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(54) **STARTING METHOD FOR A WEAVING MACHINE**

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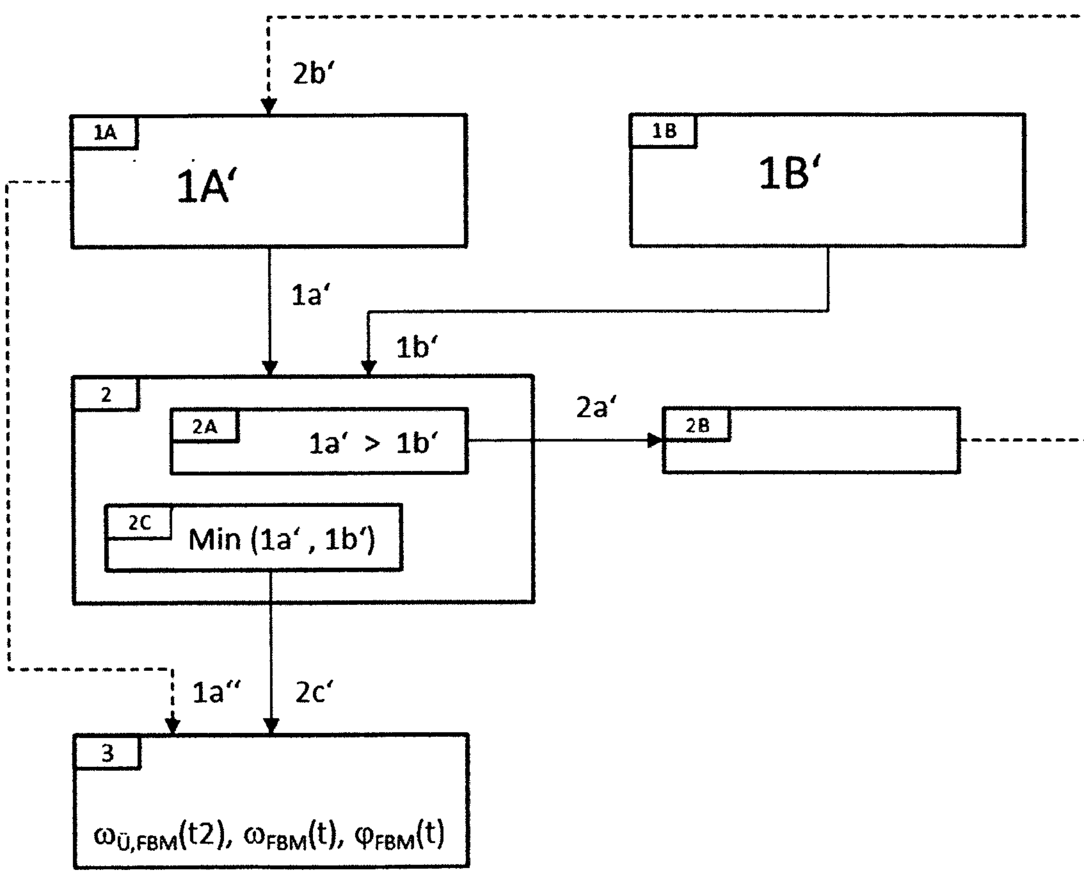
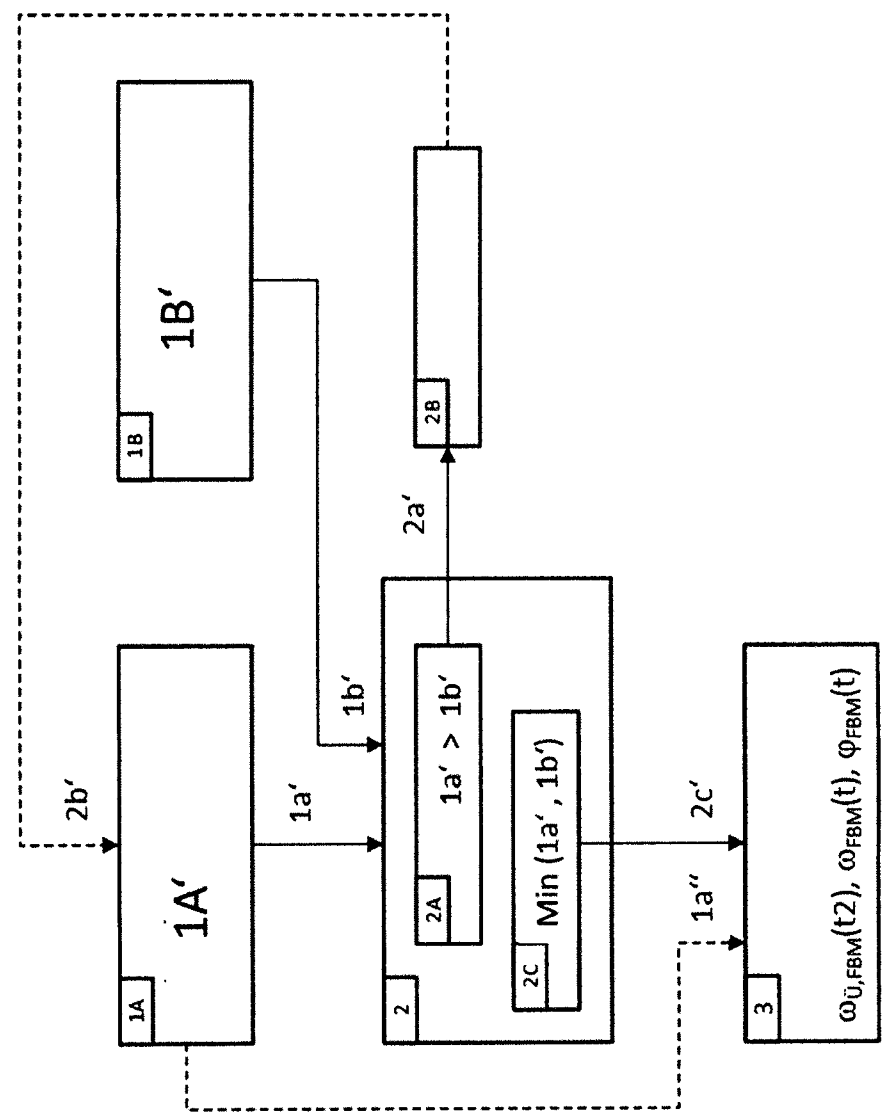
(57) **ABSTRACT**

The invention relates to a method for the controlled run-up of a weaving and shedding machine, wherein the weaving and the shedding machine are connected with a controller, wherein the weaving machine is driven by means of a main drive, wherein the shedding machine is driven by means of an electric motor auxiliary drive, wherein the weaving and the shedding machine are connected by means of a common converter intermediate circuit for the energy flow transmission, wherein the shedding machine is started at a time point t0 and is run-up until to a time point t1 to an overspeed that lies above its operating rotational speed, wherein the time point t1 lies before a time point t3, wherein the weaving machine is started at a time point t2 and wherein the start phase of the weaving machine lies in the time interval from the time point t2 to the time point t3, and wherein a power transmission (feedback) by means of the converter intermediate circuit from the shedding machine to the weaving machine is carried out in the stated start phase. The method according to the invention is characterized in that the shedding machine is run-up to a predetermined overspeed between the time points t0 and t1, and that the gradient of the rotational speed progression of the shedding machine is more negative in a later section of the start phase than in an earlier section.




1B′
1B
2B
2a′
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1b′
2
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2C
Min (1a′ , 1b′)
2c′
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3
$\omega_{Ü,FBM}(t2)$, $\omega_{FBM}(t)$, $\varphi_{FBM}(t)$

FIG. 1

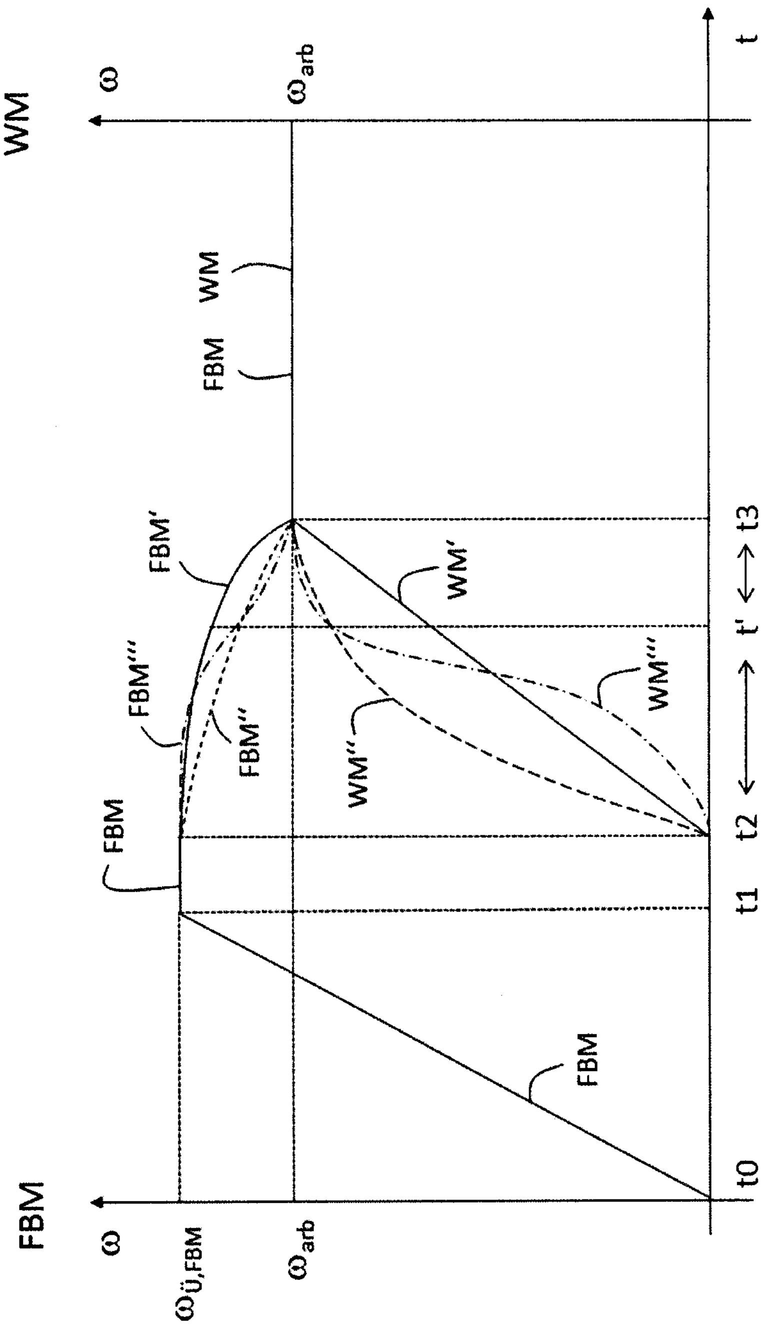
WM
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FIG. 2

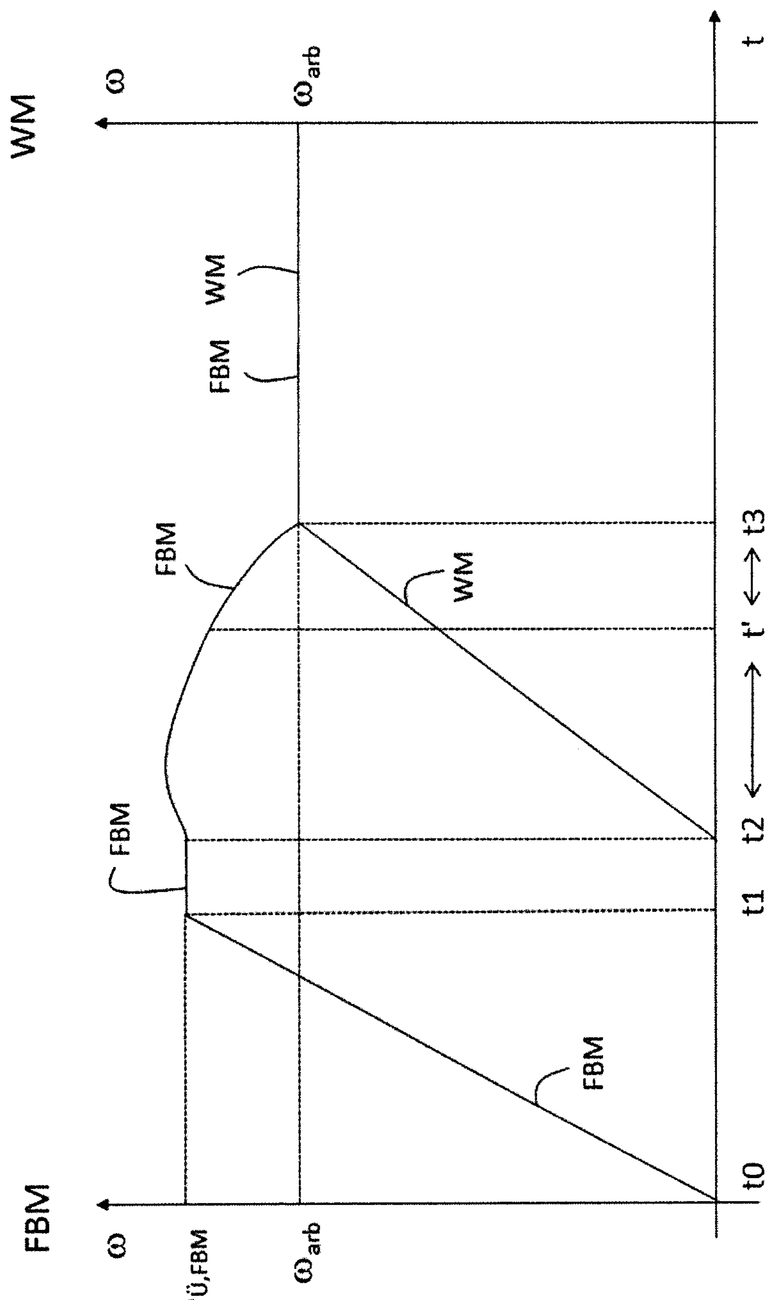

FIG. 3

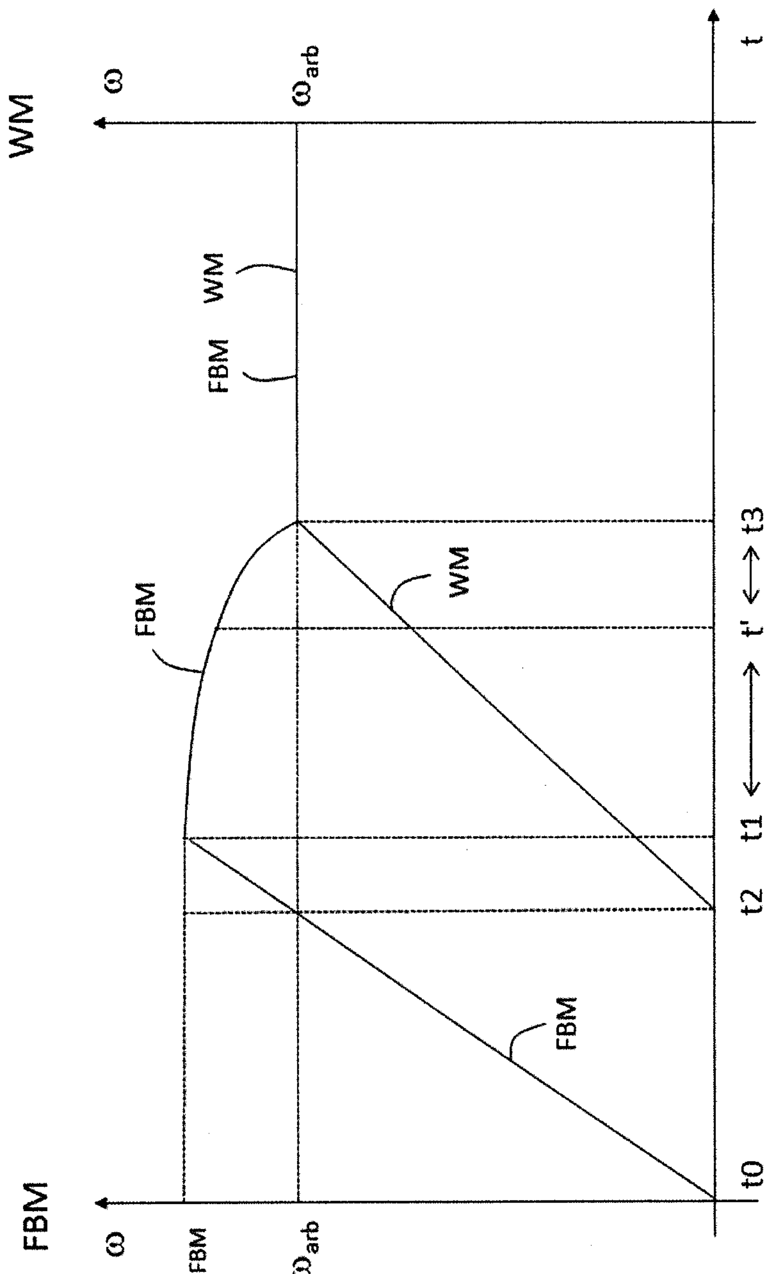

FIG. 4

STARTING METHOD FOR A WEAVING MACHINE

[0001] The present invention relates to a method for the controlled start-up or run-up of a weaving and shedding machine, wherein the weaving machine is driven by means of a main drive, while the shedding machine is driven by means of an electric motor auxiliary drive. Such weaving and shedding machines are known. In these, the shedding machine comprises a separate drive of which the central drive shaft, from which the motions of the shedding means are derived, is connected with an electric motor. In that regard it involves such shedding machines in which the shedding means can be decoupled from the motion of the central drive shaft, which are e.g. dobby machines of the type 2881 from the company Staeubli or Jacquard machines of the type LX from Staeubli or SI from the company Bonas.

[0002] Is The drive shaft of the weaving machine, from which the further motions (weaving reed, if applicable mechanical weft insertion elements) are derived, is in turn connected with at least one actuator that drives it directly and that is similarly usually embodied as an electric motor. Such direct drives are very simple in their mechanical construction, nearly maintenance free, and very precisely regulateable.

[0003] Furthermore the drives of the weaving machine and of the shedding machine are connected by means of a common DC voltage intermediate circuit, hereinafter referred to as a converter intermediate circuit, so that they, mutually together, can form or produce an energy flow.

[0004] One of the disadvantages of a previously mentioned direct drive for the weaving machine is that the high peak power necessary for the required highly dynamic starting of the weaving machine must be provided directly via the actuator. This peak power is to be supplied essentially directly through the electric power supply network. Such power peaks can lead to strong voltage drops even in the case of a stable power supply network and suitable supply conductor cross-sections, whereby such voltage drops progress further into the intermediate circuit voltage of a converter utilized for the direct drive, and there they cause a fault-triggered interruption and stopping of the weaving machine start. The problem becomes significantly more intense if the weaving machines are operated on weak power supply networks. This is becoming the case ever more with the increasing shifting of textile production into developing countries and emerging or transitional nations. The conditions become even more disadvantageous when a pre-transformer becomes necessary due to the rated voltage level and/or type of the electric power supply network, whereby the pre-transformer, due to its additional characteristic impedance, makes the power supply network even weaker from the viewpoint of the weaving machine that is to be started.

[0005] If the weaving machine start up to the rotational speed provided for the first reed beat-up, called the operating rotational speed in the following, is no longer possible due to the abovementioned reasons, then a known countermeasure involves reducing this rotational speed. That is to say, the operating rotational speed for the first reed beat-up then lies more or less significantly under the operating rotational speed that is actually provided for the article. However, this can lead to start marks and an unacceptable reduction of the quality in the woven product. A general reduction of the operating rotational speed is similarly not an acceptable solution, because the production of the product would take correspondingly longer, which puts the economic profitability of the weaving mill in question.

[0006] The DE 200 21 049 U1, as the closest prior art, refers to the possibility, for separated drives for weaving and shedding machine, to configure the preferred starting process of the shedding machine that is known from the DE 100 53 079 C1 in such a manner so that it supports the subsequent starting process of the weaving machine with its kinetic energy. For that, the shedding machine is accelerated to a rotational speed above the operating rotational speed that is to be reached at the end of the weaving machine start. While then the weaving machine starts, the shedding machine gives off kinetic energy through re-braking for supporting the starting of the weaving machine, that is to say during its start phase.

[0007] The DE 200 21 049 U—especially due to its focusing on a drive solution with common motorized elements for web and shedding machine—suggests that the braking process of the shedding machine begins with the beginning of the weaving machine start and proceeds (practically) uniformly during this starting process. It has been found, however, that such a feeding back is not optimal, because thereby at the beginning of the weaving machine start the shedding machine would feed back more energy than is required by the weaving machine. The voltage level in lo the common converter intermediate circuit for the drives of weaving and shedding machine would then rise sharply, and the energy would have to be converted into heat in the braking resistance and would be lost for the process.

[0008] It is therefore the object of the invention to reduce the peak power requirement of the weaving machine through better utilization of the kinetic feedback energy of the shedding machine, whereby the process security is to be ensured by maintaining the voltage limits in the converter intermediate circuit. Also, no reductions in the starting dynamics of the weaving machine should need to be accepted.

[0009] The object is achieved in the method according to the invention through the features of the independent patent claim. According to the invention, the method for starting or running-up on the one hand comprises the starting or running-up of the shedding machine to a predetermined overspeed or excess rotational speed (named step **1** in the following), and on the other hand comprises the adjusted setting of the rotational speed reduction of the shedding machine in such a manner so that the gradient of the rotational speed curve or progression of the shedding machine is more negative in a later section of the starting phase than in an earlier section (named step **2** in the following).

[0010] The abovementioned step **1** consists in that the overspeed, to which the shedding machine is accelerated relative to the operating rotational speed at the first reed beat-up, is predetermined, thus exactly defined, in its value and/or its upper limit. It is especially preferred that the overspeed is calculated automatically at least based on machine data, but preferably also based on process data. This will be explained in more detail further below.

[0011] Step **2** provides a non-ramp-shaped progression or curve, thus a is non-constant gradient—beginning with the overspeed from step **1**—for the rotational speed of the shedding machine, for a time range t**1** to t**3**, that advantageously temporally completely encompasses the starting process from t**2** to t**3** of the weaving machine or also can temporally coincide therewith. The gradient progression or curve is such that the energy feedback is larger in a later time section of the starting process than in an earlier time section. This means that the braking of the shedding machine does not proceed in a uniform manner (ramp-like) over the weaving machine start, but rather becomes stronger in a later section of the starting phase and preferably toward the end of the weaving machine start. In this manner, the actual energy requirement of the weaving machine is taken into account, with consideration of heat and other losses.

[0012] Thus, according to the invention the feeding back of the energy or power proceeds in a manner adapted to the demand or requirement, that is to say to an especially strong extent when also the demand or requirement by the starting weaving machine is the strongest.

[0013] Advantageously, at the temporal center or midpoint, the gradient of the rotational speed progression or curve of the shedding machine between the time point t**2** and a time point t' is less negative than at the temporal center or midpoint between the time points t' and t**3**. Thereby, the gradient of the rotational speed curve of the shedding machine toward the end of the starting phase is more negative than in an earlier time period of the starting phase. This means that, at the end of the starting phase more energy is fed back from the shedding machine to the weaving machine than at the beginning of the starting phase.

[0014] A similar advantageous rotational speed curve provides that at the temporal center or midpoint the gradient of the rotational speed curve of the shedding machine between the time point t**2** and a time point t' comprises a smaller absolute value than at the temporal center or midpoint between the time points t' and t**3**.

[0015] It is especially preferred that the gradient of the rotational speed curve of the shedding machine toward the end of the starting phase is the most negative out of the entire time period of the starting phase. Therefore, in this embodiment the energy feedback is the greatest at the end of the weaving machine start, at the time point t**3**.

[0016] If the gradient of the rotational speed curve of the shedding machine beginning with the time point t**1** or t**2**, depending on which comes later, is a strictly monotonic falling or decreasing function, then the energy supply from the shedding machine to the weaving machine rises or increases continuously, which relatively exactly reflects the actual energy demand or requirement of the weaving machine.

[0017] In a preferred embodiment, also the rotational speed curve for the starting weaving machine is prescribed not in a ramp-like manner, but rather has a gradient that decreases over the entire starting process (between the time points t**2** and t**3**) or at least toward its end. Thereby the power take-up is made uniform, that is to say the power peak at the end of the weaving machine start is less strongly pronounced, whereby the energetic starting assistance by the shedding machine is facilitated. In this regard it is noted that the rotational speed of the weaving machine presently is to be understood as the value that is computationally determined from its kinetic energy and the energetically average mass moment of inertia (which will be defined in the following).

[0018] As mentioned above, the stated overspeed or excessive rotational speed of the shedding machine is preferably calculated by means of a computing unit with the use of machine data. Similarly it is preferred if the rotational speed curve of the shedding machine for the entire starting phase of the weaving machine is calculated by means of a computing unit with the use of machine data, whereby in this regard the rotational speed curve of the shedding machine is preferably oriented to the computationally expected power demand or requirement of the starting weaving machine.

[0019] The stated machine data are preferably such data that are partially or all selected from the following group: the mass moment of inertia of the shedding machine and/or of the weaving machine, the energetically average mass moment of inertia of the is shedding machine and/or of the weaving machine, network and supply relevant data such as e.g. characteristic data of the common converter intermediate circuit, technical characteristic data of the drives of the shedding machine and of the weaving machine, the peak power of the supply, etc.

[0020] Not only machine data but also process data are preferably utilized for increasing the accuracy in the calculation of the overspeed as well as of the further rotational speed curve of the shedding machine. These process data, which are advantageously at least partially utilized, are preferably based on calculated or estimated weaving machine losses and advantageously also on shedding machine losses. Preferably, these process data also include such data as are based on the duration of the stated starting phase of the weaving machine.

[0021] Both steps **1** and **2** are explained in more detail in the following.

[0022] The overspeed of the shedding machine is calculated with regard to the step **1**. Preferably at least the energetic average mass moment of inertia of weaving and shedding machine are used as the machine data. In that regard, the energetic average mass moment of inertia is the mass moment of inertia of an imaginary or virtual flywheel mass, which, rotating at the same operating rotational speed as the working machine (weaving or shedding machine), has the same kinetic energy as the pertinent working machine.

[0023] Through the relationship or ratio of these two energetically average mass moments of inertia of weaving and shedding machine, the relationship or ratio of their two associated kinetic energies is also fixed in the same magnitude as of the end of the start-up or run-up. It would now be possible (computationally) to accelerate the shedding machine to such an increased overspeed so that during its subsequent re-braking so much energy is given off so that it will be sufficient for the starting of the weaving machine. In this regard, a calculation example for the loss-free system:

[0024] Pertaining for the weaving machine:

[0025] energetically average mass moment of inertia: J_{WM}=2 kgm^2 operating rotational speed at end of start-up: ω_{Arb}=600 min^{-1} from this the kinetic energy is given as:

$$W_{kin,WM}=\tfrac{1}{2}\,J_{WM}\times\omega_{Arb}^{2}=3948\text{ J}$$

[0026] Pertaining for the Shedding Machine:

[0027] energetically average mass moment of inertia: J_{PBM}=4 kgm^2 operating rotational speed at end of start-up: ω_{Arb}=600 min^{-1} from that the following kinetic energy:

$$W_{kin,FBM}=\tfrac{1}{2}\,J_{FBM}\times\omega_{Arb}^{2}=7{,}896\text{ J}$$

[0028] In order to be able to completely cover the energy requirement of the weaving machine, the shedding machine would have to comprise a kinetic energy of (7896+3948) J=11844J at the beginning of the weaving machine start, which would correspond to a rotational speed of 735 min^{-1}.

However, such a large dimensioning of the shedding drive is not desirable for cost reasons, so that the above proposition to take the energy requirement for the weaving machine start completely out of the shedding machine is not practicable. The calculation example shows, however, that the energetically average mass moments of inertia are sensible values for the determination of the rotational speed profile or the motion path of the shedding machine during the weaving machine start.

[0029] A further important value is given by the network and supply conditions that were already mentioned above. In this regard preferably especially the characteristic data of the supply for the common converter intermediate circuit of the weaving and shedding machine are taken into account.

[0030] Furthermore, the peak power of the supply, e.g. the two-fold multiple of the rated power, that is to be applied for the duration of the weaving machine start is advantageously taken into account. It is similarly important whether a pre-transformer is utilized in the weaving mill, e.g. due to specialized networks, e.g. IT-networks. In this regard, the power and the short-circuit voltage or the internal impedance of the pre-amplifier play an important role. The network and supply conditions mentioned in the above scope and context are allocated to the machine data, similarly as the technical characteristic data of the drives of weaving and shedding machine, e.g. peak currents of the regulators or controllers and/or peak rotational moments or torques of the actuators or motors.

[0031] Above all, the expected losses of the weaving machine during the starting process are relevant with regard to the process data. These can be estimated e.g. from the temperatures of the transmission oil, or—if the machine previously was already operating—from its averaged current consumption with consideration of the stopped standstill time or once again the oil temperature and if applicable a new operating rotational speed. The losses of the shedding machine including shedding means (held frames, lifting wires) are preferably also taken into account.

[0032] The average power and the peak power can be calculated from the total energy requirement or demand of the weaving machine (sum of kinetic energy at operating rotational speed, and compensation of the losses) in the starting process and from the starting duration. In turn, from the network and supply conditions it can be estimated whether and to what extent the starting assistance by the shedding machine is necessary or to be utilized for this power (above all the peak power).

[0033] Corresponding to this extent, according to a preferred embodiment, the overspeed of the shedding machine at the beginning of the weaving machine start is determined by means of the energetically average mass moment of inertia of the shedding machine, so that upon again breaking to the operating rotational speed the necessary energy or power can be provided. If this would occur under the assumption of a uniform ramp-shaped re-braking of the shedding machine over time, then in this manner one would obtain the lowest possible value that the overspeed of the shedding machine would be allowed to have for the energy feedback.

[0034] By means of the above described way or manner, it is thereby possible to generate a mathematically unambiguous prescription or pre-definition for the rotational speed behavior of the shedding machine for the purpose of the starting support for the weaving machine, solely through the use of the step **1**. In the scope of the invention it was, however, recognized—as already mentioned above—that a uniform, that is to say ramp-shaped, braking of the shedding machine during the weaving machine start is not optimal. In this case, namely, at the beginning of the weaving machine start the shedding machine would feed back significantly more energy than is needed by the weaving machine. This can very quickly lead to a fault-triggered interruption and stopping of the starting process due to impermissibly high voltage in the converter intermediate circuit, especially with passive network supplies.

[0035] According to the invention, this problem is solved through the use of the step **2**. Due to the gradient of the shedding machine rotational speed that is more negative in a later section of the starting phase during the weaving machine start, at first only little or no energy is fed back into the converter intermediate circuit, and then correspondingly more with increasing time and therewith increasing power or energy demand by the weaving machine.

[0036] Before carrying out the abovementioned steps **1** and **2**, it is preferably determined by the stated computing unit on the basis of the machine data and if applicable the process data, whether an energetic starting support by the shedding machine is even necessary. If yes, then the operator advantageously either is requested to activate or to permit this starting support, or is notified that it was automatically activated. In the latter case it is, however, recommendable to give the operator the possibility to again deactivate the starting assistance.

[0037] The invention will be described in the following in connection with example embodiments. It is shown by:

[0038] FIG. **1** a flow diagram for illustrating a calculation method of the feedback for the case of a constant energy transmission portion;

[0039] FIG. **2** a schematic rotational speed-time diagram with **t1**<**t2** for clarifying the invention,

[0040] FIG. **3** a schematic rotational speed-time diagram with **t1**<**t2** similar to FIG. **2**, however with a local maximum of the rotational speed of the shedding machine, and

[0041] FIG. **4** a schematic rotational speed-time diagram with **t1**>**t2**.

[0042] FIG. **1** shows a calculation method that proceeds from the starting point to proportionally support the power demand of the weaving machine at every time point of the weaving machine start, wherein the proportion, seen relatively, remains constant (e.g. 40%). The weaving machine start shall proceed in such a manner so that the rotational speed calculated from the kinetic energy and the energetically average mass moment of inertia increases in a ramp-shape over time up to the operating rotational speed. Thus, in this regard the expected power requirement of the weaving machine is covered in a proportion or fraction that remains constant with respect to percentage, which is possible when the time point **t2**, that is to say the starting time point of the weaving machine, does not lie before the time point **t1** at which the shedding machine has reached its predetermined overspeed.

[0043] In the calculation step **1**A, the initial maximum power demand or requirement of the weaving machine is determined from the machine and process data **1**A'. In this example, the operating rotational speed and the energetically average mass moment of inertia of the weaving machine are used as machine data. The expected losses or loss moments of the weaving machine and the starting duration, expressed as a time or as a transited angular range, are included as process data.

[0044] Suitably one first calculates the kinetic energy of the weaving machine toward the end of the starting process, thus at the operating rotational speed. This energy divided by the transited angular range gives the mechanically effective accelerating moment. To this is added the expected loss moment at the operating rotational speed, which is mainly dependent on the oil temperature in the transmissions. The thus-arising summed moment, multiplied by the operating rotational speed, provides the maximum required power of the weaving machine.

[0045] This maximum required power itself is compared to those machine data that characterize the network or supply conditions; this involves the characteristic data of a potential pre-transformer (rated power, short-circuit voltage or internal impedance) as well as the characteristic data of the supply unit for the converter intermediate circuit (passive or active network supply, if applicable a boost or step-up converter function, peak power). The comparison is an estimate. For example, at what peak power the pertinent pre-transformer or the pertinent supply unit will be expected to exhibit what extent of voltage drop is stored in tables. If the thus-expected total voltage drop in the converter intermediate circuit is then so strong or pronounced that either the voltage demand at the motor terminals can no longer be satisfied and/or the undervoltage detector of the converter intermediate circuit would be triggered and would bring about an interruption and stoppage of the starting process, then correspondingly additional energy or power on the part of the shedding machine must be supplied. This power fraction to be supplied as a supplement from the shedding machine is output as value **1**a' (demand) from the calculation step **1**A.

[0046] It is suitable for the purpose if a calculation step **1**B is carried out simultaneously or parallel close in time with the calculation step **1**A, whereby the known peak torque or rotational moment of the shedding drive is multiplied with its operating rotational speed in the calculation step **1**B. One obtains the peak power of the shedding drive. If applicable, a loss moment is previously deducted from the peak torque. The peak power of the shedding drive calculated in this manner is output as a value **1**b' (capacity or possibility) from the calculation step **1**B.

[0047] In the calculation step **2**, first **1**a' (demand or requirement) and **1**b' (capacity or possibility) are compared. If the demand is greater than the capacity, then problems of the abovementioned type during the starting up to the intended operating rotational speed cannot be excluded. Therefore a reaction is triggered in the step **2**B. This can consist of a warning signal to the operator, if applicable in connection with the request to select a lower operating rotational speed and to start the machine in a testing manner, see path **2**b'. In this manner, the estimates from step LA can be corrected through an actually observed behavior of the converter intermediate circuit. Another possibility involves automatically reducing the operating rotational speed, under a corresponding information notification to the operator. In this case also, the pertinent machine start can serve for verification and if applicable correction of the assumptions from step **1**A. In this regard, the reduced operating rotational speed should be calculated in such a manner so that for it the demand **1**a' is exactly as high as the capacity **1**b'.

[0048] The smaller of the two values **1**a', **1**b'—mathematically represented as Min(**1**a', **1**b')—is transferred as **2**c' to a calculation step **3**. In that one multiplies half of this peak power with the required time of the weaving machine start, one obtains the energy that is to be provided as a supplement on the part of the shedding machine, which it must thus have available at the time point of the weaving machine start t**2**. Calculation from this supplemental energy, the operating rotational speed and the energetically average mass moment of inertia of the shedding machine gives the overspeed $\omega_{Ü,FBM}$, which the shedding machine must have—in comparison to the operating rotational speed—at the time point t**2**. (For a further understanding also see the above given calculation example for a loss-free system).

[0049] The power requirement or demand of the weaving machine during the start-up develops proportionally to the rotational speed and time, and corresponding thereto—according to the above arrangement or agreement for this method—also to the power to be supplemented on the part of the shedding machine (finally up to the value **2**c'). From this fact and the already known value for $\omega_{Ü,FBM}$(t**2**), it is now possible to calculate the value ω_{FBM}(t) for the rotational speed of the shedding machine at any desired time point t up to the completion of the weaving machine start at the time point t**3**. By integration over time, one obtains the angle progression or curve ϕ_{FBM}(t). Dependent on how the drive regulator or controller requires the prescribed instructions, e.g. for equidistant time points in the range [t**2** . . . t**3**], pairs of values (support points) are formed with the associated ordinate value of ω_{FBM}(t) or ϕ_{FBM}(t), from which a software routine (if applicable in the drive regulator or controller itself) generates a mathematical expression corresponding to an electronic cam disk. The further transmission from the weaving machine of the data necessary for the calculation are referenced with **1**a'' in FIG. **1**.

[0050] A different advantageous calculation method is the use of polynomials, of which the coefficients are determined in such a manner so that thereby the rotational speed or the angular progression of the shedding machine is predefined for the range of the weaving machine start in the desired manner.

[0051] Three exemplary progressions or curves of the rotational speeds of the shedding machine (FBM) and of the weaving machine (WM) as a function of time corresponding to the invention are illustrated in FIG. **2**. The shedding machine is started at the time point to and is driven or run-up, up to the time point t**1**, to the predetermined, especially calculated, overspeed $\omega_{Ü,FBM}$ (see above). At the time point t**2**, the weaving machine is started and in a starting phase that extends from the time point t**2** to a time point t**3**, it is run-up to an operating rotational speed ω_{arb}. During this start phase, energy is fed or supplied back from the shedding machine to the weaving machine in a defined manner, whereby a possible calculation method pertaining to this has been presented above.

[0052] It is significant to the invention that the gradient of the rotational speed curve of the shedding machine is more negative in a later section of the start phase of the weaving machine (that lies between the time points t**2** and t**3**) than in an earlier section. In this regard, the later section does not necessarily border on the time point t**3** and/or the earlier section does not necessarily border on the time point t**2** (or t**1**, if t**1** lies later than t**2**, see FIG. **4**); but rather gradient progressions within the time period between the time points t2 (or t1, if t1 lies later than t2) and t3 can be compared with one another.

[0053] From FIG. 2 it can be seen, that in this example embodiment, the gradient of the rotational speed curve of the shedding machine, which is illustrated with a solid line (here referenced as FBM'), is even the most negative toward the end of the start phase with reference to the entire time span of the start phase, that is to say the curve comprises the greatest negative slope at the time point t3 within the range between t2 and t3. Preferably the gradient of the rotational speed curve of the shedding machine between the time point t2 and a time point t' marked as an example in the FIG. 2 is less negative than in the temporal midpoint or center between the time points t' and t3.

[0054] It is also possible that the rotational speed progression of the shedding machine between the time points t2 and t3 temporarily for a short time even has a positive gradient, that is to say a positive slope, in an earlier stage of the start phase, before the gradient then again becomes negative.

[0055] The rotational speed progression of the weaving machine (here referenced as WM') which is illustrated with a solid line, is illustrated rising linearly with a ramp-shape in FIG. 2, as this was assumed in the above calculation method. An alternative rotational speed progression for the weaving machine (here referenced as WM") is represented with a dashed line, wherein the rotational speed during the run-up between the time points t2 and t3 comprises a decreasing positive gradient. In such a progression, the power take-up is more uniform than in a linear run-up, because the power peak toward the end of the weaving machine start is less pronounced. An exemplary corresponding rotational speed curve of the shedding machine (here referenced as FBM") is similarly illustrated with a dashed line. The flatter curve in comparison to the rotational speed curve FBM', especially toward the end of the start phase of the weaving machine, that is to say at the time point t3, corresponds to the curve WM" of the weaving machine which is flatter there, because the energy feedback toward the end of the start phase of the weaving machine is smaller than for the previously discussed case of the ramp-shaped increase or rise of the rotational speed WM' of the weaving machine.

[0056] Furthermore, a third variant is illustrated with dash-dotted lines in FIG. 2. The rotational speed curve of the weaving machine (here referenced as WM''') comprises an S-shape, which is also repeated in the rotational speed curve of the shedding machine, referenced (here as FBM'''). The energy feedback from the shedding machine to the weaving machine is—after respective flatter rotational speed curves adjoining on the time point t2—especially large during the strongest or sharpest rise of the rotational speed of the weaving machine. Toward the end of the start phase of the weaving machine, both rotational speed progressions or curves, FBM''' and WM''', again flatten off.

[0057] The above described case of a local maximum of the rotational speed of the shedding machine is illustrated in FIG. 3. It must respectively be tested or checked whether this lies above the permissible maximum rotational speed of the shedding machine.

[0058] The case in which the time point t1 lies later than the time point t2 is represented in FIG. 4. Because—as described initially—from the point of view of the demand or requirement, the weaving machine does not profit from a support on the part of the shedding machine at the beginning of the start phase, therefore the weaving machine can already be started (at the time point t2) before the shedding machine reaches its calculated overspeed at the time point t1. It is important that thereafter it is ready to transmit energy to the weaving machine in the time interval from t1 to t3.

[0059] The activation of the main drive of the weaving machine and of the electronic auxiliary drive of the shedding machine is taken over by a controller that is prior art, and therefore is not described in further detail here. The above calculations are carried out with a computing unit that is connected with the stated controller.

[0060] The present invention is not limited to the illustrated and described example embodiments. Modifications in the scope of the patent claims are just as possible as a combination of the features, even if these are illustrated and described in different example embodiments.

1. Method for the controlled run-up of a weaving and shedding machine,
- wherein the weaving and the shedding machine are connected with a controller,
- wherein the weaving machine is driven by means of a main drive,
- wherein the shedding machine is driven by means of an electric motor auxiliary drive,
- wherein the weaving and the shedding machine are connected by means of a common converter intermediate circuit for the energy flow transmission,
- wherein the shedding machine is started at a time point t0 and is run-up until a time point t1 to an overspeed that lies above its operating rotational speed, wherein the time point t1 lies before a time point t3,
- wherein the weaving machine is started at a time point t2, and wherein the start phase of the weaving machine lies in the time interval from the time point t2 to the time point t3, and
- wherein a power transmission (feedback) by means of the converter intermediate circuit from the shedding machine to the weaving machine is carried out in the stated start phase,
- characterized in that the shedding machine is run-up to a predetermined overspeed between the time points t0 and t1, and
- that the gradient of the rotational speed progression of the shedding machine is more negative in a later section of the start phase than in an earlier section.

2. Method according to claim **1**, characterized in that in the temporal midpoint, the gradient of the rotational speed progression of the shedding machine between the time point t2 and a time point t' is less negative than in the temporal midpoint between the time points t' and t3.

3. Method according to claim **1**, characterized in that the gradient of the rotational speed progression of the shedding machine toward the end of the start phase is the most negative in the entire time span of the start phase.

4. Method according to claim **1**, characterized in that the gradient of the rotational speed progression of the shedding machine is a strictly monotonic declining function as of the later of the two time points t1 or t2.

5. Method according to claim **1**, characterized in that the stated overspeed of the shedding machine is calculated by means of a computing unit with the use of machine data.

6. Method according to claim **5**, characterized in that for the calculation of the overspeed and of the further rotational speed progression of the shedding machine, additionally process data, at least such data based on calculated or estimated weaving machine losses and advantageously also on shedding machine losses, preferably also based on the duration of the stated start phase of the weaving machine, flow into the stated calculations.

7. Method according to claim **1**, characterized in that the rotational speed progression for the weaving machine in the stated start phase is prescribed in such a manner so that at least toward its end it comprises a decreasing, that is to say less positive, gradient.

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