(54) Title: AUTOMATION NETWORK, ACCESS SERVICE PROXY FOR AUTOMATION NETWORK METHOD FOR TRANSMITTING OPERATING BETWEEN PROGRAMMABLE CONTROLLER REMOTE COMPUTER
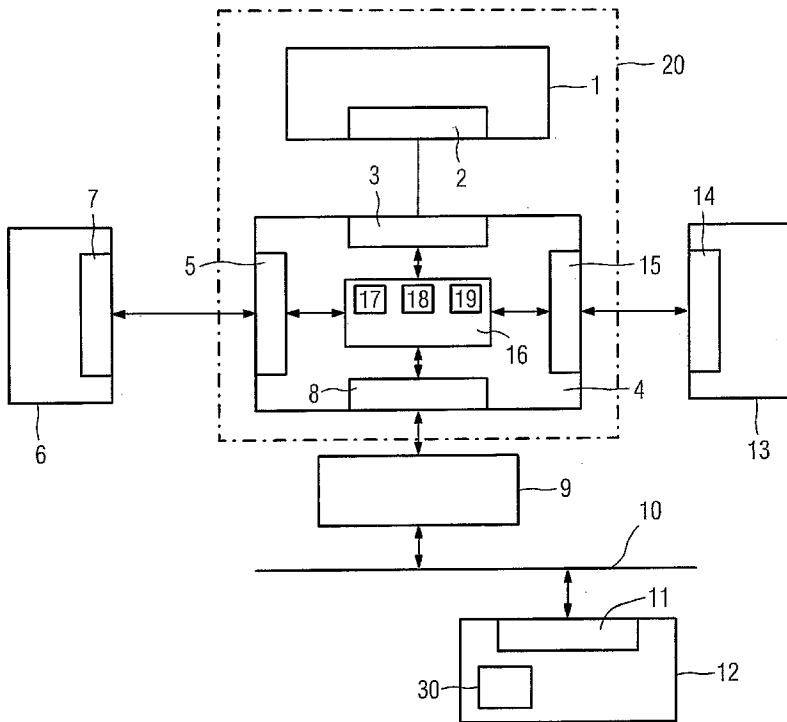
(57) Abstract: The invention relates to an automation network, an access service proxy (4) for an automation network and a method for transmitting operating data between a programmable controller (1) and a remote computer (12), wherein the operating data of the programmable controller (1) can be transmitted via the Internet (10) or an intranet by means of the HTTP protocol and displayed and/or modified on the remote computer by an Internet browser (30). The access service proxy (4) here contains a server (8) for supplying the web pages containing the operating data of the programmable controller (1) to the Internet browser (30) of the remote computer (12), an interface (5), to which an engineering system (6) can be connected so that operating data of the programmable controller (1) can be transmitted using a communication mechanism of the automation field communication via the connection between access service proxy (4) and engineering system (6), and a synchronization unit (18) for updating the content of the web pages if the operating data is modified by the engineering system (6). This provides uniform access to the operating data of the programmable controller and consequently data consistency and security against unauthorized access.

WO 2007/075099 A1

Description

Automation network, access service proxy for an automation
network and method for transmitting operating data between a
5 programmable controller and a remote computer

The invention relates to an automation network comprising at
least one programmable controller and comprising at least one
remote computer according to the preamble of claim 1, to an
10 access service proxy for an automation network according to
the preamble of claim 6 and to a method for transmitting
operating data between a programmable controller and a remote
computer according to the preamble of claim 7.

15 The term programmable controller is understood to refer to a
device which executes a control program for controlling a
process. Devices of this type are frequently called SPCs
(stored-program controllers), PLCs (programmable logic
controllers, or controllers for short), soft SPCs or soft
20 PLCs. A programmable controller can have a modular structure
and contain a programmable central processing unit and
intelligent modules which perform individual automation
functions, for example weighing, axis control, closed-loop
control, etc. In order to connect to a communication network,
25 which serves to exchange data with other components of an
automation network, for example network components or field
devices or other programmable controllers, an additional
module, which is called a communication processor, can be
provided.
30
From DE 102 07 831 A1 an engineering system for planning
and/or configuring a project is known, which project is
processed by an automation system for controlling a technical

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plant. Here, an automation network comprises said engineering system, an operating and monitoring system and an automation system to be planned and configured. The engineering system is provided for planning and/or configuring the automation

5   system. The automation system, which is connected via a bus system to the engineering system and to the operating and monitoring system, comprises different programmable controllers as well as actuators and sensors and other automation components required for controlling a technical

10   plant. The programmable controllers, which are connected to one another via said bus system and/or other suitable bus systems, can be fashioned in different ways. Thus, programmable controllers are provided for solving small, intermediate and large automation tasks within the automation

15   system, whereby microprogrammable controllers can be used for solving small automation tasks, programmable mini-controllers for intermediate automation tasks and powerful programmable controllers for solving more complex automation tasks. The question of which hardware and software components, that is,

20   which programmable controllers, operating and monitoring devices, bus systems, actuators and sensors, and of which control programs the automation system is to be equipped with depends on the complexity of the technical plant to be controlled and on the control task, whereby the required

25   hardware and software components of the automation system can be planned and/or configured by the engineering system. The engineering system is also provided for planning communication networks of the automation network, for planning continuous and sequential process flows, as well as

30   for designing operating and monitoring strategies and for creating recipes for batches and/or batch processes. The project data required for planning and/or configuring a project which will be processed by the automation system to

be designed are stored in a memory of a programming unit, for example. To plan and/or configure a programmable controller, for example, the data concerned is transferred from the programming unit to the programmable controller via a data

5   connection and communication mechanisms usually used for automation purposes. Examples of such communication mechanisms of the automation field communication based on Ethernet are PROFINET, Ethernet IP or Modbus TCP. A communication mechanism is defined by the relevant protocol,

10 which is usually standardized, and the underlying communication relation. Communication relations organize communication between the devices participating in data transfer in the network, which are also referred to as subscribers. Examples of communication relations are

15 client/server, master/slave, master/master, producer/consumer or publisher/subscriber. TCP/IP is frequently used as the communication protocol in Ethernet-based networks.

From US 6,151,625 A a programmable controller is known which

20 has a web interface for communication via the Internet or intranet. By this means, a client/server system was created which offers operators a user interface which is as user-friendly as general access services in the Web. The Web is a network of documents, which are also called pages and which

25 are stored in a distributed manner on server computers all over the world. Normally, a page contains text, various multimedia offerings, such as for example graphics, video or audio data, and hypertext links to other documents. A browser enables the user to read the pages and to select

30 interactively from the options offered on the page. The browser is a graphics program that sends requests over the Internet to a page and displays the information available on a requested page. The web interface integrated into the

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programmable controller enables a user to request and display the operating data of the programmable controller using a browser. The operating data may be controller configuration data, process data such as input and output values, register

5   states, statistical data, diagnostic data or configuration data of the input/output interfaces. A remote computer with Internet access via a browser, for example Netscape Communication's Navigator or Microsoft's Internet Explorer, is thus all that is needed in order to operate and monitor

10   the automation system via a human machine interface(HMI).

If a programmable controller has both an Internet connection to a remote computer and a proprietary data connection to an engineering system, then it can happen that operating data of

15   the programmable controller is changed by the engineering system without these changes being incorporated in the Web pages which are used for interacting with (for example operating and monitoring) a remote computer.

20   The object of the invention is therefore to create an automation network, an access service proxy for such an automation network and a method for transmitting operating data between a programmable controller and a remote computer, by means of which inconsistency between data in the web pages

25   used for interaction and the operating data actually present in the programmable controller is avoided.

In order to achieve this object, the automation network of the type stated in the introduction is equipped with the

30   features specified in the characterizing clause of claim 1. A corresponding access service proxy for a programmable controller and a method for transmitting operating data between a programmable controller and a remote computer are

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described in claim 6 and claim 7. Advantageous developments of the invention are specified in the dependent claims.

Connected upstream of one or more programmable controllers is

5   thus an access service proxy in which an interface for the modification of operating data by an engineering system is combined with a web-server-type interface for Internet communication on which the operating data is made available in web pages for an Internet browser of the remote computer,

10 which can access the web server as a web client. If the operating data is modified by the engineering system, the content of the web pages is updated by a synchronization unit of the access service proxy. Consistency in the operating data is thus achieved by the access service proxy as a

15 standard interface between automation system and outside world, and this is done irrespective of whether the operating data is modified through access from the engineering system or from the remote computer via the Internet by means of Hypertext Transfer Protocol (HTTP). Any changes in the

20 operating data of the programmable controller which affect, for example, the project or the control program and which require corresponding changes in the interface to the remote computer have to be communicated to the programmable controller via the access service proxy. The access service

25 proxy monitors the protocols which are used for modifying the operating data and detects change events. If such an event is detected, the access service proxy applies a predetermined procedure in order to ensure that the interface to the remote computer is updated in accordance with the modifications made

30 to the operating data.

The access service proxy can also establish a connection to dedicated devices, for example operating and monitoring

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devices, management and diagnostic tools, to other networks or directly to computers which are used for operating the programmable controller remotely.

5   The access service proxy can be fashioned as a device which is assigned to one or more programmable controllers and separate from said programmable controller(s). In this case, it is advantageous to provide between the programmable controller(s) and the access service proxy a connection for
10   data transmission comprising the same communication mechanisms as are used for the data connection between access service proxy and engineering system. This has the advantage that the access service proxy can be transparent for the protocol used in these communication mechanisms and can
15   therefore be implemented with particular ease.

The connection for data transmission between programmable controller and access service proxy can advantageously be fashioned as a network of the automation field communication,
20   and multiple programmable controllers can be connected to this network. This has the advantage that a single access service proxy can be used for multiple programmable controllers.

25   The access service proxy can thus be used in a wide range of different network architectures and enables equally a data connection to a programmable controller in the simplest architecture as well as operation in a network comprising multiple connected programmable controllers.
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As an alternative to this, it is of course also possible to integrate the access service proxy as a component into a programmable controller.

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Advantageously, the synchronization unit can contain a software tool which makes it possible for web pages of the access service proxy to be modified by an engineering system.

5   In this way, when changes are made to the operating data by the engineering system, it is also possible selectively to adapt in an appropriate manner the web pages of the web server located in the access service proxy to these changes.

10   Furthermore, the access service proxy can advantageously be equipped with a security unit, by means of which the identification and authorization of devices wishing to access operating data of programmable controllers located downstream of the access service proxy is carried out. The security

15   checks consequently take place at a point upstream of the programmable controllers, and the programmable controllers lying downstream of this point are better protected against attacks. The operating programs of the access service proxy are much less complex than those of the programmable

20   controllers and are therefore better protected against attacks. Different solutions can be applied for identifying and authorizing users. It is readily possible to integrate further security devices into the access service proxy.

25   The invention and embodiments and advantages thereof are described in detail below with reference to the drawings in which exemplary embodiments of the invention are shown.

Figure 1   shows an automation network comprising an access
30   service proxy and

Figure 2   shows an automation network comprising multiple
           programmable controllers and input/output devices.

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A programmable controller 1 has in accordance with Figure 1
an interface 2 which is connected to a corresponding
interface 3 of an access service proxy 4 for the transmission
5   of data by means of a communication mechanism for automation
field communication. Connected to a further interface 5 of
the access service proxy 4 is an engineering system 6
comprising an interface 7 which uses the same communication
mechanism for data transmission. Data which has to be
10   transmitted from the engineering system 6 to the programmable
controller 1 or vice versa is forwarded by the access service
proxy 4 without protocol conversion. A web server 8 of the
access service proxy 4 is connected via an optional switch 9
or router with firewall to the Internet 10 or an intranet.
15   Also located in this Internet 10 is a client 11 which is
implemented in a remote computer 12. Web pages can be
displayed and/or modified on the remote computer 12 by means
of an Internet browser 30. In order to connect an operating
and monitoring device 13 directly to the access service proxy
20   4, these are equipped with a further client 14 and a further
web server 15. The access service proxy 4 has a kernel 16
which contains a security unit 17, a synchronization unit 18
and an operating-data map 19. As indicated by broken lines 20
in Figure 1, the access service proxy 4 can, as an
25   alternative to the embodiment shown, be integrated into a
programmable controller.

The access service proxy 4 represents a uniform access point
to the operating data of the programmable controller 1, which
30   access point is responsible for all communication with remote
locations. The programmable controller 1 consequently cannot
be reached directly via the Internet, and access to the data
of the programmable controller 1 has first to be enabled by

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the access service proxy 4 connected upstream, which carries out identification and authorization through the security unit 17. Consequently, an attacker can no longer attack the programmable controller 1 directly, but only the access
5   service proxy 4. The web server 8 enables access to the operating data of the programmable controller 1 via the Internet 10. The kernel 16 of the access service proxy 4 translates the TCP/IP, FTP and HTTP protocols used in the Internet into the protocol of the communication mechanism,
10 e.g. of the PROFINET, which is used for communication between the programmable controller 1 and the access service proxy 4 in automation field communication. In each transmission of data between engineering system 6 and programmable controller 1 and between remote computer 12 and programmable controller
15 1 the synchronization unit 18 in the kernel 16 of the access service proxy 4 monitors whether operating data is modified by the data transmission. If such a change event occurs, then the synchronization unit 18 ensures the necessary data consistency. In the case of the transmission of data between
20 engineering system 6 and programmable controller 1, this can for example be achieved by the synchronization unit 18 drawing the attention of a user of the engineering system 6 to the fact that the content of the pages stored in the web server 8 and possibly also in the web server 15 has to be
25 harmonized with the changes made to the operating data of the programmable controller 1. The information to the user can for example be given in the form of a warning or an active request that prompts the user to carry out the necessary update according to the procedure specified in each case.
30 Alternatively, an automatic update can also be carried out by the synchronization unit 18. In a corresponding implementation of the web servers 8 and 15, the adaptation of the operating data can be made in the operating-data map 19.

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In the event of a request by the remote computer 12 to access
the programmable controller 1, in which no change is made to
the operating data, a protocol conversion can be waived and
the operating-data map 19 accessed through the web server 8

5   without any further communication between access service
proxy 4 and programmable controller 1 being required. If,
however, the operating data of the programmable controller 1
is modified by the remote computer 12, a protocol conversion
has to be carried out, and the access service proxy 4

10   forwards the operating-data request to the programmable
controller 1. The request is responded to in the required
manner by the programmable controller 1 and the operating-
data map 19 adapted accordingly. To do this, an OPC-XML
server (OPC: OLE for process control, OLE: object linking and

15   embedding, XML: extensible markup language), for example, can
be used on the page of the programmable controller 1 in the
interface 2, and an OPC-XML client used in the interface 3 of
the access service proxy 4. In this way, further web pages
can be stored in the programmable controller 1. To simplify

20   the detection of changes to the operating data of the
programmable controller 1, version numbers can be introduced
for projects.

The identification and authorization of users is carried out

25   by the security unit 17 prior to their accessing the
operating data of the programmable controller 1, so as to
prevent unauthorized access and thus to increase the
operating security of the automation system. Through the
access service proxy 4 it is also possible to resolve

30   conflicts in accessing the programmable controller 1 and to
record and log all access events to the programmable
controller 1.

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Figure 2 shows an exemplary embodiment of an automation
network in which an access service proxy 21 is connected
upstream of an automation system which consists of two
programmable controllers 22 and 23 and three distributed
5   input/output devices 24, 25 and 26. The devices 22...26 of the
automation system are connected to one another and to the
access service proxy 21 via a communication network 27, in
which a communication mechanism for automation field
communication is used for data transmission. It is
10   particularly clear from this exemplary embodiment that not
only the operating data of a single programmable controller
but the operating data of an entire automation system can be
kept consistent and protected against access by unauthorized
parties by means of an upstream access service proxy 21. As
15   in the diagram shown in Figure 1, connected to the access
service proxy 21 are an engineering system 28, a remote
computer 31 (via an optional switch 29 and the Internet 33)
and an operating and monitoring device 32 (directly).

20

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Claims

1. Automation network comprising at least one programmable
controller (1) and comprising at least one remote computer
5   (12), wherein operating data of the programmable controller
(1) can be transmitted via the Internet (10) or an intranet
by means of the Hypertext Transfer Protocol (HTTP) and
displayed and/or modified on the remote computer (12) by an
Internet browser (30), characterized in that an access
10   service proxy (4) is provided, said access service proxy
comprising a server (8) for supplying the web pages
containing the operating data of the programmable controller
(1) to the Internet browser (30) of the remote computer (12),
an interface (5), to which an engineering system (6) can be
15   connected so that operating data of the programmable
controller (1) can be transmitted using a communication
mechanism for automation field communication via the
connection between access service proxy (4) and engineering
system (6), and a synchronization unit (18) for updating the
20   content of the web pages if the operating data is modified by
the engineering system (6).

2. Automation network according to claim 1, characterized in
that a connection exists between the programmable controller
25   (1) and the access service proxy (4) for transmitting data
with the same communication mechanism of the automation field
communication that is provided for transmitting data between
access service proxy (4) and engineering system (6).

30   3. Automation network according to claim 2, characterized in
that the connection for data transmission between
programmable controller (22,23) and access service proxy (21)
is fashioned as a network (27) of the automation field

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communication and in that a plurality of programmable controllers (22,23) are connected to this network (27).

4. Automation network according to any one of the preceding claims, characterized in that the synchronization unit (18) comprises a software tool for modification of the web pages by the engineering system (6).

5. Automation network according to any one of the preceding claims, characterized in that the access service proxy (4) has a security unit (17) for identifying and authorizing devices accessing the operating data of the programmable controller (1).

6. Access service proxy for an automation network comprising at least one programmable controller (1) and comprising at least one remote computer (12), wherein operating data of the programmable controller (1) can be transmitted via the Internet (10) or an intranet by means of the Hypertext Transfer Protocol (HTTP) and displayed and/or modified on the remote computer (12) by an Internet browser (30), characterized in that the access service proxy is equipped with a server (8) for supplying the web pages containing the operating data of the programmable controller (1) to the Internet browser (30) of the remote computer (12), with an interface (5), to which an engineering system (6) can be connected so that operating data of the programmable controller (1) can be transmitted using a communication mechanism of the automation field communication via the connection between access service proxy (4) and engineering system (6), and with a synchronization unit (18) for updating the content of the web pages if the operating data is modified by the engineering system (6).

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7. Method for transmitting operating data between a programmable controller (1) and a remote computer (12), wherein operating data of the programmable controller (1) is transmitted via the Internet (10) or an intranet by means of the Hypertext Transfer Protocol (HTTP) and displayed and/or modified on the remote computer (12) by an Internet browser (30), characterized in that an access service proxy (4) is used, said access service proxy comprising a server (8) for supplying the web pages containing the operating data of the programmable controller (1) to the Internet browser (30) of the remote computer (12), an interface (5), to which an engineering system (6) can be connected so that operating data of the programmable controller (1) can be transmitted using a communication mechanism of the automation field communication via the connection between access service proxy (4) and engineering system (6), and a synchronization unit (18) for updating the contents of the web pages if the operating data is modified by the engineering system (6).
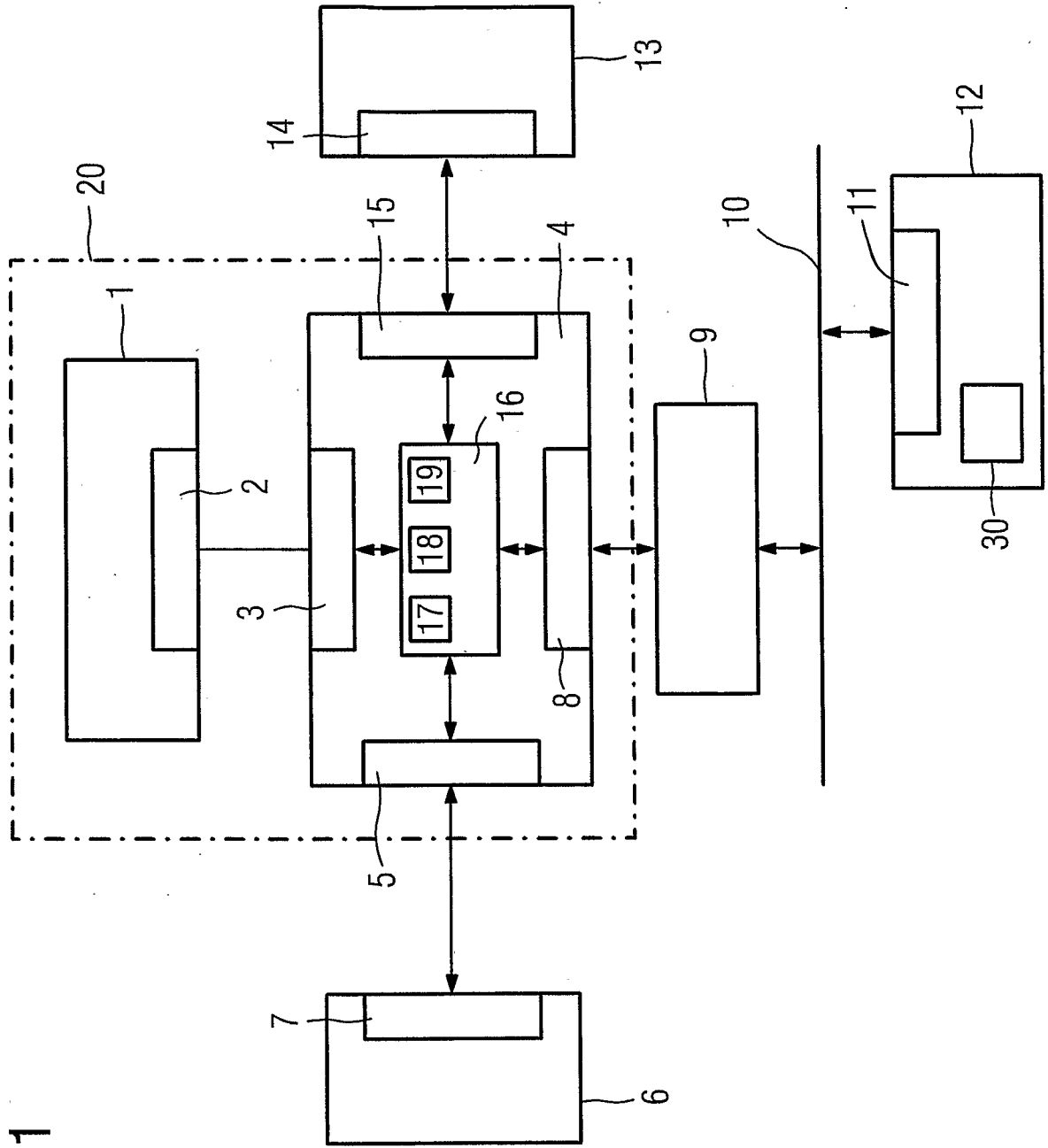
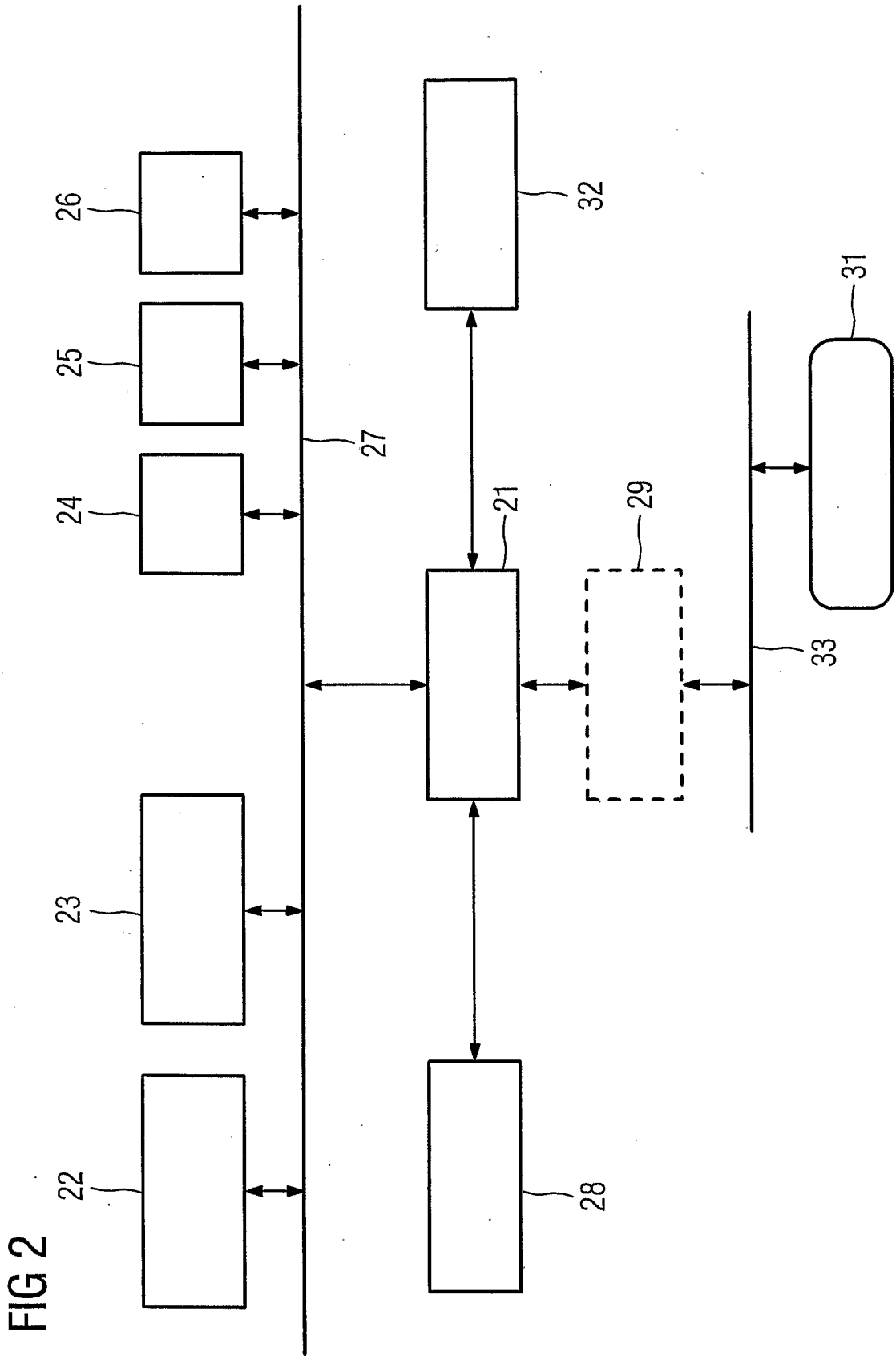**SUBSTITUTE SHEET (RULE 26)**

FIG 1

FIG 2

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
INV. G05B19/05

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 practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 02/23290 A2 (HAUNI WERKE KOERBER & CO KG [DE]; RATHJEN ANDREAS [DE]; RICHTER DIRK []) 21 March 2002 (2002-03-21) page 3, paragraph 2 - page 3, paragraph 3 page 16, paragraph 4 - page 16, paragraph 4 page 17, paragraph 1 - page 17, paragraph 1 figure 5	1-7
A	US 6 151 625 A (SWALES ANDREW G [US] ET AL) 21 November 2000 (2000-11-21) cited in the application abstract figure 2	1-7

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| X | Further documents are listed in the continuation of Box C. | X | See patent family annex. |

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 October 2006	15/11/2006

| Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016 | Authorized officer Dörre, Thorsten |

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 02/31608 A2 (SCHNEIDER AUTOMATION [US]) 18 April 2002 (2002-04-18) abstract figure 1	1-7
A	EP 1 256 861 A1 (ROCKWELL AUTOMATION TECH INC [US]) 13 November 2002 (2002-11-13) abstract figure 1	1-7

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
WO 0223290	A2	21-03-2002	AU	1049902 A	26-03-2002
			CN	1459053 A	26-11-2003
			DE	10046133 A1	28-03-2002
			EP	1328853 A2	23-07-2003
			JP	2004522213 T	22-07-2004
			US	2004015383 A1	22-01-2004
US 6151625	A	21-11-2000	CA	2271145 A1	18-03-1999
			EP	0937289 A1	25-08-1999
			JP	2001506104 T	08-05-2001
			US	2002152289 A1	17-10-2002
			WO	9913418 A1	18-03-1999
			US	6061603 A	09-05-2000
			US	6732191 B1	04-05-2004
			US	2001003804 A1	14-06-2001
			US	6282454 B1	28-08-2001
WO 0231608	A2	18-04-2002	AT	316260 T	15-02-2006
			CA	2393340 A1	18-04-2002
			DE	60116788 T2	24-08-2006
			EP	1354249 A2	22-10-2003
			JP	2004511845 T	15-04-2004
			MX	PA02005583 A	18-09-2002
			US	6640140 B1	28-10-2003
EP 1256861	A1	13-11-2002	DE	60200210 D1	25-03-2004
			DE	60200210 T2	02-12-2004
			US	2002169850 A1	14-11-2002