



(11)

EP 1 712 509 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

18.10.2006 Bulletin 2006/42

(51) Int Cl.:

B65H 67/08 (2006.01)

B65H 67/04 (2006.01)

B65H 67/06 (2006.01)

(21) Application number: **06111874.1**

(22) Date of filing: **29.03.2006**

(84) Designated Contracting States:

**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI
SK TR**

Designated Extension States:

AL BA HR MK YU

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(30) Priority: **13.04.2005 IT MI20050628**

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(54) **Device and process for handling and controlling the yarn of a crosswinding head of a crosswinding machine during the starting operations of a new lot**

(57) The invention relates to a device and process for handling and controlling the yarn (2) in a crosswinding head of a crosswinding machine during the starting operations of a new lot, said crosswinding machine being equipped with a series of crosswinding heads and at least one service trolley (16), wherein the end of the yarn (2) of a new pirn is collected by the suction mouth (7) on the pirn (1) side and delivered to the joining device (9), from where it is, in turn, collected by the suction mouth (8) on the side of the bobbin and, after the suction mouth (8) has rotated until it is close to the driving and traversing cylinder (6), engaging the yarn (2) on its back during the movement, which is transferred from this to the handling device (15) of the service trolley (16).

Fig. 3A

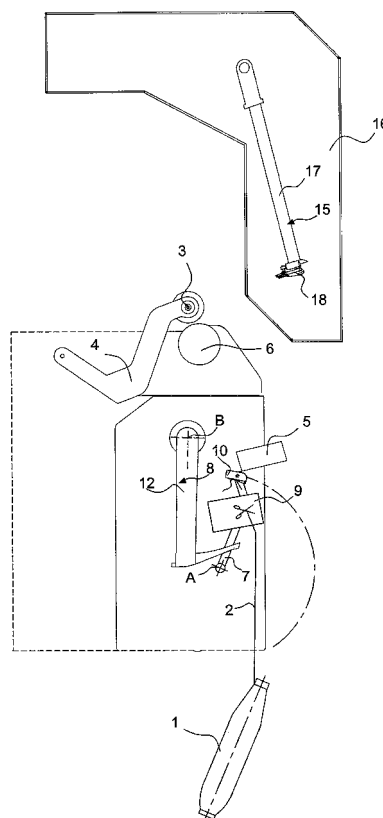


Fig. 3B

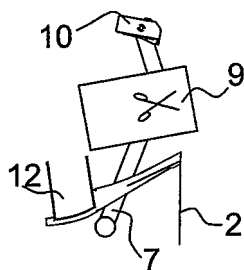
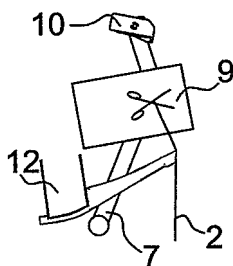


Fig. 3C

Description

[0001] The present invention relates to a device and process for handling and controlling the yarn in a crosswinding head of a crosswinding machine during the starting operations of a new lot, or for the contemporaneous replacement of a pirn with a new one and a bobbin with a new tube, around which the yarn coming from the feeding pirn is wound to form a new bobbin.

[0002] As is known, crosswinding procedures essentially consist of unwinding operations of the yarn from feeding pirns, cleaning the yarn from possible faults and its crosswinding onto tubes, according to forms and dimensions which vary according to the destination of the yarn. If the yarn is destined for feeding highspeed machines, the bobbins are normally cylindrical, or truncated-conical with a low conicity, if, on the contrary, the yarn is destined for feeding low-speed machines, the bobbins are truncated-conical with a higher conicity. The degree of conicity is selected so as to always ensure a correct unwinding of the bobbins during their final use, in the presence of more or less strong centrifugal forces.

[0003] A crosswinding machine allows the contemporaneous crosswinding of a series of bobbins, i.e. it normally comprises a series of so-called crosswinding heads, positioned side by side, and served by at least one common service device, also called trolley, which can run along the whole crosswinding machine, positioning itself in correspondence with each crosswinding head and which effects, in an automated manner, various operations which are cyclically required by each crosswinding head.

[0004] During the crosswinding, in fact, the substitution of exhausted or faulty bobbins can be necessary, or also the substitution of bobbins, which have reached the pre-established dimensions, with a new winding tube.

[0005] In particular, in the case of the starting of a new lot, or if it is necessary to contemporaneously substitute a pirn and bobbin, the crosswinding head must be stopped, the pirn and bobbin must be removed and a new pirn and a new winding tube, around which a new bobbin must be formed, must be respectively positioned in their place. The yarn coming from the new pirn must be moved to the new tube and wound onto the same in order to restart the crosswinding operations.

[0006] According to the known art, each crosswinding head is generally equipped with devices, situated along the run of the yarn from the feeding pirn to the winding bobbin, whose function is to eliminate possible yarn imperfections and remedy possible breakages. In the case of yarn defects, in fact, said defects must be located, the yarn must be cut, the faulty part eliminated and the two ends, which have formed on the side of the pirn and bobbin, respectively, must be re-joined.

[0007] In the case of accidental breakage of the yarn, the interruption of the yarn must be found and the two ends of the yarn, on the side of the pirn and that of the bobbin, respectively, must be re-joined.

[0008] It is evident that, along the run of the yarn from the unwinding pirn to the winding bobbin, in a crosswinding head, devices for detecting the characteristics of the yarn must be present, together with devices for cutting the yarn, devices for capturing the ends of the cut (or accidentally broken) yarn and devices for joining the ends of the yarn. In particular, the capturing devices of the cut yarn ends normally consist of two suction mouths, for the collection of the yarn end coming from the side of the pirn and from the side of the bobbin, respectively, situated on arms oscillating between a first operating position, corresponding to the pirn and the bobbin, respectively, and a second operating position, in correspondence with the device for joining the yarn ends, also called joiner or knoter.

[0009] The handling and controlling of the yarn during the starting operations of a new lot require the intervention of the common service device which, in cooperation with the devices of the crosswinding head situated along the run of the yarn from the feeding pirn to the winding bobbin, recovers the yarn end coming from the new pirn, positions the new winding tube on the crosswinding head and arranges the yarn end on the new winding tube.

[0010] It is therefore important to provide for all the necessary expedients so that all the devices of the different crosswinding heads can cooperate in an optimal way with the common service device, so that the yarn coming from the new pirn is effectively collected by the common service device, which, subsequently, provides for its disposal on the new tube.

[0011] According to the known technique, processes have been proposed for the handling and control of the yarn in a crosswinding head of a crosswinding machine during starting operations of a new lot, which differ in the handling and control procedure of the yarn end coming from the pirn, in particular in the way the end is collected and delivered to a handling device of the service trolley which, after the bobbin to be substituted has been removed, positions the yarn coming from the pirn so that a part of it remains blocked between the counter-pin of a bobbin-holder arm and a new winding tube which is contemporaneously placed on said bobbin-holder arm.

[0012] A known procedure for capturing the feeding pirn end and its delivery to the service trolley, is described in patent EP 1127831 in the name of Schlafhorst AG, and envisages that the yarn end coming from the pirn be collected by an arm equipped with a nipper which delivers it to a seizure and cutting device situated near the joiner. The yarn is cut by this seizure and cutting device and is collected by a collecting device, from which it is collected by a special supplementary suction tube which transfers the cut yarn to a seizure and cutting device situated in the upper area of the crosswinding head, wherein the yarn can be easily reached by the handling device of the service trolley. This solution requires a series of specific devices, in correspondence with each crosswinding head, which only operate when it is necessary to start a new lot.

[0013] According to European patent application EP 1236668, in the name of Murata Kikai Kabushiki Kaisha, a procedure is described wherein the yarn end on the pirn side is collected by the suction mouth which is situated on the side of the pirn and directly delivered by the same to the handling device of the common service trolley. This solution does not require additional devices on the crosswinding heads, but it is necessary to equip the handling device of the service trolley with an extendable arm, capable of reaching and collecting the yarn end in a lowered position with respect to that required for its subsequent arrangement on the tube.

[0014] In European patent application EP 1428783, in the name of Sauer GmbH, a process and device are described, for the starting of a crosswinding head in correspondence with a change of lot, wherein the yarn end coming from the pirn, is sucked by the suction mouth which is situated on the side of the pirn and is withheld by the same by suction and carried to an area crossed by the run of the suction mouth situated on the side of the bobbin. The suction mouth which is situated on the side of the bobbin is positioned close to the yarn, still withheld by suction by the suction mouth on the side of the pirn. Whereas the suction of the suction mouth situated on the side of the bobbin is stopped, the suction of the suction mouth which is on the side of the bobbin is contemporaneously activated, which takes custody of the yarn end. The suction mouth situated on the side of the bobbin is then rotated to its position near the bobbin, where the yarn is collected by the handling device of the common service trolley. In this way, the intervention of the service trolley is facilitated with respect to the disclosure of the Murata patent, as it is not necessary to excessively extend the arm of the service trolley, but the exchange efficiency of the yarn between the two suction mouths which takes place by deactivating the suction of the suction mouth that is on the side of the pirn and thus allowing the suction mouth situated on the side of the bobbin to suck the yarn end, does not guarantee adequate success, bearing in mind that there can be a considerable yarn length already engaged by the suction mouth on the pirn side, which can therefore hinder the sucking action on the part of the suction mouth on the side of the bobbin. This possibility of error in the delivery of the yarn is extremely undesirable as it would jeopardize the restarting of the crosswinding head, thus creating a lack of production.

[0015] An objective of the present invention is therefore to collect the yarn end coming from the new pirn and to deliver it to a position which facilitates the intervention of the service trolley, in particular its collection of the yarn to be wound around the new winding tube during the starting operations of a new lot.

[0016] A further objective of the present invention is to guarantee a higher productivity of the crosswinding machine through a higher operating factor.

[0017] These objectives according to the present invention are achieved by providing a process for the han-

dling and control of the yarn in a crosswinding machine in the starting operations of a new lot, as specified in claim 1, and a crosswinding machine particularly suitable for the embodiment of this process as claimed in claim 13.

[0018] Further characteristics of the process and crosswinding machine according to the present invention, are described in the respective dependent claims.

[0019] The present invention will be now described, for illustrative but non-limiting purposes, according to one of its preferred embodiments, with particular reference to figures 1-7 of the enclosed drawings, which schematically show some of the devices of a crosswinding head and a service trolley of a crosswinding machine during the handling and controlling of the yarn in the starting operations of a new lot, and figure 8 which shows in particular a suction head for recovering the yarn ends on the side of the bobbin, according to a preferred embodiment of the present invention.

[0020] Figures 1-7 show, in particular, a pirn 1, from which the yarn 2 unravels, which must be delivered to the end of a bobbin-holder arm 4, wherein there is a counter-pin 3 for housing a tube (not shown) around which the yarn 2 will be wound for the formation of the bobbin. On the run between the pirn 1 and the bobbin-holder arm 4, a slit-plate 5 is shown together with a driving and traversing cylinder 6. In addition, a suction mouth 7 is shown, for the suction of the yarn 2 ends on the side of the pirn 1, together with a suction mouth 8 for the suction of the yarn 2 ends on the side of the bobbin and a joining device 9.

[0021] As is known, under formation conditions of the bobbin, the slit-plate 5 has the function of revealing defects of the yarn 2 and possibly cutting it, by means of a cutting device not shown in the figures, but substantially situated in the same position as the slit-plate 5. The driving and traversing cylinder 6 carries the yarn 2 according to a backwards and forwards movement along the whole length of the bobbin, so that the yarn 2 is uniformly distributed along the whole length of the bobbin. For this purpose, the driving and traversing cylinder 6 is crossed by several grooves, also called cavities, inside which the yarn 2 is passed, maintaining the driving and traversing cylinder 6 in rotation.

[0022] The function of the two suction mouths 7 on the side of the pirn and 8 on the side of the bobbin, is, on the contrary, to collect the ends of the yarn 2, for example formed as a result of cutting or breakage of the yarn 2, and connected to the pirn 1 and to the bobbin, respectively, and to carry them to the joining device 9, which re-establishes the continuity of yarn 2.

[0023] According to the present invention, in correspondence with the starting of a new lot, figure 1, a new pirn 1 is arranged in operating position and the end of yarn 2 which comes from the same, is collected by suction on the part of the suction mouth 7. The seizing of the yarn 2 end is further assured by a nipper 10, situated at the end of the suction mouth 7, which intervenes by blocking the yarn 2 after a part of the same yarn 2 has been

sucked by the suction mouth 7.

[0024] The suction mouth 7, with the nipper 10 closed, is then rotated around the rotation axis A, unwinding the yarn 2 from the pirn 1 and until the same yarn 2 has been induced to cross the joining device 9 (figure 2). In this phase, the closing of the nipper 10 not only ensures the seizure of the yarn 2, but also prevents an excessive amount of yarn from being sucked, as could happen if the seizure of the yarn 2 were left to a continuous suction action exerted by the suction mouth 7. The closing of the nipper 10 also makes the suction of the suction mouth 7 superfluous, and this can be deactivated.

[0025] With reference to figure 3, and, in particular, to the details shown in figures 3A-3C, it is shown how the yarn 2 is, at this stage, delivered to the joiner 4 by the suction mouth 7 on the side of the pirn and, subsequently, from the joiner 4 to the suction mouth 8 on the side of the bobbin.

[0026] In particular, with reference to figure 3A, the joiner 9 cuts the yarn 2 and withholds its end coming from the pirn 1. The suction of the suction mouth 7 is activated and the nipper 10 is opened to remove the end of the yarn which has remained on the suction mouth 7 after the cutting. At this point, figure 3B, the joiner 9 withholds the yarn 2 coming from the pirn 1, and once the suction mouth 7 on the side of the pirn has finished its operations, it is ready to return to its standby position. The suction mouth 8, on the side of the bobbin, is moved towards the yarn 2, along the run of the yarn 2 itself, from the pirn to the joiner 9. Subsequently, as shown in figure 3C, the suction from the suction mouth 8 is activated and the yarn 2 is released from the joiner 9, as it is sucked by the suction mouth 8.

[0027] The suction mouth 8 on the side of the bobbin, is rotated around its rotation axis B and, maintaining its suction activated, it rises, engaging the yarn 2 on its back and unwinding it from the pirn 1 (figure 4). During this phase, the position of the yarn 2 on the back of the suction mouth 8, can be suitably constrained by means of positioning devices. As the suction inlet 11 of the suction mouth 8 is extremely large (due to the main function of the suction mouth 8, which consists in recovering the end of a broken yarn 2 from the bobbin, said end being in any possible point along the length of the bobbin), the back of the suction mouth 8 narrowing as it proceeds from the aspiration inlet 11 towards the oscillating arm 12 of the suction mouth 8, the yarn 2 can be situated in any position of the back of the suction mouth 8 and, during the rotation of the same around its rotation axis B, in the absence of the positioning means, could also fall to the side. The positioning means of the yarn 2 are preferably produced in the form of at least one taper seat 13, situated on the back of the suction mouth 8, V-shaped so that, once the yarn 2 has been collected along the arms of the V-shaped taper seat 13, it tends to converge towards the center of the taper seat 13 itself. With reference to figure 8, even more preferably, the positioning means of the yarn comprise two V-shaped taper seats, a first taper seat 13 near

the suction inlet 11 of the suction mouth 8, substantially having the same width as the inlet 11 of the suction mouth 8, and a second taper seat 14, near the arm 12 of the suction mouth, which has smaller dimensions. During the rotation around the axis B, in fact, the suction mouth 8 engages the yarn 2 first with its portion closer to the aspiration inlet 11. Consequently, due to the action of the first taper seat 13, the yarn 2 has already reached a well-defined position when it engages the whole back of the suction mouth 8 and, therefore, the second taper seat 14.

[0028] When the suction mouth 8 has reached the run-end, i.e. with the suction inlet 11 near the driving and traversing cylinder 6, as shown in figure 5, the yarn 2 occupies a well-defined position in the space between the part of the back of the suction mouth 8 which is further away from the suction inlet 11 and the slit-plate 5. In correspondence with this position, the yarn 2 can be reached with great precision by the handling device 15 of a service trolley 16. In particular, the handling device 15 comprises a telescopic arm 17, at whose end there is a nipping and cutting device 18.

[0029] From an operative point of view, the calling signal of the service trolley 16 on the part of the crosswinding head engaged in a starting operation of a new lot, can be sent at the beginning of the operation, so that the trolley 16 is positioned in correspondence with the crosswinding head before the suction mouth 8 has reached the intervention position of the handling device 15. In this way, the devices of the trolley 16 which are charged with the doffing operations of the bobbin and its substitution with a new tube, are ready to intervene when the suction mouth 8 reaches the intervention position, but the trolley 16 could be compelled to wait.

[0030] Alternatively, the calling signal of the service trolley 16 can be sent subsequently, so that the trolley 16 is positioned in correspondence with the crosswinding head after the suction mouth 8 has reached the intervention position of the handling device 15. In this way, the time the service trolley 16 dedicates to the specific crosswinding head for the doffing operations of the bobbin and its substitution, is minimized, but the crosswinding head could be compelled to wait.

[0031] With reference to figure 6, once the handling device 15 of the service trolley 16 has reached the yarn 2, in correspondence with the area immediately below the back of the suction mouth 8, as defined by the positioning means, the nipping and cutting device 18 captures the yarn 2. Subsequently, as shown in figure 7, the nipping and cutting device 18 cuts the yarn 2 and withholds the end coming from the pirn 1. The end of the yarn remaining on the side of the inlet 11 of the suction mouth 8, is sucked and removed.

[0032] The handling mechanism 15, still maintaining its hold on the yarn 2 end coming from the pirn 1, moves away from the crosswinding head, to facilitate the return of the suction mouth 8 to its rest position, by the rotation of the oscillating arm 12 around the rotation axis B.

[0033] The subsequent insertion phases of the yarn 2

end onto the new winding tube can be completed by the handling device 15, according to any of the known techniques, which have the common aspect of engaging the yarn 2 end between the base of the tube and the counterpoint 3 of the bobbin-holder arm 4.

[0034] The handling device 15 of the service trolley 16, subsequently releases the yarn 2, and a new bobbin can be formed, whereas the service trolley 16 becomes available for intervening on other crosswinding heads of the crosswinding machine.

[0035] The present invention is described for illustrative and non-limiting purposes, according to preferred embodiments, but it is understood that variations and/or modifications can be applied by experts in the field, included in the protection scope, as defined in the enclosed claims.

Claims

1. A process for handling and controlling the yarn (2) in a crosswinding head of a crosswinding machine during the starting operations of a new lot, said crosswinding machine being equipped with a series of crosswinding heads and at least one service trolley (16), each of said crosswinding heads comprising a pirn (1), from which a yarn (2) unwinds, which is wound to form a bobbin around a winding tube, a suction mouth (7) and a suction mouth (8), for the suction of the yarn (2) ends possibly formed, by breakage or cutting, on the side of the pirn (1) and on the side of the bobbin, respectively, and for the delivery of these ends to a joining device (9), situated along the run of the yarn (2) from the pirn (1) to the bobbin, for reestablishing the yarn continuity, said service trolley (16) sliding along the whole crosswinding machine so as to position itself in correspondence with each crosswinding head and comprising a handling device (15) of the yarn (2), **characterized in that** it comprises the following phases:

- collection, by suction, of the yarn (2) end of a new pirn (1) on the part of the suction mouth (7) on the side of the pirn (1),
- consignment of the yarn (2) from the suction mouth (7) on the side of the pirn (1) to the joining device (9),
- collection, by suction, of the yarn (2) end coming from the pirn (1) and withheld by the joiner (9) on the part of the suction mouth (8) on the side of the bobbin,
- collection of the yarn (2) withheld by the suction mouth (8) on the side of the bobbin by a handling device (15) of the service trolley (16),
- positioning of a new winding tube of the yarn (2) coming from the pirn (1) and starting the formation of a new bobbin.

2. The process for handling and controlling the yarn in a crosswinding head of a crosswinding machine during the starting operations of a new lot according to claim 1, **characterized in that**, after the collection phase of the yarn (2) on the part of the suction mouth (7) and before the consignment phase of the yarn (2) to the joining device (9), the following phase is included:

- movement of the suction mouth (7) on the pirn (1) side, carrying the yarn (2) which is being unwound from the pirn (1) until it crosses the joining device (9).

3. The process for handling and controlling the yarn in a crosswinding head of a crosswinding machine during the starting operations of a new lot according to claim 2, **characterized in that**, during said movement phase of the suction mouth (7) on the side of the pirn (1), carrying the yarn (2) which is being unwound from the pirn (1), the yarn (2) is withheld with the use of a nipper (10) situated at the end of the suction mouth (7).

4. The process for handling and controlling the yarn in a crosswinding head of a crosswinding machine during the starting operations of a new lot according to claim 3, **characterized in that**, while the yarn (2) is withheld by the nipper (10), situated at the end of the suction mouth (7), the suction of the suction mouth (7) is deactivated.

5. The process for handling and controlling the yarn in a crosswinding head of a crosswinding machine during the starting operations of a new lot according to claim 1, **characterized in that** the delivery phase of the yarn (2) by the suction mouth (7) on the side of the pirn (1) to the joining device (9), includes the following sub-phase:

- cutting of the yarn (2) on the part of the joiner (9), suction of the end (2') above the cut on the part of the suction mouth (7) and withholding the part of the yarn (2) coming from the pirn (1) on the part of the joining device (9).

6. The process for handling and controlling the yarn in a crosswinding head of a crosswinding machine during the starting operations of a new lot according to claim 1, **characterized in that**, said collection of the yarn (2) on the part of the suction mouth (8) on the side of the bobbin, comprises the following sub-phases:

- movement of the suction mouth (8) on the side of the bobbin, from its rest position to a position in which the suction inlet (11) is in correspondence with the yarn (2) passing from the pirn (1)

- to the joining device (9),
 - suction of the yarn (2) part which comes from the pirn (1) on the part of the suction mouth (8) on the side of the bobbin and contemporaneous release on the part of the joining device (9).
7. The process for handling and controlling the yarn in a crosswinding head of a crosswinding machine during the starting operations of a new lot according to claim 6, **characterized in that**, during the movement of the suction mouth (8) on the side of the bobbin, from its rest position to a position in which the suction inlet (11) is in correspondence with the yarn (2) passing from the pirn (1) to the joiner (9), the suction of the suction mouth (8) is deactivated.
8. The process for handling and controlling the yarn in a crosswinding head of a crosswinding machine during the starting operations of a new lot according to claim 1, **characterized in that**, after the collection phase of the yarn (2) on the part of the suction mouth (8) and before the collection of the wire (2) by the handling device (15), the following phase is included:
- movement of the suction mouth (8) on the side of the bobbin, with the suction activated, until it is positioned close to the driving and traversing cylinder (6), the suction mouth (8) engaging the yarn (2) on its back, during the movement.
9. The process for handling and controlling the yarn in a crosswinding head of a crosswinding machine during the starting operations of a new lot according to claim 8, **characterized in that**, during the movement phase of the suction mouth (8) on the side of the bobbin until it is positioned close to the driving and traversing cylinder (6), the yarn (2) which is engaged on the back of the suction mouth (8) is compelled to assume a pre-established position.
10. The process for handling and controlling the yarn in a crosswinding head of a crosswinding machine during the starting operations of a new lot according to claim 1, **characterized in that**, said yarn (2) collection phase on the part of the handling device (15) of the service trolley (16) comprises the following sub-phase:
- nipping and cutting of the yarn (2) on the part of the handling device (15), which withholds the end of the yarn (2) coming from the pirn (1), whereas the end (2') on the side of the inlet (11) of the suction mouth, is sucked and moved away.
11. The process for handling and controlling the yarn in a crosswinding head of a crosswinding machine during the starting operations of a new lot according to claim 1, **characterized in that** the service trolley (16) is positioned in correspondence with the crosswinding head after the suction mouth (8) has reached the intervention position of the handling device (15).
12. The process for handling and controlling the yarn in a crosswinding head of a crosswinding machine during the starting operations of a new lot according to claim 1, **characterized in that** the service trolley (16) is positioned in correspondence with the crosswinding head after the suction mouth (8) has reached the intervention position of the handling device (15).
13. A crosswinding machine comprising a series of crosswinding heads and at least one service trolley (16), each of said crosswinding heads comprising a pirn (1), from which a yarn (2) is unwound and which is wound to form a bobbin around a winding tube, a suction mouth (7) and a suction mouth (8), for the suction of the yarn (2) ends possibly formed, by cutting or breaking, on the side of the pirn (1) and on the side of the bobbin, respectively, and for the delivery of these ends to a joining device (9), situated along the yarn (2) run, from the pirn (1) to the bobbin, for reestablishing the yarn continuity, said service trolley (16) sliding along the whole crosswinding machine so as to position itself in correspondence with each crosswinding head and comprising a handling device (15) of the yarn (2), for effecting the process as defined in claims 1-12, **characterized in that** each crosswinding head comprises means for the control and coordination of the movement and suction of the suction mouths (7) and (8).
14. The crosswinding machine according to claim 13, **characterized in that** said suction mouth (7) on the side of the pirn (1) comprises a nipper (10) for blocking the yarn (2) even with the suction deactivated.
15. The crosswinding machine according to claim 13, **characterized in that** said suction mouth (8) on the side of the bobbin comprises, on its back, a device for arranging the yarn (2) in a pre-established position.

Fig. 1

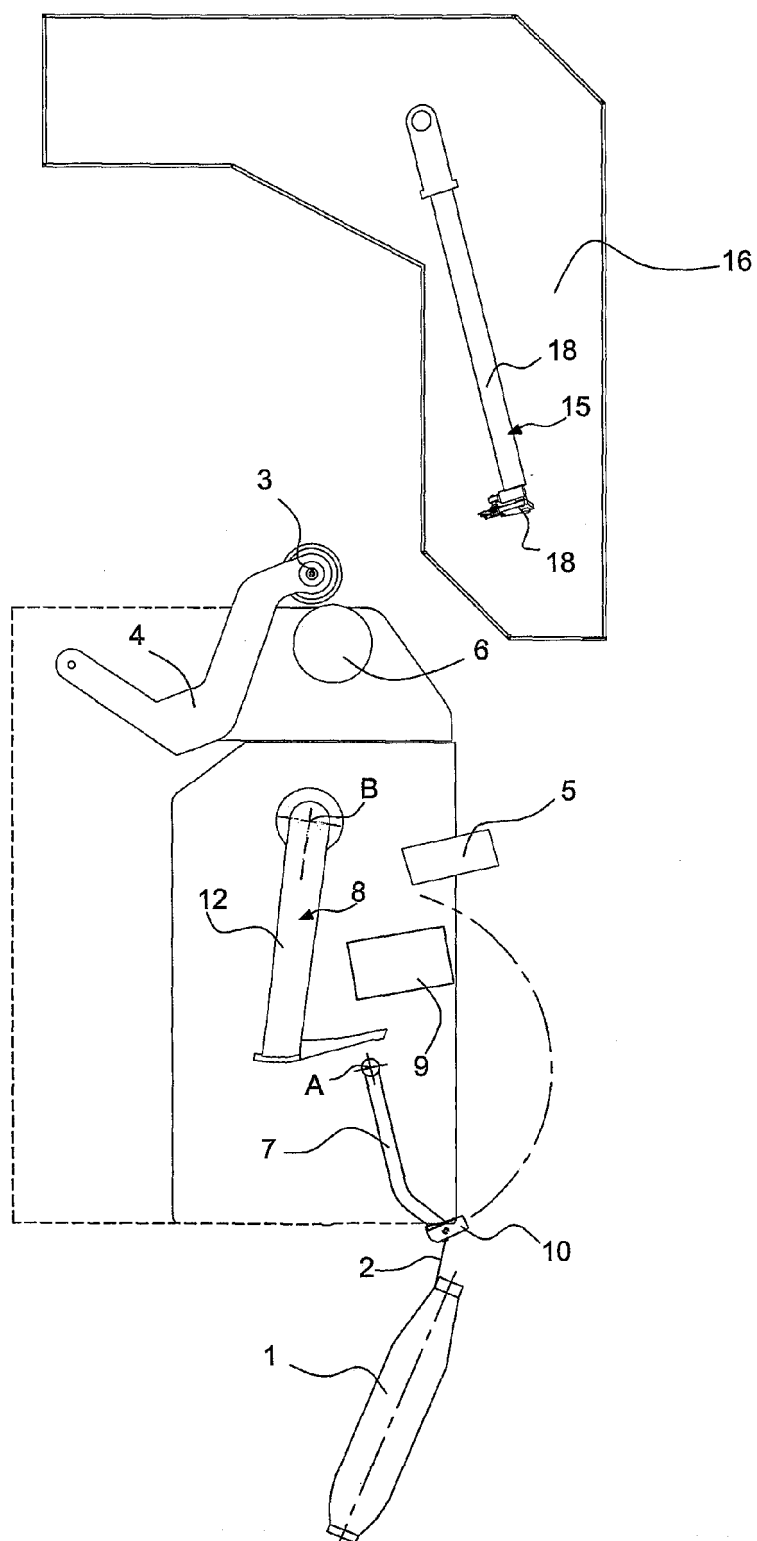


Fig. 2

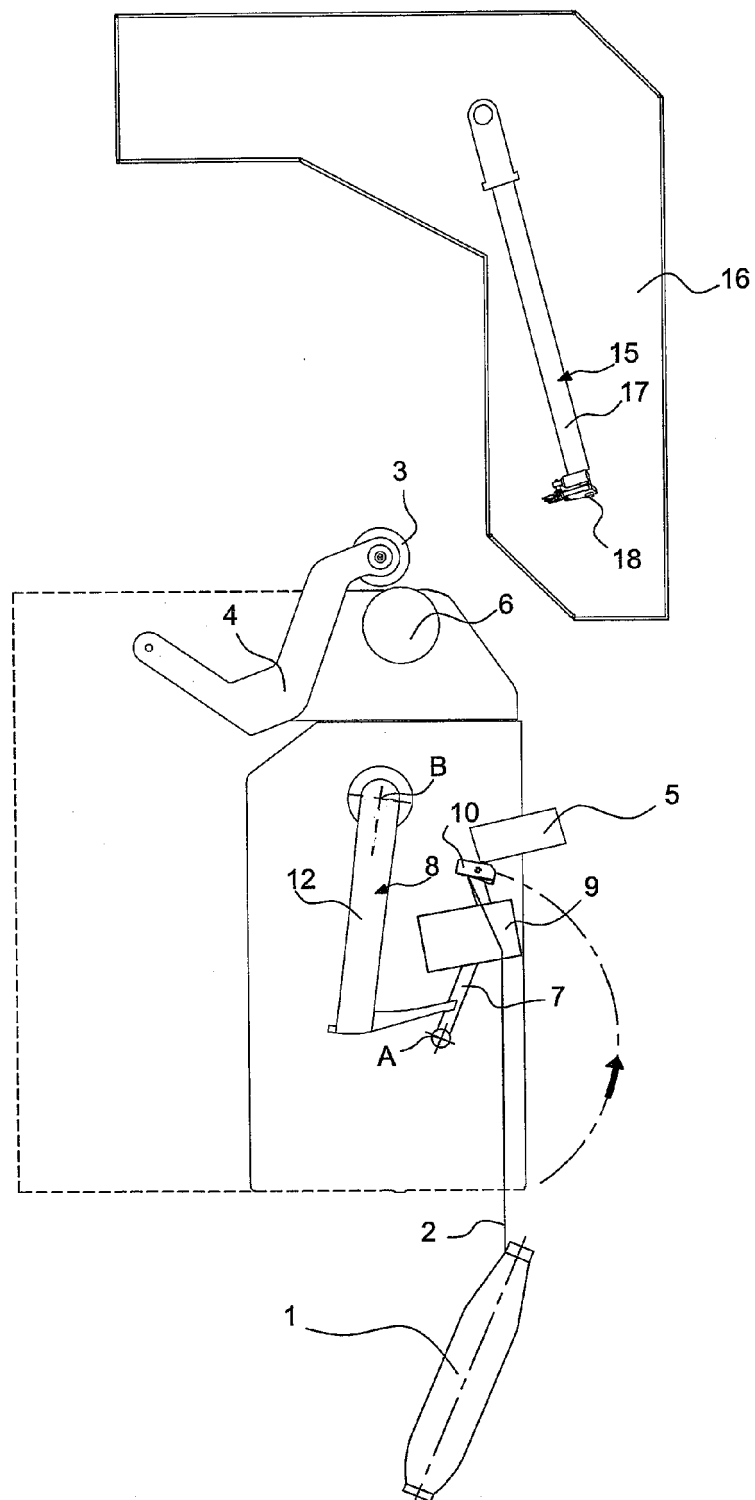


Fig. 3A

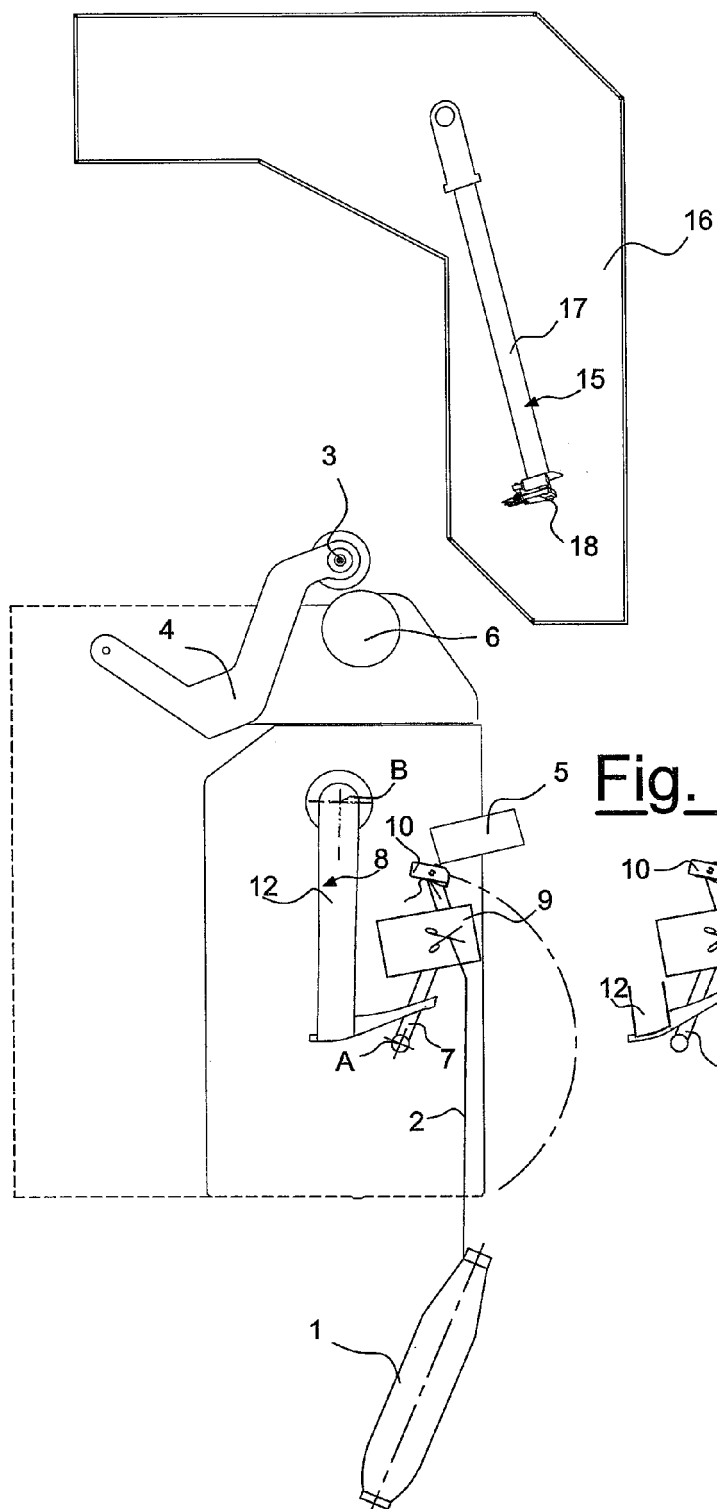


Fig. 3B

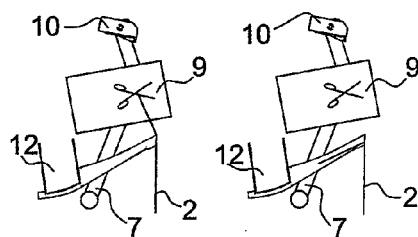


Fig. 3C

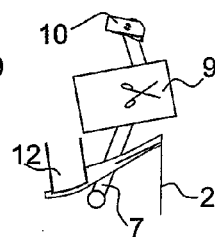


Fig. 4

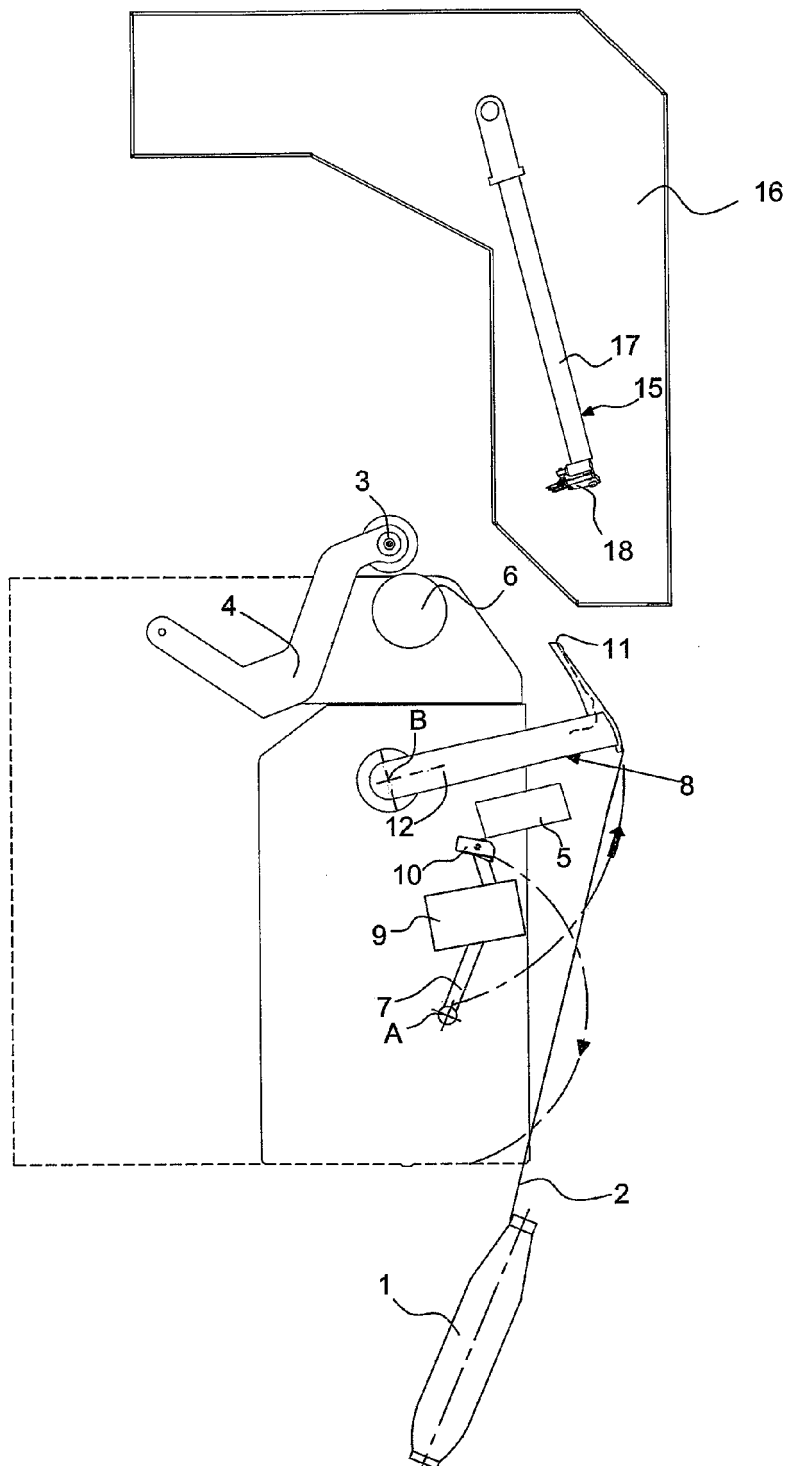


Fig. 5

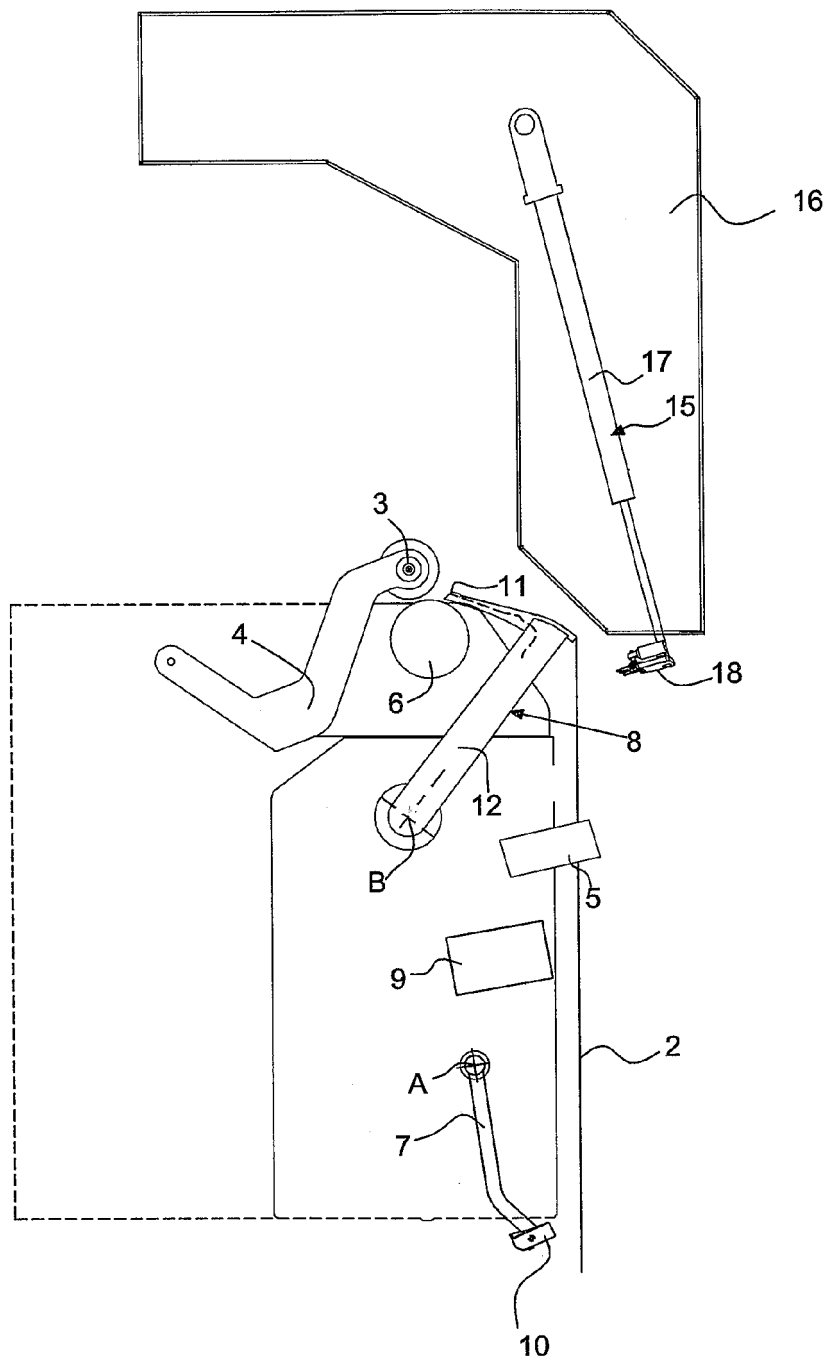


Fig. 6

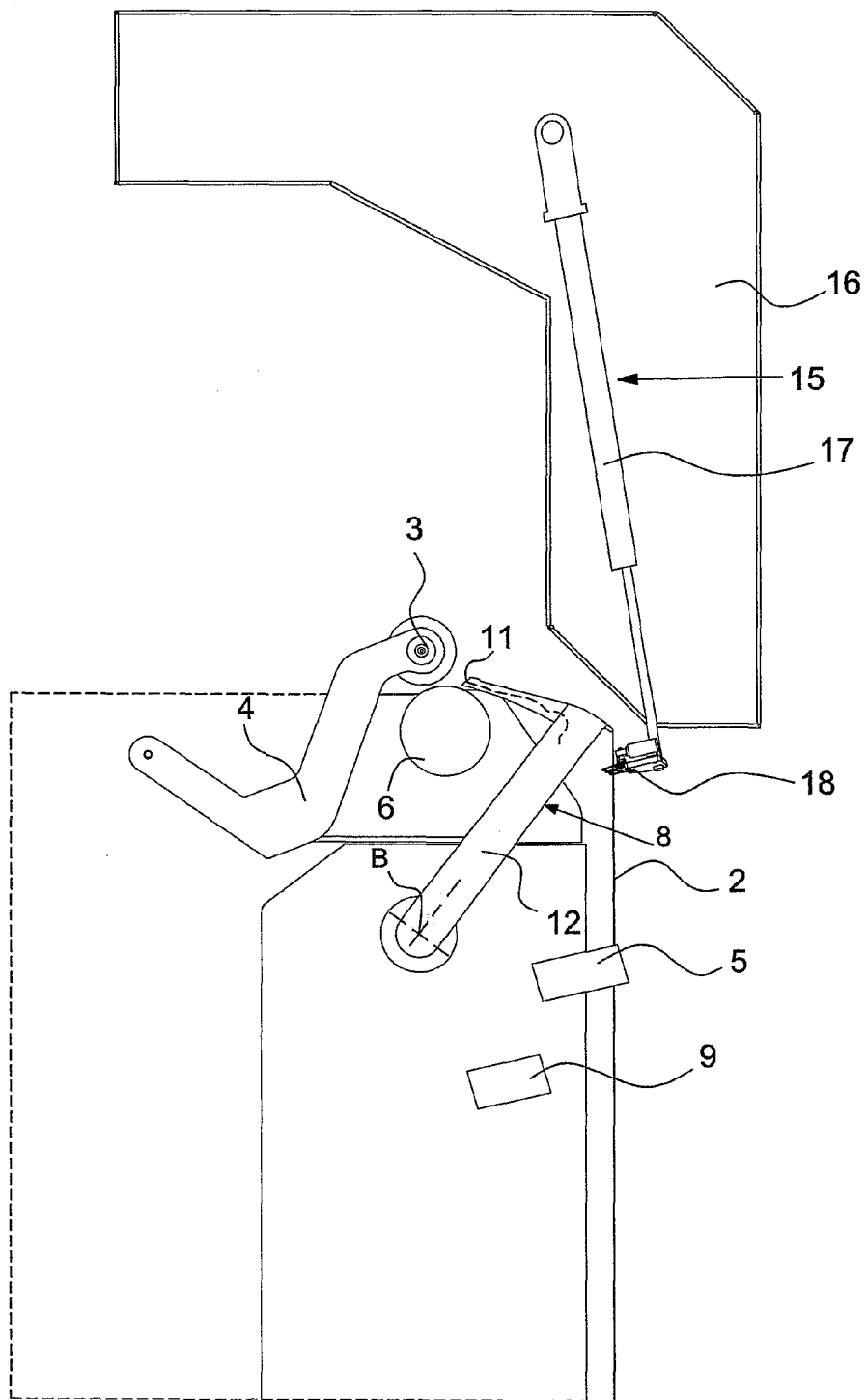


Fig. 7

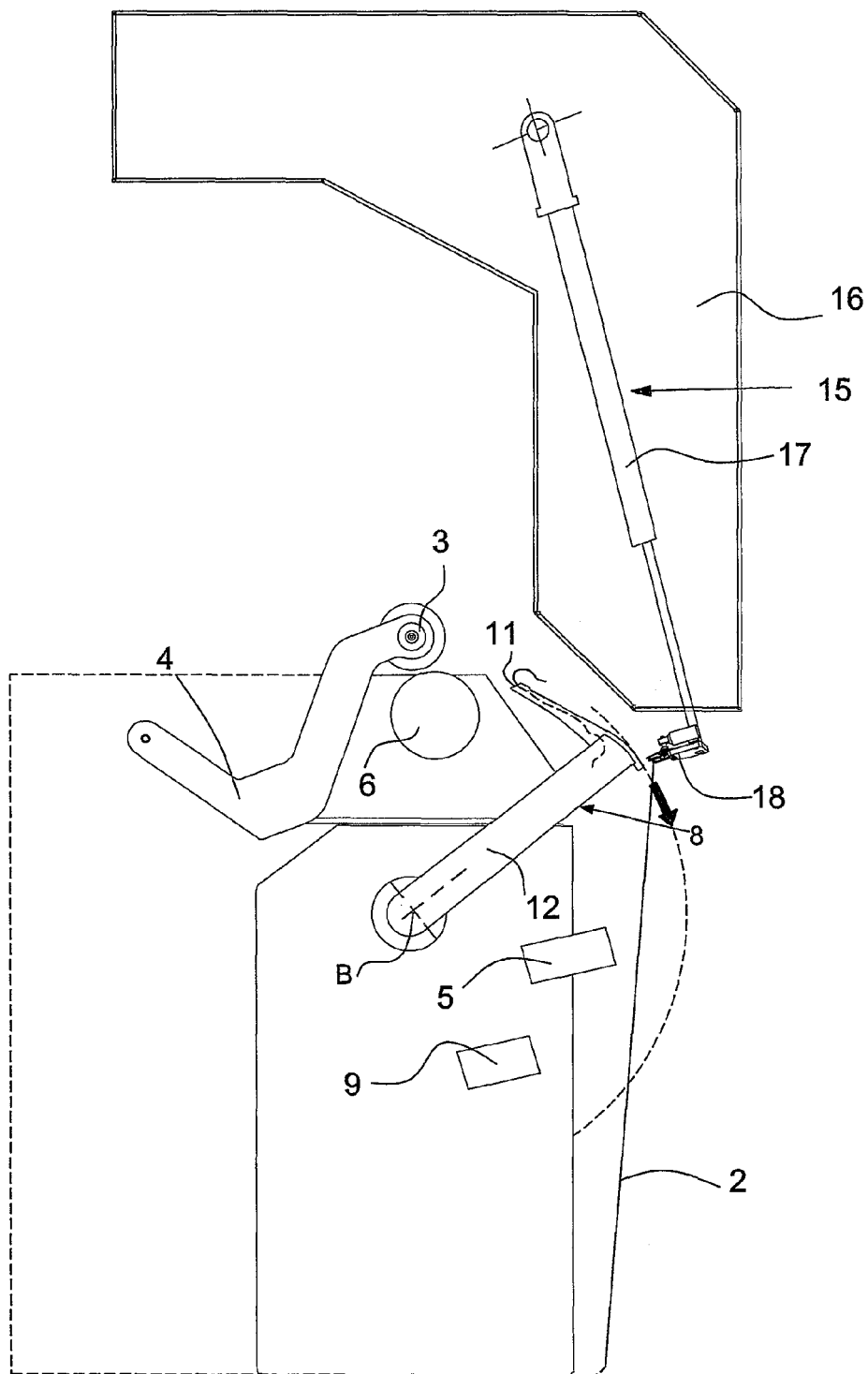
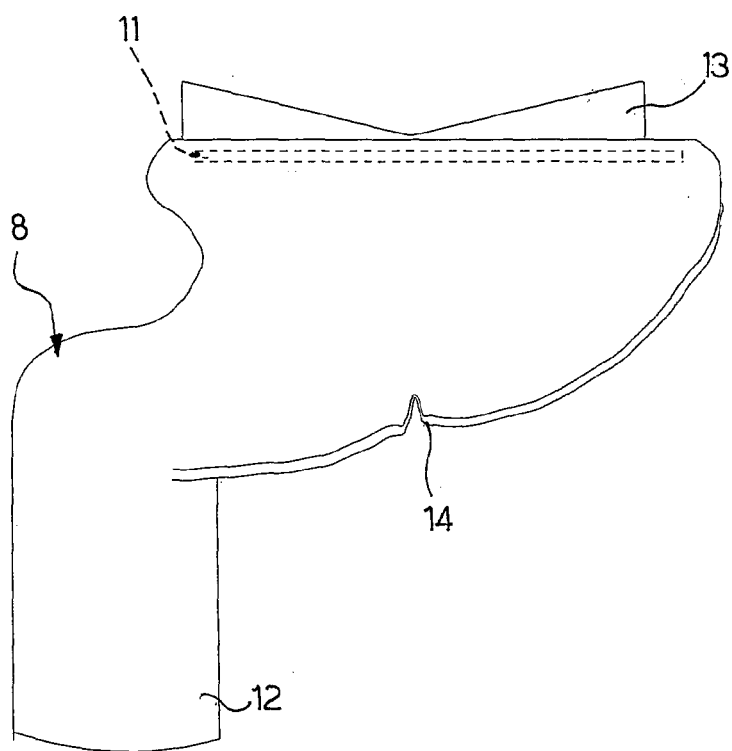


Fig. 8



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1127831 A [0012]
- EP 1236668 A [0013]
- EP 1428783 A [0014]