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(71) Applicant: **RICAMBI TESSILI-RI.TE S.R.L.**
33081 Aviano (IT)

(72) Inventor: **DE CAPITANI, Enzo**
23851 Galbiate (IT)

(74) Representative: **Petraz, Gilberto Luigi et al**
GLP S.r.l.
Viale Europa Unita, 171
33100 Udine (IT)

(54) **APPARATUS AND METHOD TO REMOVE THE FUZZ OF A YARN**

(57) An apparatus to remove the fuzz of a yarn (11) comprises a burner assembly (12) defining a treatment zone (14) through which the yarn (11) advances along a work axis (X).

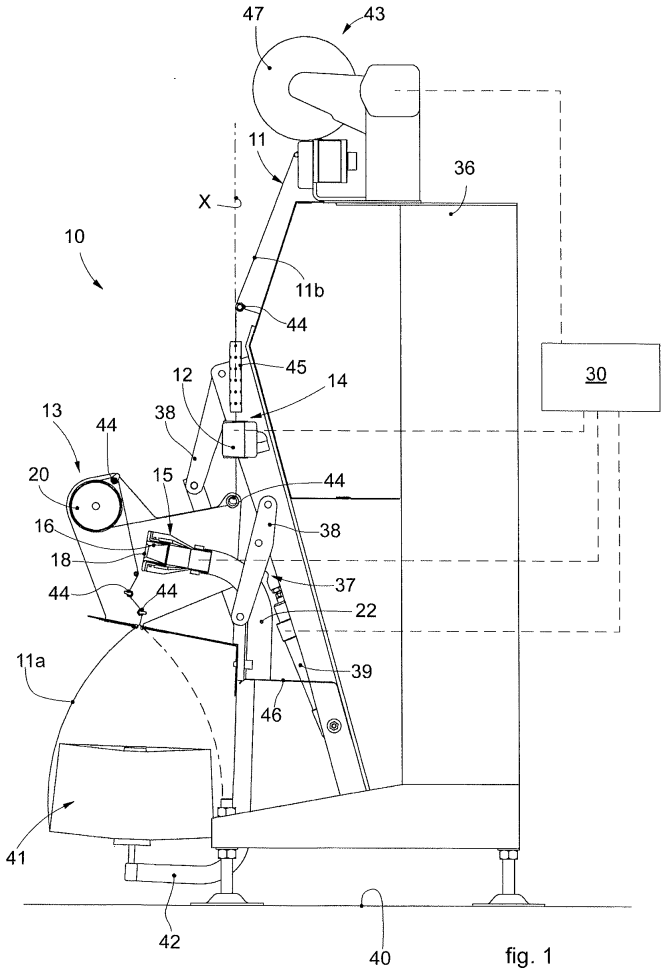

fig. 1

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Description

FIELD OF THE INVENTION

[0001] Embodiments described here concern an apparatus to remove the fuzz of a yarn, and the corresponding method. In particular, the apparatus and the method of the invention are used to remove the fuzz in order to obtain yarns, generally consisting of short fibers, which are more resistant and with a better aesthetic appearance, that is, smoother and more uniform.

BACKGROUND OF THE INVENTION

[0002] The operation to eliminate the surface fuzz of a yarn is conventionally obtained by means of a so-called gassing method, in special devices called gassing machines.

[0003] Yarns subjected to gassing are those obtained mainly from short fibers of vegetable, animal, artificial or synthetic origin.

[0004] In such gassing machines, the yarn, which normally comes from a spool, is made to pass through a flame, and is then collected downstream in another spool.

[0005] One of the major problems of this method is the post-breakage gassing of the yarn, also called "gassing of the knot".

[0006] When a yarn breaks during gassing, it is necessary to stop the collection spool, manually recover a segment of yarn already gassed by unwinding it from the spool, join the two ends of yarn by means of a knot, and restart the machine.

[0007] Since the yarn can re-enter into contact with the flame when it has already reached a certain steady state speed, the first restarting segment is normally unwound outside the gassing chamber, and then enters it when the yarn already gassed previously is still passing through: this is to prevent there being segments of non-gassed yarn in the collection spool. This means that the segment of yarn to be recovered must be several meters long, or better several tens of meters long.

[0008] This recovery, knotting, and restarting procedure is currently carried out manually by an operator, to the detriment of the productivity of the gassing machine and the quality of the gassing of the yarn around the knot.

[0009] Furthermore, normally, the operator manually collects the yarn that he/she recovers from the spool, forming a sort of skein that can become tangled, making the operation of restarting the gassing very complicated.

[0010] No matter how careful the operator is in keeping the loops of yarn he/she collects stretched and not overlapping, given the high number of machines he/she has to follow and the frequency of re-knotting operations of yarns that break, it often happens that when restarting the yarn it breaks again due to a tangle of the skein that cannot be unraveled by itself.

[0011] There is therefore a need to perfect an apparatus and a method to remove the fuzz of a yarn which can overcome at least one of the disadvantages of the state of the art, in particular linked to the restarting step that follows the breaking of the yarn and the formation of a knot.

[0012] In particular, one purpose of the present invention is to provide an apparatus to remove the fuzz of a yarn that allows to always obtain a good quality gassed yarn even after the possible breakage of the yarn.

[0013] Another purpose of the present invention is to provide an apparatus to remove the fuzz of a yarn which allows to increase the productivity and efficiency of the gassing operation, making it more efficient to recover the yarn after its breakage and to restart the gassing machine following said breakage.

[0014] Another purpose of the present invention is to define a method to remove the fuzz of a yarn which makes the recovery of the yarn after its breakage more orderly, fast and easy to implement, and also the gassing thereof

[0015] The Applicant has devised, tested and embodied the present invention to overcome the shortcomings of the state of the art and to obtain these and other purposes and advantages.

SUMMARY OF THE INVENTION

[0016] The present invention is set forth and characterized in the independent claims. The dependent claims describe other characteristics of the present invention or variants to the main inventive idea.

[0017] In accordance with the above purposes, an apparatus to remove the fuzz of a yarn comprises, according to the present invention, a burner assembly defining a treatment zone through which the yarn advances along a work axis.

[0018] According to the invention, the apparatus comprises an assembly to recover the yarn disposed upstream of the treatment zone and comprising a compartment to house the yarn associated with a suction assembly.

[0019] In particular, the suction assembly is configured to suck in and accumulate a defined quantity of yarn in the housing compartment following the interruption of its treatment.

[0020] Advantageously, this solution can be carried out automatically by reducing the manual interventions required to restore the treatment, for example but not only, following the breakage of the yarn.

[0021] In fact, the assembly to recover the yarn as above is configured to automatically rewind, in an orderly manner and outside the burner assembly, a desired segment of the treated yarn, for example downstream of the knot if the interruption is due to the breakage of the yarn. In this way, it is not necessary to even turn off the burner assembly, which otherwise would cause possibly considerable energy and economic losses, also considering that some burner technologies, once turned off, require a long time to restore the optimum functioning regime.

[0022] Furthermore, the assembly to recover the yarn

as above is also configured to allow to release the recovered yarn in an orderly manner, without blockages, until it reaches the steady state speed required for the gassing, and then re-introduce it into the burner and into the treatment zone. In this way, no segment of the yarn is left untreated, that is, not gassed, and a good quality gassed yarn is always obtained.

[0023] The present invention also concerns a method to remove the fuzz from a yarn, the method comprising a treatment step to remove the fuzz of the yarn in which a yarn is made to pass through a treatment zone along a work axis and the surface fuzz of the yarn is burned by a burner assembly.

[0024] According to the invention, the method as above also comprises:

- a step of interrupting the treatment;
- a step of recovering the yarn that has already passed along the work axis through the treatment zone by means of an assembly to recover the yarn disposed upstream of the treatment zone, in the direction of feed of the yarn, and comprising a compartment to house the yarn associated with a suction assembly;
- a step of restoring the treatment by feeding the yarn, recovered in the recovery step as above, to the burner assembly and to the treatment zone.

[0025] Advantageously, the recovery of the yarn and the subsequent restoration of the treatment are completely automated, thus reducing the manual intervention of an operator to a minimum and maximizing the productivity of the apparatus as above.

ILLUSTRATION OF THE DRAWINGS

[0026] These and other aspects, characteristics and advantages of the present invention will become apparent from the following description of some embodiments, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a lateral view of an apparatus to remove the fuzz of a yarn in accordance with the present invention in a first configuration;
- fig. 2 is a lateral view of the apparatus of fig. 1 in a second configuration;
- figs. 2a - 2b are variants of the apparatus of fig. 2 in different conditions of use;
- fig. 3 is a lateral view of the apparatus of fig. 1 in a third configuration;
- fig. 4 is a section view of a component of the apparatus of fig. 1.

[0027] To facilitate comprehension, the same reference numbers have been used, where possible, to identify identical common elements in the drawings. It is understood that elements and characteristics of one embodiment can conveniently be incorporated into other embodiments without further clarifications.

DESCRIPTION OF EMBODIMENTS

[0028] We will now refer in detail to the various embodiments of the invention, of which one or more examples are shown in the attached drawings. Each example is supplied by way of illustration of the invention and shall not be understood as a limitation thereof. For example, the characteristics shown or described insomuch as they are part of one embodiment can be adopted on, or in association with, other embodiments to produce another embodiment. It is understood that the present invention shall include all such modifications and variants.

[0029] Before describing these embodiments, we must also clarify that the present description is not limited in its application to details of the construction and disposition of the components as described in the following description using the attached drawings. The present description can provide other embodiments and can be obtained or executed in various other ways. We must also clarify that the phraseology and terminology used here is for the purposes of description only, and cannot be considered as limitative.

[0030] With reference to the drawings, an apparatus 10 to remove the fuzz of a yarn 11 comprises a burner assembly 12 defining a treatment zone 14 through which the yarn 11 advances along a work axis X.

[0031] The burner assembly 12 is configured to produce a flame to burn the surface fuzz of the yarn 11 which moves along the work axis X.

[0032] Consequently, upstream of the burner assembly 12 there is an untreated yarn 11a and downstream of the burner assembly 12 there is a treated yarn 11b.

[0033] In particular, the apparatus 10 in accordance with the present invention is particularly suitable to eliminate the fuzz of yarns 11 obtained from short vegetable, animal or synthetic fibers.

[0034] However, the application of the present apparatus 10 to yarns 11 obtained from long fibers of various types is not excluded.

[0035] By fuzz of the yarn 11 we mean the totality of threads or fibers protruding laterally from the yarn 11. This fuzz is especially present in the case of yarns 11 obtained from short fibers.

[0036] With the terms "treat", "treated" and "treatment", here and hereafter in the description we mean the removal of the fuzz of the yarn 11 by burning it by means of the burner assembly 12. This operation is also called "gassing" of the yarn 11.

[0037] According to one embodiment, the burner assembly 12 can be fed with hydrogen gas.

[0038] According to one embodiment, the burner assembly 12 can be fed with traditional gases, such as for example methane or LPG.

[0039] According to the invention, the apparatus 10 comprises an assembly 13 to recover the yarn 11 disposed upstream of the treatment zone 14.

[0040] The recovery assembly 13 comprises a compartment 16 to house the yarn 11 associated with a suction assembly 15.

[0041] The assembly 13 to recover the yarn 11 is configured to recover a segment of yarn 11 from a collection spool 47, with the modes better explained below, following an interruption of the treatment due, for example, to the breakage of the yarn 11 itself. Consequently, the assembly 13 to recover the yarn 11 allows to automate the recovery of the yarn 11 which is currently carried out manually by an operator.

[0042] When the yarn 11 breaks (fig. 2a), the treatment is interrupted, a segment of already treated yarn 11b is recovered, a knot 17 is made (fig. 2b) and the treatment of the yarn 11, by means of the burner assembly 12, is restarted. In particular, upstream of the knot 17 there is untreated yarn 11a and downstream thereof there is treated yarn 11b.

[0043] As mentioned, following the breakage of the yarn, a segment of treated yarn 11b is recovered by the collection spool 47, and a reserve of already treated yarn 11b is formed so that, when the treatment is restarted in the treatment zone 14 following the formation of the knot 17, the apparatus 10 can reach the steady state speed with the already treated yarn 11b which is first kept outside the treatment zone 14, and then is inserted therein, taking care that as the yarn 11 returns into the treatment zone 14, the yarn 11a to be treated is not already passing therein, which could otherwise not be subjected to a correct treatment.

[0044] In other cases, a momentary interruption of the treatment can be due, for example, to the sudden shutdown of the burner assembly 12. In fact, the yarn 11 can continue to advance along the work axis X for a few more moments after the sudden shutdown of the burner assembly 12, with consequent non-treatment of part of it.

[0045] According to one embodiment, the compartment 16 to house the yarn 11 comprises an aperture 18 to introduce the yarn 11 facing toward the work axis X and a perforated containing element 19 disposed, with respect to the work axis X, behind the aperture 18 to introduce the yarn 11.

[0046] The suction assembly 15 is configured to create a depression inside the housing compartment 16 in order to suck in a flow of air A2 from the outside so as to accumulate the yarn 11 in an orderly manner on the containing element 19 inside the housing compartment 16.

[0047] In particular, this depression generates a suction of the flow of external air A2 with consequent recovery of the yarn 11 through the introduction aperture 18 and subsequent packing thereof on the containing element 19 while the air exits through the latter.

[0048] According to one embodiment, the housing compartment 16 can have a truncated cone shape with the lower base coinciding with the aperture 18 to introduce the yarn 11, and the upper base coinciding with the containing element 19.

[0049] According to one embodiment, the taper angle α of the housing compartment 16, between the introduction aperture 18 and the containing element 19, can have a value comprised between 5° and 9°, preferably between 6° and 8°. Advantageously, this taper angle α is such that it optimizes the suction preventing turbulences harmful to the accumulation of the yarn 11 inside the housing compartment 16, and maximizes the depression inside the housing compartment 16. In this way, the yarn 11 is accumulated in an orderly manner inside the housing compartment 16, without creating tangles or intricate skeins.

[0050] According to one embodiment, the volume of the housing compartment 16 comprised between the aperture 18 to introduce the yarn 11 and the containing element 19 is sized so as to contain at least 10 meters of yarn 11.

[0051] Advantageously, the housing compartment 16 can contain even between 20 meters and 30 meters of yarn 11, so as to guarantee that the yarn 11, once released by the recovery assembly 13, reaches the correct treatment speed in order to be treated, and that this treatment occurs so that the untreated yarn 11a can completely pass through the treatment zone 14.

[0052] According to one embodiment, shown by way of example in fig. 4, the suction assembly 15 terminally comprises a flange 23 inside which there is housed a bushing 24 defining the housing compartment 16.

[0053] According to one embodiment, the suction assembly 15 comprises a duct 21 to feed a forced flow of air A1, for example compressed air. The feed duct 21 is associated with the flange 23 and is configured to generate the depression inside the housing compartment 16.

[0054] The duct 21 to feed the forced flow of air A1 can be disposed laterally to the flange 23.

[0055] The duct 21 to feed the forced flow of air A1 can be associated with the delivery of a compressor.

[0056] Between the flange 23 and the bushing 24 there is provided a circumferential chamber 25 to distribute the forced flow of air A1 arriving from the feed duct 21.

[0057] According to one embodiment, the suction assembly 15 comprises a discharge duct 22 associated with the flange 23 and configured to channel a discharge flow of air A3 resulting from the sum of the suctioned flow of air A2 coming from the introduction aperture 18 and of the forced flow of air A1 coming from the feed duct 21.

[0058] According to one embodiment, the circumferential chamber 25 is in direct communication with the discharge duct 22.

[0059] In particular, the circumferential chamber 25 is connected to the discharge duct 22 by means of a circumferential aperture 27 through which the forced flow of air A1 coming from the feed duct 21 passes.

[0060] The circumferential aperture 27 is disposed downstream of the aperture 18 to introduce the yarn 11 and of the containing element 19.

[0061] Advantageously, the forced flow of air A1 exiting the circumferential aperture 27 generates a depression in the housing compartment 16, causing the suction of

the external flow of air A2 through the introduction aperture 18. In this way, the yarn 11 is recovered in an automated, compact and orderly manner inside the housing compartment 16, thus reducing the down times following a momentary interruption of the treatment, for example following the breakage of the yarn 11, and guaranteeing an increase in the productivity of the apparatus 10 itself.

[0062] Between the circumferential aperture 27 and the circumferential chamber 25 there can be provided a conical chamber 28 which better channels the forced flow of air A1, coming from the feed duct 21 and distributed in the circumferential chamber 25, toward the discharge duct 22.

[0063] The conical chamber 28 narrows toward the circumferential aperture 27 in such a way that the circumferential aperture 27 acts substantially as a nozzle to deliver and distribute the forced flow of air A1 in the discharge duct 22.

[0064] The discharge duct 22 has at its end a discharge aperture 26 opposite the introduction aperture 18 and configured to release the discharge flow of air A3 externally.

[0065] According to one embodiment, the flange 23 can be made in a single body with the discharge duct 22.

[0066] According to another embodiment, the flange 23 can be mechanically coupled or welded to the discharge duct 22.

[0067] According to an embodiment shown in fig. 4, between the flange 23 and the bushing 24 there is provided a conical support 32. This conical support 32 can act as support and positioning of the containing element 19 and of the bushing 24 inside the flange 23.

[0068] In the example embodiment of fig. 4, between the flange 23 and the conical support 32 there is provided the circumferential chamber 25.

[0069] Furthermore, in the example embodiment of fig. 4, the conical support 32 is connected to the flange 23 by means of attachment means 33 and by means of an elastic sealing ring 34.

[0070] According to one embodiment, between the bushing 24 and the flange 23 there can be provided a component 35 to clamp the containing element 19 configured to correctly position the containing element 19 inside the flange 23 and under the bushing 24.

[0071] For example, in fig. 4, the clamping component 35 is provided between the bushing 24 and the conical support 32 and is constrained to the flange 23 by means of the attachment means 33.

[0072] According to an embodiment shown in fig. 4, a support element 29 is provided on which the containing element 19 is positioned.

[0073] According to one embodiment, the containing element 19 is a grid. Advantageously, this grid allows air, but not the yarn 11, to pass from the introduction aperture 18 toward the discharge duct 22. Consequently, this containing element 19 performs a filtering function of the suctioned flow of air A2.

[0074] For example, the containing element 19 can have a filtering membrane suitable for the passage of air only.

[0075] The support element 29 is perforated presenting compartments 31 for the passage of the suctioned flow of air A2.

[0076] The apparatus 10 also comprises a support frame 36 on which the burner assembly 12 and the assembly 13 to recover the yarn 11 are mounted.

[0077] The support frame 36, advantageously, keeps the burner assembly 12 substantially aligned along the work axis X.

[0078] According to one embodiment, the assembly 13 to recover the yarn 11 is mounted mobile on the support frame 36.

[0079] In particular, the assembly 13 to recover the yarn 11 is associated with the support frame 36 by means of a movement mechanism 37 which allows the selective movement of the recovery assembly 13 away from or toward the support frame 36.

[0080] The support frame 36 can have a box-like shape and can be suitable to be installed on walls, bases or other fixed supports. For example, in figs. 1-3 the support frame 36 rests on a base plane 40 and the work axis X is perpendicular to this base plane 40.

[0081] According to one embodiment, the assembly 13 to recover the yarn 11 has a first operating position to recover the yarn 11 external to the work axis X (fig. 2) and at least a second operating position (Figs. 1 and 3) to feed the yarn 11 to the burner assembly 12 along the work axis X.

[0082] According to an embodiment shown in figs. 1-3, the movement mechanism 37 is provided with an actuation device 39, for example an actuation piston, configured to selectively move the recovery assembly 13 from the first to the second operating position and vice versa.

[0083] According to an embodiment shown in figs. 1-3, the movement mechanism 37 is provided with one or more articulated arms 38 associated with the support frame 36 on one side and with the recovery assembly 13 on the other. The articulated arms 38 are associated with the actuation device 39 and allow the firm anchoring of the recovery assembly 13 to the support frame 36 in the first and in the second operating position, and in the transition from one to the other.

[0084] In particular, in the first operating position (fig. 2) the recovery assembly 13 is in a position external to the support frame 36 adjacent laterally to the burner assembly 12. In the first operating position the recovery assembly 13 is activated to recover the yarn 11.

[0085] In the second operating position (fig. 1 and 3) the recovery assembly 13 is at least partly recessed in the support frame 36 below the burner assembly 12. In the second operating position the recovery assembly 13 is activated in order to feed the yarn 11 into the treatment zone 14 and the apparatus 10 is ready to restore the conventional treatment of the yarn 11.

[0086] According to one embodiment, the recovery assembly 13 has an inactive position (fig. 1) once the feed

of the previously recovered yarn 11 is finished. In the inactive position, the recovery assembly 13 is completely recessed in the support frame 36 below the burner assembly 12 and does not interact with the conventional treatment of the yarn 11.

[0087] According to one possible embodiment, the second operating position of the recovery assembly 13 can coincide with the inactive position thereof.

[0088] According to one embodiment, the recovery assembly 13 is provided with a tensioning device 20 configured to accompany the yarn 11 into the housing compartment 16 when the recovery assembly 13 is in the first operating position, and from the housing compartment 16 toward the burner assembly 12 when the recovery assembly 13 is in the second operating position.

[0089] The tensioning device 20 can be defined by a roller or disc, rotatable around an axis perpendicular to the work axis X and on which the yarn 11 is wound.

[0090] According to one embodiment, the yarn 11 is transferred with advantageously constant speed of feed between one or more feed elements and one or more collection elements, along the work axis X, through the treatment zone 14.

[0091] According to one embodiment, the speed of feed of the yarn 11 through the treatment zone 14 along the work axis X can be comprised between 500 m/min and 1500 m/min. This speed is coordinated with the intensity of the flame produced by the burner assembly 12 in order to correctly treat the yarn 11.

[0092] With reference to figs. 1-3, by way of example the apparatus 10 comprises a feed device 41 located upstream of the burner assembly 12 and configured to feed the untreated yarn 11a along the work axis X to the burner assembly 12.

[0093] For example, the feed device 41 can comprise a spool of untreated yarn 11a, or a bobbin or skein of yarn 11 to be subjected to gassing.

[0094] The feed device 41 can be associated, by means of suitable connection means 42, with the recovery assembly 13.

[0095] According to one embodiment (fig. 1), during the treatment of the yarn 11, the tensioning device 20 is configured to direct and stretch the yarn 11 coming from the feed device 41 toward the burner assembly 12 and the treatment zone 14.

[0096] With reference to figs. 1-3, by way of example the apparatus 10 comprises a collection device 43 located downstream of the burner assembly 12 and configured to collect the treated yarn 11b.

[0097] For example, the collection device 43 can comprise the spool 47 to collect the treated yarn 11b, or a bobbin, suitably mounted on the support frame 36.

[0098] For example, the collection device 43 can comprise a pin integral with the collection spool 47 and a motor member (not shown) associated with the support frame 36 and configured to selectively make the pin rotate, so as to wind the treated yarn 11b onto the collection spool 47.

[0099] The yarn 11 is transferred along the work axis X from the feed device 41, located upstream of the burner assembly 12, to the collection device 43, located downstream of the burner assembly 12, whose flame determines its treatment.

[0100] According to one embodiment, the apparatus 10 can comprise a tubular element 45 disposed in the treatment zone 14.

[0101] In particular, this tubular element 45 is above and close to the burner assembly 12 and aligned with the latter along the work axis X.

[0102] The tubular element 45 can define inside it a treatment chamber in which the flame to treat the yarn 11 is produced and develops. This tubular element 45 allows to control and command the removal of the fuzz in a targeted, fast and efficient manner.

[0103] According to one embodiment, the apparatus 10 can comprise one or more means 44 to support and direct the yarn 11 associated with the support frame 36 and configured to direct and maintain the yarn 11 in tension and in translation movement during the recovery of the yarn 11 by the recovery assembly 13, and during the treatment of the yarn 11 along the work axis X by the burner assembly 12.

[0104] According to one embodiment, in the first position, shown in fig. 2, the recovery assembly 13 can have a configuration to recover and a configuration to feed the yarn 11.

[0105] In the recovery configuration (fig. 2) the treated yarn 11b, downstream of the knot 17, is recovered, by means of suction of the suction assembly 15, in the housing compartment 16 starting from the collection device 43, that is, in a direction opposite that of treatment. In this configuration, the untreated yarn 11a present upstream of the suction assembly 15, in the feed device 41, is not moved.

[0106] The recovery assembly 13 remains in the first position until the housing compartment 16 is filled correctly.

[0107] In the feeding configuration, the treated yarn 11b, upstream of the knot 17, housed in the housing compartment 16, is sent to the collection device 43, that is, in the direction of treatment. In this configuration, the untreated yarn 11a present upstream of the suction assembly 15, in the feed device 41, is not moved.

[0108] According to one embodiment, the treated yarn 11b, upstream of the knot 17, housed in the housing compartment 16 (fig. 2) is sent to the collection device 43 by activating the motor member associated therewith.

[0109] According to one embodiment, when the treated yarn 11b recovered downstream of the untreated yarn 11a reaches a minimum speed of feed sufficient to treat the yarn 11 in the treatment zone 14, the recovery assembly 13 passes from the first position to the second position. In this way, the manual intervention before restoring the treatment is advantageously reduced or eliminated and, moreover, a yarn 11 is obtained that is always suitably treated, that is, gassed, even close, for example,

to knot 17.

[0110] In particular, in this way it is possible to avoid turning off the burner assembly 12 during the recovery of the yarn 11 and to restore the treatment only when the untreated yarn 11a reaches the correct speed of feed for an adequate treatment. This allows to increase the productivity of the apparatus 10.

[0111] According to one embodiment shown by way of example in fig. 3, the recovery assembly 13 assumes a plurality of intermediate positions from the first to the second position, up to the inactive position, when the treated yarn 11b recovered downstream of the untreated yarn 11a reaches a minimum speed of feed.

[0112] According to one embodiment, the minimum speed of feed of the yarn 11 is comprised between 300 m/min and 500 m/min. Advantageously, this speed is the minimum speed sufficient to allow the yarn 11 to pass inside the treatment zone 14 without it burning and, therefore, breaking.

[0113] According to one embodiment shown by way of example in fig. 1, the apparatus 10 can be provided with a support element 46 protruding transversely from the support frame 36 and facing toward the work axis X.

[0114] The support element 46 can be, for example, a plate welded or mechanically anchored to the support frame 36.

[0115] Advantageously, the support element 46 has an upper support surface, facing toward the burner assembly 12, flat so that the discharge duct 22 of the recovery assembly 13 in the first operating position rests on the support element 46 obstructing the discharge aperture 26.

[0116] In this configuration, the discharge flow of air A3 is impeded by the support element 46, generating an inversion of the discharge flow of air A3 from the discharge duct 22 toward the introduction aperture 18. This configuration allows to clean the containing element 19 and the housing compartment 16 of dirt, unburnt scraps and fuzz which are blown together with the yarn 11 in the second operating position and/or in the inactive position of the recovery assembly 13. In this way, the recovery assembly 13 self-cleans preventing repeated maintenance steps and inefficiencies of the recovery assembly 13.

[0117] According to one embodiment, the burner assembly 12 and the recovery assembly 13 can be governed by a command and control unit 30.

[0118] According to one embodiment, if the yarn 11 breaks or there is a need to interrupt the treatment process, the command and control unit 30can automatically command the selective activation of the recovery assembly 13 and its movement from the first to the second position quickly and efficiently.

[0119] In addition, the command and control unit 30 governs the flame produced by the burner assembly 12, also automatically commanding the selective shutdown and/or restoration of the burner assembly 12 quickly and efficiently, if needed.

[0120] According to one embodiment, in the command and control unit 30 the speed of feed of the yarn 11 can be pre-set, according to the type of yarn 11 to be treated and the level of productivity to be obtained.

[0121] According to one embodiment, the apparatus 10 can be completely automated, presenting sensors (not shown) for recognizing the type of yarn to be treated 11a, the level of fuzz thereof and the correct tension thereof along the work axis X, before the process to treat the yarn 11 in the burner assembly 12.

[0122] According to one embodiment, the apparatus 10 can be provided with sensors (not shown) which detect the presence of the yarn 11 along the work axis X, communicating possible breakages thereof to the command and control unit 30 in such a way as to selectively activate the recovery assembly 13.

[0123] In particular, according to the data detected by the sensors as above, the command and control unit 30 can regulate the intensity of the flame of the burner assembly 12 so as to guarantee the correct treatment of the yarn 11, and possibly in order to reduce energy consumption during the recovery of the yarn 11 by the recovery assembly 13.

[0124] Furthermore, sensors may be present, located after the treatment of the yarn 11 by the burner assembly 12, which detect whether the yarn 11 has been correctly treated so as to selectively activate the recovery assembly 13 in the event of incorrectly gassed treated yarn 11b, in order to optimize and automate the treatment process.

[0125] Furthermore, the command and control unit 30 can modify and correct the gassing parameters in feedback, if defects or treatment imperfections are found.

[0126] According to one embodiment, the recovery assembly 13 can also be provided with sensors that detect the level of accumulation in the housing compartment 16 in the first operating position of the recovery assembly 13 and/or the speed of feed of the yarn 11 in the passage from the first to the second operating position, so that the command and control unit 30 compares these values detected with the pre-set ones and, also on the basis of the values detected by the previously described sensors, selectively drives the recovery assembly 13 and/or the burner assembly 12.

[0127] According to the invention, a method to remove the fuzz from the yarn 11 comprises a treatment step (fig. 1) to remove the fuzz of the yarn 11 in which the yarn 11 is made to pass through the treatment zone 14 along the work axis X and the surface fuzz of the yarn 11 that runs along the work axis X is burned by the burner assembly 12.

[0128] According to the invention, the method as above also comprises:

- a step of interrupting the treatment (fig. 2a, 2b);
- a step of recovering (fig. 2) the yarn 11 that has already passed along the work axis X through the treatment zone 14 by means of the assembly 13 to recover the yarn 11;

- a step of restoring (figs. 2 and 3) the treatment by feeding the yarn 11, recovered in the recovery step as above, to the burner assembly 12 and to the treatment zone 14.

[0129] During the treatment step, as shown by way of example in fig. 1, the recovery assembly 13 is in the inactive position as above, in which it does not interfere with the treatment, that is, the gassing, of the yarn 11.

[0130] According to one embodiment, the step of interrupting the treatment is associated with a breakage of the yarn 11 (fig. 2a). In this case, before the recovery step, it is provided to make the knot 17 (fig. 2b) in order to join the two ends of the broken yarn 11.

[0131] In particular, the sensors as above which detect the presence of the yarn 11 communicate to the command and control unit 30 to drive the actuation device 39 so as to move the recovery assembly 13 into the first operating position (fig. 2a) moving the yarn 11 outside the treatment zone 14.

[0132] In this configuration, an operator who makes the knot 17 (fig. 2b) can intervene. Alternatively, the making of the knot 17 can also be automated, for example by means of machinery, reducing the manual intervention of an operator to a minimum.

[0133] According to a further embodiment, before the step of interrupting the treatment, there is provided a step of checking the treated yarn 11, 11b in which it is verified whether the yarn 11, 11b has been treated correctly and, in the event of a negative outcome, the step of interrupting the treatment is performed. This checking step can be carried out using the sensors as above and the command and control unit 30. By negative result we mean that the treated yarn 11b has not been treated, or has been partly treated, or it does not meet the treatment criteria required and, for example, set in the command and control unit 30.

[0134] In particular, in this case, the recovery assembly 13 is moved to the first operating position and the yarn 11 is recovered externally to the treatment zone 14 (fig. 2) by the length necessary for the correct restoration of the gassing of the untreated, or wrongly treated, yarn 11a.

[0135] In the event of a positive outcome, the yarn 11 is continuously gassed in the treatment zone 14 along the work axis X without needing to interrupt the treatment step.

[0136] According to one embodiment, the step of recovering the yarn 11 provides to recover, outside the work axis X and the treatment zone 14, the previously treated yarn 11 for a total length of at least 10 meters, advantageously between 20 and 30 meters. This step advantageously allows to recover a defined quantity of already treated yarn 11 such that, when the recovery assembly 13 unrolls this quantity for the subsequent restoration of the treatment, the unrolled yarn 11 reaches the minimum treatment speed before the untreated yarn 11a reaches the burner assembly 12. In this way, it is not possible, during the restoration step, for part of the untreated yarn 11a to go past the treatment zone 14 without being treated.

[0137] In particular, the overall length of the recovered yarn 11 can be sized in such a way that the untreated yarn 11a, recovered together with the treated yarn 11b, during the restoration step reaches the optimal treatment speed along the work axis X in the treatment zone 14 comprised between 500 m/min and 1500 m/min. In this way, the optimal treatment of the untreated yarn 11a is guaranteed even after the interruption step.

[0138] According to one embodiment, the recovery of the yarn 11 in the housing compartment 16 occurs by means of suction by the suction assembly 15 which, by sucking in air from the outside, accumulates the yarn 11 through the introduction aperture 18 in the housing compartment 16.

[0139] During the recovery of the yarn 11, the collection device 43, by means of the motor member, turns the collection spool 47 in the opposite direction to that of the treatment step, so as to feed the yarn 11 toward the recovery assembly 13.

[0140] In particular, during the recovery of the yarn 11, the tensioning device 20 can also rotate in the opposite direction to that of the treatment step, facilitating the accumulation of the yarn 11 inside the housing compartment 16.

[0141] During the recovery, the drive of the collection device 43 can be governed by the command and control unit 30 in cooperation with the drive of the recovery assembly 13.

[0142] According to one embodiment, the step of restoring the treatment provides to feed the yarn 11 from the housing compartment 16 to the collection device 43.

[0143] In the restoration step, the suction device 15 is still activated, sucking in air from the outside, so as to keep the yarn 11 packed in an orderly manner inside the housing compartment 16 until it is completely unwound toward the collection spool 47.

[0144] In this case, the tensioning device 20 can rotate in the same direction as that of the treatment step, facilitating the correct exit of the yarn 11 from the housing compartment 16 toward the collection device 43.

[0145] According to one embodiment, the step of restoring the treatment provides to feed the yarn 11, recovered in the recovery step, to the burner assembly 12 and to the treatment zone 14 after it has reached a minimum speed of feed along the work axis X comprised between 300 m/min and 500 m/min. In this way, the recovered yarn 11 is fed to the burner assembly 12 only when it reaches the speed sufficient to be treated.

[0146] When the yarn 11 reaches the minimum speed of feed, the recovery assembly 13 is moved by means of the actuation device 39 from the first operating position to the second operating position (fig. 3) until reaching the correct position for treating the yarn 11 along the work axis X (fig. 1).

[0147] Advantageously, when the yarn 11 reaches the minimum speed of feed, the knot 17 is still in the housing compartment 16. In fact, the knot 17 or, in general, the

untreated, or wrongly treated, yarn 11a passes in the treatment zone 14 only when the yarn 11 reaches the optimum speed for a correct gassing, for example comprised between 500 m/min and 1500 m/min.

[0148] Advantageously, the method as above allows to increase the productivity of the apparatus 10, by reducing the manual intervention by an operator and the consequent problems related to such manual intervention as described above. Furthermore, the method as above allows to obtain yarn 11 of good quality and completely gassed.

[0149] According to one embodiment, at the end of the restoration, there is provided a step of cleaning the recovery assembly 13 and, in particular, the housing compartment 16.

[0150] In particular, the cleaning step provides to maintain the suction assembly 15 switched on at the end of the restoration and/or during the treatment step (fig. 1) and to obstruct the discharge duct 22 of the suction assembly 15 so as to generate an inversion of the flow of air sucked in that comes out from the introduction aperture 18 expelling dirt, fuzz and/or residues from burning sucked in during the previous steps, which have remained trapped on the containing element 19 and in the housing compartment 16.

[0151] It is clear that modifications and/or additions of parts or steps may be made to the apparatus 10 to remove the fuzz of a yarn 11 and to the corresponding method as described heretofore, without departing from the field and scope of the present invention.

[0152] It is also clear that, although the present invention has been described with reference to some specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of apparatus 10 and corresponding method, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

[0153] In the following claims, the sole purpose of the references in brackets is to facilitate reading: they must not be considered as restrictive factors with regard to the field of protection claimed in the specific claims.

Claims

1. Apparatus to remove the fuzz of a yarn (11), comprising a burner assembly (12) defining a treatment zone (14) through which the yarn (11) advances along a work axis (X), **characterized in that** it comprises an assembly (13) to recover the yarn (11) disposed upstream of said treatment zone (14) and comprising a compartment (16) to house the yarn (11) associated with a suction assembly (15).

2. Apparatus as in claim 1, **characterized in that** said compartment (16) to house the yarn (11) comprises an aperture (18) to introduce the yarn (11) facing toward the work axis (X) and a perforated containing element (19) disposed, with respect to said work axis (X), behind said aperture (18) to introduce the yarn (11).

3. Apparatus as in claim 2, **characterized in that** the volume of the housing compartment (16) comprised between said aperture (18) to introduce the yarn (11) and said containing element (19) is sized to contain at least 10 meters of yarn (11).

4. Apparatus as in claim 2 o 3, **characterized in that** said containing element (19) is a grid.

5. Apparatus as in any claim hereinbefore, **characterized in that** said assembly (13) to recover the yarn (11) has a first operating position to recover the yarn (11) external to the work axis (X), and at least one second operating position to feed the yarn (11) to the burner assembly (12) along the work axis (X).

6. Method to remove the fuzz from a yarn (11) comprising a treatment step to remove the fuzz of the yarn (11) in which a yarn (11) is made to pass through a treatment zone (14) along a work axis (X), and the surface fuzz of the yarn (11) is burned by a burner assembly (12), **characterized in that** it comprises:

   - a step of interrupting said treatment;
   - a step of recovering the yarn (11) that has already passed along the work axis (X) through the treatment zone (14) by means of an assembly (13) to recover the yarn (11) disposed upstream of said treatment zone (14), in the direction of feed of the yarn (11), and comprising a compartment (16) to house the yarn (11) associated with a suction assembly (15);
   - a step of restoring said treatment by feeding the yarn (11), recovered in said recovery step, to the burner assembly (12) and to the treatment zone (14).

7. Method as in claim 6, **characterized in that** the step of interrupting the treatment is associated with a breakage of the yarn (11), **and in that,** before said recovery step, it is provided to make a knot (17) to join the two ends of the broken yarn (11).

8. Method as in claim 6, **characterized in that,** before the step of interrupting the treatment, a step of checking the treated yarn (11) is provided, in which it is verified whether the yarn (11) has been treated correctly and, in the event of a negative outcome, the step of interrupting the treatment is performed.

9. Method as in any claim from 6 to 8, **characterized in that** the step of recovering the yarn (11) provides to recover, outside the work axis (X) and the treatment zone (14), the yarn (11) previously treated for

a total length of at least 10 meters, advantageously between 20 and 30 meters.

10. Method as in any claim from 6 to 9, **characterized in that** said step of restoring the treatment provides to feed the yarn (11), recovered in said recovery step, to the burner assembly (12) and to the treatment zone (14) after it has reached a minimum speed of feed along the work axis (X) comprised between 300 m/min and 500 m/min.

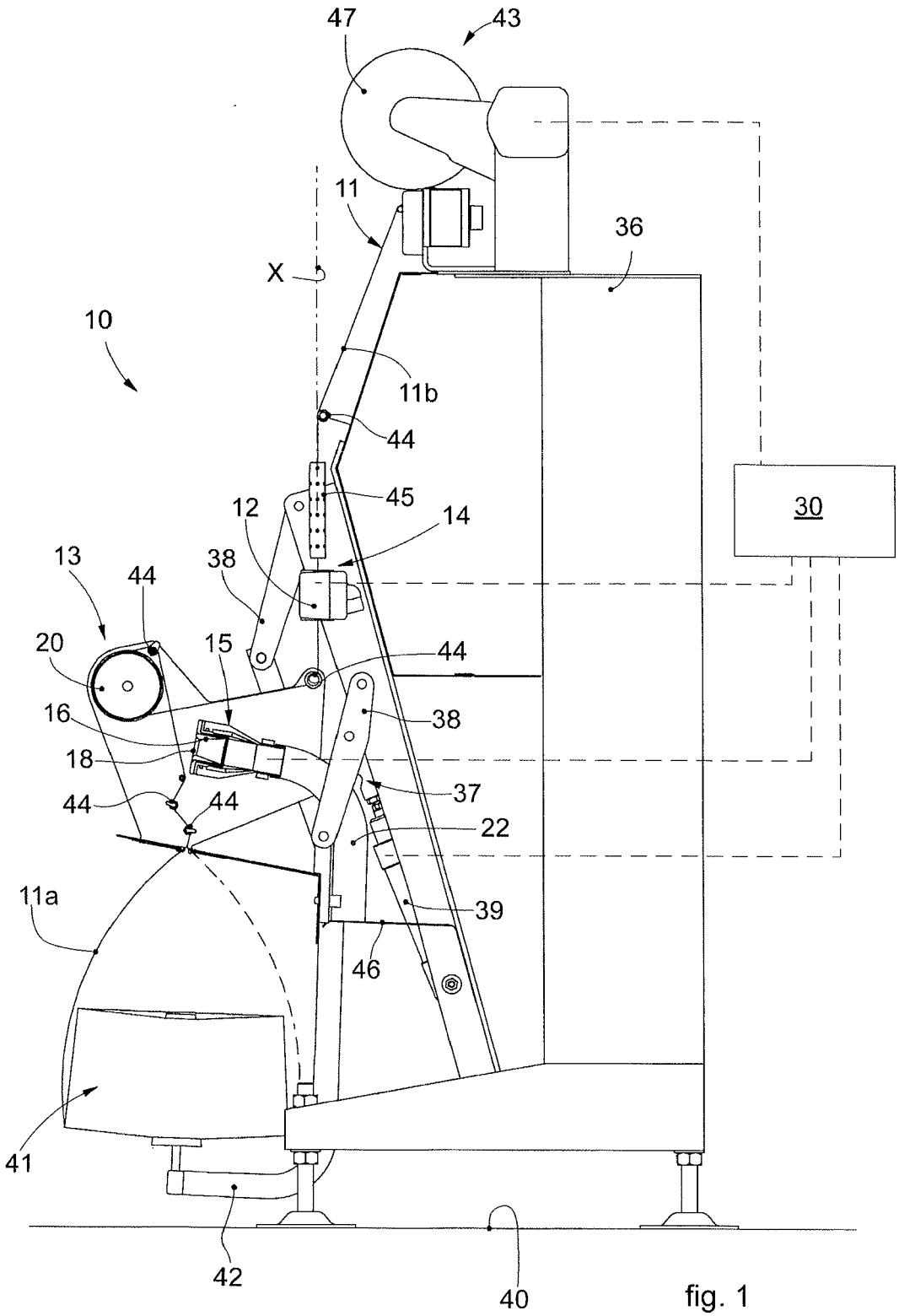
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fig. 1

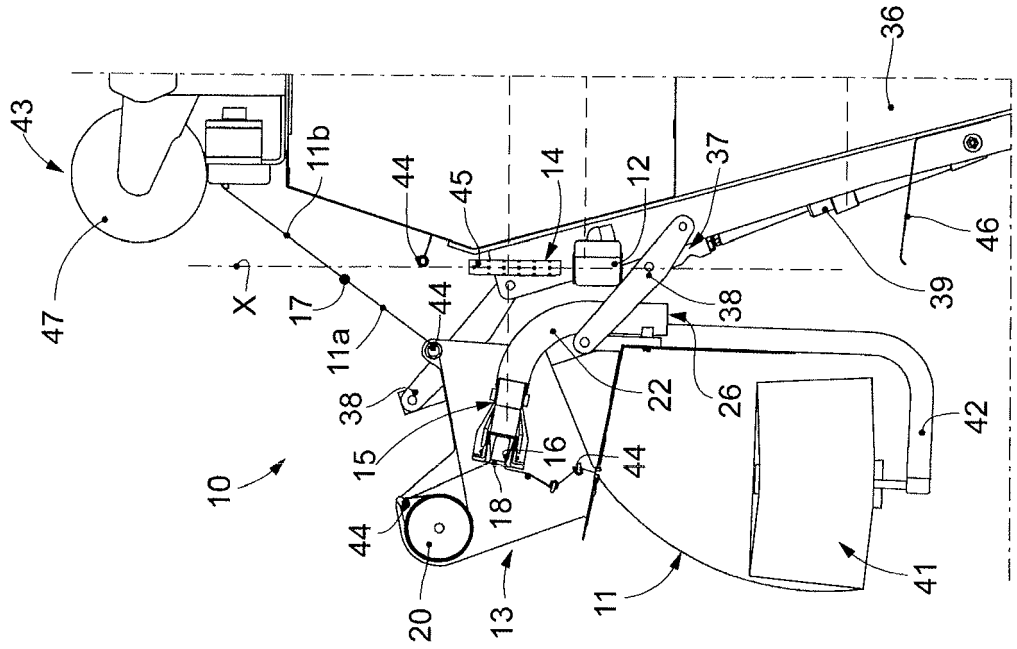
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fig. 2b

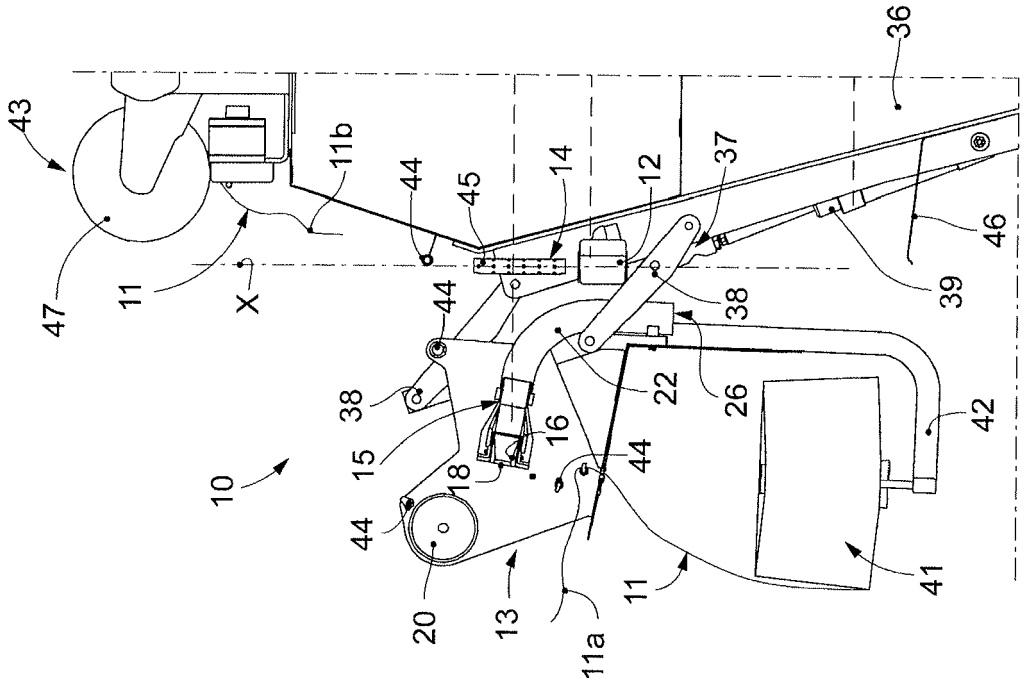
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fig. 2a

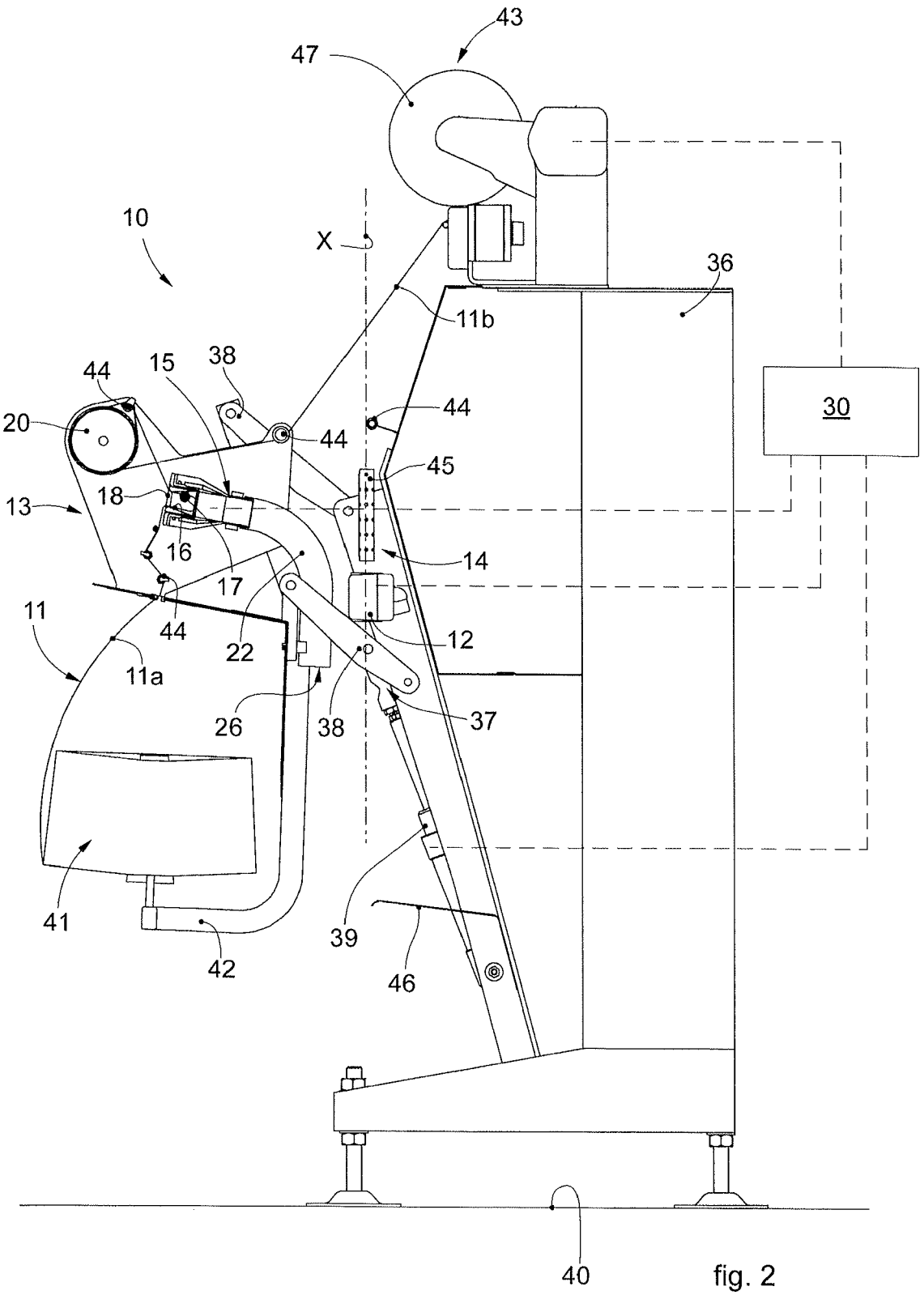
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fig. 2

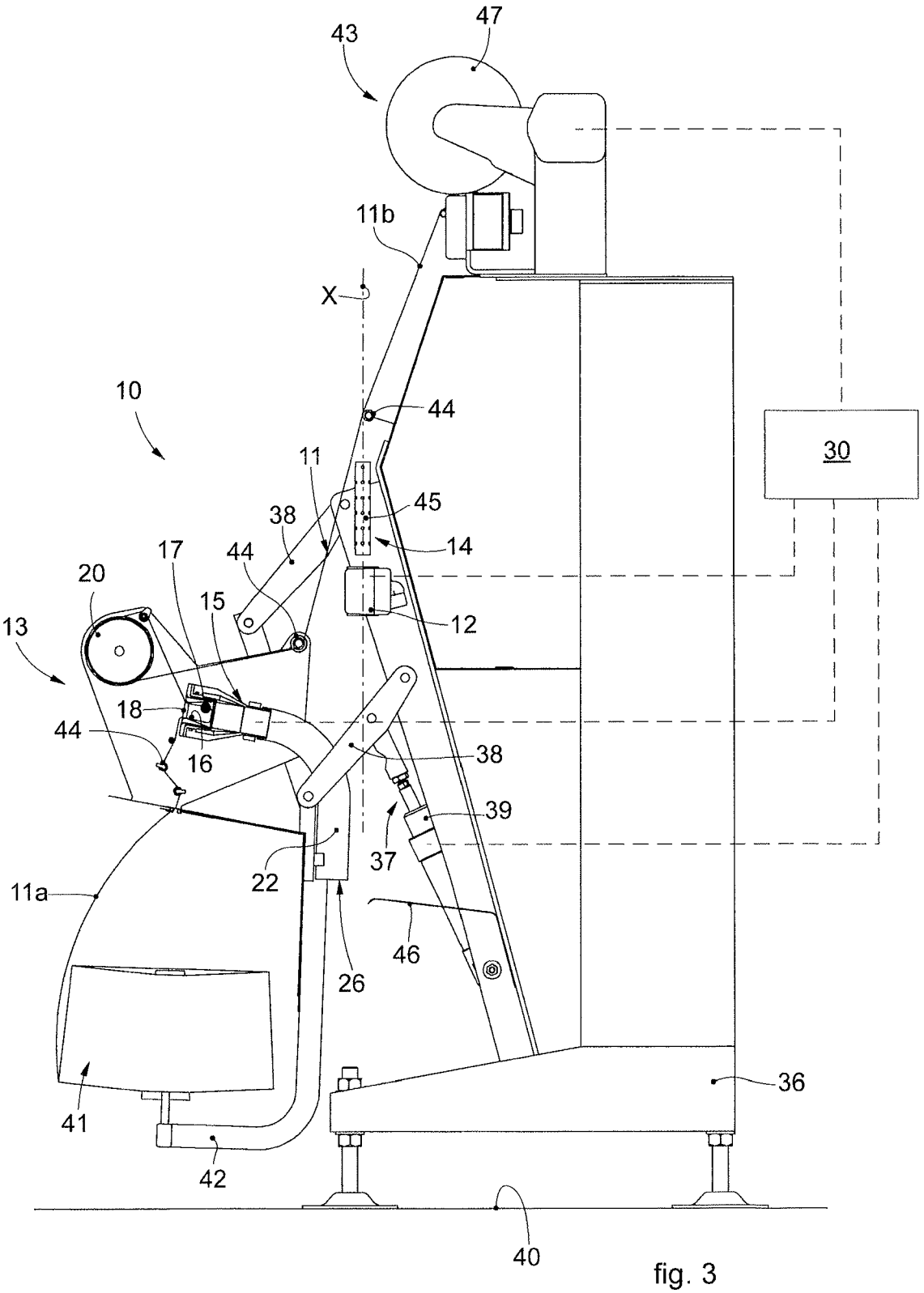
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fig. 3

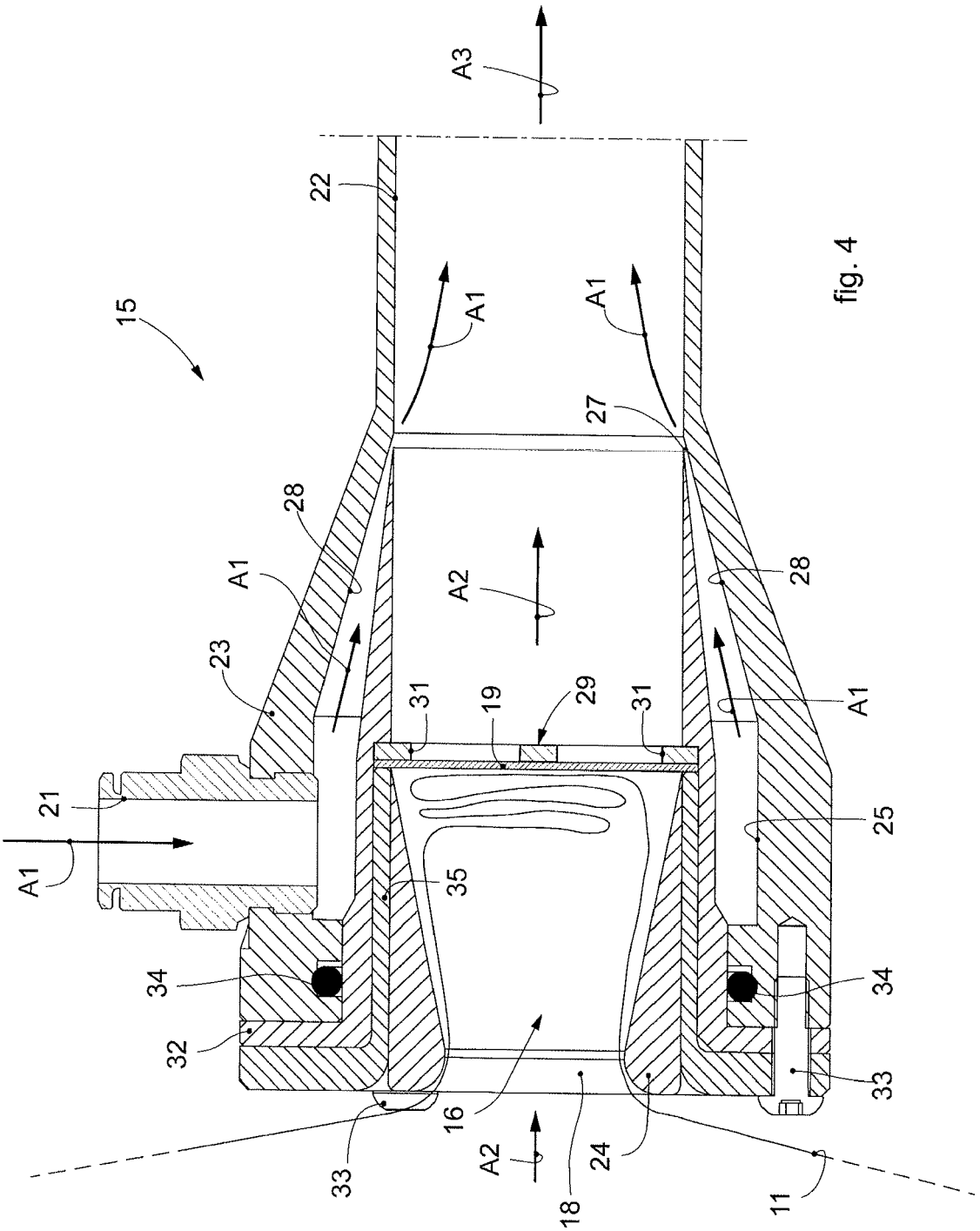
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fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 20 16 9131

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D02J
B65H
D02G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 September 2020	Van Beurden-Hopkins

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02-09-2020

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