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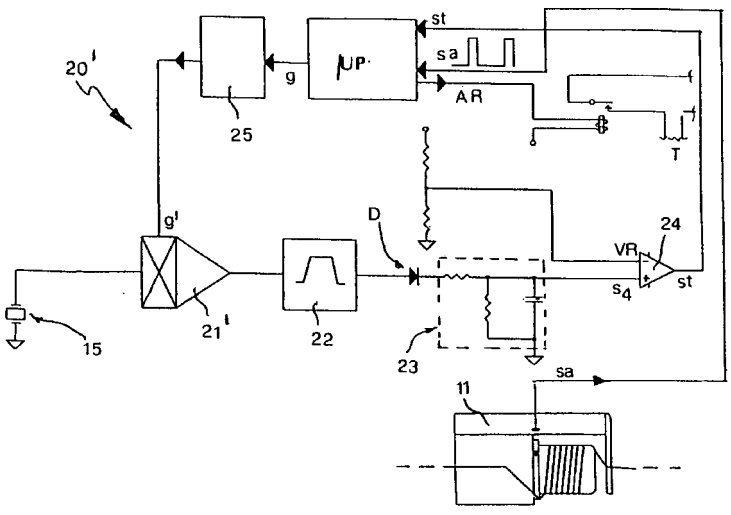
(54) Method and device for weft yarn monitoring in weaving processes and the like

(57) A method for monitoring weft yarn in weaving processes in which the weft yarn is fed to the loom (T) by means of a feeder (11) with a windmilling arm for depositing a weft reserve. The method comprises the steps of: generating a signal indicating the presence of the yarn at the input of the feeder (11); amplifying and rectifying the signal; and comparing the signal with a parametric reference voltage (VR) in order to obtain a signal for halting the loom in the absence of the yarn presence signal. In order to prevent an excessively weak presence signal from failing to halt the loom (T) when the yarn breaks, the method is improved by adding the additional steps of correspondingly varying the amplification gain of the presence signal and/or the parametric reference voltage (VR) as one or more factors of the weaving process (yarn count and type, travel speed, mechanical tension) vary correspondingly.

Fig. 2



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Description

[0001] The present invention relates to a method and a device for weft yarn monitoring in weaving processes.

[0002] It is well-known to experts in the field that in weaving processes the weft yarn is fed to the loom by means of weft feeders, which are devices equipped with a fixed drum and with a windmilling arm which winds onto the drum a plurality of turns of yarn which constitute a weft reserve. The turns unwind in a controlled manner from the drum when required by the loom at each beat.

[0003] It is also known to use, in said weft feeders, sensors which are adapted to detect the presence of the yarn at the input of the feeder. Their purpose is to indicate whether the weft yarn has broken, so that a monitoring system associated with the feeder can send halting information for the loom and halt said loom before the weft reserve of said feeder is used up completely by said loom; this circumstance can cause gaps in the fabric being woven and in any case forces one to rethread the entire feeder, with consequent prolonged suspensions of the weaving process.

[0004] Conventional sensors that are normally used for this purpose are piezoelectric sensors provided with a piezoelectric plate which acts as a sensitive element and is coupled to at least one ceramic element which acts as a yarn support. The yarn slides on the ceramic element, generating a vibration which is transmitted to the piezoelectric plate, which in turn generates a substantially pulsed voltage which constitutes the yarn presence signal.

[0005] As an alternative to the piezoelectric sensor, load cells are also used which are adapted to produce an electric signal which is proportional to the mechanical tension of the yarn. In any case, the signal produced by the sensor is processed in a known manner in an amplifier and discriminator circuit, for example of the type shown in Figure 1 and described hereinafter, and is applied to a microprocessor in the form of a high or low digital signal which is present at the output of a final comparator of the circuit; the microprocessor is adapted to generate a loom halt signal if the weft presence signal provided by the sensor is missing.

[0006] This conventional weft yarn monitoring system has many drawbacks, the main one being the extreme sensitivity of the system to various factors, hereinafter concisely termed weaving factors, such as in particular the roughness and count of the yam, the speed with which the yarn slides on the presence sensor of the feeder and/or the mechanical tension with which it adheres to it.

[0007] Typically, the relation between the signal emitted by the sensor, whether piezoelectric or load-sensing, and the weaving factors is an increasing relation, in that the higher the roughness and/or travel speed and/or contact tension of the yarn, the higher the intensity of the signal emitted by the sensor. This causes considerable difficulties in the operation of the above-described monitoring system, since when several weaving factors have very small values, the intensity of the signal emitted by the sensor may be insufficient with respect to the comparison threshold, so that the system generates a false halt of the loom.

[0008] On the other hand, the amplification of the presence sensor signal cannot be excessively high and the comparison threshold cannot be excessively low, since this would cause, in the presence of high-value weaving parameters and therefore of a correspondingly high presence signal, an undesirable amplification of the noise associated with the high signal, for example resonance noise which, by exceeding the comparison threshold, would in turn cause the system to fail to intervene.

[0009] In the hope of obviating these drawbacks, it has been proposed to introduce a delay between the interruption of the signal produced by the weft presence sensor and the loom halting signal in order to extract, from such delay, a criterion of assurance that the weft yam has actually broken.

[0010] However, a system of this type, disclosed in Swiss patent application No. 2568872/78, has the drawback, in case of high operating speeds of the loom and therefore of high travel speeds of the weft yarn (for example 900 meters per minute or more), of not ensuring that the loom stops in time when the yarn breaks, consequently using up the weft reserve provided on the feeder.

[0011] A partial solution to this problem is disclosed in European patent No. 325.793 and consists in rendering the delay variable in inverse proportion to the yarn travel speed. However, also this solution is not free from drawbacks, since the signal emitted by the presence sensor at low yarn travel speeds, by being very low in intensity, can require excessive intervention delays in order to assuredly appreciate its absence and discontinuity, and therefore the instability of the operation of the monitoring system at the low yarn travel speeds may be unacceptable.

[0012] The aim of the present invention, starting from the notion of the drawbacks of conventional monitoring methods and systems, is to eliminate them, and within the scope of this aim the invention has the important particular object of providing a monitoring method and device which ensure prompt and assured intervention of the loom halting system even in the presence of highly unfavorable weaving factors, particularly low yarn travel speeds and in the presence of low-count yarns with high surface continuity (for example glossy yarns).

[0013] Another important object of the present invention is to provide a monitoring device which is simple and reliable and is entirely constituted by solid-state electronic components and has absolutely no mechanical elements that interact with the monitored weft yarn.

[0014] According to the present invention, this aim,

these objects and others which will become apparent from the detailed description that follows are achieved with a monitoring method and device having the specific characteristics stated in the appended claims.

[0015] Substantially, the invention is based on the concept of monitoring the weft yarn by means of a system which has means for amplifying the signal produced by a weft presence sensor and means for comparing the amplified signal of the sensor with a parametric reference voltage and to correspondingly vary, in said system, the amplification gain and/or the parametric reference voltage as the value of one or more weaving factors varies correspondingly.

[0016] Typically, according to the invention there is a monitoring system with an amplifier and a comparator for processing the weft presence sensor signal, in which a signal which is proportional to the rotation rate of the windmilling arm of the feeder is sent to the microprocessor that controls the entire weaving process and provides, on a dedicated output, a system adjustment signal which is inversely proportional to said rotation rate; said adjustment signal being adapted to vary the gain of said amplifier, decreasing as said rotation rate increases and increasing it as said speed decreases.

[0017] As an alternative, the microprocessor is programmed in order to generate an adjustment datum, in terms of parametric comparison voltage, which is directly proportional to said rotation rate, so as to increase the parametric reference voltage applied to the comparator means as said rotation rate increases and so as to decrease the voltage as the rate decreases.

[0018] Further characteristics and advantages of the monitoring method and device according to the present invention will become apparent from the detailed description that follows and with reference to the accompanying drawings, given by way of non-limitative example, wherein:

Figure 1 is a schematic functional circuit diagram of a conventional weft yarn feeding and monitoring system;

Figure 2 is a circuit diagram, similar to Figure 1, of the monitoring system according to a first embodiment of the present invention;

Figure 2a plots the variation of the amplification gain in relation to the rotation rate of the feeder in the improved monitoring system of Figure 2;

Figure 3 is a circuit diagram, similar to Figure 1, of the monitoring system according to a second embodiment of the invention;

Figure 3a plots the variation of the parametric reference voltage in relation to the rotation rate of the feeder in the improved monitoring system of Figure 3.

[0019] Initially with reference to Figure 1, the reference sign T generically designates a weaving loom, for example of the high-speed type; the reference numeral 10 designates a conventional system for feeding the weft yarn F to the loom T; and the reference numeral 20 designates the equally known system for monitoring the weft yarn F.

[0020] The system 10 substantially comprises a weft feeder 11 with a fixed drum 12 on which a windmilling arm, associated with a rotating disk 13 arranged at the base of the drum, winds a plurality of turns of yarn F, which unwinds from a spool 14; said turns constitute a weft reserve RT.

[0021] At the input of the weft feeder 11 there is a sensor 15 which is meant to report any yarn breakage to the monitoring system 20, so that the system 20 promptly halts the loom T before said loom uses up entirely the weft reserve RT.

[0022] In a per se known manner, the system 20 comprises an amplifier 21, to which the signal s1 from the sensor 15 is applied; the amplifier is followed by a bandpass filter 22, whose output signal s3 is first rectified by a diode D and then filtered by a low-pass filter 23 constituted by a unit R1-C1 with which a resistor R2 for discharging the capacitor C1 is associated. The rectified and filtered output signal s4 is applied to the positive input of a comparator 24 which compares signal s4 with a DC reference voltage VR, providing on its output U a high (digital) signal st when s4 is higher than VR (presence of weft yarn F) and, vice versa, a low signal (lack of weft yarn F) when s4 is smaller than VR. In the latter case, a microprocessor μP, which receives the signal st on a dedicated input, emits on one of its outputs a halting signal AR for the loom T.

[0023] In order to achieve the stated aim and objects, according to the present invention the above-described monitoring system is improved as shown in Figure 2, in which similar or corresponding components are designated by the same reference numeral and which shows that said improved system, generally designated by the reference numeral 20', comprises an input amplifier 21' of the variable-gain type, driven by the signal that is present at the output of a digital/analog converter 25 which receives in input a datum supplied by the microprocessor μP. The microprocessor receives, on one of its inputs, a signal sa which originates from the feeder 11 and is proportional to the rotation rate W of the windmilling arm of the feeder and is programmed so that the signal that controls the gain G of the amplifier 21' varies substantially in inverse proportion to the signal sa related to the rotation rate W. Accordingly, the gain G of the amplifier 20' (and, correspondingly, the signal s4 applied to the comparator 24) vary as shown in the chart of Figure 2a, decreasing as the rotation rate W increases and increasing as said rate decreases.

[0024] In the second embodiment of Figures 3 and 3a, the microprocessor μP of the monitoring system 20" is programmed so as to generate a datum VR which can vary in direct proportion to the signal sa that corresponds to the rotation rate W and is applied to a con-

verter 25''. At the output of the converter, therefore, there is a datum VR'' expressed in voltage terms, which is adapted to be applied to the comparator 24, in order to supply a parametric comparison voltage which, as clearly shown in Figure 3a, is directly proportional to the rotation rate W of the feeder 11, i.e., it increases and decreases as said rotation rate increases and decreases.

[0025] 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.

[0026] In particular, it is possible to combine in a single monitoring system both the control of the gain of the amplifier 21' and the control of the reference voltage VR on the comparator 24 as described in detail for each one of said above-described and separately considered systems.

[0027] The disclosures in Italian Patent Application No. TO99A000204 from which this application claims priority are incorporated herein by reference.

[0028] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A method for monitoring weft yarn in weaving processes in which the weft yarn (F) is fed to the weaving loom (T) by means of a feeder (11) with a windmilling arm for depositing a plurality of turns of yarn (F) which constitute a weft reserve (RT), said method comprising the steps of: generating a signal (s1) indicating the presence of the yarn at the input of said feeder (11); amplifying and rectifying said signal; and comparing said signal with a parametric reference voltage (VR) in order to obtain a signal for halting the loom in the absence of said yarn presence signal (s1), characterized in that it comprises the additional steps of correspondingly varying the amplification gain (G) of said presence signal (s1) and/or said parametric reference voltage (VR) as one or more factors of the weaving process vary correspondingly.

2. The monitoring method according to claim 1, characterized in that said factors of the weaving process comprise yarn count and type, travel speed and mechanical tension.

3. The monitoring method according to claim 1, characterized in that said gain (G) and/or said parametric reference voltage (VR) are varied in relation to the variation of the yarn travel speed, measured by detecting the rotation rate (W) of the windmilling arm of said weft feeder (11).

4. The monitoring method according to claim 3, characterized in that it comprises the step of generating a signal (sa) which is proportional to the rotation rate (W) of the windmilling arm of the feeder (11) and of sending said signal (sa) to a microprocessor (μP) which is programmed in order to provide, on one of its outputs, a variable adjustment signal (g') which is adapted to correspondingly vary the amplification gain (G) of said yarn presence signal (s1) in inverse proportion to said rotation rate (W), decreasing the gain (G) as the rotation rate (W) increases and increasing it as said rate decreases, in order to avoid generating false halting signals (AR) for the loom (T).

5. The monitoring method according to claim 3, characterized in that it comprises the step of generating a signal (sa) which is proportional to the rotation rate (W) of the windmilling arm of the feeder (11) and of sending said signal (sa) to a microprocessor (μP) which is programmed in order to supply an adjustment datum (VR''), in terms of parametric comparison voltage, which is directly proportional to said rotation rate (W) so as to increase the parametric reference voltage (VR), with which the amplified and rectified yarn presence signal (s4) is compared, as the rotation rate (W) increases, and so as to decrease said parametric voltage (VR) when said rotation rate decreases, in order to avoid generating false halting signals (AR) for the loom (T).

6. A device for monitoring weft yarn (F) for performing the monitoring method according to claim 1, comprising amplifier means (21') for a yarn presence signal (s1) generated by a sensor (15) which is arranged at the input of a weft feeder (11) with a windmilling arm which winds a weft reserve (RT) on the drum of said feeder (11), and comparator means which generate a signal (AR) for halting the loom (T) and are adapted to compare said presence signal (s1) with a parametric reference voltage (VR), characterized in that it comprises means (21'-μP) which are sensitive to the rotation rate (W) of said windmilling arm in order to vary the gain of said amplifier means (21') in inverse proportion to said rotation rate (W) and/or means (μP) for varying the parametric reference voltage (VR) supplied to said comparator means (24) in direct proportion to said rotation rate (W).

7. The device for monitoring weft yarn (F) according to claim 6, characterized in that said amplifier means

comprise a variable-gain amplifier (21'), and in that the gain (G) of said amplifier is made to vary in inverse proportion to the rotation rate (W) of said feeder (11) by a correspondingly variable signal (g') which is generated by a microprocessor (μP) which receives in input a signal (sa) which is proportional to said rotation rate (W).

8. The device for monitoring weft yarn (F) for performing the method according to claim 6, characterized in that it comprises a microprocessor (μP) which receives in input a signal (sa) which is proportional to the rotation rate (W) of said windmilling arm and is programmed to generate a variable adjustment datum (VR"), in terms of parametric comparison voltage fed to said comparator means (24); said voltage datum (VR") being variable in direct proportion to the rotation rate (W) of said windmilling arm.

9. The device according to claims 6, 7 or 8, characterized in that said sensor (15) that generates the signal (s1) that indicates the presence of the yarn (F) is of the piezoelectric type.

10. The device according to claims 6, 7 or 8, characterized in that said sensor (15) that generates the signal (sa) that indicates the presence of the yarn (F) is constituted by a load cell.

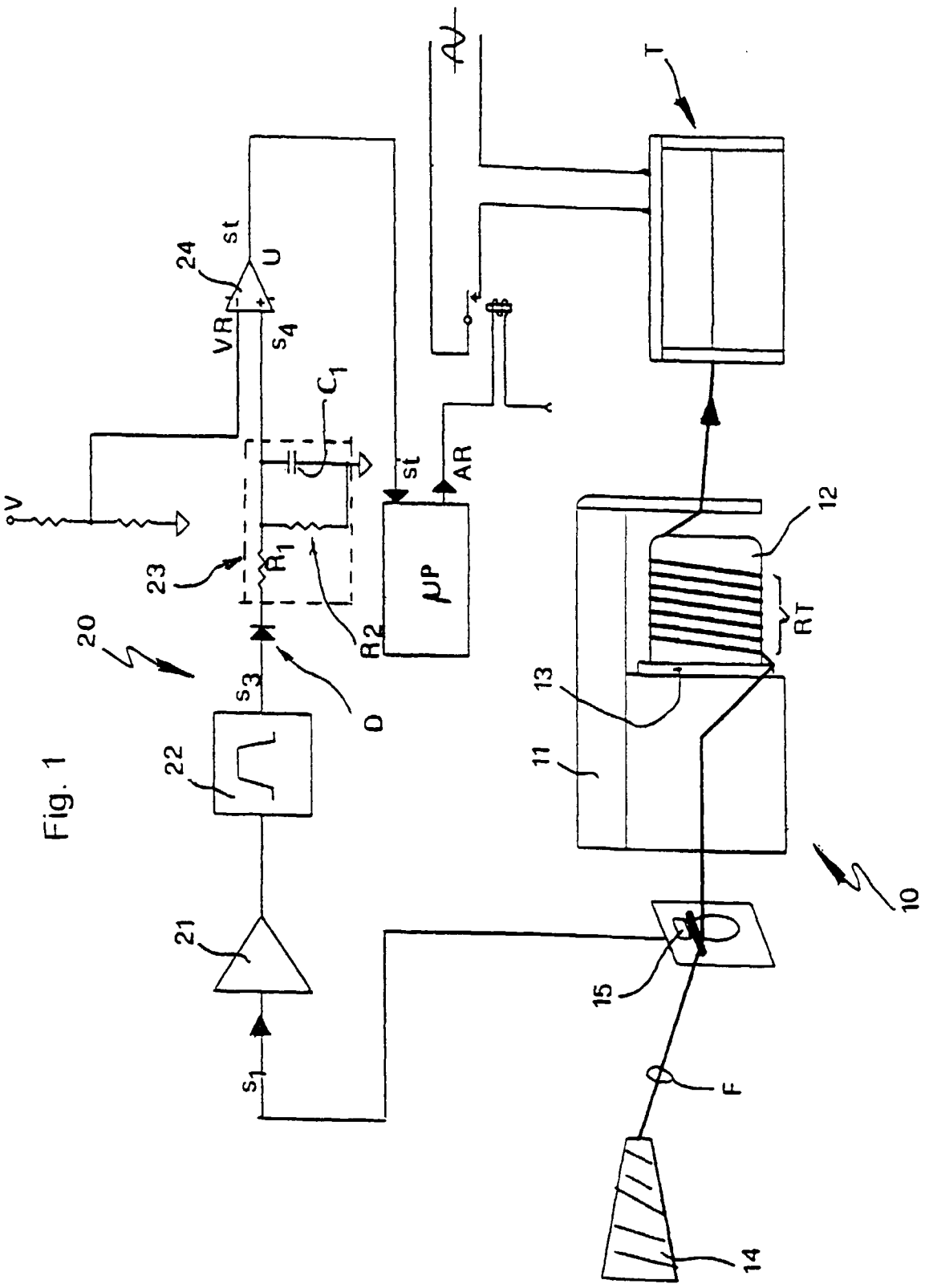
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Fig. 1

Fig. 2

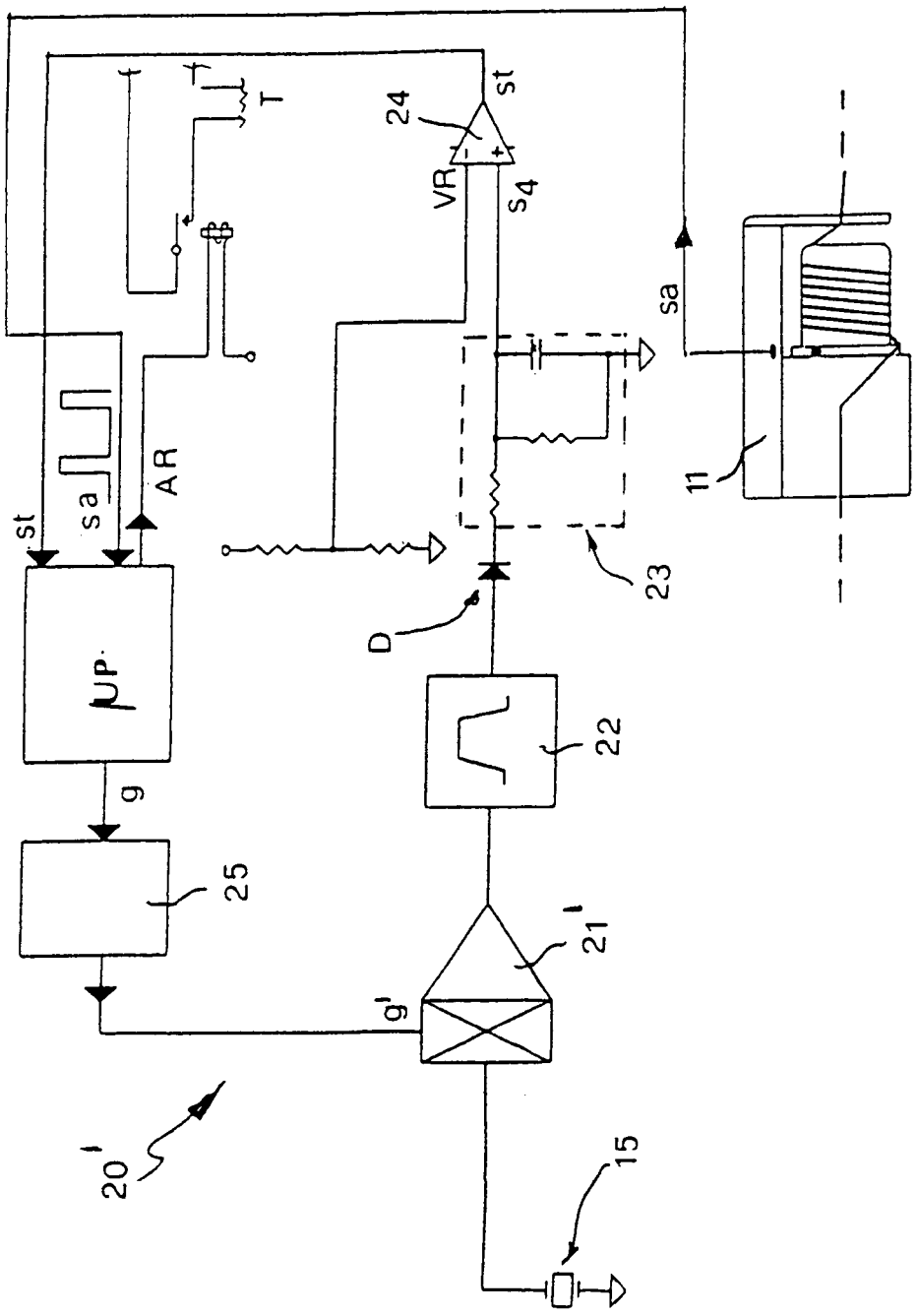


Fig. 2A

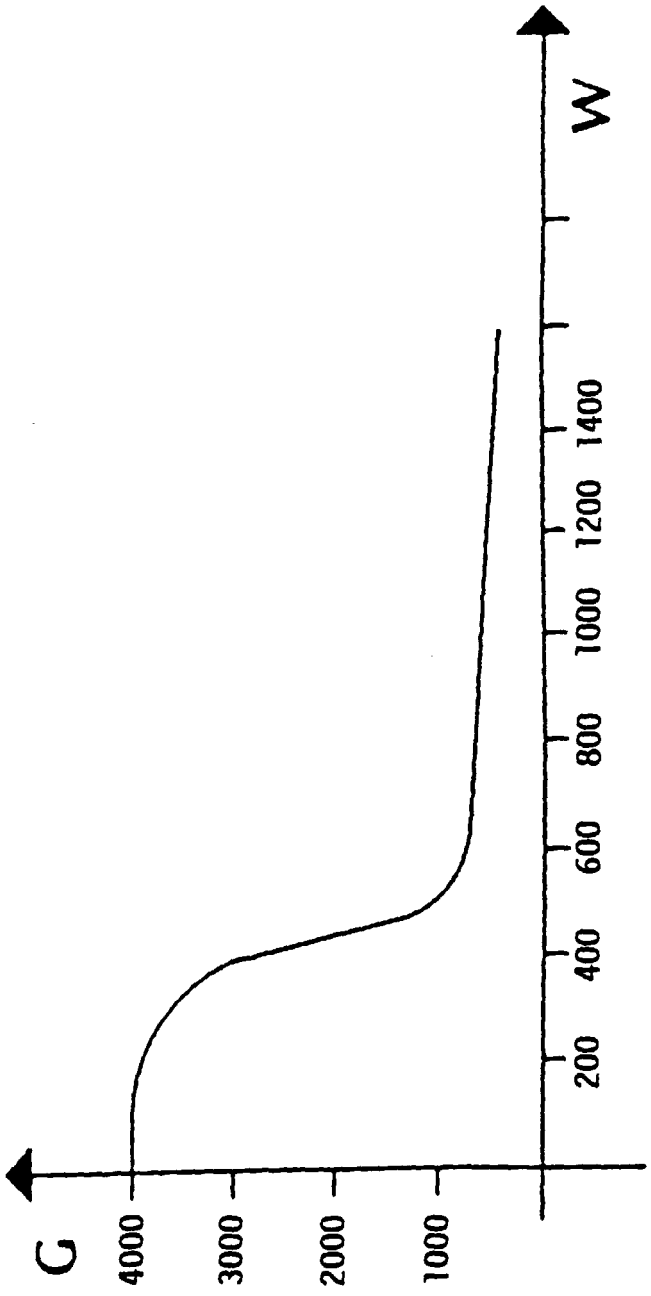


Fig. 3

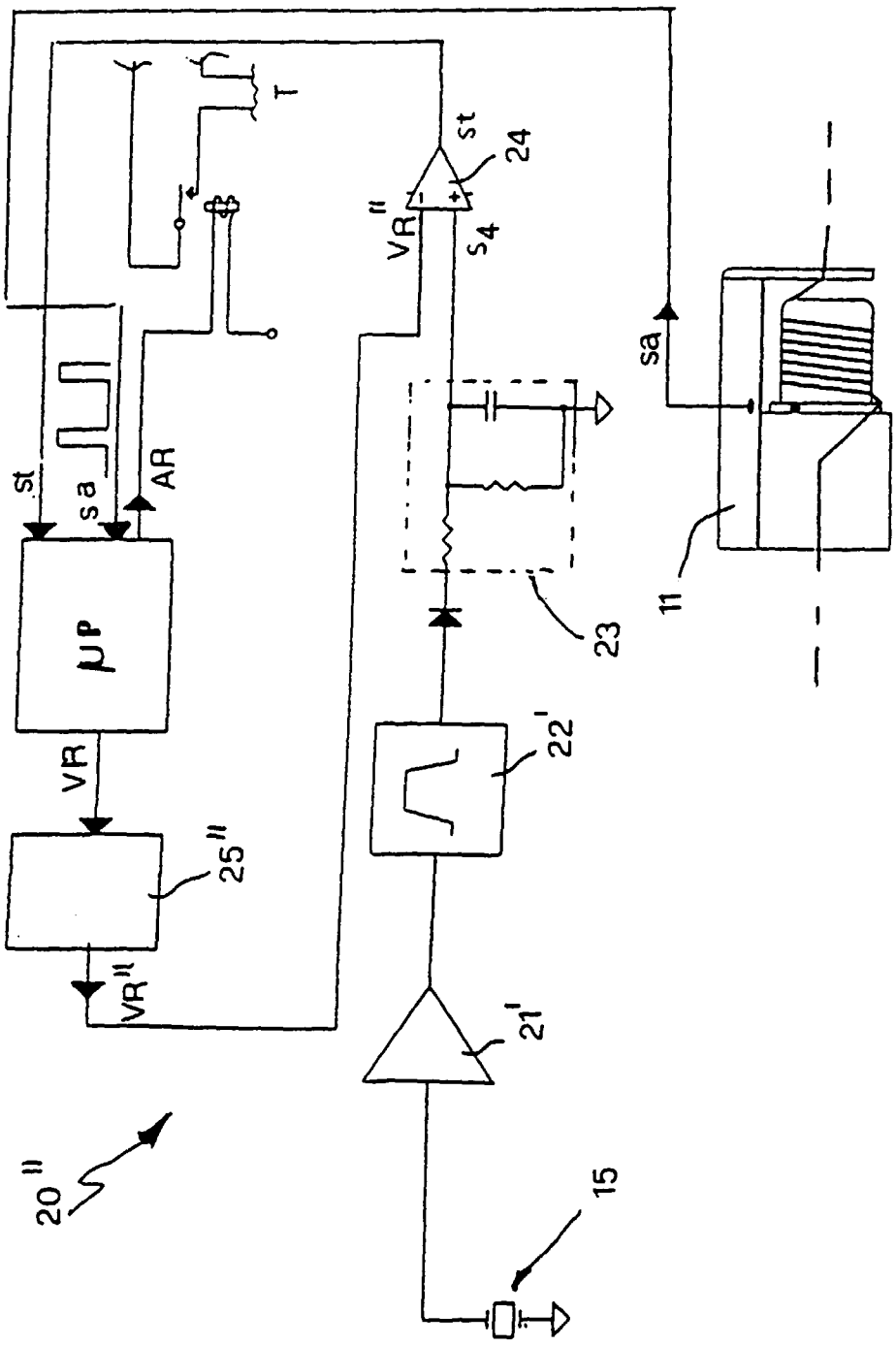
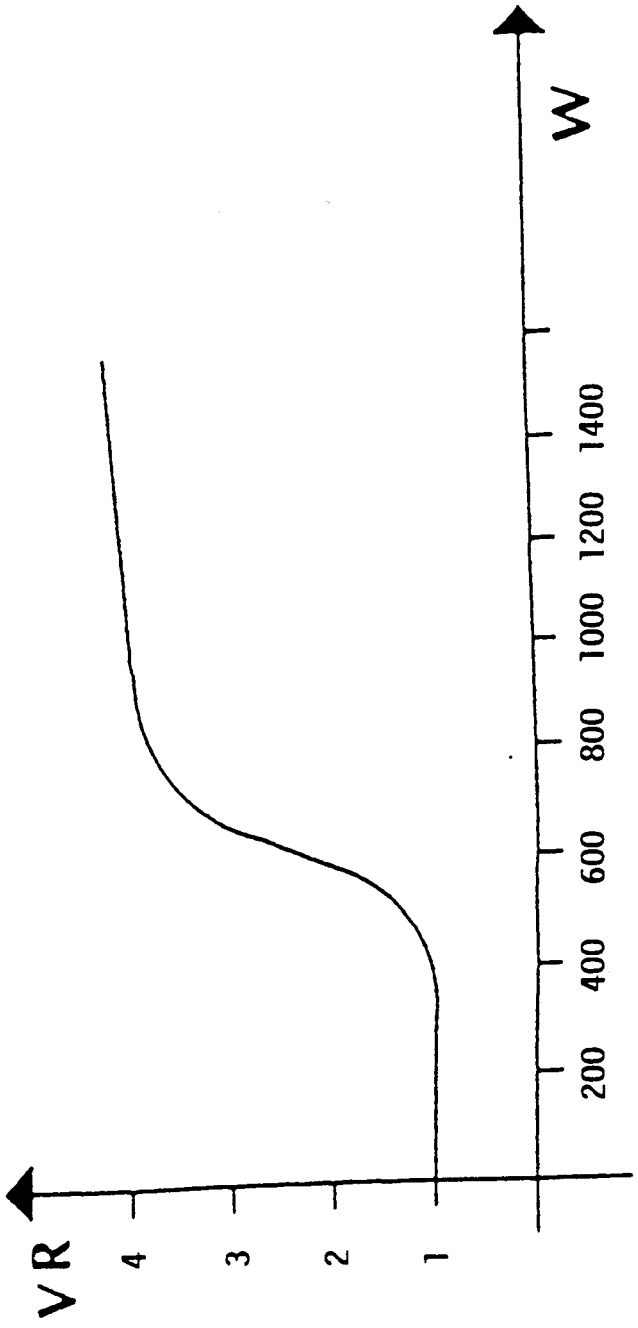


Fig. 3A



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EUROPEAN SEARCH REPORT

Application Number
EP 00 10 4465

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

D03D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 June 2000	Boutelegier, C

CATEGORY OF CITED DOCUMENTS

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