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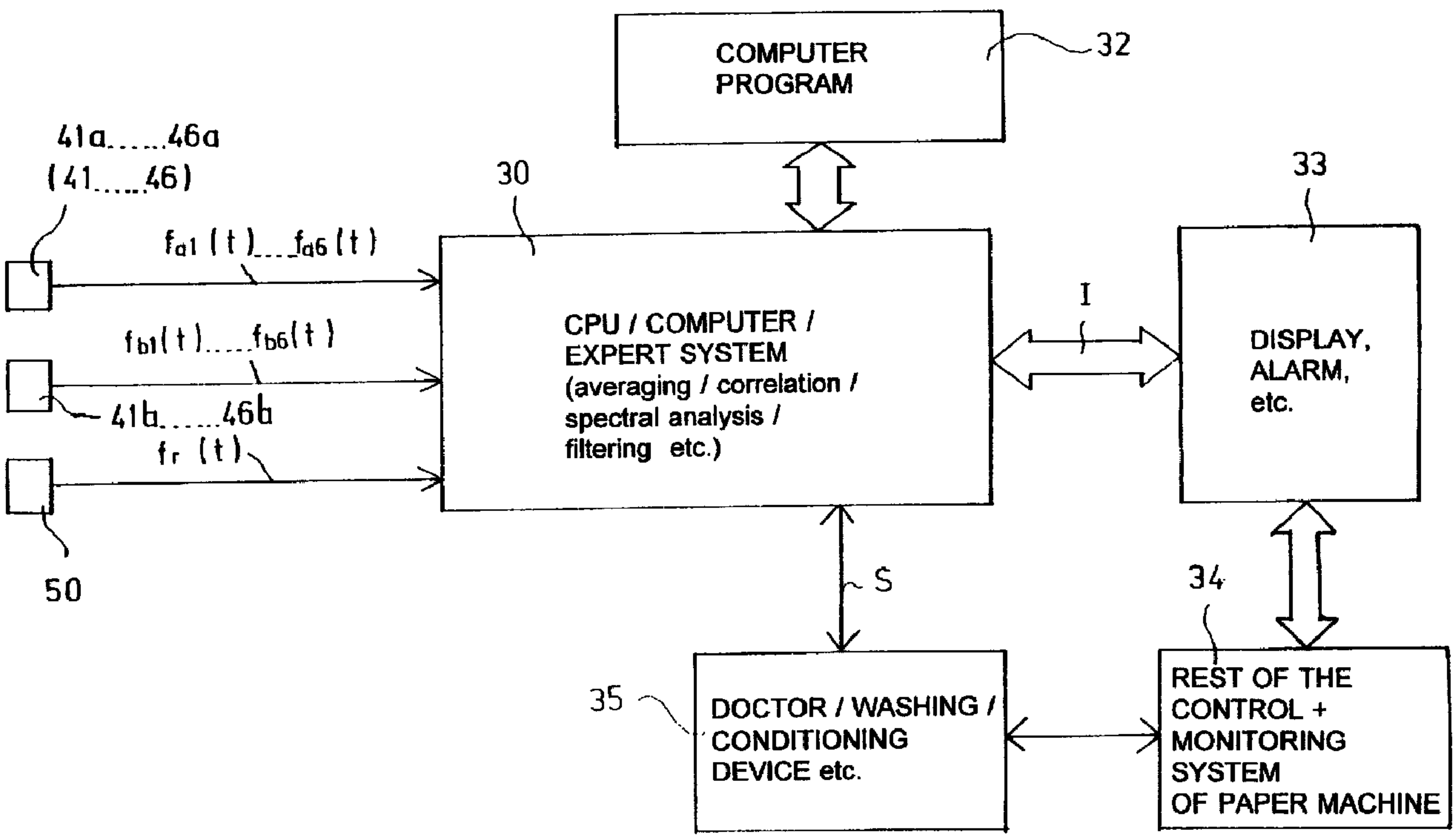
(54) Titre : PROCEDE DE DETECTION D'IMPURETES ET/OU D'ENDOMMAGEMENT D'UNE FACE PASSANT A TRAVERS UNE LIGNE DE CONTACT OU DES LIGNES DE CONTACT DANS UNE CALANDRE POUR PAPIER

(54) Title: METHOD FOR DETECTING CONTAMINATION AND/OR DAMAGING OF A FACE THAT RUNS THROUGH A NIP OR NIPS IN A CALENDER FOR PAPER



(57) Abrégé/Abstract:
The invention concerns a method for detecting contamination and/or damaging of a face (10) that runs through a nip or nips ($N_{1...}N_{10}$) in a calender for paper. In the method vibrations occurring in connection with the constructions (18, 100) of a calender are detected and processed. The vibrations are detected by means of at least one vibration detector (40; 41...46; 41a...46a, 41b...46b) fitted in connection with the bearing supports of calender rolls (11...16) or in connection with constructions (18, 100)

(57) Abrégé(suite)/Abstract(continued):
related to said bearing supports. By means of these vibration detectors the calender roll(s) (11...16) is/are identified from which the vibration derives. In the method, it is possible to observe the rotation of all of the rolls to be monitored and to measure vibration from any suitable point whatsoever, for example from the frame (100) of the machine, by employing at least one vibration detector (40), the time (T_r) of the cycle of the vibration signal obtained from said detector(s) being compared with the numbers of revolutions of the rolls to be monitored. In this way, the source of the disturbance is determined, and action is taken in order to eliminate the disturbance.

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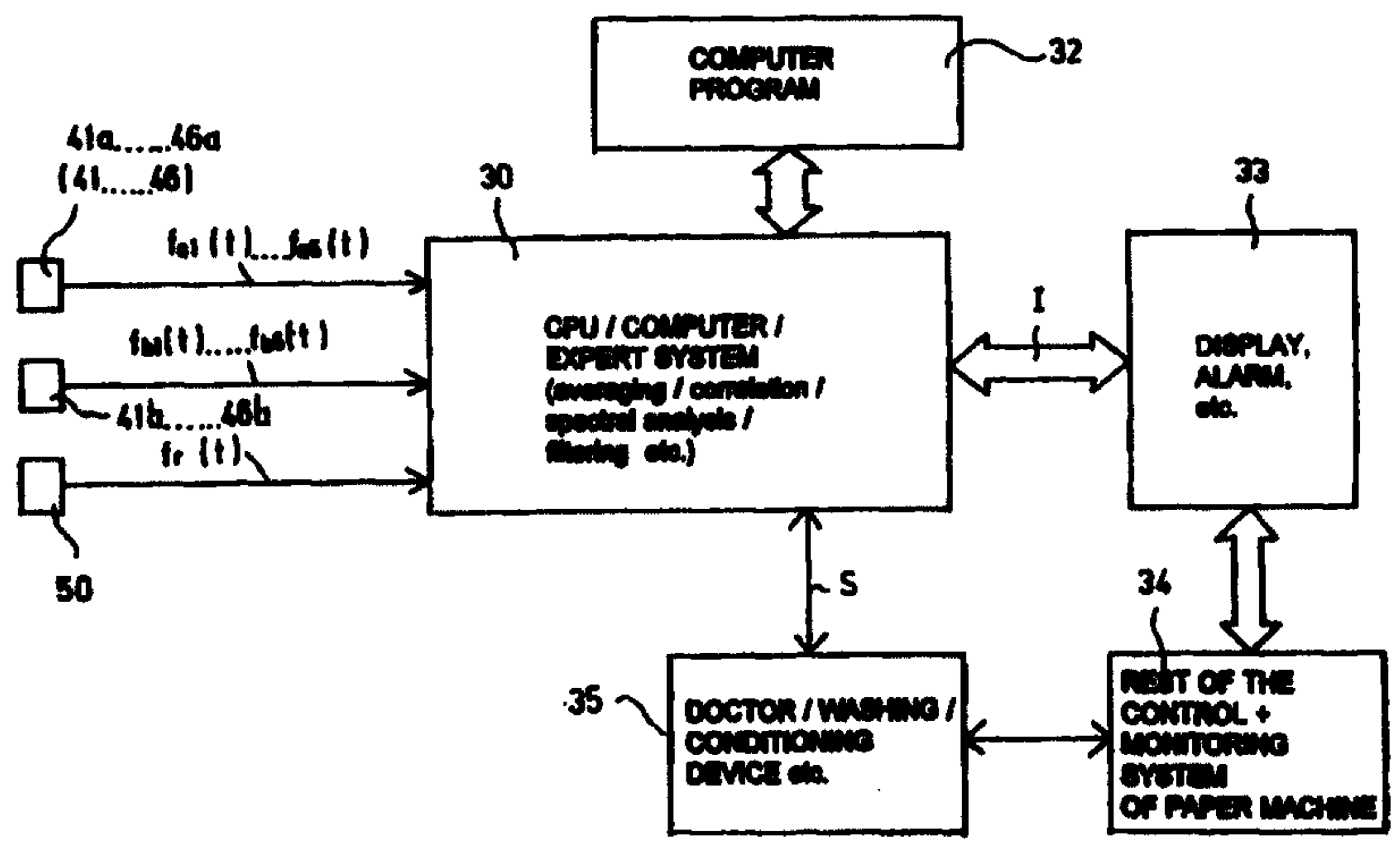
(54) Title: METHOD FOR DETECTING CONTAMINATION AND/OR DAMAGING OF A FACE THAT RUNS THROUGH A NIP OR NIPS IN A CALENDER FOR PAPER



(57) Abstract

The invention concerns a method for detecting contamination and/or damaging of a face (10) that runs through a nip or nips ($N_1...N_{10}$) in a calender for paper. In the method vibrations occurring in connection with the constructions (18, 100) of a calender are detected and processed. The vibrations are detected by means of at least one vibration detector (40; 41...46; 41a...46a, 41b...46b) fitted in connection with the bearing supports of calender rolls (11...16) or in connection with constructions (18, 100) related to said bearing supports. By means of these vibration detectors the calender roll(s) (11...16) is/are identified from which the vibration derives. In the method, it is possible to observe the rotation of all of the rolls to be monitored and to measure vibration from any suitable point whatsoever, for example from the frame (100) of the machine, by employing at least one vibration detector (40), the time (T_r) of the cycle of the vibration signal obtained from said detector(s) being compared with the numbers of revolutions of the rolls to be monitored. In this way, the source of the disturbance is determined, and action is taken in order to eliminate the disturbance.

Method for detecting contamination and/or damaging of a face that runs through a nip or nips in a calender for paper

The invention concerns a method for detecting contamination and/or damaging of a face that runs through a nip or nips in a calender for paper, in which method vibrations occurring in connection with the constructions of a calender are detected and processed.

The present invention is related to calenders for paper, in particular so-called soft calenders and supercalenders, in which soft-coated rolls are used which are particularly susceptible of damage.

A particularly advantageous embodiment of the present invention is related to monitoring of the condition of soft-coated calender rolls in view of detecting their surface damage at a sufficiently early stage and, thus, in view of permitting prevention of damage in advance.

As is known from the prior art, calenders comprise two or more hard-faced and/or soft-faced calender rolls, which form a calendering nip or nips with each other, through which nip/nips the paper web to be treated is passed. In particular rolls with soft faces, such as paper rolls or equivalent in supercalenders and rolls provided with soft coatings, in particular polymer coatings, in what is called soft calenders, are susceptible of damage. The reason for the damage is frequently contaminations, such as local fibre strings, which cause a pressure impact when they pass through the nip, which impact loads the soft coating on the calender roll and first causes its heating and, in the long run, a permanent deformation in the coating and damage. Similar deformations and damage may also occur in metallic faces of calender rolls and in the faces of bands running through calendering nips.

In respect of the particular problems that constitute the starting point of the present invention, the following is stated. The polymer-coated rolls in prior-art calenders endure uniform loading and wear well, but they are damaged very easily is some limited, even small area is heated even to a relatively little extent, for example, to a temperature higher than its environment. Owing to the high thermal expansion coefficient and to the very poor thermal conductivity of polymers, such an even little area expands rapidly and is heated further to such high temperatures that it can be deformed. If the coating on the roll has been made of so-called thermosetting resins, on re-melting it, at the same time, loses its original properties. A heating reaction of the sort described above can be caused, for example, by a little piece of paper, fibre string or "clod", or a stain separated from the coating on the paper, which adheres to the roll face and which, when entering into a calendering nip, causes a local yielding of the coating more intensive than in the environment, which heats the roll coating unevenly.

Prevention of local contamination, for example, by means of constant doctoring is, as a rule, not reasonable, neither economically nor in view of optimal quality of paper, for most of the polymer coatings that are in use do not tolerate rubbing very well, in which case the preventive cleaning itself might wear the coating to a greater extent than the calendering proper does.

However, if contaminations could be detected early enough, for example, a cleaning doctor or some other device that cleans the roll face could be operated during short periods of time without damaging the roll coating as a result of constant or frequently repeated doctoring. In such a case, the service lives of soft-faced calender rolls could be extended to a considerable extent.

As is known from the prior art, for monitoring the condition of calender rolls, in particular of soft-faced rolls, thermometers traversing in the cross direction of the machine have been used, by whose means the temperature of the coating is monitored. In said temperature monitoring application and in corresponding other prior-art systems, problems arise from the fact that the resilient roll coating, whose temperature is monitored, is, as a rule, at least to some extent electrically insulating. Thus, in the partly rubbing contact between the web and the coating, quite high charges of static electricity arise in the faces of the roll coating and of the relatively dry paper web. These charges tend to be discharged along the available routes with the lowest resistance. A thermographic camera must often be installed so that it projects from its support construction, in which case said static electric charges find exactly the thermographic camera as the easiest route of discharge, in which connection the sensitive electronic system of the thermographic camera is subjected to quite high voltages, and it must be protected specifically against such voltages.

Even if monitoring of the temperature of the face of a calender roll usually permits detecting of a local raised temperature resulting from an excessive load applied to the coating or from a local inner non-homogeneity at a sufficiently early stage, this requires installation of quite heavy, expensive and spacious equipment in the vicinity of the roll to be monitored. In particular, congestion of space causes great difficulties in connection with multi-roll treatment devices, at which every device that is not included in the web treatment process proper makes the maintenance and servicing of the device more difficult.

As is also known from the prior art, DE 43 40 700 discloses a method for detecting contamination or damages in a calender roll by detection of vibrations with vibration sensors. Damaged rolls are replaced in accordance with detected information to stop further damage in a papermaking process.

The object of the present invention is to provide a method by whose means contamination and/or damage in faces of rolls that form a calendering nip or nips and/or in faces of bands that run through nips can be monitored efficiently and by means of relatively simple devices that require little space.

It is a further object of the invention to provide a method in which the operations to be controlled based on the monitoring of the face running through the nip can be arranged to be so quick that, as a rule, permanent substantial damage does not have time to be produced in the face concerned before cleaning operations or equivalent have been started,

The present invention additionally is directed towards a method by means of whose application, when necessary, the cleaning of the face running through the nip can be applied sufficiently precisely expressly to the area that has been noticed to be contaminated, whereby economies can be obtained in respect of the medium and the energy used for the cleaning. In some cases, owing to the invention, the cleaning equipment can be dimensioned so that its capacity is lower than in the prior art.

In accordance with one aspect of the present invention, there is provided a method for detecting contamination and damage of a roll face in a calender for paper, which comprises detecting and processing vibrations occurring in connection with a frame part and a bearing support of the calendar and providing the at least one vibration detector for detecting these vibrations, wherein the at least one vibration detector is fitted in connection with the bearing supports of calender rolls and in connection with the frame part, by means of which vibration detector (s) the calender roll (s) is/are identified from which the vibration derives.

In a preferred embodiment of the invention, on the bearing housings of the calender rolls or at least on a part of said bearing housings and/or on the roll frames, at least one acceleration detector which measures vibration of the calender roll or a strain gauge detector which measures deformations arising from vibration or other, equivalent detectors is/are fitted. The measurement signals from these detectors are monitored and analyzed so that the portion of the measurement signal that arises from rotation and unbalance of the rolls is "filtered" off, and the development of the portion that arises from the geometry of the roll face is monitored. When the signal to be monitored reaches a predetermined level or when its spectrum is placed within the measurement window, the control system reports this further, and action can be taken either to replace the roll or to eliminate the source of disturbance.

By means of the system of the present invention, vibrations of the faces of calender rolls to be monitored are, in a way, "listened to" and, to the necessary extent, the site of origin of the vibrations is located so that efficient action can be taken sufficiently quickly in order to eliminate the cause of the vibration and/or to prevent further damage.

In the invention, the locating of the source of disturbance can also be carried out so that the rotation of all or several of the rolls to be monitored is observed and that vibration is measured from any suitable point whatsoever, for example from the frame of the machine. By comparing the measured vibration signal, preferably the cycle time of its repetition, with the measured speeds of rotation of the different rolls, it is possible to determine the source of the disturbance and to take action in order to eliminate the disturbance either by cleaning the roll or by replacing the roll before it is damaged.

By means of a monitoring system that applies the present invention, it is possible to create such information data bases by whose means the optimal moment of replacement of the rolls can be determined when the seriousness of the damage that has resulted in replacement of a roll is classified and stored in the memory in connection with replacement of each roll. In such a case, by means of history data, it is possible to identify the seriousness of a disturbance and to take action at the correct time.

By means of the present invention, it is possible to eliminate the problems discussed above by abandoning direct measurement of the surface temperature of the roll, by indirectly monitoring local impurities on rolls and changes in geometry on the basis of vibrations produced by them.

Advantages of the present invention, as compared with the prior-art procedure, are the following:

— In the most advantageous embodiment of the invention, it is possible to locate the soft-faced calender roll, in particular a polymer-coated roll, that has been contaminated or deformed, so that the roll can be cleaned, for example doctored, before it has been damaged and become unusable, or, if necessary, a

AMENDED SHEET

damaged roll can be replaced so that further damage or longer interruptions of production can be avoided.

— The invention permits monitoring of the calender rolls so that, in the area of the roll frame, it is unnecessary to construct a measurement equipment provided with a separate support construction, in which case considerable economies of space are obtained.

— The invention also permits locating of a calender roll that causes a disturbance or, if necessary, of an area of said roll by means of relatively simple devices and algorithms.

— The invention can be connected as a part of the general system of monitoring of the condition of the calender, and the invention can utilize the assemblies of detectors already installed in the area of bearings for the purpose of monitoring the condition of bearings, or, alternatively, the detectors installed in order to carry out the present invention in view of monitoring the condition of the roll face can also be utilized for predicting and/or monitoring of bearing damage.

— The invention is not confined to monitoring of disturbance arising from changes in temperature related to local surface temperatures on the calender rolls alone, but the system of the present invention already reacts at such an earlier stage in which a contamination has adhered to the roll face which would later additionally cause a locally raised temperature.

— Further, it can be considered to be an advantage of the invention as compared with a thermographic camera that the system of the invention can, if necessary, be configured so that it constantly monitors the portion of the roll across the entire width of the treatment nip and locates the cause of disturbance even both in the axial direction of the roll and in a vertical cross section of the roll in the direction of its circumference.

AMENDED SHEET

When the monitoring system of the invention is used in a calender with several nips, for example in a supercalender, all the rolls in the calender, or at least the rolls that are particularly susceptible of surface damage, in particular soft-faced rolls, are provided with a detector system in accordance with the invention, in which case the source of unusual vibrations can be located exactly at a contaminated and/or damaged roll so that it is possible to start eliminating the contaminations or to replace the damaged part so that further damage and production losses are avoided.

In the following, the invention will be described in detail with reference to some exemplifying embodiments of the invention illustrated schematically in the figures in the accompanying drawing, the invention being by no means strictly confined to the details of said embodiments.

Figure 1 shows a simplified block diagram illustrating the monitoring system in accordance with the invention.

Figure 2 is a schematic side view of a 10-nip multi-roll calender as a preferred environment of application of the present invention.

To begin with, reference being made to Fig. 2, a simplified exemplifying embodiment will be described as a particularly advantageous environment of application of the invention.

As is shown in Fig. 2, the multi-roll calender comprises a frame part 100, on which a stack of calender rolls has been mounted. The stack of calender rolls comprises ten calendering nips $N_1 \ldots N_{10}$ placed one above the other, which nips are loaded by means of loading devices in themselves known. The paper web W to be calendered enters into the calender in the direction of the arrow W_{in} and departs from the calender after the last nip N_{10} in the direction of the arrow W_{out}. Being guided by the guide rolls 17, the paper web W to be calendered runs through the calendering nips $N_1 \ldots N_{10}$ proper and through the reversing nip N_v. In the calender, there are six metal rolls 21,22,23,24,25,26 provided with hard and smooth coatings 20 and six rolls 11,12,13,14,15,16 provided with soft polymer coatings 10. Said hard-faced 20 and soft-faced 10 rolls are placed in the stack of rolls alternatingly so that two soft rolls 13,14 have been fitted one after the other in order to reverse the side of the paper web W that is to be calendered more intensively. The condition of the rolls 11...16 provided with soft coatings 10 is monitored by means of vibration detectors 41,42,43,44,45,46 fitted on one of the bearing housings 18 of each of said rolls. By analyzing the signals $f_1(t)...f_6(t)$ obtained from said vibration detectors 41...46, it is possible to detect damage in the soft roll faces 10 and local contamination M of the rolls 11...16 before the polymer coating 10 is damaged and becomes irreparable.

As is shown in Fig. 2, the signals $f_1(t)...f_6(t)$ which represent the vibrations and which are received from the vibration detectors 41...46 fitted in connection with one of the bearing supports 18 of each of the rolls 11...16 are passed along the bus 31 into the monitoring system 30...35 applied in the invention, an exemplifying embodiment of said system being described later in more detail with reference to Fig. 1.

In Fig. 2, the so-called reversing nip N_v is formed between two soft-faced rolls 13 and 14. Since, as a rule, the rolls 13 and 14 have different diameters, as compared with one another, a disturbance can be located in one of the rolls 13/14 by monitoring the cycle time T_r of the disturbance. In such a case, a vibration detector 43/44 is needed in one of the rolls 13/14 only. This embodiment of the invention can also be generalized so that, for example, in a calender in which all the rolls have different diameters, as compared with each other, it is possible to employ just one vibration detector 40 and one or several impulse detectors 50, and the disturbance can be located exactly in the contaminated roll based on the cycle times T_r of vibrations.

Fig. 1 is a schematic illustration of such an embodiment of the system of the present invention in which there are pairs of vibration detectors 41a...46a and 41b...46b at both of the opposite bearing supports 18 of all of the soft calender rolls 11...16. The reference letters a and b refer to opposite sides of the calender. Thus, in this respect, the illustration in Fig. 1 differs from Fig. 2, in which vibration detectors 41...46

have been shown to be fitted in connection with one of the bearing supports 18 only at each of the soft rolls 11...16. Both in Fig. 1 and in Fig. 2, an impulse detector 50 is shown, from which the synchronization signal $f_r(t)$ is obtained, which is utilized in a way that will be described in more detail later.

From the pairs of vibration detectors 41a,41b...46a,46b shown in Fig. 2, the signals $fa_1(t)...fa_6(t)$ and $fb_1(t)...fb_6(t)$ are obtained, which are passed to the unit 30. Also, to the unit 30, a signal $f_r(t)$ is passed from the impulse detector 50 placed in connection with a calender roll, which signal is formed, for example, out of a short voltage pulse coming on each revolution of the roll, the cycle time T of said pulse illustrating the circumferential speed of the rolls. In the unit 30, it is also possible to carry out spectral analysis of the signals $f_a(t)$ and $f_b(t)$, for example, by means of Fourier analyzers in themselves known. In this way, in addition to locating the disturbance, it is also possible to draw conclusions concerning the nature and the degree of seriousness of the disturbance. The signal $f_r(t)$ can be used for synchronization of the measurements and for measurement of the speed of rotation of the rolls in the monitoring system in accordance with the invention, which will be described in more detail later.

The vibration detectors 41...46 are preferably acceleration detectors, but piezoelectric detectors or transition detectors, such as strain gauge detectors, can also be used. By means of these detectors, pressure impacts of quite a high frequency, arising, for example, from fibre strings M, in the set of calender rolls or in a corresponding other face to be monitored, such as the face of a transfer belt or a press felt, are measured. Said pressure impacts produce mechanical vibrations present as a longitudinal wave movement, the substantial energy of said vibrations being, as a rule, in the sound frequency range. Besides by impurities, for example local fibre strings M, vibrations can also be caused by damage in the coatings on the rolls, which damage is present as local areas of discontinuity or as deformations in the roll faces, in particular in a soft coating 11 susceptible of damage. For example, as is shown in Fig. 2, when a fibre string M present on the soft polymer coating 10 on the first soft roll 11 passes through the second nip N_2, it produces a clearly

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distinguishable signal $f_1(t)$, which is transferred through the bus 31 into the system 30...35 illustrated in Fig. 1.

The signals $f_a(t)$ and $f_b(t)$ detected by said pairs of detectors are averaged in the unit 30, in which, moreover, the phase difference φ between the signals $f_a(t)$ and $f_b(t)$ is measured. This phase difference φ is illustrated, for example, by the difference Δt between the travel times of the vibrations, which is directly proportional to φ. A corresponding difference Δt between the travel times can be detected by means of pairs of detectors. Based on the difference Δt between the travel times described above, the location of the fibre string M in the axial direction of the rolls can be determined.

Based on the signal $f_r(t)$ of the pulse detector 50, it is possible to determine the phase angle α_m at which the fibre string M is placed from the reference plane determined by the impulse detector 50, in which reference plane the central axis of the roll is placed. Said angle coordinate α can be determined based on the following equation:

$$\alpha_m = \frac{360° \cdot Tr}{T}$$

wherein Tr = time of delay of the detecting of the vibration caused by the fibre string M, and T = cycle time of revolution of the roll.

The definition given above is based on the fact that the speed c of propagation of vibrations in the metal parts 11...16 of the rolls is considerably higher than v_k = circumferential speed of the rolls, ($c >> v_k$). Thus, it is possible to determine both coordinates of the fibre strings M, i.e. the coordinate in the axial direction of the roll, and the angle coordinate perpendicular to same.

In the unit 30 shown in Fig. 1, the signals $f_a(t)$ and $f_b(t)$ are averaged, and their phase difference φ is measured. In the measurement of the phase difference φ, it is also possible to employ the technique of correlation of the signals $f_a(t)$ and $f_b(t)$. In

AMENDED SHEET

addition to measurement of the phase difference φ, in the unit 30, it is also possible to carry out spectral analysis of the signals $f_a(t)$ and $f_b(t)$, and on the basis of said analysis, it is possible to draw conclusions concerning the nature of the disturbance. The unit 30 can include a processor (CPU) or a computer, whose operation is controlled by a computer program 32 prepared for the purpose. From the unit 30, information I is received, which is passed to the display monitor 33, which displays the appropriate display data for the operation supervisor and possible alarms, if any. Further, based on a signal s received from said unit 30, the devices 35 of cleaning and conditioning of the calender rolls can be controlled so that the cleaning operations, for example doctoring and/or water or steam jets, are applied to the contaminated roll 11...16 or even in the axial direction of the roll expressly to the locations of the impurities, and in this way the cleaning can be made more efficient and such that it wears the roll face less and consumes less cleaning medium and energy. Further, the unit 30 can be connected, preferably interactively, with the rest of the control and monitoring system 34 of the calender so as to operate synergically together with said system.

In the method of the present invention, the measurement signals can be synchronized by means of the speed of rotation of the calender rolls, which is obtained by means of the signal $f_r(t)$ and by means of the impulse detector 50. The system in accordance with the invention can operate, for example, so that, when the detector 50 bypasses the trigger point and gives an impulse, the measurement of vibration described above is started, the time used for a cycle of said measurement being invariable. After the cycle of measurement, the next triggering of the detector 50 is waited for, and a new cycle of measurement is started. These measurement cycles of invariable length are stored as a sufficient number, and the average values of the measurement signals $f_a(t)$,$f_b(t)$ are computed. The measurement of the measurement signals $f_a(t)$ and $f_b(t)$ and of the synchronization signal $f_r(t)$ can also be carried out continuously, for example for a period of about 1 minute, after which the program 32 carries out the computing of a synchronized time average.

AMENDED SHEET

The pressure impacts arising from local impurities, such as fibre strings M, and the signals $f_a(t)$ and $f_b(t)$ detected from same are, as a rule, of relatively high frequency. Since vibrations arising, e.g., from unbalance of rolls or from corresponding other reasons are at a considerably lower frequency, they can be filtered off by means of high-pass filters in the unit 30 so that they do not interfere with the observations in accordance with the invention. By employing means in themselves known in the processing of the signals, such as band-pass filtering or correlation technique, it is possible to reduce the effects of the "noise" interfering with the measurements in accordance with the present invention.

Even though, above, it has been described that the coordinates of location of impurities M on the mantles of the rolls are measured both in the axial direction and in the circumferential direction, the invention can, of course, also be applied so that just one of the coordinates is detected.

The scope of the invention also includes applications in which the coordinates of the cause of the vibration are not at all determined, but exclusively the roll is determined, in particular a soft-faced roll 11...16, and in Fig. 2 expressly the first soft roll 11, in connection with which the contamination M is present and to which, thus, the cleaning operations, such as doctoring by means of the devices 35, are applied.

As said devices 35 for cleaning and/or conditioning of the roll face or of the face of a corresponding band or felt, it is possible to use doctors in themselves known and/or, for example, nozzle devices of the sort described in the *US Patent 5,603,775*, which traverse in the axial direction of the roll and which spray a cleaning medium.

In a preferred embodiment of the invention, which has been sketched in Fig. 2, the doctor is controlled to clean expressly the roll, the roll 11 in Fig. 2, on whose soft face 10 a contamination M has been detected.

AMENDED SHEET

In accordance with the present invention, a source M of disturbance can also be located so that the rotation of all or several rolls to be monitored is observed, which rolls have, as a rule, different diameters, as compared with one another, and vibration is measured from any suitable point whatsoever, for example from the frame 100 of the machine, by means of at least one vibration detector 40. In such a case, the disturbance M can be located on a contaminated roll by comparing the cycle time T_r of the repetition of the measured vibration with the speeds of rotation of the rolls measured by means of the detectors 50. Thus, it is possible to take action in order to eliminate the disturbance either by cleaning said contaminated roll or by replacing said roll before further damage is produced. In the unit 30, it is possible to collect and to create information data bases by whose means it is possible to determine the optimal time of replacement of the different rolls, for example, by classifying the seriousness of the disturbance and by, in connection with each replacement of roll, storing the necessary data in the memory of the system 30. Thus, a docile system 30 is produced, and the seriousness of a disturbance can be identified by means of the history data collected in said system, and action can be taken at the correct moment.

When detectors fitted in connection with revolving mantles of calender rolls are employed in stead of, or in addition to, stationary vibration detectors, the transfer of data from the mobile detectors can be arranged in ways in themselves known. For the transfer of measurement signals $f_a(t)$, $f_b(t)$ and $f_r(t)$ from revolving rolls, a number of different solutions are known from the prior art, which can be applied in connection with the present invention. These prior-art solutions include various glide rings and transfer of signals by the radio. Glide rings are possible, but they are often susceptible of disturbance, and typically they require an abundance of space on the roll axles. For wireless transfer of signals, radio apparatuses are available commercially. The prior-art solutions related to said transfer of signal are not described in more detail in this connection, but in their respect, reference is made, by way of example, to the *Patent Application EP-A1-0075620* and to the applicant's *FI Patent 92,771*.

AMENDED SHEET

In the following, the patent claims will be given, and the various details of the invention can show variation within the scope of the inventive idea defined in said claims and differ from what has been stated above by way of example only.

AMENDED SHEET

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method for detecting contamination and damage of a roll face in a calender for paper, which comprises detecting and processing vibrations occurring in connection with a frame part and bearing supports of the calender roll and providing at least one vibration detector for detecting these vibrations, wherein said at least one vibration detector is fitted in connection with the bearing supports of the calender rolls and in connection with the frame part, by means of which at least one vibration detector of the calender roll(s) is/are identified from which the vibration derives, wherein the method is applied in a multi-roll calender, in which there are alternating hard-faced metal rolls and corresponding soft-faced, polymer-coated rolls placed one above the other, which rolls form calendering nips with each other, and, in connection with the bearing supports of said soft-faced calender rolls, said at least one of any of vibration detectors has been fitted, from which vibration signals have been passed to units which process vibrations.

2. A method as claimed in claim 1, wherein the rotation of several rolls to be monitored is observed, and vibration is measured from a point whatsoever, from the frame part of the calender, and at least one said vibration detector is employed, and the cycle time of a vibration signal obtained from said at least one vibration detector is compared with the speeds of rotation of the rolls to be monitored, and thereby a source of disturbance is determined, and action is taken to eliminate the disturbance.

3. A method as claimed in claim 1 or 2, wherein, in connection with the bearing supports of soft-faced, polymer coated rolls in a stack of calender rolls, or in connection with the frame part related to said bearing supports, said at least one vibration detector has been fitted, by whose means the soft-faced calender roll is determined whose soft coating has been contaminated and/or damaged.

4. A method as claimed in any one of the claims 1 to 3, wherein the method is applied in a calender in which there is a reversing nip formed by two soft-faced calendering rolls, at each of said soft-faced rolls, which have different diameters, as compared

with one another, there is a detector which monitors the speed of rotation of the roll, a said vibration detector is fitted in connection with one of said soft-faced calendering rolls of said reversing nip only, and a disturbance is located as being present on either one of said soft-faced calendering rolls of said reversing nip by making use of a cycle time of repetition of the disturbance.

5. A method as claimed in any one of claims 1 to 4, wherein vibrations in the frame part and/or roll bearings of a roll or rolls that forms/form a calendering nip or nips are detected by means of said at least one pair of said detectors, and a location of a source of disturbance in the axial direction of said roll is determined based on the phase difference of the vibrations arriving in the different detectors in the pair of detectors.

6. A method as claimed in claim 5, wherein the condition of the bearings in the calender is monitored by the detectors being placed in connection with the bearings of the roll to be mounted.

7. A method as claimed in any one of claims 1 to 6, wherein the location of a source of disturbance in the circumferential or machine direction of a face to be monitored is determined by making use of an impulse detector that records the revolutions of the face to be monitored and by making use of the point of time of an impulse obtained from said impulse detector as compared with the time of detecting of the disturbance.

8. A method as claimed in any one of claims 1 to 7, wherein, by means of a high-pass filter and by means of a band-pass filter, interfering signals placed outside a measurement window and arising from unbalance of rolls, fabrics and bands and from other vibrations are separated from signals detected by means of said at least one pair of vibration detectors.

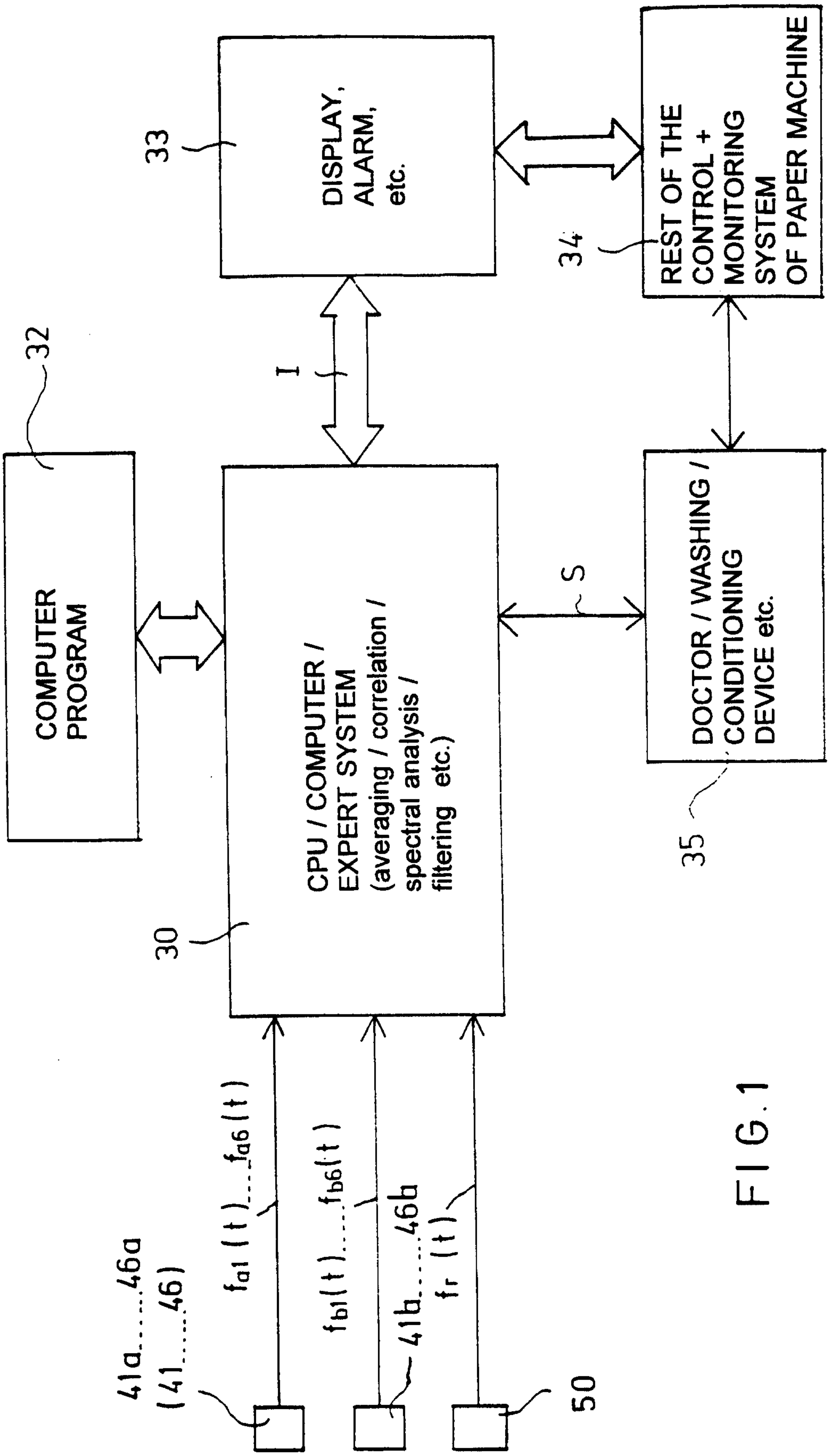
9. A method as claimed in any one of claims 1 to 8, wherein a certain amount of measurement signals are collected in memory, which signals are averaged, and, based on the signals thus obtained, at least one coordinate of a source of disturbance on a face to be monitored is determined.

10. A method as claimed in any one of claims 1 to 9, wherein vibration signals and a signal that indicates by-passing and a speed of a reference point on a face to be monitored are passed to a unit or to a computer, which is provided with a program that controls measurement and analyzes measurement results, and from said unit the measurement results are passed to display and/or alarm means.

11. A method as claimed in any one of claims 1 to 10, wherein, based on coordinates of location of sources of disturbance, devices that clean a face to be monitored are controlled so that they apply a cleaning operation of doctoring, to a soft-faced roll.

12. A method as claimed in any one of claims 1 to 11, wherein the signals received from said at least one pair of vibration detectors are subjected to a spectral analysis, on whose basis conclusions are drawn concerning the nature of the disturbance and/or effects of outside sources of disturbance are reduced.

13. A method as claimed in any one of claims 10 to 12, wherein a data base is collected and created individually, by whose means optimal times of replacement of different rolls are determined by classifying seriousness of a disturbance and by storing necessary data in memory of a unit in connection with each replacement of roll.


DISPLAY,
ALARM,
etc.
33
REST OF THE
CONTROL +
MONITORING
SYSTEM
OF PAPER MACHINE
34
32
COMPUTER
PROGRAM
I
CPU / COMPUTER /
EXPERT SYSTEM
(averaging / correlation /
spectral analysis /
filtering etc.)
30
S
DOCTOR / WASHING /
CONDITIONING
DEVICE etc.
35
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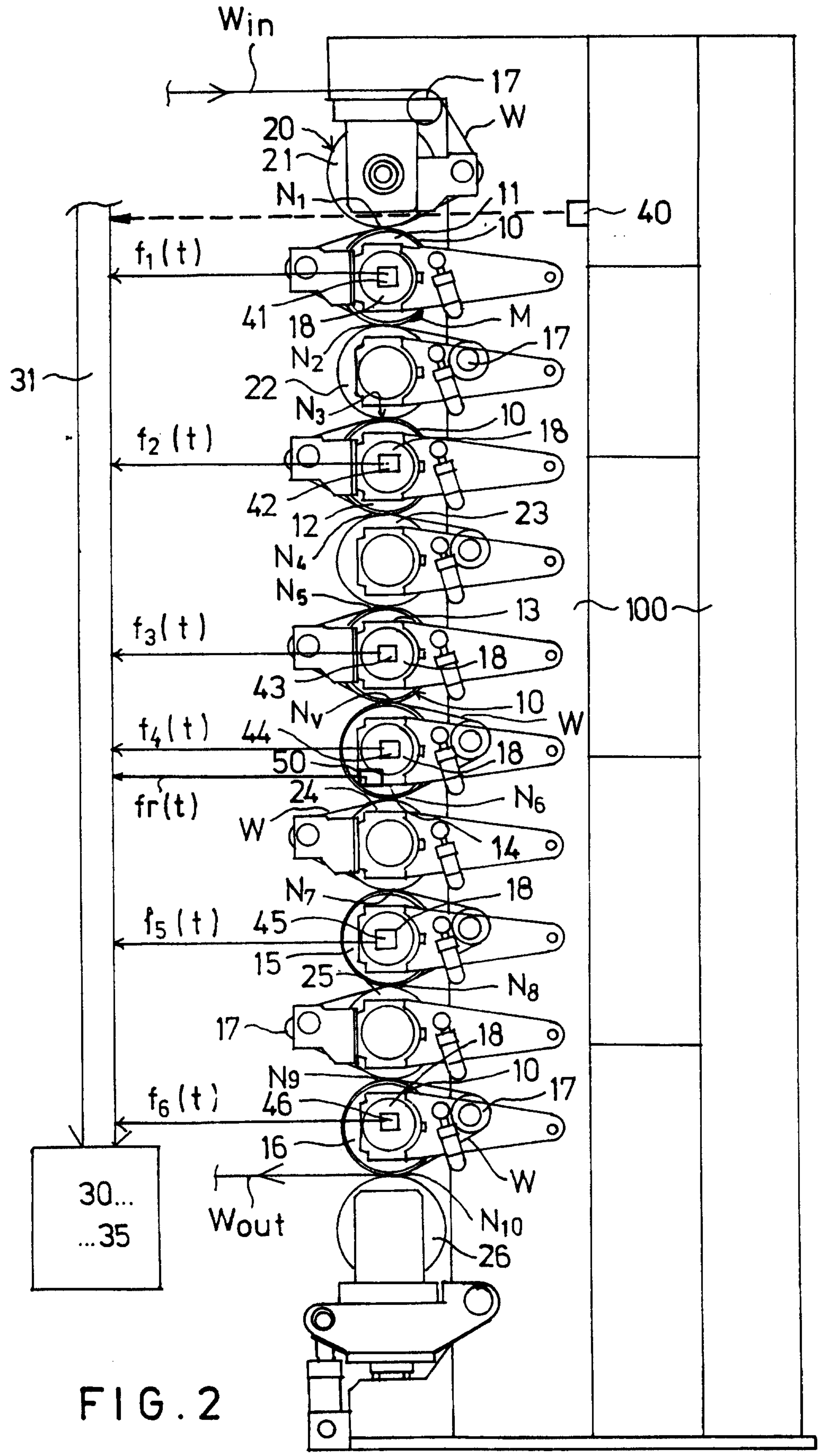
(41.....46)
fa1(t).....fa6(t)
fb1(t).....fb6(t)
41b.....46b
fr (t)
50

FIG. 1



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21
N1
11
10
40
f1(t)
41
18
M
N2
17
31
22
N3
10
18
f2(t)
42
12
23
N4
N5
13
100
f3(t)
18
43
10
Nv
W
f4(t)
44
50
18
fr(t)
24
N6
W
14
N7
18
f5(t)
45
15
25
N8
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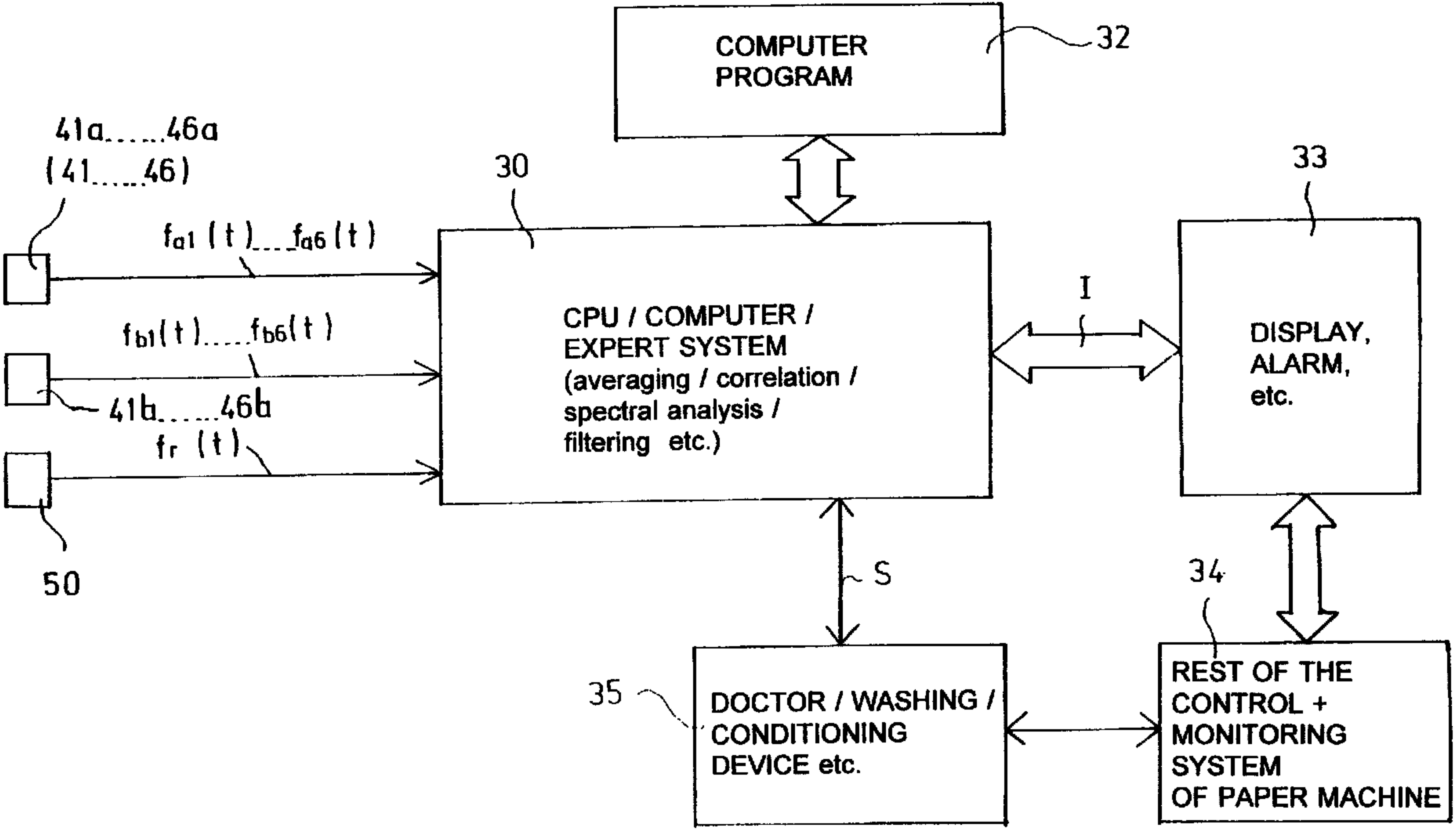
N9
10
17
f6(t)
46
16
W
Wout
N10
26
30...
...35

FIG. 2


COMPUTER PROGRAM
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41a......46a
(41......46)
30
33
$f_{a1}(t)$....$f_{a6}(t)$
I
CPU / COMPUTER / EXPERT SYSTEM (averaging / correlation / spectral analysis / filtering etc.)
DISPLAY, ALARM, etc.
$f_{b1}(t)$.....$f_{b6}(t)$
41b......46b
$f_r(t)$
50
S
34
35
DOCTOR / WASHING / CONDITIONING DEVICE etc.
REST OF THE CONTROL + MONITORING SYSTEM OF PAPER MACHINE