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- (54) Title: A METHOD FOR DETERMINING A PERFORMANCE INDICATOR FOR A PROCESSING SYSTEM

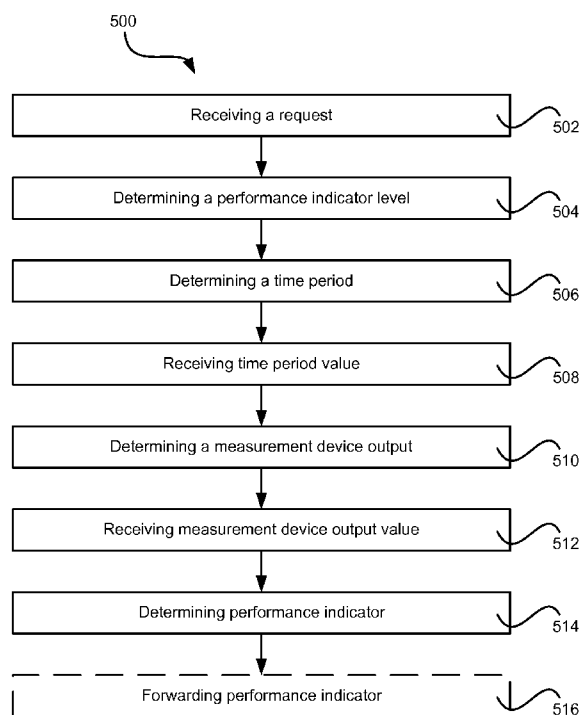


Fig 5

(57) Abstract: It is presented a method for determining a performance indicator for a processing system. The processing system is divided in a number of processing lines, referred to as a first sub-level, in turn divided in a plurality of machine units, referred to as a second sub-level. The method comprises receiving a request for a performance indicator, determining a performance indicator level by determining if said performance indicator is associated with said processing system, one of said processing lines in said first sub-level or one of said machine units in said second sub-level, determining a time period related to said performance indicator level, receiving a time period value related to said time period, determining a measurement device output related to said performance indicator, receiving at least one measurement device output value related to said measurement device output, and determining said performance indicator based on said measurement device output value and said time period value.



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A method for determining a performance indicator for a processing system

Technical Field

The invention generally relates to the field of automation in the processing industry. More particularly, it relates to a method for determining a performance indicator, a method for detecting an inefficiency in a processing system, a method for adjusting a processing system and a control device.

Background of the invention

Today, food processing plant owners around the world are striving to improve the performance of their equipment. One reason for this is that the price for food is increasing, making it more important to reduce the product loss. Another reason is that the demands for making sure that the food has been processed properly and is safe to consume are increasing, making it important to continuously and closely monitor the performance of the equipment in order to make sure that the food is processed in a correct manner. Moreover, during the last years there has been an increased focus on the consumption of clean water having the effect that there is a need to be able to monitor the usage of clean water and, in a next step, to be able to optimize the equipment and the line such that the usage is kept as low as possible. To sum up, most food processing plant owners today require a monitoring system such that they can continuously and closely monitor the performance of the food processing.

A problem today is how to indicate the performance of the food processing system to an operator in an accurate and flexible manner.

Summary

Accordingly, the present invention preferably seeks to mitigate, alleviate or eliminate the above mentioned problem by providing according to a first aspect a method for determining a performance indicator for a

processing system, said processing system being divided in a number of processing lines, referred to as a first sub-level, said processing lines being in turn divided in a plurality of machine units, referred to as a second sub-level, said method comprising

5 receiving a request for a performance indicator,
 determining a performance indicator level by determining if said performance indicator is associated with said processing system, one of said processing lines in said first sub-level or one of said machine units in said second sub-level,

10 determining a time period related to said performance indicator level,
 receiving a time period value related to said time period,
 determining a measurement device output related to said performance indicator,

 receiving at least one measurement device output value related to said
15 measurement device output, and
 determining said performance indicator based on said measurement device output value and said time period value.

The processing system may be related to three time periods, these three time periods being

20 total time, being all hours within a certain time period,
 available time, being all hours within a certain time period except idle time, and

 available production time, being available time except planned shutdown.

25 Each of said processing lines may be related to four time periods, these four time periods being

 total time, being all hours within a certain time period,
 available time, being all hours within a certain time period except idle time,

30 available production time, being available time except planned shutdown, and

 operating time, being available production time except for line specific stops.

Each of said machine units may be related to five time periods, these five time periods being

total time, being all hours within a certain time period,

5 available time, being all hours within a certain time period except idle time,

available production time, being available time except planned shutdown,

operating time, being available production time except for line specific stops, and

10 production time, being operating time except machine unit specific stops.

The step of determining said performance indicator may be made by an external device.

Further, said method may further comprise forwarding said
15 performance indicator to an external device.

According to a second aspect it is provided a method for detecting an inefficiency in a processing system, said method comprising

determining a processing system performance indicator for said processing system according to according to the first aspect,

20 if said processing system performance indicator differs from a processing system reference value,

determining a processing line performance indicator for at least one of said processing lines in the processing system according to the first aspect,

25 if said processing line performance indicator differs from a processing line reference value,

determining a machine unit performance indicator for at least one of said machine units in said processing line,

if said machine unit performance indicator differs from a machine unit reference value,

30 identifying a machine unit related to said machine unit performance indicator.

The method may further comprise

sending a notification that an inefficiency has been detected for said machine unit.

The method may further comprise
identifying a processing line related to said processing line indicator
5 differs from a processing line reference value.

According to a third aspect it is provided a method for adjusting a processing system, said method comprising

detecting an inefficiency in said processing system according to the second aspect, and
10 changing at least one setting for said machine unit being identified to be related to said machine unit performance indicator that differs from said machine unit reference value.

The method may further comprise
after said step of changing, determining an updated machine unit
15 performance indicator according to the first aspect,
determining if said updated machine unit performance indicator differs from said machine unit performance indicator,
if said updated machine unit performance indicator differs from said machine unit performance indicator, changing again at least one setting for
20 said machine unit.

The method may further comprise
transferring at least said machine unit performance indicator to a reference database,
receiving information on which setting that should be changed and to
25 what said setting should be changed.

According to a fourth aspect it is provided a computer program comprising computer program code adapted to perform any one of aspects above when said computer program is run on a computer.

The computer program may be embodied on a computer readable
30 medium.

According to a fifth aspect it is provided a control device configured to determine a performance indicator for a processing system, said processing system being divided in a number of processing lines, referred to as a first

sub-level, said processing lines being in turn divided in a plurality of machine units, referred to as a second sub-level, said control device comprising
a request receiver configured to receive a request for a performance indicator,

5 a processor configured to determine a performance indicator level by determining if said performance indicator is associated with said processing system, one of said processing lines in said first sub-level or one of said machine units in said second sub-level, and to determine a time period related to said performance indicator level,

10 a time period value receiver configured to receive a time period value related to said time period,

said processor being further configured to determine a measurement device output related to said performance indicator,

15 a measurement device output value receiver configured to receive at least one measurement device output value related to said measurement device output, and

said processor being further configured to determine said performance indicator based on said measurement device output value and said time period value.

20

Brief description of the drawings

The above, as well as additional objects, features and advantages of the present invention, will be better understood through the following illustrative and non-limiting detailed description of preferred embodiments of the present invention, with reference to the appended drawings, wherein:

25 Fig 1 generally illustrates a processing system.

Fig 2 illustrates an organization chart for a processing system.

Fig 3 illustrates a control device.

Fig 4a-c illustrates time models.

30 Fig 5 illustrates a flowchart for determining a performance indicator.

Fig 6 illustrates a flowchart for detecting inefficiencies in a processing system and optionally adjusting the food processing system to mitigate the inefficiencies.

Fig 7 illustrates an example of interaction between different processing system and a settings change database.

Detailed description of preferred embodiments

5 Fig 1 generally illustrates a processing system, more particularly an example presenting general processing components of a dairy processing system 100. When designing a food processing system many different aspects need to be taken into account, e.g. level of flexibility in terms of volume, level of flexibility in terms of different products and level of
10 redundancy. An effect of this is that many food processing systems have a unique design.

 Milk is received via a milk reception station 102. Most often, at the milk reception station 102 lorries with tanks filled with milk arrive and the milk is pumped into balance tanks 104a, 104b, 104c. In this example three balance
15 tanks 104a, 104b, 104c are used. A good reason for having more than one tank is that after the milk has been received tests are made on the milk in order to make sure that it is not unhealthy. By having more than one tank this procedure can be made without upholding the entire process if unhealthy milk is found in one of the tanks.

20 As illustrated in the figure, in this example, the milk may be put in any of the balance tanks 104a, 104b, 104c. Although not illustrated, this is achieved by having valves controlling the flow of the milk from the milk reception station 102 to the balance tanks 104a, 104b, 104c. The valves are in modern dairies controlled remotely by using a monitoring/controlling
25 software.

 Next, the milk held in the balance tanks 104a, 104b, 104c is transferred to a heat exchanger 106a, 106b. In this example two parallel heat exchangers are used. An advantage of this is that the process may continue even when one of the heat exchangers are down, e.g. due to cleaning or
30 service. The heat exchangers 106a, 106b may be different kinds of heat exchangers. If only milk will be processed, plate heat exchangers may be used. If milk and products containing fibers, such as fruit juice, tubular heat exchangers may be used. Other examples of heat exchangers used within

food processing are coil heat exchangers and scraped surface heat exchangers.

As can be readily understood by the skilled person feeder pumps, flow controllers, pressure valves, check valves etc are used for transferring the milk between the different machine units in a safe and reliable manner.

After having pre-heated the milk it can be transferred to a deaerator 108a, 108b in which the air content in the milk is reduced in order to reach a desired level. Next, the milk can be transferred to a separator 110a, 110b in which the milk is divided into cream (high fat content) and skim milk (low fat content). After being separated, the milk is transferred to a homogenizer 112a, 112b, in which fat globules are reduced into minor pieces.

As illustrated, there may be provided pipes such that the milk may be steered in different paths. For the same reason as described above in relation to the two heat exchangers, it is beneficial to have this flexibility if one machine unit is down. Another reason is that the processing system is more flexible in terms processing alternatives. For instance, a certain product recipe may require, for instance, additional deaeration, which in turn may result in that both the deaerators 108a, 108b in parallel can be used for the same batch.

In this example, after having been homogenized the milk is transferred to the heat exchanger 106a, 106b again for being heat treated such that unwanted microorganisms are killed. In order to reduce fouling in the heat exchangers 106a, 106b the milk can be transferred to a holding tube 114a, 114b in which the milk is kept at a certain period of time at a certain temperature, depending for instance on the protein content of the product and the heat exchanger design, such that the protein denaturates.

After the holding tube 114a, 114b, the milk can be transferred to the heat exchanger 106a, 106b once again, but this time to be cooled down. By using the same heat exchanger for both heating the incoming milk and cooling the outgoing milk, energy can be transferred between these two with the positive effect that a more energy efficient heat exchanger is achieved. Often heat exchangers built to work in this way are referred to as regenerative heat exchangers.

Next, the milk can be transferred to intermediate storage tanks 116a, 116b, 116c in which the milk is stored before the milk is packed in filling machines 118a, 118b. As illustrated, the processing system may be designed such that the milk can be steered from any of the heat exchangers 106a, 106b to any of the intermediate storage tanks 116a, 116b, 116c. A reason for having this flexibility is to be able to continue even though one of the intermediate storage tanks is down.

Though not illustrated, after the milk has been put in packages, the packages may be bundled in multipacks, loaded on pallets and then sent to a storage before being transported to food stores.

As can be understood by this example, there may be a number of different paths the milk may find its way through the processing system. Most often these paths are referred to as lines or processing lines. Each of the different lines will comprise a different set-up of machine units.

In order to organize a processing plant an organization chart 200 may be used as illustrated by an example in fig 2. When considering all equipment used in the processing plant for processing food or the like, one may refer to a processing system 202. In turn, the processing system 202 may comprise a number of different lines 204a, 204b, 204c. For instance, the processing system 202 may be built as a flexible processing system that can process both nectar, or other beverage not comprising fibers, or juice, or other beverage comprising fibers. When processing nectar a first line adapted for beverage without fibers may be used and when processing juice a second line adapted for beverage with fibers may be used.

The lines 204a, 204b, 204c comprise machine units 206a, 206b, 206c, 206d, 206e, 206f, 206g. As illustrated in fig 2 by way of example, one and the same machine unit may be part of several lines. For instance, one and the same packaging machine may be used for both packaging nectar processed by the first line referred to above and juice processed by the second line also referred to above.

In order to keep track of the performance of the processing plant so-called performance indicators are used. An example of a performance indicator is "Line CIP Index" (CIP – Cleaning In Place) measuring the ratio

between cleaning time and operation time for a specific line. Another example is "Unit Electricity per Litre" measuring electricity consumption per produced amount (litres) for a specific unit. Still an example is "System Chemical Consumption" measuring chemical consumption per produced amount for the processing system as a whole.

Referring to figure 3, in order to calculate such a performance indicator a control device 300 can be used. The control device 300 may be any type of computer, microcontroller or the like capable processing data.

The control device 300 is configured to receive a request 302 for a performance indicator 308. The request 302 can provide information for which level that the performance should be determined. In this particular example, system, line or unit level. Further, the request 302 can provide information on which data to be used for determining the performance indicator, herein referred to as measurement device output (MDO) data 304. The MDO data 304 may be held in a database as illustrated, but it can also be held in any other memory that can communicate with the control device 300. With reference to the examples given above, the MDO data 304 may be time used for cleaning the line, electricity consumption for a specific machine unit or chemicals used by the processing system. As can be readily understood, the MDO data 304 may contain any kind of data relevant for determining performance.

Apart from the above mentioned, the request 302 can also provide information on which time period that should be used for determining the performance indicator 308. This will be further described in connection to fig 4a-4c. Based on which time period that should be used, time period data 306 may be received by the control device 300.

Further, the request 302 can provide information on how to calculate the performance indicator 308 based on the MDO data 304 and the time period data 306. This information may be stored in the control device 300 as software code, but how to calculate may also be provided in terms of an identification making it possible to send received MDO data and time period data together with the identification via a data communications network 310 to an external device 312 that does the actual calculation and sends a result

back to the control device 300. An advantage of having this approach is that if a way how to calculate a performance indicator is changed there is no need to reprogram control devices spread to different sites around the world.

Most often performance indicators are related to time in some way. In order to make sure that reliable performance indicators are determined it is necessary to make sure that a correct time period is considered.

For instance, if determining the performance indicator “Unit Electricity per Litre” for a heat exchanger a time period when the heat exchanger actually has been used for processing should be taken into account, and not for instance when the processing system as a whole has been used for processing since the processing system may comprise several processing lines and the heat exchanger might only be part of one of them.

In order to make sure that the correct time is used a time model has been made. The time model comprises three main parts –processing system time model, line time model and unit time model.

As illustrated in fig 4a, the processing system time model can be divided in three parts – total time, available time and available production time.

Total time should be understood to include hours in a time period, e.g. a year.

Available time should be understood to include all hours the processing system is available for operation, e.g. national holidays and weekend may be excluded if the processing system is not open for operation during these days, also referred to as idle time.

Available production time should be understood to include all available time except for when there is planned shutdown, e.g. due to rebuilding or installation of new machinery or due to that no production is planned.

Fig 4b illustrates the line time model. The line time model comprises total time, available time and available production time as the processing system time model. Further, the line time model comprises operating time.

Operating time should be understood to include available production time except for other stops. Other stops should be understood to be line

specific stops, e.g. a processing system comprising several lines may continue to produce even though one of the lines are down.

Fig 4c illustrates the unit time model. The unit time model comprises total time, available time, available production time and operating time as the line time model. Further, the unit time model comprises production time.

Production time should be understood to be operating time except for equipment stops. Equipment stops should be understood stops caused by the unit itself, also referred to as machine unit specific stops.

The wording time period used could be understood as one or a number of time slots during which the processing system, the processing line and/or the machine unit are in a certain state.

Referring to fig 5, by having a processing system divided in lines and machine units as suggested above and by having time periods as suggested above, a method 500 for determining a performance indicator performed in a control device may be implemented.

A first step 502 may be to receive a request for determining a performance indicator. In the request the time period and MDO data to be used may be specified or, alternatively, the performance indicator may be used as an ID for retrieving this information from a memory or a database.

In a subsequent step 504, when having the request, a performance indicator level can be determined. Which level to choose may be part of the request or, alternatively, the performance indicator may be used to retrieve the information. How many levels may vary depending on the complexity of the processing system, but for a food processing system the three levels presented above – processing system, line or machine unit level – may be used.

In a step 506, it is decided which time period to use. Also this information may be included in the request or, alternatively, may be retrieved from elsewhere, e.g. an external database, when knowing the performance indicator to be determined.

In a step 508, when knowing which time period to use, relevant time period data may be retrieved from e.g. a time period database. The time period database may be configured to continuously update by retrieving

information from the different machine units and/or the lines. More particularly, information on changes from one time period to another may be sent to the time period database.

5 In a step 510, it is decided which MDO to use. This information may be included in the request or can be retrieved from an external database when knowing which performance indicator to determine. This step may be performed either before or in parallel with the steps 506 and/or 508.

10 In a step 512, when knowing the MDO to use, relevant MDO values are retrieved from e.g. a MDO database. As the time period database, the MDO database may be continuously updated by retrieving data from measurement devices placed in the lines and/or in the machine units. In order to retrieve relevant MDO values points in time may be used to link the MDO values to the time period.

15 In a step 514, when having the time period value and the MDO value, the performance indicator is determined. The actual processing may be performed in a control device connected to the processing system, or alternatively, if the processing requires significant processing power or if the actual calculation should be kept secret, the actual processing may be made by an external processing device.

20 Optionally, when having determined the performance indicator, this may be forwarded to an external device, such as a server belonging to the company that has supplied the processing system in order to keep track of the performance of the processing system, the lines and the machine units.

25 In fig 6 it is illustrated by a flowchart 600 how performance indicators may be used to improve the performance of the processing system.

In a step 602 a processing system performance indicator is determined, i.e. a performance indicator taking the whole processing system into account.

30 If, in step 604, after having compared the processing system performance indicator with a processing system reference value it is decided that the processing system performance is not as good as could be expected, a processing line performance indicator is determined in step 606. If it cannot be decided which processing line that affects the processing system

performance negatively processing line performance indicators may be determined for more than one of the processing lines. Further, links between processing system performance indicators and processing line performance indicators may be used in order to know which processing line performance indicators to determine if a certain processing system performance indicator is not as good as could have been expected.

Similarly, in step 608, if the processing line performance indicator is not as good as could have been expected, e.g. this can be achieved by comparing the processing line performance indicator with a processing line reference value, a machine unit performance indicator is determined in step 610. If it cannot be decided which machine unit that affects the processing line performance indicator negatively, more than one machine unit performance indicator may be determined. Further, links between processing line performance indicators and machine unit performance indicators may be used in order to know which machine unit performance indicators to determine if a certain processing line performance indicator is not as good as could have been expected.

In step 612, by comparing the machine unit performance indicator with a machine unit reference value it can be determined if the machine unit performance indicator is according to expectations or not. If the machine unit performance indicator is not according to expectations, a machine unit can be identified in step 614.

Optionally, when having identified the machine unit not performing according to expectations, machine settings for this machine unit can be changed. In order to know how to change the machine settings a settings change database illustrated in fig 7 may be used.

After having changed the machine settings a processing system performance indicator may be determined again in step 602. In this way an iterative system is formed making it possible to incrementally improve the performance of the processing system. The settings changes and the performance indicators determined may be logged in order to be able to compare with other processing systems.

If not considered necessary to again determine the processing system performance indicator, e.g. if only one of the lines have not been according to expectations, a processing line performance indicator may be determined again after having changed the machine settings.

- 5 Further, if not considered necessary to again determine the processing line performance indicator, e.g. if only one machine unit did not perform according to expectations, a machine unit performance indicator may be determined again after having changed the machine settings.

Similarly, in step 608, if it is determined that the processing line
10 performance indicator is not according to expectations, a processing line can be identified in step 618.

When the processing line has been identified processing line settings for this processing line can be changed in step 620. After having changed the processing line settings a processing system performance indicator may
15 determined again or, e.g. if only one of the processing line did not perform according to expectations, a processing line performance indicator may be determined again.

In step 622, when having identified the machine unit or the processing line not performing according to expectations a notification can be sent, e.g.
20 via the controlling/monitoring software.

Further, a notification can also be sent as a pre-warning if a trend that a certain performance indicator will soon not fulfill expectations can be detected.

Referring to fig 7, in order to be able to amend the processing line
25 settings and/or machine unit settings in a way that will improve the performance of the processing system experiences from other processing system may be used.

In order to share the experiences a network 700 between different processing systems may be formed. In the example illustrated six different
30 processing systems can share experiences via a settings change database 702 that can contain both processing line settings and/or machine unit settings. Further, it may also contain information on successful and not successful changes made as a response to a certain performance indicator

not fulfilling expectations, both in terms of which setting to change and in terms of how much to change.

More specifically, a processing system 706 having a control device 704 may communicate with the settings change database 702. On one hand the control device 704 communicate with the settings change database 702 in order to add information to the database so that this information is available for other control devices 708a, 708b, 708c, 708d, 708e, in turn connected to processing systems 710a, 710b, 710c, 710d, 710e, in order for these to have this information when deciding which settings to change in order to improve the performance of the processing system, more particularly change settings such that a performance indicator not fulfilling expectations will do so. On the other hand, the control device 706 uses the information in the settings change database 702 to make better decisions on which setting to change and/or how much.

The information in the settings change database 702 may be stored in a number of different ways, but generally there can be links between performance indicators and settings in order to know which settings to change when performance indicators are not fulfilling expectations. Further, if a number of settings should be changed the order in which the settings should be changed can be provided as well. Since the processing system may need to adapt between the different changes time periods between the changes may be provided as well.

The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims.

16
CLAIMS

1. A method for determining a performance indicator for a processing system, said processing system being divided in a number of processing
5 lines, referred to as a first sub-level, said processing lines being in turn divided in a plurality of machine units, referred to as a second sub-level, said method comprising
receiving a request for a performance indicator,
determining a performance indicator level by determining if said
10 performance indicator is associated with said processing system, one of said processing lines in said first sub-level or one of said machine units in said second sub-level,
determining a time period related to said performance indicator level,
receiving a time period value related to said time period,
15 determining a measurement device output related to said performance indicator,
receiving at least one measurement device output value related to said measurement device output, and
determining said performance indicator based on said measurement
20 device output value and said time period value.

2. The method according to claim 1, wherein said processing system is related to three time periods, these three time periods being
total time, being all hours within a certain time period,
25 available time, being all hours within a certain time period except idle time, and
available production time, being available time except planned shutdown.

30 3. The method according to any of the preceding claims, wherein each of said processing lines is related to four time periods, these four time periods being
total time, being all hours within a certain time period,

available time, being all hours within a certain time period except idle time,

available production time, being available time except planned shutdown, and

5 operating time, being available production time except for line specific stops.

4. The method according to any of the preceding claims, wherein each of said machine units is related to five time periods, these five time periods
10 being

total time, being all hours within a certain time period,

available time, being all hours within a certain time period except idle time,

15 available production time, being available time except planned shutdown,

operating time, being available production time except for line specific stops, and

production time, being operating time except machine unit specific stops.

20

5. The method according to any of the preceding claims, wherein said step of determining said performance indicator is made by an external device.

6. The method according to any of the preceding claims, further
25 comprising

forwarding said performance indicator to an external device.

7. A method for detecting an inefficiency in a processing system, said method comprising

30 determining a processing system performance indicator for said processing system according to any of the claims 1 to 6,

if said processing system performance indicator differs from a processing system reference value,

18

determining a processing line performance indicator for at least one of said processing lines in the processing system according to any of the claims 1 to 6,

5 if said processing line performance indicator differs from a processing line reference value,

determining a machine unit performance indicator for at least one of said machine units in said processing line,

if said machine unit performance indicator differs from a machine unit reference value,

10 identifying a machine unit related to said machine unit performance indicator.

8. The method according to claim 7, further comprising
15 sending a notification that an inefficiency has been detected for said machine unit.

9. The method according to claim 7 or 8, further comprising
20 identifying a processing line related to said processing line indicator differs from a processing line reference value.

10. A method for adjusting a processing system, said method comprising

detecting an inefficiency in said processing system according to claim 7 to 9, and

25 changing at least one setting for said machine unit being identified to be related to said machine unit performance indicator that differs from said machine unit reference value.

11. The method according to claim 10, further comprising
30 after said step of changing, determining an updated machine unit performance indicator according to claim 1,

determining if said updated machine unit performance indicator differs from said machine unit performance indicator,

if said updated machine unit performance indicator differs from said machine unit performance indicator, changing again at least one setting for said machine unit.

- 5 12. The method according to claim 10, further comprising
transferring at least said machine unit performance indicator to a
reference database,
receiving information on which setting that should be changed and to
what said setting should be changed.

10

13. A computer program comprising computer program code adapted
to perform any one of claims 1 to 12 when said computer program is run on a
computer.

- 15 14. The computer program according to claim 13 embodied on a
computer readable medium.

15. A control device configured to determine a performance indicator
for a processing system, said processing system being divided in a number of
20 processing lines, referred to as a first sub-level, said processing lines being in
turn divided in a plurality of machine units, referred to as a second sub-level,
said control device comprising

- a request receiver configured to receive a request for a performance
indicator,
25 a processor configured to determine a performance indicator level by
determining if said performance indicator is associated with said processing
system, one of said processing lines in said first sub-level or one of said
machine units in said second sub-level, and to determine a time period
related to said performance indicator level,

30 a time period value receiver configured to receive a time period value
related to said time period,

said processor being further configured to determine a measurement
device output related to said performance indicator,

20

a measurement device output value receiver configured to receive at least one measurement device output value related to said measurement device output, and

- said processor being further configured to determine said performance indicator based on said measurement device output value and said time period value.
- 5

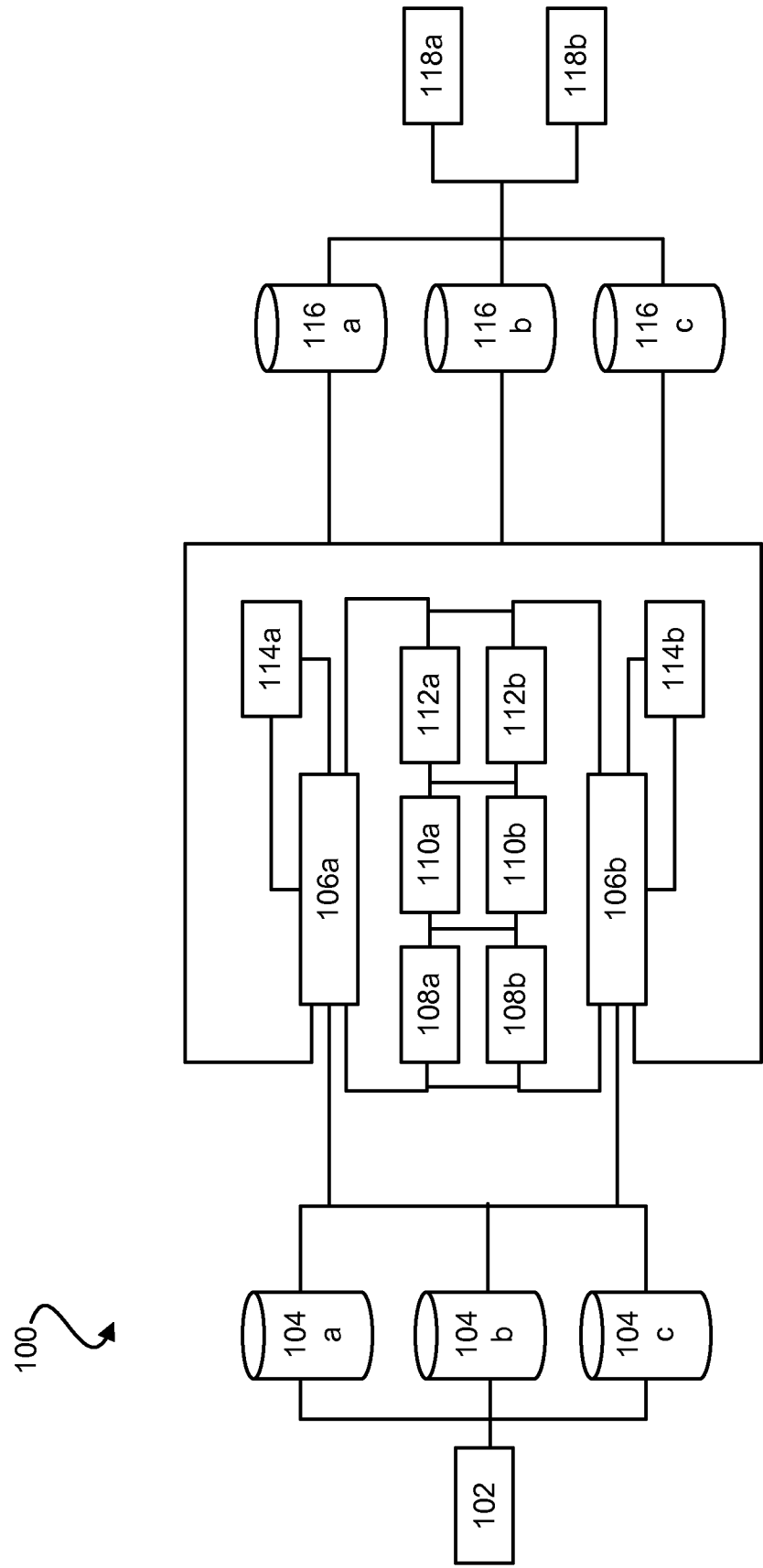


Fig 1

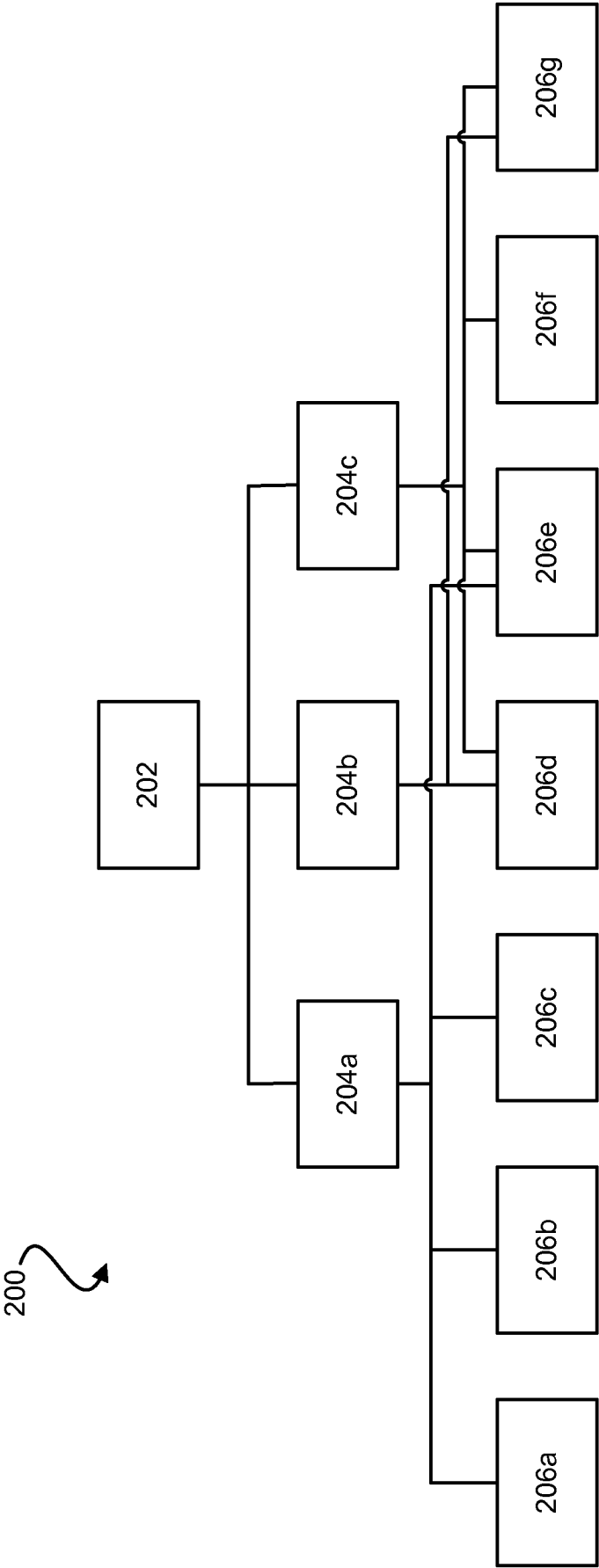


Fig 2

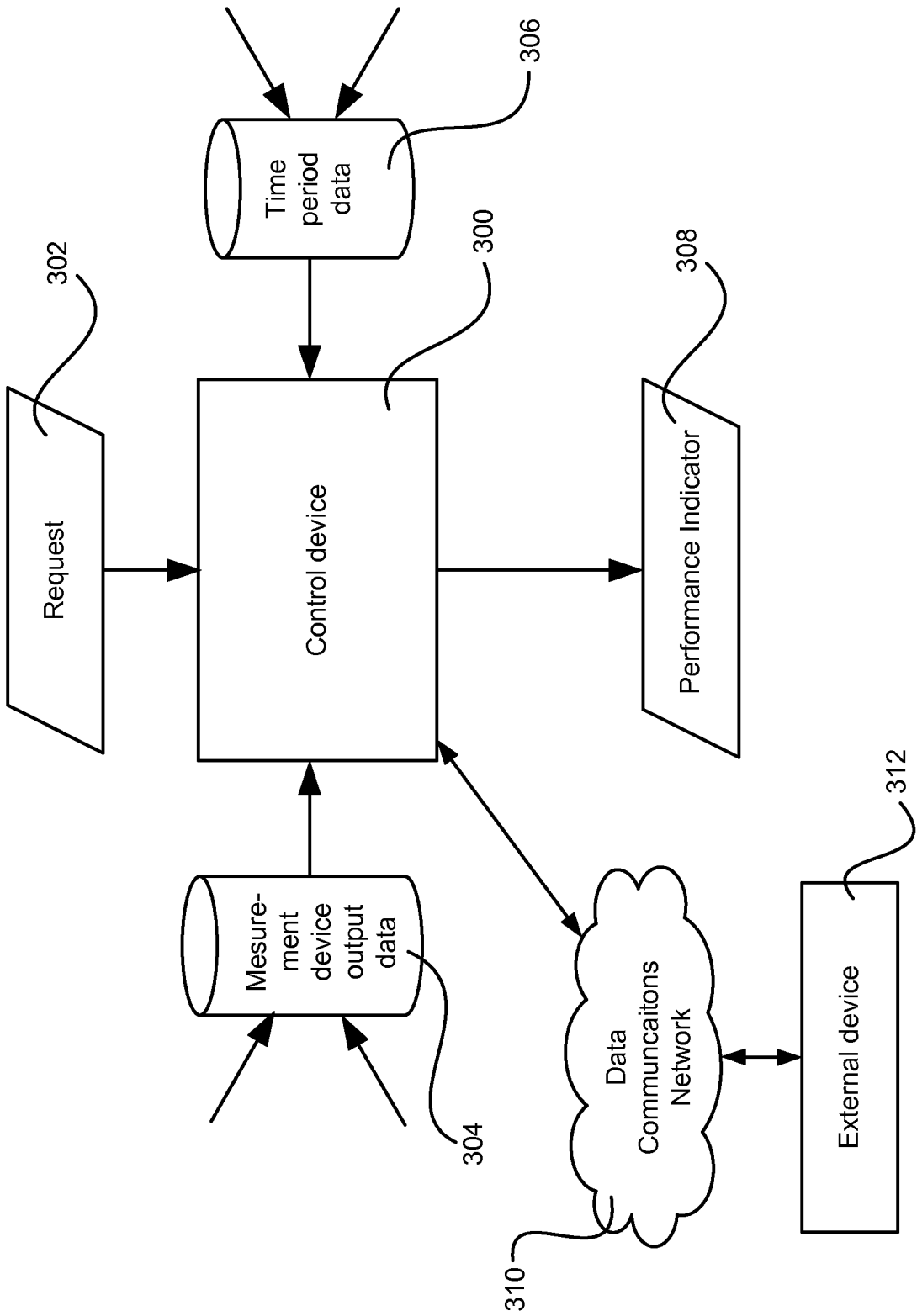
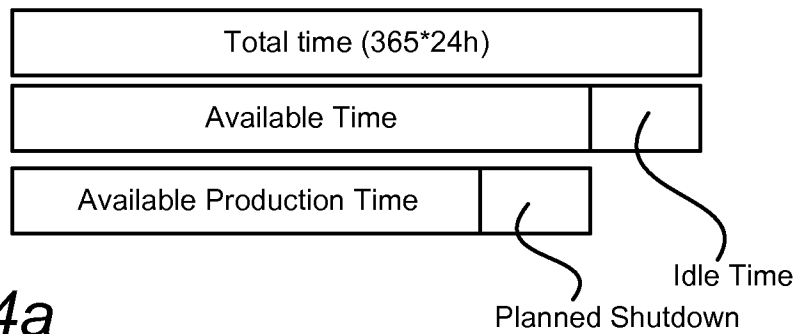
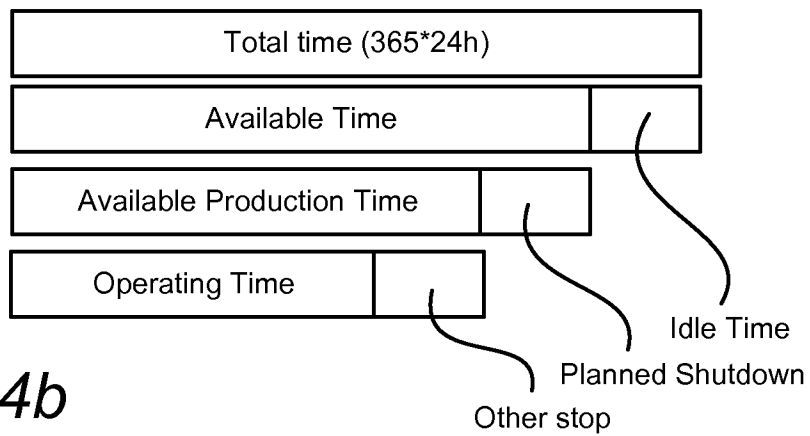
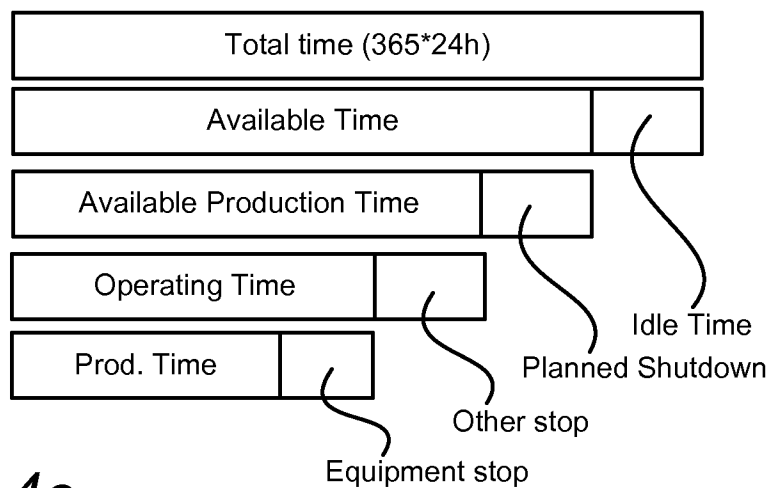
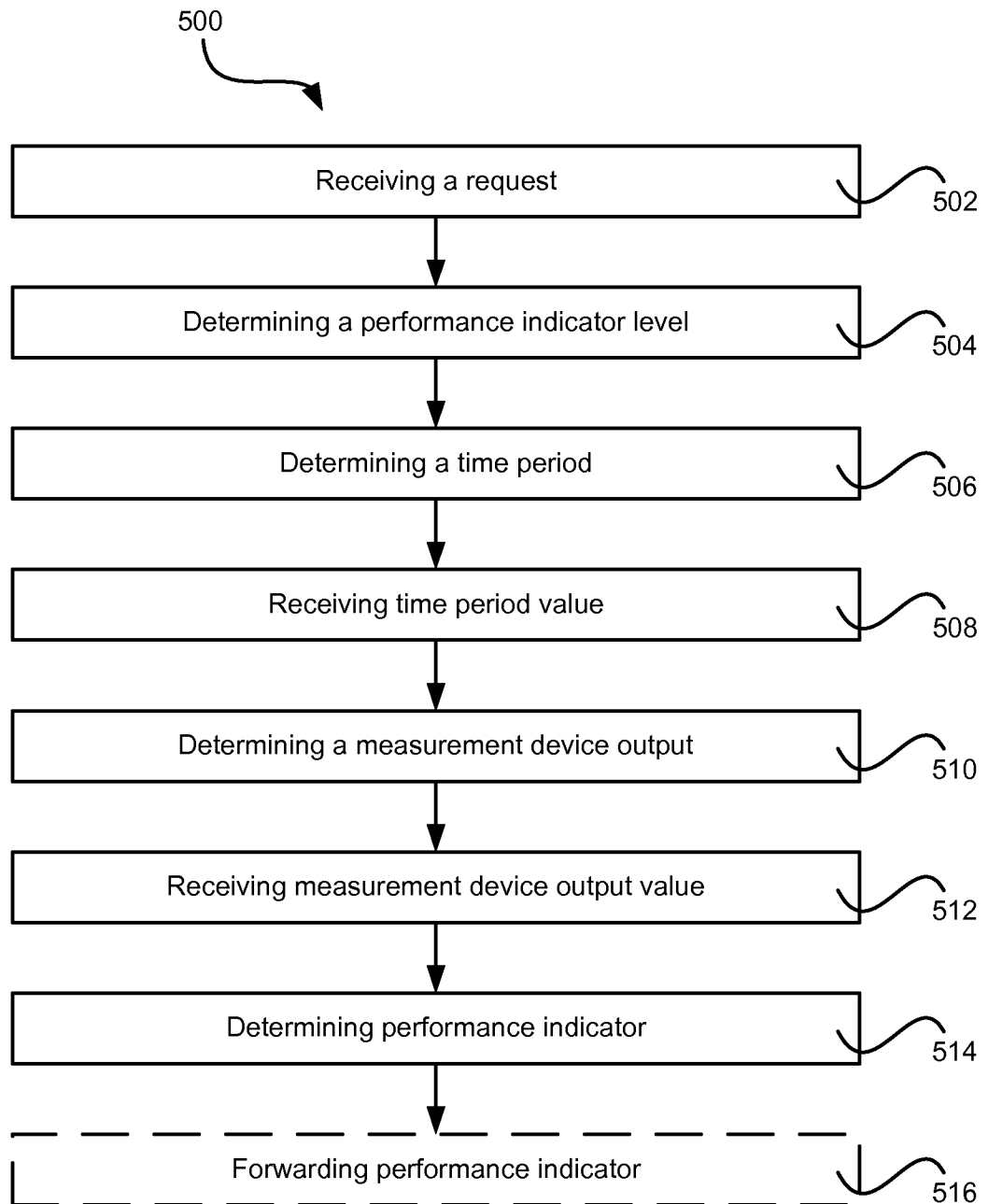
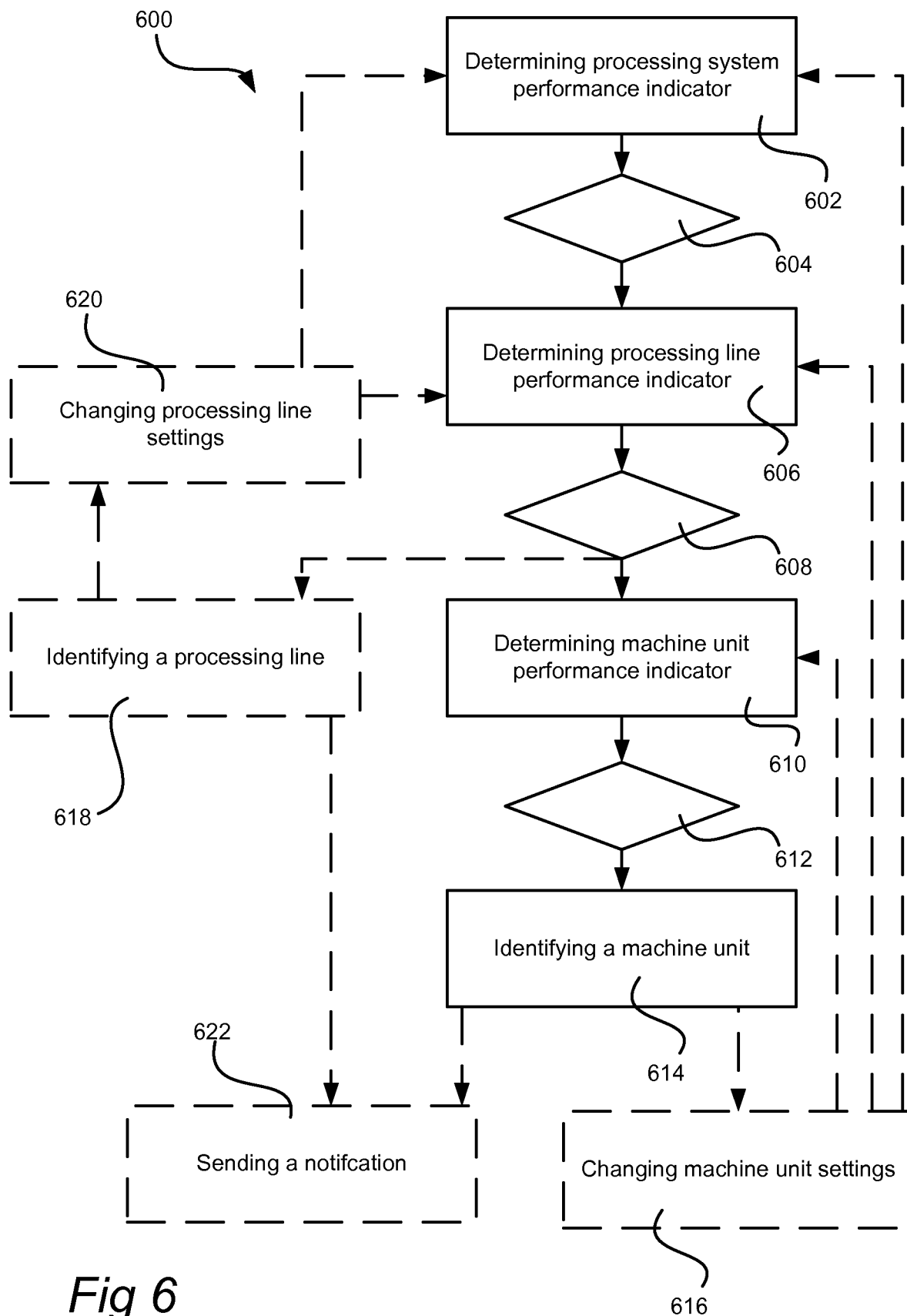


Fig 3

Processing System Time Model*Fig 4a***Line Time Model***Fig 4b***Unit Time Model***Fig 4c*

*Fig 5*



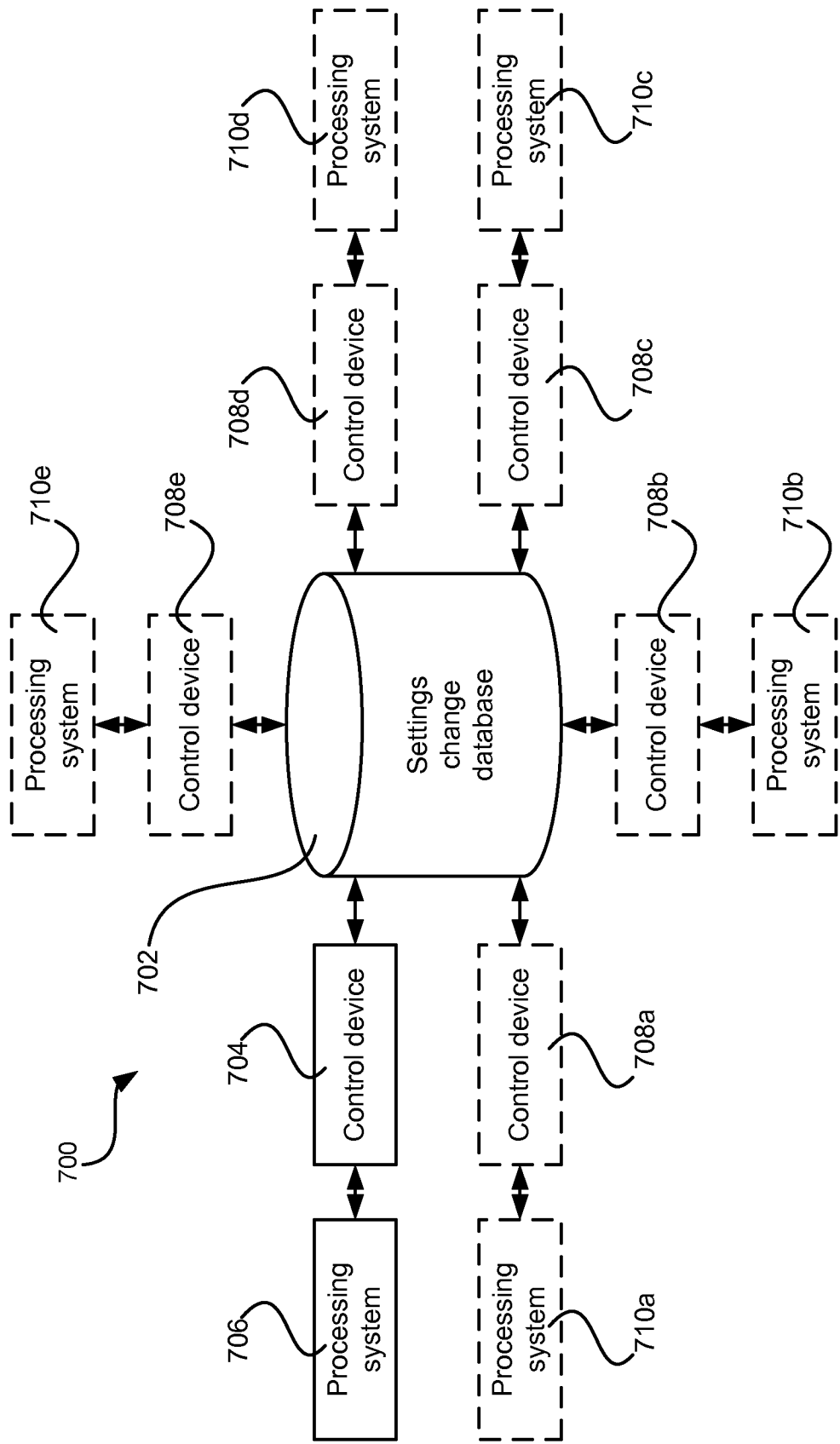


Fig 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/058266

A. CLASSIFICATION OF SUBJECT MATTER
INV. G05B23/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03/058506 A1 (KIMBERLY CLARK CO [US]) 17 July 2003 (2003-07-17) paragraphs [12.41.47], [0054], [0055], [0060], [0208] -----	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search

4 July 2013

Date of mailing of the international search report

15/07/2013

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Sundin, Martin

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2013/058266

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 03058506	A1	17-07-2003	AU 2002360803 A1 24-07-2003
			EP 1468380 A1 20-10-2004
			US 2003158795 A1 21-08-2003
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			WO 03058506 A1 17-07-2003
