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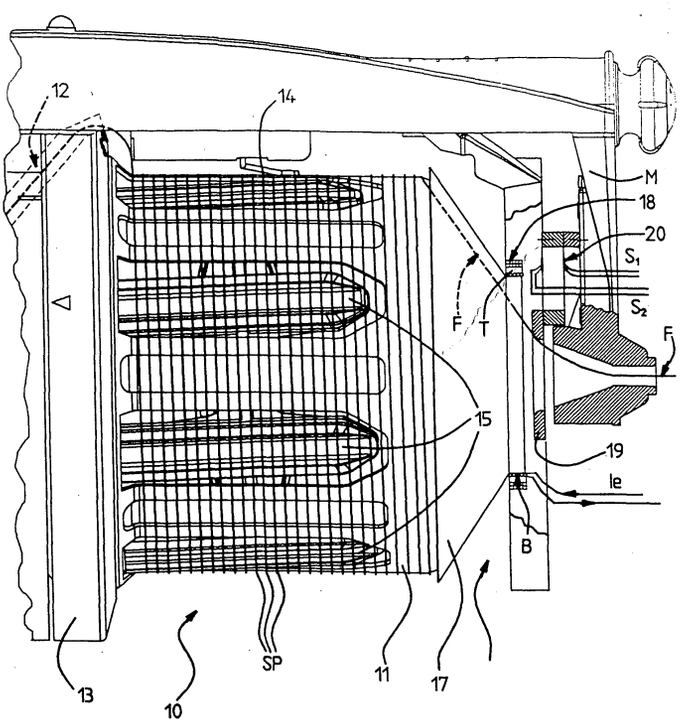
(54) A tension-sensing device for the thread of weft feeders in textile machines

(57) A device for sensing the mechanical tension of the thread (F) and for converting it into electrical signals for driving modulated braking means (17) in weft feeders (10) for textile machines comprises a thread-guiding bush (19) crossed by the thread that unwinds from the drum (11) of the feeder (10) and means (24-25) for sensing and converting the mechanical tension that the thread transmits to the bush. According to the invention, the thread-guiding bush (19) is rigidly coupled to one of the rigid elements of a suspension frame (20) so as to be an integral part thereof, and the frame comprises at least two rigid frame elements (19a-21) and at least two elastically deformable elements (22-23), which are mutually and rigidly connected to each other according to a configuration shaped substantially like an elastically deformable quadrilateral.

Fig. 1



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Description

[0001] The present invention relates to weft feeders for textile machines in general and to an improved device for sensing the mechanical tension of the thread and for converting it into electrical signals for driving modulated braking means of said weft feeders.

[0002] More particularly, the invention relates to weft feeders of the type described in prior European patent No. 0 536 088 in the name of the same Applicant, which comprise a fixed drum, on which a weft reserve is accumulated in the form of turns of thread, and a circular braking body, typically a frustum-shaped body, which is actuated electrodynamically by an excitation current that is modulated according to the variations in the mechanical tension of the thread that unwinds from the drum of the feeder when requested by the textile machine.

[0003] In weft feeders of the specified type, which are assumed to be known to the person skilled in the art and are briefly referenced hereinafter as known feeders, the frustum-shaped braking body is supported by elastic means frontally and coaxially to the drum of the feeder and is pushed by said means into adjustable elastic contact engagement, with its larger cross-section, against said drum along a tangent circumference of the drum that is slightly smaller than the maximum circumference. The thread slides between said braking body and said drum along an inclined path that lies between said tangent circumference of the drum and a thread-guiding bush, typically but not necessarily located at the smaller cross-section of the frustum-shaped braking body. Said braking body is controlled by an electrical actuating means, constituted for example by a linear or rotary motor powered by a modulated excitation current, or consists of an electrodynamic means comprising a coil through which said excitation current flows and which is wound on a cylindrical end portion of the braking means, which lies in the annular gap of a magnetic field source, typically a permanent magnet.

[0004] In known weft feeders of the specified type, the thread-guiding bush is supported at the free end of a moderately elastic supporting rod, whose other end is rigidly coupled, by interlocking, to a rigid support of the braking body.

[0005] Two or more strain gauges are arranged on the supporting rod and are typically inserted in a bridge circuit that is suitable to provide an electrical signal, which depends on the mechanical action applied by the unwinding thread to said thread-guiding bush and is used to modulate said excitation current that powers the actuating means of the braking body: a motor or an electrodynamic coil.

[0006] In such a system for sensing the mechanical tension of the thread, said thread, due to the sliding friction generated by contact with the bush, transmits to its own supporting rod a predominant bending torque in which a torque arm extends from the point of contact between the thread and the thread-guiding bush to the section where the supporting rods interlock. Since the thread travels along the entire circumference of the bush during its unwinding from the drum, the point of contact between the thread and the bush moves cyclically to diametrically opposite points of the bush, periodically changing the extension of the torque arm by a maximum extent that is equal to the diameter of said bush and generating accordingly a corresponding periodic variation of the bending torque that affects its supporting rod. This variation, sensed by the strain gauges associated with the rod, is a considerable noise component for the modulation signal emitted by said bridge circuit and having the purpose of modulating the excitation current that energizes the electric actuating means of the braking body.

[0007] The aim of the present invention, in consideration of the above severe drawback of said known devices for sensing and converting the mechanical tension of the thread, is to eliminate said drawback, and within the scope of this general aim the invention has the particular object of providing an improved sensing and conversion device so as to eliminate any unwanted periodic and non-periodic component added to the variable mechanical tension generated in the thread due to the sliding of said thread in order to transmit a stress that corresponds strictly and exclusively to said mechanical tension to the sensing elements provided for converting it into the electrical signal for modulating the excitation current of the actuating means of the braking body.

[0008] According to the present invention, the above object as well as others that will become better apparent from the detailed description that follows are achieved with an improved device for sensing and converting the mechanical tension of the thread having the specific characteristics defined in the claims that follow.

[0009] Substantially, the invention is based on the concept of suspending the thread-guiding bush, rather than from a supporting rod, from an elastically deformable frame of the type described in prior US patent no. 4,300,648, in which some of the frame elements perform, when said frame undergoes a deformation, movements that depend on the intensity of the actuating forces but are substantially independent of the point of application of said forces and in which the deformable elements of the frame are provided with load sensing means.

[0010] In accordance with this concept, the present invention relates to an improvement to devices for sensing and converting the mechanical tension of the thread in weft feeders, which consists of the fact that the thread-guiding bush in which the thread that unwinds from the feeder drum slides is rigidly coupled to a suspension frame in order to form an integral part thereof, said frame comprising at least two rigid frame elements and at least two elastically deformable elements, which are mutually and rigidly connected to each other according to a configuration shaped substantially like an elastically deformable quadrilateral in which said bush, due to the

force transmitted thereto by the thread that passes through it, moves parallel to itself; at least one of the elastically deformable elements of the frame being provided with the pair of strain gauges that compose the bridge circuit that generates the modulation signal, which corresponds to the mechanical tension of the thread, for modulating the excitation current of the electrical means for the modulated actuation of the braking body of the feeder.

[0011] The features, purposes and advantages of the improved sensing and conversion device according to the invention will become better apparent from the detailed description that follows with reference to the accompanying drawings, given only by way of non-limitative example and wherein:

Figure 1 is a side elevation view of the front portion of a weft feeder with the improved device for sensing and converting the mechanical tension of the thread;

Figure 2 is an enlarged-scale view of a detail of Figure 1;

Figure 3 is a view taken in the direction of arrows III-III of Figure 2.

[0012] In the drawings, reference number 10 generally designates the front part of a known weft feeder, which comprises a fixed drum 11 on which a swivel arm 12, associated with a flywheel 13 arranged at the base of the drum 11, winds a plurality of turns SP of thread F which constitute a weft reserve. When requested by the textile machine, loops of thread SP unwind from drum 11 in order to feed said machine, and a known system of sensors, which comprises a feeler 14 for sensing the weft reserve and additional magnetic and/or optical sensors, not shown, monitors the weft reserve and actuates swivel arm 12 as the loops unwind from drum 11. A set of rods 15, cyclically protruding from the side wall of drum 11, moves the rewound loops along said drum, thus replenishing said reserve.

[0013] In its unwinding motion, the thread is controlled by a braking means, generally designated by reference number 16, which maintains substantially constant the mechanical tension of the thread as the advancement speed of said thread varies. For this purpose, there is a braking means comprising, in a manner known per se, a frustum-shaped body 17, which is pushed by the adjustable elastic action of suspension means, not shown, against drum 11, and acts on thread F, which as it unwinds from drum 11 slides between said drum and the frustum-shaped body 17.

[0014] The braking action applied by body 17 to the thread is modulated electrically. More particularly, the described feeder 10 is of the type in which the braking action is modulated electrodynamically by the reaction of an excitation current Ie that flows through a coil B, which is associated with the smaller end section of the frustum-shaped body 17 and moves in the annular gap T of the circular side wall 18 of a permanent magnet that is suspended frontally and coaxially to drum 11. Said excitation current is modulated, according to the variations of the mechanical tension of the advancing thread, by the signal produced by a bridge circuit (not shown), which comprises at least two strain gauges or load cells which are sensitive to the mechanical tension with which thread F affects a thread-guiding bush 19, which is located at the smaller section of braking body 17 and in which the thread that unwinds from the drum 11 slides. Due to the rotary motion of the turns of thread that unwind from drum 11, the point P of contact between thread F and bush 19 (Figure 2) moves along the internal circumference of said bush, moving cyclically to diametrically opposite points, as shown by P-P' in the figure.

[0015] According to the present invention, the thread-guiding bush 19 is rigidly coupled to a suspension frame 20, so as to be integral with it; the frame comprises at least two rigid frame elements and at least two elastically deformable elements, which are mutually rigidly connected to each other according to a configuration that is substantially shaped like an elastically deformable quadrilateral.

[0016] More specifically, one of the rigid elements of frame 20 is constituted by a rigid support 19a for connecting bush 19 and the other rigid element is constituted by a coupling bar 21 that is meant to connect frame 20 to a support M of feeder 10, while both of the elastically deformable elements are constituted by corresponding metal leaves 22 and 23, in which one end is rigidly coupled to the rigid support 19a and the other end is rigidly coupled to bar 21.

[0017] Strain gauges 24 and 25 are arranged on the metal leaves 22 and 23 and are suitable to produce corresponding electrical signals S1-S2 that are proportional to the deformations of the individual leaves. In a per se known manner, the strain gauges 24-25 are inserted in said bridge circuit that provides the signal for modulating the excitation current Ie that produces the modulated actuation of the braking body 17.

[0018] In the improved system described above, said bush 19, which constitutes substantially an integral part of one of the rigid elements of its own deformable suspension frame 20, due to the force transmitted thereto by the thread F that passes through it, moves parallel to itself, and this characteristic operating mode, in accordance with the stated purpose, prevents, as is clearly evident to the person skilled in the art, the mechanical tension that acts on the thread and is sensed by the strain gauges 24 and 25 from being altered by the periodic movement of the point of contact P between the thread F and the bush 19.

[0019] Without altering the concept of the invention, the details of execution and the embodiments may of course be altered extensively with respect to what has

been described and illustrated by way of non-limitative example without thereby abandoning the scope of the invention.

Claims

1. A device for sensing the mechanical tension of the thread (F) and for converting it into electrical signals for driving modulated braking means (17) in weft feeders (10) for textile machines, of the type that comprises a thread-guiding bush (19) crossed by the thread that unwinds from the drum (11) of said feeder (10), and means (24-25) for sensing and converting the mechanical tension that the thread transmits to said bush, **characterized in that** the thread-guiding bush (19) is rigidly coupled to one of the rigid elements of a suspension frame (20) so as to be an integral part thereof, said frame comprising at least two rigid frame elements (19a-21) and at least two elastically deformable elements (22-23), which are rigidly connected to each other according to a configuration shaped substantially like an elastically deformable quadrilateral in which said bush (19), due to the force transmitted thereto by the thread that passes through it, moves parallel to itself.

2. The device of claim 1, **characterized in that** the rigid elements of the suspension frame (20) of the bush (19) are constituted respectively by a rigid support (19a) to which said bush (19) is rigidly coupled and by a coupling bar (21) for connecting the frame (20) to the weft feeder (10) and **in that** both of the elastically deformable elements are constituted by respective metal leaves (22 and 23).

3. The device of claim 1 or 2, **characterized in that** said metal leaves (22-23) both have one end that is rigidly coupled to said rigid support (19a) of the bush (19) and another end that is rigidly coupled to said coupling bar (21).

4. The device of any of claims 1 to 3, **characterized in that** each of said metal leaves (22-23) supports a means for sensing and converting the mechanical tension of the thread (F), and **in that** said means comprise respective strain gauges (24-25) inserted, in a manner known per se, in a bridge-like circuit that provides the signal for modulating the excitation current (Ie) to cause the modulated actuation of the braking body (17).

Fig. 1

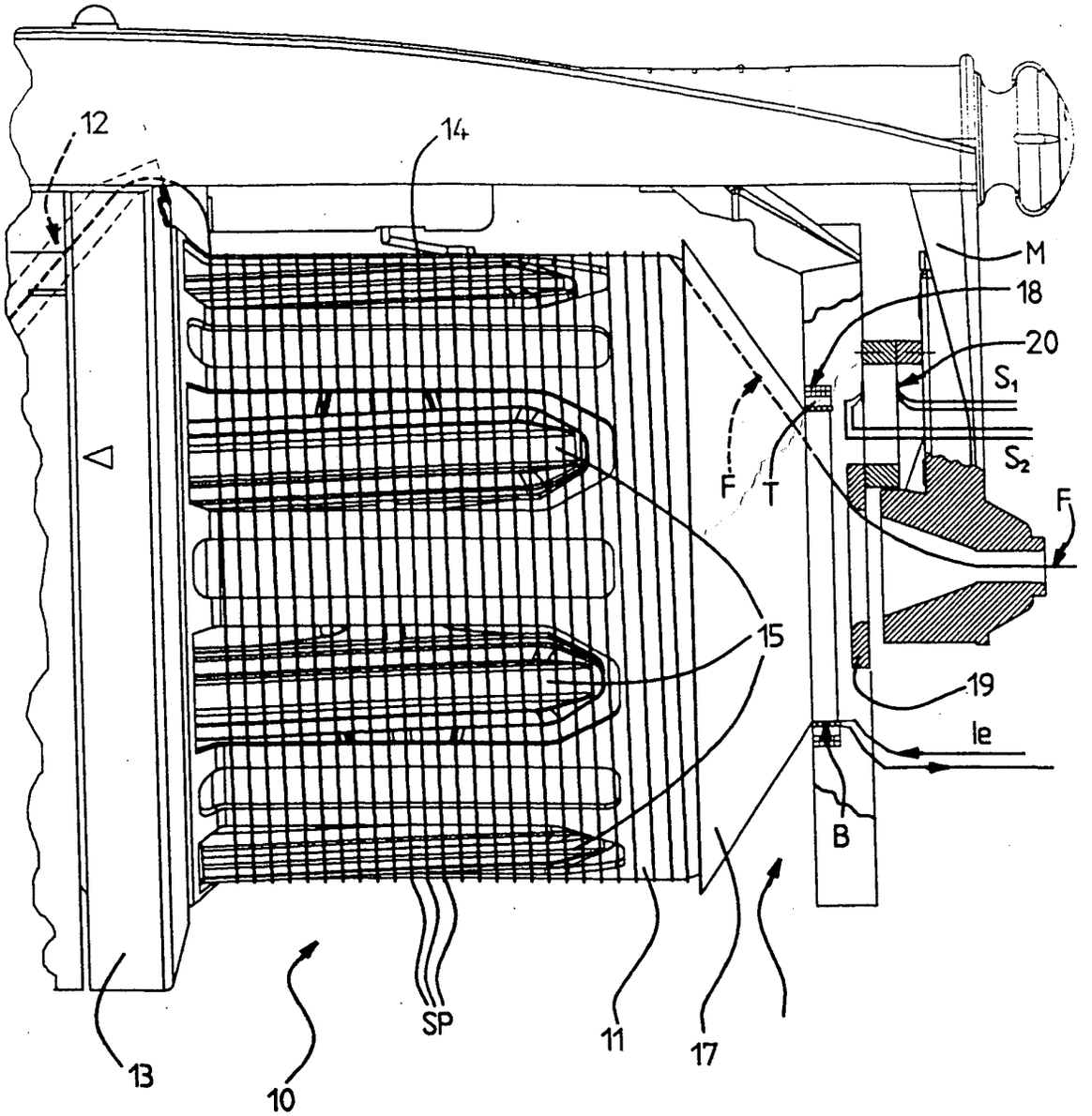

Fig. 2

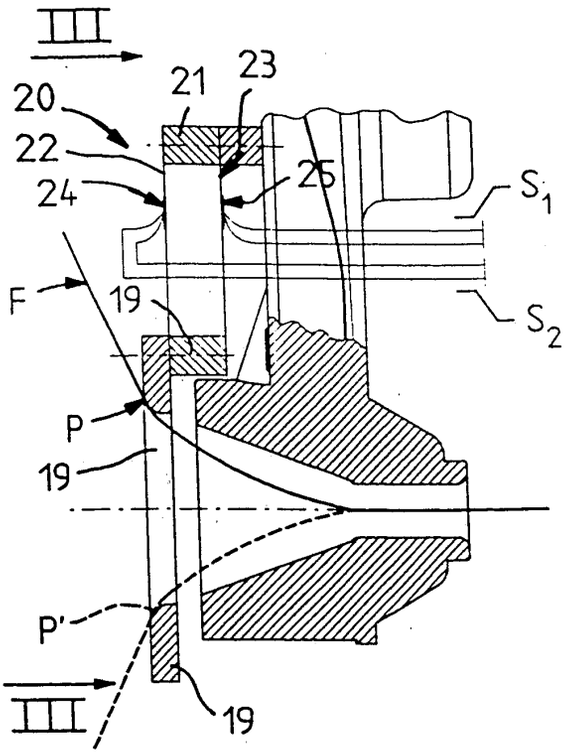

Fig. 3