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(54) Benævnelse: **Procesanalysesystemer med automatisk forberedelse af væskeprøve og tilslutning til proceskontrolsystemer**

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Description

The invention relates to modular analysis systems for processes, for example chemical, physical, biochemical, biotechnological or other industrial processes, as well as to a corresponding connection to process control systems for controlling these processes, and to a computer program product.

It is known from the prior art that in order to monitor a process, for example the manufacture of a chemical product, samples are regularly taken from the process and then analysed. To this end, in many cases it has previously been necessary for a laboratory assistant or technician to take a sample manually. In general, such a sample cannot be analysed directly, but requires sample preparation before it is possible to carry out the actual analysis, for example using a chromatograph, a mass-spectrometry detector or another type of analyser. In this case, for example, gas chromatographs or high-performance liquid chromatographs (HPLC) may be used as chromatographs. The analysis result is then reported by the laboratory assistant to the manager of a process control system, so that he or she can input suitable modifications into the process control system if need be.

The manual working steps required of a laboratory assistant for carrying out the sample preparation may be very extensive. In order to help with this, automatic sample preparation systems have been developed for the sample preparation for chromatography, for example HPLC. Laborpraxis, Würzburg, 1990, 14, 11, 936, "Automatic sample preparation in HPLC", Wolfgang Vogel, has disclosed such an automatic sample preparation system for HPLC. The system carries out fully automatically dilution series, system performance tests, multipoint calibrations, standard additions and precolumn derivatizations, which are normally carried out by a laboratory assistant. After the sample preparation, the samples are then examined by liquid chromatography.

Corresponding systems for automatic sample preparation have furthermore been disclosed by Journal of Chromatography A, 730 (1996), 39-46, "Automation of sample preparation as a preliminary stage in the high-performance liquid chromatographic determination of polyphenolic compounds in sherry wines", D. A. Guillén et al., in Journal of Automatic Chemistry, Vol. 17, No 1 (January-February 1995), pages 21-24, "A PC-controlled module system for automatic sample preparation and analysis", Östen Einarsson, in Pulp Expert Guide Book (October 1996), pages 1-62 and in US 2003/013199.

A disadvantage common to such previously known automatic sample preparation systems is that they are suitable only for sample preparation for chromatography. Such automatic sample preparation systems are not hence flexibly usable for other analysis methods, but rather are only usable in a manner dedicated to chromatography. Another disadvantage is that samples to be analysed have to be taken manually from the process and must be delivered to the sample preparation. A further disadvantage is that the analysis result is primarily only of an informative nature, and is not therefore used directly in the control of the process.

It is therefore an object of the invention to provide an improved process analysis system and an improved method and computer program product for controlling a process.

The objects of the invention are respectively achieved by the features of the independent patent claims. Preferred embodiments of the invention are specified in the dependent patent claims.

The invention allows fully automatic integration of the sample analysis with upstream liquid sample preparation into a process control system. To this end, samples are automatically taken from the process by a suitable device. A sample which has been taken is processed by automatic sample preparation

and then analysed. The analysis result is then transmitted, for example via a field bus, to a process control system. The latter can then adjust the process accordingly. The present invention hence allows online conduct of sample preparation and analysis as an integral part of a process control system.

The steps required in order to prepare the sample for the analysis are carried out by the automatic sample preparation. Depending on the analysis method which is employed, these may for example comprise the following steps:

filtration of the sample in order to prevent obstruction of lines, valves and columns,

dilution of the sample with one or more different solvents, in which case the dilution may be carried out in one or more steps; the concentration of a sample is thereby brought into the measurement range of the analyser being used; in particular, dilution series with different concentrations are possible, for example in order to carry out multipoint calibrations,

addition of an internal standard; the evaluation of the results is thereby facilitated, and a more accurate result is achieved in many cases;

cooling or thermal regulation of the sample in order to obtain a suitable temperature for the analysis, this is necessary in particular for temperature-sensitive substances as well as for substances which entail problems owing to their viscosity and, for example, can be measured properly only when heated;

stripping of the sample with a gas, in order to remove unwanted volatile components;

stripping of the sample with a gas and analysis of the gas phase; volatile components, for example from waste water, can thereby be determined;

extraction of constituents by addition of suitable solvents;

precipitation of sample constituents, for example for purification or separation of other substances which are present;

derivatization, for example silylation of the sample, in order to convert the sample into a chemical form which is suitable for the analysis of the sample: in the case of reactive compounds, for example, without derivatization there is a risk that the sample may decompose on the chromatography column.

A controllable bypass module is used for taking a sample from the process. The bypass module is connected to an automatic sample preparation system. This makes it possible to obtain a sample directly from the process via the bypass module, and to deliver it automatically to the sample preparation.

After the automatic sample preparation, the prepared sample is then delivered to an analyser. The analysis result is then transmitted to a process control system, for example via a field bus.

The automatic sample preparation is modularly constructed. The modules are, for example, sample valves, burettes, dosing valves and the like, which are connected to one another via lines. The automatic sample preparation is hence carried out through appropriate operation of the individual modules by a control unit.

Preferably, the sampling unit for taking the sample from the process, as well as the analyser, are modularly constructed and connected via such lines to the modules for the sample preparation. This provides a modularly constructed and integrated system for taking the samples, for the sample preparation and for the sample analysis. This modular construction has the advantage, in particular, that the

automatic sample preparation can be adapted to different analysers without great outlay.

This modular construction is also reflected in the control program of the system. Driver software for each module is stored in the control unit of the system. The control program accesses this driver software in order to carry out the steps of the automatic sample preparation and analysis according to a working procedure predetermined by the user.

The procedure of the control program is established by parameters which can be defined by the user. For example, the user may select available modules, and actions to be carried out by them, via a graphical user interface of a conventional personal computer (PC). In this way, procedure sequences for the sampling, the sample preparation and the sample analysis can be defined with the aid of the modules in a tabular form.

The parameters describing this procedure are then exported by the PC and transmitted to the control unit of the control system. There, these parameters establish the program procedure of the control program. The parameters hence determine the order in which the control program calls up individual driver programs, as well as the control parameters which the control program gives to the driver software in order to make a particular module perform a particular action.

A particular advantage in this case is that a computer expert is not needed for establishing the program procedure of the control program, since the program procedure can be entered intuitively via a graphical user interface by selecting modules and the actions to be carried out. In particular, a laboratory assistant or technician can hence use the graphical user interface to describe the steps previously carried out manually by him or her. This description is then used as the parameterization for the control program, so that the latter addresses the respectively required driver software in the necessary order.

According to a preferred embodiment of the invention, an automation component is used as the control unit, for example a Simatik S7 from the company Siemens AG. Such an automation component is designed for problem-free continuous use in an industrial environment, and is therefore not liable to "crash" like a conventional PC. A particular advantage in this case is that the PC, with the aid of which the user inputs the procedure, and the control unit can be disconnected from one another during operation of the system, i.e. the PC can be disconnected from the control unit after the parameters which establish the program procedure have been transmitted from the PC to the control unit. Operation of the control unit independently of the PC is therefore possible.

The analysis system according to the invention is particularly advantageous since, owing to its modular construction and its flexibility which can thereby be achieved, it can be used for a very wide variety of processes, in particular, for chemical, physical, biochemical, biotechnological or other industrial processes.

Preferred embodiments of the invention will be explained in more detail below with reference to the drawings, in which:

Figure 1 shows a block diagram of a preferred embodiment of a control system according to the invention,

Figure 2 shows a flow chart representing a preferred embodiment of the control method employing the system in Figure 1,

Figure 3 shows a preferred embodiment of a modularly constructed automatic sample preparation system with a bypass module and a sample analysis module,

Figure 4 shows a perspective representation of example combinations of the modules,

Figure 5 shows a graphical user interface on a PC for establishing the program procedure,

Figure 6 shows a block diagram of a preferred embodiment of the control system with an automation component.

Figure 1 shows a block diagram of an embodiment of a control system according to the invention. The control system has a bypass module 100 for taking a sample 102 from a process 104. The bypass module 100 is connected to a control unit 106, which can operate the bypass module 100 in order to take the sample 102 from the process 104.

The bypass module 100 is connected to a sample preparation system 108, so that the sample 102 goes from the bypass module 100 into the sample preparation system 108. The sample preparation system 108 contains various modules M1, M2, M3,..., a particular functionality being fulfilled by each of the modules.

These may be sample valves, burettes, dosing valves and the like. They are connected to one another via a line network. Through operation of the sample preparation 108, i.e. individual modules of the sample preparation system, by the control unit 106, the sample 102 is hence subjected to automatic sample preparation. The resulting prepared sample 110 then goes from the sample preparation system 108 into the an analyser 112. The analyser 112 is, for example, a gas or liquid chromatograph, a mass-spectrometry detector or analyser for carrying out Raman spectroscopy or near-infrared spectroscopy. The analyser 112 outputs an analysis result 114 which is transmitted to the control unit 106, for example in the form of the file.

Instead of a single analyser 112, a plurality of such analysers may also be connected to the sample preparation system 108 in a parallel circuit.

The control unit 106 has a bus interface 116, via which the control unit 106 is connected to a field bus 118. The latter may, for example, be a Profibus or industrial Ethernet. Coupling via conventional wiring (individual signals) or via serial interfaces is furthermore possible.

The control unit 106 outputs the analysis result 114, or part of it, via the bus interface 116 onto the field bus 118 in the form of a data telegram, which has an automation component of the process control system 120 as its target addresses. The relevant automation component of the process control system 120 processes the analysis result as a control variable, for example by comparison with a setpoint value, in order to adjust the process 104 accordingly if need be.

As an alternative, the adjustment may also be carried out by transmitting the analysis result via the field bus 118 to a control panel, where it is displayed. The display of the analysis result may be combined with an acoustic or optical warning signal when the analysis result lies outside a setpoint range. Adjustment of the process may then be carried out if need be, for example through manual input by the user in order to modify a process parameter.

As an alternative, the control may also be carried out by using model-based automated process control, i.e. for example by using control in state space, a neural network or a hybrid neural network with rigorous model components.

The control unit 106 contains a program 122, which is used to control the program procedure of the sampling by operation of the bypass module 100, the sample preparation by operation of the sample preparation system 108 and the sample analysis by operation of the analyser 112. In order to operate the bypass module 100, the modules M1, M2, M3,..., the sample preparation system 108 and the analyser 112, the program 122 accesses corresponding driver programs 124 which are respectively

assigned to one of the modules. The program procedure of the program 122 is established by parameters 126 which establish the chronological order of the operation of modules and the control parameters to be given to the respective driver program.

In order to input the parameters 126 into the control unit 106, the latter has a PC interface 128. The control unit 106 can be connected to a PC 130 by means of the PC interface 128. The PC 130 has a user interface 132, which is preferably designed as a graphical user interface.

A user inputs the parameters 126 via the user interface 132. After this input has been carried out, a corresponding file 134 is exported and transmitted from the PC 130 to the control unit 106. In this way, the control unit 106 receives the parameters 126 which establish the procedure of the program 122. After the file 134 has been transmitted from the PC 130 to the control unit 106, the link between the PC 130 and the control unit 106 can be disconnected. This has the advantage that unimpaired function of the control unit 106 is no longer dependent on the PC 130.

The user can also carry out selection of the analyser 112 via the user interface 132, when there are a plurality of analysers connected in parallel. The procedure of the program 122 for the conduct of the sample preparation necessary for the selected analyser 112 is established at the same time by the selection of the analyser 112.

Furthermore, it is also possible for the same sample preparation to be usable for different analysers 112. In this case, an appropriate quantity of the sample is prepared and then apportioned to these analysers. This apportioning of the prepared sample is likewise carried out under the control of the program 122.

Another variant is that a sample prepared for a particular

type of analyser requires further preparation steps in order to be used for another type of analyser. In this case, a certain quantity of the sample prepared for the first type of analyser may be extracted before carrying out further sample preparation steps with the remaining quantity of sample.

Via the program 122, it is hence possible for a sample to be prepared for a plurality of analyses to be carried out essentially simultaneously in the analysers connected in parallel. It is likewise possible for the sample preparation to be carried out in several stages, the intermediate products being delivered, in the correct order, to corresponding types of analysers.

The control system in Figure 1 hence makes it possible to automate the manual taking of a sample from the process which was required in the prior art, and the sample preparation and analysis, and furthermore to feed the analysis result into a process control system as a control variable. On the one hand, this makes it possible to save significantly on personnel resources. On the other hand, owing to its modular construction, the control system can be adapted to different analysis tasks with very minor outlay in terms of both hardware and software.

The procedure can be defined intuitively via the graphical user interface, for example by a laboratory assistant or technician who can hence contribute his or her expertise to the automation of the procedure. Furthermore, the control system also allows improved process control since, on the one hand, the sampling is carried out in accurately predefined time intervals or at programmable times, the sample preparation and analysis are carried out fully automatically with consistent quality in a reproducible way, and the analysis result can be fed into the adjustment of the process as a control variable with no time delay.

Figure 2 illustrates this procedure once more. In step 200, a

sample is taken from the process. This is done through operation of a sampling unit, for example a bypass module, by the control unit of the control system. In step 202, the sample which has been taken is then delivered to an automatic sample preparation system, for example via a liquid line. In step 204, the automatic sample preparation is carried out according to a predetermined program procedure. In step 206, the prepared sample is put into an analyser, where it is analysed.

If there are a plurality of analysers, the prepared sample is divided up and put into two or more analysers for an analysis running simultaneously in parallel. The consequent analysis result or results are then transmitted in parallel or sequentially to a process control system. This is done in step 208. In step 210, the process control system can make an adjustment to the process based on the analysis result, if need be.

Steps 200 to 210 are preferably performed cyclically within predetermined time intervals, or after the process control system has established that a particular condition has been satisfied and the process control system has used the field bus to send the control unit a corresponding request signal to obtain an analysis result.

Figure 3 shows an embodiment of the sampling, the automatic sample preparation and sample analysis of a control system according to the invention. Elements in Figure 3 which correspond to elements in Figure 1 are in this case denoted by the same references.

The bypass module 100 has a bypass 300 which, through various valves 302 which can be operated by the control unit, makes it possible to take a sample from the process 104. The bypass module 100 is connected via lines 304 to various modules of the sample preparation system. These include the sample preparation module 306, the calibration module 308, the

syringe module 310 and other modules 312 and 314, the injection module 316 and the waste module 318. The said modules are connected to one another via lines 304 or can be connected to one another by appropriate valve settings. The various modules and valves can be operated by the control unit of the control system.

For example, the sample taken from the process 104 by the bypass module 100 goes directly, or via one of the other modules, into the sample preparation module 306 where further substances are added to the sample according to a predetermined procedure, for example in order to dilute the sample. To this end, a mixing vessel 307 is provided in the sample preparation module 306. Elements for regulating the sample to a suitable temperature may furthermore be provided in the sample preparation module 306. After the sample preparation has been completed, the prepared sample is taken from the sample preparation module 306 and injected into the analyser via the injection module 316.

The injection module 316 has an injector 319, from which the prepared sample is injected directly into the sample. The prepared sample reaches the injector 319, for example, from the syringe module 310 or from the sample preparation module 306. Filtration units 317 are arranged in corresponding feed lines leading to the injector 319.

Figure 4 shows an example of the various modules and their combination in a perspective view. For example, the following predetermined modules are available for the construction of the control system: PC electronics module 400 with an LCD display, a PC slot and a keyboard, electronics module 402 for holding the control unit, sample module 404 for fulfilling various functionalities, analyser module 406 with an analyser, for example a gas chromatograph, into which a prepared sample can be introduced via a dosing valve, chemicals module 408 and 410 of different sizes. The chemicals modules 408 and 410 can be used to hold various solvents, an internal standard,

calibration solutions, extraction agents or derivatization reagents.

These modules may, for example, be interconnected to form the combination 412. A sample preparation system can hence be assembled flexibly according to the sample preparation required for the analysis.

It is furthermore advantageous that the modules can be planned and manufactured individually. Furthermore, a plurality of sample modules may be connected to a single analyser, and different analysers may also be connected to a single sample module.

Figure 5 shows a window 500 of a graphical user interface (cf. the user interface 132 in Figure 1). The window 500 contains the representation of an explorer tree 502 in which the available modules are listed, i.e. the "devices" of the automatic sample preparation system. The explorer tree 502 furthermore shows the program procedures which can be carried out with the aid of these devices.

A program procedure is input by a user in a tabular form. To this end, the program procedure is subdivided into sequences, to which a sequence number is respectively assigned. Each sequence is furthermore given a sequence name. A sequence consists of, for example, three steps. A user-defined action is carried out by one of the devices in each step. The user can hence intuitively establish the program procedure for the sample preparation by selecting devices and inputting corresponding parameters.

According to the embodiment in Figure 6, this is done by calling up a separate mask 600, 602 and 604 for each device selected by the user, for example "mixer", "valve 1" and "valve 2", respectively. The user inputs the specific device parameters via such a mask.

The device parameters are then transmitted from the PC 130 to the control unit 106, which is for example an S7 controller from the company Siemens. During the running of the program in the control unit 106, these parameters are then given to the corresponding device drivers 606, 608, 610. The corresponding hardware components are operated by means of this.

The software development is preferably carried out on the basis of function types. Function types form the basis for the compilation of procedures, i.e. they contain information and parameters pertaining to a particular functionality. The function types are used as a library and are programmed for the control unit. The function parameters are then mapped in the PC.

From the library of function types, a type is selected and specially parameterized. This provides the description of a device, which is given its own name and can be included in the procedures. The relevant device name appears in the explorer tree of the user interface (cf. Explorer tree 502 in Figure 5).

Procedures can be established on the basis of the devices defined in this way by selecting the devices in a particular order. A procedure consists of a number n of sequences, which are carried out in succession. Up to three actions may preferably be defined in a sequence, and these are run in parallel. In this case, an action consists of a defined device which is started in a sequence within a procedure. A cycle is defined by the order of the procedures which is established in this way by the user.

On the basis of function types, i.e. an abstract description of device classes, device descriptions can hence be compiled efficiently for the specific parameters of a sample preparation.

List of references

bypass module	100
sample	102
process	104
control unit	106
sample preparation system	108
prepared sample	110
analyser	112
analysis result	114
bus interface	116
field bus	118
process control system	120
program	122
driver programs	124
parameters	126
PC interface	128
PC	130
user interface	132
file	134
bypass	300
valve	302
lines	304
sample preparation module	306
mixing vessel	307
calibration module	308
syringe module	310
module	312
module	314
injection module	316
filtration unit	317
waste module	318
injector	319
PC electronics module	400
electronics module	402
sample module	404
analyser module	406
chemicals module	408

chemicals module	410
combination	412
window	500
explorer tree	502
mask	600
mask	602
mask	604
device driver	606
device driver	608
device driver	610

Patentkrav

1. Analysesystem til en proces med:
- styrbart bypassmodul (100) til udtagelse af en flydende prøve fra processen forbundet med
- styrbare midler (108; 302, 304, 306, 307, 308, 310, 312, 314, 316, 317, 318) til forberedelse af væskeprøve forbundet med
- styrbare midler (112) til analyse af prøven forbundet med
- midler (116) til overførsel af et analyseresultat (114) til et proceskontrolsystem (118, 120)
- en styreenhed (106), og
idet
- de styrbare midler til forberedelse af væskeprøven er organiseret i forskellige moduler (M1, M2, M3,...), idet der ved hjælp af hvert modul realiseres en bestemt funktionalitet, og idet enkelte moduler i forberedelsen af væskeprøven kan styres ved hjælp af styreenheden (106),
- et modul til forberedelse af væskeprøven (306) har et rørekar (307),
- bypassmodulet 100 er forbundet med styreenheden (106),
kendetegnet ved, at
- styreenheden (106) har et styreprogram (122) og driverprogrammer (124) til styring af modulerne til midlerne til forberedelsen af væskeprøven, idet styreprogrammet (122) til styring af forløbet af prøveudtagelsen, forberedelsen af væskeprøven og prøveanalysen har adgang til driverprogrammerne (124),
som hver især er allokeret til et af modulerne, og
- en brugergrænseflade (132) til indlæsning af en analysesekvens på en computer (130), idet brugergrænsefladen (132) er udformet således, at en programkørsel i styreprogrammet er bestemt ved valg af repræsentationer i modulerne og indlæsning af de aktioner, der skal udføres ved hjælp af de valgte moduler på computeren (130), og computeren har midler til eksport af de data (134), der beskrives af analysesekvensen, til styreprogrammet,
- idet de data (134), der beskriver analysesekvensen, tjener

som parametrisering til styreprogrammet, således at dette starter de i hvert tilfælde påkrævede driverprogrammer i den nødvendige rækkefølge.

2. Analysesystem ifølge krav 1, idet midlerne til analyse af prøven har en chromatograf, en kombination af chromatograf og massespektrometrisk detektor (GC-MS eller HPLC-MS) eller en anden analysator.

3. Fremgangsmåde til regulering af en proces i et analysesystem, som til automatisk forberedelse af væskeprøve har styrbare midler til forberedelsen af væskeprøven organiseret i forskellige moduler (M1, M2, M3,...), idet hvert af modulerne realiserer en bestemt funktionalitet, idet et modul til forberedelse af væskeprøve (306) omfatter et rørekar (307), og idet enkelte moduler i forberedelsen af væskeprøven styres ved hjælp af en styreenhed (106) med et styreprogram, idet styreprogrammet har adgang til driverprogrammer (124), som hver især er allokeret til et af modulerne, og denne adgang sker i henhold til en af brugeren forud givet parametrisering,
med følgende trin:
- brugerens indlæsning af en analysesekvens på en computer (130) via en brugergrænseflade, idet brugergrænsefladen (132) er udformet således, at en programkørsel af styreprogrammet er bestemt ved hjælp af valg af repræsentationer i modulerne for midlerne til forberedelsen af væskeprøven og indlæsning af de aktioner, der skal udføres ved hjælp af de valgte moduler på computeren (130),
- eksport af de data (134), der beskrives af analysesekvensen, til styreprogrammet, idet de data (134), der beskriver analysesekvensen, tjener til parametrisering til styreprogrammet, således at dette starter de i hvert tilfælde nødvendige driverprogrammer i den nødvendige rækkefølge,
- udtagelse af en prøve fra processen ved hjælp af styring af et bypassmodul (100) til udtagelse af en flydende prøve af processen, som er koblet sammen med en anordning til automatisk forberedelse af væskeprøven,

- tilførsel af prøven fra prøveudtagelsesenheden til anordningen til den automatiske forberedelse af væskeprøven i rørekarret (307) på prøveforberedelsesmodulet (306),
- styring af anordningen til den automatiske forberedelse af væskeprøven med styreprogrammet,
- automatisk gennemførelse af forberedelsen af væskeprøven,
- tilførsel af den forberedte prøve til en analyseenhed,
- styring af analyseenheden til analyse af den forberedte prøve,
- udsendelse af et analyseresultat på et bussystem i et proceskontrolsystem til efterregulering af processen på basis af analyseresultatet ved hjælp af proceskontrolsystemet.

4. Fremgangsmåde ifølge krav 3, idet der af en bruger via en brugergrænseflade i computeren i tabelform udvælges moduler og aktioner, der skal gennemføres af modulerne, og brugerens valg eksporteres i form af parametre til overførsel til styreenheden.

5. Computerprogramprodukt, navnlig digitalt lagermedie, til gennemførelse af fremgangsmåden ifølge et af kravene 3 eller 4 i et analysesystem ifølge et af kravene 1 eller 2.

Fig. 1

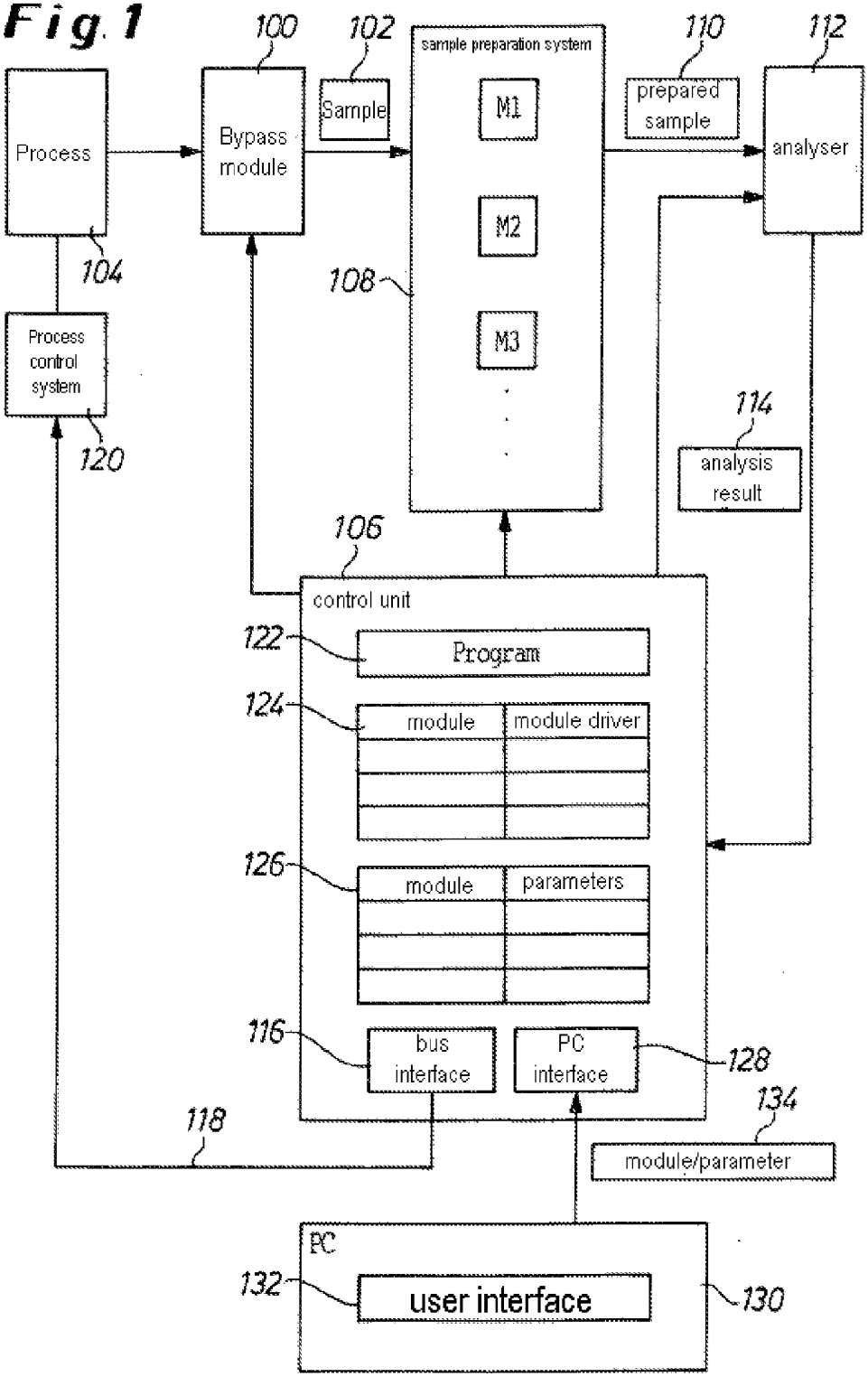
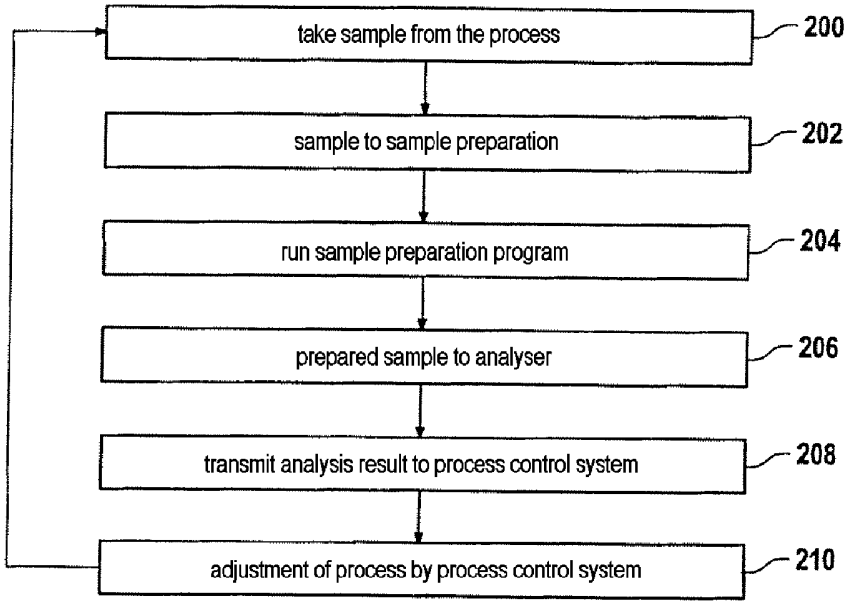

100
102
sample preparation system
110
112
Process
Bypass module
Sample
M1
prepared sample
analyser
M2
104
108
M3
Process control system
114
analysis result
120
106
control unit
122
Program
124
module
module driver
126
module
parameters
116
bus interface
PC interface
128
134
118
module/parameter
PC
132
user interface
130

Fig. 2


take sample from the process
200
sample to sample preparation
202
run sample preparation program
204
prepared sample to analyser
206
transmit analysis result to process control system
208
adjustment of process by process control system
210

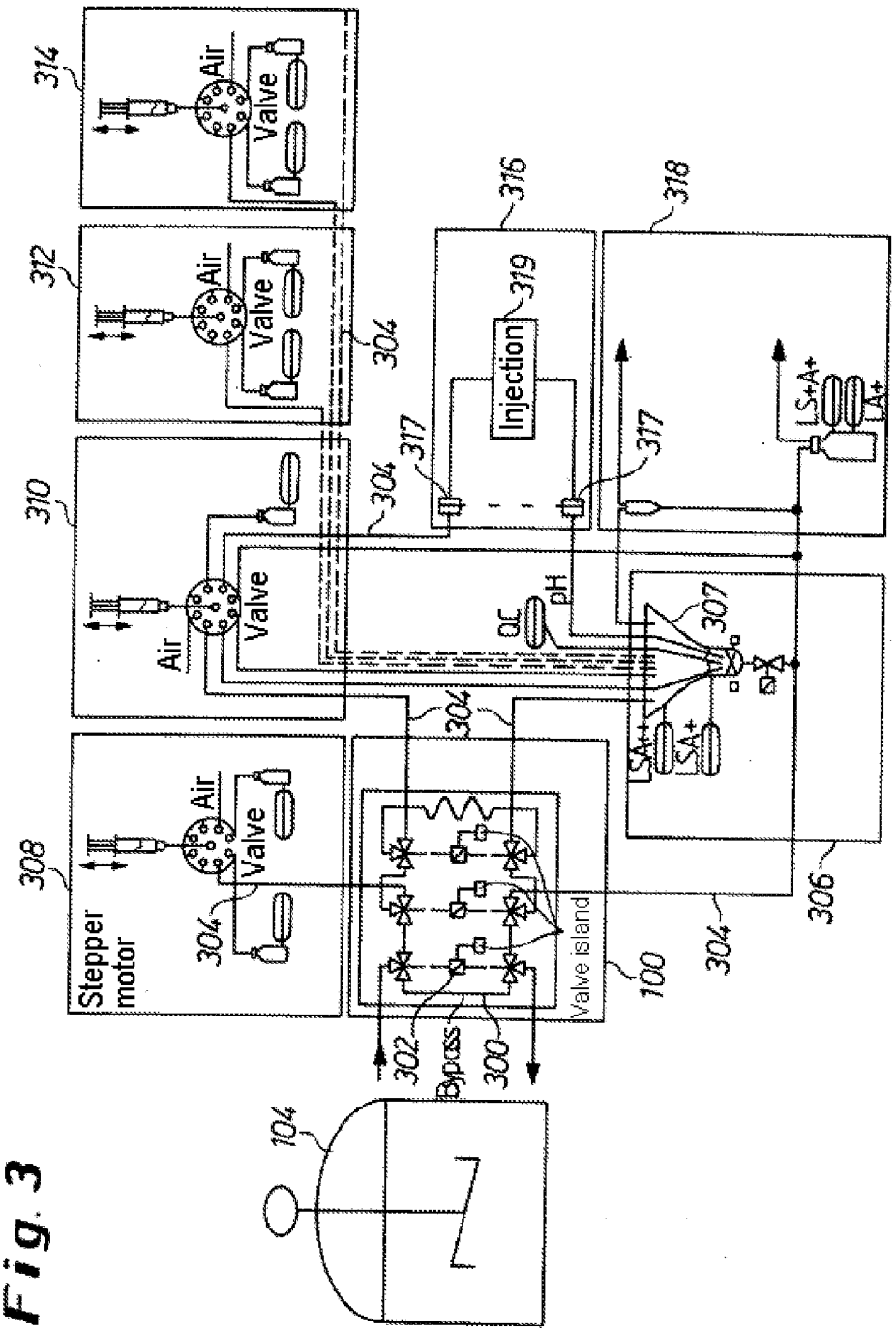

314
Air
Valve
312
Air
Valve
304
316
318
319
Injection
317
317
LS+A+
A+
310
304
Air
Valve
QC
pH
307
304
SA++
SA+
308
Stepper motor
Air
Valve
304
Valve island
100
304
306
302
Bypass
300
104

Fig. 3

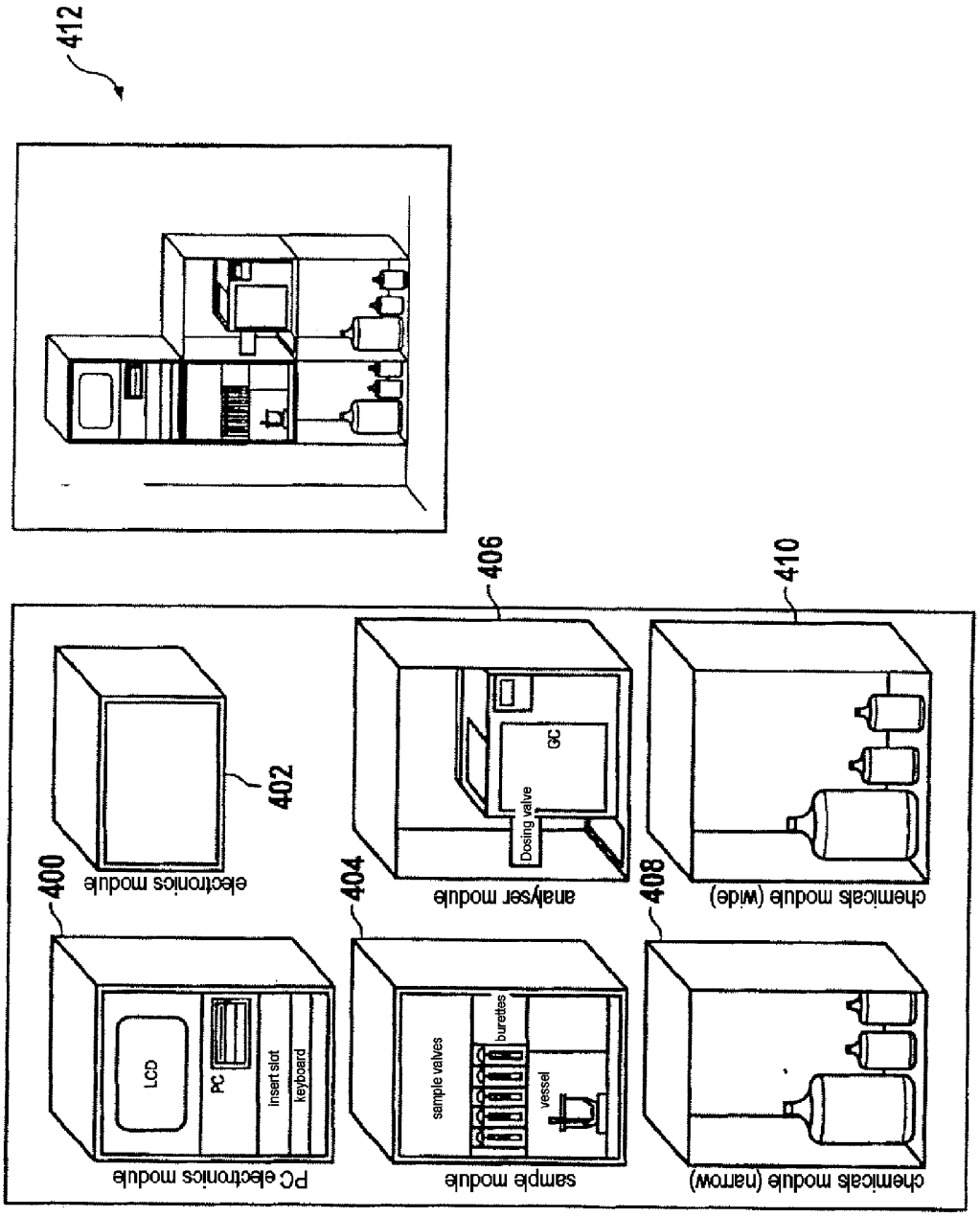

412
406
410
402
400
404
408
GC
Dosing valve
LCD
PC
insert slot
keyboard
sample valves
burettes
vessel
electronics module
analyser module
chemicals module (wide)
PC electronics module
sample module
chemicals module (narrow)

Fig. 4

Fig. 5

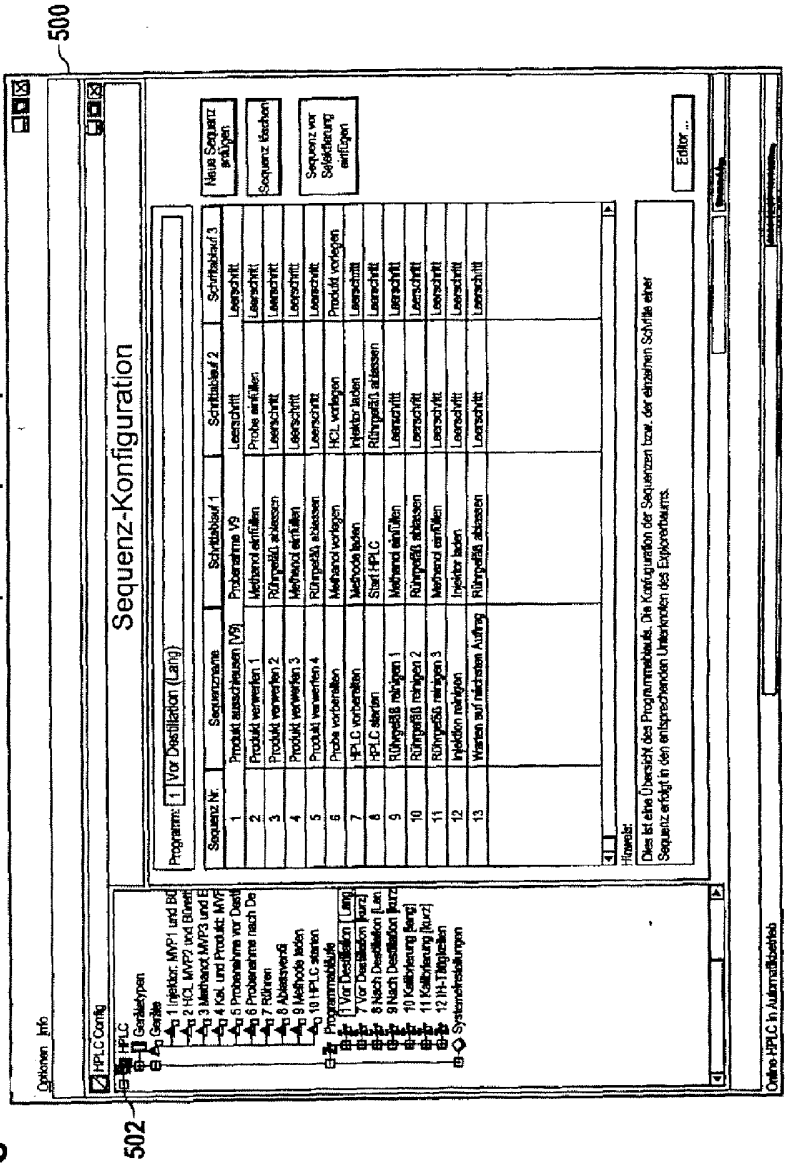
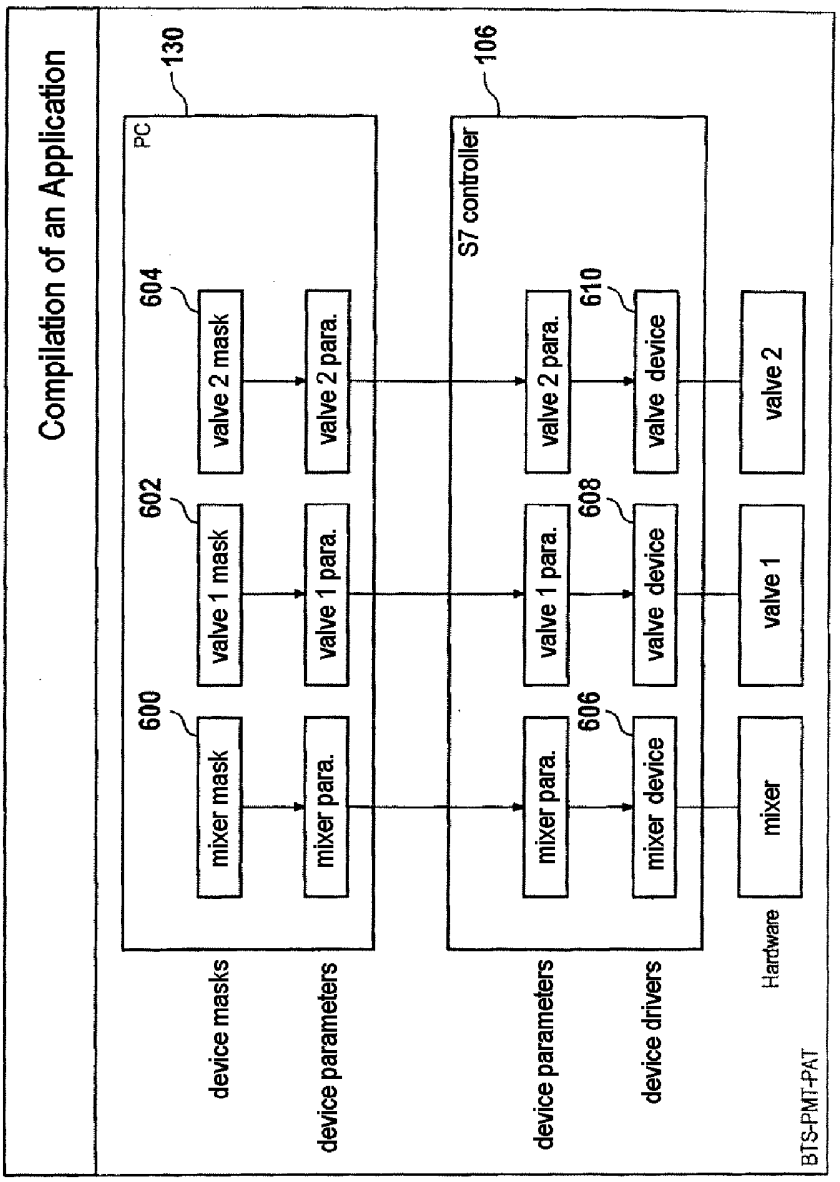

Procedure Control for Liquid Sample Preparation
500
502
Sequenz-Konfiguration
Programm: 1 Vor Destillation (Lang)
Sequenz Nr.
Sequenzname
Schrittablauf 1
Schrittablauf 2
Schrittablauf 3
Neue Sequenz anfügen
Sequenz löschen
Sequenz vor Selektierung einfügen
Editor ...
Hinweis:
Dies ist eine Übersicht des Programmablaufs. Die Konfiguration der Sequenzen bzw. der einzelnen Schritte einer Sequenz erfolgt in den entsprechenden Unterknoten des Explorerbaums.
Online HPLC in Automatikbetrieb

Fig. 6


Compilation of an Application
PC
130
S7 controller
106
600
602
604
606
608
610
mixer mask
valve 1 mask
valve 2 mask
mixer para.
valve 1 para.
valve 2 para.
mixer para.
valve 1 para.
valve 2 para.
mixer device
valve device
valve device
mixer
valve 1
valve 2
device masks
device parameters
device parameters
device drivers
Hardware
BTS-PMT-PAT