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(54) **Device and process for controlling and feeding spools coming in bulk from spinning to an automatic spooler**

(57) Device and process for controlling spools coming in bulk from spinning and for subsequently feeding them for automatic spooling, wherein spools (2) travel on a main conveyor belt (1) whereon an optical sensor (3) is arranged, wherein the spool (2) in motion with the belt (1), thus acquiring the profile and the posture of the spool (2). On the basis of the detected profile, a deviating ele-

ment (5) deviates the normal spools on a secondary sorting line (6) that receives and works the deviated spools towards the spooler and to be oriented with the base downwards, or does not deviate the anomalous spools from the main conveyor belt (1), letting them continue towards a collecting box for their subsequent separate treatment.

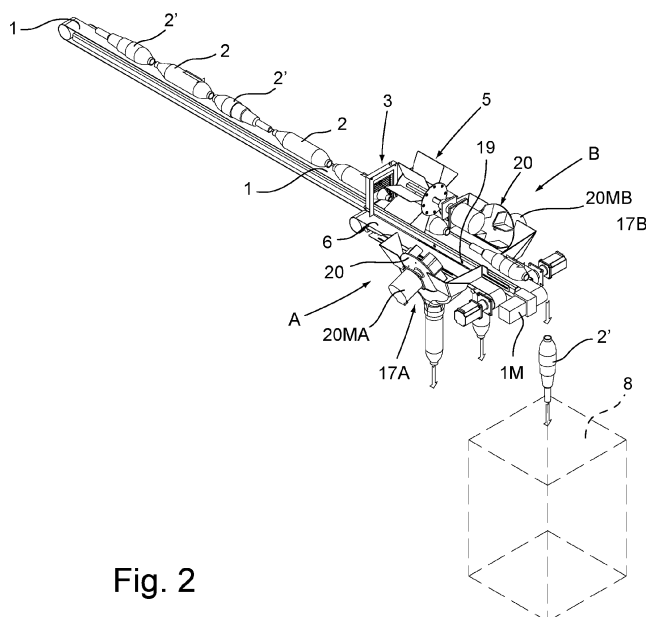


Fig. 2

Description

[0001] The present invention refers to a device and to a process for controlling spools coming in bulk from spinning and for their subsequent feeding for automatic spooling.

[0002] In industry there is widespread use of the technique of producing yarns in a first spinning stage - typically ring spinning that produces yarn by winding it in a spool on a frusto-conical quill - followed by a second spooling stage in which the yarn is unwound from its spool, removed of its defects and rewound in a reel, which contains a much greater amount of yarn and that corresponds to a substantially number of processed spools. The spooling process is much faster than spinning and therefore a small number of spooling units or stations is able to serve a large number of winding stations. In general, a ring winding station produces a spool in a time in the order of magnitude of hours, whereas the same spool is spooled in a time in the order of magnitude of a minute in the spooling station.

[0003] The present invention concerns the transferring and delivery of the spools full of yarn to the spooler, so-called "in bulk", that is with the full spools transported indistinctly between the two processes, for example through trolley-carried crates. Generally, the spools coming from the spinning machine have the end part of their thread wound for a certain number of revolutions around the package of the spool or around the base of its quill.

[0004] The initial stage of processing of the spool in the spooler consists of its preparation with an automatic device before sending it to the spooling stations. In such a device the end part of the yarn on the spool is freed from the base of the quill, or from the body of the spool, and unwound from the outer surface of the spool for a certain length. The yarn is then cut to size and slotted in the upper end of its quill, from which the spooling station - at the start of the unwinding of the newly fed spool - can take it, join it with the end available on the reel and start spooling again.

[0005] The device for preparing spools is generally on-board the automatic spooler and its preparation cycle is controlled by a dedicated controlling unit thereof, which controls and commands in succession the various operations of the cycle and thus sends the prepared spools onto the transportation circuit towards the spooling stations for their unwinding.

[0006] Before being fed to the spooler, to the preparing device and then to the spooling stations that make it up, the spool to be unwound must be controlled as for its shape characteristics and correctly oriented vertically.

[0007] In automatic spoolers there is widespread use of the transportations system with the spools in upright position, which moves and works the spools and the quills, using platelet supports to be placed onto conveyor belts or similar service moving members of the machine, to individually carry said spools and quills in the process movements in the spooler. The provision of keeping the

spool in upright position both in transport and processing, transferring and thus working the spools practically without touching them, permits to avoid the spools being subject to dirtying or deterioration by contact of the members of the machine.

[0008] The typical shape of the spools is shown in figure 1A. The thread is wound on a frusto-conical quill with a larger base and a smaller tip. The form of the winding is determined by the motion of the bed of the spinning machine moved continuously to lift and lower the spinning rings and to distribute the winding of yarn on the spools wound on their quills to form - from the bottom up - an initial section with spherical progression close to the base, a substantially straight cylindrical middle section with straight generatrix and a more inclined conical section towards the tip.

[0009] A spool having such a shape can be easily and reliably worked in the usual preparation devices that operate with times of the order of 3-5 seconds and that are capable of supplying the spooling stations with the foreseen frequency. On the other hand, in case the shape of the spool is not the foreseen one - as for example shown in figures 1B and 1C - and has a different progression, with irregularities especially in its cylindrical middle section, the usual automatic preparation devices are not capable of working it in the foreseen times and of supplying the spooling stations with the required frequency, thus reducing the overall productivity of the entire production line downstream.

[0010] Therefore, there is the need of ensuring the best overall efficiency of processing by presenting regular and well-oriented spools to the spooling, placing them upright with their base on the transport platelets of the spooler.

[0011] The present invention is aimed at the control and selection of spools to be fed for spooling, which come in bulk from the spinning process, and at their delivery in the correct position to the transport system of the spooler.

[0012] The invention is described here with reference to a typical embodiment thereof upstream of an automatic spooler.

[0013] The present invention, in its most general embodiment of a device for selecting and delivering the spool, is defined in the first claim. Variants or preferred embodiments are defined in claims 2 to 7.

[0014] The present invention, in its most general embodiment of a process for selecting and delivering the spool, is defined in the eighth claim. Variants or preferred embodiments are defined in claims 9 to 12.

[0015] The characteristics and advantages of the device and of the process for selecting and delivering spools according to the present invention will become clearer from the description of a typical embodiment thereof, exemplifying but not limiting, illustrated in figures 2 to 7. Figures 1, on the other hand, refer to the technical problem.

[0016] In general, the spools coming in bulk from the spinning stage are preliminarily singled out, for example through vibrating spiral devices, like in patent US

5,255,775, which make the spools go up again in line one by one on a spiralled path and send them still in line on a transport path towards the spooler.

[0017] In the embodiment of figure 2, which shows an isometric view of the overall structure of the device, the transportation path of the spools already singled out consists of the main conveyor belt 1 on which the spools 2 travel flatwise and arranged with their axis parallel to the direction of motion of the conveyor belt, through the effect of directional guides arranged at its sides and not shown in the figures for the sake of clarity of the drawings. The spools 2 can lie indistinctly with the base or the tip forwards. The prior art - for example DE 19840299 A - describes the identification of the position of the spool based on the measurement of the diameter of its quill: a greater diameter corresponds to the base of the quill that must fall first towards the transportation circuit of the spooler. In the prior art such a measurement is in any case carried out with the spool not moving.

[0018] The first stage of the process according to the invention consists of detecting the profile of the spool 2 that travels flatwise on the main belt 1, actuated at constant speed by its motor 1M. On the conveyor belt 1 some spools with irregular profile are also shown, indicated with 2'. The detection is carried out in the optical sensor 3, arranged on the path of the conveyor belt 1.

[0019] Such an optical sensor is used to detect, by scanning, the transversal dimension of the spool transiting on the conveyor belt 1: for this purpose, optical sensors that are already available in the state of the art can be used, like for example transmitted light optical sensors consisting of an emitter and a receiver arranged as a portal astride of the transiting spool, or else light reflected optical sensors by the body of the spool with emitter and receiver on the same side, or finally television camera sensors that process the image taken by scanning. However, in the following description we will refer for the sake of example to the transmitted light detection technique.

[0020] The device also comprises a controlling unit G - not indicated in the figures for the sake of simplicity - that receives the signals of the detection relating to the arriving spool from the optical sensor 3 and processes the profile of the spool, on the basis of which it processes and sends the commands to the various other members of the device.

[0021] The spool 2 in motion with the belt 1 passes into the portal sensor 3, arranged astride of the conveyor belt 1 and which will be described in greater detail hereafter, arranging itself in the path between the lighting element and the receiving element and creating a shaded area. The output signal is therefore proportional to the shade created by the object transiting through the portal sensor 3.

[0022] During the passage of the spool in the portal 3 the signals exiting from the sensor are acquired at regular intervals and a sequence of values representative of the complete profile of the spool that has crossed the sensor is obtained. The transiting spool is then treated in varying

ways, on the basis of its profile acquired by the controlling unit G processing the signals coming from the initial sensor 3.

[0023] In Patent Applications DE 3942304 and JP 62060778 means for detecting spools in motion on the conveyor belt are described. The spools are deviated or not from their path on the basis of the performed detection.

[0024] From the reading of the profile of the spool it is possible to detect its orientation, thus recognising whether the spool proceeds with the base or the tip facing forwards. With this reading it is possible to recognise in advance the spools with anomalous geometry (for example coca-cola bottle shaped, hand grenade shaped and so on) or incomplete spools, which would be difficult to use and would cause a loss of efficiency for the entire spooler. These particular spools can be discarded preliminarily and do not enter the normal work cycle, but are worked separately.

[0025] In the exemplifying embodiment shown in figure 2, onto the path of the main conveyor belt 1 a deviator element 5 is thus placed that deviates, or does not deviate, the spool towards its feeding to the transport system of the spooler. Parallel to the conveyor belt 1 at least one secondary sorting conveyor belt 6 is arranged that receives the spools deviated by the deviator element 5 towards the spooler. Considering the times required for detecting and sorting the spools much less than the times required for orienting and delivering the spools to the spoolers, in the exemplifying embodiment of figure 2 there are two secondary sorting belts, 6A and 6B, arranged on the two sides A,B of the main conveyor belt 1: in this way, it is possible to increase the capacity and reliability of feeding of the device according to the invention. During the possible repair or maintenance interventions on the line of one of the two belts, the device can in any case work with reduced capacity with the other secondary sorting belt 6A,B in operation.

[0026] The transiting spools 2' that result having an anomalous and unacceptable profile are left to continue on the conveyor belt 1 and discharged into a collecting box 8 for their subsequent separate treatment. The spools with a normal and acceptable profile, on the other hand, are deviated towards the spooler.

[0027] The deviator element - in its normal operation - alternately deviates the spools resulted having a normal and therefore acceptable profile to the right and to the left in the two secondary sorting belts, indicated with 6A, B. In the exemplifying embodiment of figure 3, which shows the sorting process in greater detail, the deviator element 5 is realized as a paddle wheel 11, fitted onto a drive shaft 12 set in rotation in steps by a motor 13, controlled by the controlling unit G that receives the signals relating to the arriving spool, as well as information relating to other members of the device, from the portal optical sensor 3, and sends them the operative commands.

[0028] Alternatively, such a deviator element can be

realized with compressed air jets, as for the discharging of the sorting belts that are described hereafter. The controlling unit G firstly, on the basis of the signals coming from the sensor 3, detects whether the spool has a correct profile: if not, it lets it proceed and does not command the deviator 5. For accepted spools, the controlling unit G instead decides onto which of the two secondary belts 6A,B to deviate the spool with synchronous movement with the arrival of the spools.

[0029] The "normal" decision is for the alternate mode: one to the right and the other to the left in sequence. Alternatively, it is possible to sort the spools to the right or to the left on the basis of the free/occupied state of the two belts 6A,B, detected with detection sensors of such a state connected to the controlling unit G.

[0030] As stated above, in normal operation of the deviator 5 towards the two sorting belts 6A,B, the controlling unit G controls the motor 13 to make the shaft 12 and the paddle wheel 11 rotate by one step with alternate clockwise/anti-clockwise motion, so as to alternately send one spool to the left and one to the right, and to remain "neutral" when it must allow a spool 2' resulted to be irregular on the basis of the reading of its profile to pass.

[0031] In the operation of the deviator 5 towards just one of the two sorting belts 6A,B, the controlling unit G instead controls the motor 13 to make the shaft 12 and the blades 11 rotate by one step at a time, with discontinuous motion or always clockwise or always anti-clockwise, so as to send all of the spools towards the belt that remains operating, still leaving the deviator 5 "neutral" when it must allow a spool 2' resulted to be irregular on the basis of the reading of its profile to pass.

[0032] The synchrony between the arrival of the spool 2 on the conveyor belt 1 at the deviator 5 and the actuation by step of the deviator itself is properly controlled by a sensor arranged on the path of the belt itself.

[0033] The configuration of the two sorting branches to the right and to the left of the belt indicated with letter A or B is identical and parallel. The sorting belts 6A,B are actuated by their motors 6MA and 6MB, they move with motion coherent with that of the conveyor belt 1, they receive the spool 2 deviated by the deviator 5 one at a time by falling and lead it to stop against an intercepting bulkhead 15A,B. The presence of the spool is controlled by a sensor arranged at the intercepting bulkhead 15A, B itself.

[0034] The spool 2 is then translated transversally by its sorting belt 6A,B towards an orientating device 17A, B that, on the basis of the reading of its profile in the portal sensor 3, positions it with the base downwards so that it falls in upright position on its transport platelet.

[0035] In the exemplifying embodiment of figures 2 and 3, the means for transversally translating the spool 2 are nozzles 19A,B arranged on the opposite side to that of the orientating device 17A,B and that emit compressed air jets: the spool 2 rolls towards the opening of the orientating device 17A,B.

[0036] In the exemplifying embodiment of figure 3, as well as in figures 4 and 5, which show it separate in isometric view, the orientating device 17A,B is conceptually analogous to the one described in the cited patent US 5,255,775. The orientating device 17A,B consists of a rotary plate 20 with an open recess on the side of its sorting belt 6A,B and consisting of two pairs of supports 21,22 for receiving and horizontally supporting the spool 2; the plate 20 is arranged on a funnel-shaped receiver 24 underneath that carries the falling spool towards its transport platelet after the rotation of the plate 20 that positions it with the base downwards.

[0037] The rotary plate 20 is set in rotation at steps of 90° by a motor 20M, controlled by the controlling unit G: such a rotation is controlled clockwise or anti-clockwise on the basis of the orientation detected with the initial reading of the profile of the spool, thus knowing whether the spool has arrived with the base or with the tip facing forwards. As shown in figure 4, the spool 2 has been introduced horizontally into the recess of the immobile plate 20, through the compressed air jets from the nozzles 19, to be rotated in the anti-clockwise direction. As shown in figure 5, the plate 20 is then rotated by 90° to cause the spool oriented with its base downwards into the funnel 24 to fall. In order to receive a new spool 2 to be oriented the plate 20, with a single recess consisting of the supports 21,22, must be once again rotated to carry its pairs of supports 21,22 in horizontal position.

[0038] According to an improved embodiment thereof, the orientating device 17 on the other hand consists of a rotary plate 20 with a cross-shaped recess 25 open on the side of its sorting belt 6A,B, and consisting of four pairs of supports 21,22 and 26,27. In this way, the plate 20, which has just discharged a spool 2 downwards, is ready to immediately receive a new spool without being rotated again.

[0039] As already outlined, the device and the process for controlling and selecting spools coming in bulk from spinning and for subsequently feeding them to the spooler are controlled by the controlling unit G that, on the basis of the signals that it receives both from the optical sensor 3 and from the various presence sensors of the spool, processes the profile of the spool and sends the commands to carry out the various operations of the cycle in synchrony.

[0040] One of the peculiar characteristics of the present invention is that of operating on the basis of the reading of the complete profile of the spool, detecting it in the optical sensor 3 in which the spool passes in movement. A typical embodiment of the detecting optical sensor is shown in an isometric view in figures 6 and 7, which illustrates a transmitted light optical sensor 3 (emitter and receiver) seen from the left and from the right respectively.

[0041] On the two sides of the portal 3 a series of light emitters 31 and light receivers 32 is respectively arranged, with a pitch of a few mm between each other. The passage of the spool 2 in the portal sensor 3 gener-

ates a shaded height zone 34 and axially variable along the spool detected with the receivers 32.

[0042] With the series of emitter and receivers arranged on the two sides of the portal 3 it operates with a frequency of the order of 1 kHz and with a final resolution of the profile of the spool of the order of 1 mm. The spools 2 pass in the portal at constant speed of the order of 30-50 m/min, determined by that of the main conveyor belt 1.

[0043] The flow of the arriving spools is continuous but not ordered: the space intervals between the spools coming out from the vibrating spiral device are not constant. The interspace between spool and spool on the belt 1 depends on average on the flow rate of the vibrating spiral device upstream that feeds it. It should not be less than 10 cm, so as not to have interference both in the detection of their profile and, particularly, in their subsequent deviation from the main conveyor belt 1 to the two secondary belts 6A,B. Two spools overlapped or embedded, or even simply stuck end to end, are detected as a single spool and generate an unknown profile.

[0044] For this purpose it is foreseen to suitable space the spools, for example firstly detecting the distance between the spools exiting from the spiral device and then consequently adjusting the frequency and flow rate of the vibrating spiral device or making the spools that are too close to the preceding spool fall from the spiral device.

[0045] The calibration of the portal sensor is carried out - at the start of the processing of a new batch of spools - with a reading of the profiles of a plurality of sample spools selected as acceptable (of the order of 10-15) and making them pass all laid in the same direction (for example all with the base facing forwards) in the portal sensor, with the self-learning mode of the system. The average of the profiles of the 10-15 spools detected in this way constitutes the reference profile for the spools with the base facing forwards. The same reference profile seen in the opposite direction constitutes the reference profile for the spools with the tip facing forwards.

[0046] It is optionally possible to repeat the learning procedures, inserting a different series of samples of further reference profiles, for example for half-spools or for empty quills, in the eventuality that they be adduced at the vibrating spiral device and then having to be discriminated to work them in a different way.

[0047] During processing, the system consisting of the portal sensor 3 and the controlling unit G thus acquires the profile of every spool that crosses the sensor. Every profile acquired is compared with the reference profiles (with the base or the tip facing forwards) calculating their likeness, for example through the Mathematical Correlation Index, consisting of a correlation coefficient between the sample signal and the detected signal, comprised between values of +1 and -1, according to the usual statistical processing techniques, where the positive values relates to one direction of the spool (for example with the tip facing forwards) and the negative values to the opposite direction. The spool is considered to

belong to the class for which the likeness index exceeds a certain predetermined absolute value, for example 0.9. The spools with a likeness value less than the predetermined value are dubious and thus discarded and to be worked separately.

[0048] Compared to the systems available in the prior art for controlling and feeding spools before delivering them to the spooler, the device according to the present invention offers substantial advantages and at least the following ones deserve a mention.

[0049] Compared to the technical solutions currently used - for example from patent US 5,255,775 - which use, for singling out and orienting the spools coming in bulk from spinning, the mere control of the diameter of the quill for its orientation with the rotary cross, the present invention preliminarily detects the profile of the spool with the optical detection system. Such detection permits not only to know the posture of the spool and to orient it correctly, but also to adduce to the spooler only the spools suitable for preparation in automatic devices on-board the spooler, discarding the unsuitable spools, with a significant increase in the use factor of the entire production line.

[0050] The detection of the spools is carried out in movement without stopping them and allows the controlling unit G to process the profile and to identify the acceptability and the posture of the spools in times of the order of 10-20 msec. In such short times the device for selecting spools is capable of feeding two orientating devices 17, sorting them with the sorting device 5 on the two secondary sorting belts 6A,B and the orientating devices 17A,B, doubling their capacity with respect to the single line and fully exploiting the flow rate of the vibrating spiral device that reaches the order of magnitude of 3000-4000 spools/h.

Claims

1. A device for controlling the spools coming in bulk from the spinning and for their further feeding for the automatic spooling, wherein spools (2) move along a transport path towards an orientating device (17), wherein their posture is detected with a unit detecting the position of their base, and therefore, according to the detection of their posture, rotates them with their base downwards so that the spool (2) falls in an erected position onto the transport system of the spooling machine, the detector comprising an optical sensor (3), placed on the path of a conveyor belt (1), whereon the spool (2) in motion with the belt (1) passes lying, allowing the optical sensor (3) to scan detect the transversal dimension of the spool in transit on the conveyor belt (1) and to a controlling unit G, which receives from the optical sensor (3) the signals of such detection, to process the profile of the spool, thus acquiring the profile of the spool (2), and a deviating element (5) which deviates the spool (2) on

- at least a secondary sorting conveyor belt (6) which receives the sorted spools towards the spooling machine and to be oriented with their base downwards, or it does not deviate it from the main conveyor belt (1), letting it continue towards a collecting box (8) of the anomalous spools (2') for their further separate processing, such deviating element (5) acting upon command of the controlling unit G according to a detected profile of the spool (2) or (2') **characterized in that** the secondary sorting belts are two (6A and 6B), placed on both parts A, B of the main conveyor belt (1), whereon the spools are deviated with the deviating element (5), each belt (6A and 6B) feeding one own orientating device (17A, B).
2. The device according to claim 1, **characterized in that** it comprises a transmitted light optical portal sensor (3), placed astride a conveyor belt (1), wherein the spool (2) in motion with the belt (1) passes lying creating a shadow zone.
 3. The device according to claim 1, **characterized in that** the deviating element (5) is realized as a paddle wheel (11), keyed on a driving shaft (12) moved in rotation by steps by a motor (13).
 4. The device according to claim 3, **characterized in that** the deviating element (5) is provided with means for the stepped actuation with an alternate clockwise/ counter-clockwise movement, so as to alternately direct one spool at the left and one at the right, with the two belts operating, or for the stepped actuation always in the same direction, so as to direct all spools towards the belt that remains in operation.
 5. The device according to claim 3, **characterized in that** the deviating element (5) is provided with means for the stepped actuation for deviating the spool, at the right or at the left, according to the free/occupied state of the two secondary conveyor belts (6A, B).
 6. The device according to claim 3, **characterized in that** the path of the two secondary sorting belts (6A and 6B) is intercepted by a intercepting bulkhead (15A,B) and which, at said bulkhead (15A,B), transversal translation means (19A,B) of the spool (2) are arranged, from each sorting belt (6A,B) towards their own orientating device (17A,B), in order to place it with its base downwards.
 7. The device according to claim 3, **characterized in that** the means for the transversal translation of the spool (2) consist of nozzles (19A,B), placed on the side opposite to that of the orientating device (17A, B), and which emit jets of compressed air.
 8. A process for controlling the spools coming in bulk from the spinning and for subsequently feeding them for the automatic spooling, which provides for preliminary individually singling them, by arranging them in rows one after the other, and so feeding them to the automatic spooling, wherein the spools (2) are fed to an orientating device (17), wherein according to the detection of their posture, it rotates them with their base downwards in order for it to fall in an erected position, the spools (2) being transported on a main conveyor belt (1) whereon the detection of the profile of the spool (2) it is carried out, through an optical sensor (3), placed along the path of a conveyor belt (1), whereon the spool (2) in motion with the belt (1) passes lying allowing the optical sensor (3) to scan detect the transversal dimension of the spool in transit on the conveyor belt (1) and a controlling unit G, which receives from the optical sensor (3) the signals of such detection, to process the profile of the spool, said profile being compared with a reference profile thus tracing the orientation of the spool and discriminating the normal spools (2) from the anomalous ones (2'); and that according to such identification the deviation of the spools is performed through a deviating element (5) which deviates the normal spool (2) on at least one secondary sorting conveyor belt (6) which receives the deviated spools towards the spooling machine and to be oriented with their base downwards, or it does not deviate the anomalous spools (2') from the main conveyor belt (1) letting them proceed towards a collecting box (8) for their subsequent separate processing, such deviation being controlled by a controlling unit G according to the detected profile of the spool (2) or (2'), **characterized in that** the secondary sorting belts are two (6A and 6B), placed on both parts A, B of the main conveyor belt (1), whereon the spools are deviated with the deviating element (5), each belt (6A and 6B) feeding one own orientating device (17A, B).
 9. The process according to claim 8, **characterized in that** the detection is carried out with a transmitted light portal optical sensor (3), astride a conveyor belt (1), wherein the spool (2) in motion with the belt (1) passes lying creating a shadow zone.
 10. The process according to claim 8, **characterized in that** the secondary sorting belts are two (6A,B), placed on both sides A,B of the main conveyor belt (1), whereon the spools (2) are deviated with the deviating element (5), each of the belts (6A,B) feeding their own orientating device (17A,B), and that the deviating element (5) alternately directs one spool at the left and one at the right.
 11. The process according to claim 8, **characterized in that** the secondary sorting belts are two (6A,B), placed on both sides A,B of the main conveyor belt (1), whereon the spools (2) are deviated with the

deviating element (5), each belt (6A,B) feeding its own orientating device (17A,B), and that the deviating element (5) directs the spool at the right or at the left, according to the free/occupied state of the two secondary conveyor belts (6A,B).

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12. The process according to claim 8, **characterized in that** the calibration of the portal sensor (3) is carried out at the beginning of the processing of a new batch of spools, by reading the profiles of a plurality of sample spools, by making them pass lying and all in the same direction in the portal sensor, with the self-learning mode of the system, the average of the profiles of the spools detected with such mode representing the reference profile for the spools in such direction, the same reference profile viewed in the opposite direction being the reference profile for the spools in the opposite direction.

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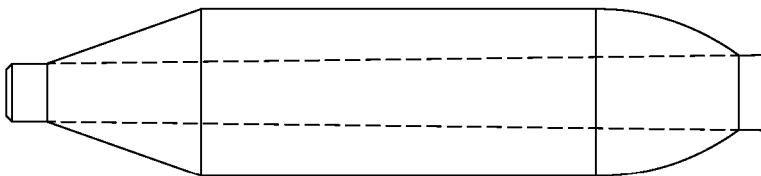


Fig. 1A

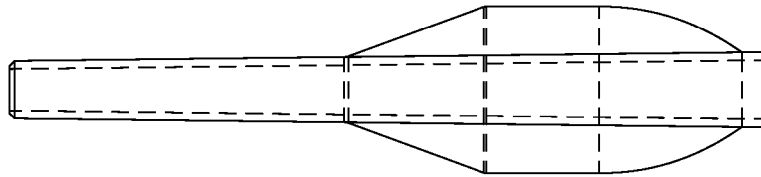


Fig. 1B

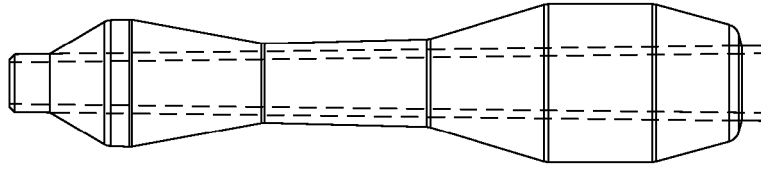


Fig. 1C

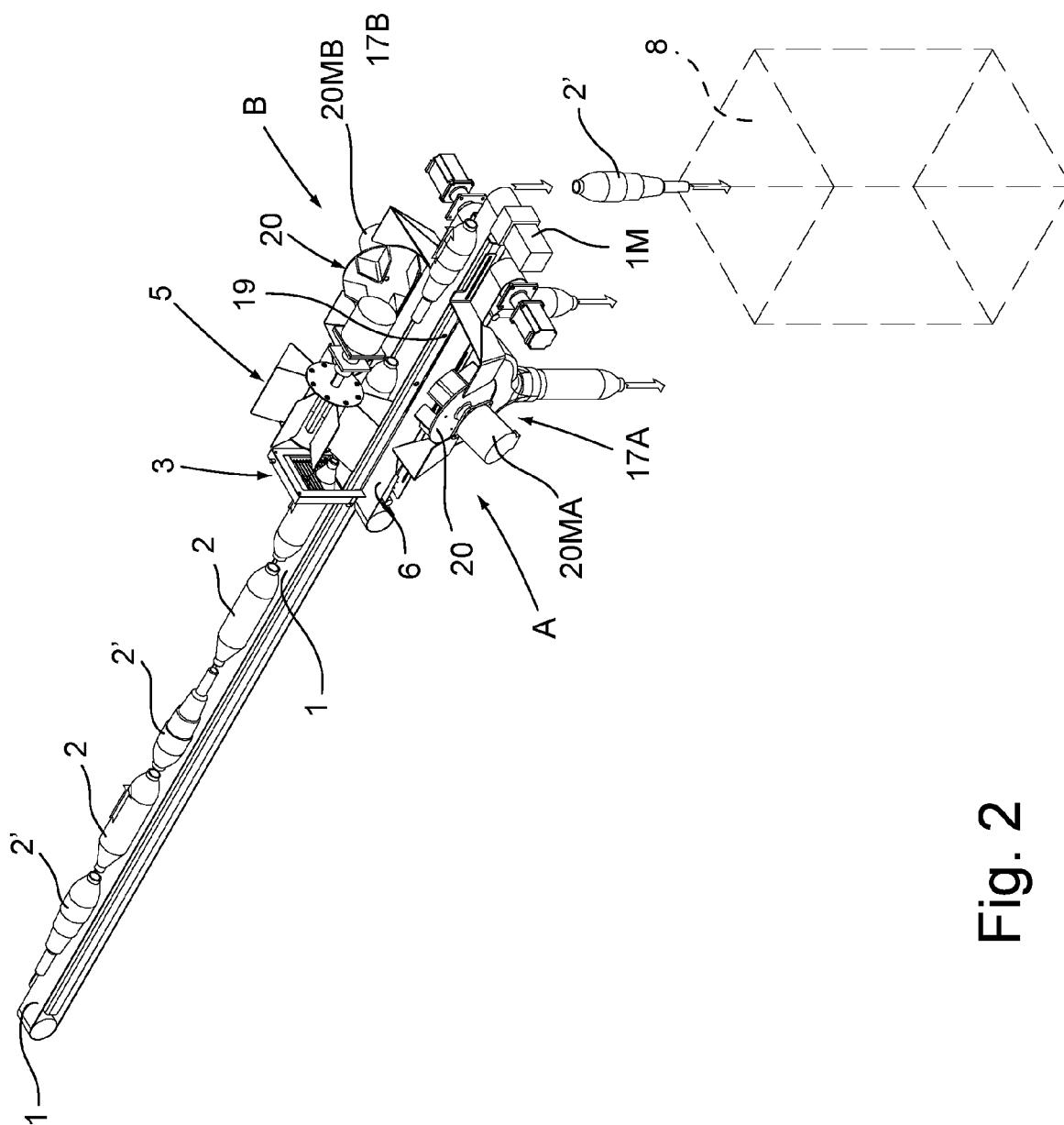
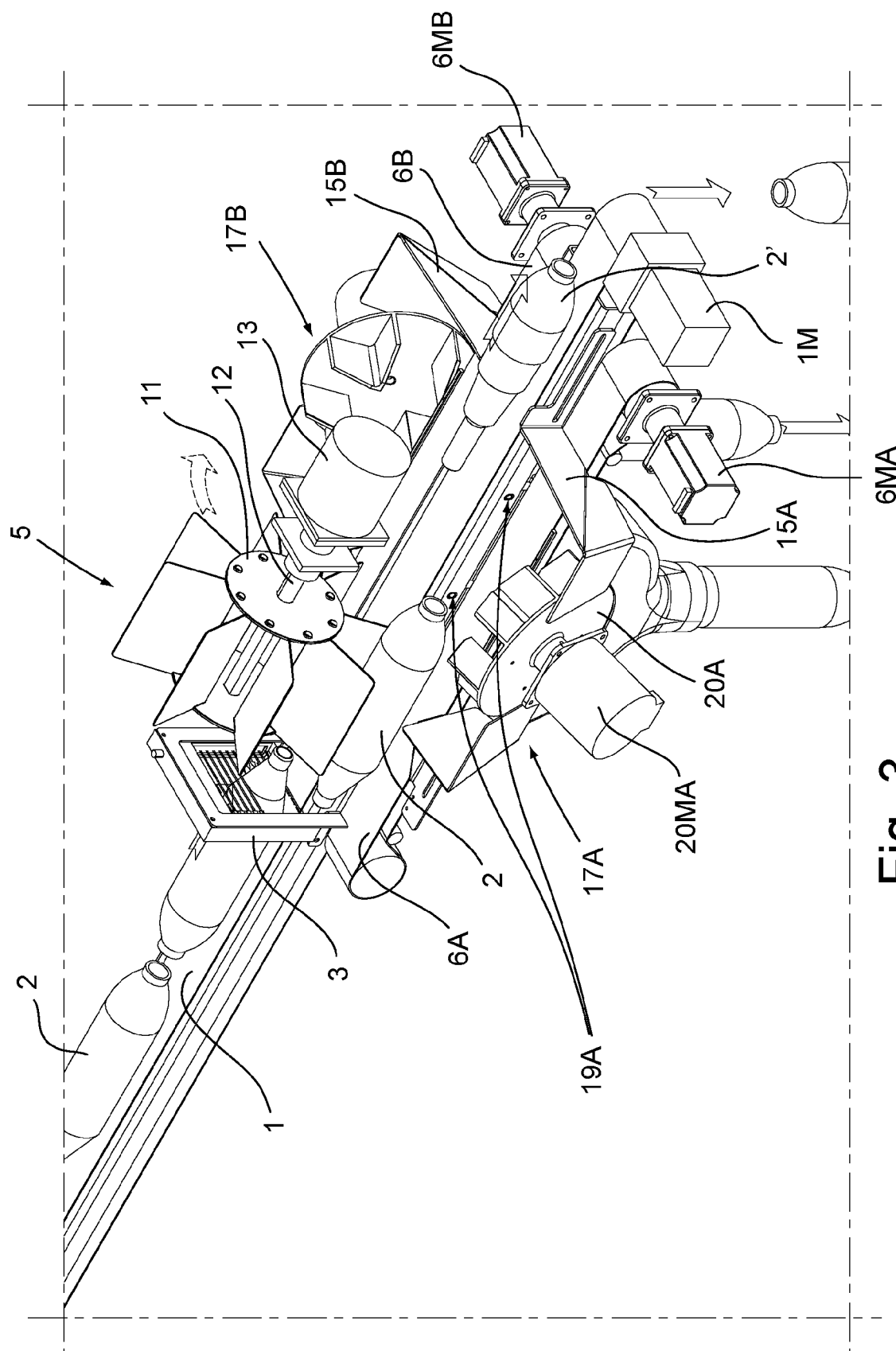


Fig. 2



6MA

Fig. 3

Fig. 5

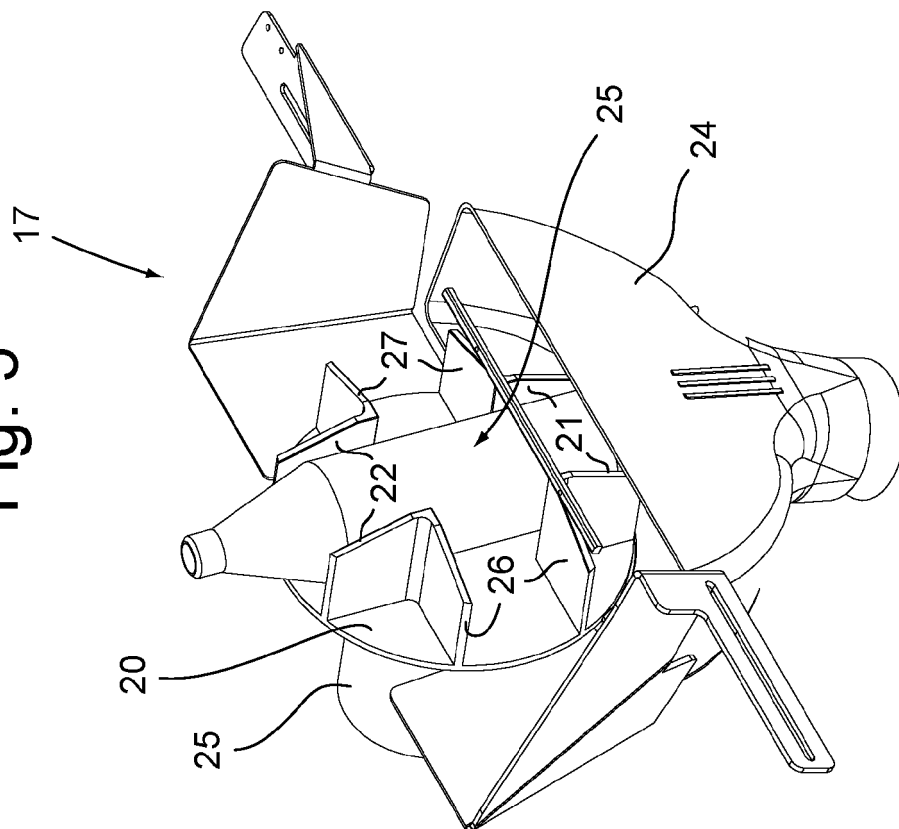


Fig. 4

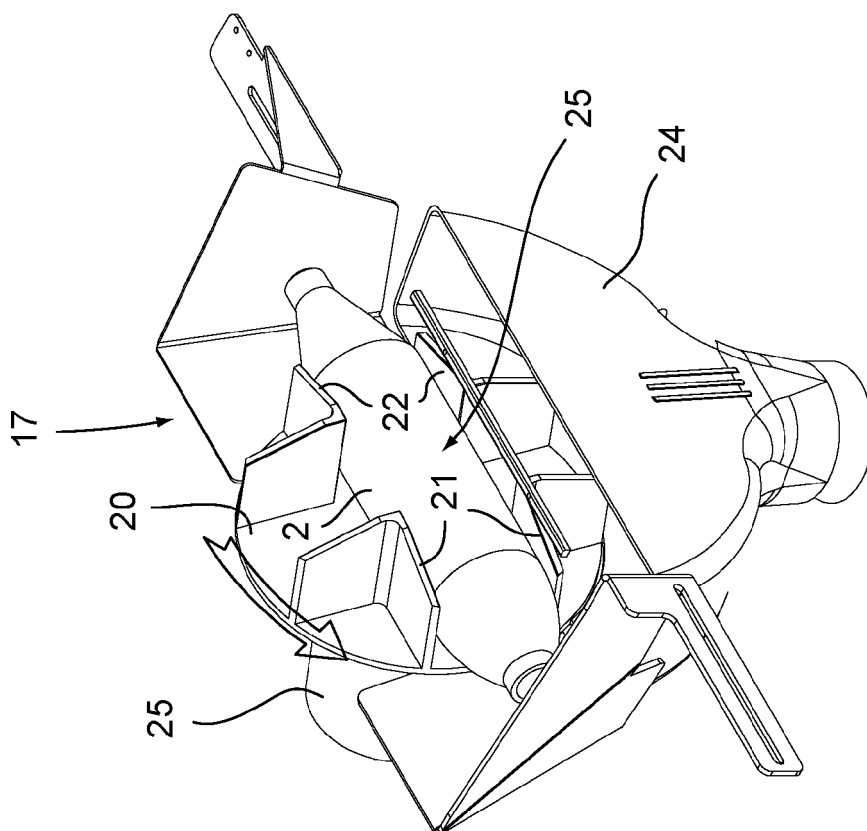


Fig. 7

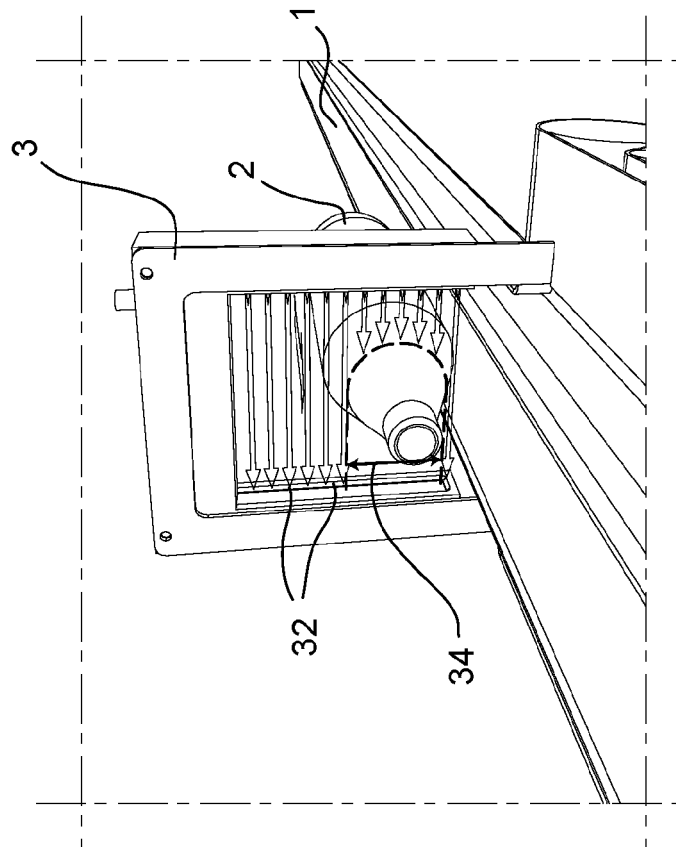
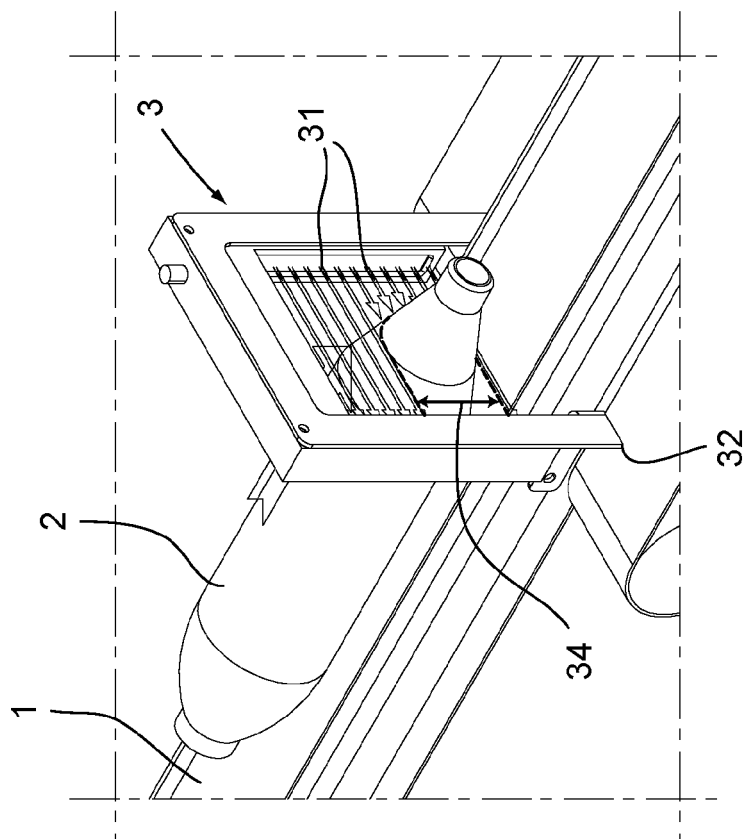


Fig. 6





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Application Number
EP 11 19 4114

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