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(54) OPEN-END TYPE SPINNING MACHINE WITH ENHANCED INTAKE NOZZLE UNIT AND RELATIVE PIECING METHOD

(57) An open-end type spinning machine (4) comprising at least one spinning head (8) having a spinning unit (12) which produces yarn (22) by introducing a fibre web into a spinning rotor (24) and a winding unit into reels (16), wherein the winding unit into reels (16) winds onto a tube (20) a reel (18) of yarn obtained from the underlying spinning unit (12),

- at least one piecing trolley (28) mobile so as to be able to position itself in the vicinity of each spinning head (8) and perform piecing operations of a broken yarn (22). Advantageously, the piecing trolley (28) comprises an intake nozzle unit (36) shaped so as to perform all the operations of grasping a yarn end and preparing the same for subsequent piecing, and an introduction group of the yarn (40), shaped to grasp the yarn end, previously prepared for piecing, and bring it to the spinning rotor (24) of the spinning unit (12) for its piecing with the yarn being formed.

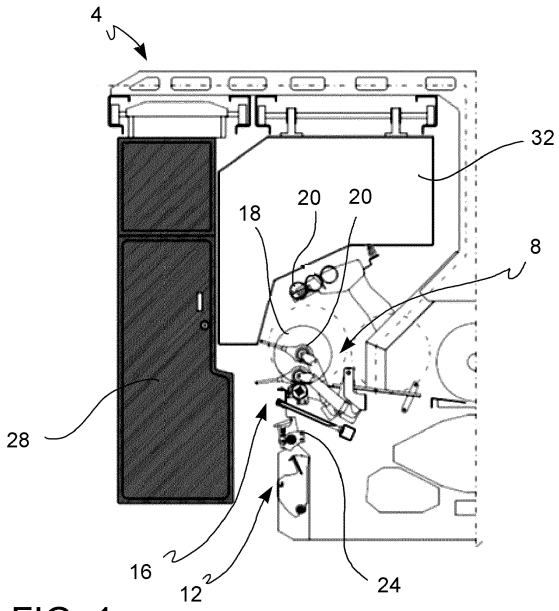

FIG. 1

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Description

FIELD OF APPLICATION

[0001] The present invention relates to an open-end type spinning machine with an enhanced intake nozzle unit and the relative piecing method in an open-end type spinning machine.

BACKGROUND ART

[0002] As is known, during the spinning process, a breakage of the yarn produced may occur in the spinning machines, with a consequent interruption of the production of yarn. The restoration of this activity involves piecing two portions of yarn: the one produced before the breakage, which is wound on the reel, and the portion which will be generated when the spinning will resume.

[0003] In open-end type spinning machines, this piecing is performed by using the yarn end picked up before the breakage to 'trigger' the spinning; in particular, the fibres of the new yarn will congregate on the old end, thus achieving a continuity in the yarn produced.

[0004] In general, in the textile industry, the procedure by which the ends of the yarn are joined is carried out by means of the piecing cycle (or simply piecing).

[0005] Usually, the known open-end type spinning machines of interest for this patent are completely automatic machines in which the doffing and piecing cycles are performed by a single trolley.

[0006] Inside this single trolley, some devices are mainly/exclusively dedicated to the doffing cycle alone, while others are mainly/exclusively dedicated to the piecing cycle.

[0007] According to a possible known solution, among the various operations carried out in the above-mentioned piecing cycle, the pick-up, preparation and handling of the yarn are performed by means of the following machines:

1. reel intake nozzle;
2. yarn centering unit;
3. yarn preparation unit;
4. introduction and extraction group.

[0008] The intake nozzle picks up the end of the yarn of the reel being formed. It contains an optical sensor to check the presence of the yarn; conventionally the device is actuated by a stepper motor.

[0009] The yarn centering unit catches the yarn from the nozzle and leads it to the preparation unit. The device is actuated by a pneumatic cylinder.

[0010] The yarn preparation unit draws in the yarn, cuts it and prepares the end for the piecing; furthermore, it is equipped with a device to ensure the gripping of the yarn by the rollers of the introduction/extraction group. The group is actuated by means of pneumatic cylinders and by means of depression.

[0011] Finally, the introduction and extraction group takes the yarn from the preparing unit to bring it in the vicinity of the output hole of the spinning unit and introduces the length thereof required to reach the rotor throat. The groups are actuated by means of stepper motors (Rotation) and by means of pneumatic cylinders (lateral displacement).

[0012] In the following, the piecing cycle of the known solutions will be described in more detail in order to better understand the technical issues that the present invention aims to solve.

[0013] One should, therefore, start from the moment in which the reel has already been stopped by the system, following the lifting, by means of the stop plate, from the drag cylinder. The trolley is already in the vicinity of the 'spinning head' where the piecing will be performed. The opening device arranged was already employed to open the spinning unit.

[0014] At this point, the reel is lifted from the stop plate by means of a reel-lifting arm; the reel intake nozzle intervenes, which descends, tilting, from the rest position to the vicinity of the reel (at a distance of about 5/6 mm) . At the same time intake is actuated. The terminal part of the nozzle has an intake cavity in the form of a low slit as wide as the width of the reel, to allow the end to be picked up in an indeterminate position on the reel.

[0015] The reel is rotated by means of the reverse roller, to allow the identification and extraction of the yarn end from the reel. At the same time, a specific device, on the same trolley, deals with the aperture of the rubber yarn extraction roll.

[0016] The search for the end continues until the optical sensor (the yarn presence sensor) of the nozzle verifies the presence thereof: if it is not detected, the search is repeated twice. If, despite the various attempts, the end is not picked up, the system managing the machine emits a warning, by means of a signal (light/sound), requesting the intervention of an operator to solve the issue.

[0017] Once the yarn has been picked up, the nozzle moves back to the rest position. This backing allows the yarn to be stretched, making space for the intervention with the yarn centering unit which descends, by tilting, into a working position, finding the yarn in a certain position. By virtue of a special "V" cavity, the centering unit intercepts the yarn and leads it in the vicinity of the yarn preparation unit. At this point the reel is stopped.

[0018] The nozzle advances slightly forward to loosen the yarn, the scissors of the centering unit cut the yarn which is picked up, by suction, by the yarn preparation unit. The cut piece of yarn is drawn in and removed from the reel intake nozzle while it returns to the rest position thereof.

[0019] The new end just made is directed by the preparation device which, by means of a jet of compressed air, frays it to prepare it for the subsequent piecing step. Once the yarn preparation is completed, the introduction and extraction group moves into position to pick the yarn up.

[0020] At the same time, specific devices, on the same trolley, clean the rotor, clean the funnel, close the spinning unit and prepare the web, eliminating the damaged fibres. The reel-lifting arm then lowers the reel back on the stop plate.

[0021] The prepared end, picked up by the introduction group, is first passed between the rollers of the extraction roller, then brought in the vicinity of the yarn output tube at the spinning unit, and inserted into the tube so as to reach the rotor throat. Accuracy when positioning the yarn end in the rotor throat determines the quality of the piecing.

[0022] The yarn end introduced up to the rotor throat 'triggers' the spinning, so that the fibres processed by the rotor congregate at the end properly prepared, thus achieving continuity in the yarn produced. The actual piecing is physically realized.

[0023] At this point, other devices, on the same trolley, restore the yarn extraction by restoring the contact between the extraction roller and the motor shaft thereof and, at the same time, the web feeder roller is reactivated: yarn production is resumed.

[0024] The rotation of the reel is then restarted by lowering the reel onto the drag cylinder by means of the stop plate: the pick-up is reactivated, the piecing cycle is completed and the normal spinning is restored. The trolley has completed the cycle and is free to leave.

[0025] As it may be understood from what has been described, the operations performed by the machines of the background art are rather complex and also require relatively long waiting times.

DESCRIPTION OF THE INVENTION

[0026] Therefore, the known solutions described above have drawbacks and limitations, essentially due to the fact that they involve the employment of complex and expensive mechanical systems for picking up the yarn end, centering the yarn, preparing the yarn end for the following piecing and inserting/extracting the yarn from the preparing unit to bring it in the vicinity of the output hole of the spinning unit, which are all necessary for the following actual piecing step.

[0027] Such known devices, in addition to increasing the complexity and the costs of the machine, also increase the time required to perform the piecing of the broken yarn.

[0028] The need to solve the drawbacks and limitations mentioned with reference to the background art is therefore felt.

[0029] Such need is satisfied by an open-end type spinning machine in accordance with claim 1 and by a method of piecing a yarn in an open-end type spinning machine according to claim 9.

DESCRIPTION OF THE DRAWINGS

[0030] Further features and advantages of the present invention will become more apparent from the following description of preferred and non-limiting embodiments thereof, in which:

Figure 1 shows a diagrammatic sectional view of an open-end type spinning machine in accordance with an embodiment of the present invention;

Figure 2 shows a perspective sectional view of a spinning rotor of the spinning machine of Figure 1;

Figure 3 shows 1 perspective view of an intake nozzle unit of the spinning machine according to an embodiment of the present invention;

Figure 4 shows 1 sectional view of the enlarged detail IV indicated in Figure 3;

Figures 5 to 10 show diagrammatic perspective views of components of the spinning machine of the present invention during a yarn piecing sequence;

Figures 11-12 show perspective views of an intake nozzle unit according to the present invention;

Figure 13 shows a front view of the intake nozzle unit of Figure 11;

- Figure 14 shows a sectional view of the nozzle unit of Figure 13, along the sectional plane XIV-XIV of Figure 13;
- Figure 15 shows a side view of the intake nozzle unit of Figure 13;
- Figure 16 shows a sectional view of the nozzle unit of Figure 13, along the sectional plane XVI-XVI indicated in Figure 15;
- Figure 17 shows a sectional view of the nozzle unit of Figure 13, along the sectional plane XVII-XVII indicated in Figure 15;
- Figure 18 shows a sectional view of the entrance of the intake nozzle unit of Figure 13;

Figure 19 shows a front view of a spinning head of the present invention;

Figure 20 shows a perspective view of an introduction group according to the present invention;

Figure 21 shows a side view of a step for feeding the yarn into a spinning machine according to an embodiment of the present invention.

[0031] The elements, or parts of elements, in common between the embodiments described below, will be indicated with the same reference numerals.

DETAILED DESCRIPTION

[0032] With reference to the aforesaid Figures, with numeral 4 an overall diagrammatic view of an open-end type spinning machine according to the present invention is generally indicated.

[0033] In particular, the spinning machine 4 comprises at least one spinning head 8 having a spinning unit 12 and a winding unit into reels 16, wherein the winding unit into reels 16 winds a reel of yarn 18 obtained from the underlying spinning unit 12 on a tube 20.

[0034] The spinning unit 12 produces yarn 22 by intro-

ducing a fibre web into a spinning rotor 24.

[0035] The spinning machine 4 comprises at least one mobile piecing trolley 28 so as to be able to position itself in the vicinity of each spinning head 8 and perform piecing operations of a broken yarn 22.

[0036] The spinning machine 4 comprises at least one doffing trolley 32 which can be positioned at each spinning head 8 and is fitted with devices for picking up and moving a tube 20 from a tube-holder basket to a pair of tailstocks of the winding unit into reels 16, in a known manner.

[0037] Preferably, the piecing trolley 28 and the doffing trolley 32 at least partially penetrate each other so as to mutually override each other along a patrol path of the spinning heads 8 of the spinning machine 4.

[0038] Penetrating each other means that they have a shape and follow a trajectory such that they may meet in any intermediate section and cross it without disturbing each other.

[0039] Advantageously, the piecing trolley 28 comprises an intake nozzle unit 36 and an introduction group of the yarn 40.

[0040] The intake nozzle unit 36 is shaped so as to perform all the operations of grasping an end of the yarn 22 and preparing it for the subsequent piecing, as better described below. The introduction group of the yarn 40 is shaped to grasp the end of the yarn 22, previously prepared for piecing, and bring it in the vicinity of the spinning rotor 24 of the spinning unit 12 for the piecing thereof with the yarn being formed.

[0041] According to an embodiment, the intake nozzle unit 36 comprises an intake nozzle 44, a yarn presence sensor 48 inside the intake nozzle 44, cutting means 52 for cutting the yarn 22 and a device 56 for the preparation of the end of the yarn 22.

[0042] The intake nozzle 44 is aeraulically connected, by means of a suitable piping system, not shown in the Figures, to intake means not shown in the Figures capable of creating the necessary depression to draw the yarn in; conventionally, said intake means comprise fans placed in rotation by electric motors.

[0043] Preferably, the intake nozzle 44 comprises a cavity 60 therein, which defines a forced channel or passage for the yarn 22 drawn in, as better described below.

[0044] The intake nozzle 44 comprises a slit-like entrance portion 70 which draws in the yarn and which develops into a straight cylindrical portion 72 inside which the yarn is conveyed. The straight cylindrical intake portion 72 has a nominal inner diameter Dn.

[0045] According to an embodiment, the intake nozzle 44 is provided with a flow diverter 68 aeraulically interposed between the entrance portion 70 and the intake pipe on which the nozzle, not shown in the Figures, is inserted.

[0046] The object of this device is to deviate the axis of the intake pipe, thus forcing the trajectory of the drawn in yarn to make it pass inside the cavity 60. The flow diverter 68 is constructed so as to guarantee the dimensional continuity of the internal diameter of the intake pipe, while, at the same time, avoiding any sudden change of section and roughness to avert grips on which the yarn may get caught.

[0047] The flow diverter 68 is offset with respect to the intake pipe by a misalignment C of the axis in the flow diverter 68; preferably, such misalignment 68 is related to the nominal inner diameter Dn according to the following formula: $1/2Dn<C<3/4Dn$.

[0048] By virtue of the misalignment C, the flow of air and of the yarn drawn in thereby, has a double curvature: a first curvature 76 between the axis Y' of the straight cylindrical portion 72 of the intake nozzle upstream of the flow diverter 68 and a second curvature 80 between the flow diverter 68 and the axis Y" of the intake pipe downstream of the flow diverter 68. It should be noted that the axis Y', Y" of the intake pipe 72 upstream and downstream of the flow diverter 68 are preferably parallel to each other.

[0049] In the passage between the entrance portion 70 and the flow diverter 68 the yarn is forced by the first and second curvature 76, 80, imposed by the flow diverter 68, to pass tangentially to the two curvatures themselves, choosing the smaller distance path; this ensures that the position of the yarn always lies on a bottom 84 of the hollow of the cavity 60. The bottom 84 is constituted by the portion of the cavity 60 designed for housing in abutment the drawn in yarn.

[0050] The cavity 60 develops longitudinally along the intake pipe 72 and preferably has a symmetrical section with respect to a transverse plane orthogonal to the axis Y' of the straight cylindrical portion 72 of the intake nozzle 72 upstream of the flow diverter 68.

[0051] The section of the cavity 60 has slightly different size and shapes when passing between the various transverse sections of the intake pipe 72.

[0052] According to an embodiment, the bottom 84 of the cavity 60, with respect to a sectional plane perpendicular to the main axis of extension thereof, has a variable angle of aperture 100 along the extension thereof inside the intake nozzle 44.

[0053] According to a possible embodiment, the cavity 60 in the first portion is narrower, and then widens after the section of the cutting means 52: this guarantees a more accurate positioning in the cutting and preparation steps, which will ensure a better quality of the subsequent piecing.

[0054] For example, at the cutting means 52, said angle of aperture 100 is between 80° and 100°.

[0055] At the end preparation device 56, said angle of aperture is slightly narrower, i.e., between 75° and 95°.

[0056] In any case, the cavity 60 has the purpose of conveying the drawn in yarn, creating as less turbulence as possible which may disturb the motion of the air carrying the yarn.

[0057] Therefore, the motion of the air inside the straight cylindrical portion 72 of the intake nozzle 72 shall be as laminar as possible; for this purpose, the internal

lateral surfaces of the straight cylindrical portion 72 of the intake nozzle 72 are connected and free from roughness which may facilitate the detachment of the fluid flow of air from the walls, thus generating turbulence. Turbulence would lead to undesirable displacements of the yarn, making the position thereof uncertain, thus compromising the accuracy of the relative operations.

[0058] To this end, in order to guarantee an adequate intake phenomenon without excessively increasing the air passage speed, the hydraulic effect of the convergent was recreated without excessively reducing the air passage section, in fact, between the three sections, at, respectively:

1. entrance portion 70,
2. end preparation device 56,
3. cutting means 52,

the reduction of the through area was limited. From practical tests performed, it has been verified that the best reduction compromise is between a 2.7/3.2% reduction in the through area.

[0059] According to an embodiment, the cutting means 52 are positioned in the vicinity of said cavity 60, inside the intake nozzle 44.

[0060] According to an embodiment, in the vicinity of said cavity 60, the end preparation device 56 of the yarn 22 is positioned, configured to direct a jet of compressed air on said yarn end 22, so as to prepare it for the subsequent piecing step, according to known systems.

[0061] The operation of an open-end type spinning machine according to the present invention will now be described.

[0062] In particular, the spinning machine 4 operates continuously, producing yarn by means of the spinning unit 12; in the meantime, the piecing trolley 28 and the doffing trolley 32 patrol the various spinning heads 8; if necessary, the piecing trolley 28 performs all the piecing operations required.

[0063] In case of yarn breakage, the piecing procedure is, in fact, actuated.

[0064] In particular, the piecing method comprises the steps of:

a) detecting the yarn breakage 22, for example by means of a further yarn presence sensor 49 mounted on the spinning head,
b) stopping the reel 18 by means of a stop plate actuated by the spinning head 8,
c) in the meantime, bringing the piecing trolley 28 at the spinning head 8 where the breakage of the yarn 22 occurred,
d) rotating the reel 18 by means of a reel inversion unit (not shown) of the piecing trolley 28 to start the search for the end of the yarn 22 broken on the reel 18, and, at the same time, bringing the intake nozzle unit 36 of the piecing trolley 28 in the vicinity of the reel 18 to aspirate the end by the actuating intake means properly connected to the intake nozzle 44,
e) stopping the reel 18 after having picked up the yarn 22 inside the intake nozzle 44, (operation, for example, detected by the yarn presence sensor housed inside the intake nozzle 48),
f) actuating the cutting means 52 housed inside the intake nozzle 36, removing the cut piece from the reel side 18, catching the new end made by cutting and preparing it with a jet of compressed air by means of an end preparation device 56 housed inside said intake nozzle 44,
g) actuating a yarn feeding unit 40 of the piecing trolley 28 which grasps the prepared yarn end and inserts it in the spinning unit 12.

[0065] According to a possible embodiment, simultaneously to steps d), e) and f) the piecing trolley 28 deals with the cleaning the spinning rotor 24, and/or with the cleaning of a funnel of said spinning rotor 24 and, subsequently to step g), with the lowering of the reel 18 on a relative stop plate.

[0066] According to a possible embodiment, simultaneously to steps f) and g) the spinning head 8 prepares the fibre web discarding the damaged ones and feeding the spinning rotor 24 with new fibres by means of a web feeder roller.

[0067] Preferably, during step g) the prepared end is picked up by the introduction group of the yarn 40, managed by the piecing trolley 28 which clamps the end between the feed rollers 64 thereof to bring it to the spinning unit 12.

[0068] According to an embodiment, said feed rollers 64 of the introduction group of the yarn 40 are assisted by the action of a reverse roller which, by rotating the reel 18, prevents the formation of undesirable loops which might engage the various mechanisms, so as to keep the yarn taut and without slack.

[0069] According to an embodiment, during step g), the yarn 22 is inserted by the introduction group 40 in a specific path by virtue of the aid of the yarn displacer 51 of the feeding device, and the end is fed into a yarn output channel.

[0070] Along such path a release device 50 is preferably located, which, when armed, holds an extra length of yarn which, upon request, is released by the spinning head 8 allowing the end to reach the throat of the spinning rotor 24.

[0071] At this point, the piecing trolley 28 enables the spinning head 8 and abandons it after completing its tasks.

[0072] The spinning head 8 detaches the release device, the end reaches the throat of the spinning rotor 24 and 'triggers' spinning, so that the fibres being processed by the spinning rotor 24 congregate at the end properly prepared, thus achieving continuity in the yarn produced.

[0073] The steps of the piecing cycle are summarized below, indicating in brackets, respectively with TF (spinning head) and CR (piecing trolley), the devices desig-

nated to perform each step.

[0074] Starting from the instant immediately following the breakage of the yarn detected by the sensors, the following will occur:

1) stopping of the winding reel 18 by lifting it from the drag cylinder by means of a stop plate (TF);
2) aperture of a rubber yarn extraction roll (TF) ;
3) approach of the piecing trolley 28 to the spinning head 8 concerned, stopping and stabilizing by actuating the parking brakes (CR);
4) aperture of the spinning unit 12 (CR);
5) cleaning of the spinning rotor 24 and of the funnel (CR);
6) closing of the spinning unit 12 (CR);
7) lifting of the reel 18 from the stop plate (CR) ;
8) rotation of the reel 18 by means of a reverse roller to allow the search for the end (CR);
9) catching of the end of the reel 18 by suction, performed by an appropriate intake nozzle 44 (CR) ;
10) stopping of the rotation of the reel 18 (CR) ;
11) arrival of the feeding unit blocking the yarn by clamping it between the rollers 64 (CR),
12) cutting of the yarn by scrap intake (CR);
13) preparation of the newly generated yarn end (CR) ;
14) lowering of the reel 18 on the stop plate (CR) ;
15) preparation of the web, with discharge of damaged fibres, and feeding of the spinning rotor 24 with new fibres by rotation of the web feeding roller (TF);
16) introduction of the end previously prepared into the yarn output channel, after being fed into a specific predetermined path by the introduction group (CR) ;
17) sending of the approval signal to proceed to the spinning head 8 (CR);
18) release of the parking brakes and departure from the spinning head 8 by the piecing trolley 28 (CR);
19) release of the yarn 22, by a specific release device; an extra length, specifically kept, allows to reach the throat of the spinning rotor 24 (TF);
20) restoration of the extraction of the yarn by virtue of the reset of the rubber extraction roll; the yarn production resumes (TF);
21) reactivation of the rotation of the reel 18 by lowering it on the drag cylinder by the stop plate (TF) .

[0075] With the recovery of the reel winding, the piecing is completed and the spinning is restored.

[0076] Some of the previous operations, as seen, may also be performed simultaneously because they are performed by different devices, located on the piecing trolley 28 (CR) or on the spinning head 8 (TF).

[0077] As it may be appreciated from what has been described, the open-end type spinning machine and the method of piecing a yarn of an open-end type spinning machine according to the invention allow to overcome the drawbacks presented in the background art.

[0078] The new yarn pick-up system has several advantages with respect to the solutions of the background art.

[0079] The main advantages are:

1. reduction of the number of devices adapted to complete the cycle;
2. reduction of the passages of yarn between one device and the other;
3. greater accuracy during the yarn cutting step;
4. improved efficiency in the overall management of the machine.

[0080] More in detail, the reduction of the devices adapted to perform the cycle certainly entails a reduction in the overall size, not only of the physical devices but also of the volume necessary for the actuation of the movements of the devices themselves.

[0081] Reducing the number of devices helps limiting costs, since not only redundant structures (sensors, motors, actuators, etc.) are reduced, but also relative energy consumption.

[0082] The overall reliability of the system will also improve, since the possible breakdown of mechanical components will diminish (being fewer in number) and the necessary maintenance on the devices will also be reduced.

[0083] Furthermore, the integration of different devices allows to eliminate functions which would be redundant, such as, for example, the intake system which would be replicated on the preparing unit in order to collect scrap, the centering unit, or the various sensors and motor systems allowing the motion of the devices themselves.

[0084] The use of a smaller number of devices manipulating the yarn implies a reduction in the number of yarn passages from one device to another; in particular, instead of the three intermediate passages envisaged by known systems (nozzle/centering unit, centering unit/preparing unit, preparing unit/feeding unit), the present invention only provides for one intermediate passage (nozzle/feeding unit).

[0085] Fewer passages allow to save time on the transfer of the yarn from one device to another.

[0086] A smaller number of passages also implies a lower possibility that the yarn "escapes" during the transfer, with a consequent loss of machine time to resume the yarn when restoring the cycle.

[0087] Another advantage in reducing yarn transfers is that the possibility that the yarn itself is damaged, for example, by rubbing against the moving parts of the devices during the passage from one device to another, is reduced.

[0088] An additional benefit that the new pick-up system brings is the greater accuracy that will be obtained in the cutting step: the distance between the end of the prepared yarn and the point at which it is clamped between the rollers of the feeding unit is accurately maintained and, since the yarn will not have to undergo further passages, with the same accuracy this end will be fed

into the yarn output tube.

[0089] The length of this yarn portion being accurate during the step of insertion into the yarn output tube is very important: the quality of the piecing realized during the piecing step and, consequently, the quality of the entire yarn reel decisively depends on it.

[0090] A further advantage deriving from the new pick-up system is a better efficiency in machine management deriving from the reduction of yarn handling times, since not only are the passages reduced, but also the possible procedure re-execution times in case the yarn is 'lost' during a passage.

[0091] The improvement in the efficiency also derives from the reduction in energy consumption (less engines, less sensors, etc.) and from the less energy needed to operate them. Also the reduction of maintenance (having fewer devices) has a positive impact on the overall machine efficiency.

[0092] A skilled in the art, in order to satisfy contingent and specific needs, may make numerous changes and variations to the machines and to the piecing methods of the present invention, all included, however, within the scope of the invention as defined by the following claims.

Claims

1. Open-end type spinning machine (4) comprising at least one spinning head (8) having a spinning unit (12) which produces yarn (22) by introducing a fibre web into a spinning rotor (24) and a winding unit into reels (16), wherein the winding unit into reels (16) winds onto a tube (20) a reel (18) of yarn obtained from the underlying spinning unit (12),

   - at least one piecing trolley (28) mobile so as to be able to position itself in the vicinity of each spinning head (8) and perform piecing operations of a broken yarn (22),

   characterised in that

   - the piecing trolley (28) comprises an intake nozzle unit (36) shaped so as to perform all the operations of grasping a yarn end and preparing the same for subsequent piecing, and an introduction group of the yarn (40), shaped to grasp the yarn end, previously prepared for piecing, and bring it to the spinning rotor (24) of the spinning unit (12) for its piecing with the yarn being formed.

2. Open-end type spinning machine (4) according to claim 1, wherein the intake nozzle unit (36) comprises an intake nozzle (44), a yarn presence sensor (48) inside the intake nozzle (44), cutting means (52) for cutting the yarn (22) and a preparation device of the yarn end (56) .

3. Open-end type spinning machine (4) according to claim 1 or 2, wherein the intake nozzle unit (36) comprises an intake nozzle (44) from which it draws in the yarn, wherein the intake nozzle (44) comprises, therein, a cavity (60) which defines a forced channel or passage for the drawn in yarn.

4. Open-end type spinning machine (4) according to claim 3, wherein the intake nozzle (44) comprises an entrance portion (70) which draws in the yarn and which develops into a straight cylindrical portion (72) which the yarn is conveyed into, the intake pipe having an internal diameter (Dn).

5. Open-end type spinning machine (4) according to claim 4, wherein the intake nozzle (44) is provided with a flow diverter (68) interposed aeraulically between the straight cylindrical portion (72) and an intake pipe, said flow diverter (68) diverting the axis of the straight cylindrical portion (72) of the intake nozzle and thus forcing the trajectory of the aspirated yarn to pass inside the recess (60).

6. Open-end type spinning machine (4) according to claim 5, where the flow diverter (68) is offset from the straight cylindrical portion of the intake nozzle (72) by a misalignment (C) of the axis in the flow diverter (68).

7. Open-end type spinning machine (4) according to claim 6, in which said misalignment (C) is related to the nominal inner diameter Dn according to the following formula: 1/2Dn<C<3/4Dn.

8. Open-end type spinning machine (4) according to claim 5, 6 or 7, wherein the flow diverter has a double curvature, i.e. a first curvature (76) between the Y' axis of the straight cylindrical portion of the intake nozzle (72) upstream of the flow diverter (68) and a second curvature (80) between the flow diverter (68) and the axis Y" of the intake pipe downstream of the flow diverter (68).

9. Open-end type spinning machine (4) according to claim 8, wherein said axes Y', Y" of the straight cylindrical portion of the intake nozzle (72) upstream of the intake pipe of the flow deflector (68) are parallel to each other.

10. Open-end type spinning machine (4) according to any of the claims from 3 to 9, wherein said throat (60) has a bottom (84) for housing the yarn, wherein the bottom (84), with respect to a plane perpendicular to its main axis of extension, has a variable angle of aperture (100) along its extension inside the intake nozzle (44).

11. Open-end type spinning machine (4) according to claim 10, wherein, at the cutting means 52, said an-

gle of aperture (100) is between 80° and 100°.

12. Open-end type spinning machine (4) according to claim 10 or 11, wherein, at the end preparation device (56), said angle of aperture is between 75° and 95°.

13. Open-end type spinning machine (4) according to any of the claims from 3 to 12, in which the cross-section for the passage of air in the straight cylindrical portion of the intake nozzle (72) decreases from the inlet portion (70) to the end preparation device (56), and from the end preparation device (56) to the cutting means (52).

14. Open-end type spinning machine (4) according to claim 13, wherein said reduction of the through area inside the straight cylindrical portion of the intake nozzle (72) is between 2.7% and 3.2%.

15. Open-end type spinning machine (4) according to any of the claims from 3 to 14, where in the vicinity of said recess (60) the cutting means (52) are positioned inside the intake nozzle (44).

16. Open-end type spinning machine (4) according to any of the claims from 3 to 15, where in the vicinity of said recess (60) the end preparation device (56) of the yarn is positioned, configured to direct onto said end a jet of compressed air.

17. Open-end type spinning machine (4) according to any of the preceding claims, wherein the machine (4) comprises at least one doffing trolley (32) which can be positioned at each spinning head (8) and fitted with devices for picking up and moving a tube (20) from a tube-holder basket to a pair of tailstocks of the winding unit into reels (16).

18. Open-end type spinning machine (4) according to claim 17, wherein the piecing trolley (28) and doffing trolley (32) at least partially penetrate each other in order to mutually override each other along a patrol path of the spinning heads (8) of the machine (4).

19. Method of piecing a yarn (22) in an open-end type spinning machine (4) according to any of the preceding claims, comprising the steps of:

a) detecting the yarn breakage (22) by means of the yarn presence sensor (49) mounted at the spinning head,
b) stopping the reel (18) using a stop plate actuated by the spinning head (8),
c) in the meantime bringing the piecing trolley (28) to the spinning head (12) where the yarn (22) breakage occurred,
d) rotating the reel (18) by means of the piecing trolley (28) to start the search for the yarn end broken on the reel (18), and at the same time bring the intake nozzle unit (36) of the piecing trolley (28) in the vicinity of the reel (18) to aspirate the end actuating intake means connected to the intake nozzle (44),
e) stopping the reel (18) after having picked up the yarn inside the intake nozzle (44),
f) actuating the cutting means (52) housed inside the intake nozzle (44), removing the cut piece from the reel side (18), catching the new end made by cutting and preparing it with a jet of compressed air by means of an end preparation device (56) housed inside said intake nozzle (44),
g) actuating a yarn feeding unit (40) of the piecing trolley (28) which grasps the prepared yarn end and inserts it in the spinning unit (12).

20. Piecing method of a thread in an open-end spinning machine (4) according to claim 19, wherein simultaneously with the steps d), e) and f) the piecing trolley (28) deals with cleaning the spinning rotor (24), and/or cleaning a funnel of said spinning rotor (24) said and subsequently to step g), lowering the reel (18) onto a relative stop plate.

21. Piecing method of a thread in an open-end spinning machine (4) according to claim 19 or 20, wherein also simultaneously to steps f) and g) the spinning head (8) prepares the fibre web discarding the damaged ones and feeding the spinning rotor (24) with new fibres using a web feeder roller.

22. Piecing method of a thread in an open-end spinning machine (4) according to claim 19, 20 or 21, wherein during step g), the prepared end is picked up by the feed unit (40), managed by the piecing trolley (28) which clamps the end between its feed rollers (64) to bring it to the spinning unit (12).

23. Piecing method of a thread in an open-end spinning machine (4) according to claim 12, wherein said feed rollers (64) of the feed unit (40) are assisted by the action of a reverse roller which, by turning the reel (18), prevents the formation of undesirable loops that might engage the various mechanisms, so as to keep the thread taut and without slack.

24. Piecing method of a thread in an open-end spinning machine (4) according to any of the claims from 19 to 23, wherein during step g), the yarn (22) is inserted by the feed unit (40) in a specific path and the end is introduced into a yarn output channel, wherein along such path a release device is located which when armed holds an extra length of yarn which, upon request, is released by the spinning head (8) allowing the end to reach the spinning rotor (24).

25. Piecing method of a thread in an open-end spinning machine (4) according to claim 24, wherein the piecing trolley (28) enables the spinning head (8) and abandons it after completing its tasks, and wherein the spinning head (8) detaches the release device, the end reaches the throat of the spinning rotor (24) and 'triggers' spinning, so that the fibres being processed by the spinning rotor (24) congregate at the end properly prepared, thereby achieving continuity in the yarn produced.

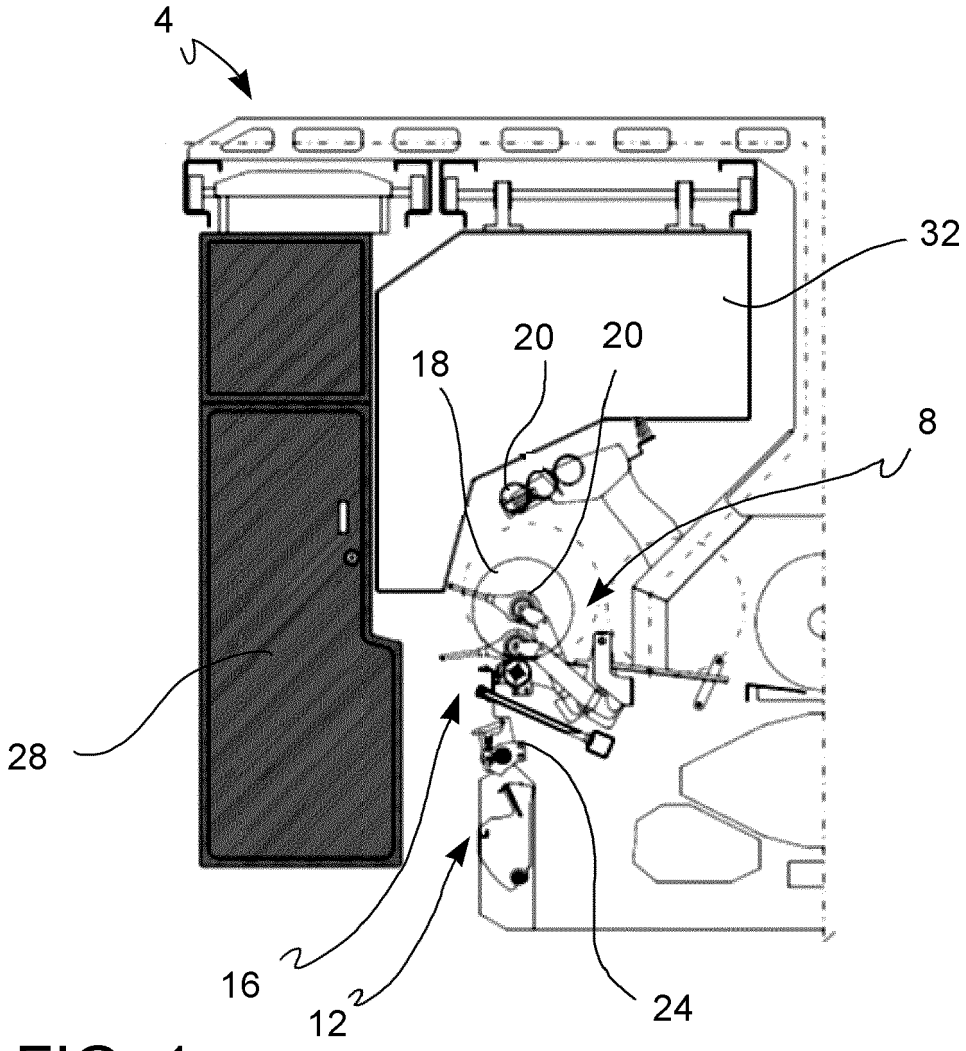


FIG. 1

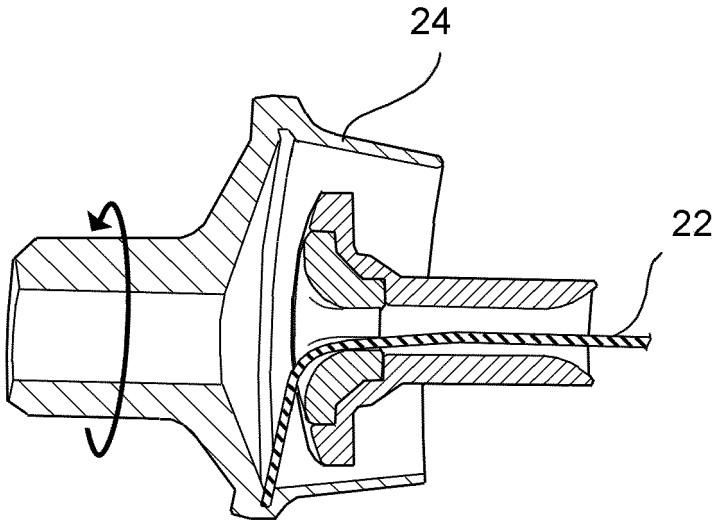
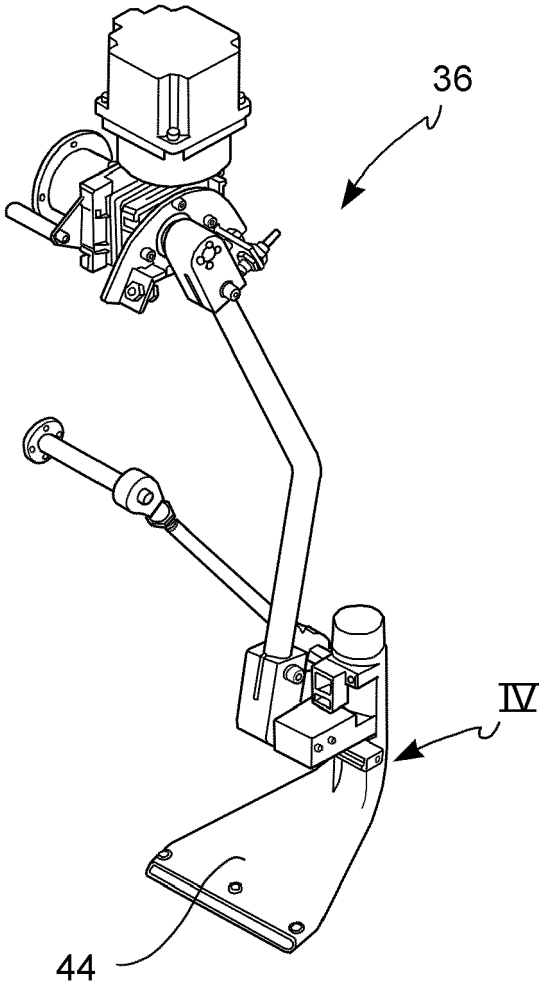


FIG. 2

FIG. 3



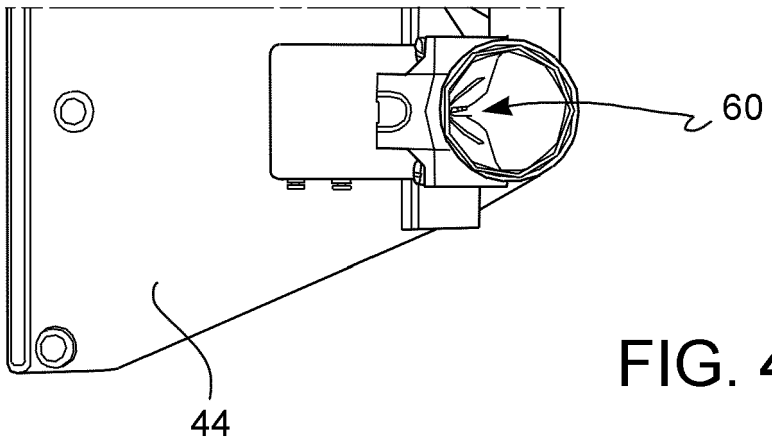


FIG. 4

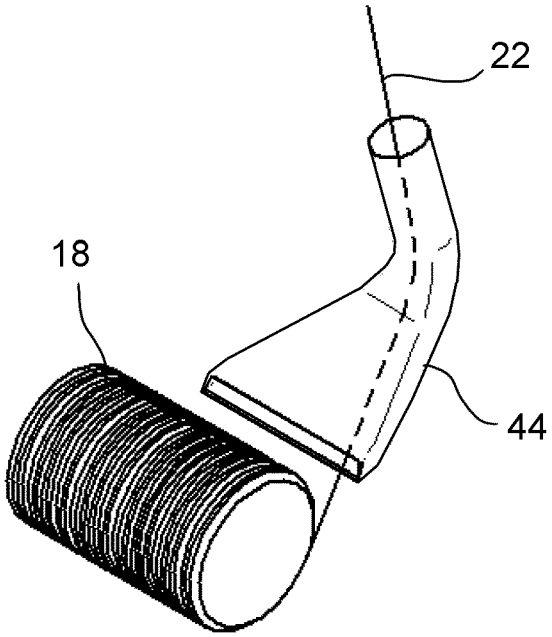


FIG. 5

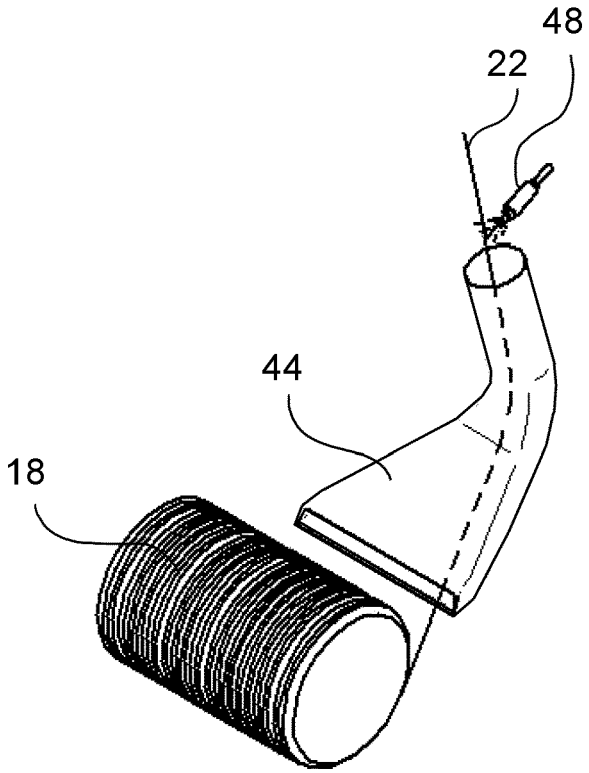


FIG. 6

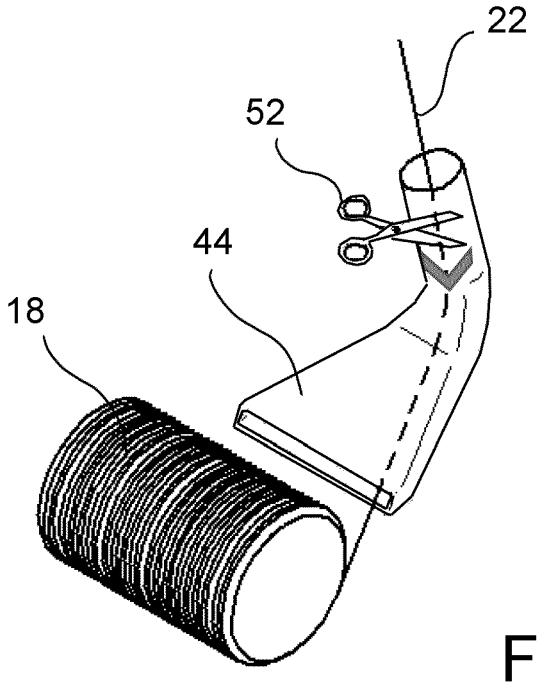


FIG. 7

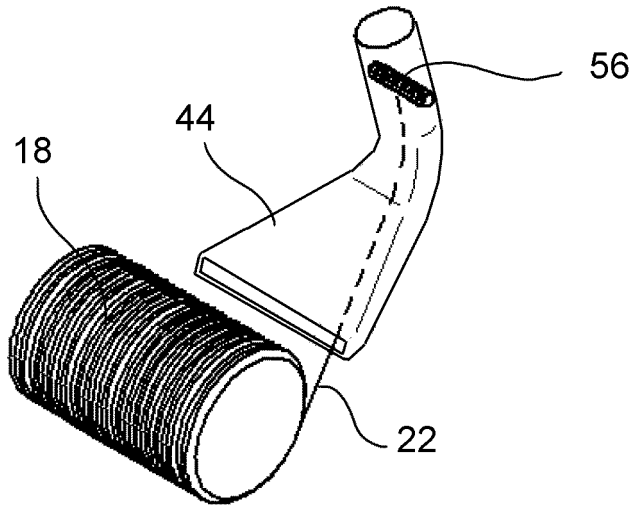


FIG. 8

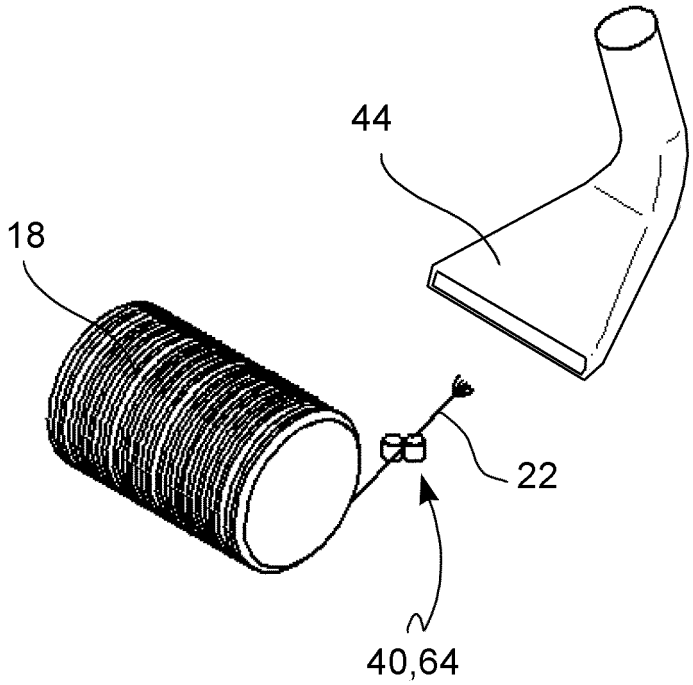


FIG. 9

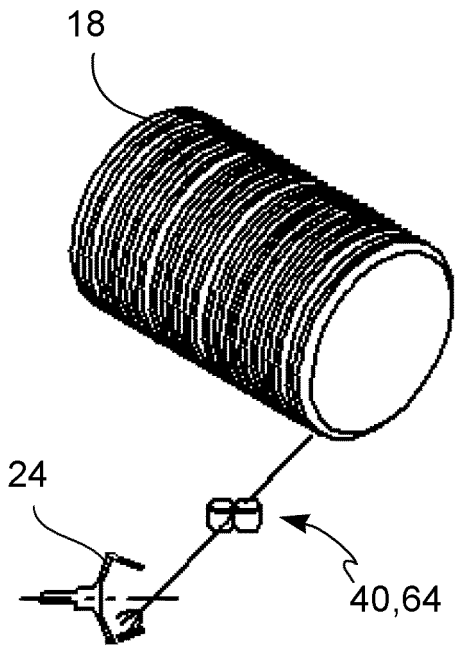


FIG. 10

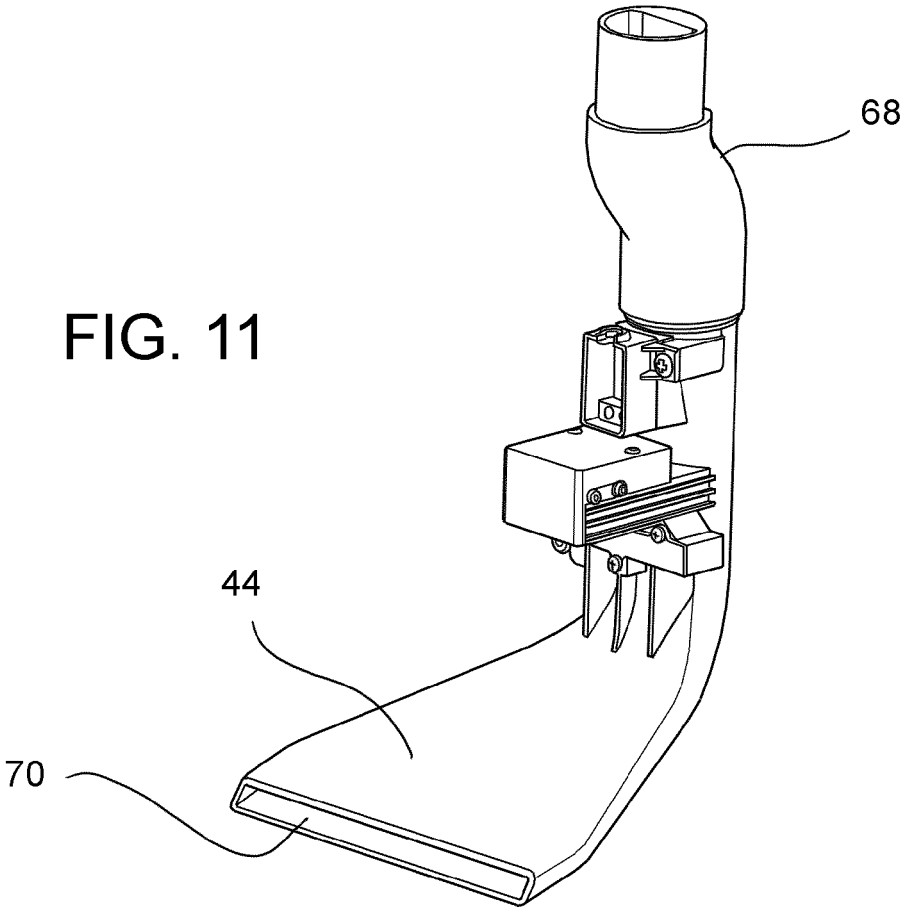


FIG. 11

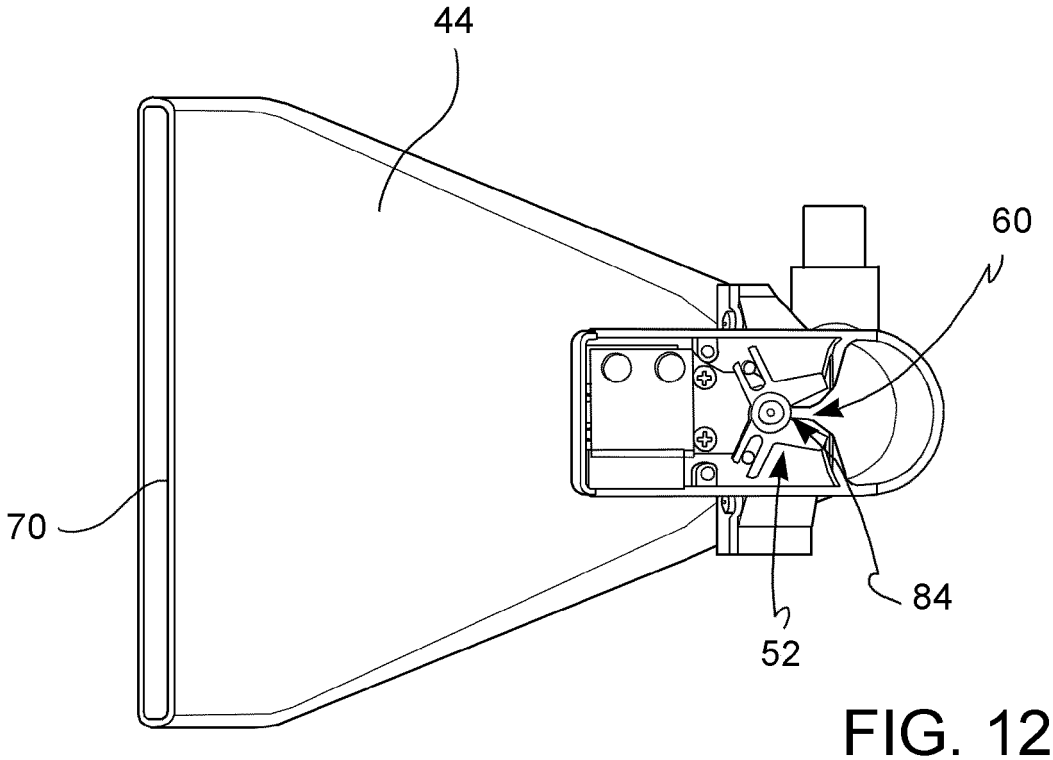


FIG. 12

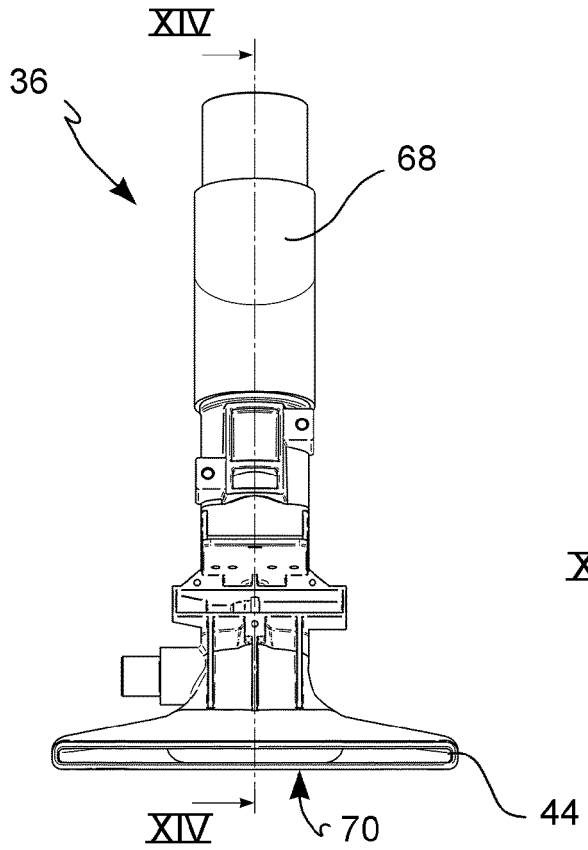


FIG. 13

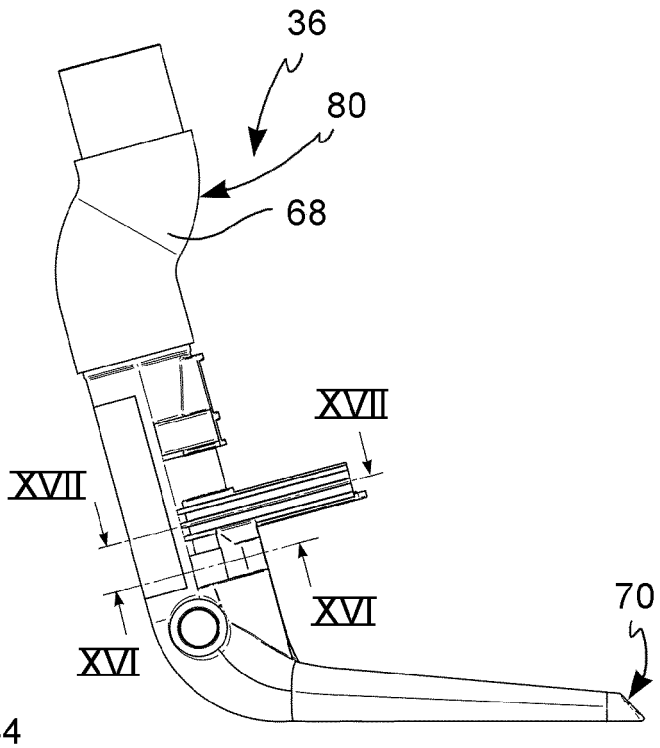


FIG. 15

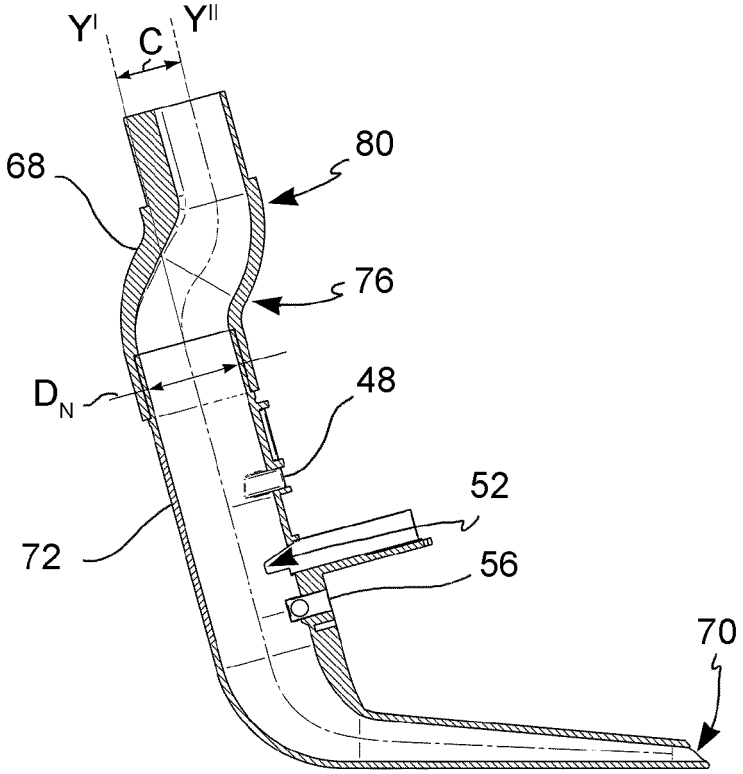


FIG. 14

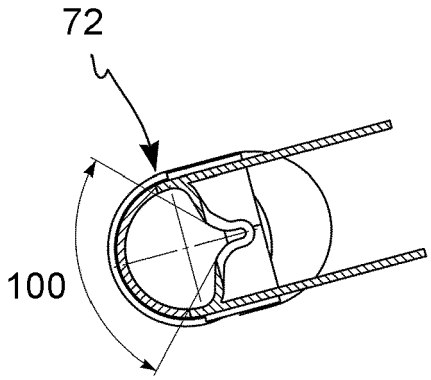


FIG. 17

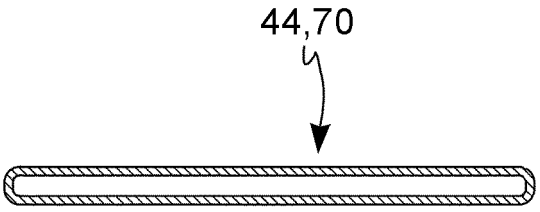


FIG. 18

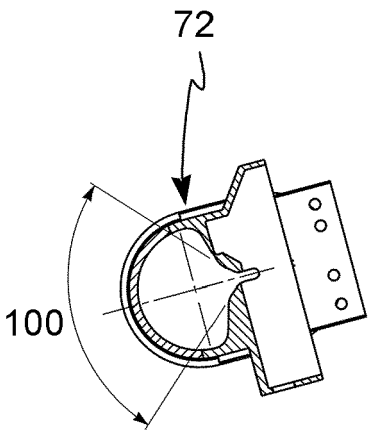
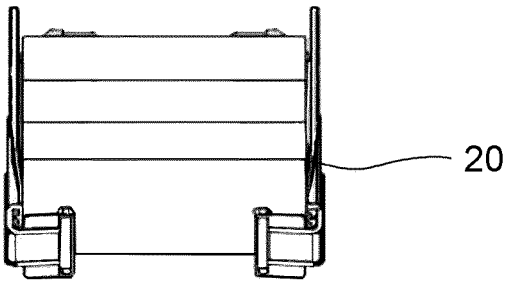


FIG. 16



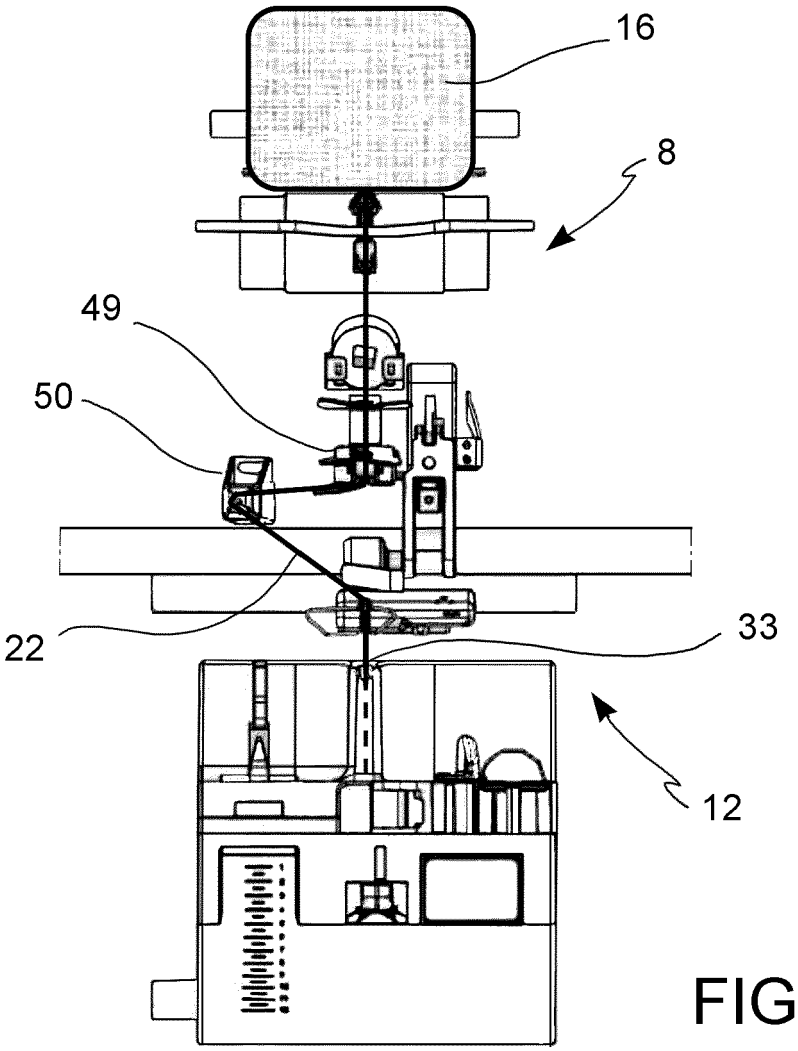


FIG. 19

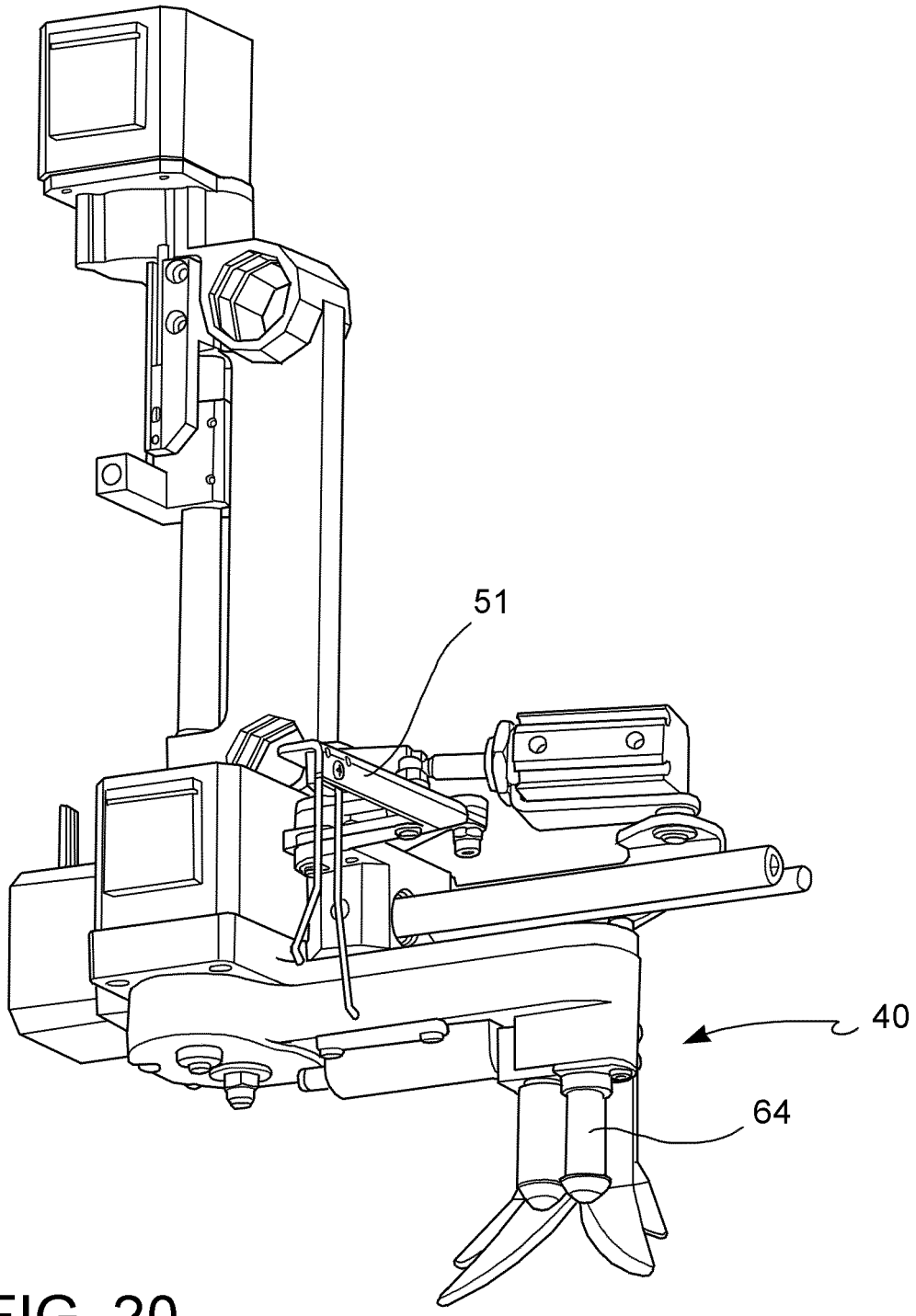


FIG. 20

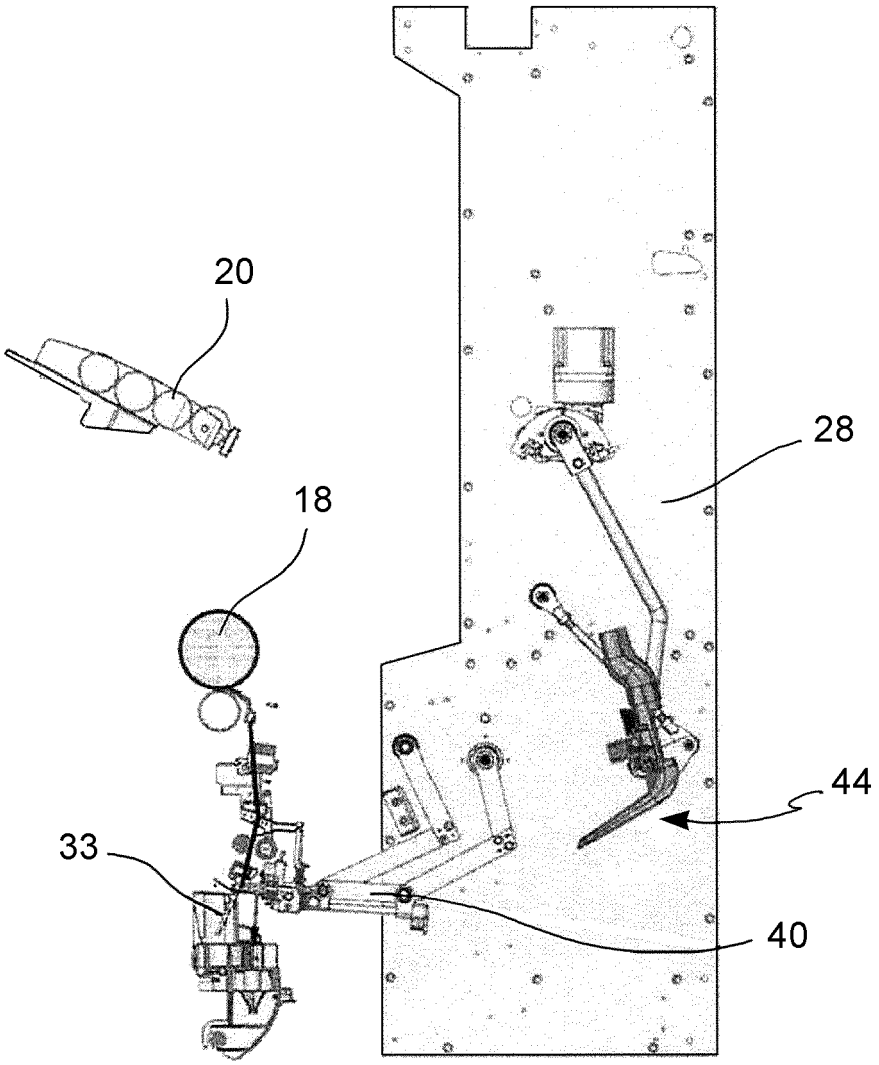


FIG. 21

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EUROPEAN SEARCH REPORT

Application Number
EP 18 20 7907

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	GB 2 187 211 A (VYZK USTAV BAVLNARSKY) 3 September 1987 (1987-09-03) * page 2, line 21 - line 24 * * page 2, line 60 - line 81 * * page 3, line 16 - line 85 * * figures 1-3 * -----	1,3-5, 19-25 2,15-17	INV. D01H4/50
Y	EP 3 124 413 A1 (RIETER INGOLSTADT GMBH [DE]) 1 February 2017 (2017-02-01) * paragraph [0041] * * figure 5 * -----	2	
Y	JP S59 69373 A (TOYODA AUTOMATIC LOOM WORKS) 19 April 1984 (1984-04-19) * paragraph [0001] * * figure 1 * -----	15-17	
A	EP 0 067 279 A1 (SCHUBERT & SALZER MASCHINEN [DE]) 22 December 1982 (1982-12-22) * page 12, line 7 - page 16, line 15 * * figures 1-2 * -----	19-25	TECHNICAL FIELDS SEARCHED (IPC) D01H B65H
A	JP H10 110334 A (TOYODA AUTOMATIC LOOM WORKS) 28 April 1998 (1998-04-28) * abstract; figures 1-13 * -----	19-25	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	8 April 2019	Humbert, Thomas

CATEGORY OF CITED DOCUMENTS

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08-04-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2187211 A	03-09-1987	CH 672927 A5	15-01-1990
		CS 257672 B1	16-05-1988
		DE 3704829 A1	10-09-1987
		GB 2187211 A	03-09-1987
		IT 1203492 B	15-02-1989
EP 3124413 A1	01-02-2017	BR 102016017714 A2	07-02-2017
		CN 106395503 A	15-02-2017
		DE 102015112661 A1	02-02-2017
		EP 3124413 A1	01-02-2017
		JP 2017043494 A	02-03-2017
		US 2017029234 A1	02-02-2017
JP S5969373 A	19-04-1984	NONE	
EP 0067279 A1	22-12-1982	BR 8203403 A	31-05-1983
		CS 274258 B2	11-04-1991
		DE 3123282 C1	22-12-1988
		EP 0067279 A1	22-12-1982
		GB 2100298 A	22-12-1982
		HK 42385 A	07-06-1985
		IN 156433 B	03-08-1985
		JP S57209174 A	22-12-1982
		MY 8600113 A	31-12-1986
		US 4463548 A	07-08-1984
JP H10110334 A	28-04-1998	NONE	

EPO FORM P0459

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