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(54) **APPARATUS FOR A WEB FORMING MACHINE**

VORRICHTUNG FÜR EINE BAHNBILDUNGSMASCHINE

APPAREIL POUR UNE MACHINE DE FORMATION DE NAPPES

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**EP-A1- 1 696 075 WO-A1-00/44981
WO-A1-2004/067839 DE-A1-102004 014 777
DE-A1-102006 033 942 FI-B1- 114 328
FI-B1- 114 557 JP-A- 2000 265 387
US-A- 5 791 067 US-A1- 2007 129 653**

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- Frank Daerden, Dirk Lefeber: "Pneumatic Artificial Muscles: actuators for robotics and automation", , 17 August 2007 (2007-08-17), XP002710290, Retrieved from the Internet: URL: http://web.archive.org/web/20061209064307/http://lucy.vub.ac.be/publications/Daerden_Lefeber_EJMEE.pdf [retrieved on 2013-08-06]
- DAERDEN F., LEFEBER D.: 'Pneumatic artificial muscles:actuators for robotics and automation' VRIJE UNIVERSITEIT BRUSSEL, DEPARTMENT OF MECHANICAL ENGINEERING, [Online] 23 January 2005, XP008130190 Retrieved from the Internet: <URL:http://lucy.vub.ac.be/publications/daerden_lefeber_ejmee.pdf, http://web.archive.org/web/*/http://lucy.vub.ac.be/publications/daerden_lefeber_ejmee.pdf>

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Description

[0001] The invention relates to an apparatus for a web forming machine the apparatus being doctor equipment adapted at both of its ends to the web forming machine with support means and the doctor equipment including a composite blade holder to which the support means are connected, like it is known from WO 00/44981.

[0002] An apparatus according to the preamble is, for example, doctor equipment with a simple construction which is loaded against the surface to be doctored by gravity. As manufactured by the applicant, such doctor equipment is marketed under the product name FiberDoc Lite. The blade holder included in the doctor equipment has a composite construction with overhanging shafts adapted to both of its ends. Bearing assemblies adapted to the overhanging shafts are attached to a web forming machine. Finally, a weight is attached to the overhanging shaft to provide loading by gravity.

[0003] Regardless of its several advantages, the proposed doctor equipment is suitable only to relatively narrow web forming machines. Furthermore, despite the weight, the generated blade pressure may turn out to be insufficient. On the other hand, even the smallest weights require a large installation space and collect loose matter on top of them. Consequently, the load of the doctor equipment changes during use. Basically, the load can also be increased, but it requires modifications in the construction or at least in the components of the doctor equipment. Due to gravity loading, the doctor equipment must also be set in a certain position, which restricts the application of the doctor equipment.

[0004] Doctor apparatuses also exist in which the blade holder is supported to a specific doctor beam. In this case the doctor beam is supported turnably by its ends to a web forming machine. For loading the doctor equipment, pneumatic cylinders are used, which are adapted between the web forming machine and the doctor beam.

[0005] With pneumatic cylinders, a sufficient blade pressure is most often achieved and loading can even be adjusted. In addition, the doctor beam can be turned to the maintenance position. However, pneumatic cylinders require a large installation space. In addition, the movements of pneumatic cylinders are often too fast and sudden. On the other hand, in the long-term use a pneumatic cylinder as if gets stuck in place. However, due to wear of the doctor blade during use, the doctor beam tends to turn slowly. In addition, the static friction of a stuck pneumatic cylinder is remarkable. As the static friction changes back to the kinetic friction, the piston of the pneumatic cylinder jerks forward, which produces disadvantageous load peaks to the doctor equipment and the surface to be doctored.

[0006] The object of the invention is to provide a novel apparatus for a web forming machine being more versatile than heretofore, yet simpler, and avoiding the prior art problems. The characteristic features of this invention

are that the actuator of the apparatus includes one pneumatic muscle. Thus the actuator becomes small-sized. Despite a compact construction, great forces are achieved with the actuator. In addition, the pneumatic muscle is reliable and withstands in demanding conditions, too. Furthermore, the pneumatic muscle has high sensitivity, which is significant particularly in small movements. In addition, the muscle lacks the so called slip-stick phenomenon, also called stick-slip phenomenon. The actuator can be applied in connection with different apparatuses of a web forming machine. For example, even simple doctor equipment can be easily made loadable.

[0007] The invention is described below in detail by making reference to the enclosed drawings, which illustrate some of the embodiments of the invention, in which

- Figure 1 shows a first embodiment of the doctor equipment according to the invention seen diagonally from behind,
- Figure 2 shows a second embodiment of the doctor equipment according to the invention seen diagonally from behind,
- Figure 3 shows a third embodiment of the doctor equipment according to the invention seen from the side,
- Figure 4 shows a fourth embodiment of the doctor equipment according to the invention with various components disassembled, and
- Figure 5 shows one example of an apparatus according to the invention for a web forming machine,
- Figure 6a shows doctor equipment according to the invention,
- Figure 6b shows the back side end of the doctor of Figure 6a,
- Figure 6c shows the front side end of the doctor of Figure 6a,
- Figure 7 is a cross-sectional view of an actuator according to the invention.

[0008] Figures 1 - 4 illustrate various doctor apparatuses according to the invention for a web forming machine. Web forming machines include paper and board machines as well as other corresponding machines. Doctor equipment is usually adapted at both of its ends to the web forming machine with support means (not shown). Supporting is often accomplished with bearing assemblies which are fastened to the frame of the web forming machine. An essential part of doctor equipment is also a blade holder which is used, as the name implies, to hold and support a doctor blade or other corresponding blade in the doctor equipment. A doctor blade is used, for example, to detach a paper web from a roll surface or to otherwise keep clean the surface of a roll or other moving element by doctoring. Doctor blades are used in coating apparatuses as well.

[0009] According to the invention, the apparatus in-

cludes an actuator 12 including at least one pneumatic muscle 13. In addition, the pneumatic muscle 13 is adapted in relation to either of the two ends of the doctor equipment and the actuator 12 is adapted to load and open the doctor equipment. This solution is compact and the pneumatic muscle is simple and reliable. The actuator 12 thus includes at least one pneumatic muscle 13. By using a certain type of pneumatic component, many problems are avoided and the actuator becomes small-sized. In the doctor application the actuator 12 is arranged between support means 10 and a blade holder 11. Due to the actuator, the blade holder can now be loaded and loading can additionally be adjusted. Opening the doctor equipment is also possible now. 'Opening' refers to turning the blade holder from the operating position to the maintenance position for the duration of cleaning and blade replacement, for example. Specifically, with the pneumatic muscle several advantages are achieved, which are illustrated in connection with the application examples. In the first embodiment shown in Figure 1, one pneumatic muscle 13 is used, which is basically a single-acting cylinder. However, the pneumatic muscle lacks a conventional piston and piston rod. In this case the kinetic friction is missing almost entirely, the operation of the muscle being thereby smooth without harmful sticking or jerking.

[0010] In Figure 1, a roll 14 and doctor equipment adapted in relation thereto are shown only partially. The surface of the roll 14 is doctored with a doctor blade 15, which is adapted to a composite blade holder 11. Attached to the blade holder there is additionally an overhanging shaft 16, which extends to support means 10 that allow the blade holder 11 to turn. Here a mounting casing 17 included in the actuator 12 is integrated as a part of the support means 10. The construction is very compact and can be easily fastened to the blade holder. The support means 10 are provided with a mounting flange 18 with holes 19 by means of which the doctor equipment is fastened to a web forming machine. Depending on the construction, the mounting casing is unmovably connected to either the blade holder or the support means. In Figure 1 the mounting casing 17 is thus unmovably fastened to the support means 10. The fastening of the pneumatic muscle can also vary. Generally, the first end 20 of the pneumatic muscle 13 is fastened to the mounting casing 17 while the second end 21 is fastened to the blade holder 11 or the support means 10 which are freely adapted relative to the mounting casing 17. In Figure 1, the second end 21 of the muscle 13 is fastened to a drive circle 22 adapted to the blade holder 11. In this case the pneumatic muscle expands upon pressurization whereas the length correspondingly shortens. Consequently, the blade holder 11 turns downwards and the doctor blade 15 is loaded against the surface of the roll 14. Upon releasing the pressure, the pneumatic muscle returns to the initial condition, whereby the doctor blade load is removed. The actuator can also be so adapted that upon releasing the pressure the doctor blade de-

taches from the surface to be doctored. Due to the round drive circle equipped with fastening holes located at regular intervals, the blade holder can be positioned freely relative to the support means. Support means of one type can then be used in different positions and in connection with different blade holders. Support means equipped with an actuator can also be retrofitted to existing doctor apparatuses.

[0011] Figure 2 shows a second embodiment of the doctor equipment according to the invention. Here, too, a composite blade holder 11 known as such is applied. Instead, the actuator 12 and the mounting casing 17 surrounding it are placed between the blade holder 11 and a bearing 23 included in the support means 10. In addition, in the second embodiment, besides the one pneumatic muscle 13, the actuator includes a second pneumatic muscle 24.

[0012] In this case it is possible to precisely control the doctor blade load by adjusting appropriately the muscle pressures. In Figure 2, the first ends of both muscles 13 and 24 are fastened to a mounting casing 17. Correspondingly, the second ends are fastened to a drive circle 22, on different sides of an overhanging shaft 16. Then the lower pneumatic muscle 13 is mainly for loading. Correspondingly, the upper pneumatic muscle 24 is for opening the doctor equipment and it can also be used to generate a counter-pressure for the muscle to be loaded. The muscles are here similar to each other. On the other hand, the muscles can be different for their characteristics, if required.

[0013] Figure 3 is a basic view of a third embodiment of the doctor equipment according to the invention. As to its basic design and operation, this resembles the embodiment of Figure 2. Here, too, a pneumatic muscle 13 adapted to a mounting casing 17 is used to load the doctor equipment. In Figure 3, the pneumatic muscle 13 is pressurized and it is therefore slightly inflated. To provide a counter-force and to open the doctor equipment, besides the one pneumatic muscle 13 the actuator includes a spring element 25. The use of a spring element simplifies the construction of the actuator and by substituting the spring element, the characteristics of the actuator can be adjusted in a simple way. Generally, the spring element 25 and the second pneumatic muscle 24 are fastened in a corresponding way as the first pneumatic muscle 13. If required, the fastening points of the components can be changed, which allows fine-tuning the operation of the doctor equipment. An overhanging shaft 16 extends through a drive circle 22 and a mounting casing 17. The drive circle 22 is additionally tied to a blade holder 11 with clips 26, whereby the force generated by the actuator 12 is conveyed from the drive circle to the blade holder 11. In the embodiments shown, a presser blade 27 is additionally used in connection with the doctor blade 15.

[0014] When substituting known weights with an actuator according to the invention, it is often sufficient that the actuator is installed only in relation to one end of the doctor equipment. On the other hand, the actuator is eas-

ily adaptable also to both ends of the doctor equipment providing thereby uniform and, when required, also high loading. With a suitable dimensioning and design of the actuator and the drive circle, an actuator of one single type can be positioned relative to either one of the ends of the doctor equipment.

[0015] A fourth embodiment of the doctor equipment according to the invention is shown in Figure 4. Here, adapted between the actuator 12 and the blade holder 11 there is a support construction 28 which extends over the entire length of the doctor equipment. In this case, a small-sized blade holder can be used as a beam-like support construction supports the main part of the doctor equipment load. Disposed at the left-hand side end there is a bearing assembly 29 allowing the support construction 28 to turn. An actuator 12 according to the invention is adapted between the end component 30 of the support construction 28 and support means 10, at the right-hand side end of the support construction 28. In the embodiment of Figure 4, two mutually symmetrical profile components 31 are meant to be connected to each other by gluing. In addition, several narrow support components 32 are used to fasten the blade holder 11 thereto. In this case, metal blade holders can even be used in the beam-like composite support construction 28 without problems due to heat expansion differences. In addition, the support components 32 are adapted to settle in a recess 33 formed between the profile components 31. For supporting to a web forming machine, the support construction 28 also includes end components 30 adapted to both ends. The shape of the end component corresponds substantially to the support construction 28 formed from the profile components 31 and it extends at least partially into the support construction 28. Firstly, the end component 30 closes the open construction and, on the other hand, the portion extending inside solidifies the end of the support construction 28. Functionally similar parts are referred to using identical reference numbers.

[0016] During tests performed to a doctor equipment application it has turned out, for example, that as a doctor blade in a conventional blade holder wears for the designed 20 mm, the tip of the doctor blade moves for about 30 mm when the blade holder turns. In this blade holder the distance between the doctor blade tip and the center of the overhanging shaft was about 240 mm. In addition, the fastening point of the pneumatic muscle had been adapted to a distance of 50 mm from the overhanging shaft. Thus this turning caused a shortening of about 1 mm in the muscle. Consequently, the required movement distances are short in which case short pneumatic muscles can be used as well. According to the invention, the unloaded length of the pneumatic muscle 13, 24 is 50 - 500 mm, more advantageously 100 - 300 mm. Thus the actuator becomes advantageously small-sized. Depending mainly on the muscle length and other dimensions, the length of the achievable axial movement is 1 - 50 mm. The same objective is supported by the fact that the unloaded diameter of the pneumatic muscle 13, 24 is 10

- 50, more advantageously 20 - 40 mm. Regardless of its small size, a slow and accurate movement is achieved with the pneumatic muscle. At the same time, forces are generated which are more than ten-fold compared to a conventional pneumatic cylinder of a corresponding size. With muscles having a diameter of 10 - 40 mm, forces of 600 - 6000 N are generated with the maximum length being several meters. In addition, the muscle provides a slow, jerkless movement. The lowest movement speeds are 0,001 mm/s. On the other hand, high accelerations, up to 100 m/s², can be achieved when required. Furthermore, the change of state from unloaded to loaded can take place at such a high frequency as 100 Hz. Normally the pressure applied is 1 - 8 bar and the air consumption is low, particularly in static loading.

[0017] The pneumatic muscle utilizes material deformation and resilience to provide linear movement. (http://en.wikipedia.org/wiki/Pneumatic_artificial_muscles; Pneumatic Artificial Muscles ie. PAMs; 11.09.2007). The basic principle is to cover a flexible hose with a rhombic fabric made of rigid fibers whereby a three-dimensional network pattern is formed. When pressurized air is led to the muscle, the hose expands and the shape of the network pattern changes. In this way an axial force is generated and the muscle shortens at the same time. Upon releasing the pressure, the network pattern returns to its original shape and the muscle lengthens to its previous dimension. The muscle is also very lightweight and completely hermetically sealed. The muscle is at the same time efficient and fast, but slow movements are also possible, on the other hand. The muscle is accurately controllable and, in addition, sticking and sliding can have been eliminated. That is, the stick-slip phenomenon can be avoided. (http://en.wikipedia.org/wiki/Stick_slip_Phenomenon; 11.09.2007). The length of the muscle remains in this way precisely as desired even for long times and the length changes are smooth. Instead of pneumatics, it is possible to utilize hydraulics, such as water hydraulics.

[0018] Besides in connection with doctor equipment, a pneumatic muscle can be applied in a web forming machine in other positions as well. A muscle-based actuator can be used, for example, for shaking a fabric or oscillating a doctor. A muscle can also be used for implementing various precision adjustments of the head-box. In addition, by placing the muscle in a curve guide pipe, the force of the muscle can be conveyed around a corner. Regardless of the application, the actuator is small-sized and maintenance-free. Either slow or fast movements are provided as required the forces being in both cases high relative to the size of the actuator. In addition, the muscle is easily and precisely controllable with reduced air consumption.

[0019] Figure 5 shows one apparatus according to the invention for a web forming machine. This apparatus is a fabric shaker in which an actuator 12 is used to operate a control element 34. The control element 34 is used to change the phase difference of eccentric masses 35 to

provide a vibrating movement. This fabric shaker is described in more detail in the European patent No. 1694910 of the applicant. Deviating from Figure 5, a small muscle can even be installed inside a control element or another construction.

[0020] Figure 6a shows a fifth embodiment of the doctor equipment according to the invention. Here, too, the doctor equipment is adapted at both of its ends to a web forming machine with support means 10. In addition, the doctor equipment includes a composite blade holder 11 to which the support means 10 are connected. The composite blade holder forms the construction supporting the doctor blade 15. In other words, a separate doctor beam is not necessary. In this invention, the term 'composite' is used to refer to a construction made of a fiber-reinforced polymeric material. In practice, the blade holder is manufactured as continuous and thus seamless by means of pultrusion. At the end of a suitably dimensioned blade holder, only simple bearings 23 are installed which are fastened to the web forming machine with support means 10. In Figures 6a - 6c the support constructions 10 are composed of simple plate constructions whereby the doctor equipment can be set in a correct location and position relative to the roll 14. In Figure 6a the roll is a fabric return roll.

[0021] In the embodiment of Figures 6a - 6c, between the support means 10 related to the two ends of the doctor equipment, there is arranged a collection chute 36 with which the material detaching from the surface of the roll 14 during doctoring can be controllably recovered. A discharge connection 37 is additionally disposed at the back side end of the collection chute 36. In this case the material can be taken out of the doctor equipment by washing with the cleaning water, for example. Shown particularly in Figures 6a and 6c there is a drive circle 22, to which the actuator 12 is fastened, arranged in the blade holder 11 and including several fastening points. Depending on the position, a suitable fastening point can be selected, which diversifies the application of the doctor equipment. By the selection of the fastening point and the characteristics of the actuator, it is also possible to influence the opening angle of the blade holder. Regardless of a short and compact actuator, a construction according to the invention can easily provide an opening angle α of 10 - 25°, more advantageously 15 - 20°, for the blade holder 11. The opening angle α is illustrated for example in Figure 3.

[0022] With a pneumatic muscle, additional advantage is further achieved due to its pull effect, since a conventional cylinder pushes. Tensile stress balances loads and the doctor blade load remains uniform. In the embodiment of Figure 7, a single pneumatic muscle 13 is used with a spring element 25 adapted around it. In the embodiment shown the pneumatic muscle 13 thus loads the doctor equipment. Deviating from the above, the spring element 25 is a compression spring. Thus, upon releasing the pressure from the pneumatic muscle 13, the compression spring opens the doctor equipment. The mount-

ing casing is additionally substituted with bellows 39. This actuator is very durable and maintenance-free and it can be integrally fastened to support means. The flexible construction of the actuator allows for installation errors due to its adaptability.

Claims

1. Apparatus for a web forming machine, the apparatus being doctor equipment adapted at both of its ends to a web forming machine with support means (10) and including a composite blade holder (11) to which the support means (10) are connected, the doctor equipment including an actuator (12) which is adapted to load and open the doctor equipment, **characterized** in the actuator (12) including at least one pneumatic muscle (13) which is adapted in connection with one of the two ends of the doctor equipment.
2. Apparatus according to claim 1, **characterized in that** the actuator (12) includes two or more pneumatic muscles (13), and/or **in that** the actuator (12) is arranged between the support means (10) and the blade holder (11).
3. Apparatus according to claim 1 or 2, **characterized in that**, in addition to the one pneumatic muscle (13), the actuator includes another pneumatic muscle (24).
4. Apparatus according to claim 1 or 2, **characterized in that**, in addition to the one pneumatic muscle (13), the actuator includes a spring element (25).
5. Apparatus according to claim 4, **characterized in that** the spring element (25) is adapted around the pneumatic muscle (13).
6. Apparatus according to any of claims 1 to 5, **characterized in that** an actuator (12) is adapted in connection with both ends of the doctor equipment.
7. Apparatus according to any of claims 1 to 5, **characterized in that** the actuator (12) includes a mounting casing (17) which is unmovably connected to either the blade holder (11) or the support means (10).
8. Apparatus according to claim 7, **characterized in that** the first end (20) of the pneumatic muscle (13) is fastened to the mounting casing (17) with the second end (21) being fastened to the blade holder (11) or support means (10) which are adapted freely relative to the mounting casing (17).
9. Apparatus according to claim 3 or 4, **characterized in that** the spring element (25) and the second pneumatic muscle (24) are fastened in a corresponding

way as the first pneumatic muscle (13).

10. Apparatus according to any of claims 1 to 9, **characterized in that** the unloaded diameter of the pneumatic muscle (13, 24) is 10 - 50 mm, more advantageously 20 - 40 mm.
11. Apparatus according to any of claims 1 to 10, **characterized in that** the unloaded length of the pneumatic muscle (13, 24) is 50 - 500 mm, more advantageously 100 - 300 mm.
12. Apparatus according to any of claims 1 to 11, **characterized in that** adapted between the actuator (12) and the blade holder (11) there is a support construction (28) extending over the entire length of the doctor equipment.
13. Apparatus according to any of claims 1 to 12, **characterized in that** a collection chute (36) is arranged between the support means (10) at the different ends of the doctor equipment.
14. Apparatus according to any of claims 1 to 13, **characterized in that** arranged in the blade holder (11) there is a drive circle (22) with several attachment points (38) to which the actuator (12) is fastened.
15. Apparatus according to any of claims 1 to 14, **characterized in that** the opening angle α of the blade holder (11) is 10 - 25°, more advantageously 15 - 20°.

Patentansprüche

1. Vorrichtung für eine Bahnbildungsmaschine, wobei die Vorrichtung ein Abstreifgerät ist, das an seinen beiden Enden zu einer Bahnbildungsmaschine mit Stützeinrichtungen (10) angepasst ist, und einen Verbundmesserhalter (11) umfasst, an dem die Stützeinrichtungen (10) verbunden sind, wobei das Abstreifgerät, das einen Antrieb (12) umfasst, der angepasst ist, das Abstreifgerät zu belasten und zu öffnen, **dadurch gekennzeichnet ist, dass** der Antrieb (12) mindestens einen pneumatischen Muskel (13) umfasst, der in Verbindung mit einem von den zwei Enden des Abstreifgeräts angepasst ist.
2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** der Antrieb (12) zwei oder mehr pneumatische Muskeln (13) umfasst und/oder dass der Antrieb (12) zwischen den Stützeinrichtungen (10) und dem Messerhalter (11) angeordnet ist.
3. Vorrichtung nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** zusätzlich zu dem einen pneumatischen Muskel (13) der Antrieb einen anderen pneumatischen Muskel (24) umfasst.

4. Vorrichtung nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** zusätzlich zu dem einen pneumatischen Muskel (13) der Antrieb ein Federelement (25) umfasst.
5. Vorrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** das Federelement (25) um den pneumatischen Muskel (13) angepasst ist.
6. Vorrichtung nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** ein Antrieb (12) in Verbindung mit beiden Enden des Abstreifgeräts angepasst ist.
7. Vorrichtung nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** der Antrieb (12) eine Montagehülle (17) umfasst, die unbeweglich mit entweder dem Messerhalter (11) oder den Stützeinrichtungen (10) verbunden ist.
8. Vorrichtung nach Anspruch 7, **dadurch gekennzeichnet, dass** das erste Ende (20) des pneumatischen Muskels (13) an der Montagehülle (17) befestigt ist, wobei das zweite Ende (21) an den Messerhalter (11) oder den Stützeinrichtungen (10) befestigt ist, die relativ zu der Montagehülle (17) frei angepasst sind.
9. Vorrichtung nach Anspruch 3 oder 4, **dadurch gekennzeichnet, dass** das Federelement (25) und der zweite pneumatische Muskel (24) auf eine entsprechende Weise wie der erste pneumatische Muskel (13) befestigt sind.
10. Vorrichtung nach einem der Ansprüche 1 bis 9, **dadurch gekennzeichnet, dass** der unbelastete Durchmesser des pneumatischen Muskels (13, 24) 10 bis 50 mm ist, vorzugsweise 20 bis 40 mm.
11. Vorrichtung nach einem der Ansprüche 1 bis 10, **dadurch gekennzeichnet, dass** die unbelastete Länge des pneumatischen Muskels (13, 24) 50 bis 500 mm ist, vorzugsweise 100 bis 300 mm.
12. Vorrichtung nach einem der Ansprüche 1 bis 11, **dadurch gekennzeichnet, dass** es zwischen dem Antrieb (12) und dem Messerhalter (11) angepasst eine Stützkonstruktion (28) gibt, die sich über die gesamte Länge des Abstreifgeräts erstreckt.
13. Vorrichtung nach einem der Ansprüche 1 bis 12, **dadurch gekennzeichnet, dass** eine Sammelrinne (36) zwischen den Stützeinheiten (10) an den verschiedenen Enden des Abstreifgeräts angeordnet ist.
14. Vorrichtung nach einem der Ansprüche 1 bis 13, **dadurch gekennzeichnet, dass** es in dem Messer-

halter (11) angeordnet einen Antriebskreis (22) mit einigen Anbringpunkten (38) gibt, an denen der Antrieb (12) befestigt ist.

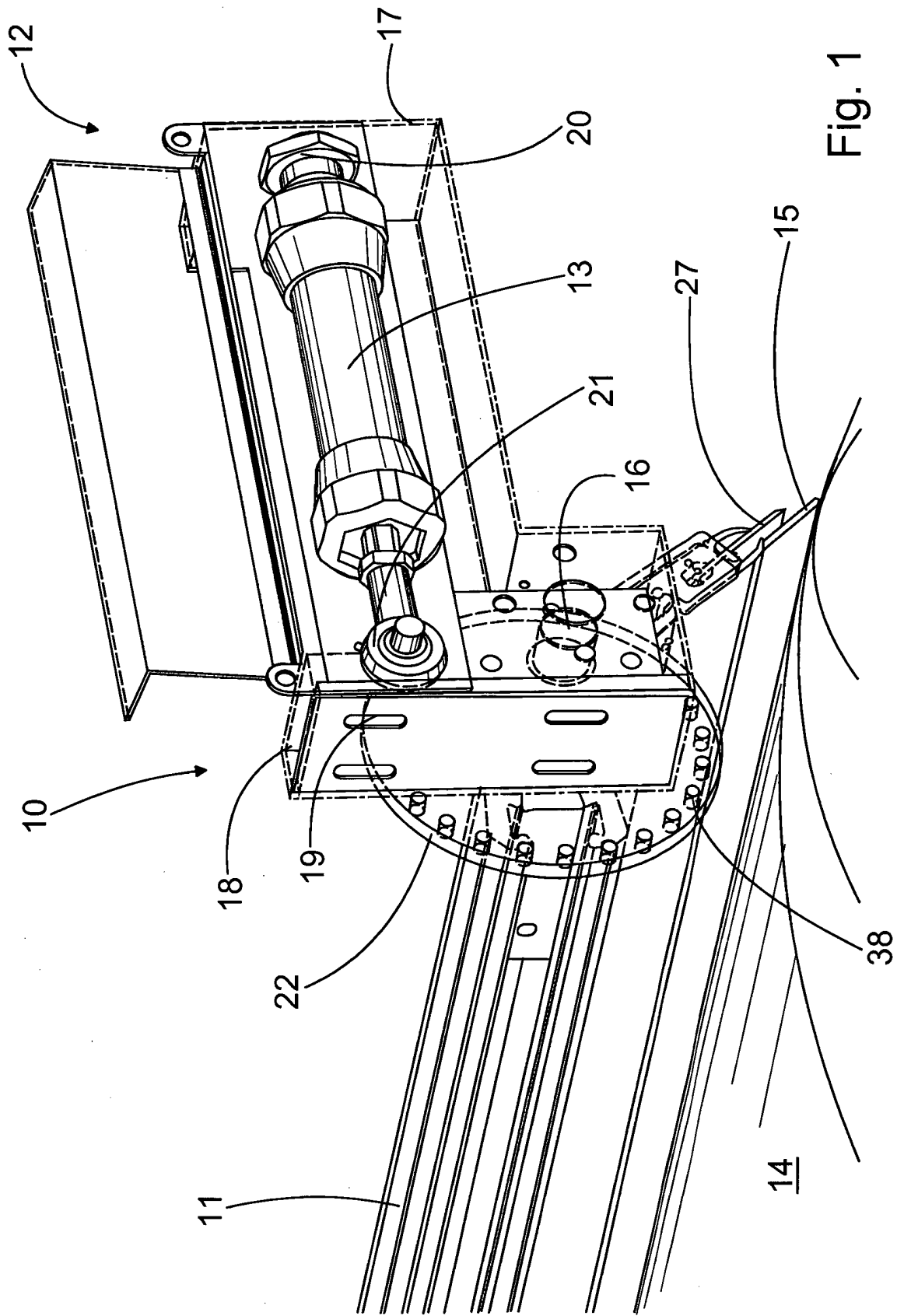
15. Vorrichtung nach einem der Ansprüche 1 bis 14, **dadurch gekennzeichnet, dass** der Öffnungswinkel α des Messerhalters (11) 10 bis 25° ist, vorzugsweise 15 bis 20°.

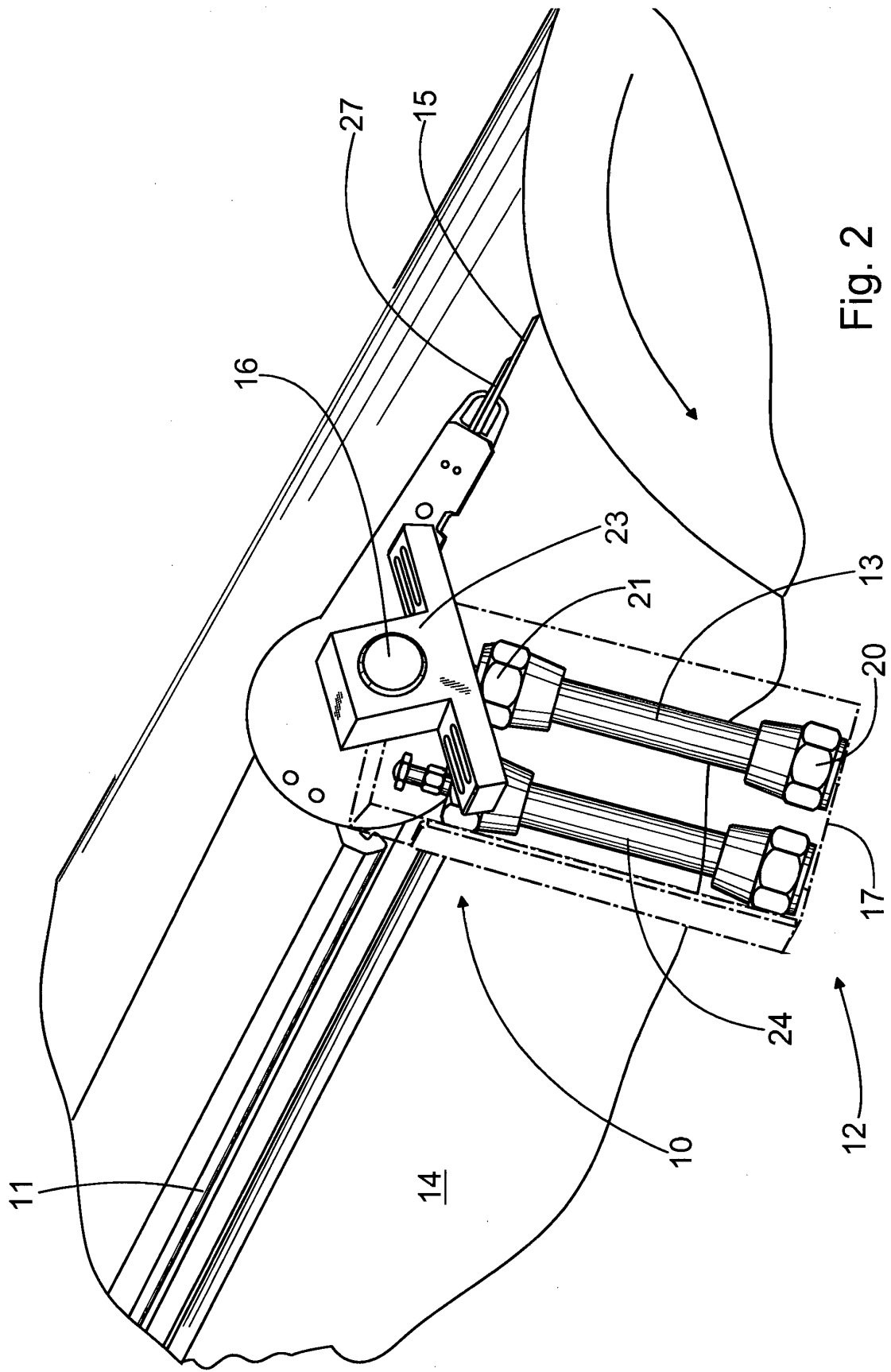
Revendications

1. Appareil pour une machine de formation de bande, l'appareil étant un équipement à docteur adapté au niveau de ses deux extrémités à une machine de formation de bande par des moyens de support (10) et comportant un support de racle composite (11) auquel les moyens de support (10) sont reliés, l'équipement à docteur comportant un actionneur (12) qui est adapté pour charger et ouvrir l'équipement à docteur, **caractérisé en ce que** l'actionneur (12) comportant au moins un muscle pneumatique (13) qui est adapté pour être relié à l'une des deux extrémités de l'équipement à docteur.
2. Appareil selon la revendication 1, **caractérisé en ce que** l'actionneur (12) comporte deux ou plusieurs muscles pneumatiques (13), et/ou **en ce que** l'actionneur (12) est agencé entre les moyens de support (10) et le support de racle (11).
3. Appareil selon la revendication 1 ou 2, **caractérisé en ce que**, en plus du muscle pneumatique (13), l'actionneur comporte un autre muscle pneumatique (24).
4. Appareil selon la revendication 1 ou 2, **caractérisé en ce que**, en plus du muscle pneumatique (13), l'actionneur comporte un élément de ressort (25).
5. Appareil selon la revendication 4, **caractérisé en ce que** l'élément de ressort (25) est adapté autour du muscle pneumatique (13).
6. Appareil selon l'une des revendications 1 à 5, **caractérisé en ce qu'un** actionneur (12) est adapté pour être relié aux deux extrémités de l'équipement à docteur.
7. Appareil selon l'une des revendications 1 à 5, **caractérisé en ce que** l'actionneur (12) comporte un boîtier de montage (17) qui est relié de façon inamovible soit au support de racle (11) ou au moyens de support (10).
8. Appareil selon la revendication 7, **caractérisé en ce que** la première extrémité (20) du muscle pneumatique (13) est fixée au boîtier de montage (17) avec

la deuxième extrémité (21) est fixée au support de racle (11) ou aux moyens de support (10) qui sont adaptés librement par rapport au boîtier de montage (17).

9. Appareil selon la revendication 3 ou 4, **caractérisé en ce que** l'élément de ressort (25) et le deuxième muscle pneumatique sont fixés (24) de manière correspondant au premier muscle pneumatique (13).
10. Appareil selon l'une des revendications 1 à 9, **caractérisé en ce que** le diamètre non chargé du muscle pneumatique (13, 24) est compris entre 10 et 50 mm, plus avantageusement entre 20 et 40 mm.
11. Appareil selon l'une des revendications 1 à 10, **caractérisé en ce que** la longueur non chargée du muscle pneumatique (13, 24) est comprise entre 50 et 500 mm, plus avantageusement entre 100 et 300 mm.
12. Appareil selon l'une des revendications 1 à 11, **caractérisé en ce qu'une** structure de support (28) s'étendant sur toute la longueur de l'équipement à docteur est adaptée entre l'actionneur (12) et le support de racle (11).
13. Appareil selon l'une des revendications 1 à 12, **caractérisé en ce qu'une** goulotte de collection (36) est agencée entre les moyens de support (10) au niveau des différentes extrémités de l'équipement à docteur.
14. Appareil selon l'une des revendications 1 à 13, **caractérisé en ce qu'un** cercle d'entraînement (22) avec plusieurs points de fixation (38) auxquels l'actionneur (12) est fixé, est agencé dans le support de racle (11).
15. Appareil selon l'une des revendications 1 à 14, **caractérisé en ce que** l'angle d'ouverture α du support de racle (11) est compris entre 10 et 25°, plus avantageusement entre 15 et 20°.





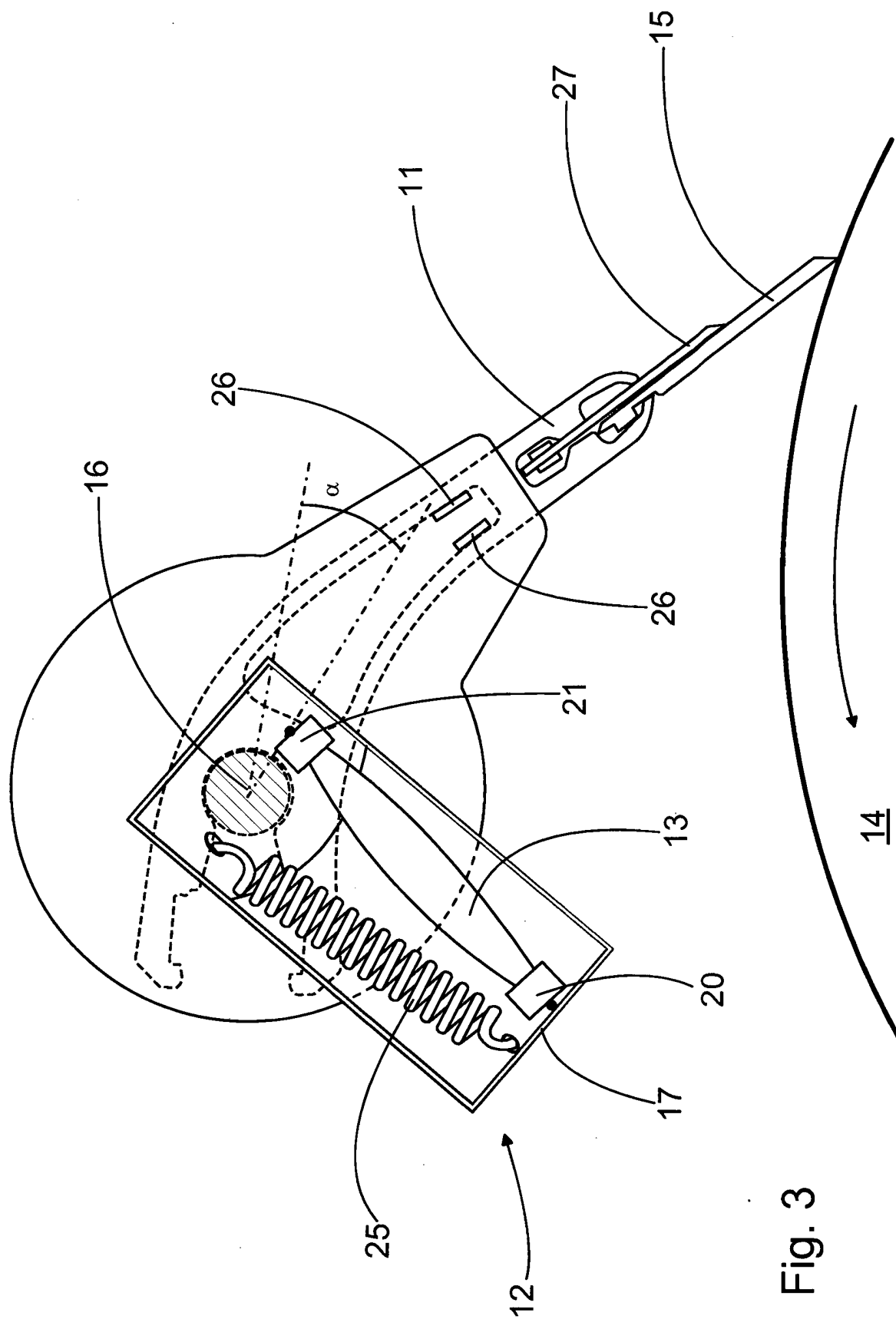


Fig. 3

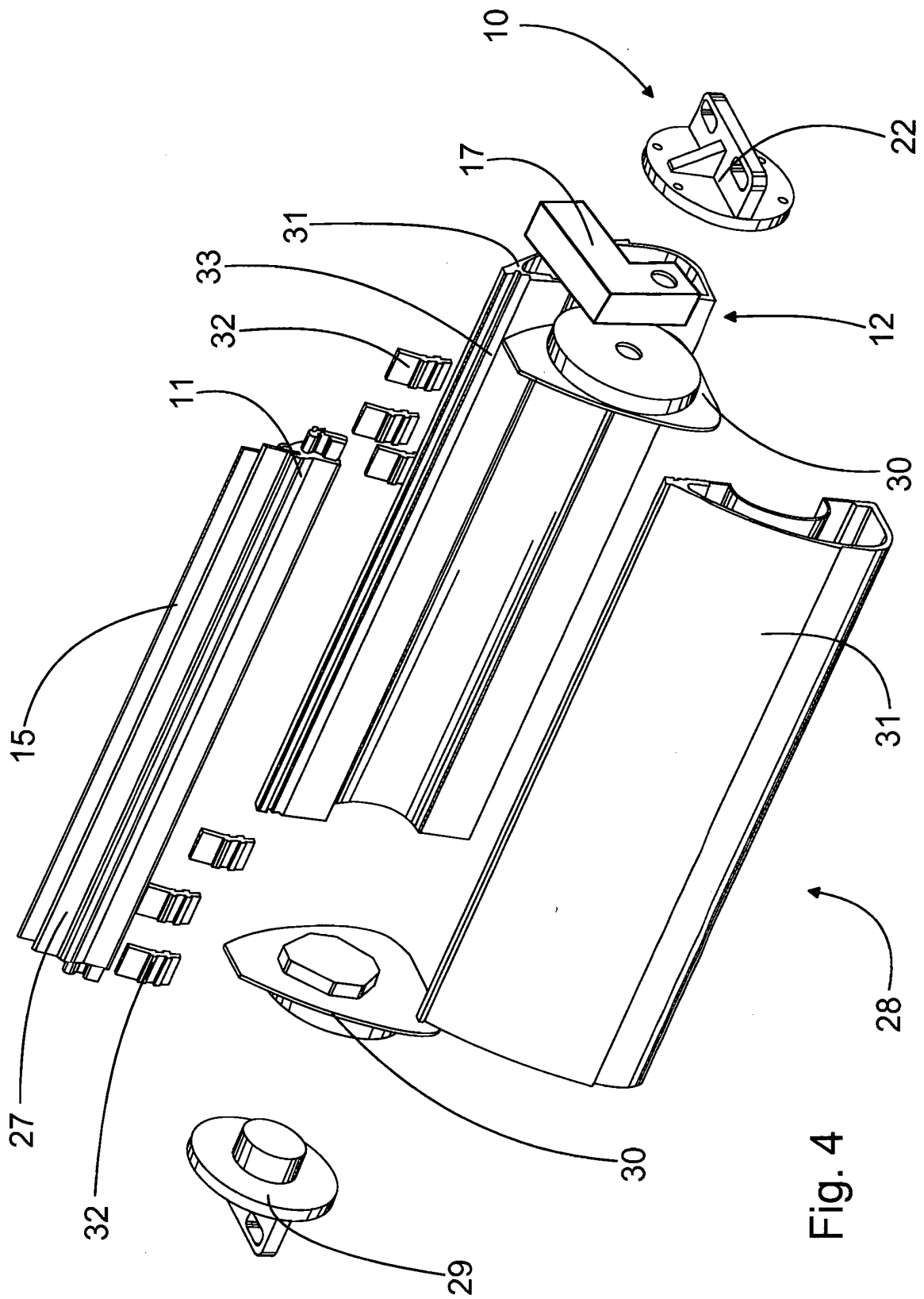


Fig. 4

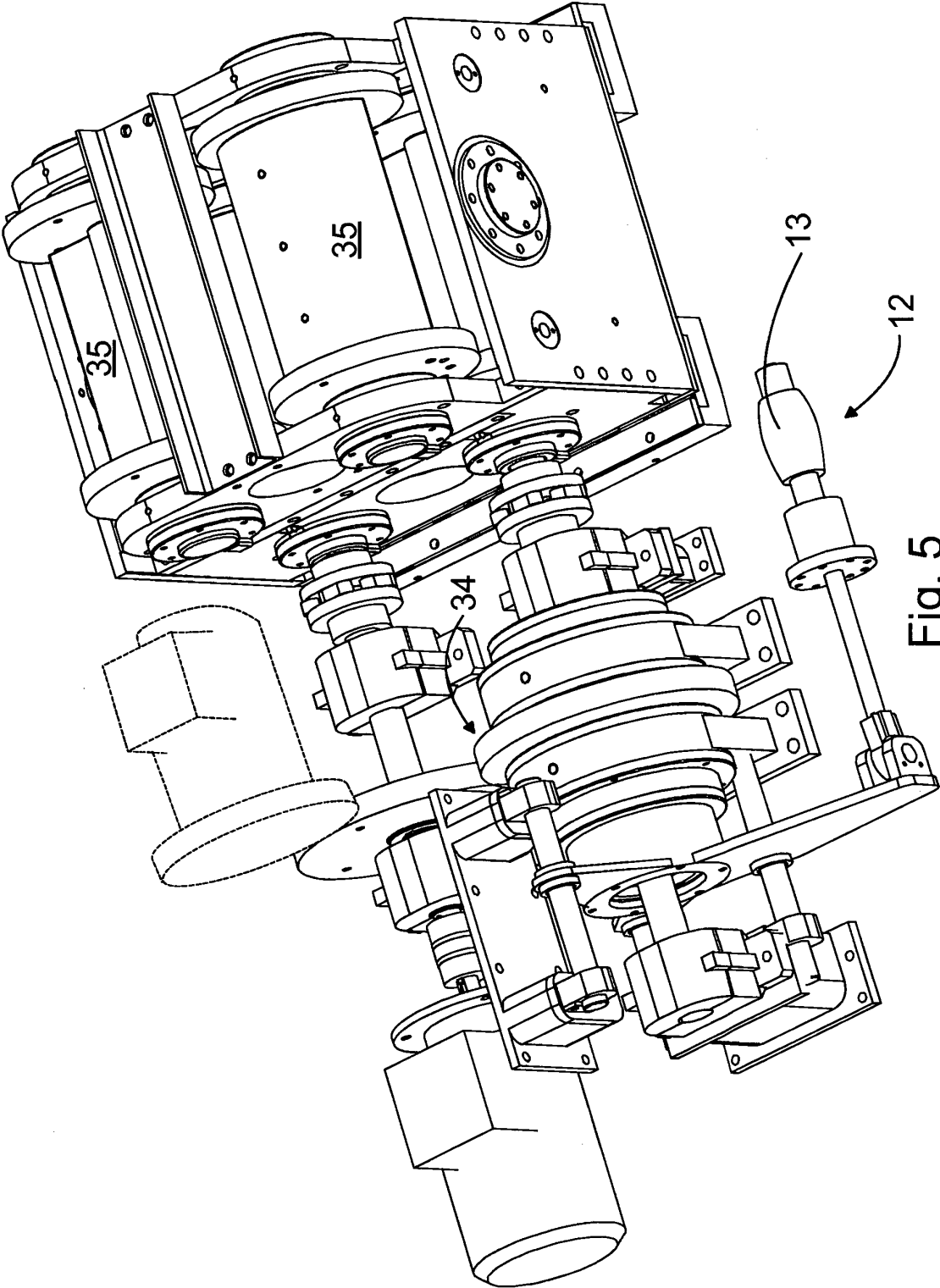
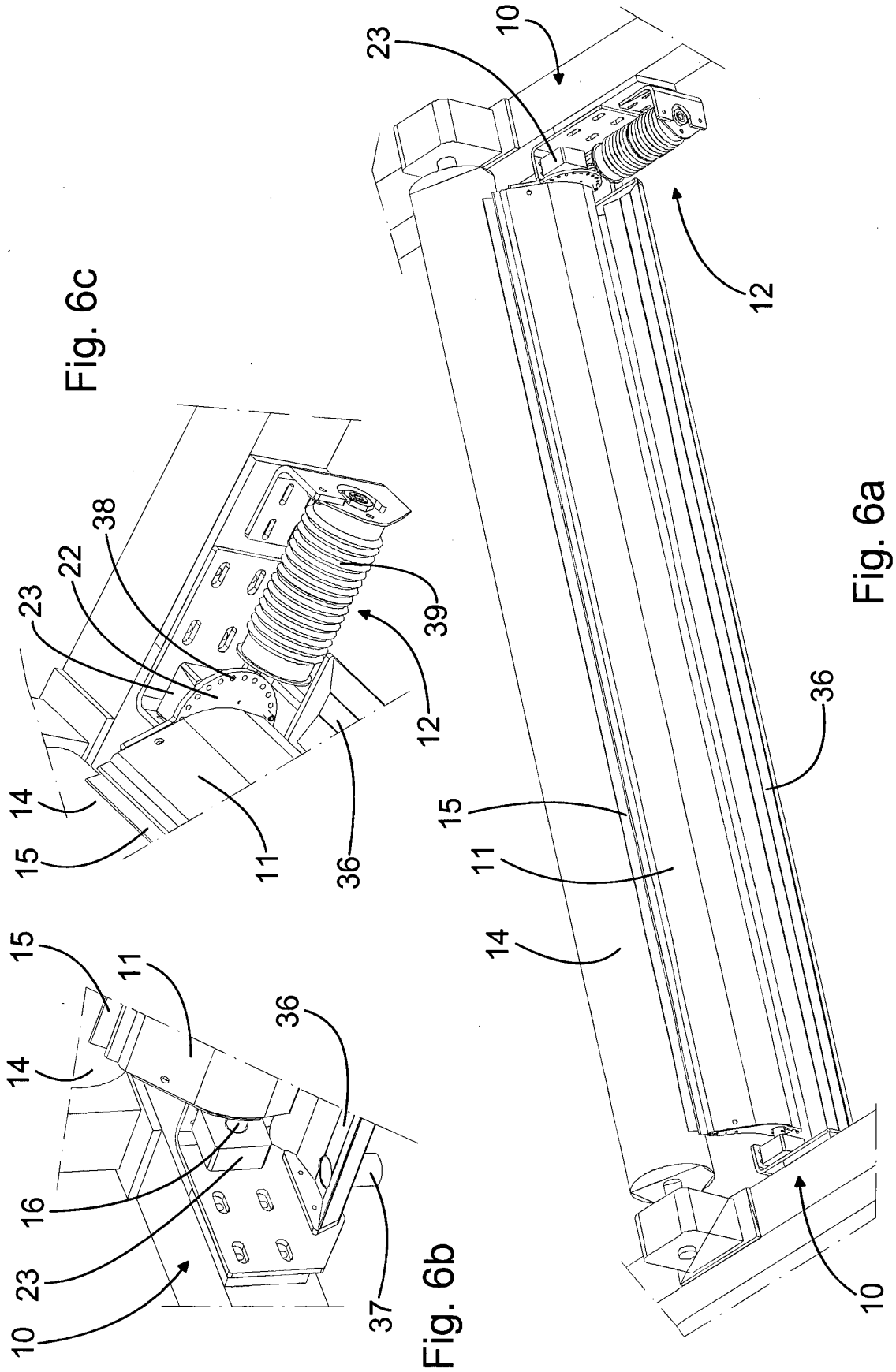


Fig. 5



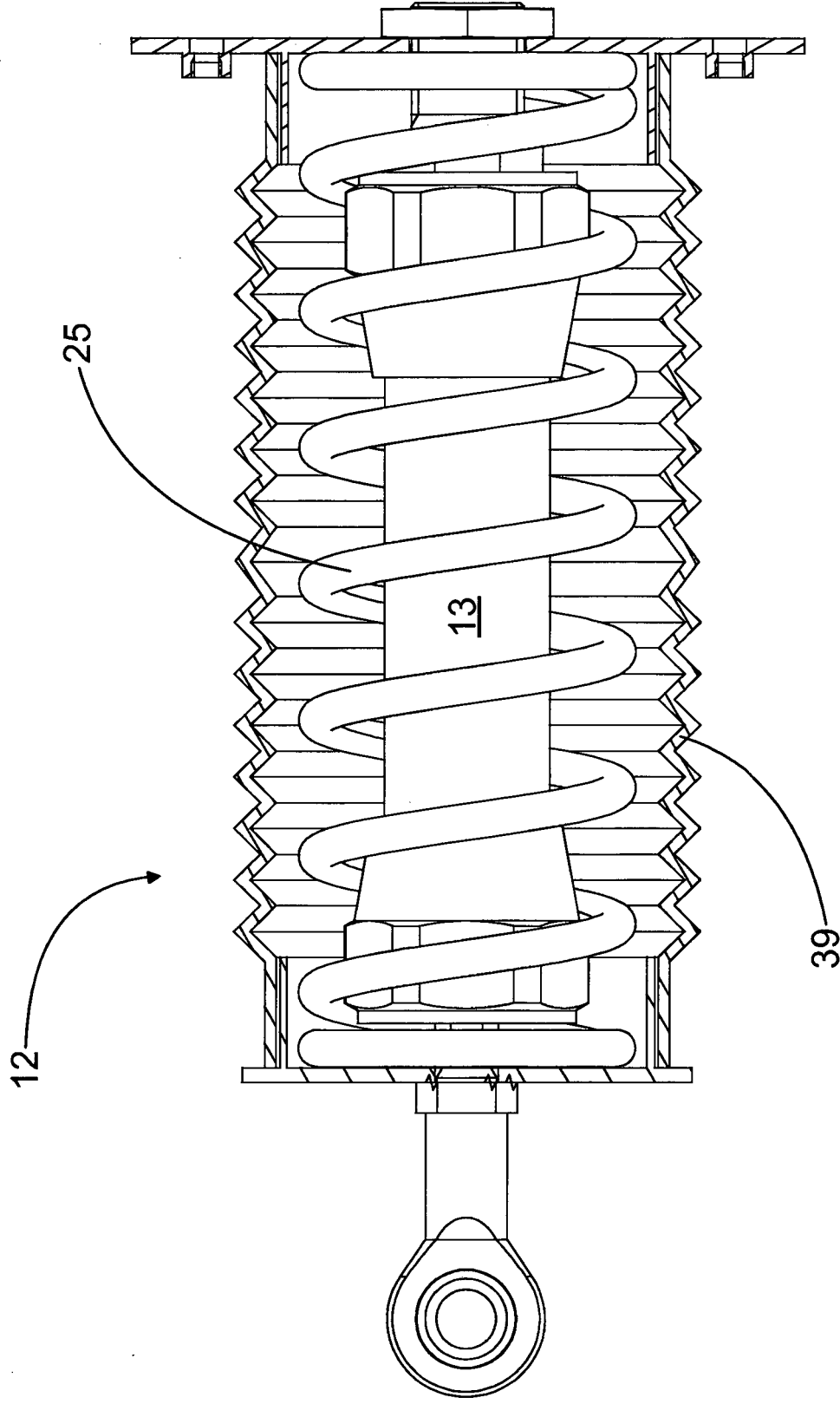


Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 0044981 A [0001]
- EP 1694910 A [0019]

Non-patent literature cited in the description

- *Pneumatic Artificial Muscles ie. PAMs*, 11 September 2007, http://en.wikipedia.org/wiki/Pneumatic_artificial_muscles [0017]