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(54) MULTIPLE MOTOR WEAVING LOOM HAVING AN IMPROVED ELECTRIC ARMATURE

(57) A weaving loom is disclosed equipped with a plurality of driving motors wherein the respective drives share a single feeder section.

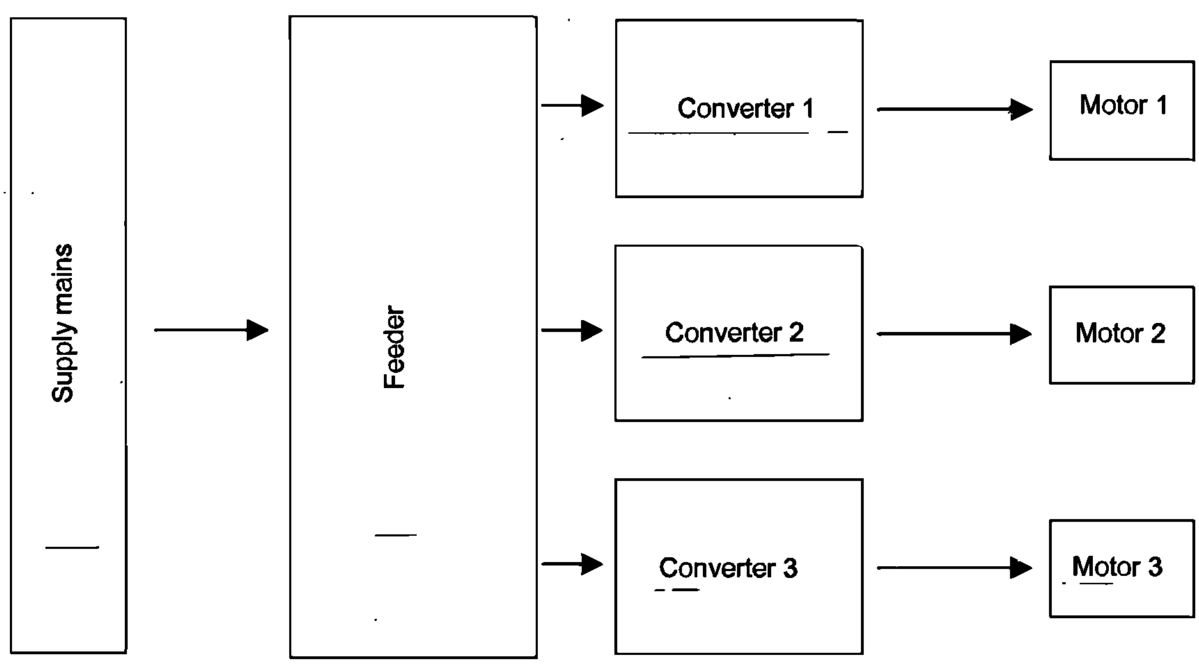

Fig. 2

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Description

Field of the invention

[0001] The present invention relates to improvements to weaving looms equipped with a plurality of driving motors.

Background of the invention

[0002] As known, in the field of weaving looms the driving devices (typically the main electric motor of the loom and the motor of the dobby) are subject to heavy working conditions, both in terms of the total power output, and of the variation frequency thereof.

[0003] The cyclical operation of the loom causes a fluctuating power absorption which, in certain conditions, can also bear a negative sign. In other words, the power transferred from the motor to a weaving member varies cyclically, bearing a positive sign when the member accelerates (kinetic energy increases due to the power output of the motor), and a negative sign when the weaving member decelerates. In the latter condition the kinetic energy lost by the weaving member is transferred back to the motor.

[0004] Depending on the operating conditions, it can hence occur that the mechanism linked to the motor generates a braking or negative torque which is itself equivalent to a generator.

[0005] In order to cope effectively with this power fluctuation, in the past various devices have been suggested.

[0006] A first solution consists in the provision of an adequate capacitance (in terms of capacitors) in the motor feeder section. In such case the power being returned by the consuming appliance is accumulated in the capacitors, causing a voltage increase according to the well-known formula $E=1/2CV^2$. The accumulated energy is then recovered (by discharging the capacitors) when the system resumes functioning as a motor.

[0007] This solution, however, has limitations in the capacitance that can be employed. Since the capacitance should be the larger, the higher the inertial energy of the system to be recovered is, in certain applications the costs and the bulk of the system become unacceptable.

[0008] In these cases an alternative outlet for the energy in excess returned to the motor must be found.

[0009] A second solution, which can therefore be employed in association with the one just described, consists in the provision of a so-called "braking resistance", i.e. a resistance circuit which is able to dissipate electric energy into heat and to intervene as soon as the capacitors reach a saturation threshold. Since the phenomenon is by its nature irreversible, it is of course inefficient.

[0010] A third, rather costly, solution provides the use of a special feeder section, which is able to transform the energy accumulated in capacitor power into regenerated power, which is made available to the supply mains (so-called "regenerative feeders"). This system, however, despite allowing satisfactory energy recovery, is little used due to its cost and susceptibility to faults.

[0011] Therefore, a fully satisfying "regenerative" system of the returned power does not exist yet.

[0012] It is further to be noted that the average power consumed by a certain load with a time-fluctuating power absorption sign is quite low if compared with the nominal power input necessary instead to cope with peak power absorption (in terms of absolute value). It is hence necessary to employ a larger-than-required rated power (with the resulting cost drawbacks), compared to that which could be used if it was possible to recover effectively the power released by the system in negative working conditions.

[0013] In weaving looms these drawbacks are severe, since very specific operating conditions exist, compared to other technical fields. In particular:

- operation of all members is, by its nature, cyclical;
- within each operating cycle the points of maximum and minimum acceleration (and consequently of power input/output) of the various members do not coincide;
- the operating frequency is high (up to 800-1000 strokes per minute);
- the shifting masses are remarkable;
- power consumption is an important variable, since each mill comprises up to several dozens weaving looms;
- it is often convenient to control electric motors by varying their speed within a cycle or a series of cycles.

[0014] In actual fact, on average these specific conditions have never become evident in all their dramatic effects, when the weaving loom was substantially of a mechanical design. In other words, the problem has not been perceived as dramatic as long as the loom configuration consisted of a single main motor drive to which a plurality of shafts and mechanical members were connected, which were reciprocally suitably linked, in order to control the different weaving members: in this way, in fact, the power input/output during the operating cycle by each weaving member was altogether mediated and redistributed by the rigidity and by the inertia effects of the mechanisms involved (shafts, flywheels, oscillating masses, etc.).

[0015] However, with the progress of electronics, which reached extremely high levels of reliability and inexpensiveness, the mechanical approach has gradually been surpassed. Proof of it is the fact that more and more independent driving systems (electric motors), which are reciprocally linked simply by electric axes coordinated and managed by a control unit, are employed and installed in looms.

[0016] Thus the mechanical system, which traditionally mediated the power absorbed/yielded, has disappeared, to the advantage of the control flexibility of electric axes which, however, by their nature, have no rigidity nor inertia capability.

[0017] The inexpensiveness and flexibility of applying a series of independent drives on the loom is yielding very encouraging results, even though the problems of energy efficiency and peak power ratings - as described above with reference to a single motor - in certain cases grow out of proportion, becoming so dramatic as to discourage the use of further electric controls.

[0018] It is an object of the present invention to address these problems by providing a weaving loom with multiple motors equipped with an electrical arrangement which partially compensates the power input and output between the various weaving members, lowering the requirements of the power supply for the loom and increasing energy efficiency, so as to benefit all-round from the lower costs of buying and running the loom.

[0019] Such an object is achieved through a power feeding arrangement of a multiple-motor weaving loom, as described in its characterising features in the attached main claim.

[0020] Other inventive aspects of the loom are described in the dependent claims.

Brief description of the drawings

[0021] Further features and advantages of the arrangement according to the invention will become apparent from the following detailed description of a preferred embodiment of the same, given by way of example and taken in conjunction with the accompanying drawings, wherein:

fig. 1 is a diagrammatic view showing a power feeding arrangement according to the known art;
fig. 2 is a diagrammatic view showing a power feeding arrangement according to the invention; and
fig. 3 is a diagram showing the torque curves against time of the different members of a gripper weaving loom.

Detailed description of the preferred embodiment

[0022] A generic weaving loom comprises a plurality of motors, to simultaneously and independently control multiple consuming appliances, i.e. different weaving members.

[0023] According to an example embodiment, the weaving loom is equipped with at least a double motor, i.e. a first motor for the main weaving members (for example the sley for the air jet loom; sley and grippers for the gripper loom), and a second motor for the weaving machine, both mounted for example with a direct drive. Preferably, the first motor is designed to "track" (positionwise or speedwise) the second one, which should normally be more powerful.

[0024] According to the known art so far employed, the power feeding arrangement of this loom provided, as shown in fig. 1, a drive for each motor, each consisting of two cascade-connected main blocks, the former called feeder (or feeding bus) and the latter converter. The feeder generally consists of a rectifier - used to convert the alternating voltage coming from the supply mains into a pulsating rectified voltage - and of capacitors, which allow to store energy both to level out the voltage to the converter, and to recover part of the energy in the singular working conditions described above. The converter, instead, acts onto the rectified voltage, through suitable electronic circuits and power switches, so as to control the driving motor in the desired way (speed, torque, etc.).

[0025] According to the invention, the drives of the various driving motors share a common single feeding bus section. In such case the single feeding bus is more powerful than the one employed according to the known art for each single motor, but - advantageously - its power is smaller than the sum of the bus power values theoretically necessary for the individual consuming appliances.

[0026] As a matter of fact, thanks to this arrangement, the power absorbed by and returned from the various consuming appliances can be redistributed within the single shared feeding bus, obtaining an overall higher energy efficiency of the loom.

[0027] Through the single feeding bus it is possible to transfer the peaks of absorbed and returned power from one motor (or converter) to the other, achieving an overall smaller loss of energy (therefore producing less heat) and consequently a greater energy efficiency.

[0028] A clear aspect of the advantages that can be achieved according to the invention is shown in fig. 3, which relates, by mere way of example, to a gripper loom. As can be gleaned from the curve representing the sum of contributions of the individual curves, the absolute value of the power input and output of the feeder (solid-line curve) - for instance in the range between 0 and t_1 - is smaller than that of the power which would be delivered by the feeder according to the known art in order to move, with independent motors, the loom and the dobby, since the respective contributions have an opposite sign, resulting in the power demanded by the loom being partially supplied by the dobby. This gives an idea of the advantage that can be gained in terms of energy efficiency with the arrangement according to the invention.

[0029] In any case, the system according to the invention can be employed in conjunction with a well-known capacitor system, which advantageously will have a smaller workload compared to the condition lacking a common shared feeding bus. It is instead possible to do completely without the braking resistance (dissipator) obtaining a greater efficiency.

[0030] It is understood, however, that the invention is not limited to the specific embodiment illustrated above, which represents only a non-limiting example of the invention, but that a number of changes may be made, all within the reach of a skilled person in the field, without departing from the scope of the invention.

Claims

1. Weaving loom of the type comprising a plurality of simultaneously and independently operating motors, **characterised in that** the drives of said motors have a single shared feeder section.

2. Weaving loom as claimed in claim 1), wherein said motors are at least the main motor of the loom and the motor of the dobby.

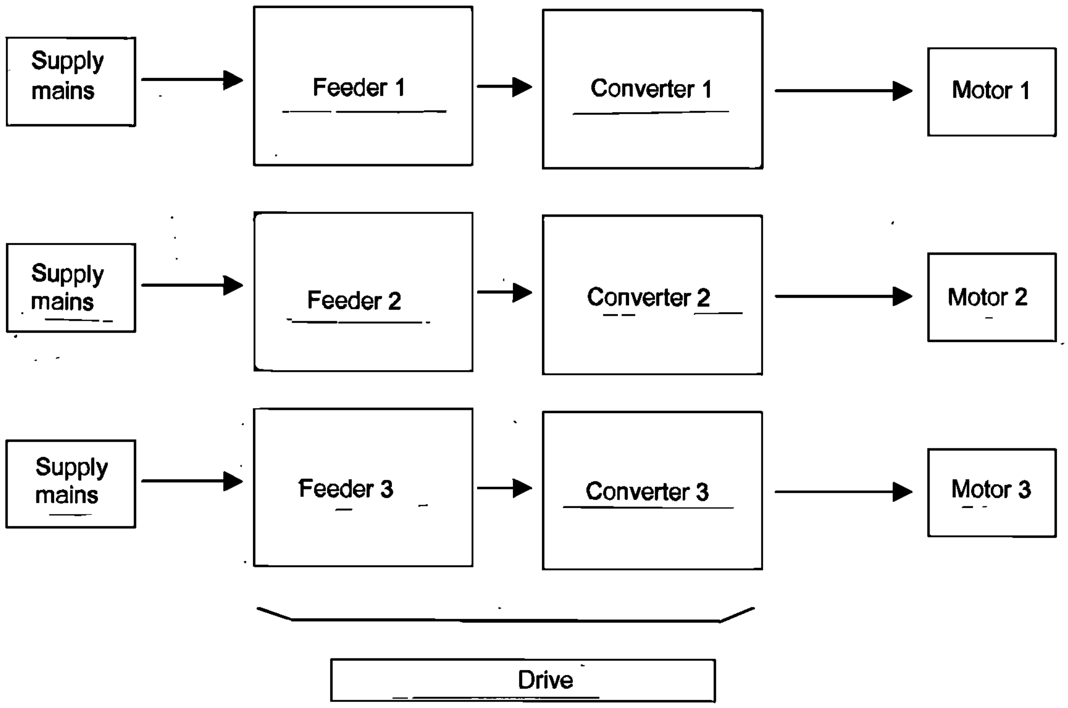
Supply mains
Feeder 1
Converter 1
Motor 1
Supply mains
Feeder 2
Converter 2
Motor 2
Supply mains
Feeder 3
Converter 3
Motor 3
Drive

Fig. 1

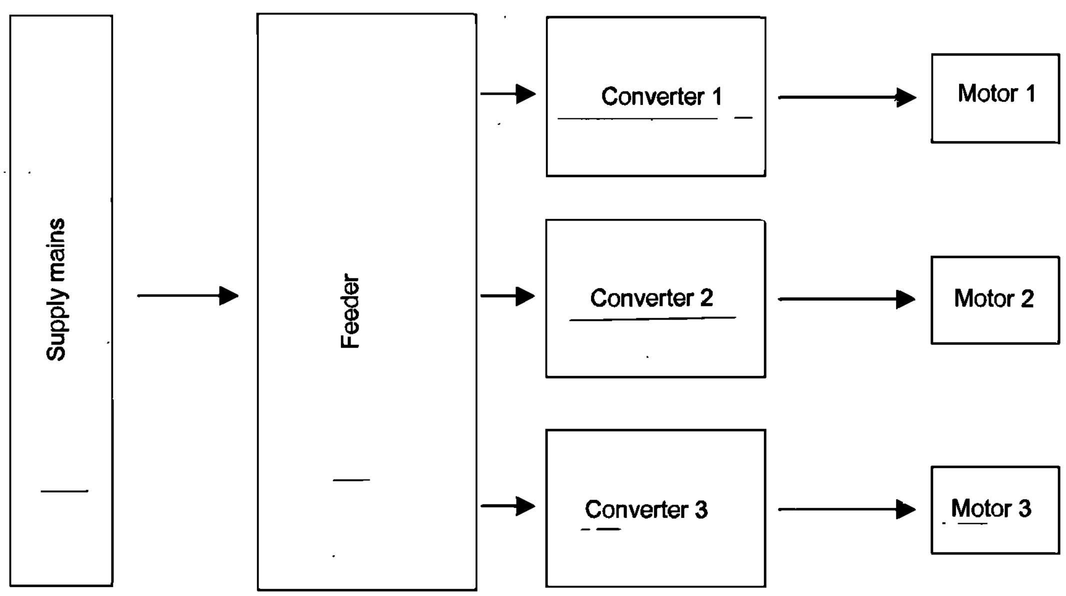
Supply mains
Feeder
Converter 1
Motor 1
Converter 2
Motor 2
Converter 3
Motor 3

Fig. 2

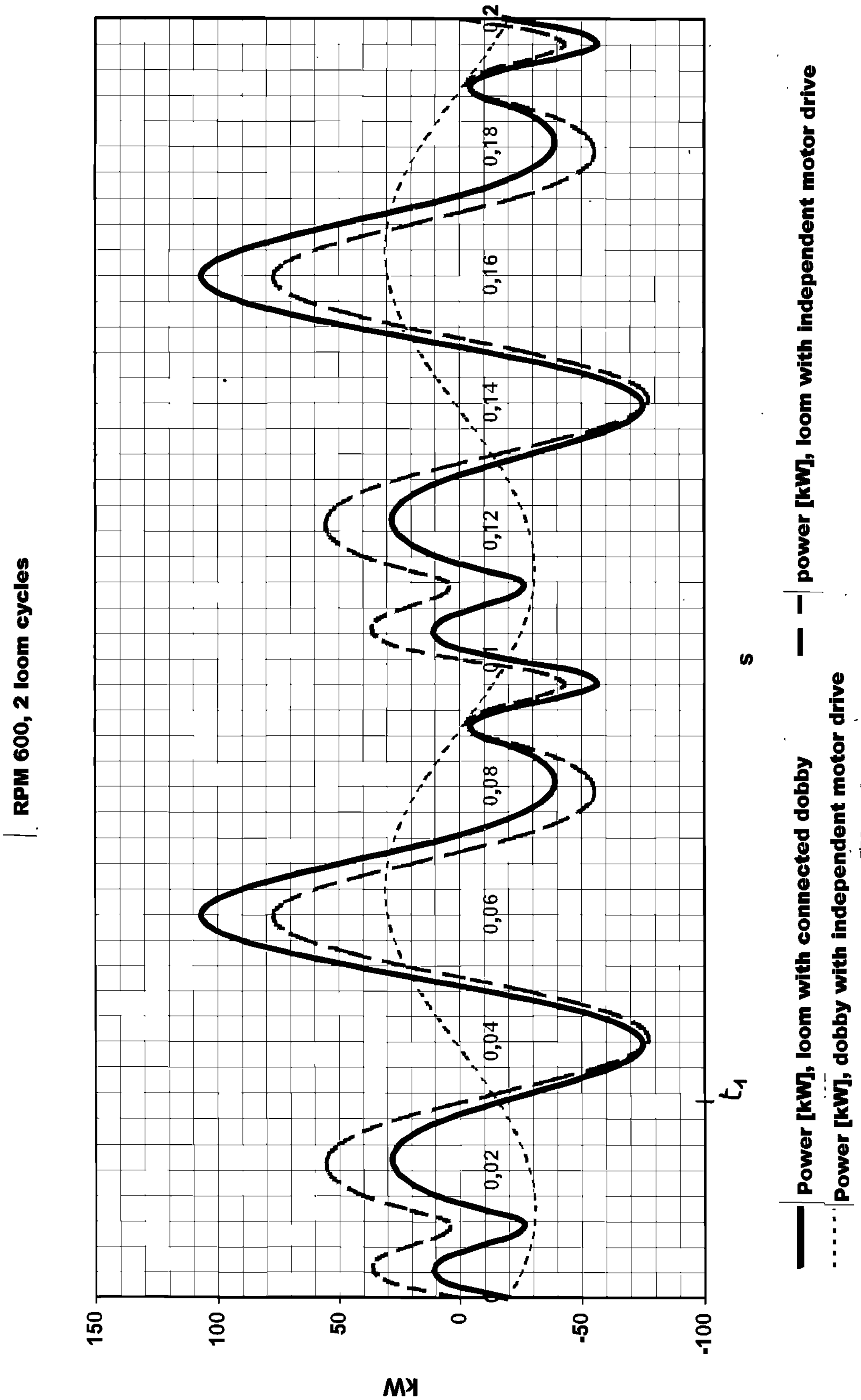
RPM 600, 2 loom cycles
150
100
50
0
-50
-100
kW
0,02
0,04
0,06
0,08
0,1
0,12
0,14
0,16
0,18
0,2
s
t_1
Power [kW], loom with connected dobby
Power [kW], dobby with independent motor drive
power [kW], loom with independent motor drive

Fig.3