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(71) Applicant: **ITEMA (Switzerland) Ltd.**
8620 Wetzikon (CH)

(72) Inventor: **Scorl, Hans-Dieter**
8630 Rueti (CH)

(74) Representative: **Faggioni, Carlo Maria et al**
Fumero Studio Consulenza Brevetti
Pettenkoferstrasse 20-22
80336 Munich (DE)

(54) **Storage device and method for storing weft threads in a loom**

(57) A storage apparatus (20) for the storage of weft threads in a weaving machine is disclosed, including a storage chamber (24) having an inlet side and an outlet side, the storage chamber being provided at the inlet side thereof with a first nozzle (21) for the blowing in of a weft thread (2) and at the outlet side thereof with a thread brake (19) for the holding tight of the weft thread and a second nozzle (22) for the removal of the weft thread from the storage chamber, wherein the storage apparatus (20) additionally includes a third nozzle (23), upstream of the second nozzle (22) and with an opposite blowing direction with respect to the second nozzle (22) to blow back the removed weft thread into the storage chamber upon detecting a weft fault or to keep taught the weft thread.

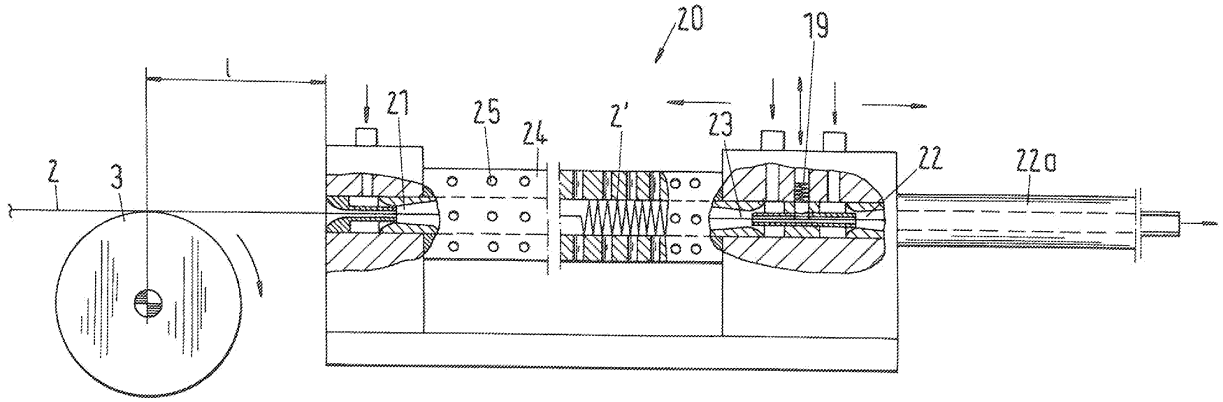

Fig.3

EP 2 230 342 A1

Description

Field of the invention

[0001] The invention relates to a method and to a storage device for the storage of weft threads in a weaving machine in accordance with the preamble of main method claim or with the preamble of main apparatus claim as well as to a weaving machine having one or more such storage apparatus or equipped for the carrying out of such a method.

Background art

[0002] Conventional weaving machines usually include a yarn store to provide a weft thread, a shed forming apparatus for the formation of a shed, a weft insertion apparatus to insert the weft thread into the shed and a reed to beat the inserted weft thread onto a fabric edge. The insertion of the weft thread takes place either in a force transmitting manner, for example by means of compressed air, or in a shape matched manner, for example by means of rapiers or projectiles. The weft insertion apparatus can, for example, contain nozzles for this purpose to accelerate the weft thread by means of compressed air or another fluid or rapiers in a guided or guided design into which the weft thread can be clamped or projectiles to which the weft thread can be fastened to insert the same into the shed.

[0003] Work has been going on for years to accelerate the weft insertion and to increase the productivity of the weaving machines in this way. Depending on the width of the machine and the weft insertion frequency, maximum thread speeds of 60 to 100 m/s are achieved on modern weaving machines. The thread acceleration takes place within around 10 ms. Accelerations result from this of $0.6x10^4$ m/s^2 to $1.0x10^4$ m/s^2. In addition to the acceleration, the deceleration of the weft thread is also limiting on performance. The thread speed drops slightly over the insertion time, for example, due to friction, increasing thread mass and further influences, and is lowered practically instantaneously to zero at the end of the weft insertion by means of a mechanical stopper. The thread tension peak arising in this process can exceed the thread breaking force so that weft thread breaks can occur. An improvement is provided by the currently used ABS braking systems with which the thread tension peaks can be reduced by around 50%.

[0004] The previous considerations assume that the weft insertion takes place approximately reproducibly. However, it has been found in practice that the total weft insertion has stochastic components in dependence on the weft material and the machine settings in that, for example, a substantial tolerance range can be observed in the thread arrival time. This makes regulation and control functions necessary on the machine side which can be made, for example, through time adjustment and/or pressure controlled main jets and relay jets on an air jet weaving machine to stabilize the weft insertion procedure and to make it as reproducible as possible.

[0005] The thread storage plays an important role for a low downtime weaving machine operation. On conventional weaving machines the weft thread is drawn off a supply reel package periodically in accordance with the weft insertion frequency and is stored intermediately on a drum store being held by a stop element. After the release of the weft thread by the stop element, the intermediately stored weft thread is inserted into a shed, for example by means of a force-transmitting thread transport, i.e. for example by means of acceleration nozzles and relay nozzles, and is stopped practically instantaneously at the end of the weft insertion by means of the stop element.

[0006] The following demands on the thread storage apparatus result for a modern weaving machine: the maximum thread withdrawal speed from the supply package amounts to 20 m/s - 22 m/s for spun yarns and 25 m/s for filament yarns. An intermediate storage is thus absolutely necessary since the ratio between the drawing off speed from the supply package and the maximum thread speeds on insertion is 1:3 to 1:4 and a direct, positive thread transport from the supply package via a delivery mechanism is consequently precluded.

[0007] Furthermore, the mean thread tension during the weft insertion should amount to 15% of the mean thread breaking strength and thread tension peaks should be limited to 50% of the mean thread breaking strength since higher thread tension peaks result in processing problems. These demands can only be satisfied using a conventional drum store with a stop element if the drum store is modified and/or if additional components such as an ABS brake are provided.

[0008] An alternative apparatus and method for the provision of weft threads in weaving machines is known from EP O 316 028 A. The apparatus described there contains a double roller to draw the weft thread from a supply package and a storage tube which is provided with a nozzle at the inlet side to blow the drawn off weft thread into the storage tube and which is provided with a thread clip at the outlet side to clamp the weft thread tight. In addition, a main nozzle is provided between the storage tube and the shed to remove the stored weft thread from the storage tube and to accelerate it in the weft direction. The stored thread quantity in the storage tube is dimensioned such that the stored thread quantity is consumed toward the end of the weft insertion and the weft thread is drawn directly off the double roller only in the final phase of insertion. The weft thread can thus be braked by a corresponding brake control implemented on the double roller. With the apparatus described in EP O 316 028 A there is the disadvantage that a thread tension peak occurs when the weft thread stored in the storage tube is consumed and the weft thread is drawn directly off the double roller. Additionally, means are lacking in the described apparatus to withdraw a weft thread from the shed in the event of a weft defect.

[0009] US-A-3 669 328 further discloses a storage tube having a driving nozzle for the weft thread and a braking nozzle at the opposite end of the storage tube. No other braking devices are provided, nor additional nozzles. Due to the braking action of the second braking nozzle, poor energy is given to the flying thread upon leaving the storage device. Due to this feature, this device cannot be employed in a very fast weaving loom, since it doesn't allow complete and reliable control over timing and number of insertions of the weft thread.

[0010] It is an object of the present invention to provide a method and a storage apparatus for the storage of weft threads in a weaving machine as well as a weaving machine having one or more such storage apparatus or equipped for the carrying out of such a method which are suitable for maximum thread insertion speeds of 60 m/s to 100 m/s and with which inserted fault weft threads can be withdrawn from the shed and used again.

[0011] This object is carried out according to the invention by the method, apparatus and weaving machine as defined in the appended claims.

Summary of the invention

[0012] In the method in accordance with the invention for the storage of weft threads in a weaving machine, a weft thread is blown into a storage chamber, which has an inlet side and an outlet side, from the inlet side by means of a first nozzle and is held at the outlet side of the storage chamber by means of a thread brake. The thread brake is opened for the weft insertion and the weft thread is removed from the storage chamber from the outlet side toward the shed by means of a second nozzle. The method is **characterized in that** the weft thread is kept taught by means of a third nozzle with an opposite blowing direction with respect to the second nozzle or is blown back into the storage chamber. The weft thread can, for example, be kept taught before the beating up stage, whereas the blowing back of the weft thread into the storage chamber can be used, for example, for the elimination of weft defects.

[0013] The weft thread is advantageously drawn off a supply package by means of a delivery apparatus, for example a continuously working delivery apparatus, and is supplied to the first nozzle. Furthermore, the removed weft thread can be withdrawn from the shed by means of a controlled roller pair and supplied to the third nozzle.

[0014] In an advantageous embodiment variant, the removed weft thread is accelerated by means of one or more acceleration nozzles which are arranged after the second nozzle in the weft direction. In a further advantageous embodiment variant, the weft thread is braked with controlled braking force toward the end of the weft insertion by means of the weft brake.

[0015] In an advantageous embodiment of the method, the delivery apparatus and/or the blowing of the weft thread into the storage chamber and/or the removal of the weft thread from the storage chamber and/or the weft insertion and/or the blowing back of the removed weft thread is/are controlled on the basis of the measured data detected by a thread sensor which can, for example, be arranged at a mixing pipe of an acceleration nozzle and by means of which, for example, the speed and/or the length of the weft thread can be detected on the removal or on the blowing back.

[0016] In a further advantageous embodiment, two or more storage apparatus are respectively provided for a weft thread colour, wherein, with weft insertions with the same weft thread colour following one another, the weft thread is removed in each case alternately or cyclically from one of the storage apparatus provided for this weft thread colour.

[0017] In a further advantageous embodiment, if a weft defect is detected, an inserted thread is withdrawn from the shed and is blown back into the storage chamber by means of the third nozzle or the length of an inserted weft thread is detected by means of a thread sensor and, in the event that a weft defect is detected, the withdrawal of the weft thread from the shed takes place by means of a controlled roller pair which is docked to the weft thread for this purpose and which is controlled on the basis of the detected length of the weft thread, with the withdrawn weft thread being blown back into the storage chamber by means of the third nozzle.

[0018] The storage apparatus in accordance with the invention for the storage of weft threads in a weaving machine includes a storage chamber having an inlet side and an outlet side, as well as a first nozzle at the inlet side of the storage chamber for the blowing in of a weft thread and a thread brake at the outlet side of the storage chamber for the holding tight and/or braking of the weft thread and a second nozzle for the removal of the weft thread from the storage chamber. The thread brake can be made as a thread brake with a controlled braking force, for example as a piezoelectric thread brake, to selectively hold the weft thread tight or to brake it with a controlled braking force. The storage apparatus in accordance with the invention additionally contains a third nozzle with an opposite blowing direction with respect to the second nozzle to tauten the removed weft thread or to blow it back into the storage chamber in the event of a weft defect.

[0019] The storage chamber advantageously has a tubular shape, having an internal round or rounded or polygonal cross-section. The storage chamber can further be made elongate and contain one, two or more storage sections in the longitudinal direction to receive the weft thread blown in and/or blown back, and the storage chamber can have a constant or tapering cross-section in the interior over at least a part of the length, for example over more than half the length.

[0020] In an advantageous embodiment variant, the second and third nozzles contain a double injector to switch over the running direction of the weft thread between removal, on the one hand, and tautening and blowing back, on the other hand. In a further advantageous

embodiment variant, the storage apparatus additionally includes one or more acceleration nozzles which are arranged downstream of the second nozzle in the weft direction and which each contain a mixing pipe to accelerate the removed weft thread and/or the second nozzle contains a mixing pipe to accelerate the removed weft thread.

[0021] In an advantageous embodiment, the storage apparatus additionally includes a thread sensor which is arranged inwardly or outwardly at a mixing pipe of the second nozzle and/or one of the acceleration nozzles to detect the speed and/or length of the weft thread on the removal or on the blowing back.

[0022] In a further advantageous embodiment, the storage apparatus selectively includes a delivery apparatus, for example a continuously working delivery apparatus and/or a delivery apparatus having a conveying wheel, to draw off the weft thread from a supply package and to feed it to the first nozzle; and/or a controlled roller pair for the thread withdrawal from a shed, wherein the roller pair is arranged between the shed and the second nozzle of the storage apparatus.

[0023] The invention furthermore includes an arrangement having a plurality of storage apparatus in accordance with one or more of the embodiments and embodiment variants described above from which a weft thread can be removed alternately or in a pattern-controlled manner, wherein the arrangement contains at least one unit having two or more respective storage apparatus arranged next to or above one another; and wherein, in the case of a plurality of units, they are arranged over and/or next to one another If necessary, the storage apparatus of a unit can form an acute angle with one another.

[0024] In addition, the invention includes a weaving machine having one or more storage apparatus for the storage of weft threads in accordance with one or more of the embodiments and embodiment variants described above and/or having at least one arrangement in accordance with the above description and/or equipped for the carrying out of a method in accordance with one or more of the embodiments and embodiment variants described above. The weaving machine can, for example, be made as a jet weaving machine, for example, as an air jet weaving machine, and/or as a rapier weaving machine and/or as a projectile weaving machine.

[0025] In an advantageous embodiment of the weaving machine, the one or more storage apparatus for the storage of weft threads and/or the at least one arrangement are arranged on a sley. In a further advantageous embodiment variant, the one or more storage apparatuses for the storage of weft threads and/or the at least one arrangement is/are arranged in a stationary manner on the weaving machine and at least one acceleration nozzle is arranged on a sley.

[0026] The method and the storage apparatus in accordance with the present invention as well as the weaving machine in accordance with the present invention have the advantage that the thread speed at which the weft thread is drawn off the supply reel package is up to four times lower than the maximum thread speed during the weft insertion and that the weft thread can be placed in low-mass loops in the storage chamber so that the thread tension acting on the weft thread upon removal from the storage chamber is comparatively small. An additional advantage is that withdrawn fault weft threads can also be placed in the storage chamber. The method and the storage apparatus in accordance with the present invention are thus also suitable for the elimination of weft defects and in particular for the automatic elimination of weft breaks. It is additionally advantageous that, where necessary, the thread brake arranged at the outlet side of the storage chamber can be used for braking with a controlled braking force in order thus to reduce thread tension peaks which can arise toward the end of the weft insertion when the weft thread placed in the storage chamber is consumed and the weft thread is tensioned.

[0027] The above and following detailed description of embodiments only serves as an example. Further advantageous embodiments can be seen from the dependent claims and from the drawings. Furthermore, individual features from the embodiments described or shown can also be combined with one another within the framework of the present invention to form new embodiments.

Brief description of the drawings

[0028] The invention will be explained in more detail in the following with reference to some preferred embodiments and to the drawings. There are shown:

Fig. 1 is a diagram showing an embodiment of a jet weaving machine with a storage apparatus in accordance with the present invention;

Fig. 2 is a diagram showing a second embodiment of a jet weaving machine with a storage apparatus in accordance with the present invention,

Fig. 3 is a detailed view, partly sectioned, of an embodiment of a storage apparatus in accordance with the present invention;

Figs. 4A-4C disclose some embodiments of an arrangement with the storage apparatus in accordance with the present invention, viewed from the side and from above;

Figs. 5A, 5B disclose a second embodiment of an arrangement with two storage apparatuses in accordance with the present invention, viewed from the side and from above;

Figs. 5C and 5D are elevation view of embodiment variants of the arrangement in accordance with Fig. 5A;

Figs. 6 and 6A are elevation and section views of an embodiment of a thread sensor for a storage apparatus in accordance with the present invention of which Fig. 6B represents a circuit diagram;

Fig. 7A is a section view of an embodiment variant

of an electrode arrangement from the embodiment of a thread sensor in accordance with Fig. 6 of which Fig. 7B represents a circuit diagram;

Fig. 8A-D are plots of thread speed, path, thread tension and brake opening with respect to an embodiment in which the method in accordance with the invention is used;

Figs. 9A, 9B are plots of the thread speed and shed movement with respect to a second embodiment in which the method in accordance with the invention is used; and

Figs. 10A-10C are diagrams showing a withdrawal operation of an inserted weft thread from a shed according to the method of the invention.

[0029] Fig. 1 shows a jet weaving machine 1 having at least one storage apparatus 20 in accordance with the present invention. The jet weaving machine can, for example, be made as an air jet weaving machine. The use of the invention is, however, not limited to air jet weaving machines, but can rather also be used advantageously on other types of weaving machines such as series shed weaving machines, rapier web machines or projectile weaving machines.

[0030] The storage apparatus 20 for the storage of weft threads 2, 2' includes a storage tubular chamber having an inlet side and an outlet side as well as a first nozzle 21 at the inlet side of the storage chamber for the blowing in of a weft thread 2. A thread brake, not visible in Fig. 1, is provided at the outlet side of the storage chamber for the holding tight and/or braking of the weft thread and a second nozzle 22 for the removal of the blown in weft thread 2' from the storage chamber. The storage apparatus additionally contains a third nozzle, not visible in Fig. 1, with an opposite blowing direction with respect to the second nozzle to keep taught the weft thread at the outlet side or to blow it back into the storage chamber in the event of a weft defect.

[0031] According to an advantageous embodiment, the storage apparatus additionally includes one or more acceleration nozzles 4 which are arranged downstream of the second nozzle 22 in the weft direction and which each contain a mixing pipe to accelerate the removed weft thread; alternatively the second nozzle contains itself a mixing pipe to accelerate the removed weft thread.

[0032] In an advantageous embodiment, the storage apparatus 20 includes a delivery apparatus 3 which can, for example, contain a conveying wheel to draw off the weft thread 2 from a supply reel package 2a and to supply it to the first nozzle 21. In a further advantageous embodiment, the storage apparatus includes a controlled roller pair 9 for the thread withdrawal from a shed, with the roller pair being arranged between the shed and the second nozzle 22 of the storage apparatus.

[0033] The jet weaving machine 1 illustrated in the drawings can be equipped with one or more of the following components; a supply reel package 2a; a thread centration device 2b to center the weft thread downstream of the supply reel package; a plurality of relay nozzles 5.1 a-c, 5.na-c to convey the weft threads 2' within the shed during the weft insertion; control valves 12, 13, 14, 15.1, 15.n to control the supply of fluid to the first, second and third nozzles of the storage apparatus, to the acceleration nozzle 4 and to the relay nozzles, with the latter being able to be made as individual relay nozzles each having a control valve or, as shown in Fig. 1, being able to be combined in groups of two or more relay nozzles which are each charged jointly with fluid from one control valve; a catching nozzle or tensioning nozzle 6 at the exit side of the loom to receive and hold the weft thread after the weft insertion when it comes out of the shed; a reed 8 for the beating up of the inserted weft threads; a sley 18 on which the reed 8 and, on a case by case basis, the acceleration nozzle 4 is fastened and which is usually made pivotable so that a beating movement can be carried out by means of the sley; a pressure supply 11; a pressure distributor 11a; a weft stop motion 17 at the catching side end of the reed to detect the arrival of the weft thread tip; and a control unit 10 to which, as required, the delivery apparatus 3, the control valves 12, 13, 14, 15.1, 15.n and, on a case by case basis, the roller pair 9 and/or the weft stop motion 17 are operatively connected.

[0034] In the embodiment shown in Fig. 1, the one or more storage apparatus 20 for the storage of weft threads or, depending on the application, optionally an arrangement of storage apparatus are arranged stationary on the weaving machine 1. Advantageously, at least one acceleration nozzle 4 is additionally arranged on the sley 18 just in front of the shed inlet. The spacing 1 between the delivery apparatus 3 and the first nozzle 21 of the storage apparatus can be selected to be comparatively short, for example around 10 cm or 15 cm, since the storage apparatus 20 is not moving with respect to the supply reel package 2a.

[0035] Fig. 2 shows a second embodiment of a jet weaving machine 1 having one or more (one for each of the weft thread to be inserted by the loom) storage apparatus 20 in accordance with the present invention. The weaving machine 1 shown in Fig. 2 in this respect substantially has the same components and the same design as the weaving machine of the first embodiment described above, with the exception of the one or more storage apparatus 20 which are arranged on the sley 18 in the second embodiment, i.e. they are moving integrally with the sley at each beating up of an inserted weft thread. Depending on the application, an arrangement of storage apparatus can also be arranged on the sley 18. A repetition of the optionally present components of the weaving machine 1 and of the storage apparatus 20 will be dispensed with in the following since they were already named within the framework of the first embodiment described above.

[0036] If the storage apparatus 20 includes a respective delivery apparatus 3, the delivery apparatus is expediently arranged before the first nozzle 21 of the stor-

age apparatus in a fixed location on the weaving machine. The spacing l between the delivery apparatus 3 and the first nozzle 21 of the storage apparatus, which typically amounts to 20 cm or more in the second embodiment, is advantageously selected to be so large that the weft thread does not come under tension on the beating up movement of the sley 18.

[0037] An additional acceleration nozzle is usually omitted with a storage apparatus arranged movable on the sley. In this case the second nozzle is mounted very close to the shed inlet and the weft thread 2' removed from the storage apparatus 20 can be accelerated by the same second nozzle 22 of the storage apparatus. In addition, with storage apparatus arranged movable on the sley, a roller pair for the weft withdrawal from the shed is not required. In this case, an inserted weft thread is withdrawn from the shed solely by operating the third nozzle of the storage apparatus.

[0038] Fig. 3 shows an embodiment of a storage apparatus 20 for the storage of weft threads in a weaving machine. In the embodiment, the storage apparatus includes a storage chamber 24 having an inlet side and an outlet side as well as a first nozzle 21 at the inlet side of the storage chamber for the blowing in of a weft thread 2 and possibly thread brake 19 at the outlet side of the storage chamber for the holding tight and/or braking of the weft thread and a second nozzle 22 for the removal of the blown in weft thread 2' from the storage chamber. The thread brake device can be made as a thread brake with a controlled braking force, for example as a piezoelectric thread brake, to selectively hold the weft thread tight or to brake it with a controlled braking force. The storage apparatus 20 in accordance with the invention additionally contains a third nozzle 23 with an opposite blowing direction with respect to the second nozzle to keep taught the removed weft thread or to blow it back into the storage chamber 24 in the event of a weft defect.

[0039] Advantageously, the storage chamber 24 is provided with pressure compensation openings 25 to reduce the pressure in the interior of the storage chamber so that the weft thread can be blown in and to generate a flow which conveys the blown in weft thread 2' in the direction of the outlet. The number of the pressure compensation openings per unit of area typically increases toward the outlet, to guarantee that the weft thread doesn't encounter a detrimental counter pressure as it approaches the outlet of the chamber.

[0040] The storage chamber 24 advantageously has a round or rounded or polygonal cross-section in the interior. The interior can, for this purpose, be shaped cylindrically, for example, and/or the storage chamber can be made as a pipe. Furthermore, the storage chamber can be made elongate and contain one, two or more storage sections in the longitudinal direction to receive and house the weft thread blown in and/or blown back. In addition, the storage chamber can have a constant or tapering cross-section in the interior over at least a part of the length, for example over more than half the length.

[0041] In an advantageous embodiment variant, the second and third nozzles 22, 23 relay on a double injector, i.e. for each nozzle one injector is provided belonging to a common nozzle body or each nozzle has its own injector in one nozzle body, with the two nozzle bodies being fastened together to switch over the running direction of the weft thread between the removal phase, on the one hand, and the tautening and blowing back phase, on the other hand. In a further advantageous embodiment, the second nozzle 22 contains a mixing pipe 22a to accelerate the removed weft thread.

[0042] The arrangement including the second and third nozzles at the outlet side of the storage chamber 24, is advantageous for keeping a good control on both tensioning and insertion timing of the weft thread.

[0043] In particular, the second nozzle 22, located downstream of the third nozzle, can be driven independently of the third nozzle 23, to accomplish proper insertion timing of the weft into the shed; while third nozzle 23 can be controlled to properly adjust tensioning of the weft and blowing it back into the storage chamber in case of weft faults.

[0044] The thread brake 19 can be arranged between the second nozzle 22 and the third nozzle 23. If the second and third nozzles contain a double injector, the thread brake is advantageously arranged, as shown in Fig. 3, between the nozzles in the common nozzle block. With nozzles made separate, it is also possible, for example, to fasten the second nozzle 22, the thread brake 19 and the third nozzle 23 to one another and/or to a common carrier.

[0045] In a further advantageous embodiment, the storage apparatus 20 additionally includes a delivery apparatus 3, for example a delivery apparatus having a conveying wheel to draw off the weft thread from a supply reel package and to supply it to the first nozzle. A continuously working delivery apparatus is advantageously provided. It is, however, also possible to operate the delivery apparatus intermittently if required, for example if the length of the weft thread to be inserted should be adapted or if a weft defect is repaired or the machine speed is changed. Suitable delivery devices are known, for example, from the documents EP 445489 A1 and EP 685585 A.

[0046] Figures 4A and 4B show an embodiment of an arrangement having two storage apparatus 20a, 20b in accordance with the present invention, viewed from the side and from above. A weft thread can be removed from the storage apparatus alternately or in a pattern controlled manner. In the embodiment shown, the two storage apparatuses 20a, 20b or, on a case by case basis, more storage apparatuses form a unit, with the storage apparatuses expediently being arranged at an acute angle next to one another, i.e. with the weft paths forming cute angles between each other. In an advantageous embodiment, the storage apparatuses 20a, 20b each include a delivery apparatus 3a, 3b at the inlet side. In addition, a reed is schematically shown as being integral with the

storage apparatuses in Figures 4A and 4B to indicate that, with the exception of the delivery apparatus, the storage apparatuses are arranged on a sley together with the reed, whereas the delivery apparatus 3a, 3b are advantageously arranged in a stationary position on the weaving machine.

[0047] Fig. 4C shows an embodiment similar on the arrangement of Figs. 4A, 4B with selectively two or four storage apparatus, viewed from the side. In this embodiment, two storage apparatuses 20.1a, 20.2a or, on a case by case basis, more storage apparatuses are arranged over one another, with the storage apparatuses expediently forming an acute angle with one another. In the same way, however, two or, on a case by case basis, more of the units which are shown in Figures 4A and 4B and which each contain two or more storage apparatuses arranged next to one another on the horizontal plane can also be arranged over one another (on the vertical plane) to form an arrangement having at least four storage units. In an advantageous embodiment, the storage apparatuses each additionally include a delivery apparatus 3.1a, 3.2a at the inlet side. In addition, in Fig. 4C a reed 8 is shown schematically as being integral with the storage apparatus to indicate that in the arrangement shown, with the exception of the delivery apparatus, the storage apparatuses are arranged movable together with the sley and the reed, whereas the delivery apparatus are advantageously arranged in a stationary position on the weaving machine.

[0048] The arrangements and/or units described above are advantageously made as prefabricated assemblies.

[0049] Figures 5A and 5B show a second embodiment of an arrangement having two or more storage apparatus in accordance with the present invention, viewed from the side and from above. A weft thread can be removed from the storage apparatus alternately or in a pattern controlled manner. In the embodiment shown, the two or more storage apparatus 20a, 20b form a unit, with the storage apparatuses expediently being arranged next to one another having the weft paths arranged parallel each other. In an advantageous embodiment, the storage apparatuses 20a, 20b each additionally include a delivery apparatuses 3a, 3b at the inlet side and/or at the outlet side and spaced apart from the other storage apparatus. Acceleration nozzles 4a, 4b are provided with launch axis thereof arranged at an acute angle to one another. In addition, in Figures 5A and 5B, a reed 8 is schematically shown as being integral with the acceleration nozzles to indicate that, in the arrangement shown, the acceleration nozzles are arranged on a sley together with the reed, whereas the storage apparatuses are advantageously arranged together with the delivery apparatus 3a, 3b in a stationary position on the weaving machine.

[0050] Figs. 5C and 5D show additional embodiments similar to the ones shown in Figs. 5A and 5B. Two storage apparatus 20.1a, 20.2a are arranged over one another. In the same way, however, two of the units which are shown in Figures 5A and 5B and which each contain two or more storage apparatus arranged next to one another can also be arranged over one another to form an arrangement having at least four storage units. Advantageously, the storage apparatuses additionally each include a delivery apparatus 3.1a, 3.2a at the inlet side and/or, at the outlet side and spaced apart from the other storage apparatus, in each case an acceleration nozzle 4.1a, 4.2a, with the acceleration nozzles expediently forming an acute angle.

[0051] In the embodiment shown in fig. 5D, three or more storage apparatuses 20.1a, 20.2a, 20.3a are arranged over one another. In the same way, however, two or more of the units which are shown in Figures 5A and 5B and which each contain two or more storage apparatus arranged next to one another can also be arranged over one another to form an arrangement having six storage units. Advantageously, the storage apparatus additionally respectively include a delivery apparatus 3.1a, 3.2a, 3,.3a at the inlet side and/or, at the outlet side and spaced apart from the other storage apparatus, in each case an acceleration nozzle 4.1a, 4.2a, 4.3a, with the acceleration nozzles expediently forming an acute angle. In addition, in Fig. 5C, a reed 8 is schematically shown as being integral with the acceleration nozzles to indicate that, in the arrangement shown, the acceleration nozzles are arranged on a sley together with the reed, whereas the storage apparatus are advantageously arranged together with the delivery apparatus in a stationary position on the weaving machine.

[0052] The arrangements and/or units described above are advantageously made as prefabricated assemblies.

[0053] In an advantageous embodiment, the storage apparatus according to the present invention additionally includes a thread sensor which can, for example, be arranged at a mixing pipe 22a of the second nozzle 22 and/or the acceleration nozzle 4, 4a, 4b, 4.1 a - 4.3a to detect the speed and/or length of the weft thread on the removal or on the blowing back phases. Figures 6, 6A and 6B show an embodiment of such a thread sensor. Fig. 6 in this respect shows a longitudinal section through the thread sensor and Fig. 6A shows a cross-section.

[0054] The thread sensor 16 in the embodiment is made as an electrostatic measurement sensor to detect one or more movement parameters of the weft thread during the weft insertion. The detection preferably takes place in a contactless manner. The thread sensor for this purpose includes a tubular carrier 16c which can simultaneously be used as a mixing pipe as required and a grid with grid elements which are arranged periodically in the thread running direction and which act as electrodes 16a, 16b. The carrier can be made from an insulating pipe, for example an insulating ceramic pipe or as a plastic pipe and the electrodes can be formed at the inside or outside of the carrier. The carrier can, however, also be made of a metal pipe and the electrodes can be applied to an insulating intermediate layer in the interior

of the pipe.

[0055] Advantageously, the electrodes 16a, 16b are shaped cylindrically, with it also being possible, however, to use other electrode shapes inside or outside the mixing pipe such as planar electrode shapes. Fig. 6B shows a possible arrangement layout of the electrodes 16a, 16b. The thread sensor shown includes two electrodes with grid elements arranged periodically and in comb-like form, with a grid element of the one conductor following a grid element of the other conductor alternately in the running direction of the weft thread. The individual grid elements of an electrode are each connected to one another via a conductor which can extend, as shown in Fig. 6B, for example, in the running direction of the weft thread.

[0056] An embodiment variant of an electrode arrangement from the embodiment in accordance with Figs. 6, 6A is shown in Figs. 7A, 7B, with Fig. 7A showing a cross-section through the electrode arrangement and Fig. 7B showing a simplified view in which the electrodes are deployed into a plane for sake of clear representation. The thread sensor in the embodiment of Figures 7A and 7B contains two electrodes 16a, 16b with grid elements arranged periodically and in double-comb form, with the grid elements engaging into one another and a grid element of the one conductor following a grid element of the other conductor alternately in the running direction of the weft thread. The individual grid elements of an electrode are each connected to one another via a conductor which, as shown in Fig. 7B, for example, connects the grid elements at the center and can extend in the running direction of the weft thread.

[0057] The general operation of an electrostatic measurement sensor which is designed on the principle of the so-called spatial filtering method is known from document EP 1033579 A2. The thread sensor described above can be operated as follows, for example: If a weft thread is located in the region of the grid elements, the loads present on the weft thread generate a periodic signal component in the grid elements which can be electronically amplified and whose frequency can be detected. The detected frequency is in this respect proportional to the speed of the weft thread. The sensor is thus able not only to detect the presence, but also the instantaneous speed of a weft thread.

[0058] The thread sensor described above with the embodiment variants described and in particular its design at a mixing pipe of an acceleration nozzle can be used and implemented also in a system without the storage apparatus described above.

[0059] The method in accordance with the invention will be described in more detail in the following with reference to Figures 1 to 5D. In the method for the storage of weft threads in a weaving machine, a weft thread 2 is blown into a storage chamber 24, which has an inlet side and an outlet side, from the inlet side by means of a first nozzle 21 and is held at the outlet side of the storage chamber by thread brake device 19. Upon weft insertion, the weft thread 2' is removed from the storage chamber at the outlet side by means of a second nozzle 22. The method is **characterized in that** the removed weft thread is kept taught by means of a third nozzle 23 with an opposite blowing direction with respect to the second nozzle 22 or is blown back into the storage chamber. The weft thread, for example, is kept taught just before and during the beating up phase, whereas the blowing back of the weft thread into the storage chamber can be used for the elimination of weft defects.

[0060] The weft thread is advantageously drawn off from a supply reel package 2a by means of a delivery apparatus 3, 3a, 3b, 3.1a

- 3.3a, for example by means of a continuously working delivery apparatus, and is supplied to the first nozzle 21. Furthermore, in case of faults, the removed weft thread can be withdrawn from the shed by means of the third nozzle 23, possibly in cooperation with a controlled roller pair 9.

[0061] In an advantageous embodiment variant, the removed weft thread is accelerated by means of one or more additional acceleration nozzles 4, 4a, 4b, 4.1a 4.3a which are arranged downstream of the second nozzle 22 in the weft direction. In a further advantageous embodiment, the weft thread is braked with controlled braking force toward the end of the weft insertion by means of the weft brake device 19, this lattter employing clamp means acting across the weft path and operated by pneumatic or electric or mechanic driving means.

[0062] In an advantageous embodiment of the method, the delivery apparatus 3, 3a, 3, 3.1 a 3, .3a and/or the blowing of the weft thread into the storage chamber 24 and/or the removal of the weft thread from the storage chamber and/or the weft insertion and/or the blowing back of the removed weft thread is/are controlled on the basis of the measured data detected by a thread sensor 16 which can, for example, be arranged at a mixing pipe 22a of the second nozzle 22 or at a mixing pipe of an acceleration nozzle 4, 4a, 4b, 4.1 a - 4.3a and by means of which, for example, the speed and/or the length of the weft thread can be detected on the removal or on the blowing back phases.

[0063] In a further advantageous embodiment, two or more storage apparatus 20 are respectively provided for a weft thread colour, wherein, with weft insertions with the same weft thread colour following one another, the weft thread is removed in each case alternately or cyclically from one of the storage apparatus provided for this weft thread colour. The term weft thread colour in this respect, as usual in the textile machine sector, embraces all yarn properties such as the colour, diameter, texture, roughness and further specific yarn properties.

[0064] In a further advantageous embodiment of the method, if a weft defect is detected, an inserted thread is withdrawn from the shed and is blown back into the storage chamber 24 by means of the third nozzle 23. The

inserted length of the weft thread can be detected by means of a thread sensor 16 and, in the event that a weft defect is detected, the withdrawal of the weft thread from the shed takes place by means of the third inverse operating nozzle and possibly with the aid of a controlled roller pair 9 which is docked to the weft thread for this reason. The roller pair 9 is controlled on the basis of the detected length of the fault weft thread, with the withdrawn weft thread being blown back into the storage chamber 24 by means of the third nozzle.

[0065] The operation method for the weft insertion using the storage apparatus described above, will be explained in more detail in the following with reference to an embodiment and with reference to Figures 1 to 3 and 8A to 8D. In the embodiment, the weft thread 2 is provided before the weft insertion by a delivery apparatus 3 and is blown into a storage chamber 24 which has an inlet side and an outlet side. At the inlet side the weft thread enters the storage 24 by means of a first nozzle 21, blowing an air jet in the inserting direction, and the thread is held at the outlet side of the storage chamber by means of a thread brake 19, with the first nozzle advantageously working in the low pressure range. The weft thread 2' blown in can be stored in the storage chamber 24 in loop form, for example. The thread brake 19 is opened for the weft insertion and the weft thread 2' is removed from the storage chamber at the outlet side by means of the second nozzle 22, also blowing an air jet in the inserting direction. The weft thread can subsequently be inserted into a shed in a known manner by means of an acceleration nozzle 4 and additional relay nozzles 5.1 a-c to 5.na-c. The weft insertion is ended by closing the thread brake device 19 and the next storage procedure begins. The thread delivery is typically not interrupted by the delivery apparatus at any time. The emptying time of the storage chamber 24 is usually proportional to the pressure with which the second nozzle 22 and the acceleration nozzle 4 are loaded.

[0066] At the weft start, the weft thread 2' stored in the storage chamber 24 is removed in a force transmitting manner by the second nozzle 22, the acceleration nozzle 4 and the relay nozzles 5.1a-c to 5.na-c. The weft thread 2' stored in the storage chamber 24 in this respect has a thread length which is smaller than the total thread length required for the weft insertion. The residual thread length up to the required total thread length is delivered by the delivery apparatus 3 in shape matched manner. If the weft thread 2' stored in the storage chamber has been removed, a thread tension peak occurs due to the transition from the force-transmitting thread transport to the shape matched thread transport. This can be alleviated in that the weft thread is braked before the weft thread 2' stored in the storage chamber is used up, for example by means of a thread brake 19 with a controlled braking force.

[0067] To keep the thread load low, operation is carried out with two or more storage apparatuses and the weft thread is removed alternately or cyclically from one of the storage apparatus. A moderate, constant speed of the delivery apparatus results from this. The speed and/or the length of the weft thread is advantageously detected during the weft insertion by a thread sensor 16 arranged at a mixing pipe 22a of the second nozzle 22 or of the acceleration nozzle and the delivery apparatus 3, on the one hand, and the braking force of the thread brake, on the other hand, are controlled using the values detected.

[0068] Fig. 8A shows a diagram of the thread speed v as a function of the loom drive angle during the weft insertion. The drive angle is proportional to the time with a constant speed. After the weft start IB, the weft thread is accelerated up to the maximum thread speed. The thread speed subsequently decreases slightly through friction and the increasing thread length and drops comparatively steeply to zero toward the end of the weft insertion so that the end 1E of the weft insertion is reached. The steepness of the speed drop is determined, on the one hand, by the braking force of the thread brake device 19 and, on the other hand, by the delivery speed of the delivery apparatus 3.

[0069] Fig. 8B shows a diagram of the path L covered by the weft thread tip as a function of the drive angle and Fig. 8C shows a diagram of the thread tension F as a function of the machine angle. The thread tension peak toward the end of the weft insertion arises by the transition from the force transmitting thread transport to the shape matched thread transport when the weft thread stored in the storage chamber is used up and the weft thread is delivered directly from the delivery device. The thread tension peak would be substantially higher without a braking of the thread speed before the transition. It can furthermore be recognized from Figures 8B and 8C that the residual thread length delivered directly from the delivery apparatus is comparatively short in comparison with the total thread length required for the weft insertion, for example less than 20% or less than 10% or less than 5% of the required total thread length.

[0070] Fig. 8D shows a diagram of the opening gap S_B of the thread brake device 19 as a function of the drive angle of the loom. The braking force of the thread brake is in this respect dependent on the opening gap.

[0071] The use of the method in accordance with the invention in the weft insertion will be explained in more detail in the following with reference to a second embodiment and with reference to Figures 1 to 3 as well as 9A and 9B. Figures 9A and 9B show the associated diagrams of the thread speeds v_I, v_{LI}, v_2, v_{L2} and shed movement H during two weft insertions following one another. To keep the thread load low, work is carried out with two storage apparatuses 20 or, if required, more storage apparatuses and the weft thread is removed alternately from one of the storage apparatuses.

[0072] In the second embodiment, the weft thread 2 is provided before the weft insertion by a delivery apparatus 3 and is blown into a storage chamber 24 which has an inlet side and an outlet side from the inlet side by means

of a first nozzle 21 and is held at the outlet side of the storage chamber by means of a thread brake device 19, with the first nozzle advantageously working in the low pressure range. The weft thread 2' blown in can be stored in the storage chamber 24 in loop form, for example. The thread brake device 19 is opened for the weft insertion and the weft thread 2' is removed from the storage chamber at the outlet side by means of a second nozzle 22. The weft thread can subsequently be inserted into a shed in a known manner by means of an acceleration nozzle 4 and additional relay nozzles 5.1a-c to 5.na-c. The weft insertion is ended by closing the thread brake 19 and the next storage procedure begins. The thread speeds v_1, v_2 of the first and second weft threads are shown in Fig. 9A as a function of the machine angle. The first weft thread after the weft start IB_1 is accelerated up to the maximum thread speed in a first machine cycle which goes from 0° to 360°. The thread speed v_1 of the first weft thread subsequently remains at a high level and drops to zero toward the end IE_1 of the weft insertion. The second weft thread remains at rest during the first machine cycle. In the subsequent second machine cycle which goes from 360° to 720°, the first weft thread remains at rest, whereas the second weft thread is accelerated up to the maximum thread speed after the weft start IB_2. The thread speed v_2 of the second weft thread subsequently remains at a high level and drops to zero toward the end IE_2 of the weft insertion. The course of the respective thread speeds v_1, v_2 is shown schematically in Fig. 9A. In practice, the course of the thread speeds will rather approach the course shown in Fig. 8A during a weft insertion.

[0073] The respective delivery speeds v_{L1}, v_{L2} at which the first and second weft threads are provided by the delivery apparatus can in this respect be substantially constant, as shown in Fig. 9A. It is, however, also possible to adapt the respective delivery speeds v_{L1}, v_{L2}, for example on adaptations of the weft thread length, on the elimination of weft defects or on changes of the machine speed. Furthermore, the weft threads can be provided intermittently as required from the delivery apparatus. Since operation is carried out with two storage apparatuses 20 in this embodiment, the weft thread can be removed alternately from one of the storage apparatus. This means that, during the weft insertion of the one weft thread, the thread store in the storage chamber belonging to the other weft thread can be filled up. A moderate and, if desired, constant speed of the delivery apparatus results from this.

[0074] Further details and embodiment variants on the second embodiment can be seen from the first embodiment described within the framework of Figures 8A to 8D.

[0075] In an advantageous embodiment of the method in accordance with the invention, a weft thread taken from the storage chamber 24 is kept taught by means of a third nozzle 23 with an opposite blowing direction with respect to the second nozzle 22. In the second embodiment shown in Figures 9A and 9B, both the first and the second weft threads are expediently tautened. The embodiment described within the framework of this embodiment example for the tautening of the weft thread can, however, also be used in a corresponding manner when weft threads following one another are removed from the same storage apparatus or from more than two storage apparatus.

[0076] Fig. 9B shows the movement of the warp threads K_1 and K_2 in the second embodiment over two machine cycles, while the respective blowing times TT_1, TT_2 for the tautening of the weft threads are drawn in Fig. 9A. At the start of the first machine cycle, the first warp thread K_1 can be raised, for example, and the second warp thread K_2 can be lowered to form a shed for the first weft insertion. The two weft threads K_1 and K_2 in this respect are representative of all warp threads of the upper shed or lower shed.

[0077] In the first machine cycle, the first weft thread is accelerated up to the maximum thread speed after the web start IB_1. The thread speed v_1 of the first weft thread subsequently remains at a high level and drops to zero toward the end IE_1 of the weft insertion. At the end IE_1 of the first weft insertion, the inserted weft thread is received and held by a catching nozzle or tensioning nozzle 6 which is arranged at the catching side end of the shed. On a case by case basis, a thread clip can be provided in addition to or instead of the catching and tensioning nozzle 6 at the catching side end of the shed to hold the inserted weft thread tight. At the same time or subsequently, the respective third nozzle 23 can be pressurized to tauten the inserted weft thread also on the insertion side of the shed. The respective thread brake device 19 is advantageously opened during the tautening.

[0078] At the end of the first weft insertion, the first warp thread K_1 is additionally lowered and the second warp thread K_2 is raised to close the shed. After the shed closure, the thread brake device 19 is normally closed and the third nozzle 23 is switched off.

[0079] In the second machine cycle, the first warp thread K_1 is lowered and the second warp thread K_2 is raised to form a shed for the second weft insertion. Reference is made to the preceding paragraphs for the description of the second weft insertion. The tautening of the second weft thread takes place in the same manner as the tautening of the first weft thread so that reference is likewise made to the preceding description for this purpose.

[0080] In a further advantageous embodiment of the method in accordance with the invention, a weft thread removed from the storage chamber 24 is blown back into the storage chamber by means of a third nozzle 23 with an opposite blowing direction with respect to the second nozzle 22. In this connection, Figures 10A-C show a further embodiment of a storage apparatus in accordance with the present invention, shown in connection with withdrawal of an inserted weft thread from a shed. The blowing back of the weft thread into the storage chamber can be used, for example, in the automatic remedy of weft

defects, for example if a weft thread standstill occurs in the shed after a weft thread brake or another disturbance, or if a weft fault occurred.

[0081] Fig. 10A shows a storage apparatus 20 during the weft insertion. In the embodiment, the weft thread 2 is provided before the weft insertion by a delivery apparatus 3 and is blown into a storage chamber 24 which has an inlet side and an outlet side from the inlet side by means of a first nozzle 21 and is held at the outlet side of the storage chamber by means of a thread brake device 19, with the first nozzle advantageously working in the low pressure range. If the storage chamber includes, as shown in Fig. 10A, two storage sections 24a, 24b which are, for example, separated from one another in the longitudinal direction by a cross-sectional restriction, the weft thread is advantageously stored in the first (i.e. the upstream one) storage section 24a. The blown in weft thread 2' can be stored in loop form in the storage chamber, for example, and has the length L_s directly before the weft insertion. The weft thread substantially has a constant length L_k from the first storage section 24a or, on a case by case basis, from the non-divided storage chamber up to a pair of thread scissors arranged at the weft side of a reed 8.

[0082] The thread brake device 19 is opened for the weft insertion and the weft thread 2' is removed from the storage chamber at the outlet side by means of a second nozzle 22. The weft thread can subsequently be inserted into a shed in a known manner by means of an acceleration nozzle 4 and additional relay nozzles. In a further advantageous embodiment variant, the second nozzle 22 contains a mixing pipe 22a to accelerate the removed weft thread even without using an acceleration nozzle 4.

[0083] If a weft thread fault is detected, for example because a weft stop motion arranged at the catching side end of the shed does not deliver any arrival signal, the weaving machine is stopped. If the weaving machine comes to a standstill, the nth shed change has normally already taken place, i.e. the not completely inserted weft thread is already bound in. The weaving machine is usually moved into the open shed n-1 for the removal of an incompletely inserted weft thread from the shed.

[0084] Fig. 10B shows the storage apparatus 20 during an automatic weft break repair. The delivery apparatus 3 is stopped as soon as a weft fault is detected. A possibility of pulling the weft thread from the shed in a controlled manner is the docking of a controlled roller pair 9. The weft thread drawn from the shed by means of the roller pair is subsequently blown back into the storage chamber by means of the third nozzle 23 and is stored in said storage chamber. If the storage chamber includes two storage sections 24a, 24b, the withdrawn weft thread 2" is preferably stored in the second storage section 24b, i.e. the downstream section. If no controlled roller pair is provided, for example with a comparatively small cloth width or if the storage apparatus is arranged together with the reed 8 on a sley, the weft thread can be withdrawn from the shed solely by the third nozzle 23.

[0085] The withdrawal of the weft thread is advantageously controlled by means of a thread sensor, for example by means of a thread sensor which is arranged in the mixing pipe 22a of the second nozzle 22 or in the mixing pipe of an acceleration nozzle 4. The thread brake device 19 in the storage apparatus and/or a thread clip in the acceleration nozzle 4 is/are closed, the roller pair is stopped and the docking is ended when the thread tip of the withdrawn weft thread has left the shed. The thread length ΔLs withdrawn from the shed can, as shown in Fig. 10B, for example, be stored after the withdrawal and placing in the second storage section 24b of the storage apparatus 20, while the remaining, non-inserted web thread 2' with the length $L_s - \Delta Ls$ can be stored in the first storage section. To avoid positive length tolerances, the withdrawn weft thread is, if necessary, cut off by a pair of thread scissors arranged at the weft side end of the reed 8, for example by means of a control cut which is carried out in every case. The control can be made so that the weft thread is only withdrawn under specific conditions, for example from a previously defined position of the weft thread tip in the shed.

[0086] Fig. 10C shows the storage apparatus 20 after the next, i.e. nth, weft insertion. The inserted weft thread with the length L_{sn} is advantageously held or clamped tight at the catching side end of the shed and is tautened by means of the third nozzle 23 to exclude thread loops on the left hand fabric side. At the same time, the weft thread length L_{sn+1} for the next weft insertion is aligned and missing lengths are added as necessary.

[0087] The method and the storage apparatus for the storing of weft threads as well as the weaving machine in accordance with the present invention have the advantage that they are suitable for maximum thread insertion speeds from 50 m/s to 100 m/s and more since the thread tension acting on the weft thread on the removal from the storage chamber is comparatively small. A further advantage is that withdrawn weft threads can also be stored in the storage chamber so that the method described above, the described storage apparatus and the described weaving machine can also be used for the automatic weft defect repair.

[0088] It is understood that scope of the invention described above is not limited to the particular embodiments illustrated, but is extended to all other variants and changes which come under the definition given in the attached claims.

Claims

1. A method for the storage of weft threads in a weaving machine in which a weft thread (2) is blown into a storage chamber (24, 24a, 24b), which has an inlet side and an outlet side, by means of a first nozzle (21) at the inlet side and is held at the outlet side of the storage chamber by means of a thread brake device (19), the thread brake device being opened

for the weft insertion, **characterized in that** the weft thread is removed from the storage chamber by means of a second nozzle (22) at the outlet side of said storage chamber, the removed weft thread is kept taught or is blown back into the storage chamber (24, 24a, 24b) by means of a third nozzle (23), located adjacent and upstream of the second nozzle (22) with an opposite blowing direction with respect to the second nozzle (22).

2. A method in accordance with claim 1, wherein the weft thread (2) is drawn off a supply reel package (2a) by means of a delivery apparatus (3).

3. A method in accordance with claim 1 or claim 2, wherein the removed weft thread is accelerated by means of one or more acceleration nozzles (4) which are arranged downstream of the second nozzle (22) in the weft direction and/or wherein the weft thread is braked by means of the thread brake device (19) with a controlled braking force toward the end of the weft insertion phase.

4. A method in accordance with any one of the preceding claims, wherein the removal of the weft thread from the storage chamber (24, 24a, 24b) and/or the weft insertion and/or the blowing back of the removed weft thread is/are controlled on the basis of the measured data detected by a thread sensor (16) which is arranged at a mixing pipe (22a) of the second nozzle (22) or at a mixing pipe of an acceleration nozzle (4) and by means of which the speed and/or length of the weft thread are detected on the removal or on the blowing back phases.

5. A method in accordance with any one of the preceding claims, wherein, in the event that a weft fault is detected, an inserted weft thread is withdrawn from the shed and is blown back into the storage chamber (24, 24a, 24b) by means of the third nozzle (23), said blown back weft thread being available in the storage chamber for a next insertion phase.

6. The method according to claim 5, wherein said storage chamber is comprised of at least a first and a second storage sections (24a, 24b) staggered in the longitudinal direction, said blown back weft thread being stored in the second section (24b) located downstream of the first section (25a).

7. The method according to claim 5) or 6), wherein said third nozzle (23) is cooperating with a controlled roller pair (9) which is docked to the weft thread and which is controlled on the basis of the detected length of the inserted weft thread.

8. A storage apparatus for the storage of weft threads in a weaving machine for implementing a method according to any one of the preceding claims, wherein the storage apparatus (20) includes a storage chamber (24, 24a, 24b) having an inlet side and an outlet side, as well as a first nozzle (21) at the inlet side of the storage chamber for the blowing in of a weft thread (2) and a thread brake device (19) at the outlet side of the storage chamber for the holding tight and/or braking of the weft thread, **characterized in that**
a second nozzle (22) for the removal of the weft thread is provided at the outlet side of the storage chamber (24), and **in that**
the storage apparatus (20) additionally includes a third nozzle (23) with an opposite blowing direction with respect to the second nozzle (22) and located upstream of the second nozzle (22), apt to tauten the removed weft thread or to blow it back into the storage chamber (24, 24a, 24b).

9. The storage apparatus according to claim 8, wherein the storage chamber (24, 24a, 24b) has a tubular shape and wherein the storage chamber (24) is elongate and contains at least one storage section (24a, 24b) in the longitudinal direction to receive the weft thread blown in and/or blown back, and the storage chamber has a constant or tapering cross-section in the interior over at least a part of the length, in particular over more than half the length.

10. The storage apparatus according to claim 9), wherein said storage chamber is comprised of a first (24a) and a second (24b) sections in the longitudinal direction, the second section (24b) is downstream of the first section (24a) and is arranged to house said blown back weft thread.

11. A storage apparatus according to any one of the claims 8), 9) or 10), wherein the second and third nozzles (22, 23) contain a double injector to change the running direction of the weft thread between removal, on the one hand, and tautening and blowing back, on the other hand.

12. The storage apparatus according to claim 11), wherein said thread brake device (19) is arranged between said second and third nozzles.

13. The storage apparatus according to any one of the claims 8 to 12, wherein the storage apparatus additionally includes one or more acceleration nozzles (4) which are arranged downstream of the second nozzle (22) in the weft direction and which each contain a mixing pipe to accelerate the removed weft thread.

14. The storage apparatus according to claim 13, additionally including a thread sensor (16) which is arranged inwardly or outwardly at a mixing pipe (22a)

of the second nozzle (22) and/or of one of the acceleration nozzles (4) to detect the speed and/or length of the weft thread on the removal or on the blowing back phases.

15. The storage apparatus according to any one of the claims 8 to 14, additionally including a delivery apparatus (3) to draw off the weft thread (2) from a supply reel package (2a) and to feed it to the first nozzle (21) and a controlled roller pair (9) for the thread withdrawal from a shed, wherein the roller pair is arranged between the shed and the second nozzle (22) of the storage apparatus (20).

16. A weaving machine (1) having one or more storage apparatuses (20) for the storage of weft threads in accordance with any one of the claims 8 to 15 and arranged for carrying out the method according to any one of the claims 1 to 7.

17. A weaving machine (1) in accordance with claim 16, wherein the one or more storage apparatuses (20) for the storage of weft threads is/are arranged so as to move integrally with a sley (18) of the loom.

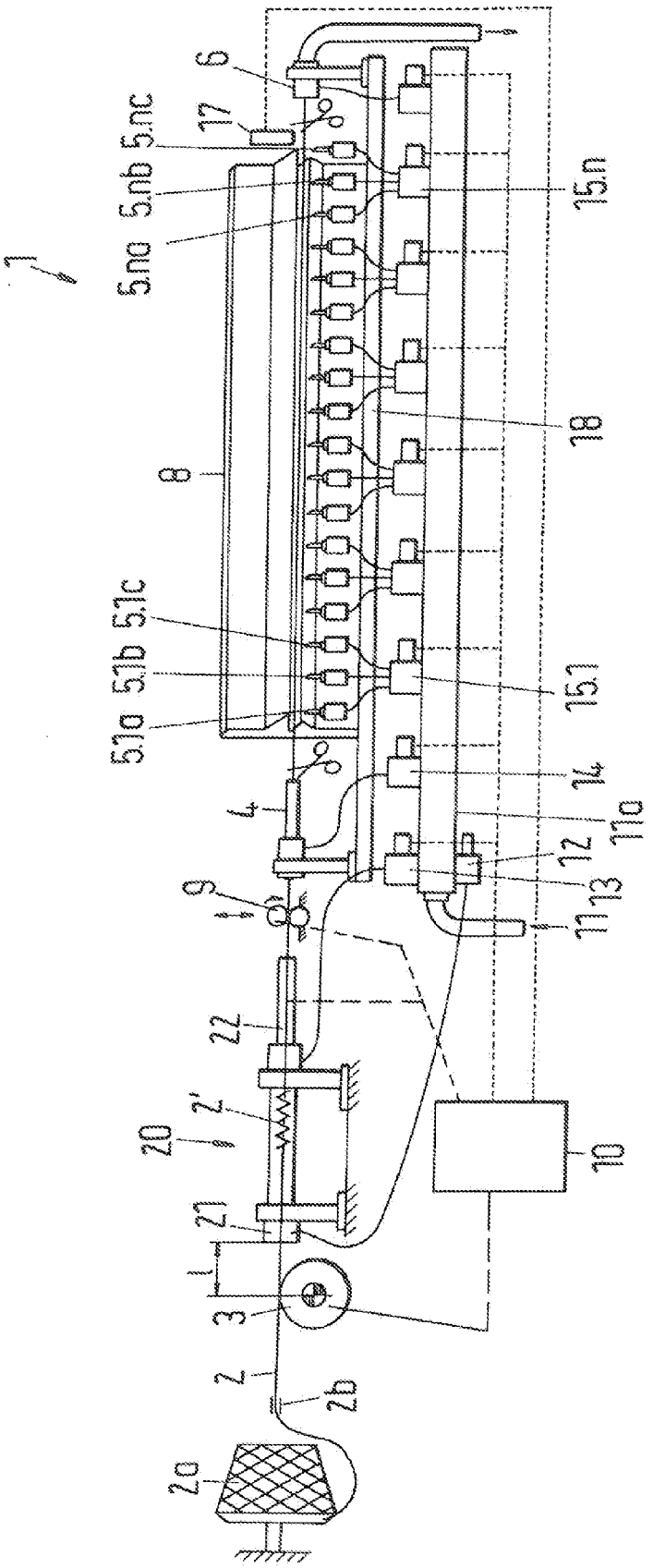
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Fig.1

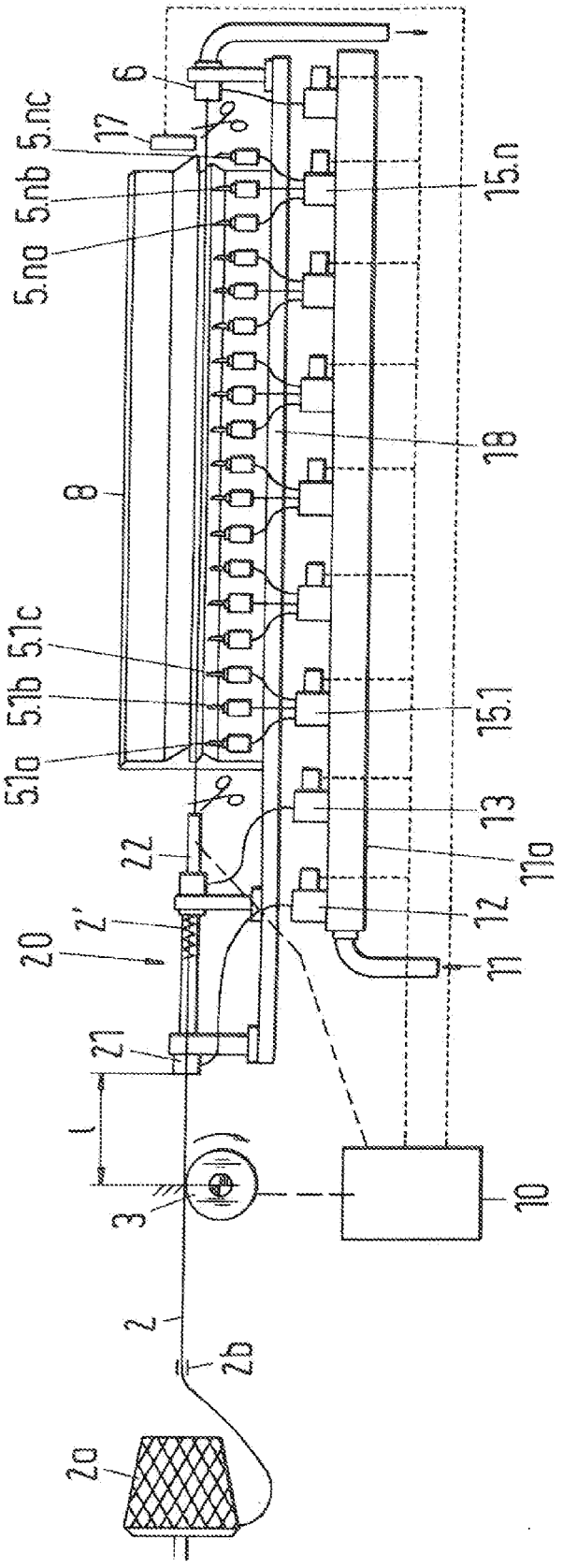
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Fig.2

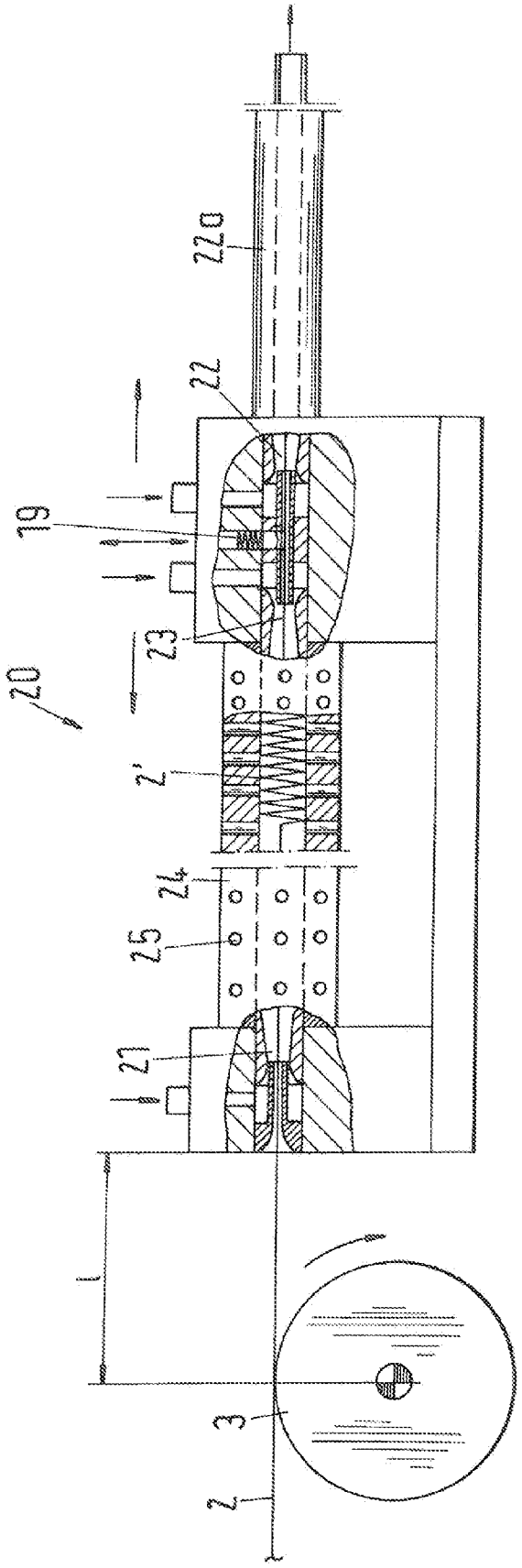

Fig.3

Fig.4A

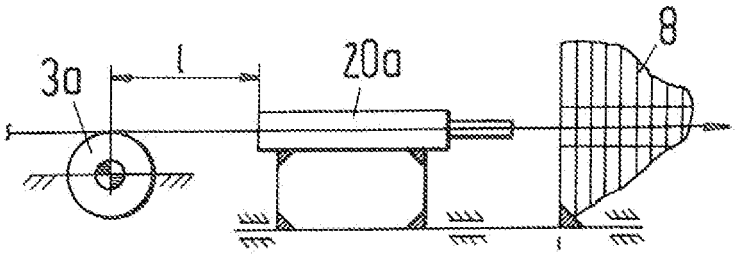

Fig.4B

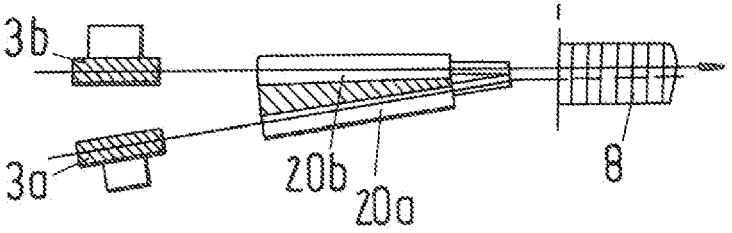

Fig.4C

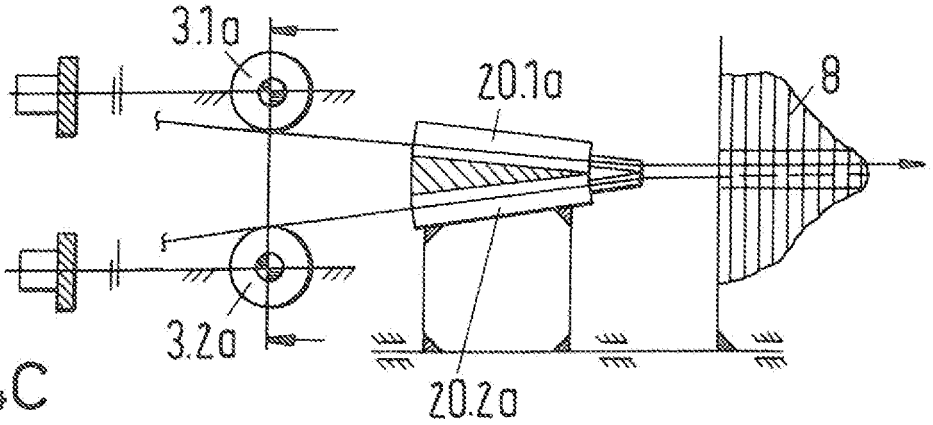

Fig.5A

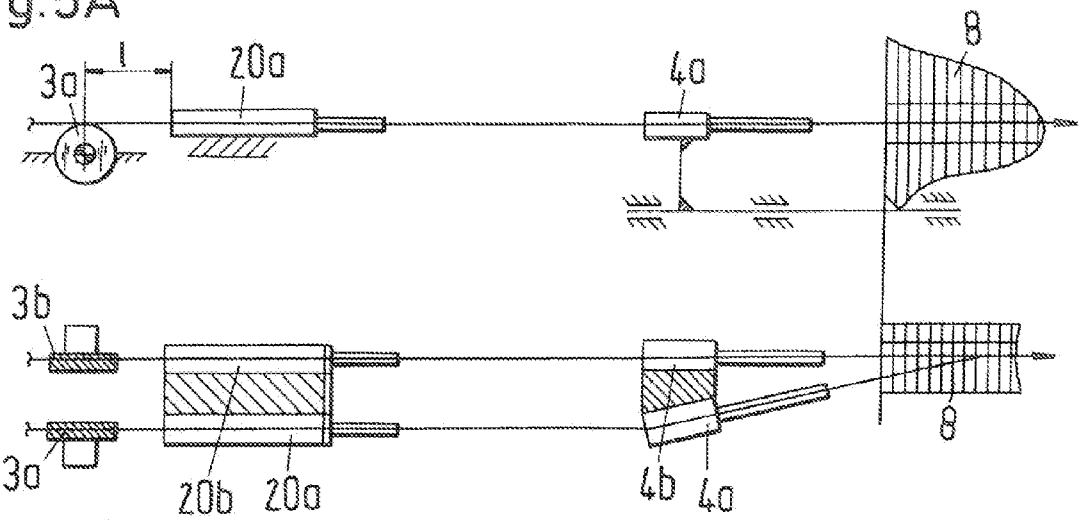

Fig.5B

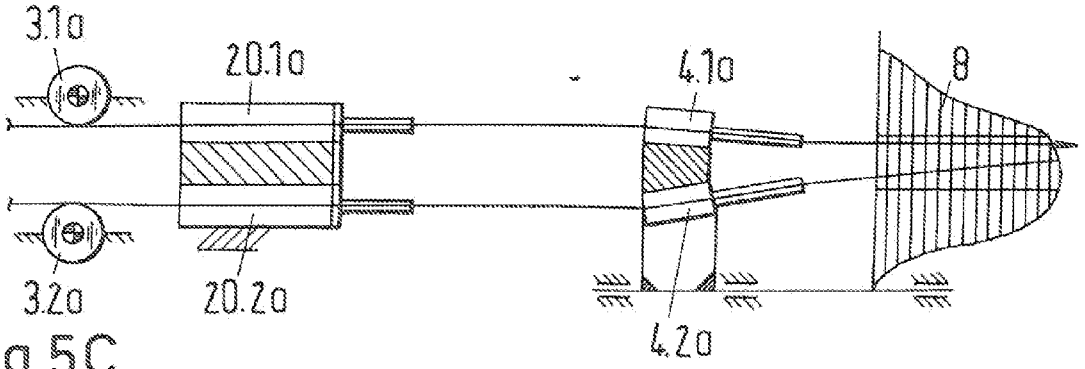

Fig.5C

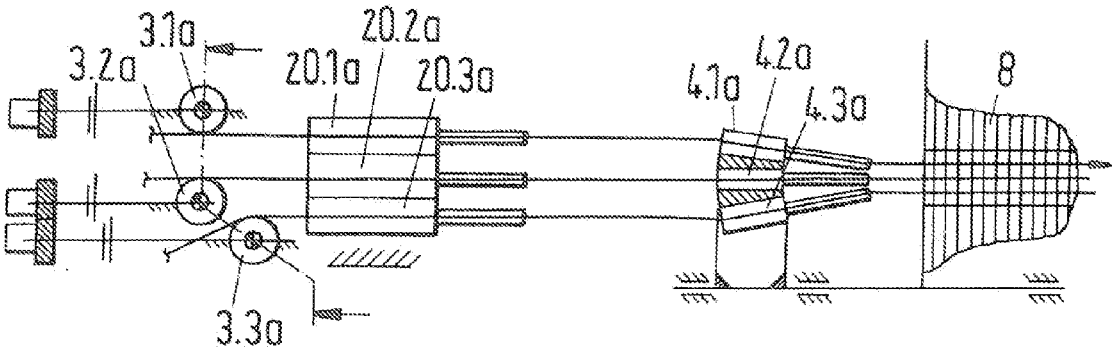

Fig.5D

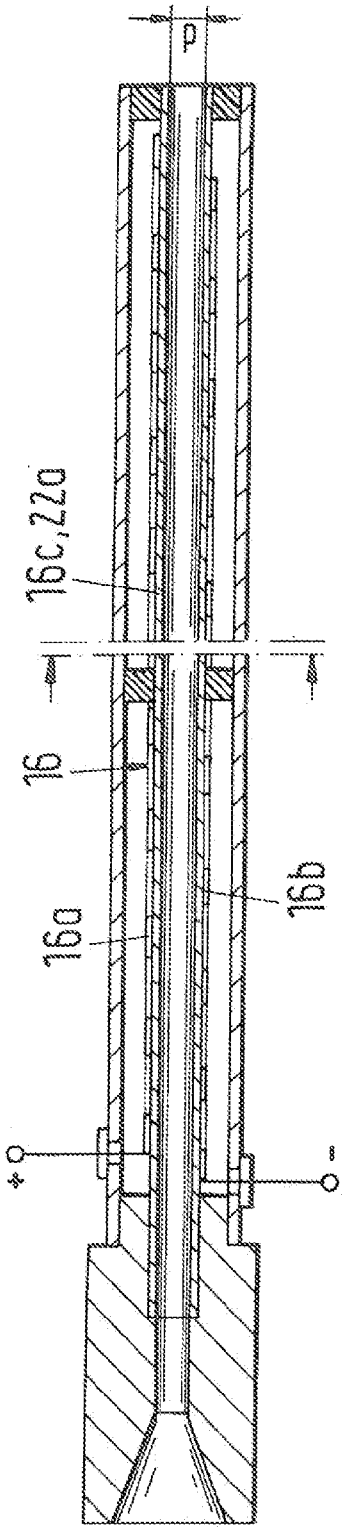

Fig.6

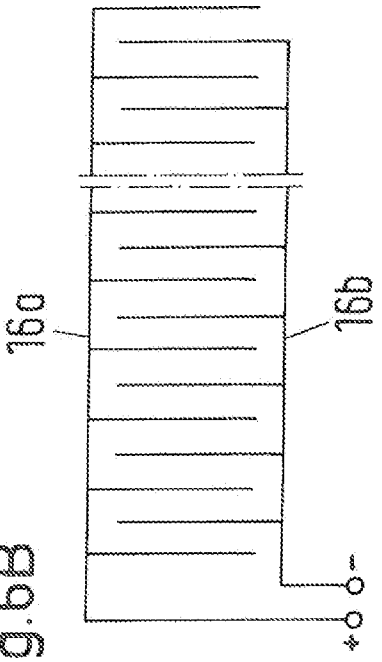

Fig.6B

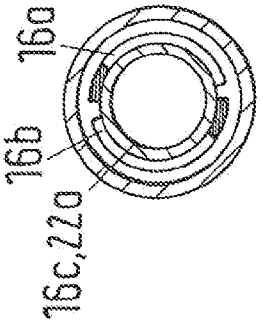

Fig.6A

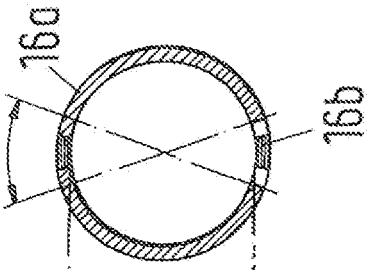

Fig.7A

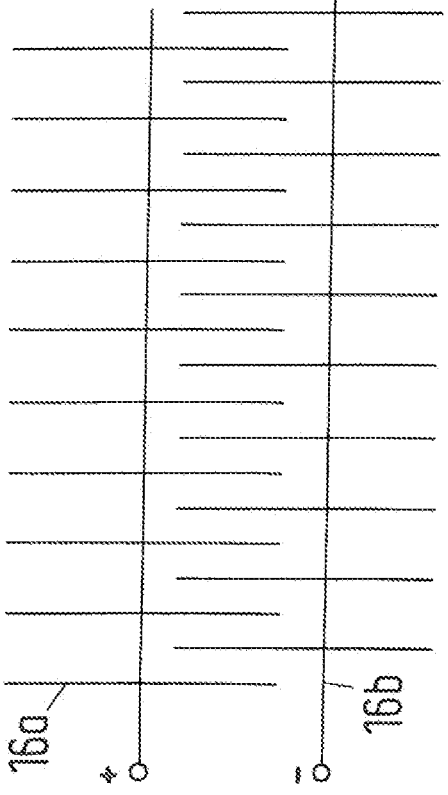

Fig.7B

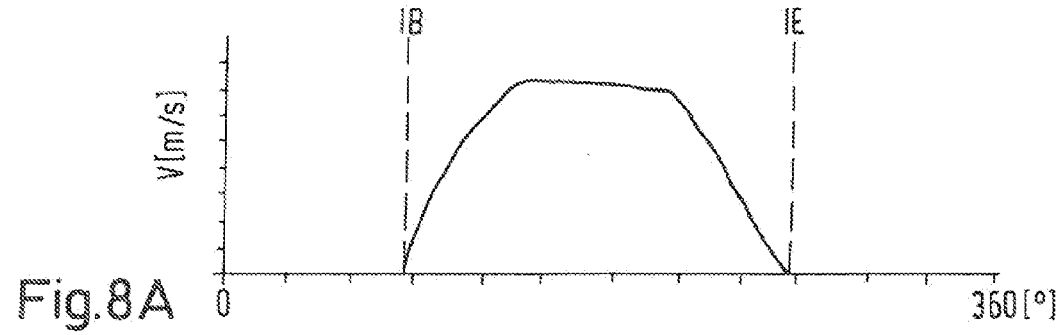

Fig.8A

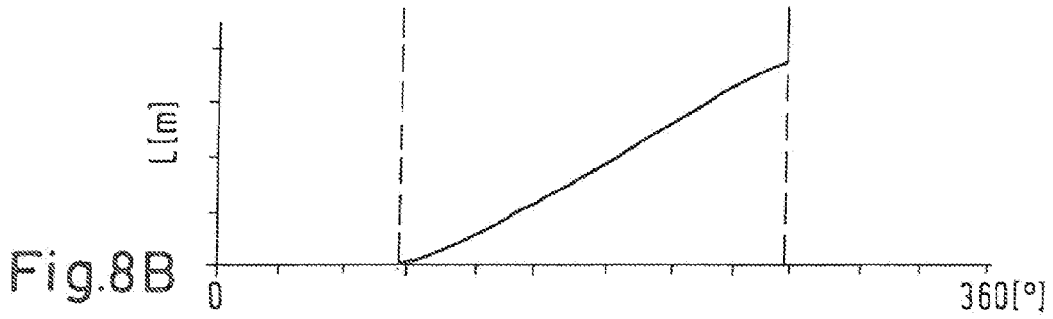

Fig.8B

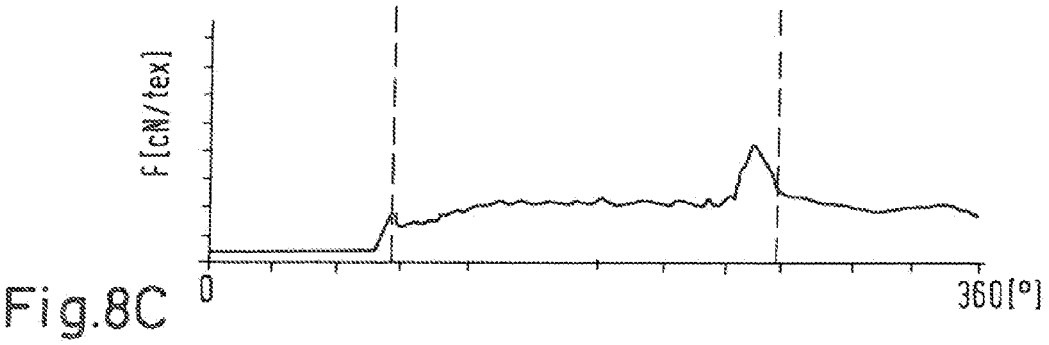

Fig.8C

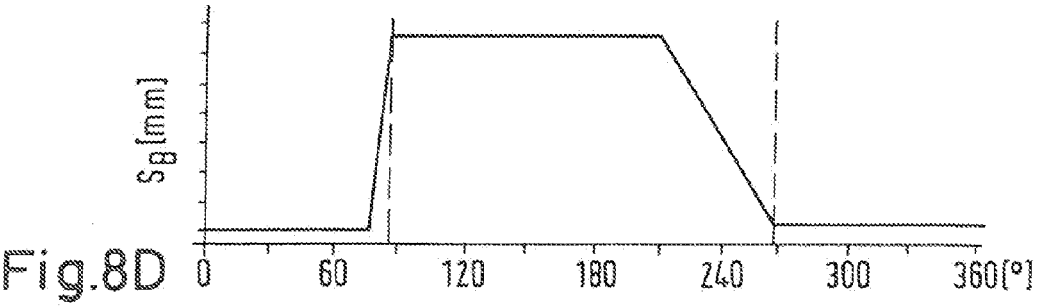

Fig.8D

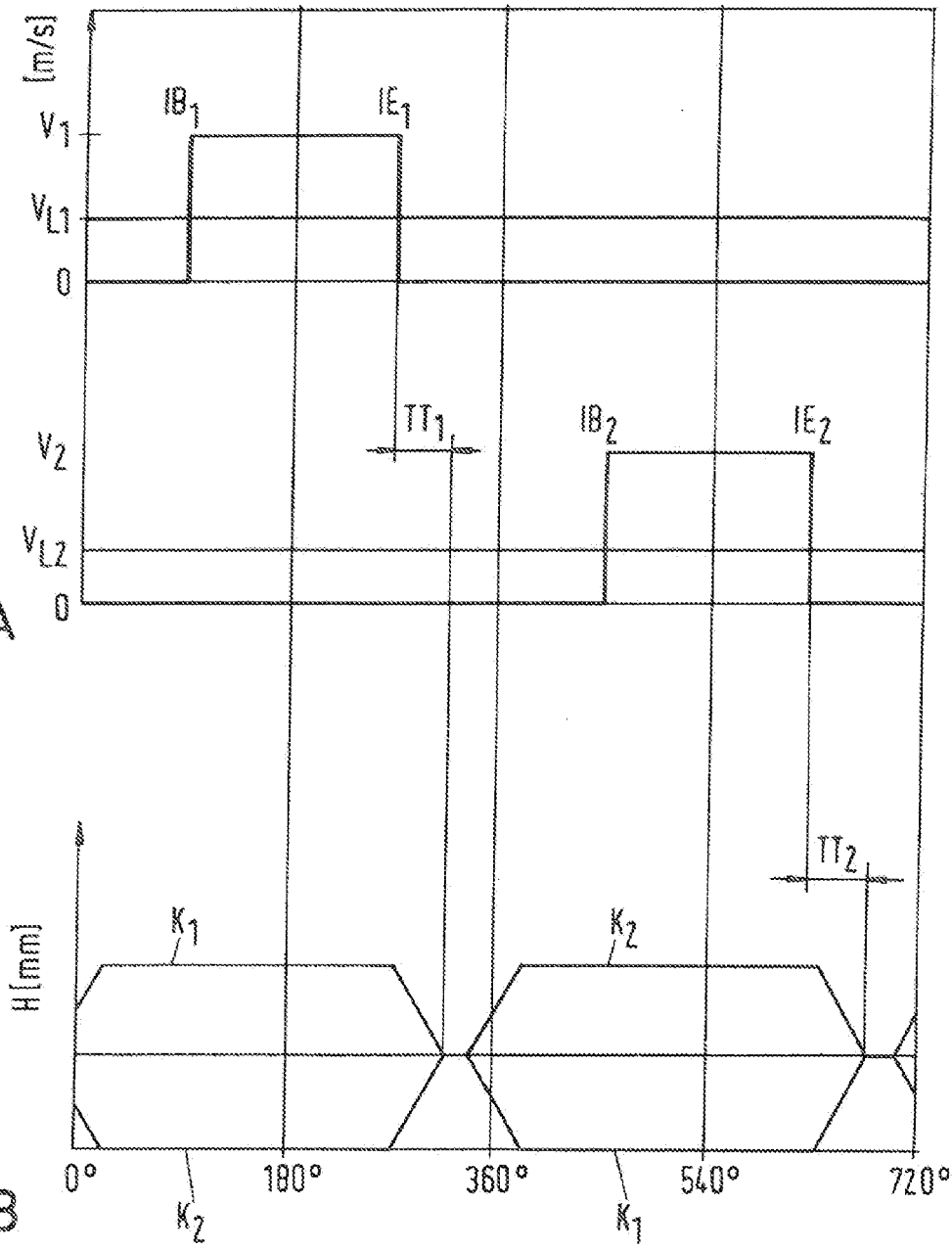
[m/s]
V1
VL1
0
IB1
IE1
TT1
IB2
IE2
V2
VL2
0
TT2

Fig.9A

H[mm]
K1
K2
0°
180°
360°
540°
720°
K2
K1

Fig.9B

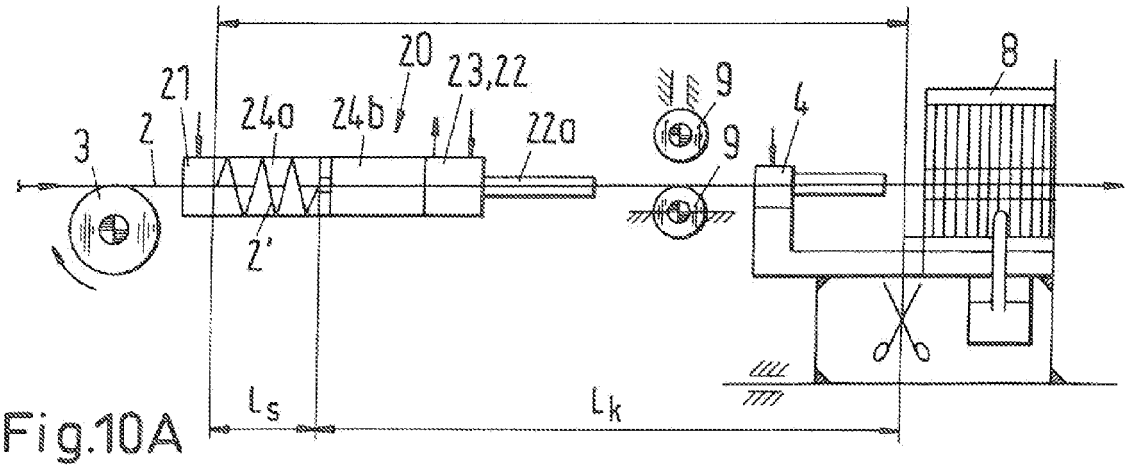

Fig.10A

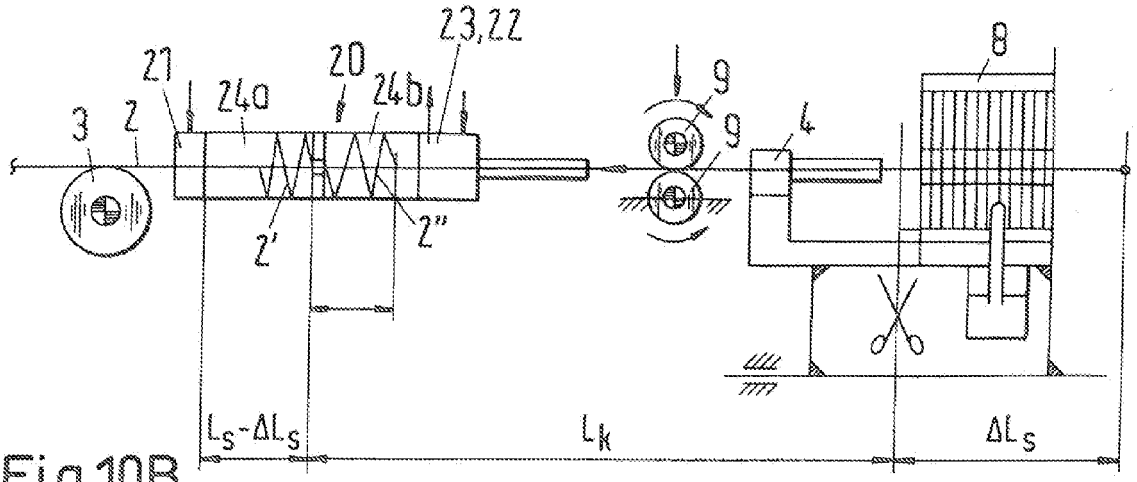

Fig.10B

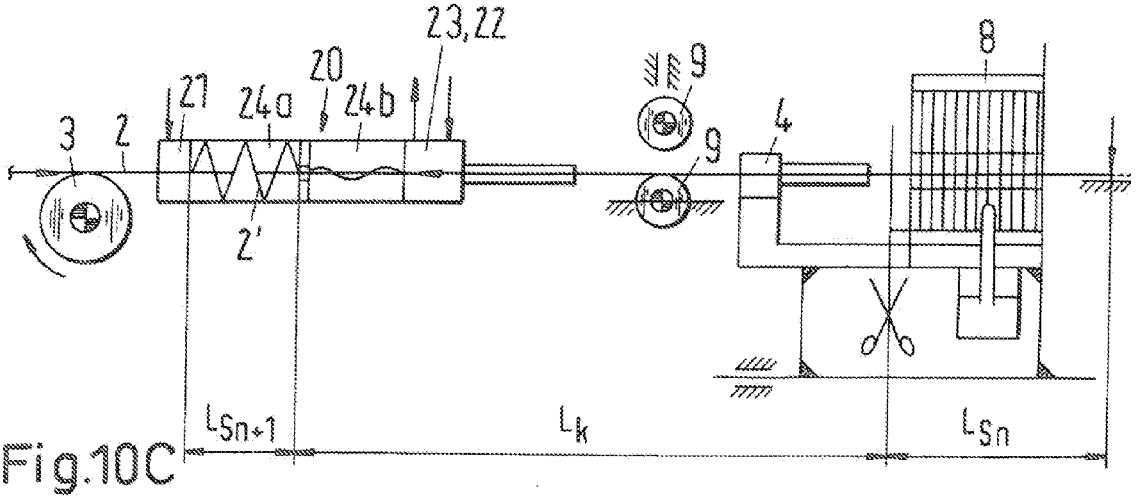

Fig.10C

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EUROPEAN SEARCH REPORT

Application Number
EP 10 15 6890

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	EP 0 316 028 A (PICANOL NV [BE]) 17 May 1989 (1989-05-17) * page 3, lines 13-19 * * page 5, lines 22-41; figures 1,19-21 * -----	1-15	INV. D03D47/36 B65H51/20
A	US 3 669 328 A (CASTELLI LUIGI) 13 June 1972 (1972-06-13) * column 1, lines 4-11 * * column 2, line 74 - column 3, line 11 * * column 3, lines 42-57 * * column 4, lines 10-40 * * figures 1-5 * -----	1-15	
A	CH 540 843 A (STUTZ HANS [CH]) 31 August 1973 (1973-08-31) * column 1, lines 6-26 * * column 3, lines 12-32 * * figures 1-7 * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC) D03D B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	16 July 2010	Louter, Petrus

CATEGORY OF CITED DOCUMENTS

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16-07-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0316028 A	17-05-1989	BE 1001188 A3	08-08-1989
		JP 1156550 A	20-06-1989
		US 4909286 A	20-03-1990
US 3669328 A	13-06-1972	AT 308022 B	25-06-1973
		BE 751995 A1	16-11-1970
		CH 515176 A	15-11-1971
		DE 2030343 A1	23-12-1970
		FR 2054585 A1	23-04-1971
CH 540843 A	31-08-1973	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Patent documents cited in the description

- EP O316028 A **[0008]**
- US 3669328 A **[0009]**
- EP 445489 A1 **[0045]**
- EP 685585 A **[0045]**
- EP 1033579 A2 **[0057]**