(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 696 304 A1**

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**19.08.2020 Bulletin 2020/34**

(51) Int Cl.:
***D02J 3/16*** *(2006.01)* ***D06C 9/02*** *(2006.01)*

(21) Application number: **20157981.0**

(22) Date of filing: **18.02.2020**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
**BA ME**
Designated Validation States:
**KH MA MD TN**

(30) Priority: **18.02.2019 IT 201900002353**

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## (54) APPARATUS TO REMOVE THE FUZZ FROM A YARN AND CORRESPONDING METHOD

(57) An apparatus to remove the fuzz of a yarn (11) is provided with a burner assembly (15) configured to produce a flame (16) to burn the surface fuzz of the yarn (11) which advances along a working axis (X).

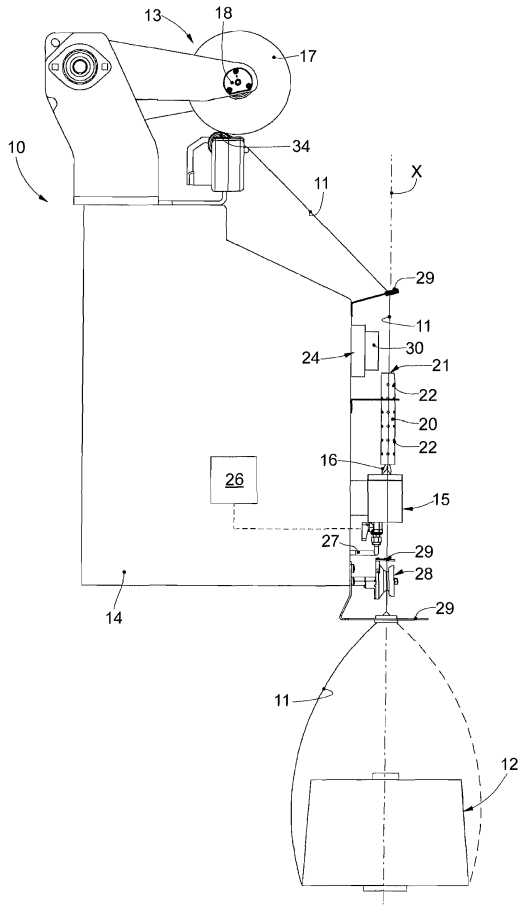


fig. 1

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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 method of the invention are used to remove the fuzz in order to obtain yarns, generally consisting of short fibers, that are more resistant and have a better aesthetic appearance, that is, smoother and more uniform.

### BACKGROUND OF THE INVENTION

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

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

**[0004]** In these gassing machines, the yarn, which normally comes from a cone, is made to pass through a flame, and is then collected downstream on another cone.

**[0005]** To gas the yarn, known apparatuses normally use common combustible gases of normal use and supply.

**[0006]** There are also gassing machines that use an electric arc.

**[0007]** If gas is used to generate the flame, flame control and management systems have to be present in the gassing machine, as well as systems for aspirating the combusted material.

**[0008]** One problem of the state of the art, which uses conventional gases, such as for example methane and LPG, is selectively igniting, extinguishing and adjusting the flame if an anomaly is identified in the continuity of the yarn such as breakage, swelling or other, which affects the final quality.

**[0009]** If the gases currently used are temporarily extinguished, once normal production resumes, they show a delay in correctly reaching their capacity to burn the fuzz.

**[0010]** This means either that the flame has to always be kept on, or that the restarting of the machine has to follow the progressive operating capacity of the flame fed with the usual gases.

**[0011]** A first problem is therefore preventing downtimes, that is, the gradual restart of the gassing step, as well as higher costs since, in addition to losing productivity, this complicates the structure and functioning of the gassing machine.

**[0012]** Therefore, the state of the art has a plurality of conditioning aspects and consequent disadvantages:

- the gassing speed, and consequently also the productivity, is strictly correlated to the normal temperature of the flame which, with traditional gases, is around 1000°C-1400°C;
- if the thread breaks, there can be very long downtimes, as well as long restart times of the flame;
- conventional gases have pollution and instability problems, as well as problems related to the maintenance, replacement and management of their feed and usage plants.

**[0013]** There are also risks associated with transporting and handling containers of pressurized gas, which have to be managed ensuring the safety of operators.

**[0014]** There is therefore the need to perfect an apparatus and a method to remove the fuzz of a yarn that can overcome at least one of the disadvantages of the state of the art.

**[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 invention or variants to the main inventive idea.

**[0017]** In accordance with the above disclosure, an apparatus to remove the fuzz of a yarn, in accordance with the present invention, is provided with a burner assembly configured to produce a flame to burn the surface fuzz of the yarn which runs along a working axis.

**[0018]** According to the invention, the burner assembly is fed with a mixture containing hydrogen gas. Preferably, the mixture comprises oxygen.

**[0019]** According to one embodiment, the burner assembly is fed with a mixture of hydrogen gas and oxygen.

**[0020]** In one embodiment, hydrogen and oxygen are pre-mixed before being introduced into the burner assembly; this promotes efficient and optimized combustion.

**[0021]** Thanks to the use of a hydrogen-oxygen mixture as indicated above, it is possible to obtain a temperature of the flame deriving from the combustion comprised between 2500°C and 3500°C, that is, much higher than what occurs in conventional burners.

**[0022]** Advantageously, the hydrogen gas allows to obtain a concentrated flame with a high temperature which acts in an extremely precise, selective and concentrated manner on the fuzz of the yarn, with no or minimal dispersions, guaranteeing an excellent final yarn product with limited energy consumption.

**[0023]** Furthermore, the use of hydrogen gas as a flame generator allows to:

- increase the speed at which the yarn is treated, in particular the feed speed of the latter along the working axis, with a consequent increase in the produc-

tivity of the apparatus;

- reduce, with the same productivity, energy consumption compared to traditional combustible gases;
- eliminate the danger of formation of carbon monoxide CO and carbon dioxide $CO_2$ (greenhouse effect);
- increase the safety of the combustion, as well as that of transport and handling, since hydrogen, in this application, is mainly used at atmospheric pressure and therefore does not generate explosion hazards.

**[0024]** In particular, since the hydrogen gas is not polluting, it allows to respect the environment and to reduce or substantially eliminate the costs associated with the control of the harmful emissions generally produced instead by the combustion of the gases used in traditional gassing.

**[0025]** In addition, the flame produced by the combustion of hydrogen quickly reaches normal operating conditions and can therefore be turned off and restarted several times, always guaranteeing an excellent gassing of the yarn and high efficiency in terms of energy and productivity.

**[0026]** Furthermore, unlike traditional gassing machines, the invention, due to the high temperature of the flame, allows to gas different types of yarn, for example yarns obtained from vegetable, animal, synthetic and mixed fibers, without the formation of carbon residues that can negatively affect the quality of the yarns.

**[0027]** The invention also concerns a method to remove the fuzz of yarns.

**[0028]** The method comprises a step in which a yarn is made to pass through a gassing path defining a working axis, and the surface fuzz of the yarn that runs along the working axis is burned by a burner assembly.

**[0029]** According to the present invention, the burning step provides to use a flame produced by the combustion of a mixture containing hydrogen gas by the burner assembly at a temperature comprised between 2500°C and 3500°C.

**[0030]** Advantageously, this method can also be applied to known gassing apparatuses by means of adaptation and implementation operations.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0031]** 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;
- fig. 2 is a front view of the apparatus of fig. 1;
- fig. 2a is an enlarged detail of a possible variant of the apparatus of fig. 2;
- fig. 3 is a perspective view of a component of the apparatus of fig. 1;
- fig. 4 is a section view of the component of fig. 3;
- fig. 5 is an exploded view of the component of fig. 3;
- fig. 6 is a view of a detail of the component of fig. 3.

**[0032]** 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.

## DETAILED DESCRIPTION OF SOME EMBODIMENTS

**[0033]** We will now refer in detail to the various embodiments of the present 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.

**[0034]** 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.

**[0035]** With reference to the drawings, an apparatus 10 to remove the fuzz of a yarn 11 is provided with a burner assembly 15 configured to produce a flame 16 for burning the surface fuzz of the yarn 11 which moves along a working axis X.

**[0036]** 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.

**[0037]** However, the application of this apparatus 10 to yarns 11 obtained from long fibers of various types is not excluded.

**[0038]** By fuzz of the yarn 11 we mean the set of threads or fibers protruding laterally from the yarn 11. The fuzz is mainly present in the case of yarns 11 obtained from short fibers.

**[0039]** According to the invention, the burner assembly 15 is fed by hydrogen gas. In particular, the burner assembly 15 is configured to burn incoming hydrogen gas and produce the flame 16 which burns the fuzz of the yarn 11. According to one embodiment, the yarn 11 is transferred with advantageously constant feed speed be-

tween one or more feed elements and one or more collection elements, along the working axis X, through the flame 16 of the burner assembly 15.

**[0040]** In particular, the temperature of the flame 16 obtained by the combustion of the hydrogen gas by the burner assembly 15 can be comprised between 2500°C and 3500°C, therefore a much higher value than what can be reached with conventional gas burners.

**[0041]** Advantageously, a flame 16 at such a high temperature allows to increase, compared to known methods, the feed speed of the yarn 11 through the flame 16 of the burner assembly 15. In this way, the productivity of the apparatus 10 can be considerably higher than that of known apparatuses.

**[0042]** According to one embodiment, the feed speed of the yarn 11 through the burner assembly 15 along the working axis X can be comprised between 500 m/min and 1500 m/min.

**[0043]** The apparatus 10 also comprises a support frame 14 on which the burner assembly 15 is mounted. The support frame 14, advantageously, keeps the burner assembly 15 substantially aligned along the working axis X.

**[0044]** The support frame 14 can have a box-like shape and can be suitable to be installed on walls, bases or other fixed supports.

**[0045]** The device 10 can comprise a feed device 12 located upstream of the burner assembly 15 and configured to feed the untreated yarn 11 along the working axis X to the burner assembly 15.

**[0046]** With the terms "treat", "treated" and "treatment", here and in the following description we mean the removal of the fuzz of the yarn 11 by burning it by means of the burner assembly 15.

**[0047]** For example, the feed device 12 can comprise a cone of untreated yarn 11, or a reel or a skein of yarn 11 to be subjected to gassing.

**[0048]** The feed device 12 can be associated, by means of suitable connection means, to the support frame 14.

**[0049]** The apparatus 10 can comprise a collection device 13 located downstream of the burner assembly 15 and configured to collect the yarn 11 once treated by the burner assembly 15.

**[0050]** For example, the collection device 13 can comprise a cone 17 for collecting the yarn 11, or a reel, suitably mounted onto the support frame 14.

**[0051]** The yarn 11 is transferred along the working axis X from the feed device 12, located upstream of the burner assembly 15, to the collection device 13, located downstream of the burner assembly 15, the flame of which determines the gassing of the yarn 11.

**[0052]** According to one embodiment, the collection device 13 can comprise a pin 18 integral with the collection cone 17, and a motor member 19 associated with the support frame 14 and configured to selectively make the pin 18 rotate.

**[0053]** According to one embodiment, the pin 18 rotates about an axis of rotation Z perpendicular to the working axis X of the yarn 11.

**[0054]** The rotation speed of the motor member 19 determines the feed speed of the yarn 11 along the working axis X inside the burner assembly 15. In this way, advantageously, by commanding and adjusting the rotation speed of the collection cone 17 it is possible to adjust the feed speed of the yarn 11.

**[0055]** According to one embodiment, the apparatus 10 can comprise at least one support element 34 located close to the collection cone 17 and configured to uniformly distribute and wind the treated yarn 11 into the collection cone 17.

**[0056]** The support element 34 can be, for example, a cylindrical element which affects the length of the collection cone 17.

**[0057]** According to one embodiment, the apparatus 10 can comprise a tensioner element 28 located between the feed device 12 and the burner assembly 15, and configured to tension the yarn 11 coming from the feed device 12, and direct it along the working axis X.

**[0058]** According to one embodiment, the tensioner element 28 is associated with the support frame 14 and is disposed in line with the burner assembly 15.

**[0059]** The tensioner element 28 can be defined by a roller, rotatable about an axis perpendicular to the working axis X and on which the yarn 11 is wound. The tensioner element 28 allows to channel the yarn 11, correctly directed along the working axis X, into the burner assembly 15.

**[0060]** According to one embodiment, the apparatus 10 can comprise one or more means 29 for supporting and directing the yarn 11 which are associated with the support frame 14 and configured to direct and keep the yarn 11 in translational movement along the working axis X.

**[0061]** The support and directing means 29 can be provided, for example, between the feed device 12 and the burner assembly 15.

**[0062]** The support and directing means 29 can also be provided, for example, between the tensioner element 28 and the feed device 12.

**[0063]** The support and directing means 29 can also be provided, for example, between the collection device 13 and the burner assembly 15.

**[0064]** The support and directing means 29 can comprise extensions protruding from the support frame 14 and provided with at least one hole in which the yarn 11 is free to pass.

**[0065]** According to one embodiment, the apparatus 10 can comprise a tubular element 20 disposed above and close to the burner assembly 15 and aligned with the latter along the working axis X.

**[0066]** According to one embodiment, the yarn 11 passes longitudinally through the tubular element 20 along the working axis X.

**[0067]** According to another embodiment, the tubular element 20 has an oblong development along the work-

ing axis X.

**[0068]** According to another embodiment, the tubular element 20 is associated with the support frame 14 and is positioned between the burner assembly 15 and the collection device 13.

**[0069]** The tubular element 20 can be provided inside with a treatment chamber 21 inside which the flame 16 is produced for the treatment of the yarn 11. The treatment chamber 21 advantageously allows to channel and better direct the flame 16 produced by the burner assembly 15 toward the yarn 11, so as to remove the surface fuzz of the yarn 11 without damaging it.

**[0070]** Furthermore, the treatment chamber 21 allows to control and command the removal of the fuzz in a targeted, fast and efficient manner.

**[0071]** According to one embodiment, the tubular element 20 can be provided with a plurality of holes 22. The holes 22 allow the passage of air and therefore a correct surface burning of the yarn 11 by the flame 16 to remove the surface fuzz thereof without damaging the yarn 11.

**[0072]** According to another embodiment, the tubular element 20 can be provided with a longitudinal slit 23, which affects the entire length of the tubular element 20, to introduce the yarn 11 into the treatment chamber 21.

**[0073]** According to one embodiment, the length of the tubular element 20 along the working axis X depends on the characteristics necessary for the fuzz removal treatment to be complete and efficient; for example, these characteristics could be the length of time the yarn 11 remains inside the treatment chamber 21 depending on the speed of the former or the temperature of the flame 16.

**[0074]** According to one embodiment, the tubular element 20 is disposed protruding externally from the support frame 14 and in line with the burner assembly 15.

**[0075]** According to one embodiment, the apparatus 10 comprises a suction member 24 configured to aspirate the combusted waste released by the burning of the fuzz of the yarn 11 by the burner assembly 15.

**[0076]** The combusted waste is the residues from the combustion of the fuzz of the yarn 11.

**[0077]** The suction member 24 can be disposed between the burner assembly 15 and the collection device 13 in order to aspirate the combusted waste released by the treatment of the yarn 11 exiting the treatment chamber 21.

**[0078]** According to one embodiment, the suction member 24 is disposed between the tubular element 20 and the collection device 13.

**[0079]** The suction member 24 can be disposed in such a way as to aspirate the combusted waste transversely to the working axis X.

**[0080]** The suction member 24 can be associated with the support frame 14.

**[0081]** According to one embodiment, the suction member 24 can be provided with a motor (not shown) disposed inside the support frame 14 and with a suction nozzle 30 protruding from the support frame transversely to the working axis X.

**[0082]** According to one embodiment, the burner assembly 15 and the tubular element 20 are disposed protruding from the support frame 14 and in line with the suction nozzle 30.

**[0083]** According to one embodiment, the burner assembly 15 is connected to a source of hydrogen gas by means of at least one feed pipe 27. The feed of the hydrogen gas can be commanded by means of a servo valve 25 which can selectively close or open the feed pipe 27 The servo valve 25 can be commanded manually by a user and/or electronically by a command and control unit 26.

**[0084]** According to a possible embodiment, the source of the hydrogen gas can be one or more cylinders associated with suitable control and management devices.

**[0085]** According to a possible embodiment, the source of the hydrogen gas can be an electrolysis generator. In this case, hydrogen is self-produced with consequent economic savings and greater safety in the management of the hydrogen gas itself.

**[0086]** According to one embodiment, the burner assembly 15 is provided longitudinally with a through seating 31 along the working axis X, configured to receive the yarn 11 and allow it to pass along the working axis X.

**[0087]** According to one embodiment, the through seating 31 can have a circular cross section so as to receive and direct the yarn 11 symmetrically along the working axis X.

**[0088]** The through seating 31 is provided with a first end 32 located below the burner assembly 15 along the working axis X, and a second end 33 opposite the first end 32.

**[0089]** The yarn 11 passes, for example, from the first end 32 to the second end 33 along the working axis X.

**[0090]** According to one embodiment, the burner assembly 15 can be provided with a longitudinal aperture 35 that allows to insert the yarn 11 into the through seating 31.

**[0091]** According to one embodiment, the burner assembly 15 comprises a plurality of nozzles 40 configured to direct the flame 16 onto the yarn 11.

**[0092]** According to one embodiment, the nozzles 40 are disposed equidistant along a circumference perpendicular to the working axis X and are, in a preferential embodiment, suitably inclined toward the yarn 11.

**[0093]** Preferably, moreover, the nozzles 40 are disposed with respect to each other so as to direct the flame 16 onto the yarn 11 by 360° around the yarn 11, so that the entire external surface of the yarn 11 is completely and uniformly affected by the gassing action.

**[0094]** According to one embodiment, the burner assembly 15 comprises at least three nozzles 40 disposed distanced from each other at 120° along the circumference as above.

**[0095]** According to one embodiment, the burner assembly 15 can be provided with a feed chamber 41 (figs.

4-6) configured to simultaneously feed all the nozzles 40 to at least one feed pipe 27 of hydrogen gas.

**[0096]** According to one embodiment, the feed chamber 41 has a circular or semicircular development which partly surrounds the through seating 31 so as to connect all the nozzles 40 with said feed chamber 41.

**[0097]** In particular, the nozzles 40 can be defined by holes (figs. 1-2 and 3-5) disposed on the second end of the through seating 31 and each communicating with the feed chamber 41 by means of connection channels 42.

**[0098]** According to one embodiment, the second end 33 of the through seating 31 can be suitably flared so that the nozzles 40 are correctly directed onto the yarn 11 which moves along the working axis X.

**[0099]** Advantageously, the feed chamber 41 can be provided with an injection channel 43 which connects it to the feed pipe 27. In this way, it is possible to have a single feed pipe 27 for a plurality of nozzles 40.

**[0100]** According to a possible embodiment, with reference to fig. 2a, the nozzles 40 can be defined by gas injection members 36 each connected to a feed pipe (not shown) and firmly associated with the support frame 14.

**[0101]** The injector members 36 can be for example torches which burn hydrogen gas to create flames 16 suitably directed onto the yarn 11, so as to burn the surface fuzz thereof without damaging it.

**[0102]** According to one embodiment, the burner assembly 15 can be governed by the command and control unit 26, which governs the in-flow of the hydrogen gas to the burner assembly 15; in the event the yarn 11 breaks or there is a need to interrupt the treatment process, it can automatically command the selective extinguishing and/or restoration of the flame 16 in a rapid and efficient manner.

**[0103]** According to one embodiment, the command and control unit 26 can command the servo valve 25 in order to partialize the flow rate of the hydrogen gas in order to adjust the intensity of the flame 16.

**[0104]** In particular, the servo valve 25 can be driven so as to close, open or half-open the feed pipe 27, based on settings provided by the user, for example on the basis of the type of yarn 11, its sizes, and other operating parameters that can condition the drive of the burner assembly 15.

**[0105]** According to one embodiment, the feed speed of the yarn 11 can be pre-set in the command and control unit 26 according to the type of yarn 11 to be treated and the level of productivity to be obtained.

**[0106]** According to one embodiment, the command and control unit 26 can determine the functioning parameters of the burner assembly 15, for example, but not only, its programmed ignition, also modifying the intensity of the flame 16 as a function of the pre-set feed speed of the yarn 11.

**[0107]** According to one embodiment, the apparatus 10 can be completely automated, with sensors (not shown) for recognizing the type of yarn 11 to be treated, the level of fuzz thereof and the correct tension thereof along the working axis X before of the process of treating the yarn 11 in the burner assembly 15.

**[0108]** In particular, according to the data detected by the sensors as above, the command and control unit 26 can adjust the intensity of the flame 16 so as to guarantee the correct treatment of the yarn 11.

**[0109]** In addition, sensors can be present, located after the treatment of the yarn 11 by the burner assembly 15, which detect whether the yarn 11 has been treated correctly so as to constantly optimize the treatment process, modifying and correcting the gassing parameters in feedback if treatment defects or imperfections are found.

**[0110]** According to one embodiment, the burner assembly 15 comprises a safety device 44 positioned between the nozzles 40 and the at least one feed pipe 27. The safety device 44 is configured to prevent backfiring following the ignition of the gas by the burner assembly 15, thus guaranteeing a better control of the flame 16.

**[0111]** With reference to fig. 5, the burner assembly 15 can comprise a main body 37 in which the feed pipe 27 and the safety device 44 are inserted.

**[0112]** The burner assembly 15 can also comprise an upper head 38 associated at the top with the main body 37.

**[0113]** The burner assembly 15 can also comprise, between the upper head 38 and the main body 37, a sealing packing 39.

**[0114]** The upper head can be provided with the nozzles 40.

**[0115]** With reference to fig. 6, the upper head 38 can be provided with the feed chamber 41. In particular, fig. 6 shows a view from below of the upper head 38 in which the feed chamber 41 is visible.

**[0116]** According to one embodiment, the main body 37 can be provided with a hole 46 which directly connects the feed chamber 41 with the feed pipe 27, or with the safety device 44.

**[0117]** According to one embodiment, the sealing packing 39 can be provided with an aperture 47 aligned with the hole 46 in order to allow the passage of the gas from the feed pipe 27 to the feed chamber 41. In this way, in fact, feed pipe 27, hole 46, aperture 47 and injection channel 43 of the feed chamber 41 are aligned.

**[0118]** Upper head 38, sealing packing 39 and main body 37 can each be provided with a through hole having the same cross section so that, once assembled one on top of the other, the holes define the through seating 31.

**[0119]** Upper head 38, sealing packing 39 and main body 37 can be made in a single body.

**[0120]** Upper head 38, sealing packing 39 and main body 37 can be connected together by means of attachment means 45, for example screws.

**[0121]** It is clear that modifications and/or additions of parts may be made to the apparatus 10 to remove the fuzz of a yarn 11 as described heretofore, without departing from the field and scope of the present invention.

**[0122]** 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, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

**[0123]** 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), said apparatus (10) being provided with a burner assembly (15) configured to produce a flame (16) to burn the surface fuzz of the yarn (11) which advances along a working axis (X), **characterized in that** said burner assembly (15) is fed with a mixture containing hydrogen gas.

2. Apparatus as in claim 1, **characterized in that** a mixture of hydrogen gas and oxygen is used to feed the burner assembly (15).

3. Apparatus as in any claim hereinbefore, **characterized in that** the yarn (11) advances through the burner assembly (15) along the working axis (X) at a feed speed comprised between 500 and 1500 m/min.

4. Apparatus as in any claim hereinbefore, **characterized in that** said burner assembly (15) comprises a plurality of nozzles (40) equidistant along a circumference perpendicular to the working axis (X) and suitably inclined toward the yarn (11), said nozzles (40) being disposed one with respect to the other so as to direct the flame (16) on the yarn (11) by 360° around the yarn (11).

5. Apparatus as in claim 4, **characterized in that** the burner assembly (15) comprises at least three nozzles (40) disposed distanced from each other at 120° along said circumference.

6. Apparatus as in claim 4 or 5, **characterized in that** the burner assembly (15) is provided with a feed chamber (41) configured to simultaneously connect all the nozzles (40) to at least one feed pipe (27) of hydrogen gas.

7. Apparatus as in claim 6, **characterized in that** the burner assembly (15) comprises a safety device (44) positioned between the nozzles (40) and the at least one feed pipe (27), said safety device (44) being configured to prevent backfiring following the ignition of the gas by the burner assembly (15).

8. Apparatus as in any claim hereinbefore, **characterized in that** it comprises a tubular element (20) disposed above and close to the burner assembly (15) and aligned with the latter along the working axis (X), said tubular element (20) being passed through longitudinally by the yarn (11) along the working axis (X) and being provided inside with a treatment chamber (21) in which the flame (16) is produced.

9. Apparatus as in any claim hereinbefore, **characterized in that** it comprises a suction member (24) configured to aspirate the combusted waste released by the burning of the fuzz of the yarn (11) by the burner assembly (15).

10. Method to remove the fuzz of a yarn (11) comprising a step in which a yarn (11) is made to pass through a gassing path defining a working axis (X), and the surface fuzz of the yarn (11) that runs along said working axis (X) is burned by a burner assembly (15), **characterized in that** the burning step provides to use a flame produced by the combustion of a mixture containing hydrogen gas by said burner assembly (15) at a temperature comprised between 2500°C and 3500°C.

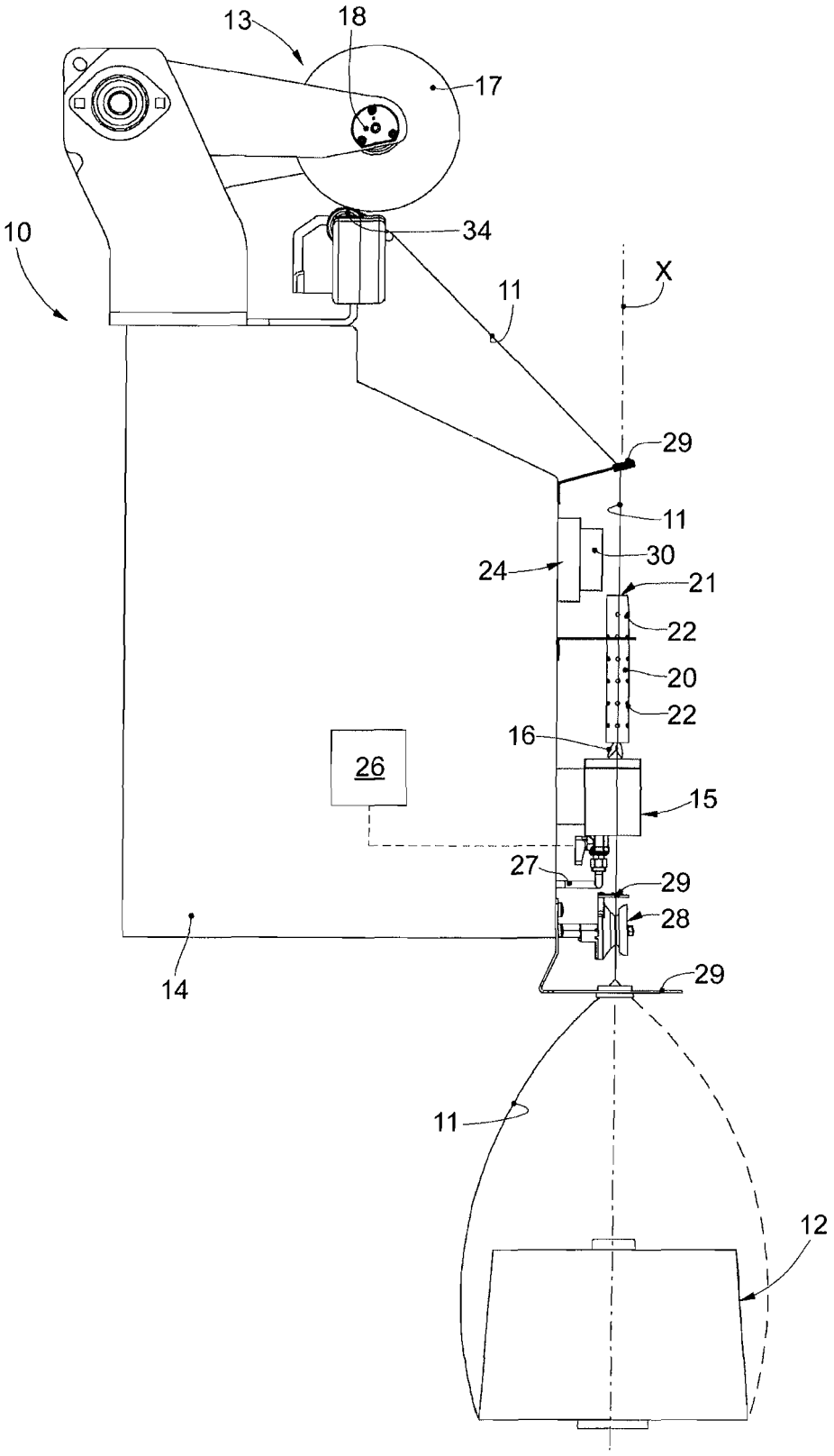


fig. 1

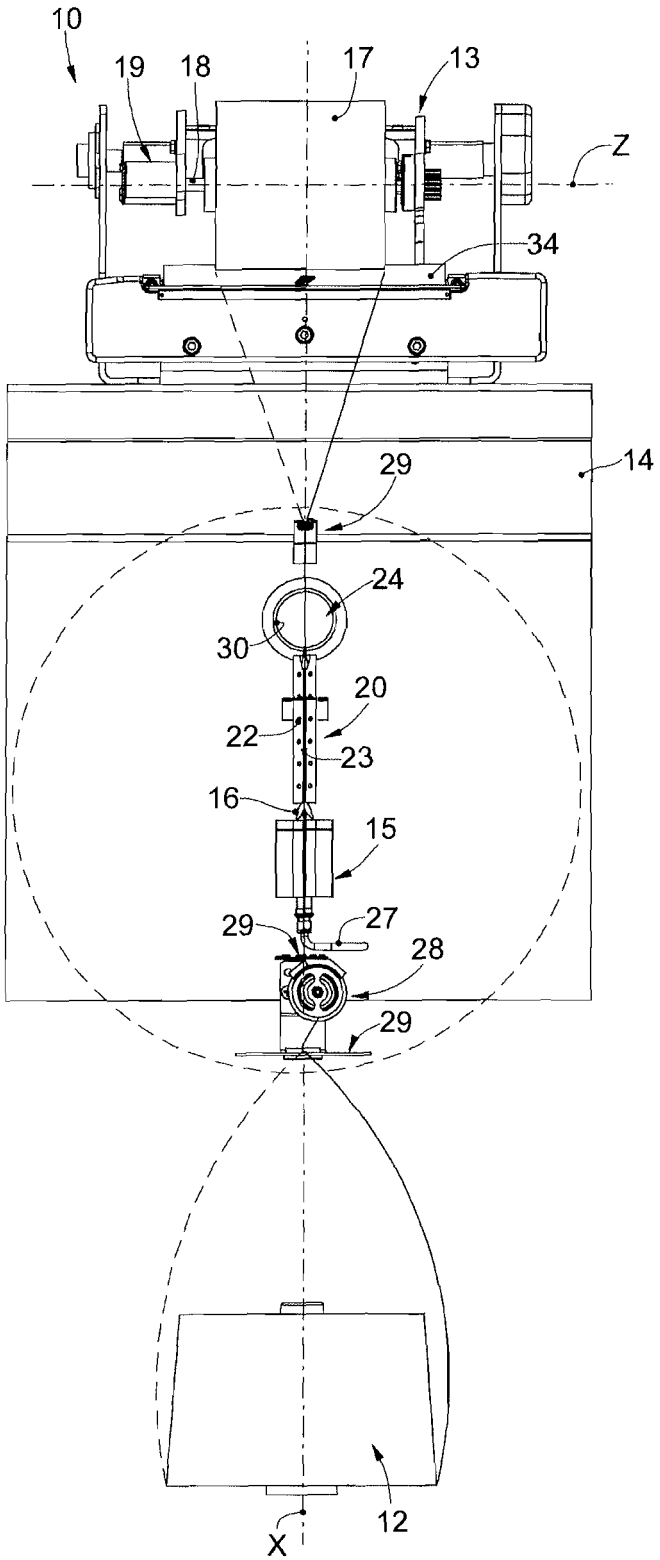
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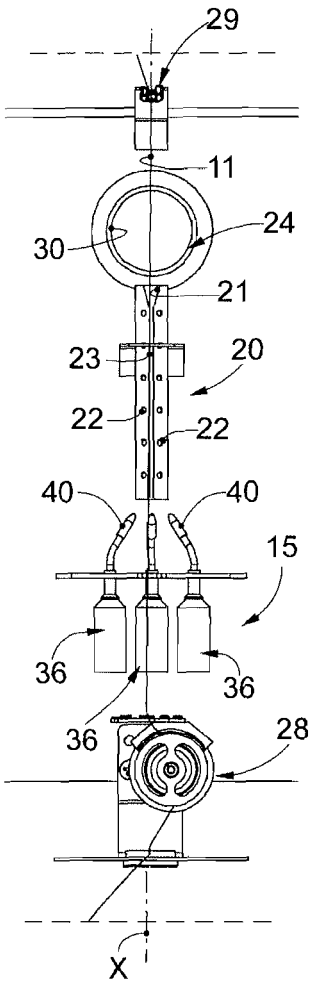
fig. 2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X

fig. 2a

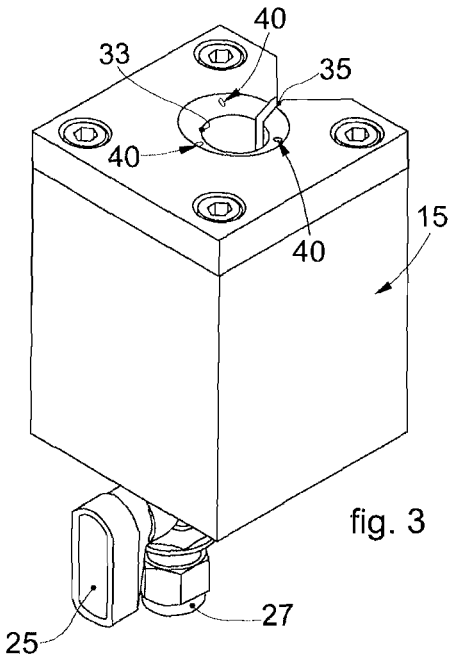
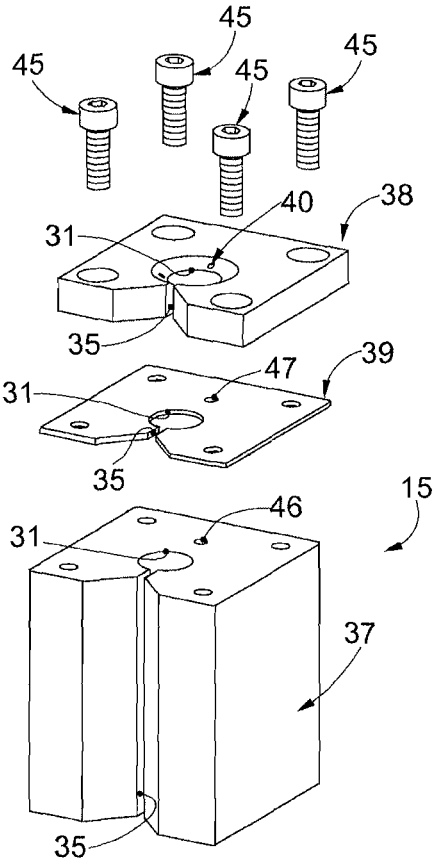
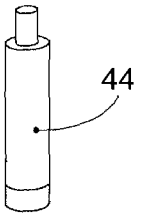



fig. 3



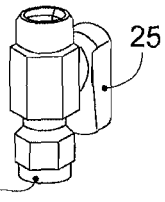




fig. 5

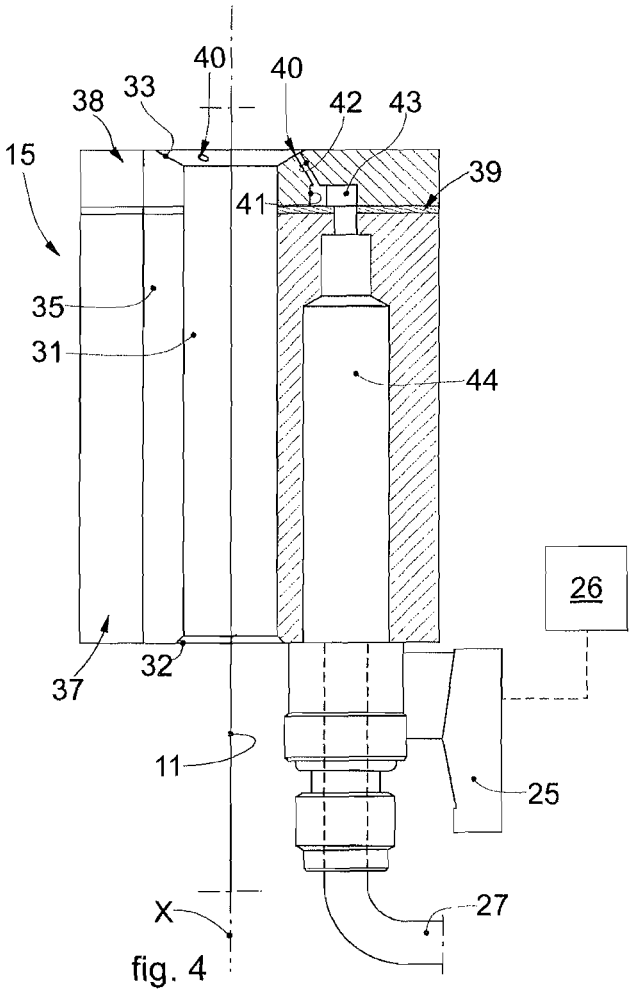



fig. 4

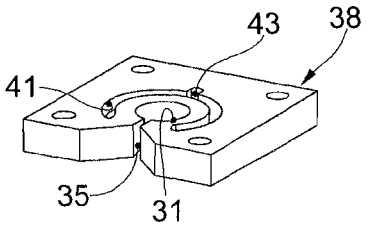



fig. 6

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# EUROPEAN SEARCH REPORT

Application Number
EP 20 15 7981

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| Y | WO 2013/139855 A1 (SSM AG [CH])<br>26 September 2013 (2013-09-26)<br>* page 3, lines 6-11; figure 1 *<br>* page 4, lines 6-7 *<br>----- | 1-10 | INV.<br>D02J3/16<br>D06C9/02 |
| Y | GB 309 320 A (OSTHOFF FA WALTER)<br>11 April 1929 (1929-04-11)<br>* page 1, lines 7-12 *<br>* page 1, lines 85-91 *<br>* page 3, lines 3-16 *<br>* page 3, lines 58-62 *<br>* page 3, line 129 - page 4, line 5 *<br>----- | 1-10 | |
| Y | GB 339 281 A (OSTHOFF FA WALTER)<br>28 November 1930 (1930-11-28)<br>* page 1, lines 10-15; claim 1 *<br>* page 3, lines 64-75 *<br>----- | 1-10 | |
| A | US 6 151 764 A (EBBINGHAUS RAINER [DE])<br>28 November 2000 (2000-11-28)<br>* column 8, lines 17-37 *<br>----- | 1-10 | |
| | | | TECHNICAL FIELDS SEARCHED (IPC)<br>D02J<br>D06C |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 25 May 2020 | Van Beurden-Hopkins |

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25-05-2020

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| WO 2013139855 A1 | 26-09-2013 | CN 104379824 A | 25-02-2015 |
| | | EP 2828424 A1 | 28-01-2015 |
| | | WO 2013139855 A1 | 26-09-2013 |
| GB 309320 A | 11-04-1929 | NONE | |
| GB 339281 A | 28-11-1930 | NONE | |
| US 6151764 A | 28-11-2000 | EP 1013815 A2 | 28-06-2000 |
| | | US 6151764 A | 28-11-2000 |

EPO FORM P0459

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