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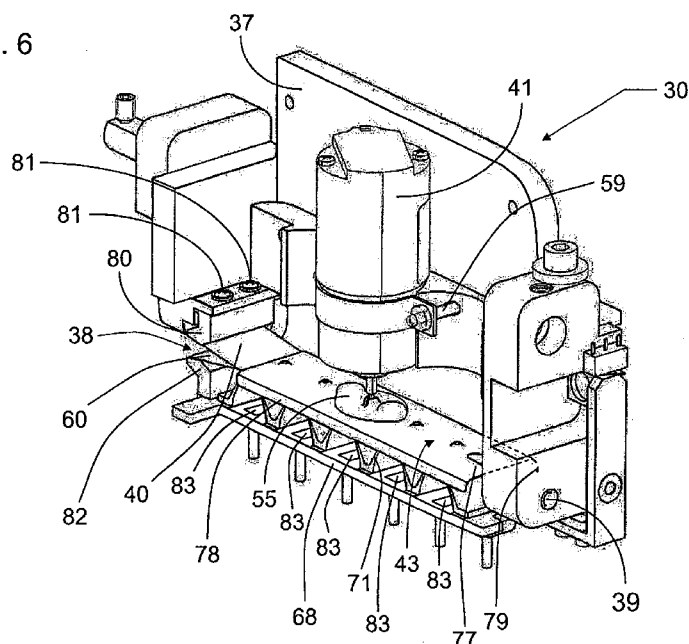
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(54) Title: THREAD BRAKE AND METHOD OF USING THE THREAD BRAKE

Fig. 6



(57) Abstract: Method and thread brake comprising a first brake element (40), a second brake element (60) and at least one actuator (41; 84, 85), wherein the first brake element (40) is displaceable and can be forced against the second brake element (60) by the at least one actuator (41; 84, 85) in order to brake a thread (3, 4, 5), and wherein the second brake element (60) is of flexible and elongate design and is distributedly supported along its length by a spring system (61).

Thread brake and method of using the thread brake

[0001] The invention relates to a thread brake, which comprises a first brake element, a second brake element and at least one actuator, in which the first brake
5 element is displaceable and can be forced against the second brake element by the at least one actuator in order to brake a thread, more particularly a weft thread for a weaving machine. The invention also relates to a method of using a thread brake.

10 [0002] BE 1010389 describes a thread brake which comprises two brake elements which are forced against one another by means of several actuators in order to brake a thread. The threads which are to be braked may comprise knots, thread bosses, thicker areas and other
15 irregularities. When such an irregularity or knot passes through the thread brake, a force peak will occur in the thread. The inertia of the actuators is too high to enable the brake elements to move away from one another sufficiently quickly to allow the knot or
20 the irregularity to pass through without an increase in force. In order to solve this problem, a number of small actuators with low inertia can be used. However, the inertia of the actuators is still too high to enable a quick movement.

25 [0003] EP 973 686 B1 describes a yarn brake or thread brake which comprises a displaceable, plate-like brake element which can be forced against a stationary brake element by a switchable electromagnet in order to brake a thread. According to the embodiment described in
30 EP 973 686 B1, the thickness of the thread affects the brake force. If, for example, a knot passes through the thread brake, the brake force is reduced in this case.

[0004] It is the object of the invention to provide a thread brake which allows knots and other

irregularities in a thread to pass through, wherein the brake force can be controlled at any moment. It is another object of the invention to provide a method of using a thread brake.

5 [0005] In order to achieve this object, a thread brake according to the invention comprises a first brake element, a second brake element and at least one actuator, wherein the first brake element is displaceable and can be forced against the second brake
10 element by the at least one actuator in order to brake a thread, and wherein the second brake element is of flexible and elongate design and is distributedly supported along its length by a spring system.

[0006] The spring system allows the second flexible
15 brake element to move and make space to allow a knot, a thread thickening, a thick area in the thread or other irregularity to pass through, while the actuator can maintain a desired brake force. As the second brake element is of elongate design, it is possible to brake
20 a thread over a relatively large length and at the same time to maintain a desired brake force while space can be made to allow a knot or other irregularity to pass through.

[0007] In addition, an alignment of the brake elements
25 can be improved as a result of the fact that the second brake element can move with respect to the first brake element. When the brake elements are not aligned, in particular are not parallel, the second brake element will, due to the spring system, align itself with
30 respect to the first brake element when a brake force is applied.

[0008] In addition, as a result of the resilient support of the second brake element, the first brake element can rest on the second brake element without

play. As a result thereof, no impact load or only a low impact load will be exerted on the thread when the actuator is activated.

[0009] According to a preferred embodiment, the second
5 brake element is designed to be a plate or plate-like,
in particular a flexible plate, more particularly a
thin flexible plate. The mass of the second brake
element is preferably kept low in order to minimize the
10 inertia of the second brake element and to allow the
second brake element to react quickly when a knot or
other irregularity passes through the thread brake.
Depending on the material used, a thin plate may be
preferred, a thin plate in the context of the invention
being defined as a plate which is sufficiently flexible
15 to move out of the way sufficiently when a knot or
other irregularity passes through the thread brake,
more particularly a plate having, for example, a
thickness in the order of magnitude of 0.1 mm or less,
more particularly a thickness of approximately 0.05 mm.
20 Such an elongate plate has a length, for example, in
the order of magnitude of 100 mm and a width of
approximately 15 mm. The second brake element is in
this case arranged with its length direction according
to the direction of movement of the thread to be
25 braked. The second brake element may be made from a
wear-resistant material.

[0010] According to one embodiment, the second brake
element contacts the spring system at several distinct
contact points. These distinct contact points are
30 distributed over the length of the second brake
element, more particularly are evenly distributed over
the abovementioned length. Distinct contact points can
be achieved by, for example, using a spring system
having more than one resilient or elastic element in
35 order to support the second brake element. These
resilient or elastic elements can be connected to one

another in order to provide stability in the direction of movement of the thread to be braked. According to another embodiment, a single-part resilient or elastic element can be used as a spring system, with the
5 single-part resilient or elastic element being able to contact the second brake element at several contact points.

[0011] By providing distinct contact points, the second brake element is "locally weak", that is to say
10 the second brake element can move away from the first brake element at a contact point to allow a knot or other irregularity to pass through, while the second brake element is held against the first brake element at other contact points in order to maintain the
15 desired brake force. The thread brake is capable of highly dynamic operation, that is to say the actuator which acts on the first brake element can accurately control the brake force and makes it possible to generate a large brake force, while the spring system
20 which interacts with an elongate and flexible second brake element allows knots or other irregularities to pass through this elongate second brake element without substantially affecting the total brake force. In this case, only a small brake force is exerted between the
25 elongate brake elements at the knot or other irregularity.

[0012] According to one embodiment, at least one elastic element having at least one fold is used as the spring system. In this case, the elastic element may be
30 formed by a polymer element or a rubber element. In addition to elastic properties, an element made from a polymer or a rubber also has damping properties. The elastic element having at least one fold, for example a folded band, may be arranged with its length direction
35 according to the direction of movement of the thread to be braked. The element having at least one fold can

contact the second brake element at various points, with the number of contact points depending on the number of windings or bends in the element having at least one fold. The second brake element may contact the elastic element at the top of such a fold. The distinct contact points are provided along the length of the second brake element, in other words are distributed along virtually the entire length of the second brake element. The element having at least one fold has a local elasticity which is perpendicular to the direction of movement of the thread to be braked. In addition, the element having at least one fold has a certain stiffness in the direction of movement of the thread to be braked.

[0013] According to one embodiment, the at least one actuator comprises an actuator element for applying an adjustable brake force. In this case, an actuator element may be provided which is preferably placed substantially in the centre of the first brake element. The actuator can have a relatively high inertia since the first brake element is not required to move suddenly. The actuator may be hydraulic, pneumatic, electric, magnetic or a combination thereof. If desired, a transmission may be provided between the actuator element and the first brake element, for example a lever transmission. Preferably, the actuator has a known characteristic which makes a control of the force or the position possible.

[0014] According to one embodiment, the actuator element is supported by at least one spring element, more particularly for compensating for gravitational forces. The at least one spring element can support parts of the actuator, such as a pin or a piston of the actuator element, which are used, for example, to transfer forces to the first brake element. According to one embodiment, the actuator element cooperates with

at least two spring elements which can exert an opposite force on the actuator element and limit a movement of the actuator element, more particularly can prevent the actuator element from coming away from a spring element during a movement. The force which is
5 exerted by the spring elements on the actuator element is preferably set so that the actuator element is supported in order to compensate for gravitational forces when the actuator is in rest state.

10 [0015] According to one embodiment, the at least one actuator element can exert a force on the first brake element via a pivot joint. A pivot joint allows a small movement between the actuator element, in particular a pin of the actuator element, and the first brake
15 element. This is advantageous in order to align the brake elements of the thread brake. A pivot joint furthermore allows both a closing force, that is to say a braking force, and an opening force to be applied to the thread brake.

20 [0016] According to one embodiment, two or more actuators are provided in order to generate a variable force between the brake elements along the direction of movement of the thread to be braked. When more than one actuator is used, a first actuator which is provided
25 near a thread entry of the thread brake is preferably used to generate a force which is lower than the force generated by a second actuator which is provided closer to a thread exit of the brake. As a result of this arrangement, the force on a knot or other irregularity
30 can be increased in a direction from the thread entry to the thread exit in order to prevent thread breakage.

[0017] Preferably, the actuator is designed as a linear electric motor. With a linear electric motor, the exerted force is approximately linear to the
35 current through the electric motor. This allows a

simple control mechanism and/or control unit for controlling the brake force of the thread brake.

[0018] According to one embodiment, the first brake element is controlled by the actuator via a pressure-exerting element. The pressure-exerting element for the first brake element is designed to be relatively stiff against deflection and can be connected to a pin of the actuator element, in particular via a pivot joint. The pressure-exerting element, also referred to as intermediate element or support element, makes it possible to distribute the force which is applied by the actuator along the length of the first brake element. According to one embodiment, the first brake element which interacts with the pressure-exerting element is designed to be a plate or plate-like, in particular as an elongate flexible plate, more particularly as a thin elongate flexible plate.

[0019] According to one embodiment, the pressure-exerting element comprises a plate, the edges of which are bent parallel to the direction of movement of the thread to be braked, preferably in the direction towards the second brake element. This makes it possible to achieve a relatively large stiffness against deflection of the pressure-exerting element using a light plate as pressure-exerting element, so that the pressure-exerting element can evenly transfer the forces from the actuator onto the first brake element. In particular by bending the aforementioned edges in the direction of the second brake element, a sliding or rolling of the thread between the brake elements in a direction perpendicular to the direction of movement of the thread is prevented.

[0020] According to one embodiment, the first brake element comprises an elongate element in the form of a thin plate. According to one embodiment, the elongate

element can be connected to the pin of the actuator element, in particular via a pivot joint. The first brake element can be made from a wear-resistant material.

5 [0021] According to one embodiment, the edges of the first brake element are bent parallel to the direction of movement of the thread to be braked, preferably in the direction of the second brake element. By bending the edges of the first brake element, which is designed
10 as a plate, for example, the stiffness of the first brake element is increased. By bending the aforementioned edges in the direction towards the second brake element, a sliding or rolling of the thread between the brake elements in a direction
15 perpendicular to the direction of movement of the thread is prevented.

[0022] According to a preferred embodiment, in use, the first brake element is arranged above the second brake element. By arranging the first brake element on
20 top of the second brake element, gravitational forces can be used to maintain the contact between the first brake element and the second brake element. However, according to another embodiment, an arrangement in which the second brake element is on top is preferable
25 in order to reduce the effect of gravitational forces on the brake force. According to yet another embodiment, the brake elements can be arranged substantially vertically in order to eliminate the effect of gravitational forces on the brake force.

30 [0023] In order to achieve the object of the invention, a method according to the invention comprises controlling a thread brake, in which the brake force is adjusted during the insertion of a weft thread into a shed of a weaving machine. Since the
35 applied brake force does not depend on the quality of

the weft thread, that is to say on knots or other irregularities, the applied brake force can be adjusted during insertion of the weft thread in accordance with a control pattern for controlling the at least one
5 actuator.

[0024] Further characteristic features and advantages of the invention will become apparent from the following description of the exemplary embodiments illustrated in the drawings.

10 Fig. 1 shows a diagrammatic representation of a gripper weaving machine having several thread brakes according to the invention;

Fig. 2 shows a front view of a thread brake according
15 to the invention;

Fig. 3 shows an enlargement of a portion of the thread brake according to Fig. 2;

20 Fig. 4 shows a side view of a thread brake according to the invention in which the brake elements are of a similar design to those in Fig. 2;

Fig 5 shows a side view similar to the side view from
25 Fig. 4 for a variant embodiment;

Fig. 6 shows a perspective view of a thread brake according to the invention;

30 Fig. 7 shows a front view of the thread brake according to the invention;

Fig. 8 shows a front view of a variant embodiment for a thread brake according to the invention;

35

Fig. 9 shows a part of a thread brake according to the invention in a front view similar to that from Fig. 3 when a knot or other irregularity passes through the thread brake.

5

Fig. 10 shows a front view of a thread brake according to the invention.

[0025] The gripper weaving machine illustrated in Fig. 10 1 comprises a drawing gripper 1 and a receiving gripper 2, by means of which threads 3, 4, 5 can be introduced as weft threads in a shed 7 formed by warp threads 6. The threads 3, 4, 5 are presented to the drawing gripper 1 according to a pattern by means of a thread-feeding device 8 with associated presentation needles 15 9, 10, 11, subsequently taken up by the drawing gripper 1 and cut off by means of a weft cutter 12. The weft cutter 12 is arranged near the insertion side 13 and between a guide 14 and the fabric edge 15.

20 [0026] The thread 3, 4, 5 is thereafter taken by the drawing gripper 1 from the insertion side 13 to approximately the centre of the shed 7, is there transferred to the receiving gripper 2 and then taken to the opposite side 16 of the shed 7 by the receiving gripper 2 and is there released by the receiving gripper 2. Thereafter the introduced weft thread is beaten up against the fell line of the fabric 18 by means of the reed 17. In the meantime, the introduced weft thread is also tied in by the warp threads 6. The drawing gripper 1 and the receiving gripper 2 are each 30 arranged on driven gripper bands 19, 20, which move them in and out of the shed 7.

[0027] From the bobbins 21, 22, 23, each of the threads 3, 4, 5 is passed to the insertion side 13 via an associated prewinder 24, 25, 26, an associated thread brake 30, 31, 32 according to the invention, a 35

thread monitor 27 having several sensor elements and associated presentation needles 9, 10, 11. A control device 28 controls inter alia the prewinders 24, 25 26, the thread brakes 30, 31, 32 and the drive elements for the presentation needles 9, 10, 11 of the thread-feeding device 8. In addition, the control device 28 can receive signals from the thread monitor 27. The aforementioned components are mounted on a frame 29.

[0028] Fig. 1 also shows a shaft 33 which rotates synchronously with the main drive shaft of the gripper weaving machine. In order to determine the angular position of this shaft 33, for example an encoding disc 34 is provided on the shaft 33, which interacts with a sensor 35 which sends signals to the control unit 28 for determining the angular position of the shaft 33. The control unit 28 is also connected to an input unit 36 by means of which data for controlling the thread brakes 30, 31, 32 are input. This makes it possible, inter alia, to control the thread brakes as a function of the angular position of the shaft 33 synchronously with the gripper weaving machine and/or as a function of the movement course of the weft thread introduced in a shed 7. Such a control mechanism is for example known from EP 973686 B1, the contents of which form part of this description.

[0029] Figs. 2 and 3 illustrate a first exemplary embodiment of a thread brake 30 according to the invention in more detail. The thread brake 30 comprises a frame 37 and two thread guides 38, 39 which determine the direction of movement A of the thread 3 to be braked, i.e. the direction in which the thread 3 is passed through the thread brake 30 from the prewinder 24 to the thread monitor 27 via the thread guide 38 at the thread entry and the thread guide 39 at the thread exit of the thread brake 30. Each thread guide 38 and 39 may, for example, consist of a thread eye.

[0030] This thread brake 30 comprises a first brake element 40 and a second brake element 60 between which a thread 3 can be braked. The first brake element 40 is arranged displaceably and can be forced against the second brake element 60 by means of an actuator 41. In this embodiment, the first brake element 40 comprises an elongate flexible plate 42 which is supported by a relatively stiff pressure-exerting element 43. The plate 42 consists, for example, of a thin flexible plate having a thickness in the order of magnitude of 0.1 mm or less, more particularly a thickness of approximately 0.05 mm, a length in the order of magnitude of 100 mm and a width of approximately 15 mm. In the direction of movement A of the thread 3 to be braked, the plate 42 comprises a curved entry portion 44, a curved exit portion 45 and a virtually flat brake portion 46 which extends between the entry portion 44 and the exit portion 45.

[0031] As is illustrated in Fig. 2, in use, the first brake element 40 is arranged on top of the second brake element 60. In this embodiment, the actuator 41 comprises an actuator element 47 by means of which an adjustable force can be applied. The illustrated actuator 41 is in this embodiment formed by a linear electric motor. To this end, the actuator 41 comprises a housing 48 with a magnet 49. The actuator element 47 of the actuator 41 in this embodiment comprises, inter alia, a support 51 provided with a coil 50 and a pin 52. The coil 50 can be controlled by a control unit 28 in order to generate a force together with the magnet 49. In this embodiment, the actuator element 47 is supported by a spring element 53 in order to compensate for gravitational forces. The spring element 53 is in this embodiment arranged around the pin 52 between the housing 48 and the support 51 and forces the pin 52 into the housing 48. Via the pressure-exerting element 43, the first brake element 40 is connected to the end

54 of the pin 52 of the actuator element 47 by means of a pivot joint 55, more particularly, for example, a ball joint. The end 54 of the pin 52 is in this embodiment arranged essentially at the centre of gravity of the pressure-exerting element 43. Between the end 54 of the pin 52 and the housing 48, a second spring element 56 is arranged which forces the pin 52 out of the housing 48, more particularly forces the pin 52 in a direction opposite to the direction in which the spring element 53 forces the pin 52 into the housing 48. In the illustrated exemplary embodiment, the spring element 53 is a helical spring, whereas the spring element 56 is a spiral spring.

[0032] The housing 48 of the actuator 41 is attached to the frame 37. Preferably, the housing 48 can be attached in different positions with respect to the frame 37 along the direction of movement B of the support 51. To this end, the housing 48 is for example attached to the frame 37 via carriers 58 which are provided with slots 57 and are fitted to the frame 37 and via bolt connections 59. In this embodiment, the housing 48 is for example arranged so that the force which is exerted on the pin 52 by the spring element 53 is slightly greater than the force which is exerted on the pin 52 by the spring element 56, so that the support 51, in the rest state, is held against the gravitational force. This makes it possible to hold the support 51 with a desired spring force. Providing two spring elements 53 and 56 also makes it possible to prevent any vibrations which could result from activating the actuator 41. In this case, the housing 48 is also arranged in such a position with respect to the frame 37 that the brake elements 40 and 60 rest against one another or touch one another when the coil 50 of the actuator 41 is not energized.

[0033] The second brake element 60 of the thread brake 30 is elongate, flexible and is supported along its length by a spring system 61. The second brake element 60 comprises a flexible plate 62. The flexible plate 62
5 comprises, for example, a thin flexible plate having a thickness in the order of magnitude of 0.1 mm or less, more particularly a thickness of approximately 0.05 mm, a length in the order of magnitude of 100 mm and a width of approximately 15 mm. The spring system 61 is
10 arranged in such a manner that the spring system 61 contacts the flexible plate 62 of the second brake element 60 at several contact points 63.

[0034] Along the direction of movement A of the thread 3 to be braked, the plate 62 comprises a curved entry
15 portion 64, a curved exit portion 65 and a virtually flat brake portion 66. The contact points 63 are for example distributed substantially evenly along the length of the second brake element 60, more particularly along substantially the entire length of
20 the brake portion 66 of the second brake element 60. As is illustrated in Fig. 3, the various contact points 63 are situated substantially at and distributed along the length of the brake portion 66 of the plate 62. In the illustrated exemplary embodiment, a number of contact
25 points 63 are provided, for example five contact points. The more contact points 63 are provided, the more easily a knot or irregularity in a thread 3 can pass through the thread brake 30 without substantially affecting the brake force which is exerted on the
30 thread 3 by the thread brake 30.

[0035] The spring system 61 illustrated in Figs. 2 and 3 comprises a single-part elastic element 71 with a number of successive folds 67, each of which can contact the plate 62 of the second brake element 60 at
35 a contact point 63. The elastic element 71 can, for example, be a polymer element or a rubber element. The

element 71 can be formed in a mold. The element 71 is arranged between the second elongate and flexible brake element 60 and a support element 68 which is fixedly attached to the frame 37. The element 71 may comprise
5 studs 69 which can engage with openings 70 which are provided in the support element 68. By the studs 69 mating with the associated openings 70 in the support element 68, the element 71 can be arranged in a certain position with respect to the support element 68. This
10 also makes it possible for each fold 67 to be arranged in a certain position with respect to the support element 68.

[0036] In the embodiment illustrated in Fig. 4, the element 71 formed by folds 67 is glued to a support
15 element 68, for example at several points. The frame 37 comprises slots 57 in order to make it possible to fix the actuator 41 in a suitable height position with respect to the frame 37 via bolt connections 59. In this embodiment, the support element 68 is attached to
20 a frame 73, for example using bolt connections 72, it being possible to arrange the frame 73 in a certain angular position with respect to the frame 37 via a connection 74 and an element 98. By adjusting the position of the element 98, the angular position of the
25 second brake element 60 with respect to the first brake element 40 can be adjusted. In this embodiment, the connection 74 may comprise a bolt connection which makes it possible to attach the frame 73 with respect to the frame 37, while the element 98 consists of a
30 stop which is provided on the frame 37 and against which the frame 73 can strike.

[0037] According to a preferred embodiment, the element 98 is formed by a magnet, while the connection
74 is formed by a shaft. This arrangement makes it
35 possible to rotate the support element 68 away from the first brake element 40 in order to make it possible,

for example, to wire and/or clean the thread brake 30. The support element 68 can subsequently be rotated back towards the first brake element 40 up to the brake position. According to a variant, an element which can
5 produce a click-fit connection may be used instead of an element 98 which is formed by a magnet. Such embodiments make it readily possible to open the thread brake and return the latter to the position prior to opening by closing it, without tools being required.

10 [0038] In the embodiment illustrated in Fig. 5, the edges 75 and 76 of the plate 42 of the first brake element 40 are bent, more particularly they are bent parallel to the direction of movement of the thread to be braked. As can be seen, the edges 75 and 76 are bent
15 towards the second brake element 60, more particularly away from the actuator 41. In this embodiment, the shape of the first brake element 40 is substantially U-shaped. Providing such edges 75, 76 is advantageous in order to prevent a thread from sliding or rolling in a
20 direction perpendicular to the direction of movement thereof in the thread brake 30 during braking.

[0039] In a variant of Fig. 5 not shown, the actuator 41 can cooperate with the plate 42 which forms the brake element 40. In this embodiment, no pressure-
25 exerting element 43 is provided and the function of the pressure-exerting element 43 can be fulfilled by the plate 42 which is provided with edges 75 and 76 and forms the brake element 40, more particularly by the relatively stiff plate 42.

30 [0040] In the embodiment illustrated in Fig. 6, the pressure-exerting element 43 for the first brake element 40 is formed by a plate 77, the edges 78 and 79 of which are bent parallel to the direction of movement of the thread to be braked. As can be seen, these edges
35 78, 79 are bent in the direction towards the second

brake element 60, more particularly away from the actuator 41. In this embodiment, the pressure-exerting element 43 is substantially U-shaped. The pressure-exerting element 43 is connected to the actuator 41 via a pivot joint 55. Here, the pivot joint 55 consists of an elastic joint which forms an elastic hinge which allows the pressure-exerting element 43 to pivot in all directions with respect to the pin 52 of the actuator 41. The force which is exerted by the pin 52 in this case acts substantially centrally on the pressure-exerting element 43, more particularly essentially at the centre of gravity of the pressure-exerting element 43. In this embodiment, the forces of the actuator 41 are evenly distributed between the brake elements 40, 60 by means of a light plate 77 which is relatively stiff against deflection, which is advantageous for braking a thread. In such an embodiment, the sliding or rolling of a thread in the thread brake 30 is also prevented.

[0041] In order to wire or clean the thread brake 30, it may be advantageous to lift the pressure-exerting element 43 by means of the actuator 41. In order to make it possible to lift the pressure-exerting element 43 substantially parallel with itself, it is advantageous to use a sufficiently stiff pivot joint 55 and for the actuator to engage essentially at the centre of gravity of the pressure-exerting element 43. In the case of a flexible pivot joint and/or when engagement takes place outside the centre of gravity, there is a risk, when the pressure-exerting element 43 is lifted, that the pressure-exerting element 43 will tilt and come to rest on the brake element 40 at a certain location.

[0042] Here, the first brake element 40 which cooperates with the pressure-exerting element 43 is designed as an essentially flat plate, more

particularly as a thin flexible band. In order to prevent the first brake element 40 from moving along the direction of movement of the thread to be braked, the first brake element 40 is attached to the frame 37 via an attaching element 80. To this end, the first brake element 40 is for example glued to the attaching element 80, this attaching element 80 being attached to the frame 37 by means of bolt connections 81. The second brake element 60 is in this case also designed in the form of an essentially flat plate, but more particularly as a thin flexible band. The second brake element 60 may be attached to the frame 37 in a similar manner via an attaching element 82 and an associated bolt connection. In this embodiment, a thread guide 38 is formed between the attaching elements 80 and 81 at the thread entry. At the thread exit, a thread guide 39 is provided in the form of a thread eye.

[0043] In order to prevent dust from collecting at the support element 68, the support element 68 may be provided with openings 83 through which dust can escape. According to a variant which is not illustrated, the support element may be designed for example as a comb-like element, with the teeth of the comb-like element being able to support the elastic element and with the grooves between the teeth of the comb-like element being able to serve as openings for the dust to escape.

[0044] In the embodiment illustrated in Fig. 7, two actuators 84 and 85 are provided for generating an adjustable or variable force. The actuators 84, 85 can be of a design similar to that of the actuator 41. According to a variant (not shown) it is also possible to provide more than two actuators. Providing two or more actuators 84, 85 makes it possible, at each actuator 84, 85, to generate a certain force between the brake elements 40, 60 which can be selected to be

different according to the direction of movement A of the thread 3 to be braked. In this embodiment, the exit portions of the brake elements 40, 60 are of an essentially straight design.

5 [0045] In the embodiment from Fig. 7, the brake elements 40 and 60 can be of a design similar to that of the brake elements illustrated in Fig. 6. The pressure-exerting element 43 may have bent edges, just like the pressure-exerting element 43 from Fig. 6. In
10 the embodiment from Fig. 7, the actuator 84 is connected to the pressure-exerting element 43 via a pivot joint 55, while the actuator 85 is connected to the pressure-exerting element 43 via, for example, a groove connection 99.

15 [0046] The thread brake 30 from Fig. 7 furthermore comprises a blow nozzle 86 which, via compressed-air lines 87 and a valve 88 which is controllable by a control unit 28, may provide an air stream along the direction of movement of the thread to be braked
20 between the brake elements 40, 60. This makes it possible, for example, to wire the thread brake 30 according to the invention or to clear any dust present. In this case, the actuators 84, 85 can be controlled by the control unit 28 in such a manner that
25 the pressure-exerting element 43 is lifted and in this way hardly no force is exerted between the brake elements 40, 60, while air is blown between the brake elements 40, 60. Similar to the embodiment from Fig. 6, the brake element 40 is attached to the frame 37 via an
30 attaching element 80 and bolt connections 81, while the brake element 60 is attached to the frame 37 via an attaching element 82 and bolt connections 89.

[0047] The embodiment from Fig. 8 illustrates a spring system 61 according to the invention which comprises a
35 number of elastic elements 90, each of which can

contact the second flexible brake element 60 at a different contact point 63 in order to support this second brake element 60 resiliently or elastically. In this embodiment, the contact points 63 are not
5 substantially evenly distributed along the length of the second brake element 60. This may be advantageous in order to limit vibrations when a knot or other irregularity passes through the thread brake 30. The elastic elements 90, also referred to as resilient
10 elements, may consist of spring elements. The elements 90 may be connected to one another by at least one connecting element 91 in order to make the elements 90 of the spring system 61 stable in the direction of movement A of the thread 3 to be braked. In this case,
15 the connecting element 91 is, for example, arranged between the frame 37. The connecting element 91 is also connected to each of the elastic elements 90 by attachment elements 92. The elements 90 are in this case supported by the frame 37.

20 [0048] In the embodiment from Fig. 9, the spring system 61 is formed by a number of elastic elements 93, 94, 95 which are arranged next to one another along the direction of movement A of the thread 3 to be braked. The elements 93 and 95 each comprise, for example, two
25 folds 96, while the element 94 comprises, for example, only one fold 96. In this case, a number of elastic elements 93, 94, 95 form a spring system 61 which is similar to the spring system 61 of Fig. 3. The elements 93, 94, 95 may be fitted on a support element 68, for
30 example by means of an adhesive joint.

[0049] The advantageous operation of a thread brake 30 according to the invention is explained with reference to Fig. 9 in which a thread 3 with a knot 97 passes through the thread brake 30 while the thread brake 30
35 applies a brake force to the thread 3 by means of the actuator 41. As can be seen, the second flexible brake

element 60, more particularly the plate 62 of the flexible brake element 60, can make way at the knot 97 to allow the knot 97 to pass. This is possible because the spring system 61 allows for the necessary way to be made. The thread brake 30 can in this case also maintain the necessary brake force since the actuator 41 and the spring system 61 furthermore allow the brake elements 40 and 60 to be pushed towards one another at locations where there is no knot 97.

10 [0050] In the embodiment from Fig.10, the thread brake comprises a first brake element 40, a second brake element 60 and an actuator 100. The first brake element 40 is displaceable and can be forced against the second brake element 60 by the actuator 100 in order to brake
15 a thread. The second brake element 60 is of flexible and elongate design, comprises a flexible plate 62 and is distributedly supported along its length by a spring system 61, for example a spring system 61 similar to the spring system as shown in Fig. 2. The actuator 100
20 is a rotational actuator and comprises a transmission element 101, for example a lever that is pivotable around an axis 102, which transmission element 101 is provided between an actuator element 103, e.g. a coil mounted on the transmission element 101, and a support
25 104 for supporting the flexible plate 42 of the first brake element 40. The support 104 is pivotable around a hinge 105 with respect to the transmission element 101. The actuator element 103 can be actuated by a control unit 28 and is moveable with respect to a stator 106 of
30 the actuator 100. The stator 106 can comprise a magnet mounted stationary in the actuator 100. The actuator 100 is attached to the frame 37 near the thread guide 38. In an alternative embodiment (not shown) the actuator 100 can be arranged near the thread guide 39.

35 [0051] In order to prevent vibrations when energizing an actuator 41, 84, 85, 100 it may be advisable, when

energizing the actuator, to energize the actuator first with a set current for a short time, then not to energize the actuator for a short time, and then to energize the actuator at the current set for the brake
5 force for the remaining time of the braking operation. This makes it possible to limit the impact load between the brake elements 40, 60 when the at least one actuator is energized, which is advantageous for preventing thread breakage during braking.

10 [0052] According to a variant embodiment (not shown), it is possible to use a fixed connection instead of a pivot joint 55 between the pin 52 and the pressure-exerting element 43 or between the pin 52 and the brake
15 element 40. A pivot joint, more particularly a ball joint or an elastic hinge has the advantage that the actuator has to be aligned less accurately with respect to the brake elements. According to a variant, a hinge connection can be used which allows pivoting about a rotary shaft, for example about a rotary shaft which is
20 arranged perpendicular to the direction of movement of the thread to be braked or about a rotary shaft which is arranged according to the direction of movement of the thread to be braked.

[0053] According to a variant embodiment (not shown),
25 the spring system according to the invention may be formed by at least one elastic element which consists of a folded band. The expression folded band is understood to mean a band which has been folded alternately several times. A folded band may in this
30 embodiment have a shape which is similar to the shape of the elastic elements 71, 93, 94 or 95. Such a folded band may, for example, be a rubber band or a band made from a polymer.

[0054] Above, the thread brake 30 for the thread 3 has
35 been described in more detail. Obviously, the thread

brakes 31 and 32 for the threads 4 and 5 may be of identical design. Of course, each of the thread brakes 30, 31, 32 may be designed according to a variant embodiment of the invention.

5 [0055] The thread brake 30, 31, 32 according to the invention makes it possible to modify the brake force between the brake elements 40, 60 while braking a thread by means of the control unit 28 in accordance with a profile. This makes it possible to brake a weft
10 thread in accordance with a certain profile during insertion of the weft thread in the shed of a weaving machine. In this case, the brake force of the brake elements 40, 60 on the thread may both be increased or decreased by controlling the force which the actuator
15 41, 84, 85 exerts on the brake element 60 via the brake element 40.

[0056] For example, in particular when used in combination with a gripper weaving machine, the brake force is set to a high value at the start of an
20 insertion of the weft thread in the shed, is then lowered during the insertion of the weft thread by the drawing gripper, is then set again to a high value for the transfer of the weft thread from a drawing gripper to a receiving gripper, is lowered again during the
25 insertion of the weft thread by the receiving gripper and is then increased again towards the end of the insertion of the weft thread by the receiving gripper.

[0057] At least in the range where the brake elements 40 and 60 contact the thread or weft thread, the brake
30 elements 40 and 60 are made from wear-resistant material, for example from steel or strip steel. According to a variant, the brake elements 40 and 60 may be provided with a wear-resistant coating, at least at their brake portions 46 and 66.

[0058] Obviously, the actuators 41, 84, 85, 100 are not limited to the illustrated embodiments, but may comprise any actuator whose force and/or position can be controlled. For example, the actuator may be formed
5 by a linear actuator, a so-called "voice coil" actuator or any other kind of actuator.

[0059] According to a variant (not shown), the thread guide 38 may be replaced by, for example, a thread guide at the exit of the rewinder 24, while the thread
10 guide 39 can be replaced by a thread guide of the thread monitor 27. In this case, the distance between the rewinder 24 and the thread brake 30 and/or the distance between the thread brake 30 and the thread monitor 27 has to be relatively small. According to a
15 variant (not shown), the thread guide 39 may, for example, also act as the thread monitor.

[0060] The thread brake according to the invention may be used for braking different kinds of yarns, for example wool, flax, chenille and other yarns. The
20 thread brake according to the invention is particularly suitable for braking heavy, coarse or delicate yarns containing irregularities.

[0061] The thread brake according to the invention, which is illustrated and described in the exemplary
25 embodiments, for braking a thread 3, 4, 5, such as a weft thread of a gripper weaving machine, may of course also be used for braking threads or weft threads on other types of weaving machines, for example air
weaving machines, water jet weaving machines,
30 projectile weaving machines or yet other types of weaving machines. Such weaving machines may be used for weaving different types of fabric, for example flat woven fabric, terry fabric, so-called tire cord fabric and yet other types of fabric. Of course, the thread
35 brake according to the invention can also be used for

braking a thread on other types of textile machines, for example on bobbin winders, beaming machines, knitting machines or other textile machines in which a thread has to be braked.

- 5 [0062] The thread brake and the method according to the invention defined by the claims are not limited to the exemplary embodiments illustrated and described by way of example, but may also include variants and combinations thereof which are covered by the claims.

Claims

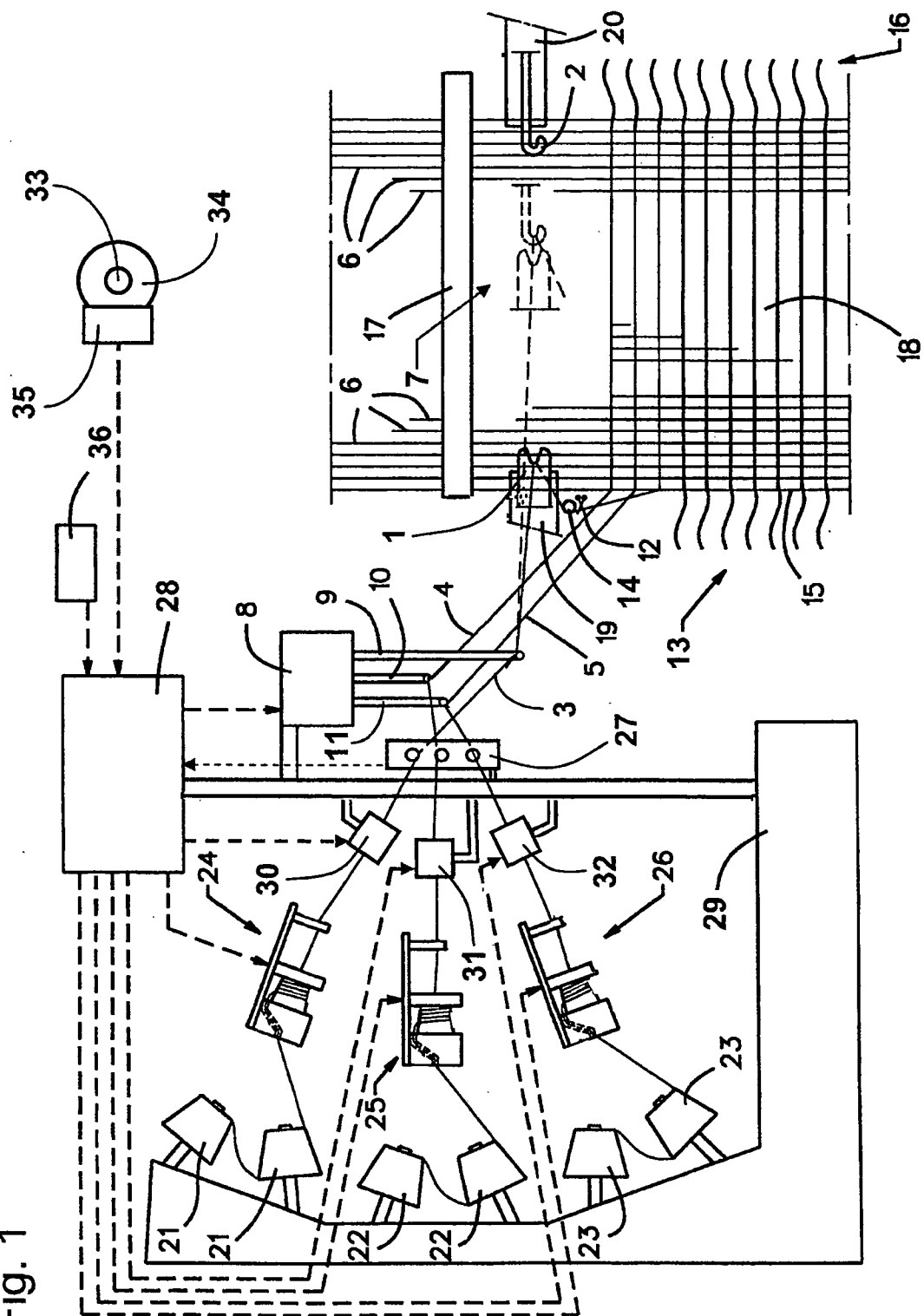
1. Thread brake which comprises a first brake element (40), a second brake element (60) and at least one actuator (41; 84, 85), wherein the first brake element (40) is displaceable and can be forced against the second brake element (60) by the at least one actuator (41; 84, 85) in order to brake a thread (3, 4, 5), characterized in that the second brake element (60) is of flexible and elongate design and is distributedly supported along its length by a spring system (61).
5
2. Thread brake as claimed in claim 1, characterized in that the second brake element (60) comprises a flexible plate (62), more particularly a thin flexible plate (62).
15
3. Thread brake as claimed in claim 1 or 2, characterized in that the second brake element (60) contacts the spring system (61) at several distinct contact points (63).
- 20 4. Thread brake as claimed in one of claims 1 to 3, characterized in that at least one elastic element (71; 93, 94, 95) having at least one fold (67; 96) is used as spring system (61), more in particular a polymer element or a rubber element.
- 25 5. Thread brake as claimed in one of claims 1 to 4, characterized in that the at least one actuator (41; 84, 85) comprises an actuator element (47) for applying an adjustable brake force.
- 30 6. Thread brake as claimed in claim 5, characterized in that the actuator element (47) is supported by at least one spring element (53, 56).

7. Thread brake as claimed in claim 5 or 6, characterized in that the actuator element (47) exerts a force on the first brake element (40) via a pivot joint (55).
- 5 8. The thread brake as claimed in one of claims 1 to 7, characterized in that two or more actuators (84, 85) are provided in order to generate a variable force between the brake elements (40, 60) along the direction of movement (A) of the thread
10 (3, 4, 5) to be braked.
9. Thread brake as claimed in one of claims 1 to 8, characterized in that the at least one actuator (41; 84, 85) is designed as a linear electric motor.
- 15 10. Thread brake as claimed in one of claims 1 to 9, characterized in that the first brake element (40) comprises a thin elongate flexible plate (42) which interacts with a stiff pressure-exerting element (43).
- 20 11. Thread brake as claimed in claim 10, characterized in that the stiff pressure-exerting element (43) comprises a plate (77), the edges (78, 79) of which are bent parallel to the direction of movement (A) of the thread (3, 4, 5) to be braked,
25 preferably in the direction towards the second brake element (60).
12. Thread brake as claimed in one of claims 1 to 11, characterized in that the edges (75, 76) of the first brake element (40) are bent parallel to the
30 direction of movement (A) of the thread (3, 4, 5) to be braked, preferably towards the second brake element (60).

13. Thread brake as claimed in one of claims 1 to 12, characterized in that, in use, the first brake element (40) is arranged on top of the second brake element (60).
- 5 14. Method for controlling a thread brake as claimed in one of claims 1 to 13, characterized in that a brake force of the thread brake (30, 31, 32) is adjusted during the insertion of a weft thread (3, 4, 5) into the shed of a weaving machine.

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Fig. 1



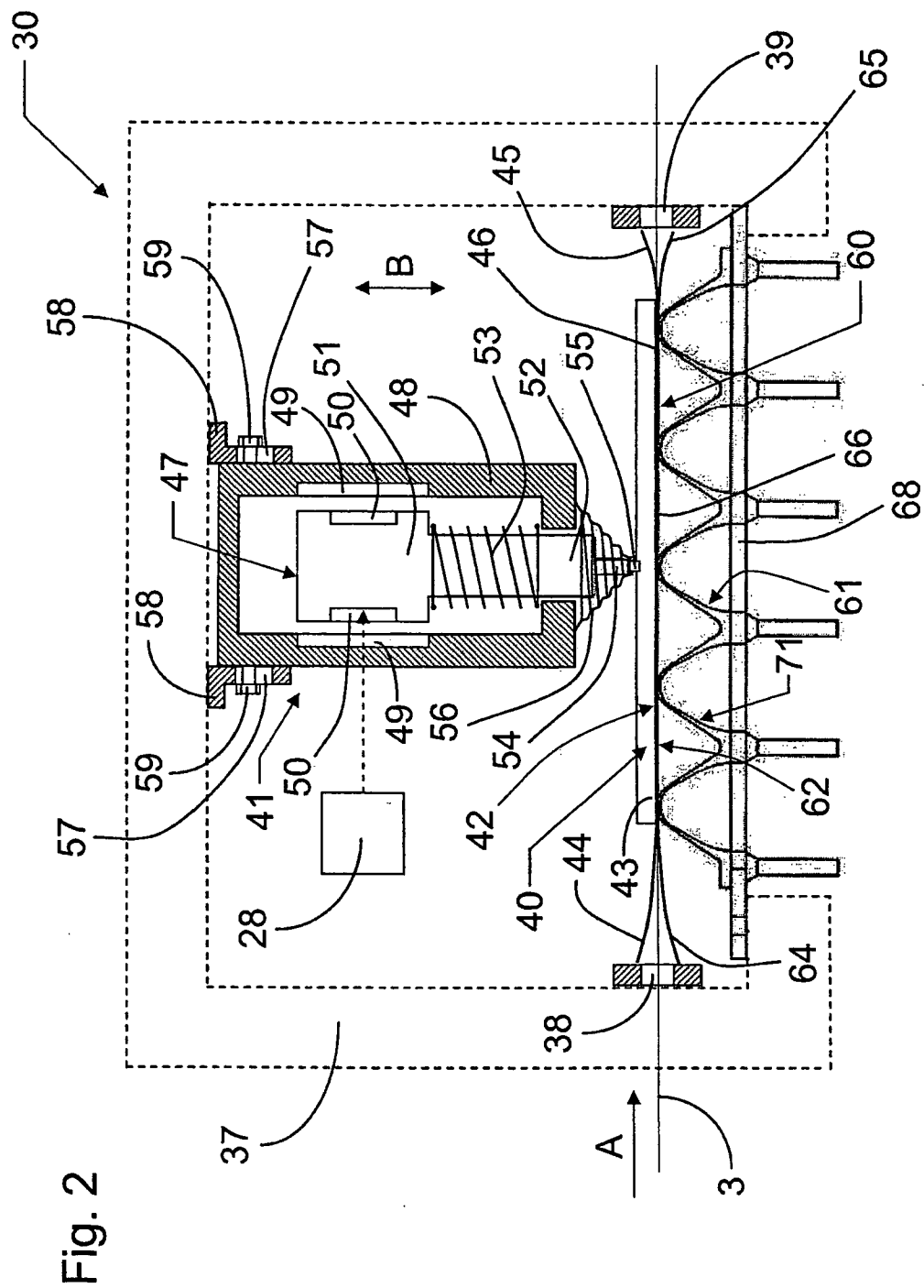


Fig. 3

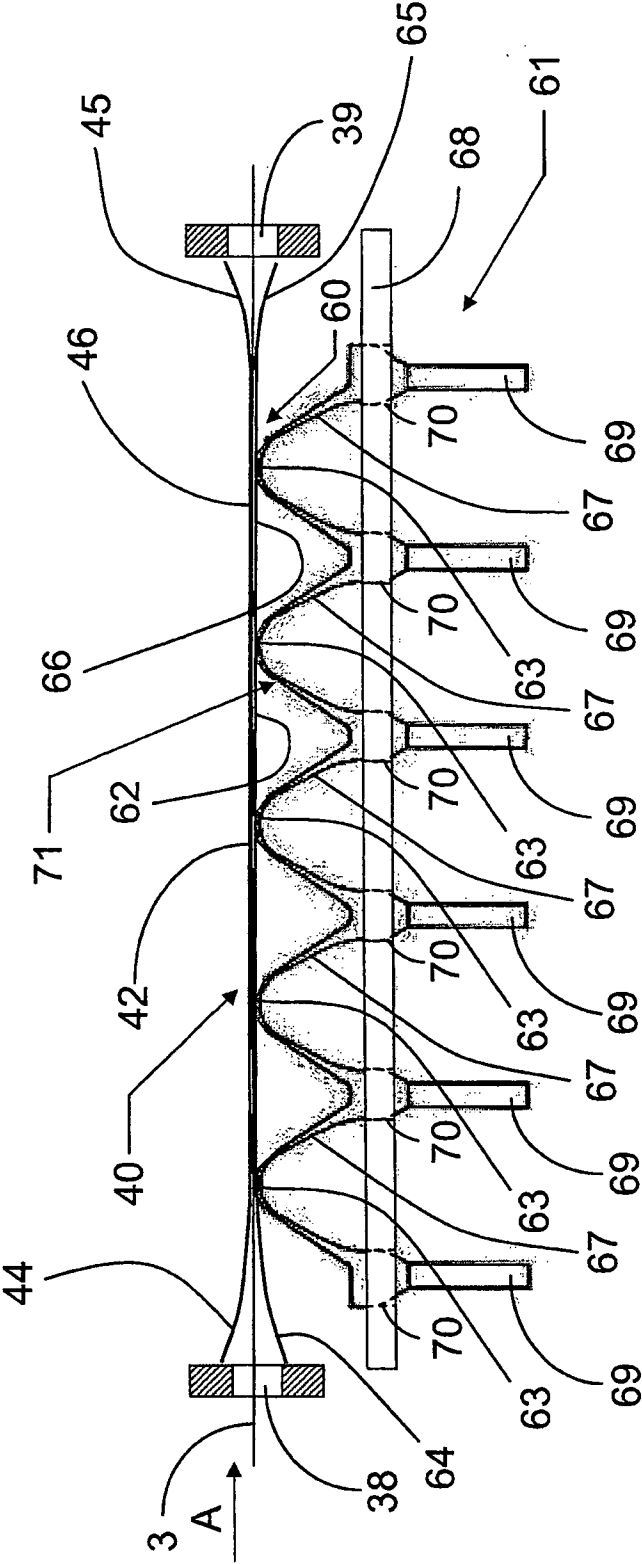


Fig. 4

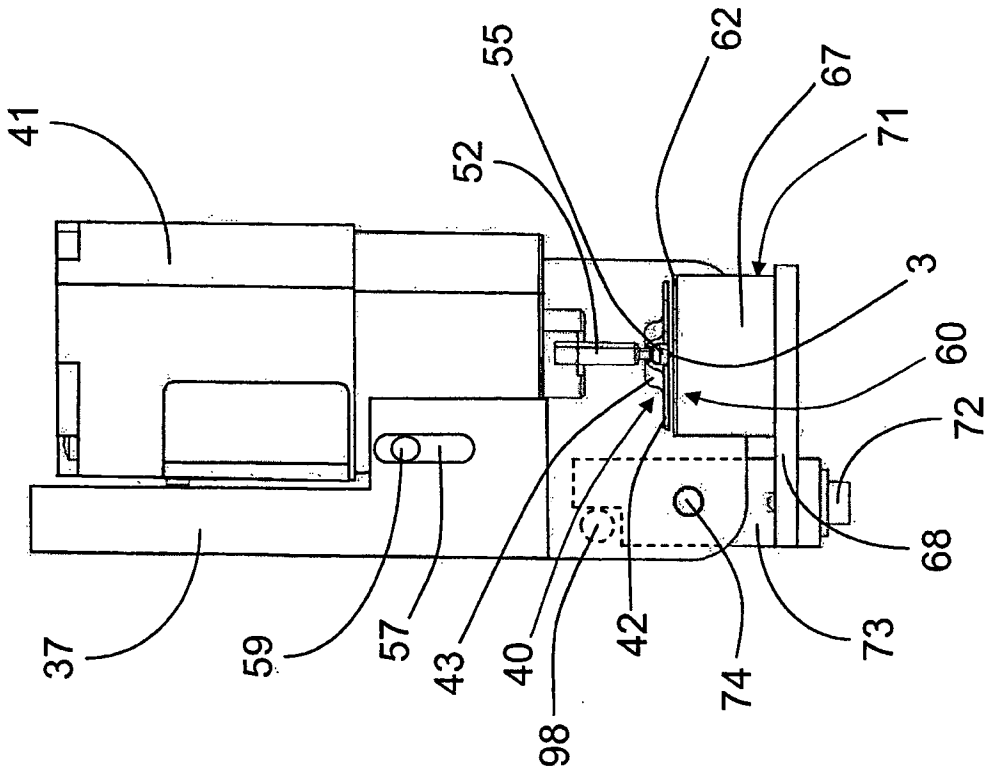
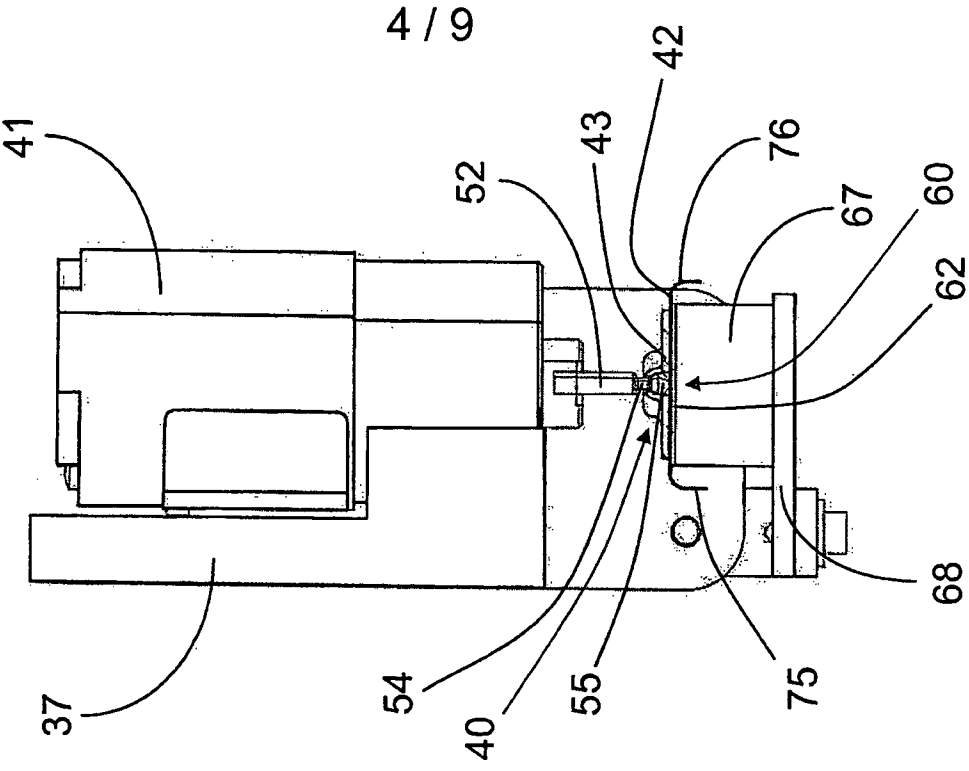
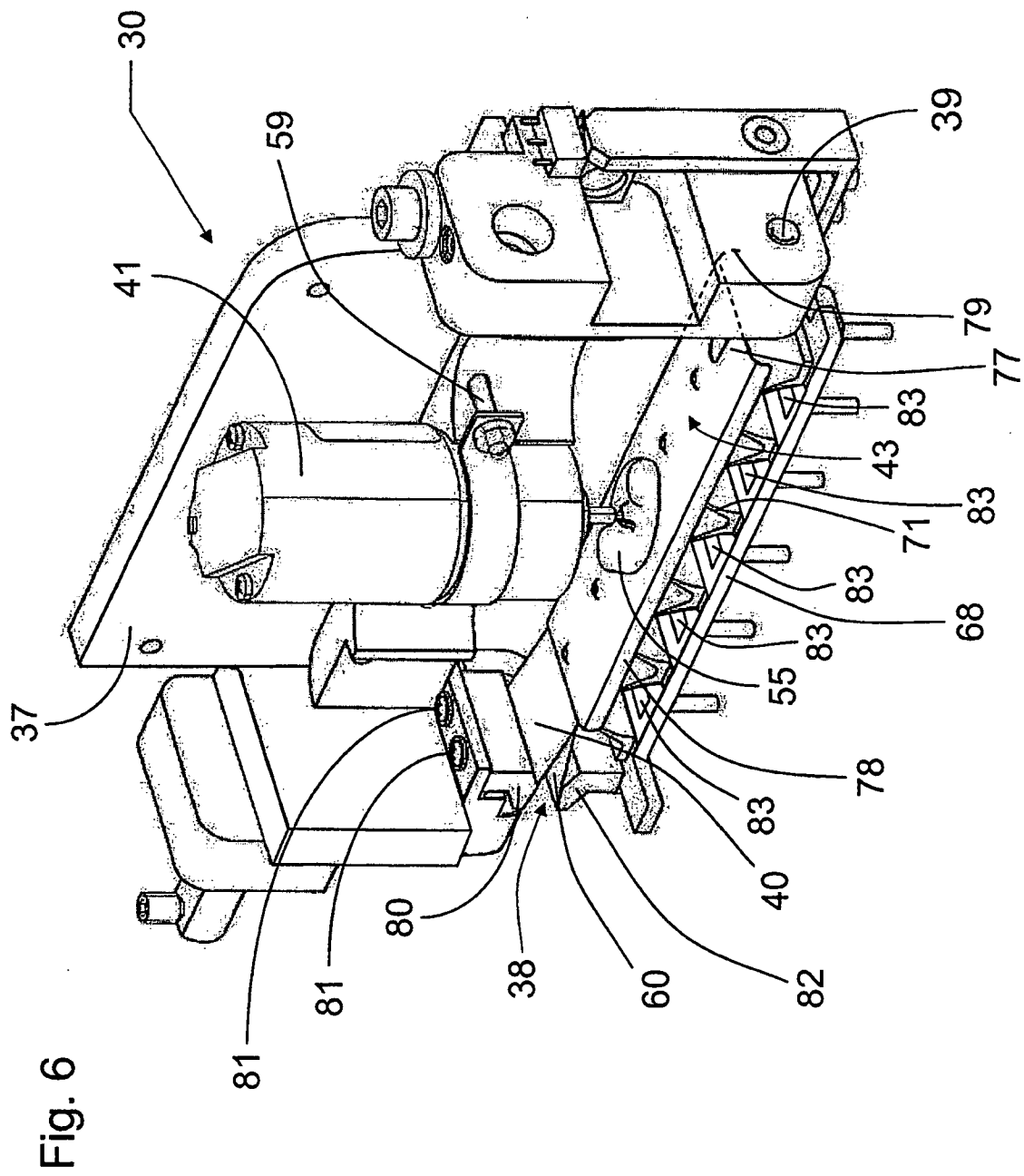


Fig. 5





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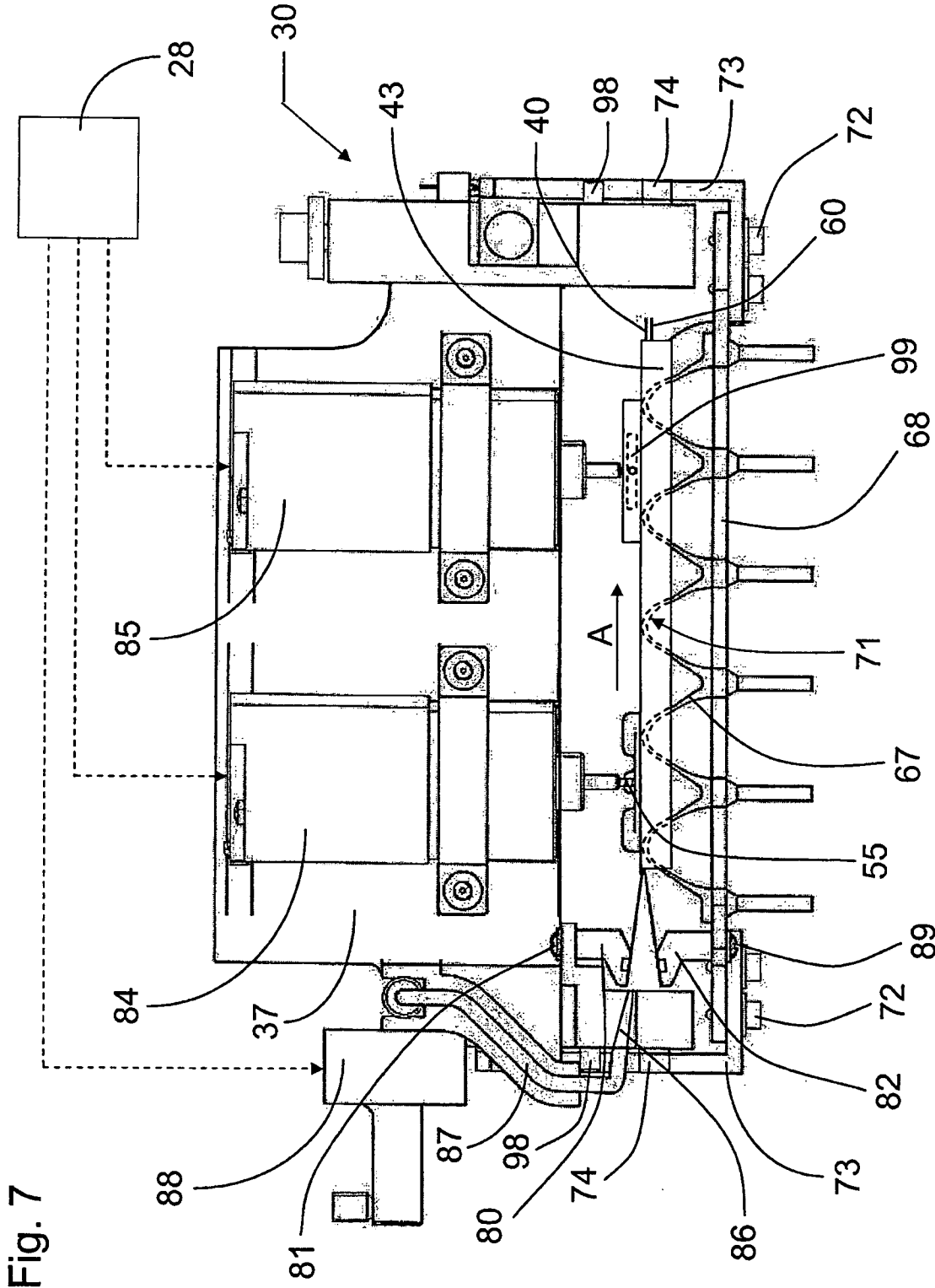


Fig. 7

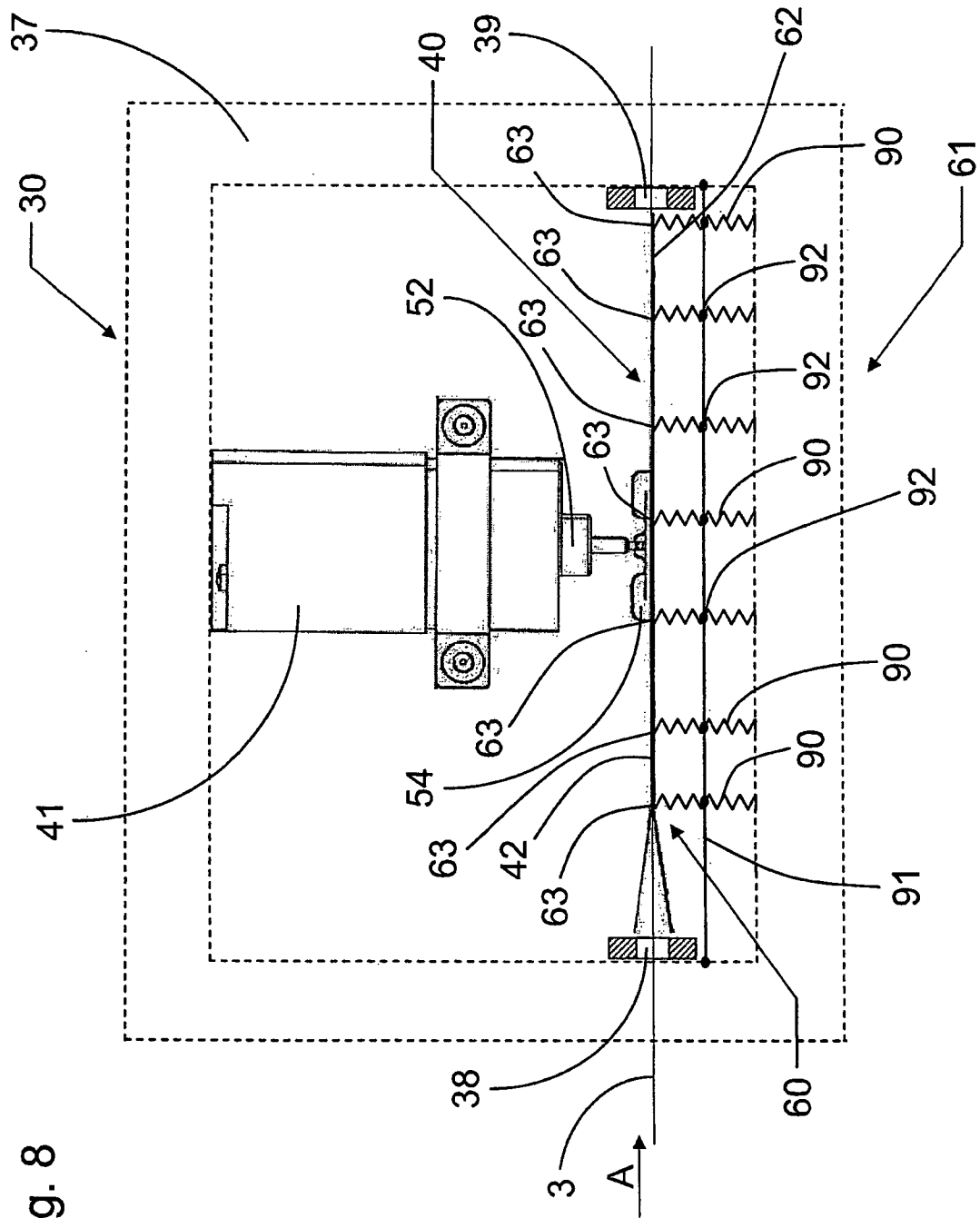
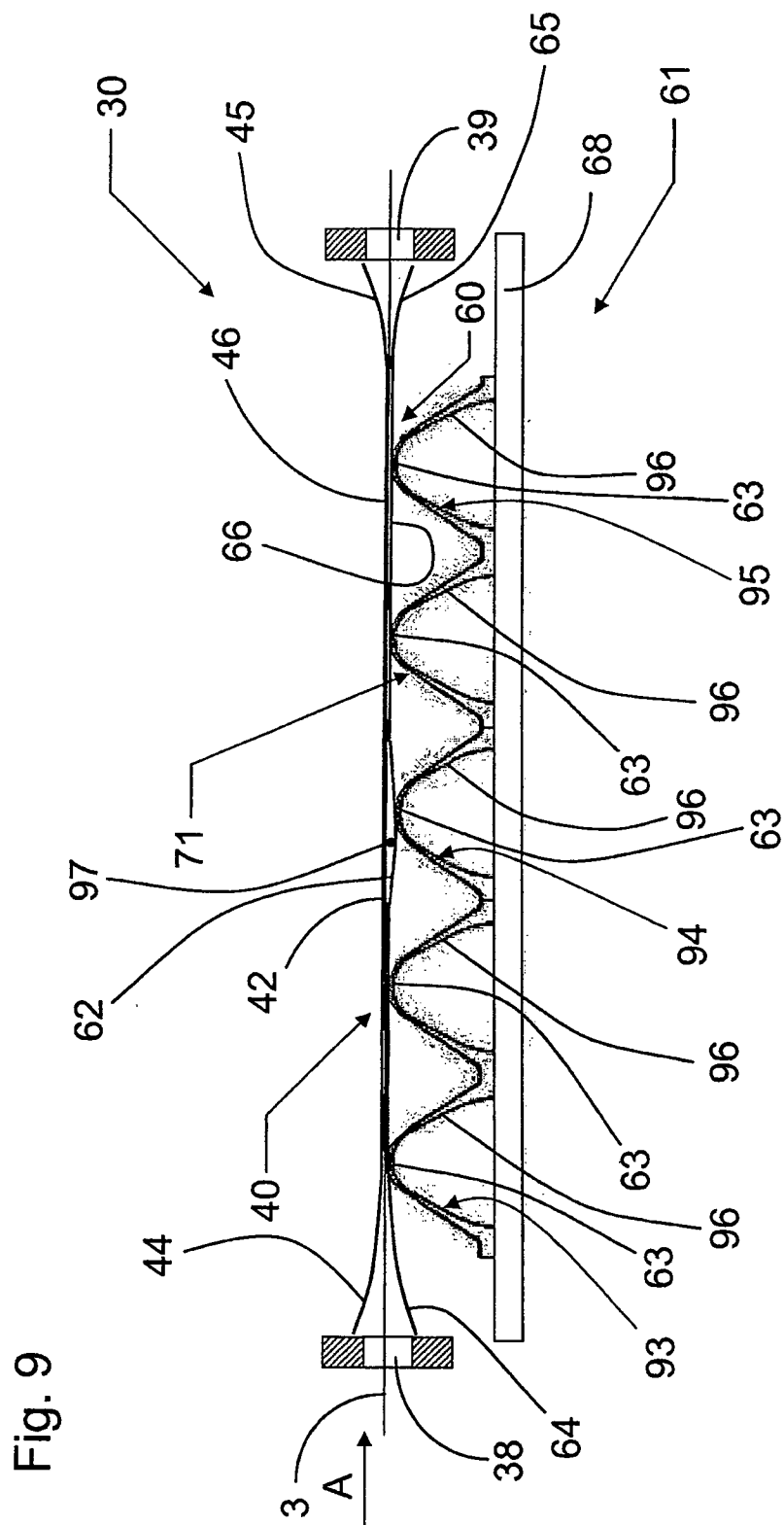
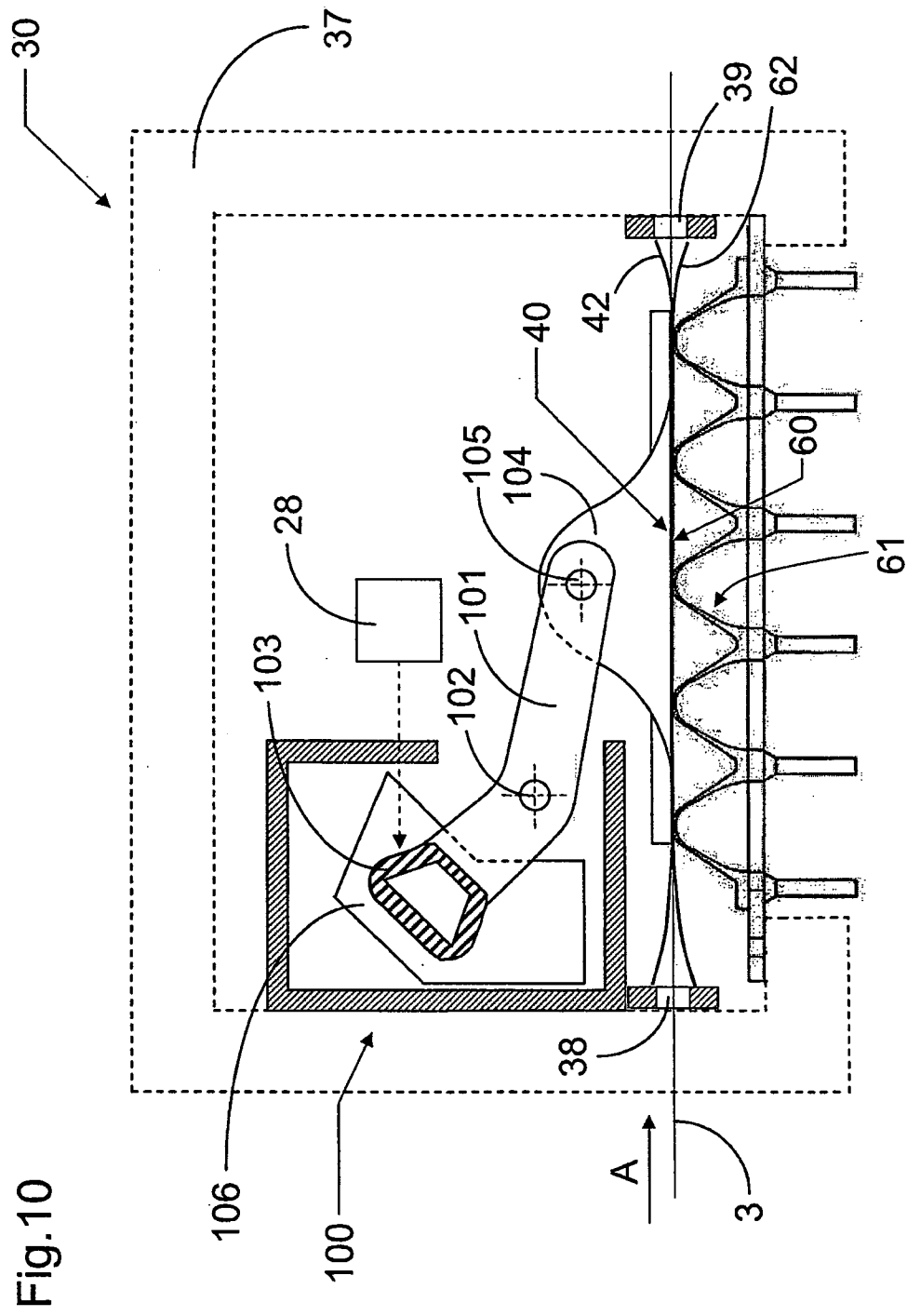


Fig. 8





INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/007692

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65H59/24 D03D47/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65H D03D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 633 711 A (PFARRWALLER ERWIN) 11 January 1972 (1972-01-11)	1-3, 5-6, 8, 14
Y	column 1, lines 25-70 column 2, lines 35-38 column 2, lines 56-70 column 3, line 72 - column 4, line 30 column 5, lines 56-60 column 6, lines 30-33; figures	4, 10-11
Y	EP 1 785 383 A1 (IROPA AG [CH]) 16 May 2007 (2007-05-16) paragraph [0010]; figure 4	4
Y	BE 1 010 389 A3 (PICANOL NV [BE]) 7 July 1998 (1998-07-07) cited in the application. figure 14	10
-/-		

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

15 December 2009

Date of mailing of the international search report

28/12/2009

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2009/007692

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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