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(54) Method and device for controlling the weft stock in weft suppliers for mechanical-pick looms, including means for notifying the color selection

(57) A method is described for controlling the weft stock in weft supplying devices (P) to mechanical-picking looms (TE'), by restoring the loops unwound from the drum, including means (Can Bus) for real-time transmission of the color selection. The method substantially consists in generating virtual signals (USP'-USP"-etc.) replacing loop-passage signals (USP), starting at the weft picking instant (*t1*) which follows the instant *(t0)* of reception of the color selection data transmitted by the transmission means; each of the virtual signals (USP'-etc.) indicating the passage of one loop being unwound from the drum of the supplier (P).

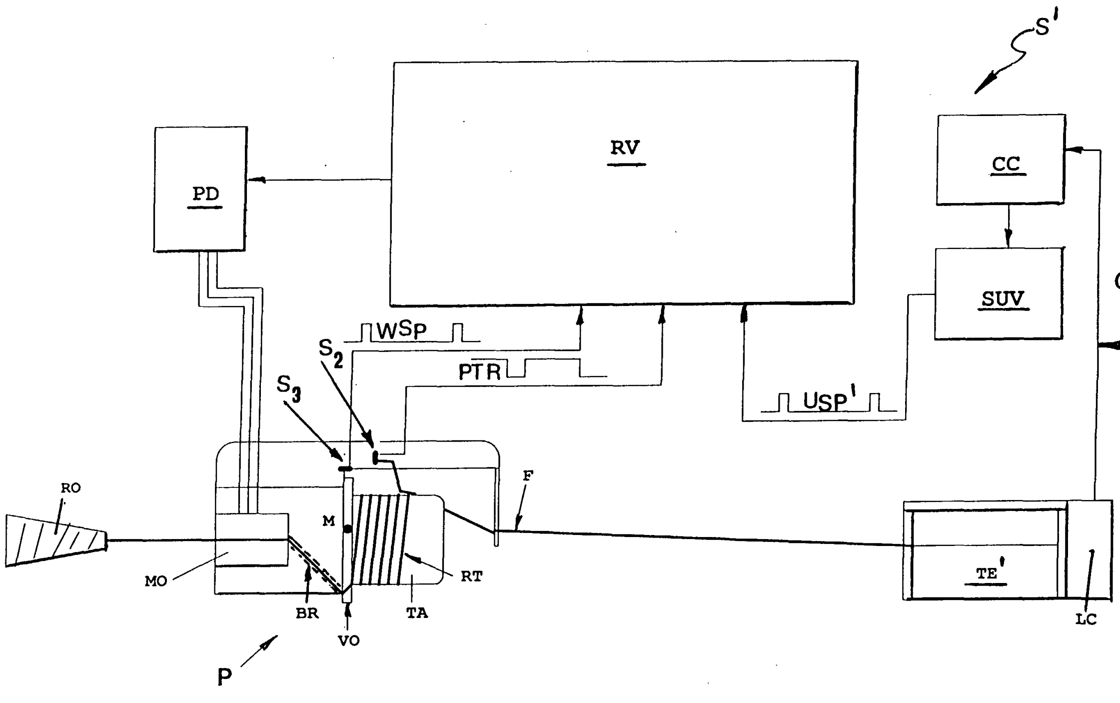

Fig. 2

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Description

[0001] This invention is concerned with an improved method and device for controlling the weft stock in weft suppliers of mechanical-picking looms, including means for real-time transmission of the color selection. More precisely, the invention relates to looms including a control unit and at least one connection line, serial or parallel, for the real-time transmission of a message concerning the color of the weft to be supplied to the loom during the current weft picking stroke and therefore the weft supplier to be selected. A prior, particularly advantageous connection line, to which the following description refers without limitation to the invention, is a line commonly known as CAN bus (Can Application Network), and found in most modern looms.

[0002] It is well known and widespread in the field of weaving to use weft supplying devices arranged between the reel and the loom and performing the task of supplying the weft by releasing it, upon request from the loom, from a weft stock stored in form of loops wound on a drum, and also the task of restoring the loops that have been released by re-winding an equivalent amount of yarn in order to maintain the weft stock unchanged.

[0003] Typically, as will become apparent from the detailed description below, a supplier system for mechanical-pick looms of the kind specified above employs one or more weft supplying devices, for example as many as the colors of the wefts that are to be picked. Each device comprises a stationary drum upon which a swivel arm, which is coupled to a motor-driven flywheel, winds yarn loops to build a weft stock. The weft supplier device is also equipped with an electronic control system that, depending on signals emitted by corresponding sensors, counts the yarn loops being unwound from the drum upon request from the loom and upon drive by the motor driving the swivel arm, the latter thus re-winding an equal number of loops to restore the weft stock.

[0004] Typically, in order to maintain the weft stock substantially unchanged, the control system processes the pulse signals generated by three sensors which respectively detect: a) each turn of the swivel arm, b) availability of weft stock on the supplier's drum and c) the passage of each loop as it unwinds from the supplier's drum. A first sensor of the tern, which detects each turn of the swivel arm, consists of a Hall sensor adapted to generate a pulsed signal at each passage of a permanent magnet attached to the flywheel of said arm. A second sensor detects the presence of weft stock on the drum, and typically consists of an optomechanical system comprising a floating rod having one end touching the yarn wound on the drum and the other end arranged for intercepting a beam of light falling on a photoelectric cell, so that the latter is darkened depending on the presence of yarn on the drum. A third sensor, called for brevity loop-passage sensor, is, as a general rule, the most critical in respect of the correct operation of the above control system, and is manufactured in different forms depending on the different requirements. The different forms are generally not quite satisfactory from the point of view of their reliability.

[0005] According to one known embodiment, described in European Patent No. 327.974 to Roj Electrotex, the loop-passage sensor consists of a photoelectric cell, with an emitter sending a beam of light towards a reflecting surface, placed near the trailing portion of the supplier's drum, to be reflected towards the photosensitive receiver. The passage of the unwinding weft loop, by interrupting said beam of light, produces an pulsed change in the signal emitted by the photosensitive receiver, yielding a usable pulse signaling a passage of the loop.

[0006] According to another known embodiment, described in EP 0 401 699, said loop-passage sensor consists of a piezoelectric plate placed near the terminal yarn guide ring of the supplier. Such a plate is placed, with respect to said yarn guide, so that the weft yarn, when drawn by the loom, moderately interacts with the plate itself and produces, by hitting it, a change of the voltage across it. The suitably amplified voltage change is a usable signal indicating a passage of the loop.

[0007] As mentioned above, both said known loop-passage sensors have considerable disadvantages and limits of applicability. In particular, known sensors of the first kind suffer form limits and operational inaccuracies if they are used in weaving processes employing dusty or lint-releasing wefts. Dust or lint, by accumulating at the zone where the light-reflecting surface is arranged, distorts or nullifies the action of the sensor.

[0008] Piezoelectric sensors of the second kind have a behaviour heavily dependent on the yarn count used in the weaving process, and it is therefore very difficult to choose an amplification of the signal generated by the sensor, which is satisfactory for both thin and thick wefts.

[0009] The invention has the main object of eliminating these and other disadvantages of the known systems. More particularly, the invention has the main important object of providing a system and a control device of the weft stock in weft supplying devices intended for mechanical-picking looms comprising means for notifying the color selection, whose operation is improved so that is is completely independent of the nature, functionality and reliability of said loop passage sensor.

[0010] This is achieved , according to the invention, by means of an improved method and device having the specific features defined in the following claims.

[0011] Substantially, this invention is based on the concept of eliminating the loop passage sensor and of replacing it with virtual signals generated by a logic block, driven by the color selection data sent by the loom's controller and transmitted to the block itself by said CAN bus; the selection data being used to start a processing procedure, residing in the logic block, causing the block to emit said virtual signals, each indicating the passage of a yarn loop.

[0012] According to the invention, the above processing procedure substantially comprises:

- defining a time variable expressed in terms of weft consumption (over time),
- generating a delay separating the instant when the color selection data reaches said logic block and the beginning of the mechanical picking of the weft,
- incrementing said variable, starting from the beginning of the weft picking, according to a linear law given by the integral of the weft consumption rate over the time interval of the weft pick,
- generating virtual signals each corresponding to and indicating the passage of a loop, whenever the amount of weft which has been consumed equals the effective length of the single loop wound on the supplier's drum,
- resetting, at the same time with the generation of each virtual signal, the weft consumption variable in order to start a new incrementing cycle of the variable and
- stopping, at the instant corresponding to the end of the pick, the integration of the weft consumption variable, and assuming as start value for the new operating cycle (initial zero) the residual value of said variable, if any.

[0013] Features, purposes and advantages of the method and device according to the present invention will become apparent from the following detailed description and with reference to the attached drawings, given by way of non-limitative example, wherein:

Fig. 1 is a block diagram of a known weft yarn supplying system to a weaving loom, using a known procedure of control of the weft supplier, based on computing data coming from the above mentioned tern of sensors.

Fig. 2 is a block diagram similar to Fig. 1 but showing the weft supplying system and the control device of the improved weft supplying device according to the present invention;

Fig. 3 is a diagram showing the temporal correlation between the variables in the processing procedure performed by the logic block of the control device of Fig. 2.

Fig. 1 shows a typical known supplier system SI for supplying a weft yarn F to a mechanical-picking loom TE, comprising at least one weft supplying device P, inserted between loom TE and reel RO, on which yarn F is wound. In a way known per se, supplier P comprises a stationary drum TA upon which a swivel arm BR, coupled to a flywheel VO and driven by a motor MO, winds a plurality of yarn loops to build a weft stock RT. A controller RV, arranged for controlling the entire system SI, generates three voltages appearing on respective outputs a, b, c of a power interface PD (driver), for the controlled supply of motor MO. A a so-called loop-passage piezoelectric sensor S1 is placed at the exit of supplier P near a terminal yarn guide GT and sends pulse signals USP to notify controller RV of the loops being unwound from drum TA. Another optomechanical sensor S2, arranged near drum TA of the supplier, acts as a feeler of weft stock RT and sends a signal PTR indicating availability of the stock to controller RV. Lastly, a further sensor S3, typically a Hall sensor, is placed in front of flywheel VO and sends controller RV a pulse signal at each revolution of arm BR as it winds a loop on drum TA. Sensor S3 is sensitive to the passage of a magnet M carried by flywheel VO.

[0014] During the weft pick, controller RV receives information on the number of loops unwound from drum TA, by means of signals USP and also receives information on the status of weft stock RT by means of signal PTR. When the stock falls below a predetermined threshold signaled by sensor S2, the controller starts motor MO in order to restore the loops withdrawn from the stock and, as each loop is rewound, it receives a corresponding signal WSP from sensor S3. By controlling the speed of motor MO, the system attempts to maintain the amount of loops of stock RT substantially unchanged, by matching the unwound loops with the rewound loops.

[0015] With reference to Figs. 2 and 3, where similar or corresponding parts are indicated with the same reference letters, the improved method and device according to the present invention will be now described. The method and the device are based on the idea of dispensing with the loop-passage sensor S1, thereby considerably improving the operating reliability of the system and considerably reducing the cost of the supplying device. To this purpose, system SI' of Fig. 2 only operates with looms TE' including a local controlling unit LC (Loom Controller), as known per se, and at least one connection line, serial or parallel, suitable for the real-time transmission of a message concerning the color of the weft to be supplied to the loom during the current weft picking stroke. Such a line, referenced as CB, is of a type commonly known as CAN bus (Can Application Network) and connects local controller LC, by means of a line controller CC, to a logic block SUV which is able to generate virtual pulsed signals USP' indicating the unwinding of loops from drum TA. To this purpose, logic block SUV, activated by the color selection data sent by loom controller LC and transmitted to the block by said Can bus CB, starts a processing procedure in which the temporal correlation between the computed variables is shown in diagram of Fig. 3.

[0016] Such variables are substantially the following:

- angle *gs*, expressed in degrees of revolution of the shaft of loom TE' (0-360), at the end of which the information on the color selection is sent to logic block SUV via bus CB. Such data may also be known to supplier P as predefined information;

- angle *gii*, expressed in degrees of revolution of the loom shaft, at the end of which the weft pick starts. Such data, as well, is transmitted via bus CB or is known to the supplier as predefined information;

- angle *gfi*, also expressed in degrees of revolution of the loom shaft, at the end of which the weft pick stops. Such data is transmitted to block SUV via bus CB or consists of information previously known to supplier P;

- delay *dsii* from instant *t0* when the color selection data reaches logic block SUV to the beginning time *t1* of the mechanical weft pick.

[0017] Moreover, logic block SUV also processes a time variable CT expressed in terms of weft consumption over time and, by resetting such variable to zero at time *t0,* i.e., to initial conditions (system start), computes an operative procedure consisting of:

- generating, starting at instant *t0* when block SUV receives the color selection data, a delay *dsii* computed as follows:

$$dsii = \frac{(gii - gs)}{6 \cdot lr} \qquad \text{(seconds)}$$

wherein *lr* is the picking rate of the loom expressed in strokes (picks) per minute;

- incrementing, starting from time *t1* of weft picking, variable CT according to a linear law represented by the integral of the weft consumption rate over the time interval of weft picking, i.e.:

$$CT = 6\int_{t1}^{tf}\left[\frac{lr \cdot lw}{(gfi - gii)}\right]dt \qquad \text{(in meters)}$$

wherein *lw* is the width of the tissue expressed in linear meters at each pick in the loom;

- generating virtual signals USP' - USP"... etc., each corresponding to a respective passage of a loop, whenever the amount of consumed weft CTc equals the effective length *ls* of the single loop wound on drum TA of supplier P;

- resetting, at the same time with the generation of each virtual signal USP', the weft consumption variable CT in order to start a new cycle of incrementing of the variable and

- stopping, at instant *tf* corresponding to the end of picking, the integration of the weft consumption variable CT, assuming as start value of the new operating cycle (initial zero) the possible residual value CTr of variable CT in such a way as to restore, during various operating cycles, all the weft residuals corresponding to fragments of length *ls* of the loop wound on the drum.

[0018] Of course, without altering the concept of the invention, the details of execution of the method and the embodiments of the device for carrying out the method may be widely changed from what has been described and shown by way of non-limitative example, while remaining within the scope of the invention.

Claims

1. Method for controlling the weft stock in weft supplying devices (P) to mechanical-picking looms (TE'), by restoring the loops unwound from the drum, including means (Can Bus) for transmission of the color selection as specified, **characterized in that** it comprises: generating, starting at the weft picking instant (*t1*) which follows the instant (*t0*) of reception of the color selection data, virtual signals (USP'-USP"-etc.) replacing loop-passage signals (USP); color selection data being employed for activating, in a logic block (SUV) operatively connected to said transmission means (Can bus), a processing procedure causing said block (SUV) to emit said virtual signals (USP'-USP"...), each indicating the passage of a yarn loop (F).

2. The method of claim 1, **characterized in that** said processing procedure consists of:

   - defining a time variable (CT) expressed in terms of weft consumption,
   - generating a delay (*dsii*) separating the instant when the color selection data reaches said logic block (SUV) and the beginning of the mechanical picking of the weft,
   - incrementing, starting from time (*t1*) of weft picking, said variable (CT) according to a linear law given by integrating the weft consumption rate over the time interval (*t1 - tf*) of weft picking,
   - generating virtual signals (USP' - USP" ... etc.), each corresponding to a respective passage of each single loop being unwound, whenever the amount of consumed weft (CTc) equals the effective length (*ls*) of the loop wound up on the drum (TA) of the supplier (P),
   - resetting, at the same time of the generation of each virtual signal (USP'-USP"...), time variable (CT) of weft consumption for starting a new cycle of incrementing of the variable, and
   - stopping, at the instant (*tf*) corresponding to the end of the picking, the integration of weft consumption variable (CT), assuming as start value of the new operating cycle (initial zero) the residual value (CTr), if any, of said time variable in such a way as to restore, during various operating cycles, all the weft residuals corresponding to fragments of length (*ls*) of the loop wound on the drum.

3. The method of claim 1 or 2, **characterized in that** said logic block generating virtual signals (USP'-USP"...) is operatively connected to said means (Can bus) of transmission of the color selection by means of a controller (CC) of said means of transmission.

4. A device for carrying out the method according to anyone of claims 1 to 3, **characterized in that** it comprises a local controller unit (LC) residing in the loom (TE'), at least one connection line (CB), serial or parallel, for real time transmission of data concerning the color of the weft to be supplied to the loom during the current weft pick and a line controller (CC) capable of transferring said data to a logic block (SUV) which is able to generate virtual pulsed signals (USP'-USP"-etc.) indicating the unwinding of the single loops from the drum (TA) of the weft supplier (P).

5. The device of claim 4, **characterized in that** said connection line (CB) consists of a Can-bus (Can Application Network).

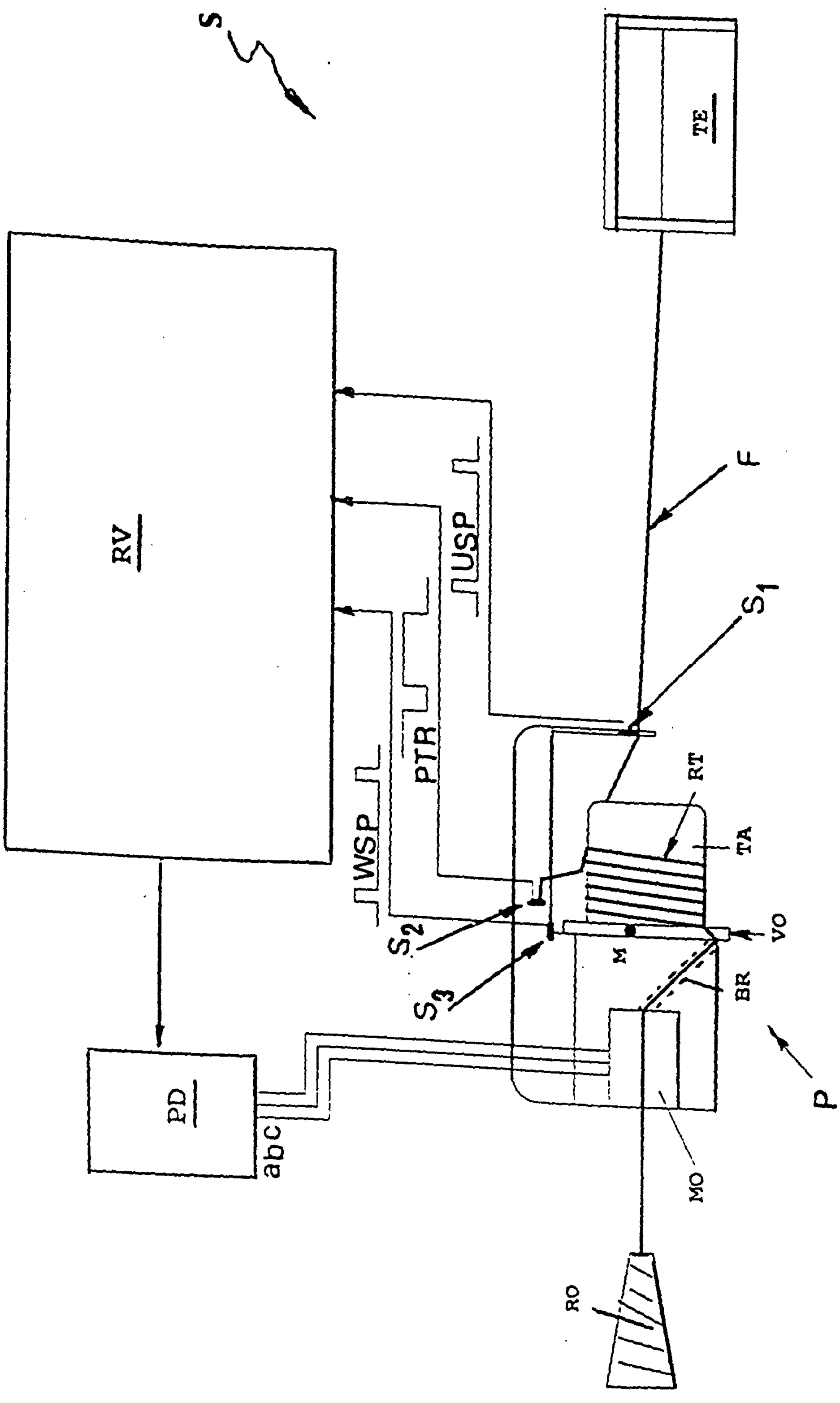

Fig. 1
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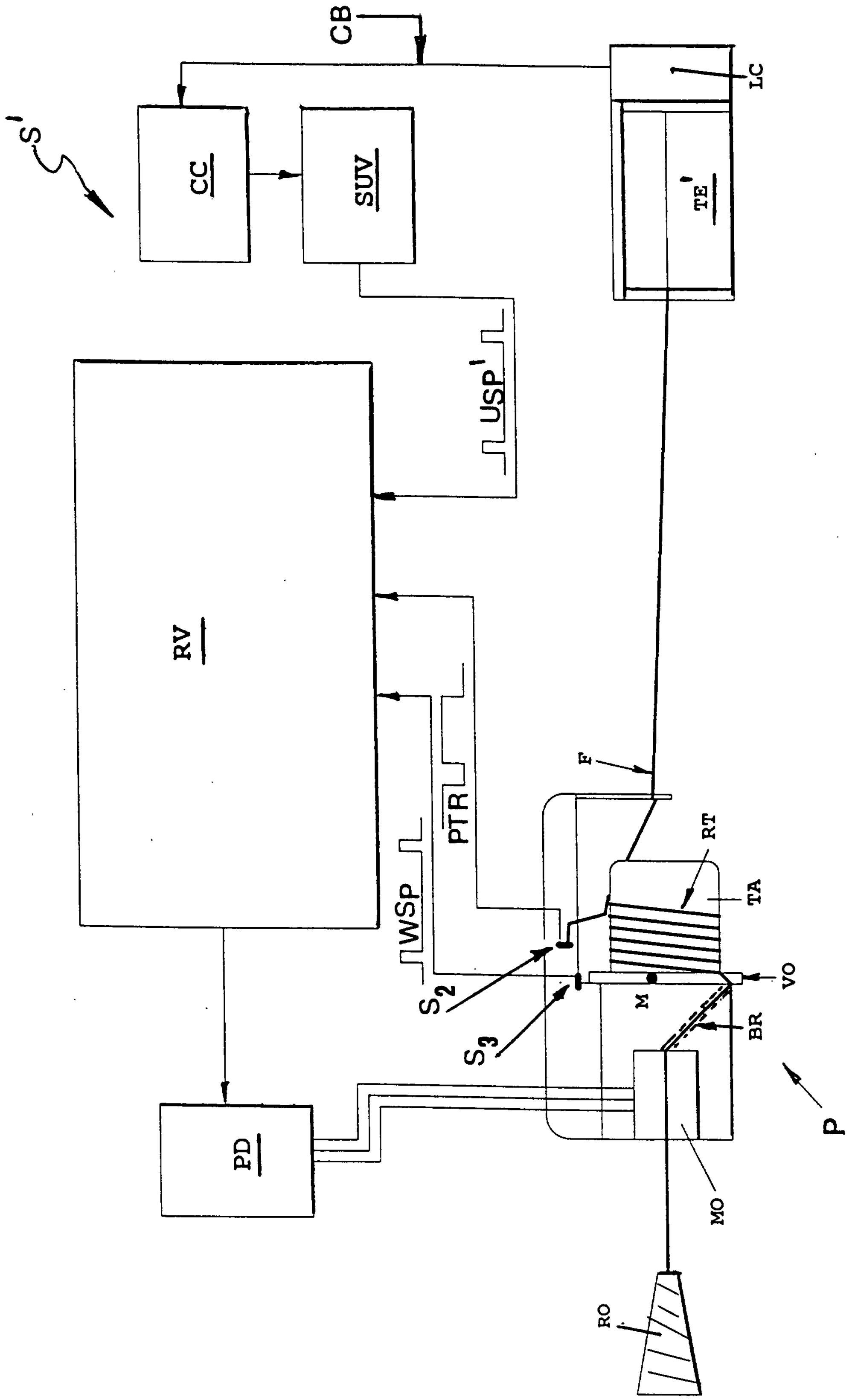

Fig. 2

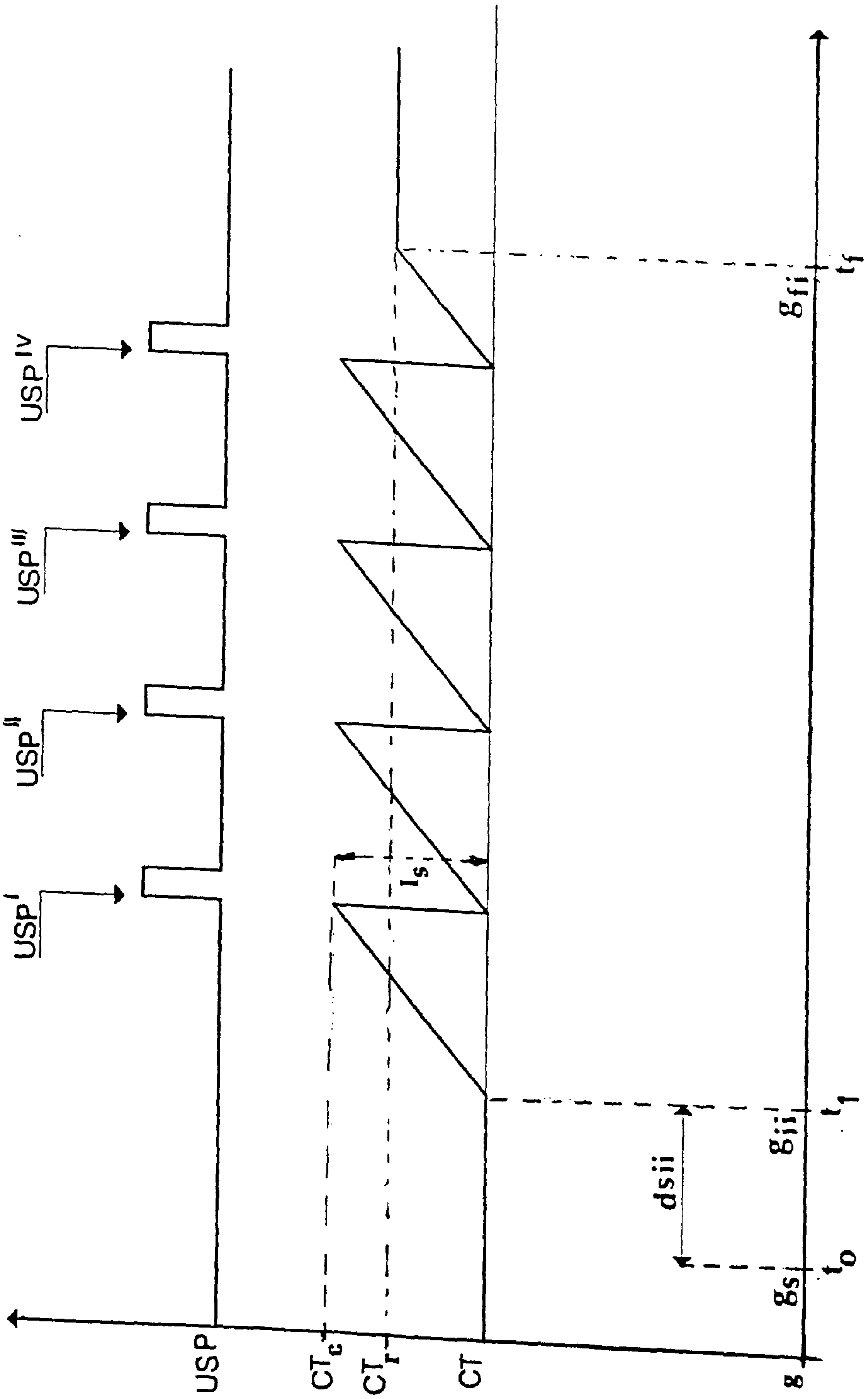

Fig. 3