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(54) **GRIPPER UNIT, CONTROL SYSTEM FOR A GRIPPER UNIT AND WEAVING MACHINE**

GREIFEREINHEIT, STEUERSYSTEM FÜR EINE GREIFEREINHEIT UND WEBMASCHINE

UNITÉ PRÉHENSILE, SYSTÈME DE COMMANDE POUR UNITÉ PRÉHENSILE, ET MÉTIER À TISSER

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Description

[0001] The invention relates to a gripper unit, a control system for a gripper unit and a weaving machine comprising a gripper unit and/ora control system for a gripper unit.

[0002] In a rapier weaving machine, a weft thread or yarn is transported at high speed and with high accelerations by means of at least one gripper. In most rapier weaving machines, a weft thread is transported by means of two grippers that move in opposite directions through an open shed, in particular a drawing gripper and a taker gripper. Hereby a weft thread coming from a bobbin is presented to and taken up by a drawing gripper for being inserted to the middle of the shed. In the middle of the shed the weft thread is presented by the drawing gripper to and taken up by a taker gripper for being inserted to the further side of the shed. Each gripper is fixed to a flexible gripper band or to a rigid gripper rod for reciprocally moving through an open shed. A gripper comprises a holder for holding a weft thread, in particular a clamp for clamping a weft thread.

[0003] It is known to provide a gripper with a holder or a clamp that can take up a weft thread while the holder or clamp is closed. These grippers are also referred to as "negative grippers". Grippers having a holder or clamp that is opened actively and closed actively for holding or clamping a weft thread are referred to as "positive grippers". Positive grippers generally co-operate with a device to open the holder or clamp. However, these devices have often quite a large inertia and are therefore limited in speed.

[0004] EP 0 309 700 A1 shows a positive gripper having a thread clamp to which an adjustment means is assigned, which adjustment means comprises a control strip mounted for pivotal movement near the gripper, the thread clamp having a stop cam engageable against the control strip with movement of said gripper to move said thread clamp to release a weft thread.

[0005] WO 2004/035891 A2 and GB 1116907 relate to a positive gripper having a clamp, wherein a jaw of the clamp is moveable between two positions and may be fixed in a first position using an auxiliary energy, while spring forces are acting on the clamp in order to bring the jaw into the second position. When stopping a supply of the auxiliary energy, the jaw is released and moved by the force of the spring to the second position.

[0006] EP 1 867 766 A1 shows a positive gripper having a thread clamp actuated by means of a magnetic force.

[0007] WO 02/095105 A1 describes a thread clamp for a weaving machine comprising a pneumatically moveable part for moving a clamp between two positions, wherein this part may be moved by means of a negative pressure in order to bring the part in a first position and by means of an overpressure in order to bring the part in a second position. A pneumatically controllable thread clamp for a weaving machine is also known, wherein a valve for controlling a compressed air supply to a pneumatic actuator is stationary mounted on the weaving machine and is communicating with the pneumatic actuator in the weft thread clamp via a supply duct.

[0008] EP 0 984 089 A1 shows a thread clamp using a pneumatic force, wherein a first device for adjusting a clamping force and a second device for actuating the first device are provided. The second device is arranged stationary and connected to a stationary control valve via ducts.

[0009] It is the object of the invention to provide a positive gripper, wherein a holder or clamp of the gripper may be closed or opened at high speed without disturbing the weaving process.

[0010] This object is achieved by a gripper unit with the features of claim 1 or 2. The gripper unit comprises a pneumatic actuator for moving the thread holder, in particular for opening and/or closing the thread holder.

[0011] In accordance with the invention, a valve is arranged adjacent to the pneumatic actuator of the gripper. In one embodiment, the exit of the valve to the actuator coincides with the inlet of the actuator. By placing the valve close to the gripper, a fast response of the pneumatic actuator is possible and the amount of compressed air between the valve and the pneumatic actuator may be minimized. Also a pressure drop between the valve and the pneumatic actuator may be avoided. The use of a pneumatic actuator is advantageous, because relatively high forces may be exerted for moving the thread holder, while the valve may be opened or closed with low energy consumption. The design of the valve is preferably adapted to the pneumatic actuator. In a preferred embodiment, an electromagnetic valve is used.

[0012] In a preferred embodiment, the valve is a 3/2 valve that in one position, preferably in an actuated position, is open to allow compressed air to flow to the pneumatic actuator, while in another position the compressed air is allowed to escape out of the pneumatic actuator to the environment. One exit of the 3/2 valve is connected to a compressed air supply, one exit is connected to the environment and one exit is connected to the pneumatic actuator. According to a preferred embodiment, a 3/2 valve may comprise a pivotable element with valve elements that is constructed so that the centre of gravity of the pivotable element coincides with the pivot axis of the pivotable element. If the pivotable element is arranged transversely with respect to the moving direction of the gripper, then the acceleration forces on this pivotable element will have no influence on the actuating of the valve, this means on the position of the valve elements.

[0013] Generally, there is a time delay between the opening of the valve and the opening of the thread holder due to the inertia of the thread holder and the inertia of the pneumatic actuator. In particular, the inertia causes that when the valve is opened during a first time interval, the thread holder will be open during a second time interval. This second time interval starts some time after the start of the first time interval and ends some time after

the end of the first time interval. In a particular embodiment, when the thread holder is closing while compressed air is allowed to escape out of the actuator, the valve may be re-opened during a short time interval in order to minimize an impact of the thread holder on the weft thread. In a further embodiment, several time intervals of opening the valve may follow each other during one single opening or closing sequence of the thread holder in order to control the extent and the velocity of the opening and/or closing of the thread holder. In this way, the extent and the velocity of the opening and/or closing of the thread holder may be controlled by controlling the moment on which and the time during which the valve of the gripper unit is opened. As an alternative or in addition, the extent and the velocity of opening and/or closing of the thread holder may be controlled by controlling the pressure of the compressed air in a storage tank that supplies compressed air to the valve and/or the pressure of the compressed air supplied to the storage tank. The pressure in the storage tank may be controlled and adapted during weaving, for example depending on the kind of weft thread and/or depending on the weft thread parameters. This also allows limiting the impact forces on the thread and on the thread holder.

[0014] In one embodiment, the gripper unit comprises an electrical switch element, wherein the valve is controlled by the electrical switch element. The electrical switch element comprises a receiving device in order to receive control signals from a transmitting device of the control device, such as trigger signals for controlling the switch element, more particularly for activating the switch element. The electrical switch element comprises an activating device to activate the valve in function of trigger signals, in particular for starting an opening or closing of a holder and for synchronising an opening and closing of the holder with the weaving machine. Hereby, the control device may trigger the electrical switch element of the gripper according to a protocol. The switch element may for example be controlled via an electrical line integrated in the gripper band, as is known from JP 9031800 A. The switch element may also be controlled wireless, which makes extra lines to the switch element superfluous, thus avoiding the need for a dedicated gripper band or activation elements running through the warp threads in the shed. According to one embodiment, the electrical switch element is controlled via optical signals, for example via a light beam, such as an infrared light signal. Using infrared light signals reduces the risk that influences due to visible light disturb the working of the electrical switch element. Preferably, the receiving device is arranged in order to receive optical signals running essentially parallel to the gripper path, for example in the weft insertion direction. Using diodes for generating an infrared light beam may be advantageous, since this requires less alignment than for example a laser beam. In another embodiment, radio signals are received by the receiving device for activating the electrical switch element. In one embodiment, the electrical switch element also comprises a transmitting device to send signals to the control device. In this way the switch element may communicate bi-directionally with the control device, preferably using a protocol and/or a modulated signal. In this way the risk that an arbitrary signal is interpreted as being a trigger signal is reduced. For controlling the valve, in particular for activating the valve, a time delay between a triggering signal for activating the valve and the starting of the opening and/or closing operation may be tolerated, if the time delay can be predicted.

[0015] According to another embodiment, the gripper unit also comprises a storing element, in particular a capacitor, for storing electrical energy for the electrical switch element and/or the at least one valve. A small and lightweight capacitor may be chosen. As mentioned above, the valve may be chosen so as to operate with low energy consumption. As a result, a small electrical storing element such as a capacitor may be used to supply enough energy in order to control the electrical switch element and/or the at least one valve. The amount of electrical energy stored in the storing element should be at least enough for a weaving cycle. Preferably, the amount is enough for at least two weaving cycles, such that a sole loading error of the capacitor is harmless or such that a number of openings of the valve are possible. In another embodiment, an electrical switch element may be used that is able to switch with an amount of energy supplied to the switch element by the triggering signal from the control device, so that no energy storage for the switch element is required.

[0016] According to the invention, the gripper unit also comprises a storage tank for storing compressed air for the pneumatic actuator and for supplying compressed air to the pneumatic actuator. Preferably, the outlet of the storage tank is situated in the vicinity of the at least one valve of the gripper unit. In one embodiment the size of the storage tank may be chosen so that enough compressed air is stored in the storage tank in order to open the thread holder at least once in the weaving cycle. In another embodiment the size of the storage tank may be chosen so that a sufficient amount of compressed air may be stored in order to deal with the compressed air loss due to leakage, in order to overcome a sole error in the process for supplying compressed air to the storage tank between two weaving cycles, in order to allow to open the valve a second time in a weaving cycle and/or to provide an additional opening period for opening the valve during slow operation of the weaving machine. In an embodiment less storage tank capacity is needed if outside the shed the thread holder is opened during the supplying of compressed air to the storage tank.

[0017] The pressure in the storage tank may be chosen suitably, for example around 5 bar, which allows to store sufficient compressed air and to minimise the amount of compressed air between the storage tank and the pneumatic actuator. This is also advantageous to keep the size or the volume of the storage tank low. Providing a storage tank close to and preferably on the gripper allows

that moving supply ducts for supplying compressed air to the storage tank may be omitted. In this way no supply ducts may come into contact with warp threads. Therefore the gripper according to the invention is "warp friendly". Also as no supply ducts move with the gripper, no additional forces due to moving supply ducts act on the gripper or on the gripper band, such that less wear due to external forces occurs.

[0018] In accordance with an embodiment, the storage tank is provided with a supply tube or inlet, via which the storage tank may be connected to a supply device for supplying compressed air to the storage tank. The supply tube or inlet may be formed as a drill-hole allowing a connection with a stationary tubular element for supplying compressed air to the storage tank. In one embodiment the inlet is arranged so in order to receive a tubular element extending in parallel to the weft insertion direction. Preferably, a return valve is provided at the inlet of the storage tank. The return valve allows compressed air to be supplied to the storage tank, but prevents the compressed air to escape from the storage tank via the inlet.

[0019] According to another embodiment, at least one return force element is provided for forcing the thread holder in a closed position, wherein the actuator forces the thread holder in an opened position against the force of the return force element. When providing a return force element the thread holder or thread clamp may be forced in a closed position for holding the weft thread. A return force element may for example be embodied as a spring.

[0020] In a preferred embodiment, the pneumatic actuator is a pneumatic piston. In one embodiment, the pneumatic piston comprises an own vent in order to allow air to escape out of the piston when the piston arrives in a predefined position. When using a 3/2 valve, preferably, the valve is already closed at this moment in order to save compressed air. Using a vent allows closing the weft holder in a short time if use is made of a return force element to this end. The air escapes out of the actuator via the 3/2 valve and via the vent. The vent may comprise several bore holes that are arranged in different locations on the piston, in particular in different locations along the moving direction of the piston.

[0021] The object of the invention is further achieved by a system according to claim 10 or 11. The control system comprises a control device used to controll an opening and/or a closing the valve at set moments in the weaving cycle. The control device may be calibrated in order to ensure that the holder of the gripper is opened and/or closed at the right moments in the weaving cycle. It may be advantageous to repeat a calibration after a number of weaving cycles in order to avoid errors due to wear, compressed air escape, etc. The opening and/or closing moments of the holder of the gripper in the weaving cycle may be controlled separately for each insertion by the control device, so that no mechanical settings are needed and so that for each separate insertion the best setting may be provided. Of course, outside the shed the thread holder of each gripper may also be opened and/or closed by means of additional mechanisms such as described for example in WO 2003/04746 or WO 97/40218. Such additional mechanisms arranged outside the shed may also be used to limit the extent of the opening of the thread holder of a gripper. Outside the shed, the drawing gripper may be opened while or just after the storage tank of the gripper unit is provided with compressed air. The taker gripper may be opened while or just after the storage tank of the gripper unit is provided with compressed air.

[0022] For a handover of a weft thread from the drawing gripper to the taker gripper, the pneumatic actuator of each gripper is preferably actuated during a small time interval by means of compressed air supplied from the storage tank to the pneumatic actuator via the at least one valve that is mounted close to or on the drawing gripper or close to or on the taker gripper, respectively.

[0023] Preferably, the control device and an electrical switch element are provided and used for wirelessly triggering an opening and/or a closing of the thread holder via the valve of the gripper unit for controlling a compressed air supply to the pneumatic actuator of the gripper unit, in particular by activating and/or deactivating said electrical switch element of the gripper unit. In one embodiment, the control device comprises at least one diode for generating an infrared light beam. When using infrared-light the risk that influences due to visible light disturb the working of the control device is reduced. Preferably, the control device triggers the electrical switch element of the gripper according to a protocol. The control device comprises a transmitting device for generating trigger signals, while the electrical switch element arranged on the gripper comprises a receiving device that complies with the triggering device for receiving trigger signals. Preferably, the control device as well as the electrical switch element both have a transmitting device and a receiving device for sending and receiving signals. Preferably, a protocol is used, wherein signals are followed by confirmation signals in order to reduce the risk that arbitrary signals are interpreted as triggering signals.

[0024] In another embodiment, the gripper unit comprises a storing element for storing electrical energy for the electrical switch element and/or the at least one valve and the control system further comprises an electrical loading device for loading said storing element, in particular said capacitor, wherein the loading device is shaped and arranged such that the gripper unit can pass along the loading device. In a preferred embodiment, the electrical loading is achieved via contact elements, such as contact strips or brushes connected to an electrical source that may make contact with contact elements of the gripper unit and connected to the storing element. Contact strips are known and described for example in JP 9031800 A. For loading the storing element, in particular the capacitor, with electrical energy it is preferred to supply only energy when the contact strips are sufficiently in mutual contact with the contact elements. In other words, an electrical energy source is controlled so

that only during periods of sufficient mutual contact of the strips and the contact elements of the gripper electrical energy is supplied for loading the storing element. Therefore unfavourable generation of sparks is avoided. Because the amount of energy used for each insertion is small, this limited time of loading is sufficient for loading enough energy. According to an alternative embodiment, the capacitor is inductively loaded, as described for example in CH 455664. Other ways for supplying electrical energy are possible.

[0025] The object is further achieved by a weaving machine comprising at least one gripper unit and/or a weaving machine comprising at least one system comprising a gripper unit and control system. In one embodiment, only one gripper unit, preferably the gripper unit comprising the drawing gripper is embodied according to the invention, whereas the other gripper unit, for example the gripper unit comprising the taker gripper is not embodied according to the invention.

[0026] In the following, some embodiments of the invention are described in more detail based on several schematic drawings in which:

Fig. 1 is a schematic, perspective view of a part of an insertion system with a gripper unit for a gripper weaving machine.

Fig. 2 is a schematic, perspective view of a gripper unit with a taker gripper.

Fig. 3 is a schematic, partially cutaway top view of the gripper of Fig. 2 in opened position of the thread holder.

Fig. 4 is a schematic, perspective view of the gripper of Fig. 2 and a pneumatic supply device.

Fig. 5 is a schematic, cutaway view of the gripper of Fig. 2 and a variant of the pneumatic supply device of Fig. 4.

Fig. 6 is a schematic, perspective view of the gripper of Fig. 2 and an electrical loading device.

Fig. 7 is a schematic, perspective view of the gripper of Fig. 2 and a control device.

Fig. 8 is a schematic, perspective view of the gripper of Fig. 2 and a control system, arranged next to a weaving shed.

Fig. 9 is a valve used in a gripper according to the invention.

Fig. 10 is a schematic, perspective view of a gripper unit with a drawing gripper.

Fig. 11 is a schematic partially cutaway side view of a part of the drawing gripper of Fig. 10, as seen according to direction P.

Fig. 12 is a variant gripper unit according to the invention with a taker gripper.

Fig. 13 is the taker gripper of Fig. 3 in closed position of the thread holder.

Fig. 14 is the taker gripper of Fig. 3 in partially opened position of the thread holder.

Fig. 15 is a variant of the taker gripper of Fig. 3 in opened position of the thread holder.

[0027] Fig. 1 schematically shows a part of an insertion system with a gripper unit 1 arranged on a flexible gripper band 3. The gripper unit 1 comprises amongst others a gripper 2 for inserting a weft thread into a shed 7 that is arranged on the gripper band 3. The gripper band 3 may be moved reciprocally in the moving direction L by a drive wheel 4 for the gripper band 3. The drive wheel 4 is provided with teeth engaging openings 5 in the gripper band 3 and driven by a drive mechanism (not shown). A control system 6 is arranged stationary next to the shed 7. The gripper 2 shown in Fig. 2 and 3 is a taker gripper.

[0028] On the gripper 2 of the gripper unit 1 are provided a thread holder 20, a pneumatic actuator 21, a valve 22, a storage tank 23, a receiving device 24 such as an optical sensor, a storing element 25 for electrical energy, a return force element 26 such as a spring and an electrical switch element 27. The gripper 2 further comprises a frame 28 and guiding elements 29 for warp threads. The gripper unit 1 is intended to be moved by the gripper band 3 at high accelerations, at high speed and with a large stroke. Consequently, it is advantageous that the weight of the gripper unit 1 with all parts thereof should be limited. In this embodiment the valve 22, the storage tank 23 and the storing element 25 are arranged at least partially in a frame 28.

[0029] In the embodiment of Fig. 2 and 3 the weft thread holder 20, in particular the thread clamp, comprises a moveable jaw 30 that is pivotable about a pivot axis 31 and a jaw 32 that is fixed to the frame 28. The jaw 30 is formed integrally with a lever 33 and held in a closed position by the force return element 26 that is formed by a spring 34 that is acting on the lever 33 of the moveable jaw 30. For opening the thread holder 20, a piston 35 of the pneumatic actuator 21 is acting on the lever 33 against the force of the spring 34. The spring 34 forces the moveable jaw 30 in closed position. The lever 33 further comprises a stop element 36 that is able to move the moveable jaw 30 or to limit the movement of the moveable jaw 30.

[0030] In accordance with the invention, the gripper unit 1 comprises a valve 22 for controlling the compressed air supply to the actuator 21 that is arranged close to the gripper 2, in particular that is arranged on the frame 28 of the gripper 2. Preferably the valve 22 is arranged adjacent to the pneumatic actuator 21 such that the exit 40 of the valve 22 is connected to the inlet 41 of the actuator 21 as shown in Fig. 3. By arranging the valve 22 in the vicinity of the pneumatic actuator 21 a fast response to a compressed air supply to the pneumatic actuator 21 is achieved and losses due to the pressurisation of the duct between the valve 22 and the pneumatic actuator 21 may be limited.

[0031] The valve 22 is activated via an electrical switch element 27 at a suitable moment in the weaving cycle of a weaving machine. This allows opening the thread holder 20 during a set period of time for taking up and holding a weft thread. The electrical switch element 27 comprises an activating device 42 to activate the valve 22 in function

of trigger signals. In the embodiment of Fig. 3, the gripper unit 1 also comprises a receiving device 24 for trigger signals with a sensor 43 that is arranged close to the gripper 2, preferably a photodiode, which may receive a signal, in particular a visible light beam or a non-visible light beam, such as an infrared light beam, for triggering the switch element 27 of the valve 22.

[0032] The valve 22 is an electromagnetic valve. The electrical energy for the valve 22 is stored in a storing element 25, in particular in a capacitor. In order to load the storing element 25 with electrical energy, electrical contact elements 44 are provided on a peripheral surface of the gripper 2, in particular on the peripheral surface of the frame 28.

[0033] Further, the gripper unit 1 comprises a storage tank 23 for storing compressed air for the pneumatic actuator 21, which storage tank 23 is arranged close to and preferably on the gripper 2, wherein the valve 22 is located near an outlet 45 of the storage tank 23. In order to minimize the weight of the gripper unit 1, the storage tank 23 is shaped to carry just enough compressed air to ensure flawless weaving. The storage tank 23 is preferably part of the frame 28 of the gripper 2. For supplying the storage tank 23, the storage tank 23 is provided with a supply tube or inlet 46 and a return valve 47. The return valve 47 prevents that air can escape out of the storage tank 23 via the inlet 46. The amount of compressed air to be stored in the storage tank 23 is at least sufficient for opening and closing the thread holder 20 during at least one weaving cycle, this means during at least one weft insertion. In case of a taker gripper, the thread holder 20 may at least be opened during a small period of time during the handover of the weft thread from a drawing gripper to the taker gripper. The amount of compressed air may of course be chosen larger than required for a weaving cycle.

[0034] Fig. 4 schematically shows an embodiment of a pneumatic supply device 10 for supplying compressed air to a storage tank 23 of the gripper unit 1. The pneumatic supply device 10 comprises a tubular element 11 to be connected to the inlet 46 of the storage tank 23. The supply device 10 is fixed on a frame part 9 of the weaving machine. Preferably, the tubular element 11 is arranged parallel to a weft insertion direction and is connected to a source of compressed air via a control valve 12 and supply ducts 13. The control valve 12 comprises, for example, an electromagnetical actuator 14. The supply device 10 further comprises at least one guiding recesses 15 that can co-operate with a guiding element 29 mounted on the gripper unit 1 and for example arranged in order to mutually align the gripper unit 1 and the pneumatic supply device 10. Thereby, when moving these to each other, the storage tank 23 may easily be coupled to the supply device 10 via the tubular element 11 and the inlet 46 which allows to supply the storage tank 23 with compressed air.

[0035] Fig. 5 shows a pneumatic supply device 10 where a tubular element 11 is arranged to enter in an inlet of a storage tank 23 provided on the gripper unit 1. A supply duct 13 is provided on the pneumatic supply device 10 having an end 59 connected to the tubular element 11. The tubular element 11 is resiliently arranged in the pneumatic supply device 10 with respect to the end 59 by means of the spring 60. This allows that the tubular element 11 can enter into the inlet of the storage tank 23 even when both are not perfectly aligned with respect to each other.

[0036] Fig. 6 schematically shows an electrical loading device 16 having contact elements 17, for example contact strips 18 in order to make contact with electrical contact elements 44 provided on the gripper unit 1. Preferably, the electrical loading device 16 is controlled to supply electrical energy only if the contact strips 18 are in mutual contact with the contact elements 44 of the gripper unit 1. In this way an unfavourable generation of sparks is avoided. As the amount of electrical energy to be stored in the storing element 25 is small, a supply of electrical energy during a limited time interval is normally sufficient for loading the storing element 25. The electrical loading device 16 is arranged outside the weaving shed. The loading device 16 is shaped and arranged such that the gripper unit 1 can pass along the loading device 16.

[0037] Fig. 7 schematically shows a control device 37 comprising a transmitting device 38 for generating and transmitting a signal 39, such as a light emitting diode for emitting a light beam. The signal 39 is intended for triggering an opening or closing of the thread holder 20 via the valve 22. The signal 39 may be received by a receiving device 24, such as a sensor 43 provided on the gripper unit 1, for example a photo diode. In a preferred embodiment, the transmitting device 38 communicates with the receiving device 24 according to a protocol. According to a protocol, each signal is followed within a preset time delay by a second signal. The time period of one signal may be set, for example, to half a millisecond, while the time delay may be set to one millisecond. If, for example, the receiving device 24 receives two signals within that time delay, the receiving device 24 accepts these two signals as a valid trigger signal. In another embodiment, the gripper unit 1 as well as the control device 37 are provided with a receiving device and a transmitting device that may communicate in accordance with a bidirectional protocol. The accuracy of a communication may further be increased by applying a filtering, for example by ignoring signals smaller than 0,2 ms or by applying a signal modulation, for example with a square wave of 40kHz. In another embodiment, the control device 37 and the gripper unit 1 may comprise a transmitting device and/or a receiving device for a wireless communication using electromagnetic waves.

[0038] Fig. 8 schematically shows a perspective view of a gripper unit 1 with a gripper 2 and a control system 6 arranged on a frame part 9 next to a shed 7 and arranged in the direction of the reed 66 of a weaving machine. In this embodiment, the control system 6 comprises an electrical loading device 16 arranged closest to the

shed 7, a control device 37 arranged furthest away from the shed 7 and a pneumatic supply device 10 that is arranged between the loading device 16 and the control device 37. In a variant embodiment these three devices may be arranged otherwise or may be embodied as one single device forming the control system 6. As shown in Fig. 4 and 8, the guiding recesses 15 may be embodied larger than required in order to allow that the guiding elements 29 pass along and may be adapted for letting pass a signal 39, such as a light beam through the pneumatic supply device 10 to reach the receiving device 24 on the gripper 2.

[0039] The actuator 14 of the control valve 12, the contact elements 17 of the loading device 16 and the transmitting device 38 of the control device 37 are controlled by a control unit 19 of the weaving machine. The control valve 12 is connected to a source 48 of compressed air for supplying compressed air to the control valve 12. The source 48 may comprise a compressor, supply ducts, a buffer tank, valve systems and/or a pressure regulator.

[0040] As shown in Fig. 9 the valve 22 is a 3/2 electromagnetic valve having three openings and two positions. In a first position, preferably an actuated position of the valve 22, compressed air is supplied from the storage tank 23 via the channels 61 and 62 to the actuator 21 for driving the piston 35 against the force of the spring 34. In a second position, preferably a non-actuated position, as shown in Fig. 9, compressed air from the actuator 21 may escape to the environment via the valve 22, more in particular via the channels 62 and 63. The valve 22 comprises a pivotable element 49 with valve elements 50 that is constructed so that the point of gravity of the pivotable element 49 coincides almost with the pivot axis 51 of the pivotable element 49. The pivotable element 49 is arranged transversely with respect to the moving direction L of the gripper unit 1 with the gripper 2 to limit inertia forces on this pivotable element 49 due to the movement of the gripper unit 1. The pivotable element 49 may for example be moved by an attraction by an electromagnet 64, against the force of a spring 65. The actuator 21 further comprises a vent 52 having several bore holes 53 and/or 54. The bore holes 53 and 54 are arranged at different locations according to the moving direction of the piston 35. This allows that compressed air can escape out of the actuator 21 when the piston 35 has reached a defined position. The bore hole 54 may for example be omitted according to a variant.

[0041] Fig. 10 and 11 show an embodiment of a gripper unit 1 with a gripper 8 according to the invention, in particular a drawing gripper, arranged on a gripper band 3. The gripper 8 with valve 22 is arranged on the gripper band 3 via a gripper carrier 68 and the frame of the storage tank 23, while the storage tank 23 with amongst others the storing element 25, the contact elements 44, the inlet 46 and the guiding elements 29 are arranged directly on the gripper band 3. The frame of the storage tank 23 and the guiding elements 29 may form part of or be integral with the frame 28 of the gripper 8. In this embodiment a thread holder 20 comprises a fixed jaw 32 which is part of a frame 28 and a moveable jaw 30 which is pivotable around a pivot axis 31 and which is connected with a lever 33. The lever 33 is moved by a piston 35 of a pneumatic actuator 21 to open the thread holder 20 against the force of a spring 34. The gripper unit 1 with the gripper 8 also comprises a valve 22 which provides the pneumatic actuator 21 with compressed air, an activating device 42, an electrical switching device 27, a receiving device 24, a storing element 25, a storage tank 23 provided with an inlet 46, electrical contact elements 44 and guiding elements 29, so that the gripper 8 may cooperate with a control system 6 and a suitable taker gripper.

[0042] Fig. 12 shows a gripper unit 1 for a weaving machine that comprises a gripper 2 with a thread holder 20, a pneumatic actuator 21 for moving the thread holder 20 and a valve for controlling a compressed air supply to the pneumatic actuator 21. The gripper unit 1 is arranged at the height of the end of the gripper band 3 and moves together with the gripper band 3. In this embodiment amongst others the storage tank 23, the storing element 25, the valve 22, the activating device 42, the receiving device 24 and the contact elements 44 are mounted on a carrier 69 that is fixed on the gripper band 3 and the edges of which form the guiding elements 29. The frame 28 of the taker gripper 2 is arranged on the gripper band 3 in the prolongation of the carrier 69 and close to the carrier 69, so that the frame 28 moves together with the carrier 69. The actuator 21 is connected to the valve 22 via a relative short duct 70 in order to provide the actuator 21 with compressed air.

[0043] According to a not shown variant in the gripper unit 1 of Fig. 12 the taker gripper 2 may be replaced by a drawing gripper 8. The taker gripper 2 and the drawing gripper 8 may of course be embodied in another way than the embodiments shown, for example with a thread holder as described amongst others in GB 1582327, DE 1710292, EP 207533, EP 1127181 or similar.

[0044] The grippers 2 and 8 are used for inserting weft threads whereby the thread holder 20 of each gripper 2 or 8 is opened and/or closed according to a set sequence during a weaving cycle. Examples of such sequences are known from CH 510151 or EP 266286. The thread holder 20 is intended to hold, in particular to clamp a weft thread during its insertion through the shed. The thread holder 20 may be opened and/or closed each time using the pneumatic actuator 21. Preferably, compressed air is supplied to the storage tank 23 and electrical energy is supplied to the storing element 25 each time the gripper is in a position outside the shed 7. Alternatively, the thread holder 20 may be opened and/or closed at a position near the middle of the shed 7 with the pneumatic actuator 21, while outside the shed 7 the thread holder 20, as schematically shown in Fig. 8, may also be opened and/or closed using a stop element 55 and a drive 56 that is controlled by a control unit 19, for example, in a way as described in WO 2003/04746 or WO 97/40218.

The stop element 55 can come into contact with the stop element 36 of the lever 33 to move the thread holder 20.

[0045] In a preferred alternative, the stop element 55 arranged outside the shed 7 may also be used to limit the extent of the opening of the thread holder 20. The stop element 55 may be positioned in a set position making use of a device as described for example in WO 03/04746 or WO 97/40218. In this embodiment, it is possible to open the thread holder 20 outside the shed 7 from the closed position as shown Fig. 13, making use of the pneumatic actuator 21, while the extent of the opening is limited with the stop element 55 to a partially open position as shown in Fig. 14. In the middle of the shed 7, the extent of the opening is not limited and is determined by the position of the pneumatic actuator 21, as shown in Fig. 2. This position can be determined by the air pressure acting on the piston 35 of the actuator 21 or by a stop mounted on the frame 28 of the gripper 2 that limits the movement of the lever 33. This allows opening the thread holder 20 more in the middle of the shed 7 than outside the shed 7. This may in particular be used for a taker gripper 2, wherein the taker gripper 2 is opened as much as possible to take over a weft thread from a drawing gripper 8 in the middle of the shed 7, while the taker gripper 2 is only opened over a small part outside to shed 7 allowing that the weft thread is further held by the thread holder 20 but not clamped any longer by the holder 20. Hereby a weft thread is held at the height of a projection 67 of the fixed jaw 32 between the moveable jaw 30 and the fixed jaw 32. This is particularly useful for releasing a weft thread. This also allows opening the weft holder 20 at a set moment in the weaving cycle that is independent from the weaving speed or any other mechanical setting.

[0046] For activating the pneumatic actuator 21 with compressed air, the control unit 19 controls the control device 37 in order to generate a signal 39 at a set moment in the weaving cycle. Then the receiving device 24 receives the signal 39 and controls the electrical switch element 27 such that the activating device 42 activates the valve 22 in function of the signal 39. In one embodiment, if the receiving device 24 receives a control and/or trigger signal 39 to control the switch element 27, the switch element 27 controls the activating device 42 such that the activating device 42 activates the valve 22 during a time interval, for example during a time interval of 5ms.

[0047] In an embodiment, for opening and keeping open the thread holder 20 the valve 22 can be actuated once. In order to limit the opening speed of the thread holder 20 the valve 22 may be actuated during several short time intervals succeeding one another. For closing the thread holder 20 the valve 22 is not actuated any longer. In order to prevent that due to the force of the spring 34 the thread holder 20 is closed with an impact force and/or is closing with a too high closing speed, the valve 22 may be actuated during one or several short time intervals during the closing operation of the thread holder 20 for limiting the closing speed, in particular for limiting the closing speed just before the impact force is exercised.

[0048] In the embodiment of Fig. 15, the force return element 26 comprises a pneumatic actuator 57 that is provided with compressed air via a valve 58 that is provided close to and preferably on the gripper 2. The valve 58 is provided with compressed air from the storage tank 23 in a similar way as the valve 22 and may be activated in a similar way as the valve 22. In this way, also the opening and the closing of the thread holder 20 will be carried out by a pneumatic actuator 21, 57. If a pneumatic actuator 57 is used to move the thread holder 20 to its closed position, it is possible to replace the pneumatic actuator 21 by a spring element. In this way, the thread holder will be opened by means of a spring element and will be closed by means of the pneumatic actuator 57. According to a variant of Fig. 15, the lever 33 may be provided with a stop element similar to the stop element 36 of Fig. 3.

[0049] Although the gripper unit 1 with gripper 2, 8 shown in the embodiments is arranged on a flexible gripper band 3 or gripper tape, it is also possible to mount the gripper unit 1 on any other kind of rapier, such as a rigid gripper rod that, for example, Is driven by a drive wheel or a drive mechanism. Of course, the applied compressed air may be replaced by any suitable fluid, such as vapour or a gas. If the gripper 2, 8 has outer contours similar to state of the art grippers, a gripper 2, 8 according to the invention can easily replace or being replaced by a state of the art gripper.

[0050] The gripper unit, the control system and the weaving machine according to the following claims are not limited to the embodiments as described above, but may also comprise variants and combinations thereof that are subject to the extent of protection of the claims.

Claims

1. Gripper unit for a weaving machine comprising a gripper (2, 8) with a thread holder (20) and a pneumatic actuator (21, 57) for moving the thread holder (20), **characterized in that** the gripper unit (1) comprises a valve (22, 58) for controlling a compressed air supply to the pneumatic actuator (21, 57) that is arranged adjacent to the pneumatic actuator (21, 57), and a storage tank (23) for supplying compressed air for the pneumatic actuator (21, 57), wherein the gripper unit (1) comprising the gripper (2, 8), the pneumatic actuator (21, 57), the valve (22, 58) and the storage tank (23) is intended to be moved by a rapier of the weaving machine.

2. Gripper unit for a weaving machine comprising a gripper (2, 8) with a thread holder (20) and a pneumatic actuator (21, 57) for moving the thread holder (20), **characterized in that** the gripper unit (1) comprises a valve (22, 58) for controlling a compressed

air supply to the pneumatic actuator (21, 57) that is arranged adjacent to the pneumatic actuator (21, 57), and an electrical switch element (27) with a receiving device (24) for receiving a signal (39) for controlling the valve (22, 58), wherein the gripper unit (1) comprising the gripper (2, 8), the pneumatic actuator (21, 57), the valve (22, 58) and the electrical switch element (27) is intended to be moved by a rapier of the weaving machine.

3. Gripper unit according to claim 2, **characterized in that** the gripper unit (1) further comprises a storage tank (23) for supplying compressed air for the pneumatic actuator (21, 57).

4. Gripper unit according to any one of claims 2 to 3, **characterized in that** the gripper unit (1) further comprises a storing element (25), for example a capacitor, for storing electrical energy for the electrical switch element (27) and/or the at least one valve (22, 58).

5. Gripper unit according to any one of claims 1 or 3, **characterized in that** the storage tank (23) is provided with an inlet (46), for coupling the storage tank (23) with a pneumatic supply device (10) for supplying compressed air to the storage tank (23) and/or that the valve (22, 58) is arranged near the outlet (45) of the storage tank (23).

6. Gripper unit according to claim 5, **characterized in that** a return valve (47) is provided at the inlet (46) of the storage tank (23).

7. Gripper unit according to any one of claims 1 to 6, **characterized in that** at least one return force element (26) is provided for forcing the thread holder (20) in a closed position, whereas the pneumatic actuator (21) forces the thread holder (20) in the opened position against the force of the return force element (26).

8. Gripper unit according to any one of claims 1 to 7, **characterized in that** the actuator (21, 57) comprises a pneumatic piston (35).

9. Gripper unit according to claim 1 to 8, **characterized in that** the exit of the valve (22, 58) coincides with the inlet of the pneumatic actuator (21, 57).

10. System comprising

- a gripper unit (1) according to any one of claims 1 or 5 to 9 comprising a gripper (2, 8) with a thread holder (20), a pneumatic actuator (21, 57) for moving the thread holder (20), and a valve (22, 58) for controlling a compressed air supply to the pneumatic actuator (21, 57); and
- a control system for the gripper unit (1),

characterized in that the control system (6) comprises a control device (37) used to control an opening and/or a closing of the valve (22, 58) at set moments in a weaving cycle.

11. System comprising

- a gripper unit (1) according to any one of claims 2 to 4 comprising a gripper (2, 8) with a thread holder (20), a pneumatic actuator (21, 57) for moving the thread holder (20), and a valve (22, 58) for controlling a compressed air supply to the pneumatic actuator (21, 57); and
- a control system for the gripper unit (1),

characterized in that the control system (6) comprises a control device (37) used to control an opening and/or a closing of the valve (22, 58) at set moments in a weaving cycle.

12. System according to claim 11, **characterized in that** the control device (37) is arranged stationary next to the shed, wherein the control device (37) and the electrical switch element (27) are used for wirelessly triggering the opening and/or the closing of the valve (22, 58).

13. System according to claim 12, **characterized in that** the control device (37) is arranged for generating an infrared light beam for triggering the switch element (27) of the valve (22).

14. System according to any one of claims 11 to 13, **characterized in that** the gripper unit (1) comprises a storing element (25) for storing electrical energy for the electrical switch element (27) and/or the at least one valve (22, 58) and the control system (6) comprises an electrical loading device (16) for loading the storing element (25) with electrical energy, wherein the loading device (16) is shaped and arranged such that the gripper unit (1) can pass along the loading device (16).

15. Weaving machine comprising at least one gripper unit (1) with a gripper (2, 8) according to any one of claims 1 to 9.

16. Weaving machine comprising at least one system according to any one of claims 10 to 14.

Patentansprüche

1. Greifereinheit für eine Webmaschine enthaltend einen Greifer (2, 8) mit einem Fadenhalter (20) und einen pneumatischen Antrieb (21, 57) zum Bewegen

des Fadenhalters (20), **dadurch gekennzeichnet, dass** die Greifereinheit (1) ein Ventil (22, 58) zum Steuern einer Druckluftzufuhr zu dem pneumatischen Antrieb (21, 57), das anliegend an den pneumatischen Antrieb angeordnet ist (2, 8), und einen Vorrattank (23) zum Liefern von Druckluft für den pneumatischen Antrieb (21, 57) enthält, wobei die Greifereinheit (1), umfassend den Greifer (2, 8), den pneumatischen Antrieb (21, 57), das Ventil (22, 58) und den Vorratstank (23) durch einen Rapier der Webmaschine bewegt werden soll.

2. Greifereinheit für eine Webmaschine enthaltend einen Greifer (2, 8) mit einem Fadenhalter (20) und einen pneumatischen Antrieb (21, 57) zum Bewegen des Fadenhalters (20), **dadurch gekennzeichnet, dass** die Greifereinheit (1) ein Ventil (22, 58) zum Steuern einer Druckluftzufuhr zu dem pneumatischen Antrieb (21, 57), das anliegend an den pneumatischen Antrieb angeordnet ist (2, 8), und ein elektrisches Schaltelement (27) mit einer Empfangvorrichtung (24) zum Empfangen eines Signals (39) zur Steuerung des Ventils (22, 58), wobei die Greifereinheit (1), umfassend den Greifer (2, 8), den pneumatischen Antrieb (21, 57), das Ventil (22, 58) und das elektrische Schaltelement (27) durch einen Rapier der Webmaschine bewegt werden soll.

3. Greifereinheit nach Anspruch 2, **dadurch gekennzeichnet, dass** die Greifereinheit (1) weiter einen Vorrattank (23) zum Liefern von Druckluft für den pneumatischen Antrieb (21, 57) umfasst.

4. Greifereinheit nach einem der Ansprüche 2 bis 3, **dadurch gekennzeichnet, dass** die Greifereinheit (1) weiter ein Speicherelement (25), zum Beispiel einen Kondensator, zum Speichern elektrischer Energie für das elektrische Schaltelement (27) und/oder das mindestens eine Ventil (22, 58) umfasst.

5. Greifereinheit nach einem der Ansprüche 1 oder 3, **dadurch gekennzeichnet, dass** der Vorrattank (23) mit einem Einlass (46) versehen ist, zum Koppeln des Vorrattanks (23) mit einer pneumatischen Zufuhreinrichtung (10) zum Zuführen von Druckluft zu dem Vorrattank (23), und/oder dass das Ventil (22, 58) nahe dem Auslass (45) des Vorrattanks (23) angeordnet ist.

6. Greifereinheit nach Anspruch 5, **dadurch gekennzeichnet, dass** ein Rückschlagventil (47) an dem Einlass (46) des Vorrattanks (23) vorgesehen ist.

7. Greifereinheit nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** mindestens ein Rückstellkraftelement (26) vorgesehen ist, um den Fadenhalter (20) in eine geschlossene Position zu zwingen, während der pneumatische Antrieb (21) den Fadenhalter (20) in der geöffneten Position gegen die Kraft des Rückstellkraftelements (26) zwingt.

8. Greifereinheit nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet, dass** der Antrieb (21, 57) einen pneumatischen Kolben (35) enthält.

9. Greifereinheit nach Anspruch 1 bis 8, **dadurch gekennzeichnet, dass** der Auslass des Ventils (22, 58) mit dem Einlass des pneumatischen Antriebs (21, 57) zusammenfällt.

10. System umfassend

- eine Greifereinheit (1) nach einem der Ansprüche 1 oder 5 bis 9 umfassend einen Greifer (2, 8) mit einem Fadenhalter (20) einen pneumatischen Antrieb (21, 57) zum Bewegen des Fadenhalters (20) und ein Ventil (22, 58) zum Steuern einer Druckluftzufuhr zu dem pneumatischen Antrieb (21, 57); und
- ein Steuersystem für die Greifereinheit (1),

dadurch gekennzeichnet, dass das Steuersystem (6) eine Steuereinrichtung (37) enthält die verwendet wird, um ein Öffnen und/oder ein Schliessen des Ventils (22, 58) bei eingestellten Momenten in einem Webzyklus zu steuern.

11. System umfassend

- eine Greifereinheit (1) nach einem der Ansprüche 2 bis 4 umfassend einen Greifer (2, 8) mit einem Fadenhalter (20) einen pneumatischen Antrieb (21, 57) zum Bewegen des Fadenhalters (20) und ein Ventil (22, 58) zum Steuern einer Druckluftzufuhr zu dem pneumatischen Antrieb (21, 57); und
- ein Steuersystem für die Greifereinheit (1),

dadurch gekennzeichnet, dass das Steuersystem (6) eine Steuereinrichtung (37) enthält die verwendet wird, um ein Öffnen und/oder ein Schliessen des Ventils (22, 58) bei eingestellten Momenten in einem Webzyklus zu steuern.

12. System nach Anspruch 11, **dadurch gekennzeichnet, dass** die Steuereinrichtung (37) stationär neben dem Webfach angeordnet ist, wobei die Steuereinrichtung (37) und das elektrische Schaltelement (27) zum drahtlosen Auslösen des Öffnen und/oder des Schließens des Ventils (22, 58) verwendet werden.

13. System nach Anspruch 12, **dadurch gekennzeichnet, dass** die Steuereinrichtung (37) zum Erzeugen eines Infrarot-Lichtstrahls zum Auslösen des Schaltelements (27) des Ventils (22) angeordnet ist.

14. System nach einem der Ansprüche 11 bis 13, **dadurch gekennzeichnet, dass** die Greifereinheit (1) ein Speicherelement (25) umfasst zum Speichern elektrischer Energie für das elektrische Schaltelement (27) und/oder das mindestens eine Ventil (22, 58) und das Steuersystem (6) eine elektrische Ladeeinrichtung (16) umfasst zum Laden des Speicherelements (25) mit elektrischer Energie, wobei die Ladeeinrichtung (16) so geformt und angeordnet ist, dass die Greifereinheit (1) entlang der Ladeeinrichtung (16) passieren kann.

15. Webmaschine umfassend mindestens eine Greifereinheit (1) mit einem Greifer (2, 8) nach einem der Ansprüche 1 bis 9.

16. Webmaschine umfassend mindestens ein System nach einem der Ansprüche 10 bis 14.

Revendications

1. Unité de pinces pour une machine à tisser comprenant une pince (2, 8) avec un porte-fil (20) et un actionneur pneumatique (21, 57) pour déplacer le porte-fil (20), **caractérisée en ce que** l'unité de pinces (1) comprend une soupape (22, 58) pour commander une alimentation d'air comprimé à l'actionneur pneumatique (21, 57) qui est disposée adjacente à l'actionneur pneumatique (21, 57), et un réservoir d'expansion (23) pour alimenter d'air comprimé pour l'actionneur pneumatique (21, 57), dans laquelle l'unité de pinces (1) comprenant la pince (2, 8), l'actionneur pneumatique (21, 57), la soupape (22, 58) et le réservoir d'expansion (23) est prévue à être déplacée au moyen d'une rapière de la machine à tisser.

2. Unité de pinces pour une machine à tisser comprenant une pince (2, 8) avec un porte-fil (20) et un actionneur pneumatique (21, 57) pour déplacer le porte-fil (20), **caractérisée en ce que** l'unité de pinces (1) comprend une soupape (22, 58) pour commander une alimentation d'air comprimé à l'actionneur pneumatique (21, 57) qui est disposée adjacente à l'actionneur pneumatique (21, 57), et un élément de commutation électrique (27) avec un dispositif de réception (24) pour recevoir un signal (39) pour commander la soupape (22, 58), dans laquelle l'unité de pinces (1) comprenant la pince (2, 8), l'actionneur pneumatique (21, 57), la soupape (22, 58) et l'élément de commutation électrique (27) est prévue à être déplacée au moyen d'une rapière de la machine à tisser.

3. Unité de pinces selon la revendication 2, **caractérisée en ce que** l'unité de pinces (1) comprend en outre un réservoir d'expansion (23) pour alimenter d'air comprimé pour l'actionneur pneumatique (21, 57).

4. Unité de pinces selon l'une quelconque des revendications 2 à 3, **caractérisée en ce que** l'unité de pinces (1) comprend en outre un élément de stockage (25), par exemple un condensateur, pour stocker d'énergie électrique pour l'élément de commutation électrique (27) et/ou l'au moins une soupape (22, 58).

5. Unité de pinces selon l'une quelconque des revendications 1 à 3, **caractérisée en ce que** le réservoir d'expansion (23) est prévu d'une entrée (46) pour coupler le réservoir d'expansion (23) avec un dispositif d'alimentation pneumatique (10) pour alimenter d'air comprimé au réservoir d'expansion (23) et/ou **en ce que** la soupape (22, 58) est disposée à proximité de la sortie (45) du réservoir d'expansion (23).

6. Unité de pinces selon la revendication 5, **caractérisée en ce qu'**une soupape de retour (47) est prévue à l'entrée (46) du réservoir d'expansion (23).

7. Unité de pinces selon l'une quelconque des revendications 1 à 6, **caractérisée en ce qu'**au moins un élément de force de retour (26) est prévu pour forcer le porte-fil (20) dans une position fermée, tandis que l'actionneur pneumatique (21) force le porte-fil (20) dans la position ouverte contre la force de l'élément de force de retour (26).

8. Unité de pinces selon l'une quelconque des revendications 1 à 7, **caractérisée en ce que** l'actionneur (21, 57) comprend un piston pneumatique (35).

9. Unité de pinces selon la revendication 1 à 8, **caractérisée en ce que** la sortie de la soupape (22, 58) coïncide avec l'entrée de l'actionneur pneumatique (21, 57).

10. Système comprenant

- une unité de pinces (1) selon l'une quelconque des revendications 1 ou 5 à 9 comprenant une pince (2, 8) avec un porte-fil (20), un actionneur pneumatique (21, 57) pour déplacer le porte-fil (20), et une soupape (22, 58) pour commander une alimentation d'air comprimé à l'actionneur pneumatique (21, 57); et
- un système de commande pour l'unité de pinces (1),

caractérisé en ce que le système de commande (6) comprend un dispositif de commande (37) utilisé pour commander une ouverture et/ou une fermeture de la soupape (22, 58) aux moments définis dans un cycle de tissage.

11. Système comprenant

- une unité de pinces (1) selon l'une quelconque des revendications 2 à 4 comprenant une pince (2, 8) avec un porte-fil (20), un actionneur pneumatique (21, 57) pour déplacer le porte-fil (20), et une soupape (22, 58) pour commander une alimentation d'air comprimé à l'actionneur pneumatique (21, 57); et
- un système de commande pour l'unité de pinces (1),

caractérisé en ce que le système de commande (6) comprend un dispositif de commande (37) utilisé pour commander une ouverture et/ou une fermeture de la soupape (22, 58) aux moments définis dans un cycle de tissage.

12. Système selon la revendication 11, **caractérisé en ce que** le dispositif de commande (37) est disposé stationnaire à côté de la foule, dans lequel le dispositif de commande (37) et l'élément de commutation électrique (27) sont utilisés pour déclencher sans fil l'ouverture et/ou la fermeture de la soupape (22, 58).

13. Système selon la revendication 12, **caractérisé en ce que** le dispositif de commande (37) est disposé pour générer un faisceau lumineux infrarouge pour déclencher l'élément de commutation (27) de la soupape (22).

14. Système selon l'une quelconque des revendications 11 à 13, **caractérisé en ce que** l'unité de pinces (1) comprend un élément de stockage (25) pour stocker d'énergie électrique pour l'élément de commutation électrique (27) et/ou l'au moins une soupape (22, 58) et le système de commande (6) comprend un dispositif de chargement électrique (16) pour charger l'élément de stockage (25) en énergie électrique, dans lequel le dispositif de chargement (16) est conçu et disposé de telle sorte que l'unité de pinces (1) peut passer le long du dispositif de chargement (16).

15. Machine à tisser comprenant au moins une unité de pinces (1) avec une pince (2, 8) selon l'une quelconque des revendications 1 à 9.

16. Machine à tisser comprenant au moins un système selon l'une quelconque des revendications 10 à 14.

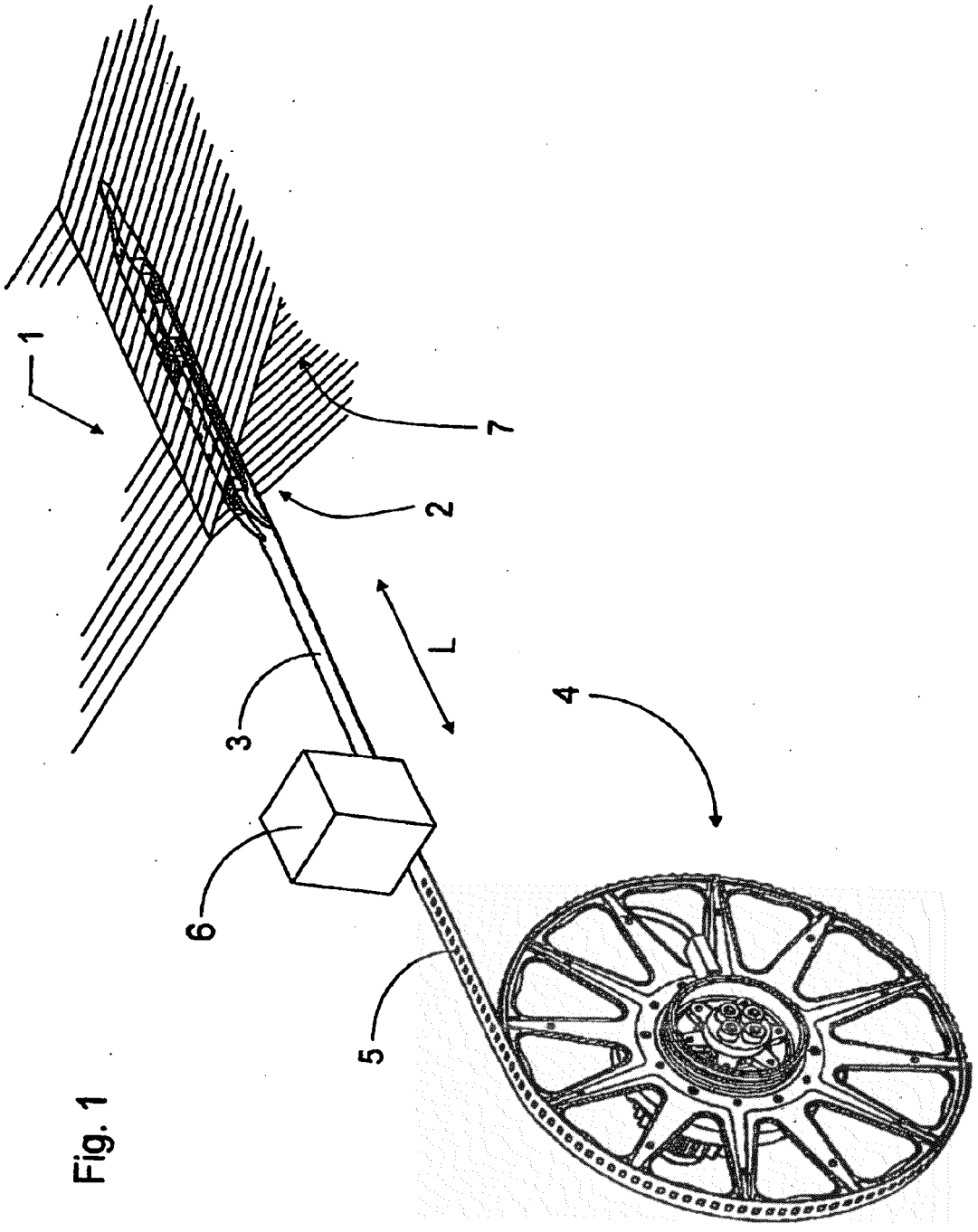

Fig. 1

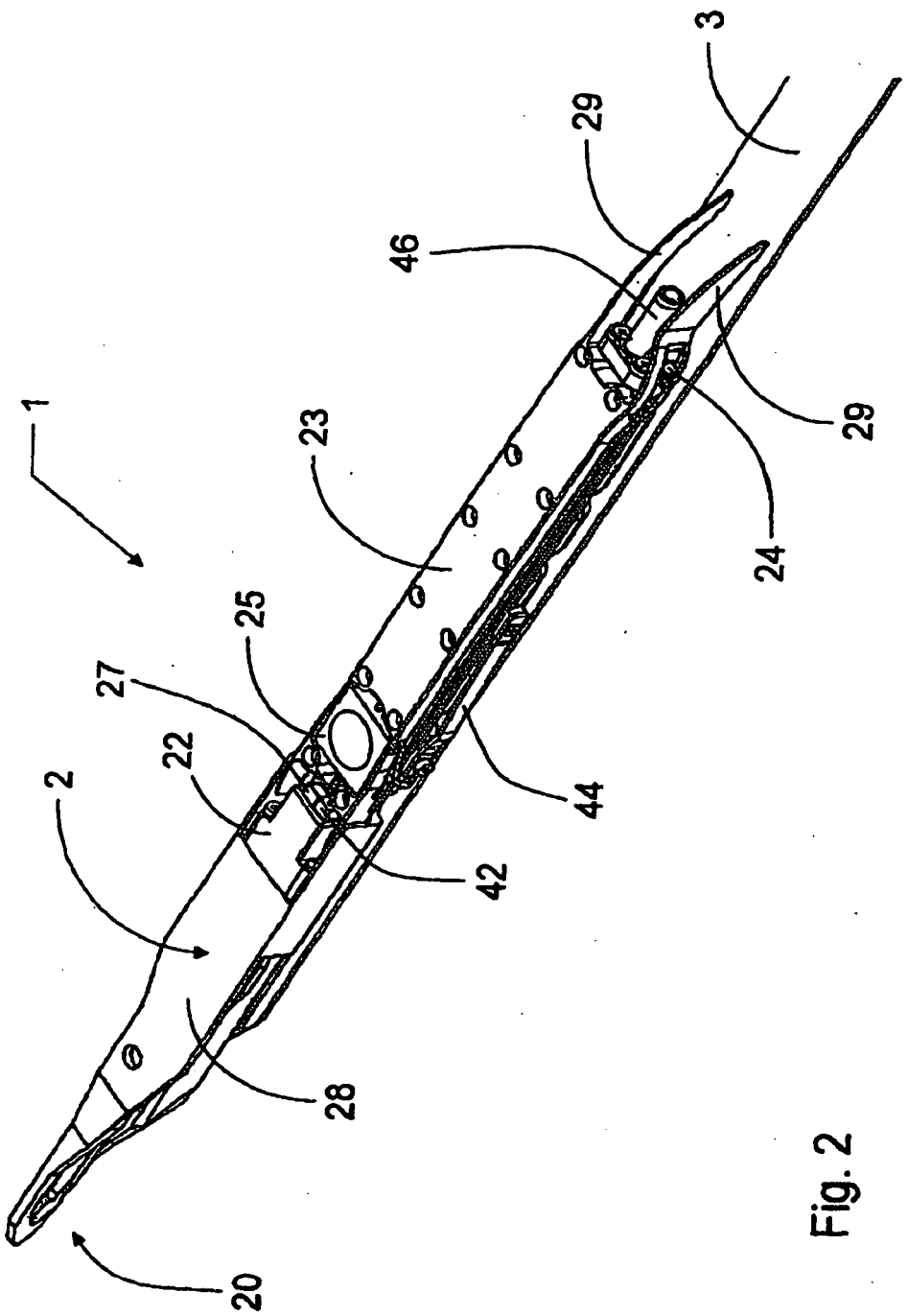

Fig. 2

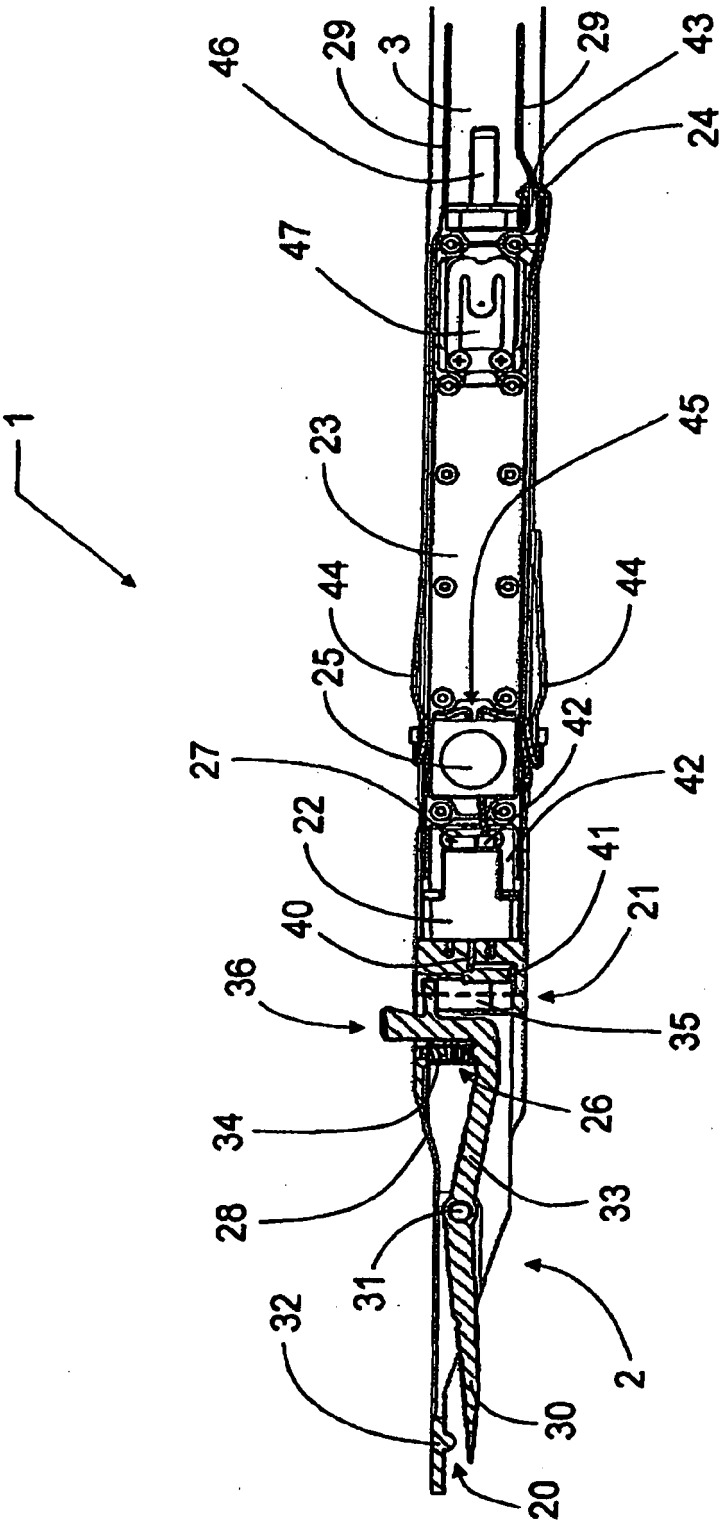
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Fig. 3

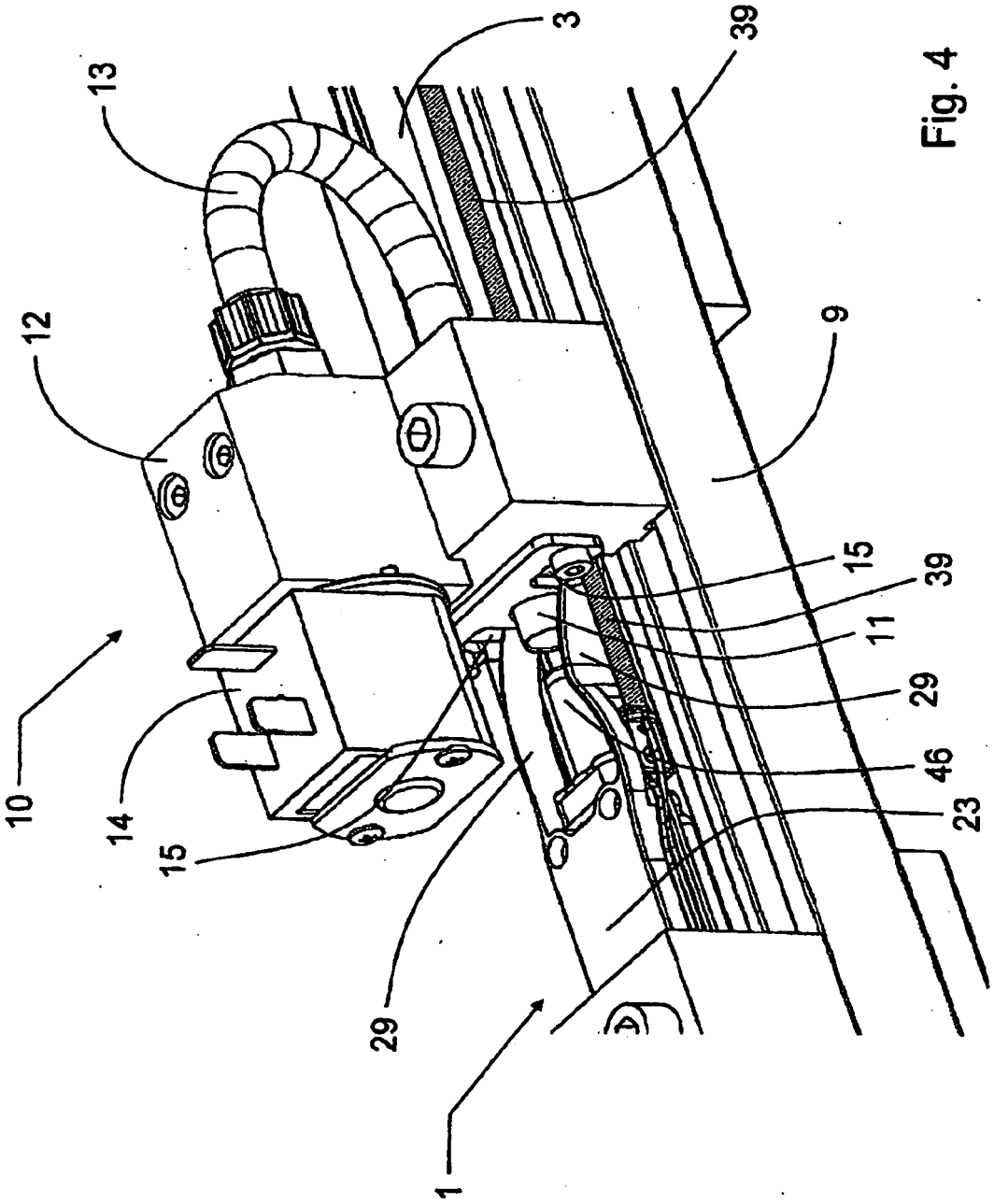
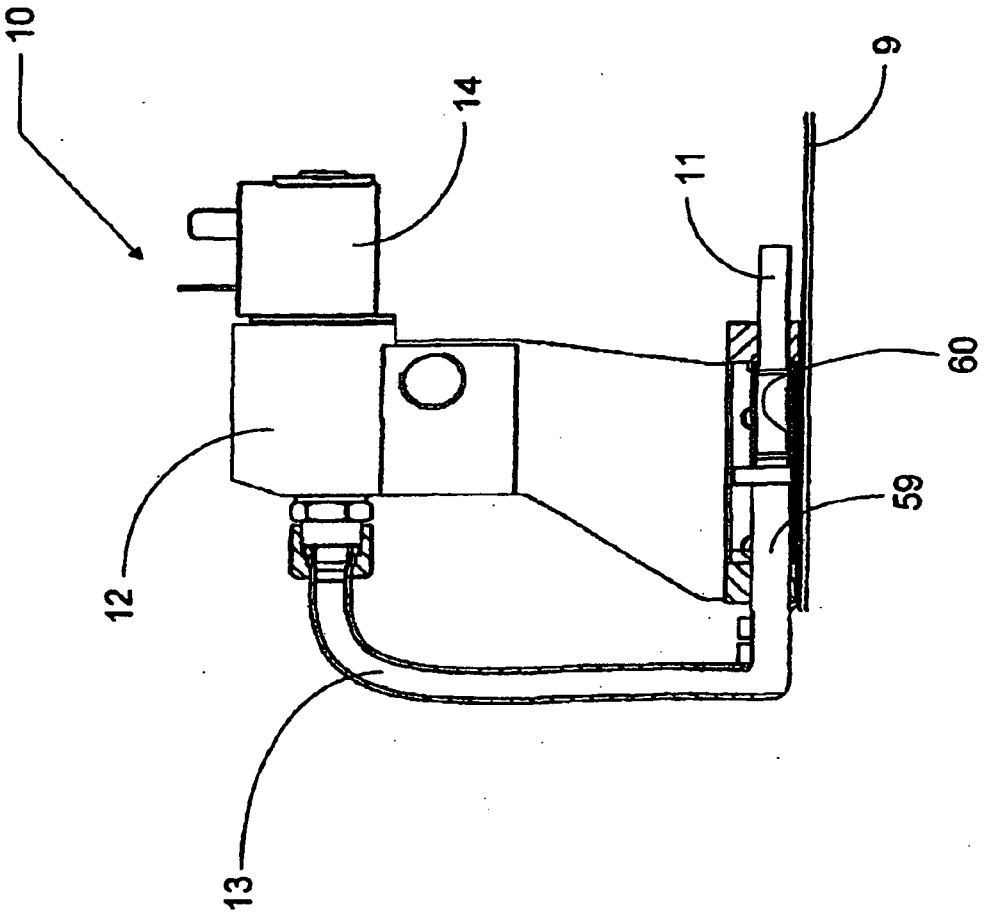


Fig. 4



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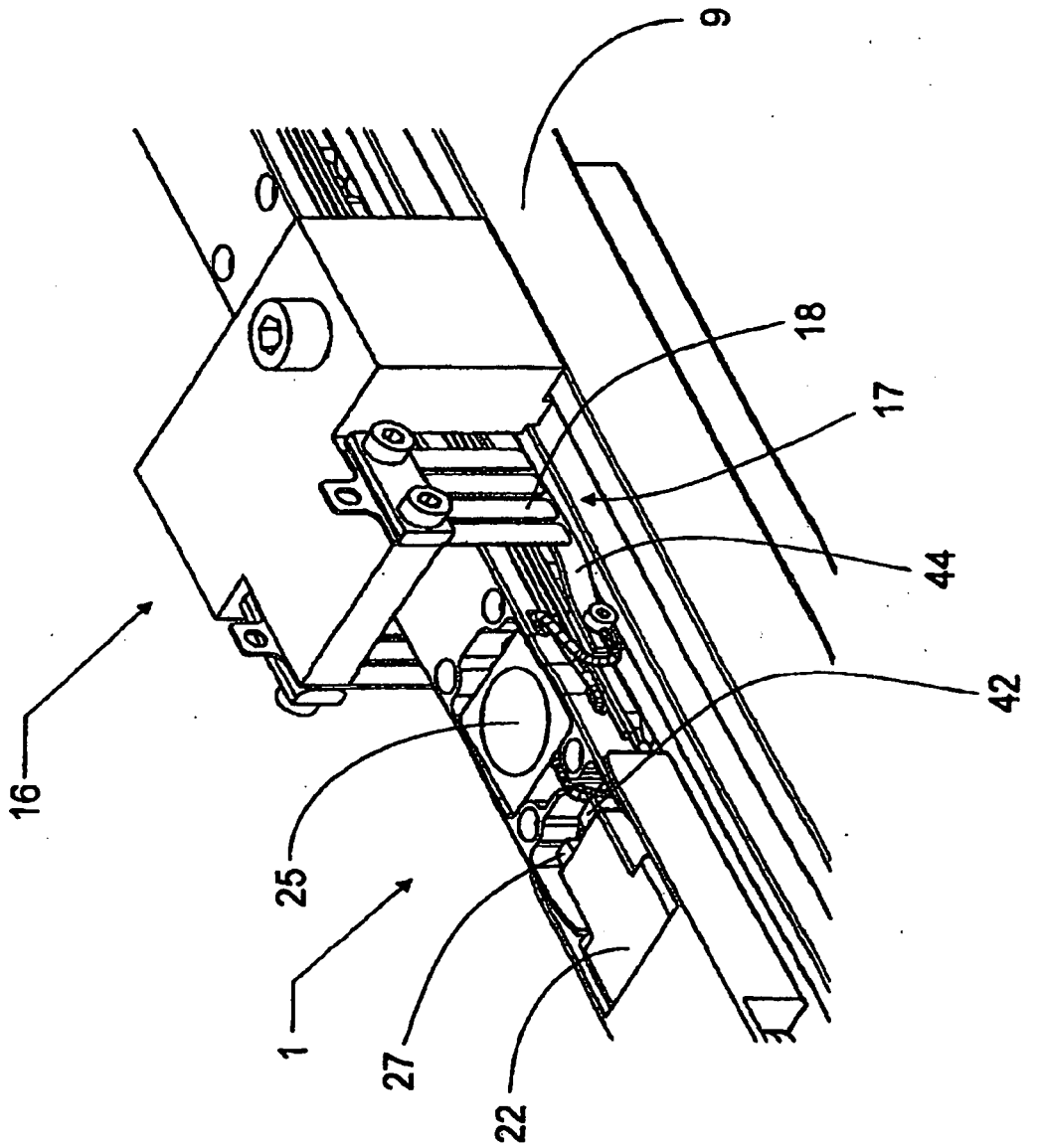

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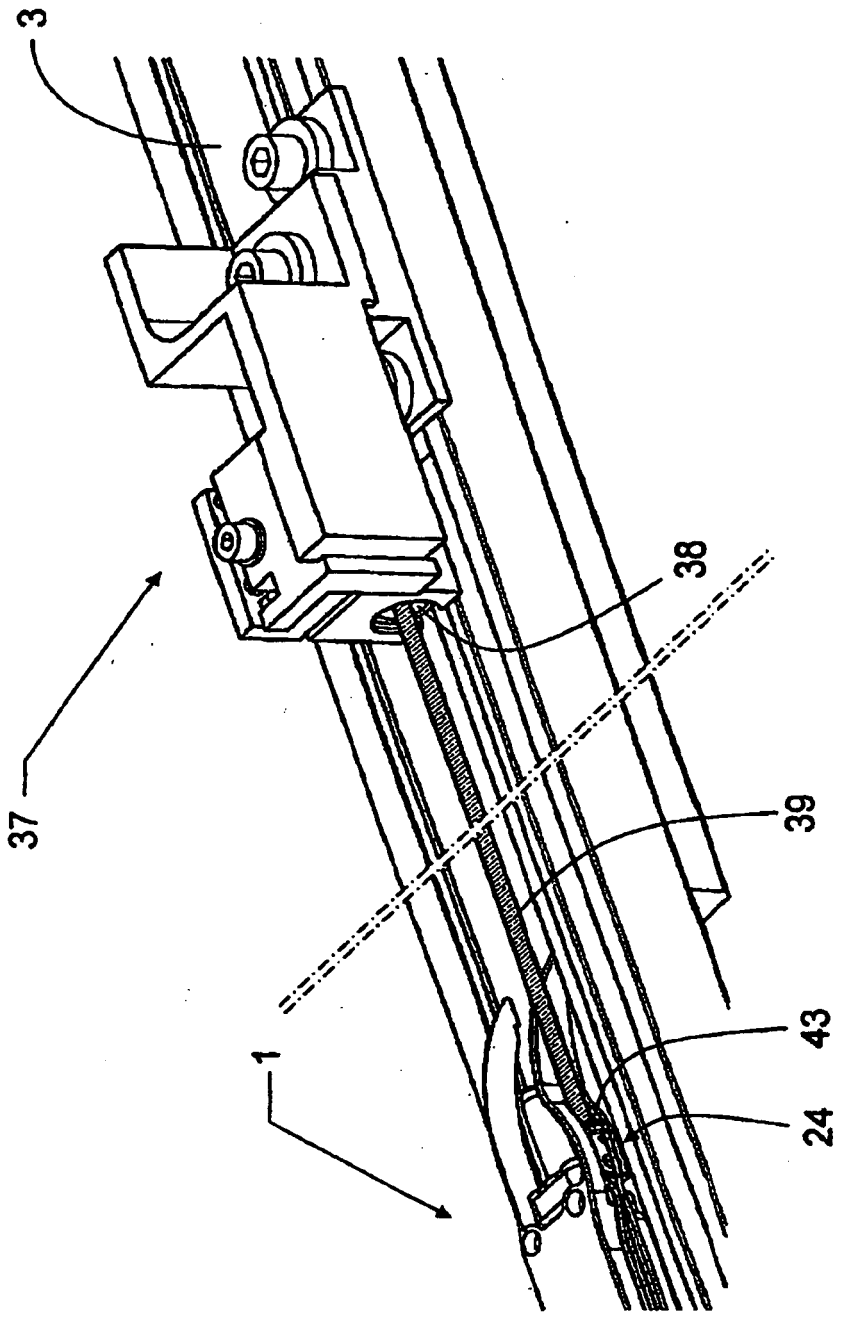
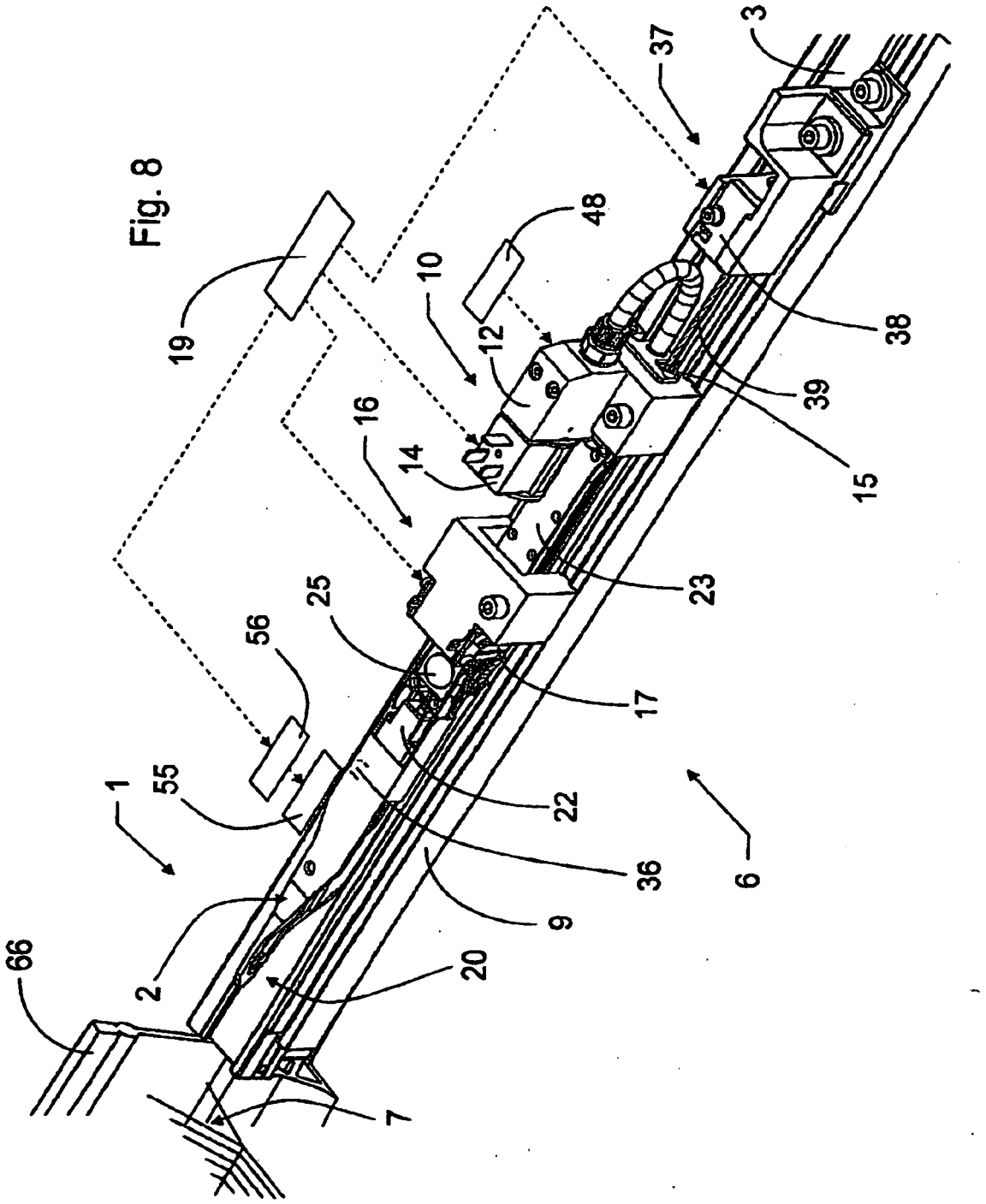


Fig. 7

Fig. 8



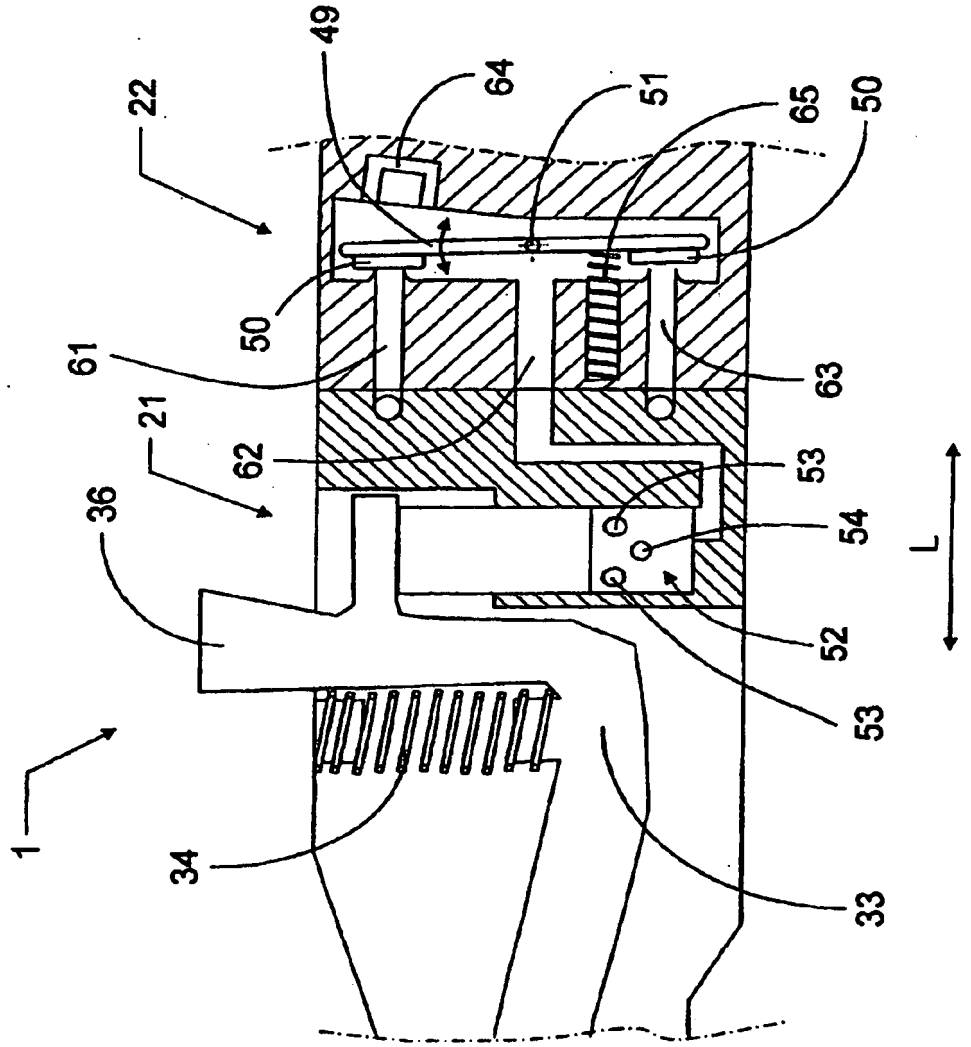
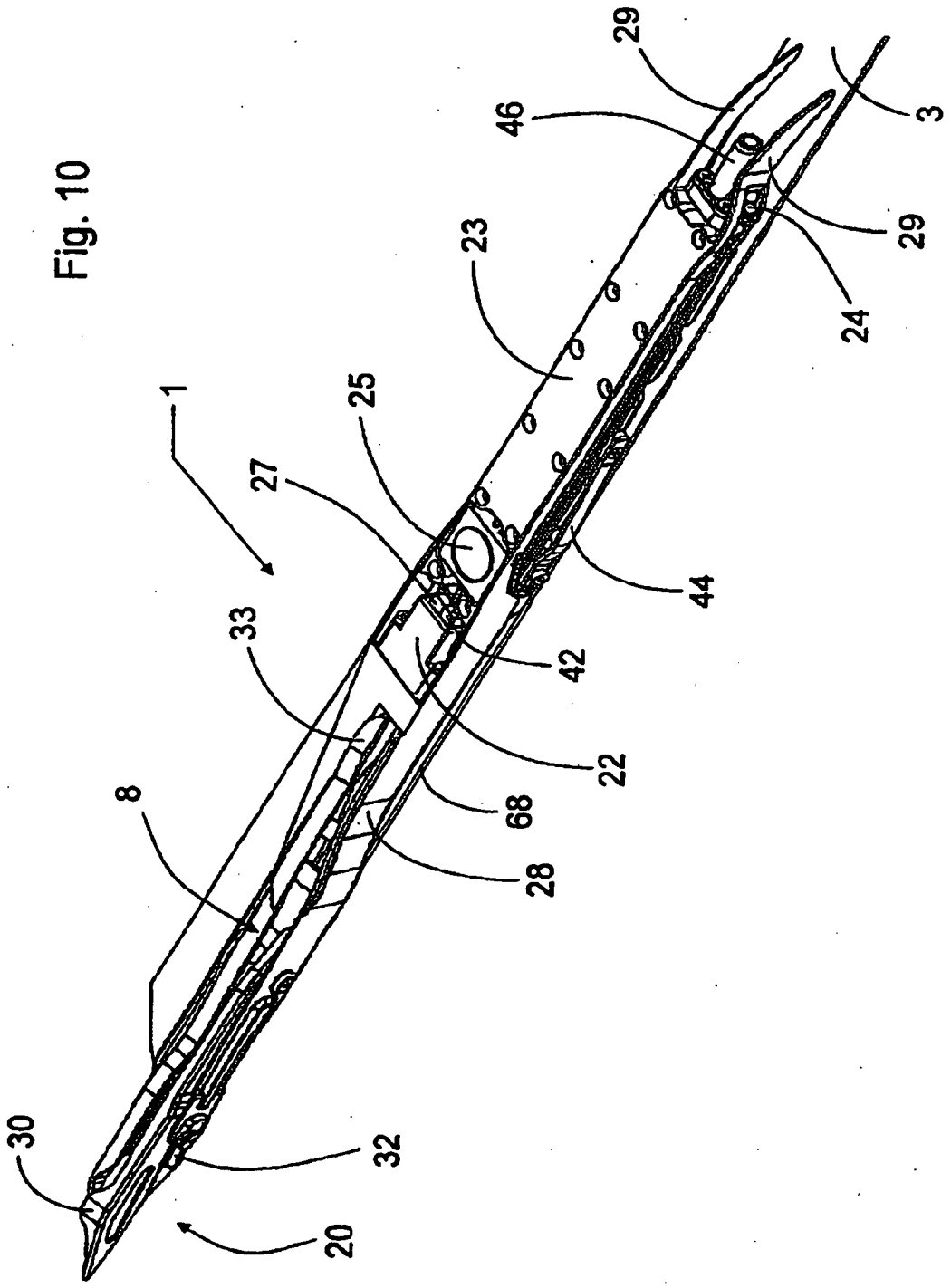


Fig. 9

Fig. 10



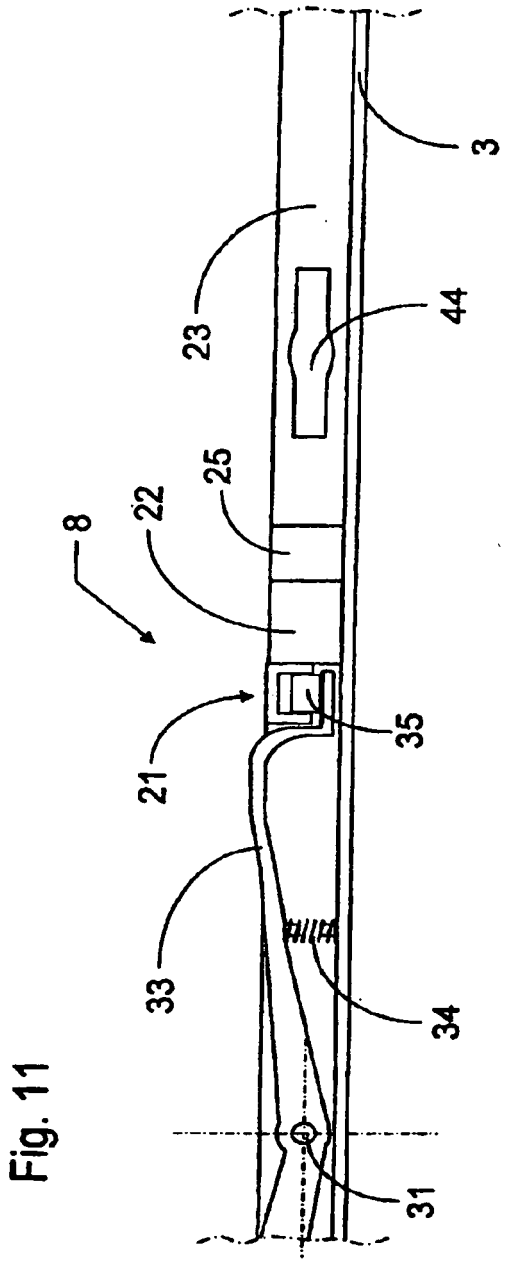

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Fig. 11

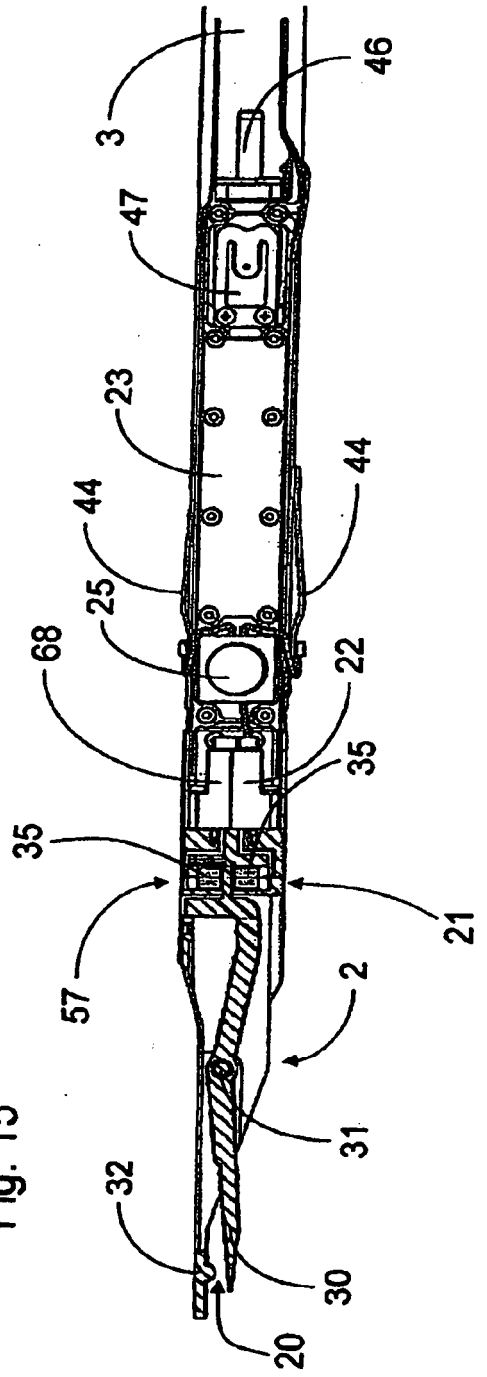
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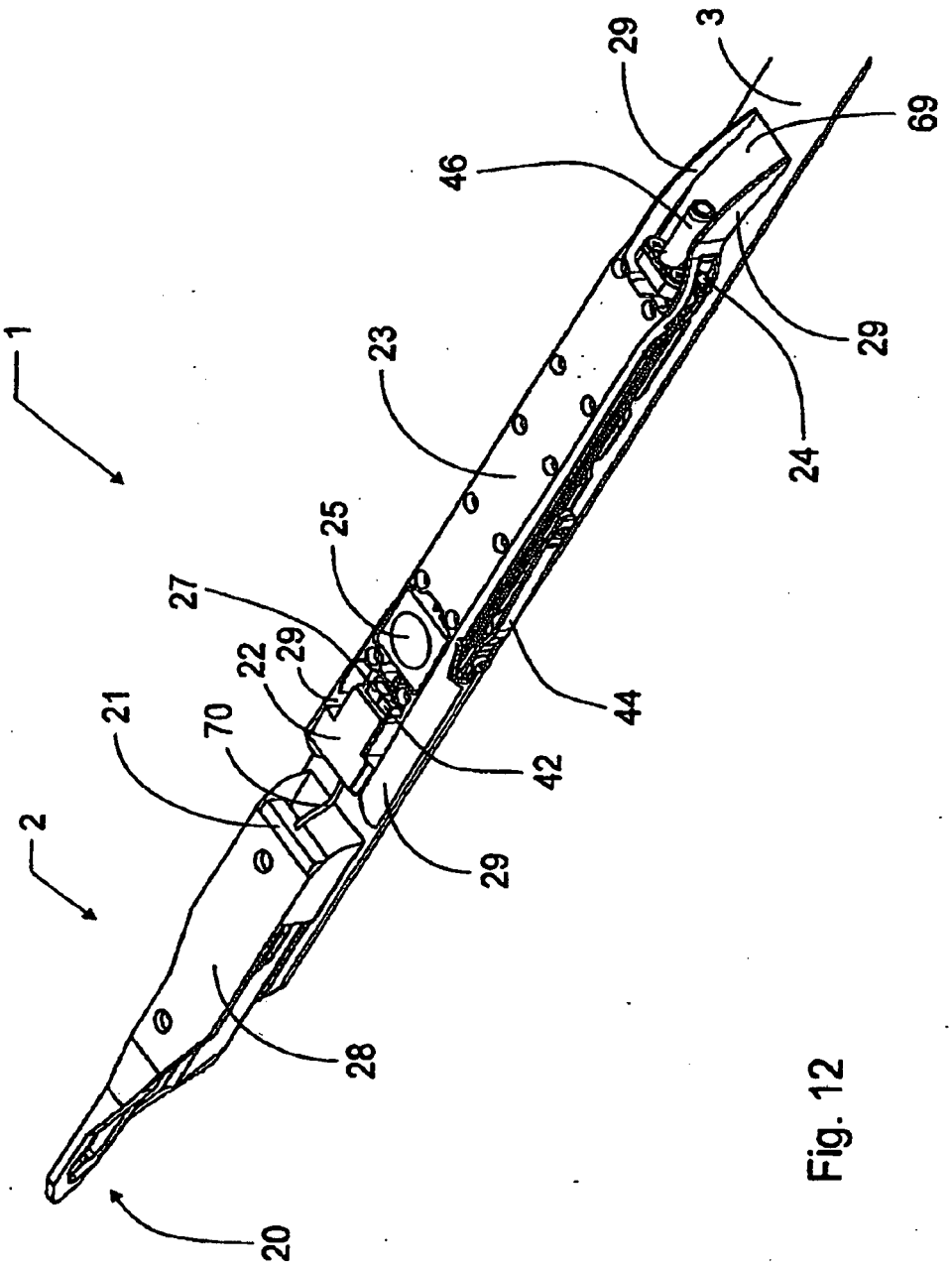
Fig. 15



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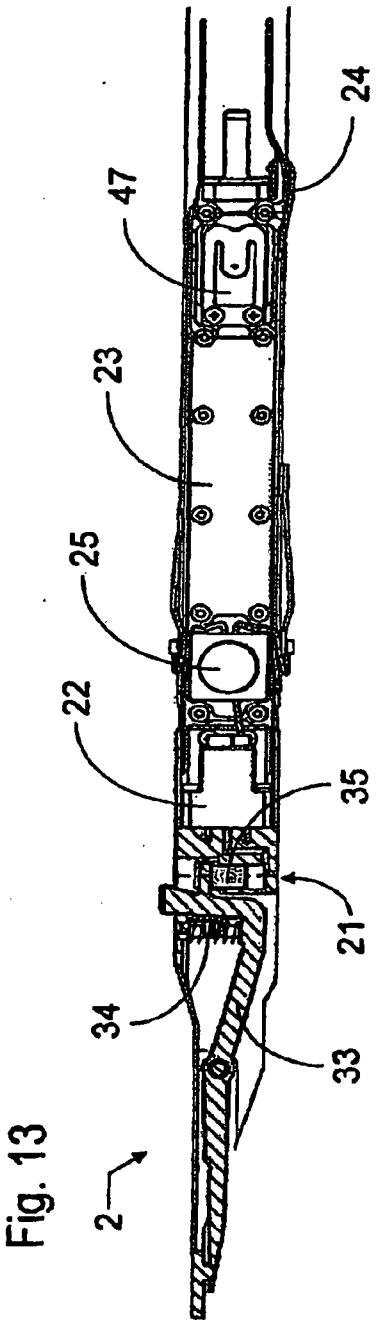
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Fig. 13

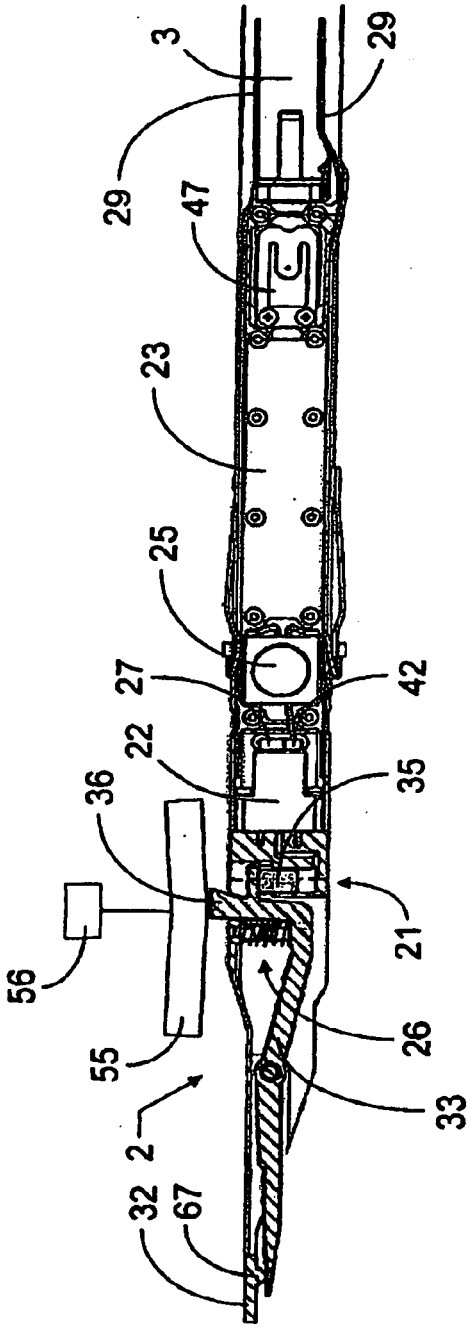
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Fig. 14

REFERENCES CITED IN THE DESCRIPTION

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