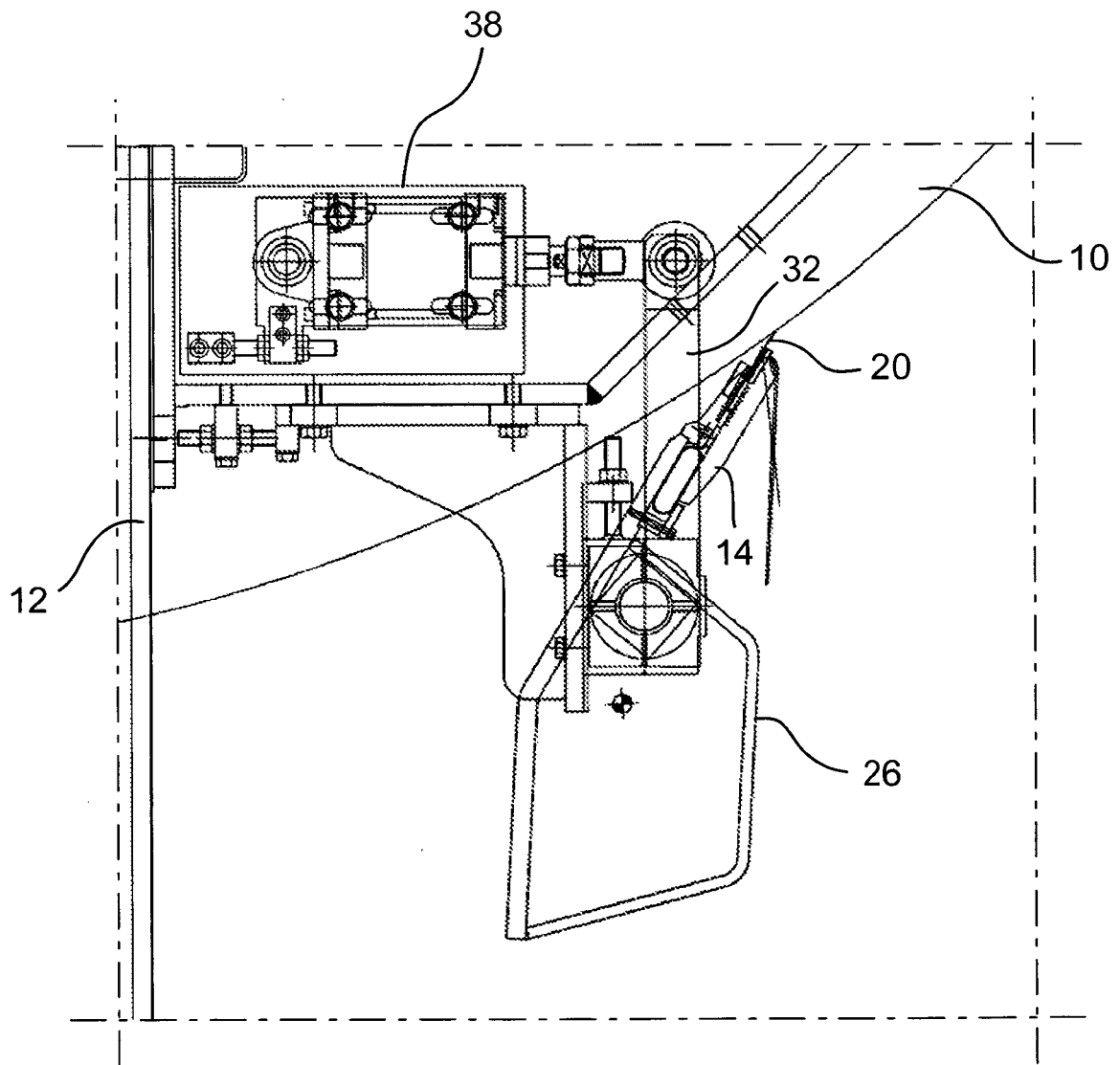


Fig. 2

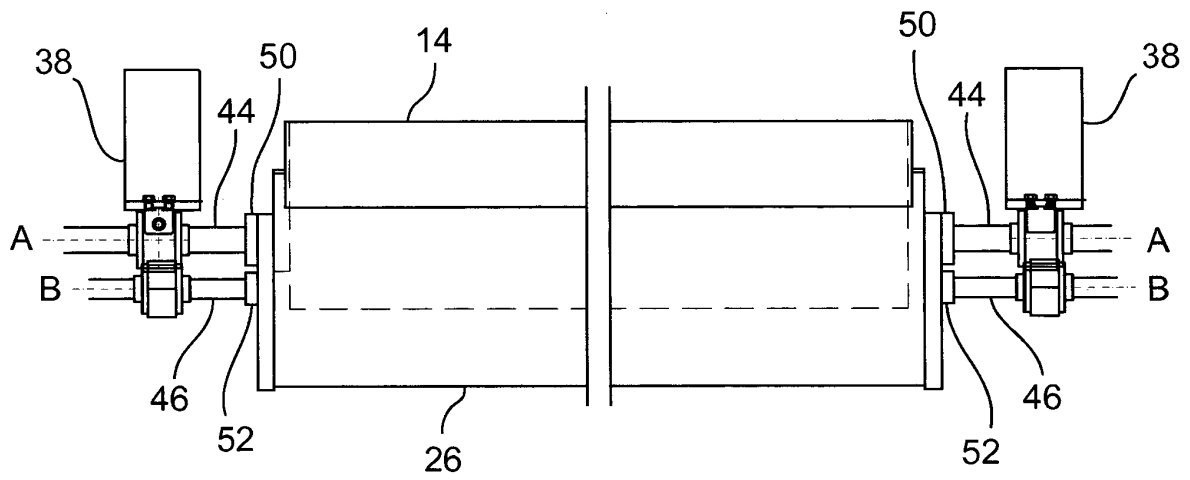


Fig. 3

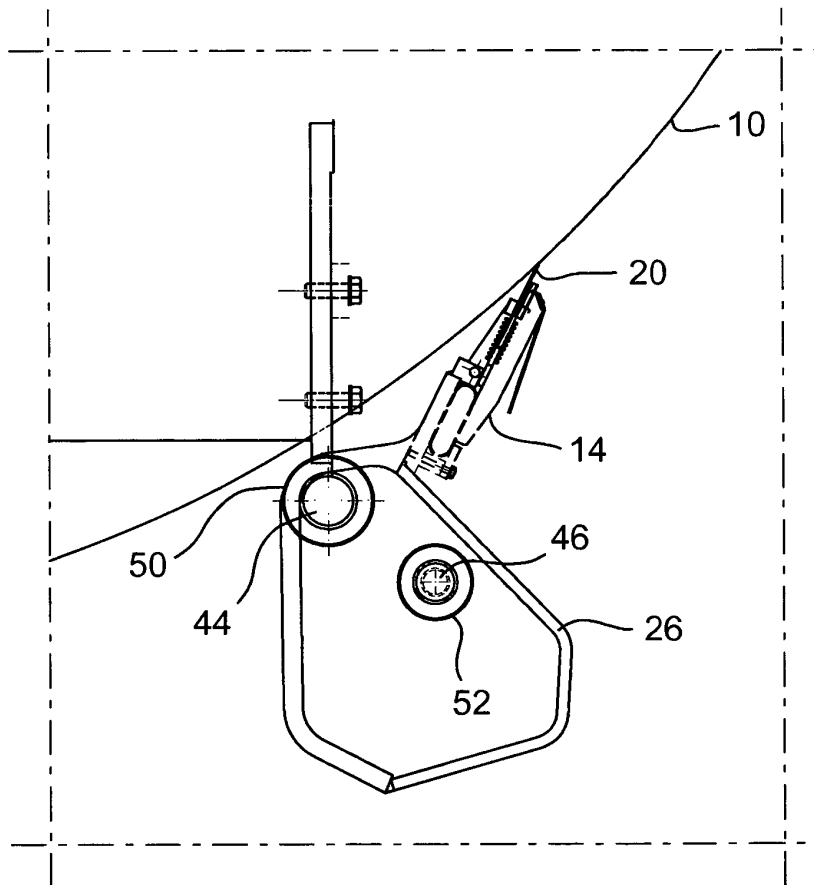


Fig. 4

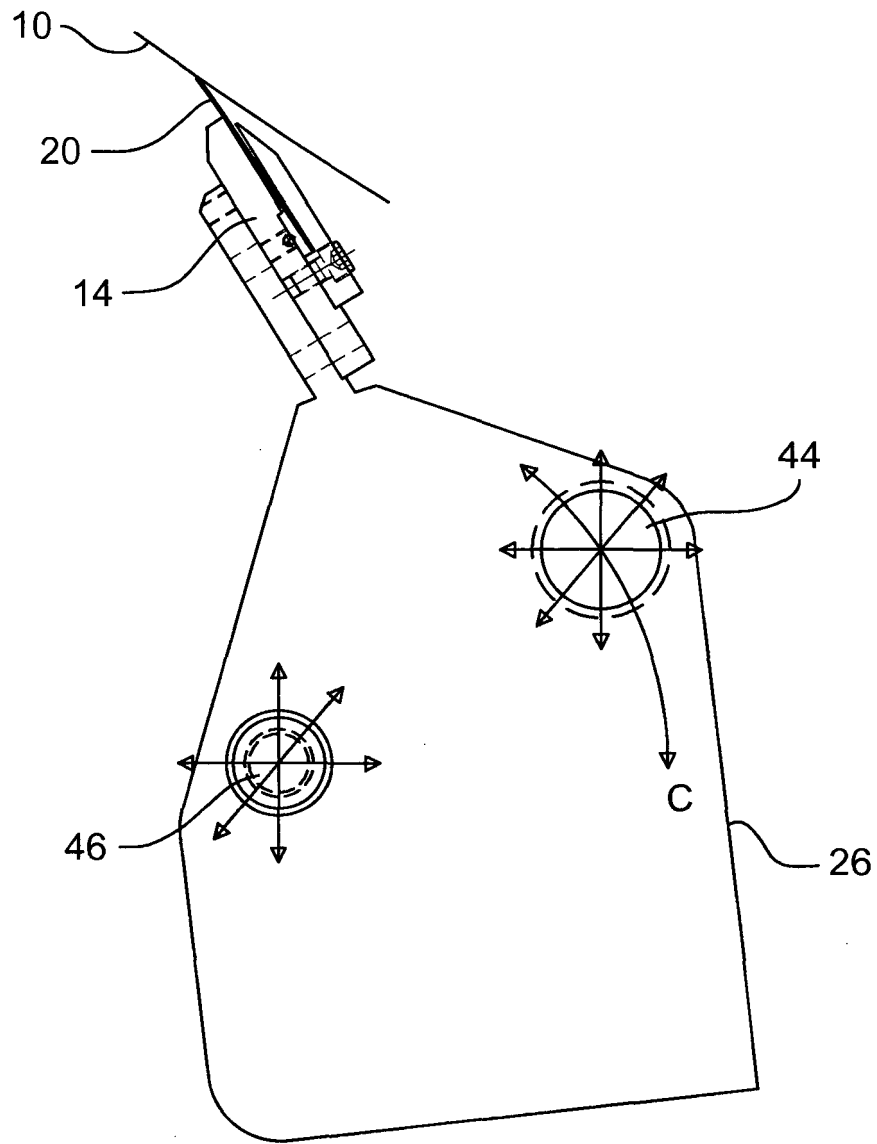


Fig. 5

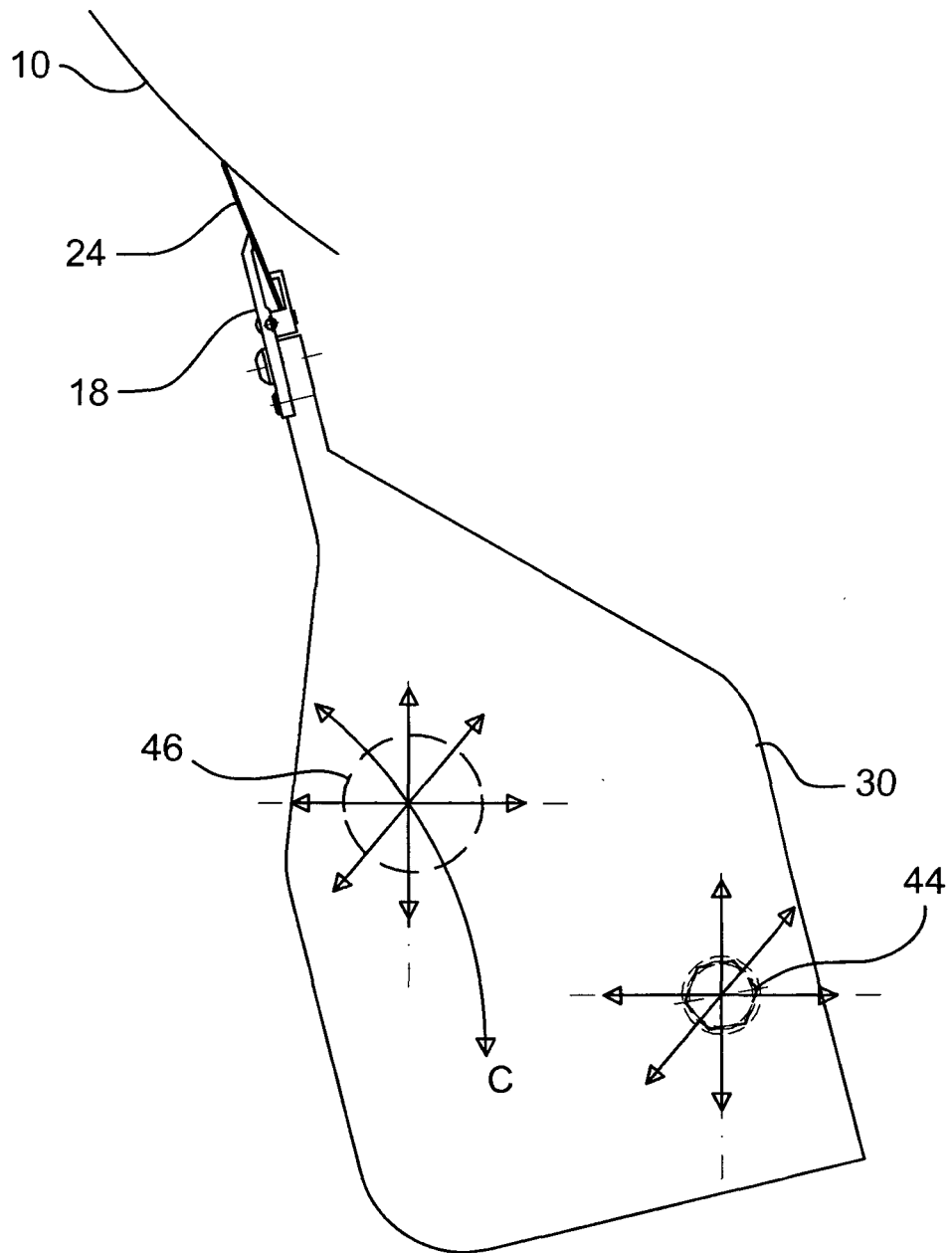


Fig. 6

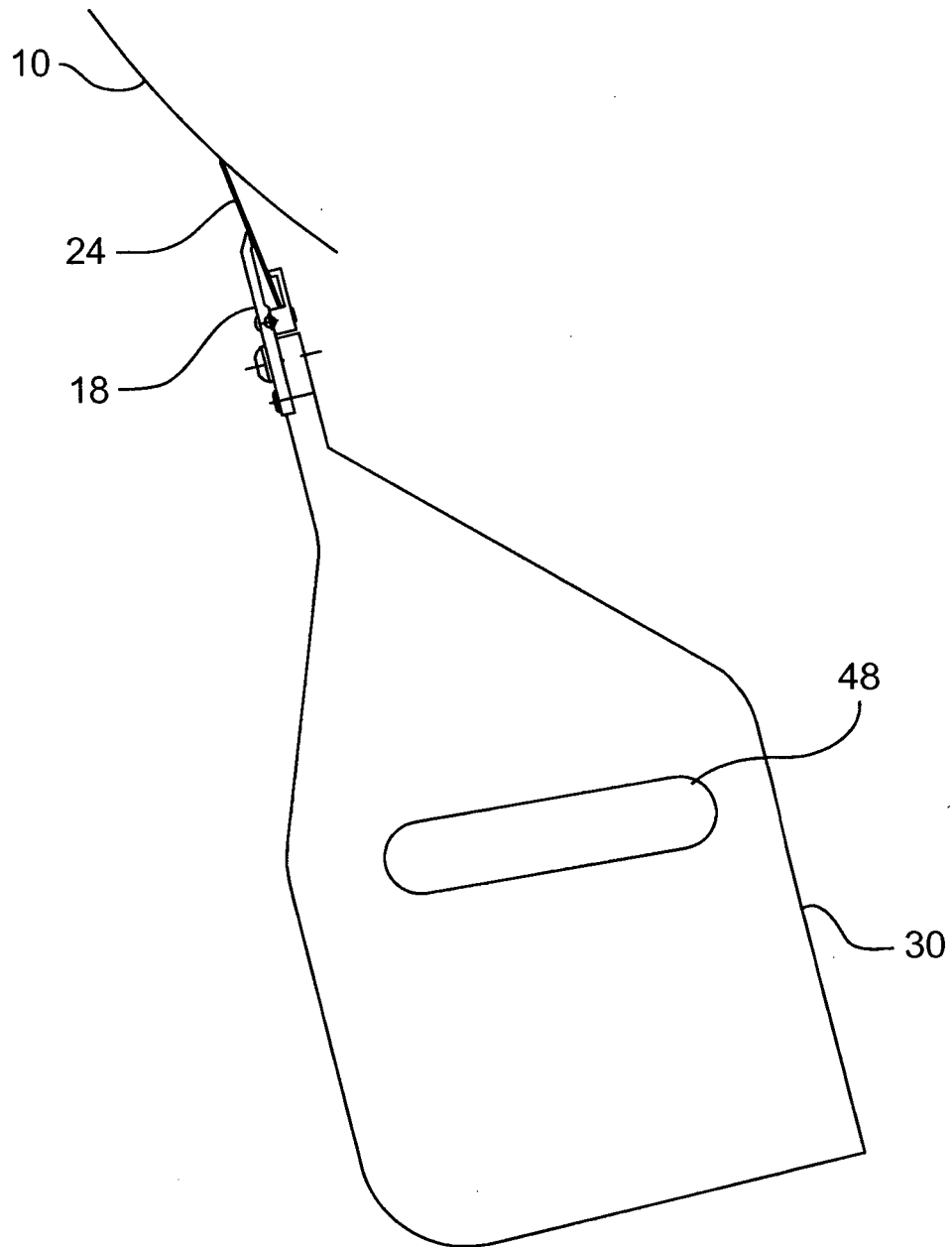


Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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