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(54) **Device and method to control the speed of rotation of the main motor in a weaving loom**

(57) A device for controlling the working speed of a loom, during the starting run of the loom, wherein the motor section of the loom comprises a double-speed motor. A first lower speed is equal to the steady speed of the loom; a second higher speed is equal or higher

than a predetermined launching speed. During the starting run, the instantaneous speed of the motor is continuously monitored and the motor section is connected, through a main clutch group, to the weaving section of the loom, in a rest state, when said speed is equal to a predetermined launching speed.

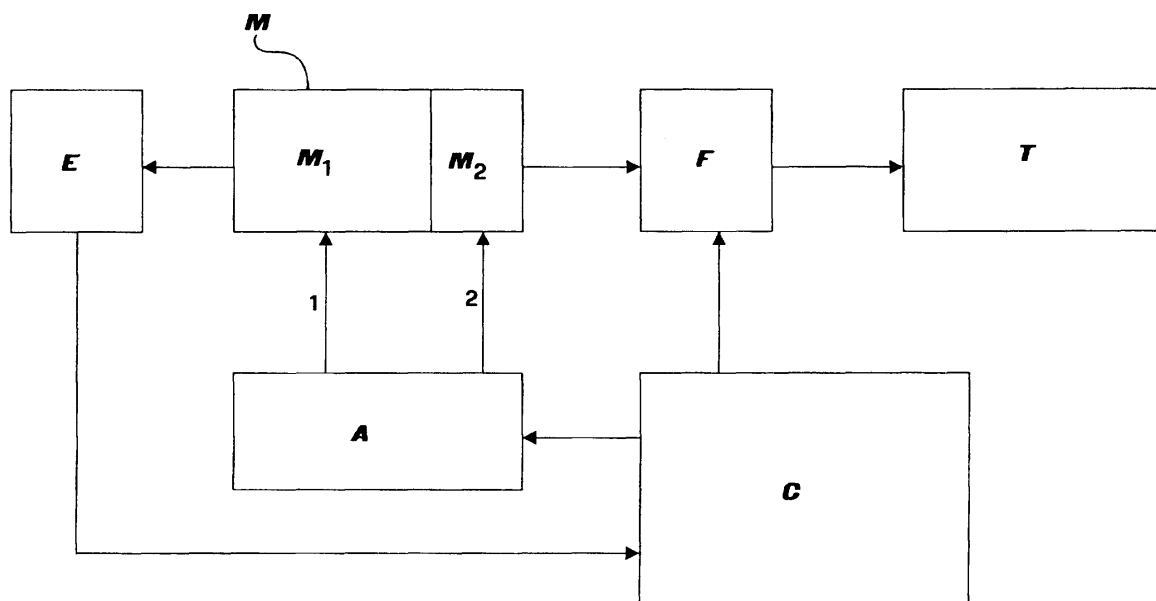


FIG.1

Description

[0001] The present invention refers to a device and a method for controlling the revolving speed of the main motor of a loom during the sudden shift from a rest to a steady state, which takes place when the movable parts of the loom start their motion and then reach the weaving speed.

[0002] As the experts in the art well know, the final quality of a fabric, especially in fabrics made of thin or high quality yarns, also depends on the fact that the working speed of the loom is as uniform as possible. Speed transients, during the weaving, can produce even a lightly different quality of the fabric, which can all the same be noticed by an expert in the art, especially in the connecting area of two fabric lengths woven at different speed. This problem is indeed quite common in the ordinary manufacturing, in particular due to the possible weaving defects (broken or short weft, breaking of the warp yarns and so on) which cause automatic stops of the loom. During these stops, in fact, a first motor section of the loom - which essentially includes a main motor of the loom and a flywheel - is separated, through a main clutch group, from a second weaving section of the loom - which includes a sley with relative reed, a weave forming machine with its heald frames and, in case, grippers for the insertion of the weft - allowing, in this way, the stopping of this second section of the loom in order to execute the desired repairing operations. Following the extraction of the possible defective wefts or the knotting of the broken weft yarns, the loom can be restarted by engaging the clutch group and so connecting said first section, which has been kept at the steady speed, to said second section of the loom, now in a rest state. In these conditions a transient of speed of the loom is unavoidable, with a temporary lowering of the speed at a value lower than the steady speed, due to the inertia of the rest section of the loom, said speed reduction leaving therefore a visible mark on the fabric being woven.

[0003] It is already known - with the aim to reduce the length of this speed transient of the loom - to increase the speed of the motor section of the loom, while the clutch that connects this one to the weaving section of the loom is disengaged, by using an inverter device. The increase of speed is determined with a trial-and-error method, in such a way that, when the clutch is engaged, the exchange of momentum between the rotating motor section and the weaving section of the loom which must be speeded up, allows to reach the desired steady weaving speed, as quickly as possible. At that point, the control of the transient by the inverter is completed and the motor keeps on rotating at its steady speed.

[0004] The above inverter device accomplishes therefore a twofold task, allowing on one hand the optimisation of the transient curve and offering, on the other hand, a large number of steady speeds, without operating on mechanical gear ratios of the loom. Moreover

said device can be easily integrated in the software system of the loom, and easily programmed and controlled as a function of a larger and larger range of variables, both technical and environmental, which can influence the weaving process.

[0005] Nevertheless, the inverter device is a sophisticated and expensive kind of device, which - even if appreciated because it is apt to fit, in an efficient way, a large number of different weaving conditions - it cannot be used in all the situations. In particular, in the field of weaving mass-production, wherein the weaving takes place according to well defined and unchanged standard conditions, there is the demand of a device *ad hoc* - for solving the problem relative to the starting transient of the loom - simpler than the inverter, so as to be more reliable and economic of this latter, and all the same apt to allow a satisfactory reduction of the length of the starting transient of the loom.

[0006] Aim of the present invention is therefore to offer a device and a method for controlling the working speed of a loom during the starting transient thereof, having a low cost and high efficiency, strength and reliability.

[0007] The aim is reached, according to the present invention, through a device for controlling the working speed of a loom, during its starting run - said loom being formed by a first section, essentially including a main motor and a flywheel, and a second section, including at least a sley and a weave forming machine, connected to said first section through a main clutch group - wherein said first section of the loom, rotating at a predetermined launching speed higher than the steady speed of the loom, is connected through the main clutch group to said second section of the loom, in a rest state, characterised in that said main motor is a double-speed motor, a first lower speed being equal to said steady speed of the loom and a second higher speed being equal or higher than said launching speed.

[0008] The invention also concerns a method for controlling the working speed of a loom, which provides, during the starting run of the loom, the following subsequent steps:

- a) starting said double-speed motor, while the clutch connecting the motor section of the loom to the weaving section is disengaged;
- b) monitoring the instantaneous speed of said motor during the acceleration transient from said first to said second speed;
- c) operating the engagement of said clutch in the moment wherein the instantaneous speed of the double-speed motor is equal to said predetermined value of launching speed; and, at the same time,
- d) activating the power supply of said motor at said first speed.

[0009] The device and the method of the present invention will be now described in more details, making

also reference to a flow chart here enclosed as Fig. 1, which shows the working principles thereof.

[0010] According to the present invention, the main motor M of the loom is an electric motor with two windings M1 and M2, separately supplied by the power supply A, through circuits 1 and 2. Depending on the fact that the power supply A involves just circuit 1 or both of them, motor M is apt to develop two different and predetermined steady revolving speeds V1 and V2; for the sake of brevity, in the following, said motor will be simply defined as double-speed motor. The double-speed motor M is designed in order to have its lower speed V1 corresponding to the standard steady speed of the loom, and its second speed V2, higher than speed V1, being equal or higher than the highest value of speed which could be desired from motor M during the starting run of the loom.

[0011] The increase of speed of the loom in respect of the speed V1, in the following defined as overspeed Vs, is set according to the inertial features of the weaving section T of the loom downstream of the main clutch F, which section, as widely known, comprises a sley and relative reed, a weave forming machine and relative driven heald frames, and finally, in case of a gripper loom, carrying and drawing grippers. The setting operation must result in the fact that the additional momentum of the motor section of the loom, deriving from said overspeed Vs, must be as equal as possible, in absolute value, to the momentum necessary to start the above said section T of the loom downstream of the clutch F, at the speed V1. In this way, in fact, the motor M brought to the launching speed V1 + Vs is slowed down exactly to the speed V1 in a very short time, which is the same time necessary to the complete engagement of the clutch F.

[0012] With the aim to control, in a proper way, the value of the overspeed Vs - considering that the double speed motor M doesn't have in itself any speed control device - according to the present invention said motor should be combined to a rotation angle meter device E. Said device is in turn connected to a processing central unit C, which is usually already provided on the loom for the general working of the loom itself. A specific board of said unit is apt to convert the instantaneous measure of the rotation angle of the motor M, provided by the meter device E, in a measure of instantaneous speed and thereafter to compare said last measure with the predetermined value of the launching speed V1 + overspeed Vs.

[0013] In general terms, when the loom is stopped for the research of a fault, the motor M is kept in motion at the steady speed V1. After the repairing is completed, when the operator gives the START order to the loom, the processing unit C gives the consent to the circuit 2 of the power supply A and the motor M starts to increase its speed from V1 to V2, according to a variation law which is constantly controlled by the unit C according to a feedback closed ring control model, as described

heretofore. At the moment wherein the overspeed of motor M reaches the predetermined value Vs, the unit C operates the engagement of clutch F and, in the same time, disables the circuit 2 of the power supply M, keeping the power supply only on circuit 1. In this way, as a result of the exchange of momentum from the motor section M to the weaving section T of the loom, motor M slows down exactly to the steady speed Vi and keeps on rotating at said speed, thanks to the fact that the power supply A has been in the meantime enabled only on circuit 1. Naturally, the control system described above successfully works also in case of starting of motor M from a rest condition, i.e. at the beginning of the working cycle or after a long interruption. In this case, the wait imposed by the central unit M after the START order of the operator will be longer than in the former case, because the speed transient of the motor M, for going from the speed 0 to the launching speed V1 + Vs, is correspondingly longer.

[0014] Said above predetermined value of overspeed Vs can be manually set by the operator, on the control keyboard of the unit C, on the basis of former experimental data. Preferably, said value should be automatically calculated by the central processing unit C. To this purpose said unit provides to store data relative to the values of the overspeed Vs and the trend of n preceding transients, and to process said data through an appropriate algorithm, so as to calculate a value of overspeed Vs apt to minimise the duration of transient n + 1. Preferably said duration is lower than the length of time of a single weft insertion cycle. In the present looms, working at a speed of about 600-1000 cycles per minute, this means a duration of the transient lower than 6-10 hundredth of a second. In this way is then possible to obtain a continuous adaptation of the values of the overspeed Vs to every single loom, not only as a function of its mechanical features but also of the specific weaving conditions in the loom itself, for example following a variation of the woven yarns, of the kind of grippers, of the number of heald frames, of the environmental conditions and so on.

Claims

1. Device for controlling the working speed of a loom, during the starting run of the loom - said loom being formed by a first section, essentially including a main motor and a flywheel, and of a second section, including at least a sley and a weave forming machine, connected to said first section through a main clutch group - wherein said first section of the loom, rotating at a predetermined launching speed higher than the steady speed of the loom, is connected through the main clutch group to said second section of the loom, in a rest state, characterised in that said main motor is a double-speed motor, a first lower speed being equal to said steady speed of the

loom, and a second higher speed being equal or higher than said launching speed.

2. Device as in claim 1), further including a processing unit apt to activate the power supply of said double-speed motor and to monitor its instantaneous speed, and, furthermore, to control said main clutch group. 5
3. Device as in claim 2), wherein the instantaneous value of said launching speed is calculated from the processing unit by detecting, through a meter device for the rotation angle of said main motor of the loom, the angular displacements of said motor in the unit of time. 10 15
4. Device as in claim 3), wherein the value of overspeed for the $n + 1$ starting transient of the loom is calculated by said processing unit on the basis of stored data of overspeed and trend of transient of the n previous starting transient. 20
5. Method for controlling the working speed of a loom, said method using a device as in any one of the preceding claims, characterised in that, during the starting run of the loom, the following steps are provided: 25
 - a) starting said double-speed motor, while the clutch connecting the motor section of the loom to the weaving section is disengaged; 30
 - b) monitoring the instantaneous speed of said motor during the acceleration transient from said first to said second speed;
 - c) operating the engagement of said clutch in the moment wherein the instantaneous speed of the double-speed motor is equal to said predetermined value of launching speed; and, at the same time, 35
 - d) activating the power supply of said motor at said first speed. 40

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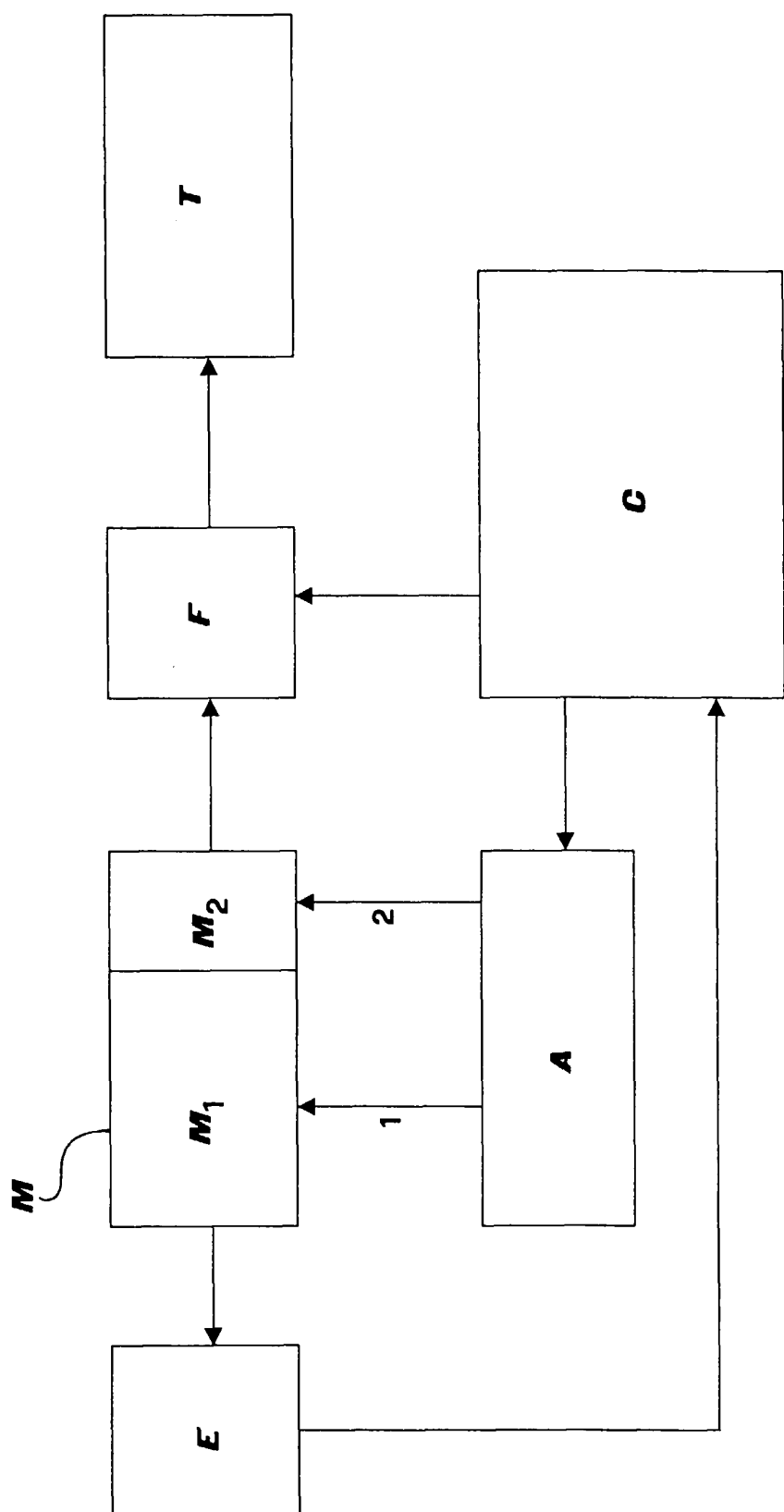


FIG. 1