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(54) Yarn tension sensor for yarn-feeding devices

(57) The tension sensor (28) is installable on a yarn feeder (10, 24) for measuring the tension of the delivered yarn, and comprises a support (30), a plate (46) of a ceramic material having a mounting portion (48) anchored to the support (30), and a flexible projection (50) extending from the mounting portion (48) for deviating the unwinding yarn with one of its ends (51) slidably engaged by the yarn. Circuit means (R1, R2, R3, R4, RP1, RP2, RS1, RS2) incorporated in the plate (46) generate variable electric signals as a function of the position of the flexible projection (50). A base of a ceramic material (56) is bonded to the mounting portion (48) by vitrification and is screwed to the support (30).

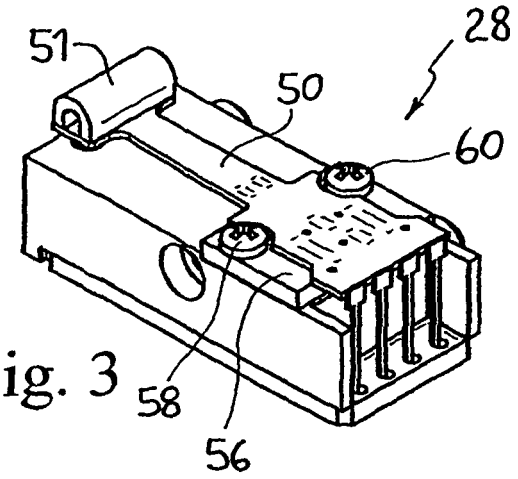

Fig. 3

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Description

[0001] The present invention relates to a yarn tension sensor for yarn-feeding devices.

[0002] As known, in the textile processes yarn-feeding devices are used which draw the yarn from a reel and feed it to a textile machine in a controlled way.

[0003] In particular, so-called "negative" yarn feeders are known, which generally comprise a stationary drum on which a motorized swivel arm winds a plurality of yarn loops forming a weft reserve. Upon request from the textile machine, the loops are unwound from the drum and are fed to the textile machine via a braking device which is controlled on the basis of a signal received from a tension sensor arranged downstream of the feeder, in such a way as to maintain the yarn tension substantially constant at a desired level. An example of this type of control on a negative yarn feeder is disclosed in EP-A-707 102.

[0004] So-called "positive" yarn feeders are also known, which generally comprise a rotating weft-winding drum which draws the yarn from a reel and feed it to the textile machine. In this case, it is also known, e.g. from US 4,752,044 and US 4,953,367, to control the tension of the yarn delivered by the feeder in such a way as to maintain it substantially constant at a desired level, by varying the speed of rotation of the drum on the basis of a signal received from a tension sensor.

[0005] WO 99/59909 describes a tension sensor suitable for applications with both negative and positive yarn feeders. The sensor comprises a plate made of a ceramic material and provided with a flexible projection which is arranged to contact the yarn and to slightly deviate its path, thereby being subjected to the transverse component of the yarn tension. The plate incorporates resistors disposed with the so-called "thick film" technology, which are connected to one another to form a Wheatstone bridge. Some of these resistors are disposed on the flexible projection of the plate, so that their resistance changes as a function of the bending of the projection and also the bridge generates an output signal which changes as a function of the bending of the projection and, consequently, of the yarn tension.

[0006] The plate is fastened to a support anchorable to the feeder, and to this purpose it is clamped between the support and a bracket by a pair of screws. Such fastening method has the advantage that it does not require to change the shape of the plate, which is cut by laser into a standard profile that is accurately defined in order to optimize the response accuracy of the sensor, as well known to the person skilled in the art. However, it also has drawbacks, because the variations in the ambient temperature, as well as the heating due to the operation of the feeder, cause the bracket to bend in a very different way with respect to the plate. The bending of the bracket generates tensions on the flexible projection, which consequently changes its liability to bend, thereby affecting the signal generated by the sensor.

[0007] In the attempt of overcoming the above drawback, it was proposed to glue the plate to the support. However, this fastening system is not feasible, because the glue would continuously be exposed to the oils used in the textile process and therefore it would become less effective and less stable in a short time. Moreover, the glue would also be subjected to uncontrolled thermal distortions, so that this system would not overcome the problem of the low accuracy.

[0008] Therefore, it is a main object of the present invention to improve the accuracy of the yarn tension sensors of the above-mentioned type, by providing a system for fastening the plate to the support which does not require any change to the shape of the plate, and which is substantially unaffected by the variations in temperature in the working environment, so that the operation of the flexible projection is not affected and the signal emitted by the sensor is not distorted.

[0009] The above object and other advantages, which will better appear from the following description, are achieved by the yarn tension sensor having the features recited in claim 1, while the dependent claims state other advantageous, though secondary features of the invention.

[0010] The invention will be now described in more detail, with reference to a few preferred, non exclusive embodiments, shown by way of non limiting example in the attached drawings, wherein:

- Fig. 1 is a view in side elevation of a negative yarn feeder on which a general yarn tension sensor is mounted;
- Fig. 2 is a front view of a positive yarn feeder on which a general yarn tension sensor is mounted;
- Fig. 3 is a perspective view of a yarn tension sensor according to the invention;
- Fig. 4 is an exploded, perspective view of the sensor of Fig. 1;
- Fig. 5 is a perspective view showing an isolated component of the sensor of Fig. 3;
- Fig. 6 diagrammatically shows the electric circuit incorporated in the sensor;
- Fig. 7 is a diagram showing the error of measurement over the temperature in relation to the plate alone, the plate supported according to the prior art, and the plate supported according to the invention;
- Fig. 8 is an exploded, perspective view of a sensor according to an alternative embodiment of the invention;
- Fig. 9 is a diagram showing the error of measurement over the temperature in relation to the plate alone,

the plate supported according to the prior art, and the plate supported according to the alternative embodiment of the invention of Fig. 8.

[0011] With initial reference to Fig. 1, a general, negative yarn feeder 10 is shown, which comprises a stationary drum 12 on which a flywheel 14 driven by a motor 14 winds a plurality of loops of yarn F forming a weft reserve. Upon request from the textile machine (not shown), the loops are unwound from the drum 12 and are fed to the textile machine. The yarn delivered by feeder 10 is clamped between the delivery edge of drum 12 and a hollow, frustoconical braking member 20 controlled by position on the basis of a signal received by a generl yarn tension sensor TS, in such a way as to maintain the yarn tension substantially constant at a desired level. Sensor TS is mounted on a stationary arm 22 and contacts the yarn delivered by the feeder in such a way as to slightly deviate its path, whereby it is subjected to the transverse component of the yarn tension.

[0012] Having now reference to Fig. 2, a general positive yarn feeder 24 is shown, which comprises a rotating weft-winding drum 26 which draws yarn F' from a reel R (only diagrammatically shown) and feed it to the textile machine (not shown). The tension of the yarn delivered by the feeder is controlled to be substantially constant at a desired level, by varying the speed of rotation of drum 26 on the basis of a signal received from a general tension sensor TS' attached to the feeder and subjected to the yarn tension in a way similar to the previous embodiment.

[0013] Having now particular reference to Figs. 3-6, a tension sensor 28 according to the invention is shown, which is suitable for applications with both negative yarn feeders and positive yarn feeders.

[0014] Tension sensor 28 comprises a support or basement 30 having a lower face 32 and an opposite upper face 34 provided with a depression 36 terminating at a longitudinal end of the basement, on which a feeler 38, which will be better described below, is fixed. A printed circuit 40 is attached to lower face 32 by a screw 42 and a nut (not shown) received in a hexagonal seat 44 formed in depression 36. Basement 30 also has a transverse hole 45 in order to be fixed to the feeder by a screw, as shown in Figs. 1, 2.

[0015] Feeler 38 comprises a plate 46 made of a ceramic material and provided with a mounting portion 48 having an elongated flexible projection 50 extending therefrom, which is provided with a sliding block 51 of a semi-cylindrical shape at its free end, on which the yarn is slidable. Flexible projection 50 provides a feeler arm that, in use, deviates the path of the yarn with its sliding block 51, whereby the arm is subjected to the transverse component of the yarn tension.

[0016] In a way known per se, in the area where mounting portion 48 is connected to elongated projection 50, four main resistors R1, R2, R3, R4 are disposed with the so-called "thick film" technology, two of which, R1 and R3, are arranged on the upper surface of plate 46. The other two resistors R2, R4 are arranged on the opposite surface (Fig. 5). The main resistors are connected to one another to form a Wheatstone bridge (Fig. 6). Further four resistors are disposed on mounting portion 48, two of which, RP1 and RP2, are connected in parallel to two main resistors arranged adjacent to each other, R1 and R4 respectively, and are required for the "zero setting" of the bridge. The other two resistors, RS1, RS2, are connected in series to the other two main resistors, R2 and R3 respectively, for the compensation in temperature of plate 46. The four ends of the Wheatstone bridge lead to respective contact pins 52, which are welded to the edge of mounting portion 48 facing away from elongated projection 50, and extend at right angles towards printed circuit 40, where they engage respective rheophores 54. Contact pins 52 are received in a recess 55 formed in the corresponding end of basement 30. In a conventional way, the bridge generates an output signal that changes as a function of the bending of the projection and, consequently, of the yarn tension.

[0017] As shown in detail in Fig. 5, in order to anchor plate 46 to basement 30, a rectangular base 56 of a ceramic material is connected to the lower surface of mounting portion 48 by vitrification. Rectangular base is received in depression 36 and is fastened to the latter by a pair of screws 58, 60 with nuts 62, 64. Screws 58, 60 are inserted in respective holes 66, 68 bored in base 56 at the opposite sides of plate 46, and in respective passages 70, 72 formed in the flat depression 36.

[0018] In Fig. 7, the error of measurement over the temperature, with respect to the plate per se is shown by continuous line, to the plate anchored according to the prior art by dotted lines, and to the plate anchored according to the invention by chain lines. It is evident that the error of measurement D (in grams) over the temperature T (in °C), with a tension sensor according to the invention, is about one tenth of the error with a prior art sensor. This is due to the fact that base 56 does not influences the deformation of elongated projection 50 because it is bonded by vitrification under mounting portion 48, in order to connect plate 46 to basement 30. Therefore, the elongated projection has a characteristic of bending with respect to the temperature that is very similar to the theoretical characteristic, thereby resulting in a more accurate, and more raliable, signal generated by the sensor.

[0019] An alternative embodiment of the invention is shown in Fig. 8, wherein a piece of both sides adhesive tape 158 is used in lieu of the pair of screws with nuts for fastening rectangular base 56 to depression 36.

[0020] The diagram of Fig. 9 is equal to the diagram of Fig. 7, with the addition of double-chain line X that shows the error of measurement with a sensor according to the above-described, alternative embodiment. As apparent from Fig. 9, the error is further reduced with a tension sensor according to this second embodiment.

[0021] A few preferred embodiments of the invention have been described herein, but of course many changes

may be made by a person skilled in the art within the scope of the claims. For instance, other types of anchor means may be used, in lieu of screws or both sides adhesive tapes, for fastening the rectangular base to the support, such as rivets, glue, and the like.

Claims

1. Tension sensor (28) installable on a yarn feeder (10, 24) for measuring the tension of the yarn delivered therefrom, comprising:

   - a support (30),
   - a plate (46) of a ceramic material having a mounting portion (48) anchored to the support (30) by connection means, and a flexible projection (50) extending from the mounting portion (48) for deviating the unwinding yarn with one of its ends (51) slidably engaged by the yarn, and
   - circuit means (R1, R2, R3, R4, RP1, RP2, RS1, RS2) incorporated in the plate (46) and connected to generate variable electric signals as a function of the position of said flexible projection (50),

   characterized in that said connection means comprise a base of a ceramic material (56), which is bonded to said mounting portion (48) by vitrification and is removably anchored to the support (30) by anchor means (58, 60, 62, 64).

2. The tension sensor of claim 1, **characterized in that** said anchor means comprise a pair of screws (58, 60) inserted in respective holes (66, 68) which are bored in respective portions of the base (56) projecting to the opposite sides of said mounting portion (48).

3. The tension sensor of claim 1, **characterized in that** said anchor means comprise a piece of both sides adhesive tape (158) sandwiched between said base (56) and said support (30).

4. The tension sensor of any of claims 1 to 3, **characterized in that** said base (56) is bonded to the surface of the mounting portion (48) facing the support (30).

5. The tension sensor of any of claims 1 to 4, **characterized in that** said mounting portion (48) is received in a depression (36) formed on a face (34) of the support (30).

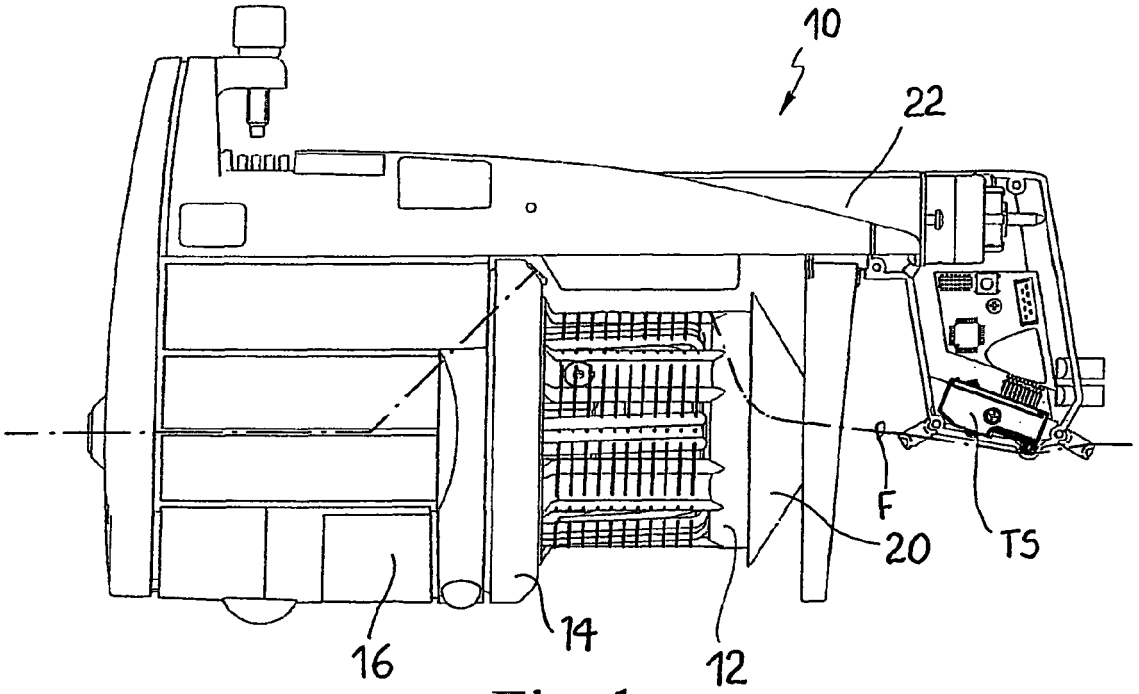

Fig. 1

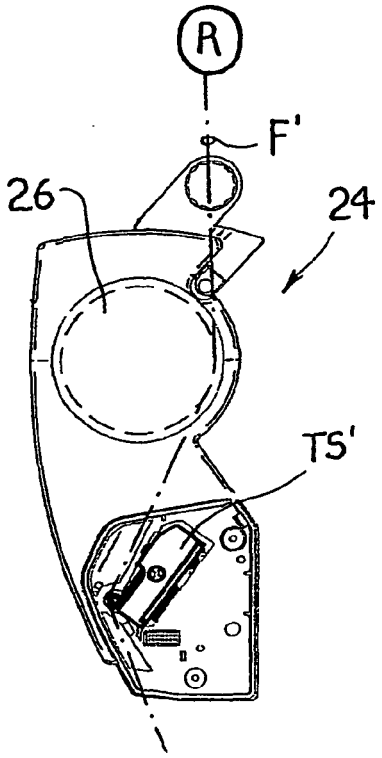

Fig. 2

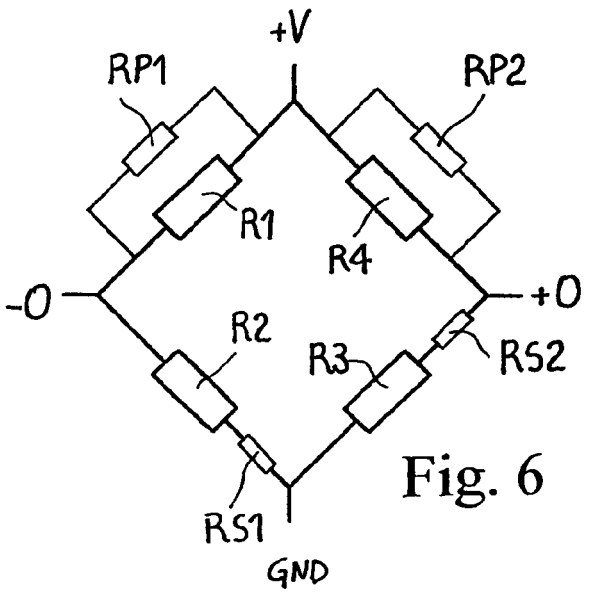

Fig. 6

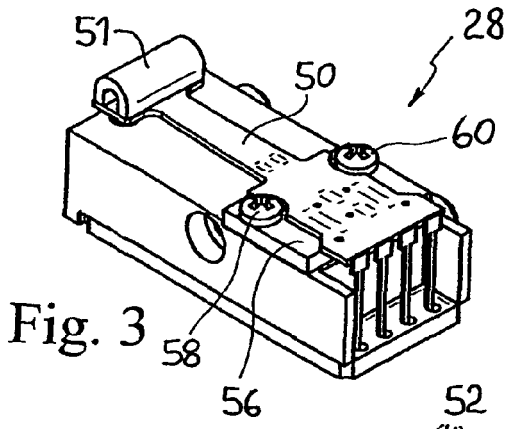

Fig. 3

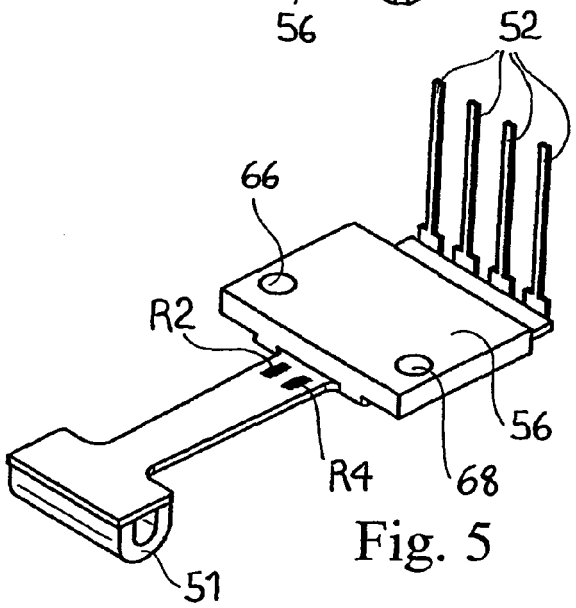

Fig. 5

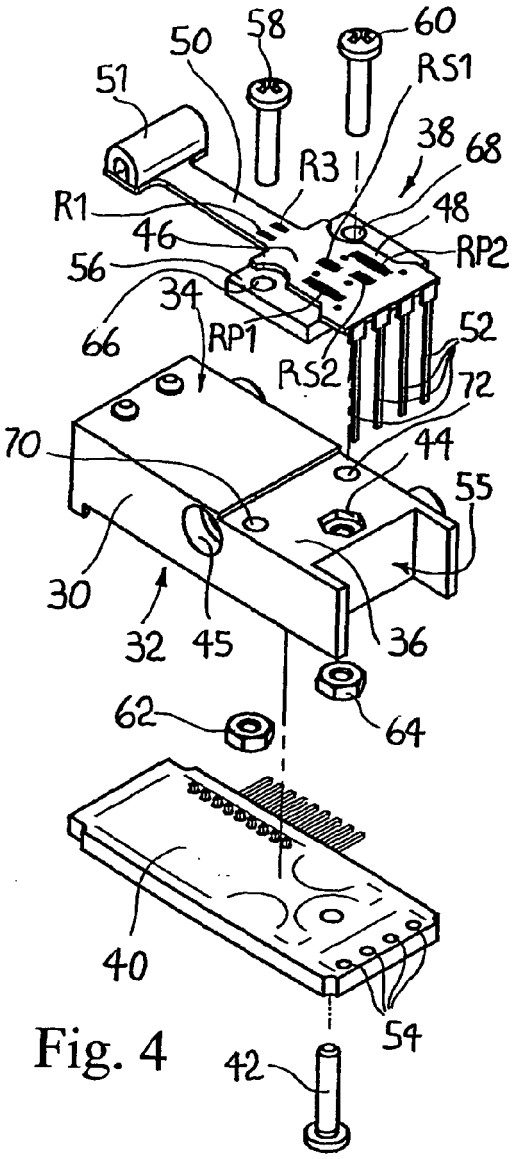

Fig. 4

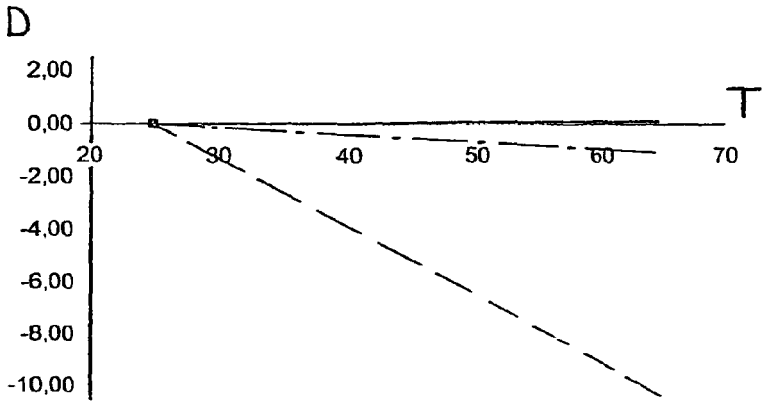

Fig. 7

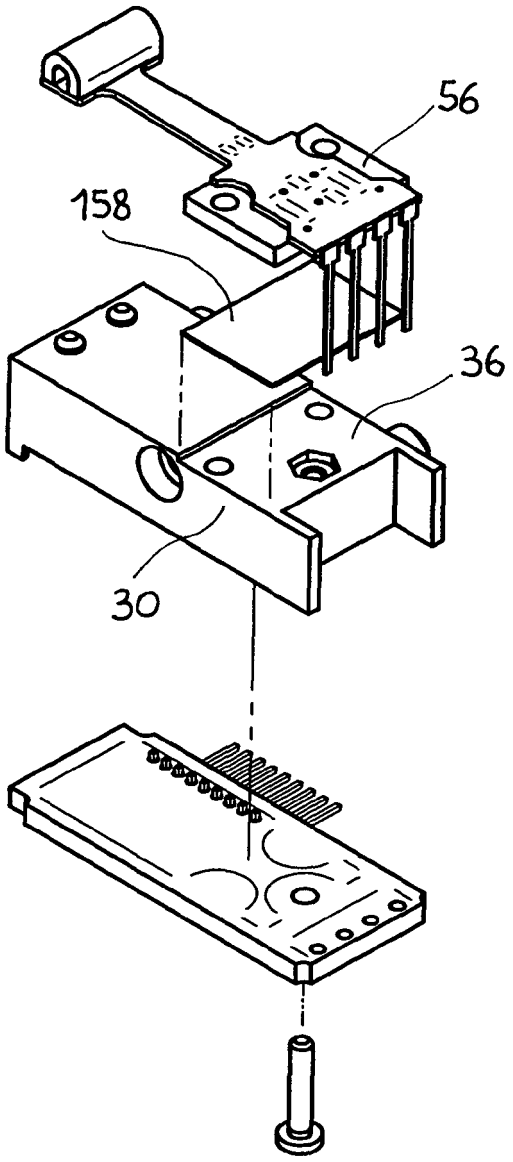

Fig. 8

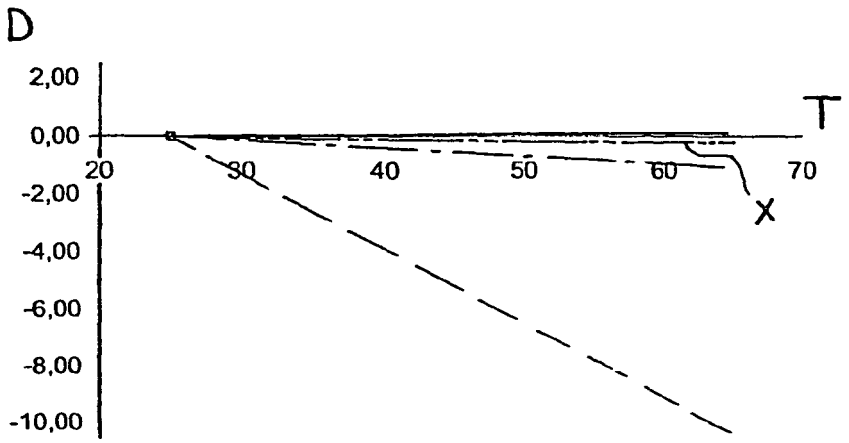

Fig. 9

European Patent Office

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Application Number
EP 08 01 1753

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 July 2008	Lemmen, René

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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- US 4752044 A **[0004]**
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