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(54) System to control the quality of yarn and relative device.

(57) System to control the quality of yarn in association with spinning machines or twisting frames, in which the yarn (12) cooperates with a yarn-guide loop (11) fitted solidly to an arm (14) which bears the yarn-guide loop (11) and which is secured to the structure of the machine, the system including at least one piezoelectric sensor (13) solidly fitted to the arm (14) bearing the yarn-guide loop (11), the piezoelectric sensor (13) being associated with a data processing and control means (17), which processes the signal generated by the piezoelectric sensor (13) and generates an electrical signal (16) of a sinusoidal type having an amplitude proportional to the tension of the yarn (12) and a frequency proportional to the speed of rotation of the balloon.
Device to control the quality of yarn, which is suitable to be integrated in the system of the claims hereinbefore and comprises an arm (14) secured to the structure of the machine and bearing a yarn-guide loop (11) solidly fixed to the arm (14), the arm (14) being solidly associated lengthwise with a piezoelectric sensor (13).

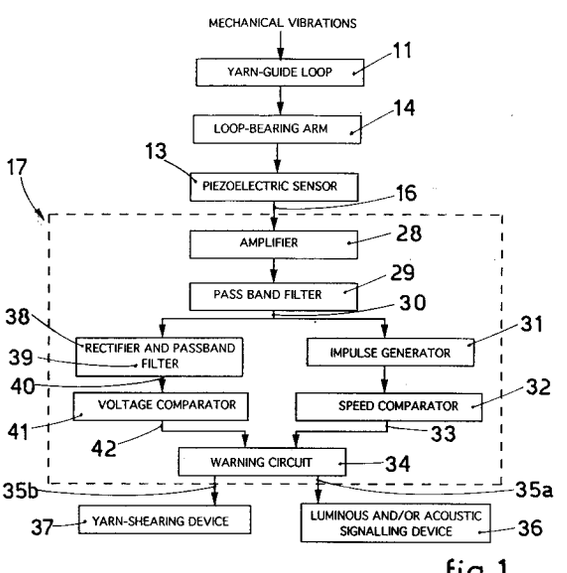

fig.1

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This invention concerns a system to control the quality of yarn and also a relative device, as set forth in the respective main claims.

The system to control the quality of yarn according to the invention is applied advantageously to the textile field and, to be more exact, to single-twist or two-for-one twisting frames as well as ring spinning machines.

The system to control the quality of yarn according to the invention enables anomalies to be detected and signalled in the yarn unwound from the twisting frame or spinning machine and the take-up of yarn on the yarn package or spindle to be halted.

This invention can be applied to yarns made of any type of fibres, whether they be natural or manmade, continuous or discontinuous, of a staple length for wool or cotton.

The invention can be employed on all existing textile machines and can be used for yarns of various materials and dimensions without being modified.

In the spinning machines and twisting frames of the state of the art the yarn unwinding from the yarn package passes through a yarn-guide loop, which is generally located above and on the same axis as the spindle and has the task of limiting the balloon created by the centrifugal force generated by the rotation of the spindle.

Devices have been disclosed which signal the breakage of the yarn with a view to providing a remote control of those machines.

In the device disclosed by DE-A-4.010.318 the yarn which has already left the yarn-guide loop is made to cooperate with a feeler device, which includes a piezoelectric sensor that senses the tension of the yarn and converts that tension into an electrical impulse, which is sent to a suitable signalling and control device.

This feeler device entails the drawback that it can only detect anomalies arising from the complete or partial breakage of the yarn since a lack of yarn leads to a lack of the signal sent by the feeler device to the signalling and control device.

Moreover, the feeler device cannot signal any other faults in the yarn which would make unsatisfactory the quality of the yarn produced.

FR-A-2.267.399 discloses a yarn-guide loop having a reduced section, which is caused to cooperate with a coil and affects the magnetic field produced by the coil. This document teaches only the monitoring of the speed of rotation and not the tension of the yarn, nor can it be deemed that, if this document is combined with DE-A-4.010.318, it is possible to arrive at the invention now under examination, for the working concepts are different.

FR-A-2.267.399 mentions the use of a transducer of a type different from the coil but gives no information about how this different transducer should work nor how it should be installed.

GB-A-2,023,671 discloses another form of embodiment of a device that detects breakage of the yarn running in spinning machines, the device comprising a piezoelectric sensor fitted to the yarn-guide loop, but in this patent the piezoelectric sensor is fitted resiliently and removably to a small supporting plate pivoted on a supporting bracket installed on the spinning machine.

The intermediate connecting elements may generate their own vibrations, and therefore the electrical output signal is disturbed and for this reason can be analysed only as a presence or absence of a signal.

In this case too the detector device can signal only the breakage of the yarn and cannot give information about other types of faults which may be included in the yarn running through.

In the case of two-for-one twisting frames various shortcomings may take place, such as the breakage of one of the yarns leading to the lack of the twisting operation, or else the union of undesired yarns whereby more yarns than those required are coupled together, or else the slipping of the spindle which causes a loss of twist in the yarn; or the belt setting the spindle in rotation may break with a resulting lack of twist in the yarn produced.

The feeler devices of the state of the art do not enable these types of shortcomings to be identified and lead to the production of yarns of a low quality.

Moreover, the feeler devices of the state of the art do not enable the inclusion of lumps in the unwinding yarn to be signalled, and therefore these lumps remain in the yarn produced, which is therefore of a low quality.

The present applicants have designed, tested and embodied this invention to overcome the shortcomings of the state of the art and to achieve further advantages.

This invention is set forth and characterised in the respective main claims, while the dependent claims describe variants of the idea of the main embodiment.

One purpose of the invention is to provide a yarn quality control system which makes possible the detection and signalling of anomalies in the yarn such as even partial breakage of the yarn, unions of pluralities of yarns, loss of twist or complete lack of twist in the yarn produced.

The system to control the yarn according to the invention enables also the inclusion of lumps in the yarn passing through to be detected.

A further purpose of the invention is to reduce to a minimum the number of contacts between the yarn and rigid elements against which the yarn runs so as to guide the yarn and/or ensure the desired tension of the yarn and/or to ascertain the

presence or absence of yarn.

Furthermore, the yarn quality control system according to the invention may be combined with a yarn shearing device which is actuated automatically as soon as the yarn quality control system according to the invention detects one of the above anomalies.

The applicants therefore have the purpose of achieving a yarn quality control system the sensor of which makes possible the detection of the speed of rotation of the balloon and of the tension of the yarn or yarns with which the sensor cooperates without thereby introducing further elements in contact with the yarn running through.

In the system according to the invention the yarn quality control device is solidly fixed to the arm bearing the yarn-guide loop through which the yarn, or yarns, being wound runs, or run.

Thus one single simple element performs a double function with a resulting saving of the costs of materials and of the assembly of the component parts and also a reduction of materials and of the time involved in installation of the device on the machine.

To be more exact, the yarn quality control system according to the invention comprises also a sensor of a piezoelectric type solidly associated with the yarn-guide loop so as to form a continuous assembly together with the arm that bears the yarn-guide loop.

According to a variant the arm bearing the yarn-guide loop includes at least one sensor of a piezoelectric type solidly fitted directly to the arm, and advantageously on the perimeter of the arm, and arranged along the arm.

According to a development of this variant a desired reduction of the cross section of the arm is included in cooperation with the piezoelectric sensor so as to amplify the oscillations and vibrations acting on the sensor.

The device according to the invention does not include additional elements to connect the piezoelectric sensor to the arm bearing the yarn-guide loop, and this situation reduces considerably the vibrations detected by the piezoelectric sensor, and thus the vibrations are substantially only those caused by the yarn or yarns running through the yarn-guide loop.

This feature enables an electrical signal emitted by the piezoelectric sensor to be obtained which is substantially free of disturbances due to additional mechanical connecting elements.

In the device according to the invention this signal can therefore be analysed not only as a presence or absence of a signal of detection of breakage of the yarn but also as regards its own characteristics such as amplitude and frequency in obtaining further information about the yarn or yarns running through the yarn-guide loop.

The device according to the invention can be fitted readily and quickly to new and existing machines since it is installed to form one single body with the arm bearing the yarn-guide loop.

The yarn running through the yarn-guide loop exerts thereupon a centrifugal force, the point of application of which coincides with the point of contact between the yarn and the yarn-guide loop and therefore can move around the circumference of that loop.

As is known, this centrifugal force generates on the yarn-guide loop oscillations and vibrations, which affect the arm bearing the yarn-guide loop and are transmitted thereby to the piezoelectric sensor and converted thereby into an electrical signal.

Since the piezoelectric sensor is fitted to the arm so as to form continuity therewith, it is possible to detect not only oscillations and vibrations but also the axial stresses of tension or compression exerted by the yarn on the yarn-guide loop, these stresses arising from those occurring in the arm.

In the yarn quality control system according to the invention these electrical signals generated by the mechanical vibration transmitted by the arm to the piezoelectric sensor are amplified and freed of spurious signals, thus providing a signal which is a function of the speed of rotation of the balloon and of the tension of the yarn running through.

The electrical signal leaving the filter means is converted into impulses to control the speed of rotation and into voltage to control the tension of the yarn.

On the one hand these impulses are examined by the control device and compared with a determined value of speed.

If the average speed of rotation of the yarn varies beyond a given pre-set percentage determined as desired, a suitable signal is generated which actuates an acoustic and/or visual warning circuit or a stop signal.

This same signal may also actuate a yarn shearing means which has the task of stopping take-up of yarn in the event of anomalies.

On the other hand this signal is processed and examined so as to generate a signal which represents the average tension of the yarn. This average tension is processed to find its differential variations as compared to a pre-set value.

If these differential variations of tension exceed a given threshold value, a suitable signal is generated which actuates an acoustic and/or visual warning circuit or a stop signal or else a signal to shear the yarn running through.

If the signal is associated with an efficient enough filter means, it is also possible to detect the inclusion of lumps in the yarn running through

and thus actuate the warning, stopping or shearing means.

The attached figures are given as a non-restrictive example and show some preferred embodiments of the invention as follows:-

Fig.1
is a block diagram of the method of working of the yarn quality control system according to the invention;

Fig.2
shows diagrammatically the yarn quality control device according to the invention in association with a yarn package;

Fig.3a
is a side view of a first form of embodiment of the yarn quality control device according to the invention;

Fig.3b
shows a partly cutaway view of the yarn quality control device according to the arrow A of Fig. 3a;

Figs.4a and 4b
show variants of the embodiment of the yarn quality control device of Fig.3b;

Figs.5a and 5b
show in an enlarged scale two cross-sections of a possible variant of the device of Fig.3a along the lines B-B and C-C respectively.

The reference number 10 in the attached figures denotes generally a device to control the quality of yarn according to the invention.

The purpose of this invention is to provide a yarn quality control device 10 having the task of a yarn-guide loop 11 and of a detector of anomalies in yarn 12 running through.

The anomalies which can be detected by this yarn quality control device 10 according to the invention may be various and may include a lack of yarn 12, a variation in the speed of rotation, a variation in the tension of the yarn 12, the inclusion of lumps in the yarn running through and the union of undesired yarns 12.

A further purpose of the invention is to provide a quality control device 10 which not only signals the presence of such anomalies but is also able to stop the take-up of yarn 12 when one or another of those anomalies occurs.

The quality control device 10 according to the invention is used with a yarn 12 running in spinning machines or in single-twist or two-for-one twisting frames and makes possible the detection of loss of twist due to spindle slip 15 or of lack of twist in the yarn 12 owing to breakage of the transmission belt.

Moreover, where the yarns are being produced with a plurality of yarns 12 twisted together, the yarn quality control device 10 according to the invention enables the lack of one of the yarns 12 and also the union of undesired yarns 12 to be detected.

As is known, the yarn 12 leaving the spindle 15 in rotation is made to cooperate with the yarn-guide loop 11 located above and on the same axis as the spindle 15 so as to limit the balloon generated by that rotation.

According to the invention the yarn quality control device 10 includes at least one piezoelectric sensor 13 firmly associated with an arm 14 that bears the yarn-guide loop 11 (Fig.6) so as to form a continuous extension of that arm 14.

The piezoelectric sensor 13 is fitted firmly, and without additional connecting elements, to the arm 14 bearing the yarn-guide loop 11 and advantageously on the perimeter of, and along, that arm.

As is known, the piezoelectric sensor 13 converts into electrical impulses the oscillations and vibrations generated by the yarn 12 running through the yarn-guide loop 11.

The piezoelectric sensor 13 is connected by connecting cables 19 to a data processing and control means 17.

So as to amplify the vibrations, the arm 14 bearing the yarn-guide loop 11 has advantageously a reduced cross-section coinciding with the piezoelectric sensor 13. In this case the reduced cross-section is provided by a narrowing notch 43, which may be on the same side as that to which the piezoelectric sensor 13 is fitted or on the opposite side and substantially corresponding to the lengthwise point of application of the piezoelectric sensor 13 (see Figs.4).

The piezoelectric sensor 13 cooperates advantageously with a surface or hollow 18, which contains the sensor 13 lengthwise.

According to a variant (Figs.5a and 5b) a plurality of piezoelectric sensors 13 are arranged on the periphery of the arm 14 according to two or more cartesian axes for instance so as to detect the oscillations of the yarn-guide loop 11 on different planes. In this example the piezoelectric sensors 13 are two in number arranged at 90° to each other and enable the oscillations of the yarn-guide loop 11 to be detected on two planes at a right angle to each other.

In this case the arm 14 contains reductions of its cross-section or hollows 18 coinciding advantageously with the various piezoelectric sensors 13; these reductions of cross-section are associated with a coordinated series of notches 43 arranged in suitable positions with the piezoelectric sensors 13.

These notches 43 are intended to accentuate the vibrations and oscillations of the yarn-guide loop 11 sensed by the piezoelectric sensors 13 and therefore to increase the sensitivity of the sensors 13.

The piezoelectric sensor 13 generates an electrical signal 16, which is processed by an appro-

priate data processing means 17 which, in the event of anomalies, generates a warning signal 35a, as will be described better in the description that follows.

In a first form of embodiment (Fig.4b) the arm 14 bearing the yarn-guide loop 11 includes at an intermediate lengthwise position a hollow 18 in which the piezoelectric sensor 13 is fitted.

The piezoelectric sensor 13 is associated with connecting cables 19, which are connected to the data processing and control means 17. In this case the arm 14 contains an axial bore 20, through which the connecting cables 19 are passed.

A covering element 21 consisting of a slidable sleeve 25 cooperates with the hollow 18 so as to protect the piezoelectric sensor 13 against any impacts.

The slidable sleeve 25 includes positioning and clamping means 22, which in this case consist of an annular ledge 23 that cooperates with an annular groove 24 of a mating shape machined in the arm 14 bearing the yarn-guide loop 11 (Fig.4b).

The forms of embodiment in Figs.4 show the narrowing notch 43 machined in the arm 14 on the opposite side to, and corresponding to, the hollow 18.

In the form of embodiment of Fig.4a the covering element 21 consists of the sleeve 25, which has an outer diameter equal to the outer diameter of the arm 14 and cooperates with a mating seating 26 machined circumferentially in the arm 14 and corresponding with the hollow 18.

In this case the sleeve 25 contains a separating slit 27 (Fig.5a) extending along its whole length so as to enable the sleeve 25 to be deformed and enlarged while being fitted to the arm 14.

Fig.1 shows a possible working diagram of the control device 10 according to the invention; this is described in greater detail hereafter.

The piezoelectric sensor 13 is stimulated by the oscillations and vibrations caused by the yarn 12 running through the yarn-guide loop 11; these vibrations and oscillations are transmitted by the yarn-guide loop 11 to the arm and thence, by transfer, to the piezoelectric sensor 13, which generates an electrical signal, which is amplified by an amplifier 28 and treated by a band-pass filter 29, which eliminates the noises of the mains frequency and the noises of high frequencies due to spurious oscillations of the yarn 12.

The sinusoidal output signal 30 of the band-pass filter 29 is characterised by a frequency corresponding to the speed of rotation of the balloon and therefore of the spindle 15 and by an amplitude proportional to the tension of the sliding yarn 12.

On the one hand the sinusoidal output signal 30 is converted into impulses by an impulse shaping means 31. These impulses are then counted and their value is compared with a value of rotation speed by a first comparator 32, which generates a speed differential signal 33 which is sent to a warning circuit 34.

If this speed differential signal 33 exceeds a pre-set determined threshold value, the warning circuit 34 sends a first actuation signal 35a, which actuates an acoustic and/or visual alarm device 36 or a blocking device, which is not shown here.

In this case the warning circuit 34 sends also a second actuation signal 35b, which actuates a yarn shearing means 37, which interrupts the take-up of yarn 12.

On the other hand, the sinusoidal output signal 30 is converted into direct current voltage by a rectifier 38 equipped with a low pass filter 39, which enables the voltage fluctuations to be eliminated by generating a voltage signal 40 which represents the average tension of the yarn 12.

The voltage signal 40 is then processed by a second comparator 41, which generates a voltage differential signal 42 that is sent to the warning circuit 34.

If this voltage differential signal 42 exceeds a pre-set determined threshold value, the warning circuit 34 sends a first actuation signal 35a, which actuates the acoustic and/or visual alarm device 36 or a blocking device, which is not shown here.

In this case the warning circuit 34 sends a second actuation signal 35b, which actuates the yarn shearing means 37, which interrupts the take-up of yarn 12.

Claims

1. System to control the quality of yarn in association with spinning machines or twisting frames, in which the yarn (12) cooperates with a yarn-guide loop (11) fitted solidly to an arm (14) which bears the yarn-guide loop (11) and which is secured to the structure of the machine, the system being characterised in that it includes at least one piezoelectric sensor (13) solidly fitted to the arm (14) bearing the yarn-guide loop (11), the piezoelectric sensor (13) being associated with a data processing and control means (17), which processes the signal generated by the piezoelectric sensor (13) and generates an electrical signal (16) of a sinusoidal type having an amplitude proportional to the tension of the yarn (12) and a frequency proportional to the speed of rotation of the balloon.

2. System to control the quality of yarn as in Claim 1, in which the data processing and control means (17) in controlling the speed of

rotation converts the electrical signal (16) into impulses which are counted and compared with a determined reference value, this comparison generating a speed differential signal (33) that conditions the speed of rotation.

3. System to control the quality of yarn as in Claim 2, in which, when this speed differential signal (33) exceeds a given pre-set threshold, the data processing and control means (17) generates at least one actuation signal (35a-35b).

4. System to control the quality of yarn as in any claim hereinbefore, in which the data processing and control means (17) in controlling the tension of the yarn (12) converts the electrical signal (16) into voltage, which is compared with a determined reference value so as to generate a voltage differential signal (42).

5. System to control the quality of yarn as in Claim 4, in which, when the voltage differential signal (42) exceeds a given pre-set threshold, the data processing and control means (17) generates at least one actuation signal (35a-35b).

6. Device to control the quality of yarn, which is suitable to be integrated in a system according to any claim hereinbefore and comprises an arm (14) secured to the structure of the machine and bearing a yarn-guide loop (11) solidly fixed to the arm (14), the device being characterised in that at least one piezoelectric sensor (13) is fitted lengthwise and solidly to the arm (14).

7. Device to control the quality of yarn as in Claim 6, in which the piezoelectric sensor (13) is associated with a hollow (18) contained in the arm (14).

8. Device to control the quality of yarn as in Claim 6 or 7, in which the piezoelectric sensor (13) cooperates with a reduction of section (18) of the arm (14).

9. Device to control the quality of yarn as in Claim 6 to 8, in which the arm (14) includes a covering and protective element (21) in correspondence with the piezoelectric sensor (13).

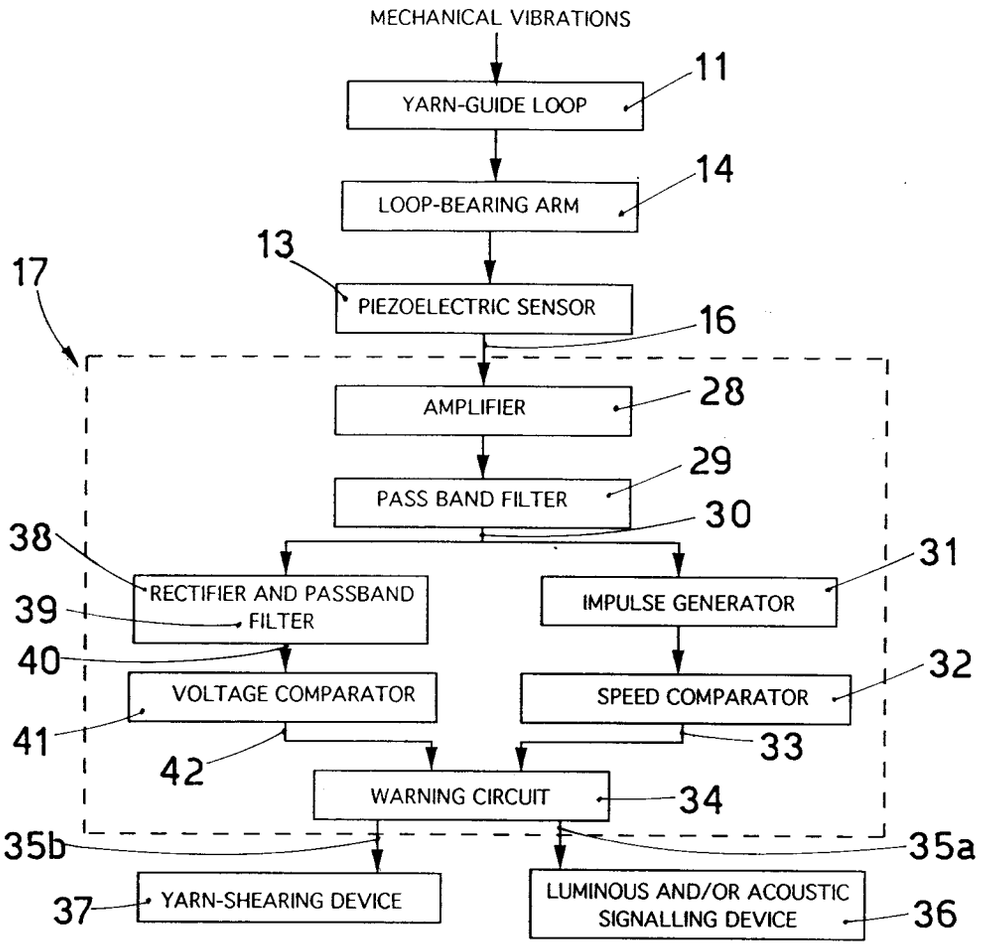
MECHANICAL VIBRATIONS
YARN-GUIDE LOOP
11
LOOP-BEARING ARM
14
13
PIEZOELECTRIC SENSOR
17
16
AMPLIFIER
28
PASS BAND FILTER
29
30
38
RECTIFIER AND PASSBAND FILTER
39
IMPULSE GENERATOR
31
40
VOLTAGE COMPARATOR
SPEED COMPARATOR
32
41
42
33
WARNING CIRCUIT
34
35b
35a
37
YARN-SHEARING DEVICE
LUMINOUS AND/OR ACOUSTIC SIGNALLING DEVICE
36

fig.1

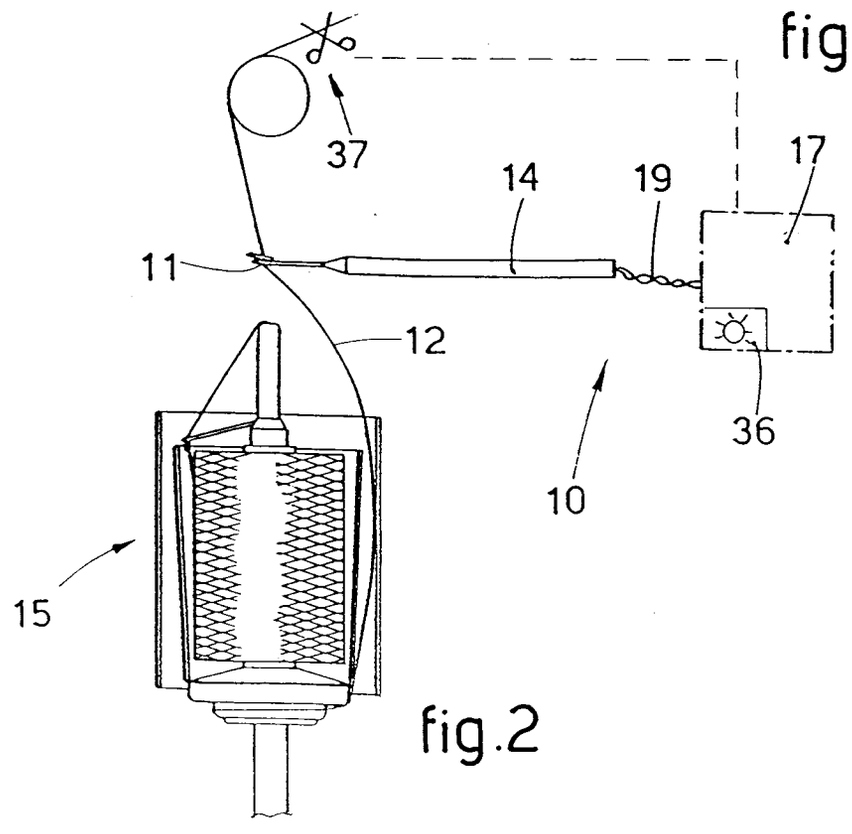
37
14
19
17
11
12
36
10
15

fig.2

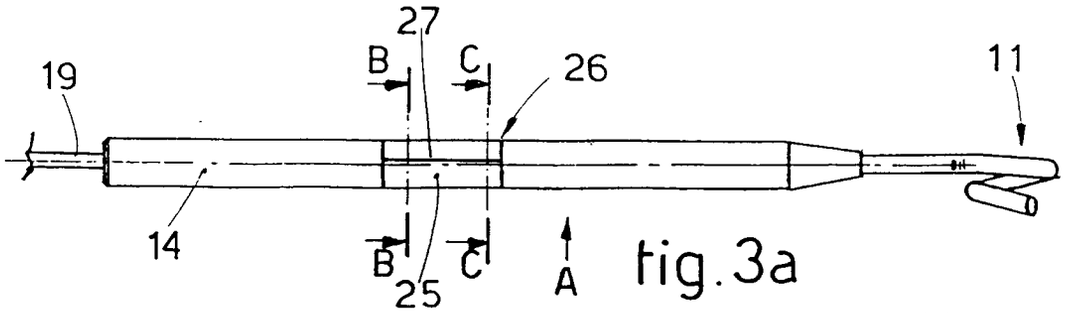

fig.3a

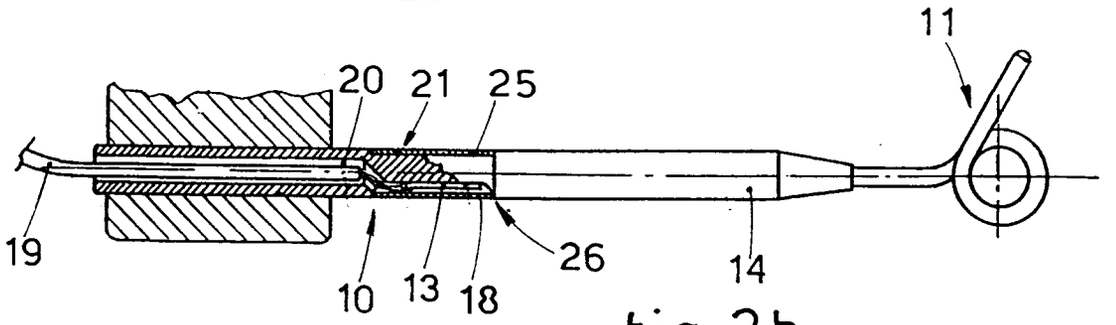

fig.3b

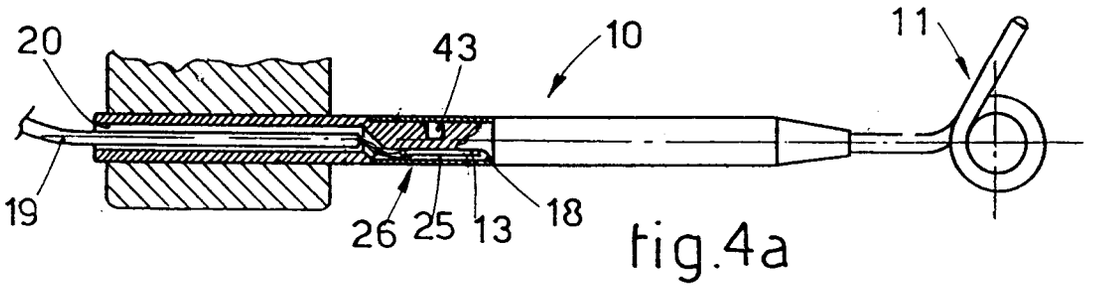

fig.4a

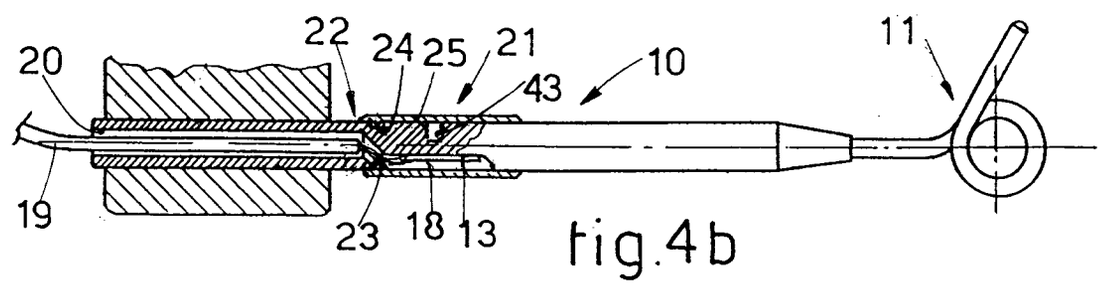

fig.4b

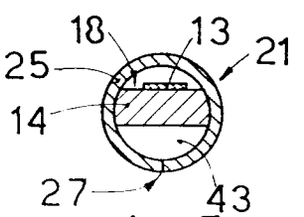

fig.5a

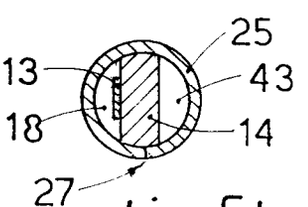

fig.5b

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EUROPEAN SEARCH REPORT

Application Number
EP 94 10 1790

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
Y,D	DE-A-40 10 318 (MURATA KIKAI) * the whole document *	1,6-9	D01H13/16 B65H63/032
Y,D	FR-A-2 267 399 (PALITEX PROJECT-COMPANY) * page 6, line 16 - line 28; claims 1,8 *	1,6-9	
A,D	GB-A-2 023 671 (SHINZO KITAMURA) * the whole document *	1,6-9	
A	EP-A-0 436 204 (MASCHINENFABRIK RIETER) * the whole document *	1,6-9	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

D01H
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 April 1994	Raybould, B

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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