Title: CONTROL SYSTEM, AND A SENSOR AND ACTUATOR TO BE USED IN THIS CONTROL SYSTEM

Abstract: The invention relates to a control system for a processing installation or production plant or the like, provided with at least one control loop, comprising a sensor, a controller and an actuator, the sensor being designed for measuring a parameter of the processing installation or the production plant that is to be controlled, and the actuator is adjustable for influencing the parameter to be controlled, wherein a predetermined selection from the group comprising the sensor and the actuator is designed for moving within the process installation or production plant.
Control system, and a sensor and actuator to be used in this control system.

The invention relates to a control system for a processing installation or production plant or the like, provided with at least one control loop, comprising a sensor, a controller and an actuator, the sensor being designed for measuring a parameter of the processing installation or the production plant that is to be controlled and/or recorded, and the actuator being adjustable for influencing the parameter to be controlled. The invention also relates to a sensor or actuator to be used in this control system. The processing installation or production plant referred to in this application relates to a closed installation wherein the production process takes place, and of which measuring and/or controlling the parameters to be controlled is rendered more difficult because of the closed nature of the installation, owing to which the parameter to be measured and/or controlled cannot, or only with difficulty, be measured or controlled directly.

Control systems are known from everyday practice and are used in numerous situations. For example, in the domestic situation control systems are known for controlling the temperature in the home, but also for controlling the temperatures in appliances used in the domestic situation.

Control systems are also used in all kinds of industries, which may include both batch and continuous processes of the processing industry, but may also include production plants processing raw materials, manufacturing plastic or non-plastic materials, processing or manufacturing metals, synthesising medication and fine-chemicals, producing beverages such as soft drinks and beer, as well as producing other food stuffs. In short, where this application refers to a (closed) installation for carrying out a production process, such as a processing installation or a production plant, this term should be understood in the broadest possible sense, and includes all such (closed) installations that are suitable for industrial manufacture or material production as covered
by Article 3 of the Treaty of Strasbourg of 27 November 1963 concerning the unification of some principles of patent law.

The accuracy and effectiveness of the control systems as used in numerous industrial fields are limited because for one thing, the sensors and actuators to be used make it possible only to a limited extent to measure parameters that are of importance for the operational management, and for another thing, to influence them adequately. This applies even more when several parameters need to be influenced simultaneously, and when cross-influencing occurs from the actuator to be adjusted to other parameters than the parameter of the production management substantially to be influenced by this actuator.

Where processing installations such as reactors, separators, ovens and the like are involved, there is the additional problem that matter present in these processing installations is often not mixed homogeneously in the sense that locally, or in the course of time, variations may occur in the processing conditions that may be a result obtained by design or may be the result of a desired or undesired process development.

It is the object of the invention to avoid the above described limits of the known control system and to make it possible to render a control process more effective by means of the control system.

To this end the control system or the sensors and/or actuators to be used in this control system are characterised by one or several of the claims following the description.

In a first aspect of the invention the control system is characterised in that a predetermined selection from the group comprising the sensor and the actuator is designed for moving within the closed installation.

In this way the possibility is created to render parameters of the operational management of a processing installation or production plant measurable and influenceable, which parameters cannot be reached in the prior art because they may relate to aspects that take place deep within the processing installation or production plant.
To this end it is advantageous that the predetermined selection from the group comprising the sensor and the actuator is designed for monitoring a process or production stream in the closed installation.

In this way the sensor and/or actuator may simply be moved for monitoring the stream of the material or the liquid moving within the processing installation or production plant. This is, for example, a simple manner of monitoring the parameter development in a sluggish flow.

An alternative embodiment of the control system according to the invention is characterised in that the predetermined selection from the group comprising the sensor and the actuator is provided with a propulsion organ.

This allows the purposeful direction of the sensor and/or the actuator to a chosen position in the processing installation or the production plant in order to monitor and influence the processing progress at that location.

The effective use of the control system according to the invention is facilitated by the predetermined selection from the group comprising the sensor and the actuator being equipped with at least one energy source and an organ facilitating localisation.

The fact that the sensor and/or the actuator is equipped with its own energy source allows this sensor and/or actuator to be completely integrated in the closed processing installation or closed production plant without the need for it to be coupled to external energy supplies. The localisation-facilitating organ is useful for the exact localisation of the sensor and/or actuator in order to allow a measurement and/or control to take place in accordance with this location.

A suitable embodiment of the control system referred to above is characterised in that the localisation-facilitating organ is a transponder designed for co-operating with a transmitter/receiver provided inside or outside of the closed processing installation or closed production plant.

For the transmitter/receiver and the transponder it is possible to use, for example, ultra-wideband radio tech-
nology. The person skilled in the art is quite familiar with such ultra-wideband radio technology so that no further elu-

The localisation-facilitating organ may also be a

transmitter that is designed for co-operating with a receiver

provided inside or outside of the closed processing installa-

tion or the closed production plant.

A particular aspect of the invention relates to the

embodiment in which the sensors and/or actuators of the at

least one control loop are provided with localisation-

facilitating organs, which are designed for determining a mu-

tual position and/or distance between said sensors and/or ac-

tuators. To this end these sensors and/or actuators are inte-

grated in a wireless communication network, and the control

action locally desired can be carried out adequately and

quickly.

As already generally explained in the above, the

control system according to the invention is widely applica-

ble.

For example, it is possible that when the predeter-

mined selection from the group comprising the sensor and the

actuator falls on the sensor, the same is provided with a

measuring organ for a parameter that has previously been de-

termined from the group comprising temperature, pressure,

concentration, pH, tension. The just referred to tension may

be both a mechanical and an electrical tension.

A provision within the frame of the invention is

further that when the predetermined selection from the group

comprising the sensor and the actuator falls on the actuator,

the same is equipped for influencing an operational parameter

of the closed processing installation or the closed produc-

tion plant.

A first suitable embodiment of the control system

according to the invention is characterised in that the ac-

tuator is embodied with a coating film, which film is de-

signed for the controlled alteration of at least one physical

property thereof, selected from the group comprising polar-
ity, permeability, solubility, crystallinity, dissociation of functional groups.

This makes it possible to selectively catch or release molecules, ions or metallic particles.

Another embodiment of the control system according to the invention is characterised in that the actuator is embodied with a catalyst-forming coating layer, which is designed for the controlled release of the catalyst.

The fact that the catalyst can be released in a controlled manner makes it possible to very accurately influence a progress of a process.

Still another embodiment of the control system according to the invention is characterised in that the actuator is embodied with an ultrasonic source or other energy source, with which it is possible to, at the right place and the chosen moment, induce germination of a heterogeneous phase in a (production) process.

This makes a very accurate and flexible control of heterogeneous processes such as crystallisation and liquid-liquid extraction and condensation possible.

As already mentioned, the control system according to the invention is very widely applicable. It is, for example, possible that several control loops are provided, each of which comprising a sensor, a controller and an actuator, and that the controllers form a part of a multi-variable dynamic controller based on a model of the processing installation or production plant.

The invention is further embodied in a separate sensor and/or separate actuator as described above as part of the control system according to the invention.
CLAIMS

1. A control system for a closed installation for realising a production process, provided with at least one control loop, comprising a sensor, a controller and an actuator, the sensor being designed for measuring a parameter of the production process progressing in the installation and which is to be controlled, and the actuator is adjustable for influencing the parameter to be controlled, characterised in that a predetermined selection from the group comprising the sensor and the actuator is designed for moving within the closed installation.

2. A control system according to claim 1, characterised in that the predetermined selection from the group comprising the sensor and the actuator is designed for monitoring a process or production stream in the closed installation.

3. A control system according to claim 1 or 2, characterised in that the predetermined selection from the group comprising the sensor and the actuator is provided with a propulsion organ.

4. A control system according to one of the claims 1-3, characterised in that the predetermined selection from the group comprising the sensor and the actuator is equipped with at least one energy source and an organ facilitating localisation.

5. A control system according to claim 4, characterised in that the localisation-facilitating organ is a transponder designed for co-operating with a transmitter/receiver provided inside or outside of the installation.

6. A control system according to claim 4, characterised in that the localisation-facilitating organ is a transmitter designed for co-operating with a receiver provided inside or outside of the installation.

7. A control system according to one of the claims 4-6, characterised in that the sensors and/or actuators of the at least one control loop are provided with localisation-
facilitating organs, which are designed for determining a mutual position and/or distance between said sensors and/or actuators.

8. A control system according to one of the preceding claims, characterised in that the predetermined selection from the group comprising the sensor and the actuator falls on the sensor, and the same is provided with a measuring organ for a parameter that has previously been determined from the group comprising temperature, pressure, concentration, pH, tension.

9. A control system according to one of the claims 1-7, characterised in that the predetermined selection from the group comprising the sensor and the actuator falls on the actuator, and the same is equipped for influencing an operational parameter of the production process progressing in the installation.

10. A control system according to claim 9, characterised in that the actuator is embodied with a coating film, which film is designed for the controlled alteration of at least one physical property thereof, selected from the group comprising polarity, permeability, solubility, crystallinity, dissociation of functional groups.

11. A control system according to claim 9, characterised in that the actuator is embodied with a catalyst-forming coating layer, which is designed for the controlled release of the catalyst.

12. A control system according to claim 9, characterised in that the actuator is embodied with an energy source, preferably an ultrasonic source for, at a predetermined place and/or moment, inducing germination of a heterogeneous phase in the production process.

13. A control system according to one of the preceding claims, characterised in that several control loops are provided, each of which comprising a sensor, a controller and an actuator, and that the controllers form a part of a multivariable dynamic controller based on a model of the production process progressing in the installation.
14. A sensor for a processing or operating parameter selected from the group comprising temperature, pressure, concentration, pH, tension, **characterised** in that during use, the same is movable in a closed installation for carrying out a production process.

15. A sensor according to claim 14, and as described as part of the control system according to one of the claims 2-13.

16. An actuator for influencing a processing or operating parameter, **characterised** in that during use, the same is movable in a closed installation for carrying out a production process.

17. An actuator according to claim 16, and as described as part of the control system according to one of the claims 2-13.
# INTERNATIONAL SEARCH REPORT

**INTERNATIONAL SEARCH REPORT**

**International application no.**

PCT/NL2006/050296

## A. CLASSIFICATION OF SUBJECT MATTER

**INV. 305D021/02**

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)

G05D G05B

Documentation searched other than minimum documentation to the extent that such documents are indicated In the fields searched

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

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

See patent family annex.

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**Date of the actual completion of the international search**

16 April 2007

**Date of mailing of the international search report**

23/04/2007

Name and mailing address of the ISA

European Patent Office, P.B. 5318 Patentgan 2 NL - 2280 HJ Rijswijk

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**Authorized officer**

Groen, Fokke

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