(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 187 631 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
05.07.2017 Bulletin 2017/27

(51) Int Cl.:
D03D 51/08 *(2006.01)* ***D03D 47/32*** *(2006.01)*

(21) Application number: **16206650.0**

(22) Date of filing: **23.12.2016**

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

(30) Priority: **28.12.2015 CZ 20150939**

(71) Applicant: **VÚTS, a.s.**
Liberec XI - Ruzodol I
460 01 Liberec (CZ)

(72) Inventors:
- **Mlynar, Jiri**
  463 31 Chrastava (CZ)
- **Beran, Martin**
  460 01 Liberec 2 (CZ)

(74) Representative: **Musil, Dobroslav**
Zabrdovicka 801/11
615 00 Brno (CZ)

(54) METHOD FOR REMOVING A WEFT INCORRECTLY INSERTED BY A HYDRAULIC PICK INTO THE SHED OF A WEAVING MACHINE AND A HYDRAULIC DEVICE FOR PERFORMING THE METHOD

(57) The subject of the invention is a method for removing a weft incorrectly inserted into the shed of a hydraulic weaving machine. The removal of the weft on the hydraulic weaving machine is carried out through a sequence of consecutive dependent operations, by the control system without operator intervention, whereby these operations, if performed correctly, lead to detecting the defectively inserted weft in the fabric, removing the defectively inserted weft, replacing it with a new weft and finally to automatic restart of the machine to resume normal production mode. All these tasks, including current control of all the operations of the sequence, are performed without machine operator intervention. Automatic removal of the weft is performed by some standard systems used on the machine and by a system of checking whether the removal of the weft has been successful and of subsequent checking whether the new weft insertion into the shed has been successful.

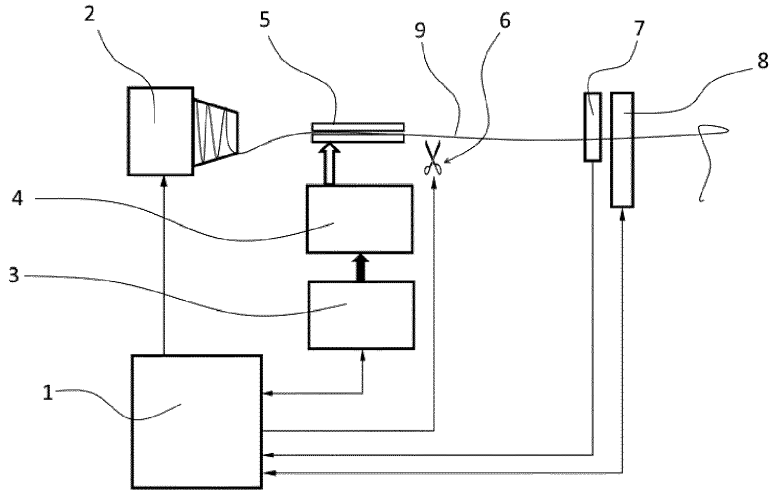

Fig. 1

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Description

Technical field

[0001] The invention relates to a method for removing a weft incorrectly inserted by a hydraulic pick into the shed of a weaving machine, in which a control system for detecting the incorrectly inserted weft performs the stopping of the machine, removes the incorrectly inserted weft and restarts the machine into production mode, whereby during the same revolution of the machine when the weft was improperly inserted (picked), the signal to stop the machine is generated by the control system of the machine, by which means interruption of the defectively inserted weft at the entrance of the shed is prevented. Subsequently, after the machine is stopped, the operation of the machine is reversed to a state with an open shed position in which the weft was not inserted properly, whereupon a new weft is inserted, thus removing the weft which was previously incorrectly inserted from the open shed, whereupon on the side of the shed remote from the picking nozzle it is determined whether the weft thread has been removed successfully and the machine is either restarted and switched into production mode or it is stopped and error signalling is initiated.

[0002] The invention also relates to a device for removing a weft incorrectly inserted by a hydraulic pick into the shed of a hydraulic weaving machine, which comprises a measuring device of the length of the weft thread, aligned with a hydraulic picking nozzle, which is situated on one lateral side of the shed and is directed to the other side of the shed in the direction of the fabric being formed, whereby a weft stop is mounted on the machine frame and in the area between the picking nozzle and the proximal edge of the fabric being formed a means for interrupting the weft is mounted on the machine frame, the picking nozzle being connected to a pump of the weft insertion system, which is connected to a drive, whereby the measuring device, the pump drive, the means for interrupting the weft and the weft stop are connected to the control system of the weaving machine.

Background art

[0003] On hydraulic weaving machines the weft thread is inserted into the shed of the weaving machine by a flow of a fluid, which is launched into the shed of the hydraulic weaving machine together with the weft. The pressure fluid stream carries the weft through the shed and transports the weft end from one side of the shed to the other side of the shed, thereby inserting the weft into the shed along its entire length, i.e. across the full weaving width of the fabric being formed.

[0004] The individual devices of the hydraulic weaving machine, which participate in the weft insertion process, particularly a mechanism for shed formation, a device for the preparation and insertion of the weft thread into the shed, a hydraulic pump which supplies an appropriate stream of the picking fluid to the picking nozzle at required moments of the weaving cycle, are mutually coupled by mechanical couplings to be properly synchronized.

[0005] If for any reason a fault occurs in the weft insertion into the shed, e.g., the front end of the weft does not pass through the whole length of the shed, etc., it is necessary to stop the whole machine and remove this incorrectly inserted weft. Otherwise, a defect in the fabric would arise. The removal of the weft which was improperly inserted by a hydraulic weft insertion mechanism into the shed of the hydraulic weaving machine with a hydraulic weft insertion system into the shed is currently carried out in such a manner that after stopping the machine and opening the shed, the operator seizes the defectively inserted weft manually, in the best case using a special tool (a hook), and pulls it out (removes it) from the shed. Subsequently, while the machine is not working, the operator steps on the pedal for manual control of weft insertion, by which means the required dose of the picking fluid is manually fed to the picking nozzle and one weft insertion operation is performed (i.e. weft insertion into the shed). The operator checks whether the weft insertion was performed correctly and manually starts the machine, which continues weaving, wherein at first the weft that has been inserted in the shed is beaten up manually to the fell of the fabric being fomed and after that normal process of fabric formation continues.

[0006] CZ 1990-2875 A3 discloses a solution of removing a weft on an air jet weaving machine, in which the removal of a defectively inserted weft is performed by inserting the following uninterrupted weft while varying the mutual position of the weft insertion means and a binding point. That means that this is a non-static method of weft insertion, which is highly demanding in terms of the speed of weft insertion, synchronization of the individual parts of the machine and acceleration of the machine from standstill so as to perform "cleaning" weft insertion. Another disadvantage of this solution is the fact that a weft stop is used for detecting whether the weft has indeed been removed, which is, however, a controversial thing to do for checking the weft after being removed, because the weft stop as such is not able to reveal a double weft, which often arises after removing a weft fault on the hydraulic machine, and the fabric exhibits a fault.

[0007] The disadvantage of the background art is the necessity of manual or only a partially automated removal of the defectively inserted weft on the hydraulic weaving machine, which therefore requires the presence and activities of a human operator. Another drawback is the fact that removing the incorrectly inserted weft is time-consuming, which limits the effective use of the hydraulic weaving machine for fabric manufacturing.

[0008] The aim of the invention is to eliminate or at least minimize the disadvantages of the background art.

Principle of the invention

[0009] The aim of the invention is achieved by a method for removing a weft incorrectly inserted by hydraulic pick into the shed of a weaving machine, whose principle consists in that insertion of a new weft is performed as a static insertion without the motion of the opened branches of the warp and without the motion of the means for transferring the new weft to the fell of the woven fabric, whereby after this static weft insertion, at first the number of threads situated in the control zone is determined and then, according to the number of the threads in the control zone, the control system performs transfer of the new weft to the fell of the fabric being formed, whereupon the machine is either automatically restarted and switched into production mode or it is stopped by the control system and error signalling is initiated.

[0010] The principle of the device for removing a weft incorrectly inserted by a hydraulic pick into the shed of a hydraulic weaving machine consists in that the drive of the pump of the weft insertion system is composed of an individual drive which is mechanically independent of the other parts and elements of the hydraulic weaving machine and connected to the control system, whereby on the side of the shed remote from the hydraulic picking nozzle is located a detector of the weft removal, which is also connected to the control system.

[0011] The present invention enables to use a fully automatic removal of a weft incorrectly inserted by hydraulic weft insertion into the shed of a hydraulic weaving machine, which results not only in saving labour for the machine operation and other advantages, but also in increasing overall machine effectiveness by approximately 12 %.

Description of the drawings

[0012] The invention is schematically represented in the drawing, where Fig. 1 shows an arrangement of the parts of the hydraulic weaving machine used for removing the incorrectly inserted weft, Fig. 2 shows a detail of the area of sensing whether removal of the defectively inserted weft has been successful in the status without the inserted weft and Fig. 3 shows a detail of the area of sensing whether removal of the defectively inserted weft has been successful in the status with the inserted weft.

Specific description

[0013] The invention will be described referring to an example of embodiment of a hydraulic weaving machine, which is widely known, and therefore in the following text no other parts of the hydraulic weaving machine will be mentioned but those parts which are used to implement this invention. The hydraulic weaving machine comprises an unillustrated system of warp threads, which are guided to a mechanism for shed formation. A beating-up device is located behind the mechanism for shed formation in the direction of the motion of warp threads. The final member of the beating-up device ensures the transfer of the weft **9** from the shed to the fell of the fabric being formed. The woven fabric is wound onto a cloth beam.

[0014] The weft thread is properly arranged in the machine construction, e.g., it is wound on a suitable bobbin. The weft thread is guided to a weft length measuring device **2**, from which it is guided further on to a picking nozzle **5**. The system consisting of the measuring device **2** and the nozzle **5** is arranged on one lateral side of the shed and is directed to the other side of the shed, i.e. in the direction of the width of the fabric being formed, as usually. On the opposite side of the shed, i.e. in the direction of the weft **9** insertion into the shed (in the direction of picking the weft **9** through the shed) behind the woven fabric, a weft stop **7** and a detector **8** of the weft **9** removal are mounted on the machine frame. In the area between the picking nozzle **5** and the proximal edge of the woven fabric, a means **6** for interrupting the weft **9** is mounted on the machine frame.

[0015] The picking nozzle **5** is with its hydraulic distribution system connected to the outlet of the fluid from the pump **4** of the weft insertion system, whereby the mechanical drive of the pump **4** of the weft insertion system is secured by connecting the pump **4** to an individual drive **3**. The individual drive **3** of the pump **4** of the weft insertion system is mechanically independent of the other subunits and elements of the hydraulic weaving machine.

[0016] The measuring device **2** of the weft, the individual drive **3** of the pump **4** of the weft insertion system, the means **6** for interrupting the weft **9**, the weft stop **7** and the sensor **8** of the weft **9** removal are connected to the control system **1** of the weaving machine.

[0017] The control system **1** of the weaving machine controls the operation and coordination of the activities of the individual subunits and means of the weaving machine, so that fabric with the required parameters will be produced. That means that the standard weaving process takes place, in which weft threads **9** are blown successively into the shed by the stream of the picking fluid ejected by the picking nozzle **5**, whereby after each successful insertion, which is checked by the weft stop **7** on the other side of the shed, the weft **9** is separated from the other weft threads by the means **6** for interrupting the weft **9** and subsequently the weft **9** is transferred by a beating-up mechanism to the fell of the woven fabric. In this manner, weaving cycles are continuously repeated and fabric is produced.

[0018] If the weft stop **7** detects a state in which the weft **9** with its front end did not extend over the entire width of the weft **9** insertion, i.e. the entire width of the woven fabric enlarged by edge strips, in which the weft **9** exceeds the width of the woven fabric, it emits a signal about this state to the control system **1**, which generates a signal to stop the machine. The signal to stop the machine is generated already during the same revolution of the machine in which the incorrectly inserted weft **9** was detected.

[0019] In addition, the above-mentioned signal to stop the machine prevents the interruption of the detected incorrectly inserted weft **9** at the entrance into the shed by severing from the rest of the weft thread in the measuring device **2** of the weft **9**. In the process of normal weaving, this interruption is performed by the means **6** for interrupting the weft **9**.

[0020] After stopping the machine, the machine operation is automatically reversed by the control system **1**, i.e. the individual parts of the machine are put in reverse operation to such a position of the individual components of the machine (state), in which the shed with the detected defectively inserted weft **9** is opened, whereby this detected defectively inserted weft **9** is at the entrance into its shed still connected to the weft **9** supply on the measuring device **2**.

[0021] In this position of the individual subunits of the machine, at this state of the machine, one static insertion of the new weft **9** is carried out through thus opened shed, by which means the new weft **9** is inserted into the shed. The new weft **9**, which due to the fluid stream from the picking nozzle **5** not only flies over the whole required width of the machine, but at the same time by acting dynamically on the previously defectively inserted weft **9**, to which the newly picked weft **9** is still connected due to the suppression of the cutting off by the means **6** for interrupting the weft **9** which still lies in the same shed, causes pulling out (ejection, expulsion, removal) of this incorrectly inserted weft **9** from the shed in the direction of the weft insertion. This automatic static insertion of the new weft **9** is made possible by the individual drive **3** of the pump **4** of the weft insertion system.

[0022] After inserting the new weft **9** into the shed and therefore after the assumed pulling out (ejection, expulsion, removal) of the previously incorrectly inserted weft **9** the detector **8** of the weft **9** removal, which is located on the side of the shed remote from the picking nozzle **5**, is activated. The detector **8** of the weft **9** removal finds out how many wefts **9** are physically present in the control zone, i.e. at the end of the shed behind the weft stop **7**.

[0023] If the removal of the defectively inserted weft **9** has been successful, there must be only one weft thread **9** present in the control zone and in that case the control system **1** performs individual transfer of this new weft **9** to the fell of the fabric being formed and puts the hydraulic weaving machine into operating mode of standard fabric production, which means that automatic restart of the hydraulic weaving machine is performed and the machine continues producing the required fabric.

[0024] If there are more than one weft thread **9** in the control zone, e.g., two or three weft threads, whereby this could be a loop formed by one weft thread **9** when at least two parts of one weft **9** are situated in the control zone, or, on the contrary, there is no weft **9** in the control zone, it means that the attempt to remove the defectively inserted weft **9** has failed.

[0025] After it has been found out that the attempt to remove the incorrectly inserted weft **9** has failed, the control system **1** decides on further action according to the nature of the failure. For example, if in the control zone there are more weft threads **9** than one, the whole process, as well as the machine, is automatically stopped and signalling is initiated to show that the defectively inserted weft **9** has not been automatically removed. Similarly, if there is no weft **9** in the control zone, the whole process, as well as the machine, is automatically stopped and signalling is initiated to show that the new weft has not been inserted.

[0026] Although attempts to remove the incorrectly inserted weft can be repeated, it appears that repeating the process of automatic removal of the incorrectly inserted weft **9** or uninserted new weft **9** does not significantly improve the effectivity of the process and it is more favourable with respect to the effective use of the machine to call the operator to solve the problem already after the first failure and then restart the machine manually.

[0027] In the illustrated exemplary embodiment, the detector **8** of the weft **9** removal comprises an ultrasonic sensor **80**, which is mounted reversibly displaceably on the machine frame in the control zone transversely to the direction of the insertion (picking) of the weft threads **9**. Below the control zone is located a collecting plate **81**, e.g. sheet metal, with a longitudinal opening **810**. The collecting plate **81** extends from the beating-up position of the weaving reed **0**, see Fig. 2, as far as to the position of the weaving reed **0** at back dead centre below the space defined by the size of the shed in a vertical plane, see Fig. 3. The position of the collecting plate **81** ensures that there are no parts of the weft **9** deposited on its surface. Moreover, the collecting plate **81** is during the machine operation very intensely sprayed by the disintegrating water jet of the hydraulic weft insertion system. The ultrasonic sensor **80** is mounted on a piston rod **820** of a pneumatic cylinder **82**, which is via an unillustrated electro-pneumatic valve connected to a source of compressed air and to the control system **1**. The ultrasonic sensor **80** is further aligned with a air blower nozzle **83**, which is also connected to the source of compressed air whose supply is controlled by the above-mentioned electro-pneumatic valve. The weft **9** properly inserted into the shed lies before being transferred to the fell of the woven fabric on the collecting plate **81** over the longitudinal opening **810** formed in it. Once the pneumatic cylinder **82** has been started, the supersonic sensor **80** is blown over by the air blower nozzle **83**, whereupon the supersonic sensor **80** moves across the weft insertion path above the collecting plate **81** and the longitudinal opening **810** formed in it. During this motion, in reality it represents a path of, e.g., approximately 50mm, the ultrasonic sensor **80** moves at a certain distance above the collecting plate **81** as far as to the back position of the weaving reed **0**, as is shown in Fig. 3, scanning the impulses of ultrasound radiation reflected from the wefts **9** lying on the collecting plate **81** across the longitudinal opening **810**. The observed number of impulses then substantially cor-

responds to the number of wefts **9**, or, in other words, the threads lying in the control zone. Accordingly, the control system **1** decides on further action, i.e. automatic restart or signaling failure status (due to the failure to remove the incorrectly inserted weft **9** or failure to insert a new weft **9**), as has been described above.

[0028] In an unillustrated exemplary embodiment, the detector **8** of the weft **9** removal comprises an optical sensor instead of an ultrasonic sensor **80**, which is mounted either on the same movable structure as the above-described ultrasonic sensor **80**, or on another suitable structure allowing the optical sensor to move within the control zone. Preferably, the optical sensor is aligned with a cleaning device, e.g., a air blower nozzle, connected to the source of compressed air and serving to remove the picking fluid and impurities from the optical elements of the optical sensor.

[0029] Similarly, also the ultrasonic detector **80** is in the unillustrated exemplary embodiment mounted on another suitable structure allowing the movement of the ultrasonic sensor **80** within the control zone.

Claims

1. A method for removing a weft (9) incorrectly inserted by hydraulic picking into the shed of a hydraulic weaving machine, in which a control system for detecting incorrect weft (9) insertion performs the steps of stopping the machine, removing the incorrectly inserted weft (9) and restarting the machine to resume production mode, whereby during the same revolution of the machine in which the weft (9) was defectively inserted, a signal is generated by the control system (1) of the machine to stop the machine and thus interruption of the incorrectly inserted weft (9) is prevented at the entrance to the shed and subsequently, after the machine is stopped, the machine operation is reversed to a state of the machine with the shed in an open position in which the weft (9) was improperly inserted, whereupon a new weft (9) is inserted, by which means the previously defectively insterted weft (9) is removed from the opened shed and after that on the side of the shed remote from the picking nozzle (5) it is assessed whether the attempt to remove the weft has been successful and the machine is either restarted to resume production mode, or it is stopped and error signalling is initiated, **characterized in that** the insertion of the new weft (9) is carried out as static weft insertion without the motion of the opened branches of the warp and without the motion of the means for transferring the new weft (9) to the fell of the fabric being formed, whereby after this static weft insertion, at first the number of threads situated in the control zone is determined and subsequently, according to the observed number of threads in the control zone, the control system (1) performs the transfer of the new weft (9) to the fell of the fabric being formed, whereupon the machine is either automatically restarted to production mode or the control system (1) stops the machine and initiates error signalling.

2. The method according to claim 1, **characterized in that** the number of threads situated in the control zone is determined by ultrasound.

3. The method according to claim 2, **characterized in that** when detection of the number of threads situated in the control zone is started, the sensor of the number of threads situated in the control zone is cleaned.

4. A device for removing a weft (9) incorrectly inserted by hydraulic pick into the shed of a hydraulic weaving machine, which comprises a weft lentgth measuring device (2) aligned with a picking nozzle (5), which is situated on one lateral side of the shed and is directed to the other side of the shed in the direction of the width of the fabric being produced, wherein on the machine frame is mounted a weft stop (7), whereby a means (6) for interrupting of the weft (9) is mounted on the machine frame in the area between the picking nozzle (5) and the proximal edge of the woven fabric, the picking nozzle (5) being connected to a pump (4) of the weft insertion system, which is connected to a drive, whereby the measuring device (2), the drive of the pump (4), the means (6) of interrupting the weft (9) and the weft stop (7) are connected to a control system (1) of the weaving machine, **characterized in that** the drive of the pump (4) of the weft insertion system is composed of an individual drive (3), which is mechanically independent of the other subunits and elements of the hydraulic weaving machine and is connected to the control system (1), whereby on the side of the shed remote from the picking nozzle (5) is situated a detector (8) of the weft (9) removal, also connected to the control system (1).

5. The device according to claim 4, **characterized in that** the control system (1) is equipped with a program for controlling a sequence of consecutive operations controlled without operator intervention, including detecting the incorrectly inserted weft (9), removing the incorrectly inserted weft (9) and its replacement with a new weft (9), checking whether the removal of the faulty weft (9) has been successful, the new weft (9) insertion and subsequent automatic restart of the machine to normal operating mode.

6. The device according to claim 4 or 5, **characterized in that** the detector (8) of the weft (9) removal comprises an ultrasonic sensor (80), which is reversibly displaceably mounted on the machine frame in the control zone transversely to the direction of the weft

(9) insertion and is connected to the control system (1) of the machine.

7. The device according to claim 6, **characterized in that** below the control zone is located a collecting plate (81) with a longitudinal opening (810), which extends from the beating-up position of the weaving reed (0) as far as to the position of the weaving reed (0) at back dead centre.

8. The device according to claim 4 or 5, **characterized in that** the sensor (8) of the weft (9) removal comprises an optical sensor, which is reversibly displaceably mounted in the control zone transversely to the direction of the insertion of the weft threads (9) on the machine frame and is connected to the control system (1) of the machine.

9. The device according to claim 6 or 8, **characterized in that** the ultrasonic sensor (80) or the optical sensor is mounted on a piston rod (820) of a pneumatic cylinder (82), which is connected to a source of compressed air and the control system (1) of the machine.

10. The device according to claim 9, **characterized in that** the ultrasonic sensor (80) or the optical sensor is aligned with an air blower nozzle (83) connected to the source of compressed air and the control system (1) of the machine.

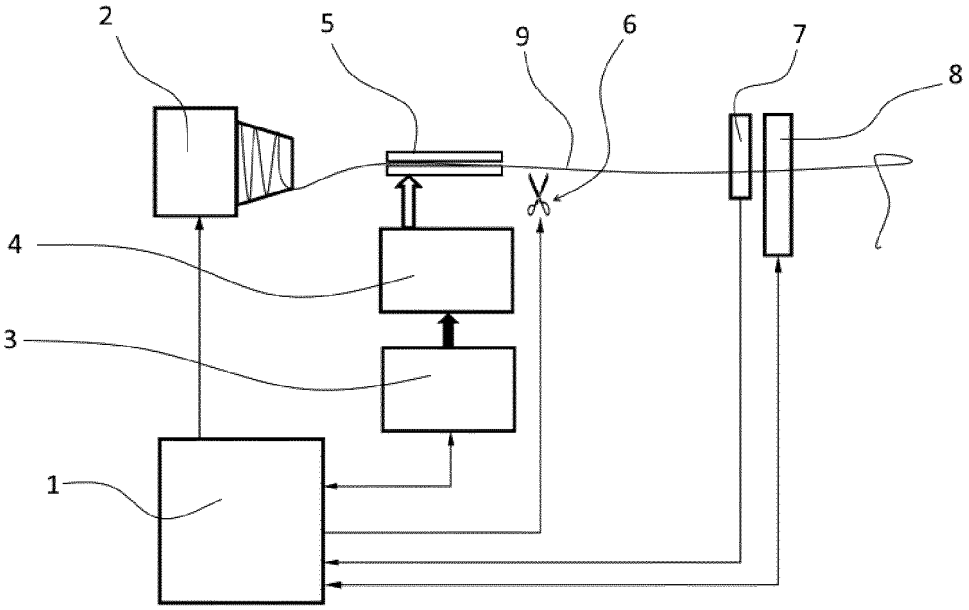

Fig. 1

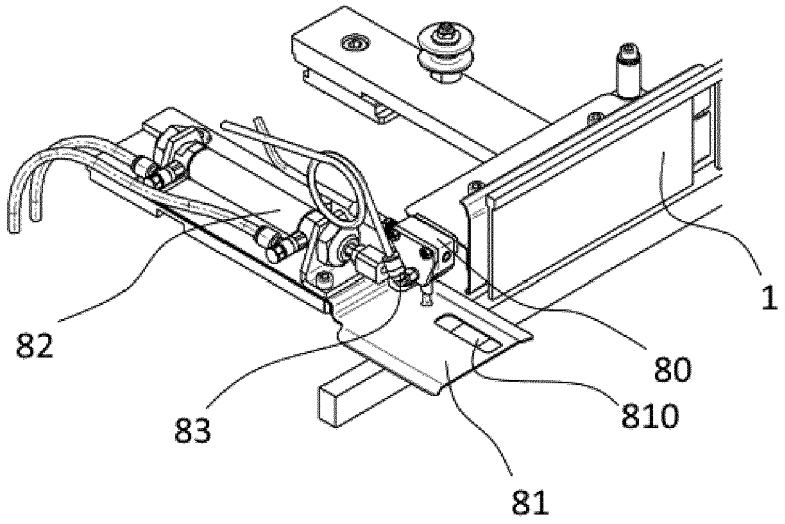

Fig. 2

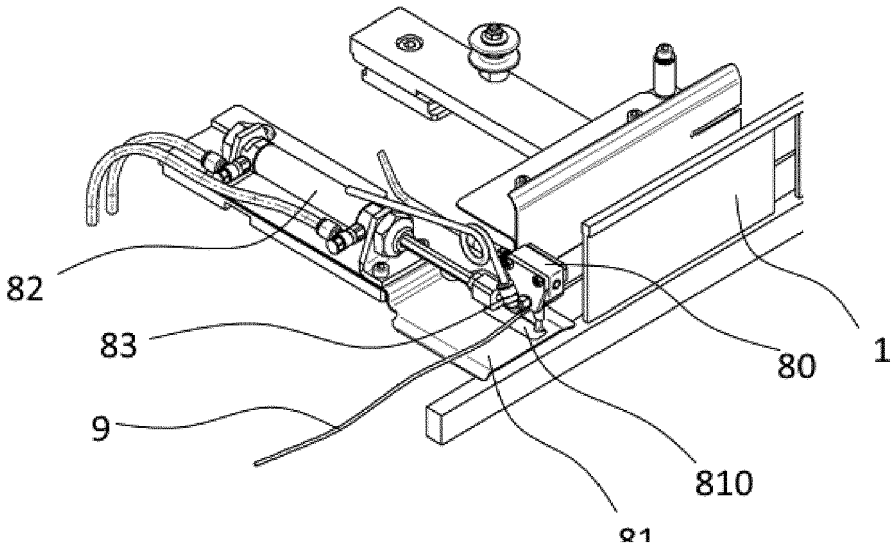

Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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