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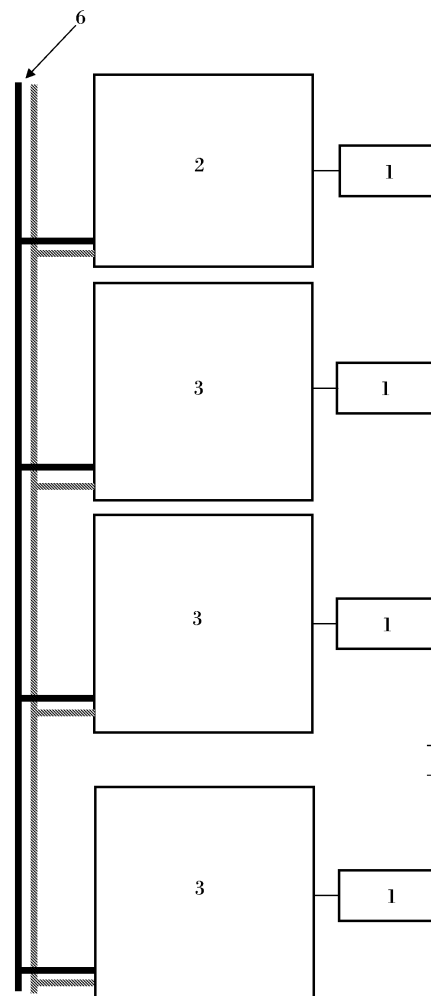
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(54) **Time switch**

(57) The present invention refers to a time switch that comprises at least one remote actuator (3) and a control device (2). The communication between said, at least one, remote actuator (3) and the control device (2) performed by a power line carrier communication link.

Additionally, the invention discloses a procedure for programming a remote actuator (3) that comprises the steps of sending a switching sequence to a remote actuator (3), and executing the switching sequence. A switching sequence is defined as a sequence of at least two manoeuvres of the remote actuator (3).



**FIG. 3**

## Description

### OBJECT OF THE INVENTION

[0001] The present invention relates to a time switch. Said time switch is designed to operate a number of devices, each one according to its own switching sequence, said operation been made with no additional wiring to communicate the time switch with the devices.

### BACKGROUND OF THE INVENTION

[0002] Time switches are known in the state of the art. Basic time switches allow switching on and switching off a device or a load according to a defined sequence. It is not possible to operate two different devices with two different switching sequences with the same time switch. Two different devices with two different switching sequences need two different basic time switches to operate correctly said devices.

[0003] Modern time switches allow operating simultaneously more than one device, each one with its own switching sequence. In this case, the time switch has two different circuits, the first one is the power circuit, used to energize the switching elements and the second one is the control circuit, used to provide the switching instructions to the switching elements.

[0004] The power circuit is connected to the power grid. The control circuits known in the state of the art are low voltage circuits decoupled from the power grid. Therefore, two different sets of wiring coexist on the time switch.

### BRIEF DESCRIPTION OF THE INVENTION

[0005] The invention, on a first aspect, relates to a time switch. According to the present invention said time switch comprises at least one remote actuator and a control device. The communication between the, at least one, remote actuator and control device is performed through a power line carrier communication link.

[0006] The power line carrier communication link used to connect the remote actuators and the control device permits to avoid additional wiring, since both remote actuators and control device are connected to the power grid.

[0007] Each remote actuator may comprise at least one switching element. A switching element may actuate on a single device, therefore, a remote actuator may operate on a number of devices.

[0008] Moreover, the control device may comprise at least one switching element. Therefore, the control device may act as a remote actuator.

[0009] The control device may comprise a memory configured to store at least a switching sequence for each switching element of all the remote actuators. A switching sequence must be understood in the present invention as a sequence of at least two manoeuvres of a switching

element.

[0010] A switching sequence may be, for example, a cyclic sequence of ON and OFF states with a defined period and an ON status length. A second example may be an ON pulse starting at a certain time, during a certain amount of time. The previous two switching sequence are described as two possible, and non-limiting, examples.

[0011] The control device may comprise a processor configured to schedule all the possible switching sequences of the switching elements. The scheduling process implies to analyze all the different switching sequences and decide how they can be implemented, taking into consideration the number of switching elements and the time periods of the different manoeuvres that must be performed. All the switching sequences are stored in the memory of the control device.

[0012] Each remote actuator may comprise a memory configured to store at least one switching sequence. The control device may store the switching sequences of all the switching elements, in order to manage them on a centralized manner. Similarly, the control device may send individual instructions or a whole set of instructions to the remote actuators. Said set of instructions is what has been defined previously as a switching sequence. The memory of the remote actuator is built to store said set of instructions.

[0013] Each remote actuator may comprise a processor configured to implement the switching sequence stored in the memory of the remote actuator. The control device schedules the switching sequences and sends the information to the remote actuator. Then, the processor of the remote actuator implements its own switching sequence. Said switching sequence may comprise manoeuvres on one or several switching elements of the remote actuator.

[0014] The time switch may be digital, that is, all the information is coded, sent and received in a binary format.

[0015] The communication between the remote actuators and the control device is performed through the power line. At the same time, the power line is used to feed the remote actuators and the control device. Therefore, no additional wiring is needed to operate the time switch of the invention.

[0016] On a second aspect, the invention refers to a procedure for programming an at least one remote actuator. Said procedure comprises the steps of sending a switching sequence to a remote actuator and executing said switching sequence. The switching sequence in this case defines a sequence of at least two manoeuvres of the remote actuator.

[0017] The procedure of the invention permits to have a time switch with several remote actuators that may operate autonomously, each one executing its own switching sequence.

[0018] The switching sequence may be repeated at regular intervals. The switching sequence therefore can be sent once and repeated periodically.

**[0019]** Alternatively, the switching sequence may be regularly sent to the remote actuator. In this case, the same, or a different switching sequence each time, may be sent on a regular basis.

**[0020]** The procedure may comprise a step of time synchronization of the, at least one, remote actuator. Said synchronization is performed to assure the operation of the time switch.

**[0021]** In order to include a new remote actuator, the procedure may comprise a step of recognition of a remote actuator by a control device, prior to the step of sending a switching sequence to a remote actuator. After the recognition step, remote actuators will execute instructions sent from the recognized control device, although instructions from other remote control units may be received, but not executed.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

**[0022]** To complement the description being made and for the purpose of aiding to better understand the features of the invention according to a preferred practical embodiment thereof, a set of drawings is attached as an integral part of said description, showing the following with an illustrative and non-limiting character:

Figure 1.- It shows an schematic view of the control device according to the present invention.

Figure 2.- It shows an schematic view of a remote actuator according to the present invention.

Figure 3.- It shows an schematic view of a remote switch according to the present invention.

### **PREFERRED EMBODIMENT OF THE INVENTION**

**[0023]** On the present embodiment of the invention, the time switch controls the operation of four different apparatus (1) placed on different locations on an industrial premises or a household.

**[0024]** The time switch comprises a control device (2) and three different remote actuators (3). Each remote actuator (3) comprises two different switching elements (4), although only one of them is used on the embodiment disclosed. The control device (2) comprises two additional switching elements (5). Only one of said switching elements (5) is used. Therefore, three apparatus (1) are controlled by three remote actuators (3), while the fourth apparatus (1) is controlled by the control device (2).

**[0025]** The control device (2) and the three remote actuators (3) are connected to the power line (6) in order to feed their internal circuits. The mains or power line (6) are connected in both cases to a power unit (7, 8) that comprises a coupling network (9, 10), designed to obtain from or to add the information to the power line (6), and a regulated power source (11, 12) to filter or stabilize the electricity coming for the power line (6) and feed a PLC transceiver (13) and control unit (14), in the case of the control device (2), or a PLC transceiver (16), in the case

of the remote actuator (3). Moreover, the power line (6) acts as a communication link between the control device (2) and the remote actuators (3). In order to send and receive instructions to and from the power line (6), both the control device (2) and the remote actuators (3) comprise a PLC transceiver (13, 15) designed to code and decode the information sent and received. Therefore, no additional wiring is needed to communicate the control device (2) with the remote actuators (3).

**[0026]** The control device (2) manages the operation of the time switch. Therefore, it comprises a memory (16) to store the switching sequence of any switching element (4, 5) of the time switch and a processor (17) to schedule the switching sequences stored on the memory (16). The switching sequences are introduced by means of a user interface unit (18) that comprises a display to show the information entered and the switching element (4, 5) and/or the remote actuator (3) to which said information applies, and a number of push-buttons to enter the information.

**[0027]** A switching sequence may be, for example, an ON/OFF commutation. A combination of ON/OFF commutations may be considered too as a switching sequence. Two particular cases of the latter are, for example, a cycle or a pulse switching sequence.

**[0028]** A cycle switching sequence corresponds to a periodic sequence of ON and OFF stages, characterised by the whole period duration and the ON stage duration, for example.

**[0029]** A pulse switching sequence, on the other hand, corresponds to an ON stage starting at a defined time, and lasting a certain amount of time.

**[0030]** The switching sequence may be repeated at regular intervals by the switching element (4, 5). In this case, the switching element (4, 5) may be considered autonomous since, while it is performing the switching sequence received, its action does not depend on the control device (2).

**[0031]** Alternatively, the control device (2) may regularly send a switching sequence to the remote actuator (3). Two consecutive switching sequences may be equal or different, depending on the schedule programmed on the control device (2).

**[0032]** If the switching sequence consists on an ON or OFF commutation, with the following manoeuvre after at least one minute, the control device (2) may send the corresponding order to the remote actuator (3) and said order is executed immediately by the remote actuator (3).

**[0033]** Alternatively, the control device (2) may send a complete set on instructions grouped on a switching sequence to a remote actuator (3). Each remote actuator (3) comprises a processor (19) and a memory (20) designed to store, manage and execute the switching sequence received.

**[0034]** The memory (20) of each remote actuator (3) stores the switching sequence received. It may store a switching sequence for the two switching elements (4) that the remote actuator (3) comprises. The processor

(19) of the remote actuator (3) is configured to execute the switching sequence stored on the memory (20).

[0035] The control device processor (17) and the remote actuator processors (19) perform two different activities. The control device processor (17) is responsible to schedule the different switching sequences, that is, to choose the better option to transmit the different manoeuvres that build a switching sequence to the corresponding switching element (4, 5). Two main options exist, the first one is to send individual manoeuvres, one at a time, and the second one is to send the complete switching sequence to the remote actuator (3). One of the criteria used to choose between both options is the time gap between two consecutive manoeuvres. If the time gap is smaller than one minute, it may be needed to send the complete switching sequence to the remote actuator (3). In this case, the remote actuator (3) receives the switching sequence and executes said switching sequence. The remote actuator processor (19) in this case is configured to execute the instructions received. As it has been commented previously, said instructions have been scheduled by the control device processor (17).

[0036] The invention further discloses a time synchronization step of the remote actuator (3). The control device (2) comprises a clock (21), whose information is sent to the remote actuators (3). The remote actuators (3) use this information to correct the time estimate that they have calculated. Having this information and performing the commented correction, the switching sequence will be executed on time and with no delay. The time synchronization step may be executed every minute, every five minutes, every ten minutes or according to any other defined period.

[0037] The invention disclosed comprises a recognition step, performed by the control device (2) and any new remote actuator (3) that is included on the time switch. Once the remote actuator (3) has been properly accepted or recognized by the control device (2), the remote actuator (3) will accept instructions only from its control device (2), therefore, two different control devices (2), that is, two time switches, may operate on the same power line (6) grid with no interference.

[0038] The recognition step is performed sending an identification code of the remote actuator (3) to the control device (2) and an identification code of the control device (2) to the remote control (3). Said identification codes are stored and the remote actuators (3) or control device (2) will only accept instructions if they are sent by an accepted device (2, 3). The device acceptance is checked according to the identification code sent with the instructions. A user interface unit (22) included on the remote actuator is used to performed the recognition step. Said user interface unit (22) comprises a recognition press-button to start the recognition step and a LED that lights when the recognition step has finished successfully. In any other case, the LED blinks. The control device user interface unit (18) comprises an analogous recognition press-button to complete the recognition step.

[0039] In view of this description, a person skilled in the art will understand that the embodiments of the invention that have been described can be combined in many ways within the object of the invention. The invention has been described according to several preferred embodiments thereof, but it will be evident for a person skilled in the art that many variations can be introduced in said preferred embodiments without exceeding the scope of the claimed invention.

## Claims

1. Time switch **characterized in that** it comprises at least one remote actuator (3) and a control device (2), said, at least one, remote actuator (3) and control device (2) comprising a power line carrier communication link.
2. Time switch according to claim 1, **characterized in that** the, at least one, remote actuator (3) comprises at least one switching element (4).
3. Time switch according to any of claims 1-2, **characterized in that** the control device (2) comprises at least one switching element (5).
4. Time switch according to any of claims 1-3, **characterized in that** the control device (2) comprises a memory (16) configured to store at least a switching sequence for the, at least one, switching element (4) of the, at least one, remote actuator (3), being the switching sequence a sequence of at least two manoeuvres of the switching element (4).
5. Time switch according to claim 4, **characterized in that** the control device (2) comprises a processor (17) configured to schedule the, at least one, switching sequence of the, at least one, switching element of the, at least one, remote actuator (3), stored said, at least one, switching sequence in the memory of the control device (16).
6. Time switch according to any of claims 4-5, **characterized in that** the, at least one, remote actuator (3) comprises a memory (20) configured to store at least one switching sequence.
7. Time switch according to claim 6, **characterized in that** the, at least one, remote actuator (3) comprises a processor (19) configured to implement the switching sequence stored in the memory of the, at least, remote actuator (20).
8. Time switch according to any of claims 1-7, **characterized in that** time switch is digital.
9. Time switch according to any of claims 1-8, **characterized in that**

**terized in that** the, at least one, remote actuator (3) and the control device (2) are connected to the power line (6).

10. Procedure for programming a at least one remote actuator (3), **characterized in that** it comprises the steps of: 5
  - sending a switching sequence to a remote actuator (3), 10
  - executing the switching sequence, being the switching sequence a sequence of at least two manoeuvres of the remote actuator (3).
11. Procedure according to claim 10, **characterized in that** the switching sequence is repeated at regular intervals. 15
12. Procedure according to claim 10, **characterized in that** a switching sequence is regularly sent to the remote actuator (3). 20
13. Procedure according to any of claims 10-12, **characterized in that** it comprises a step of time synchronization of the, at least one, remote actuator (3). 25
14. Procedure according to any of claims 10-13, **characterized in that** it comprises a step of recognition of a remote actuator (3) by an control device (2), prior to the step of sending a switching sequence to a remote actuator (3). 30
15. Procedure according to any of claims 10-14, **characterized in that** the switching sequence comprises at least one ON stage and one OFF stage. 35

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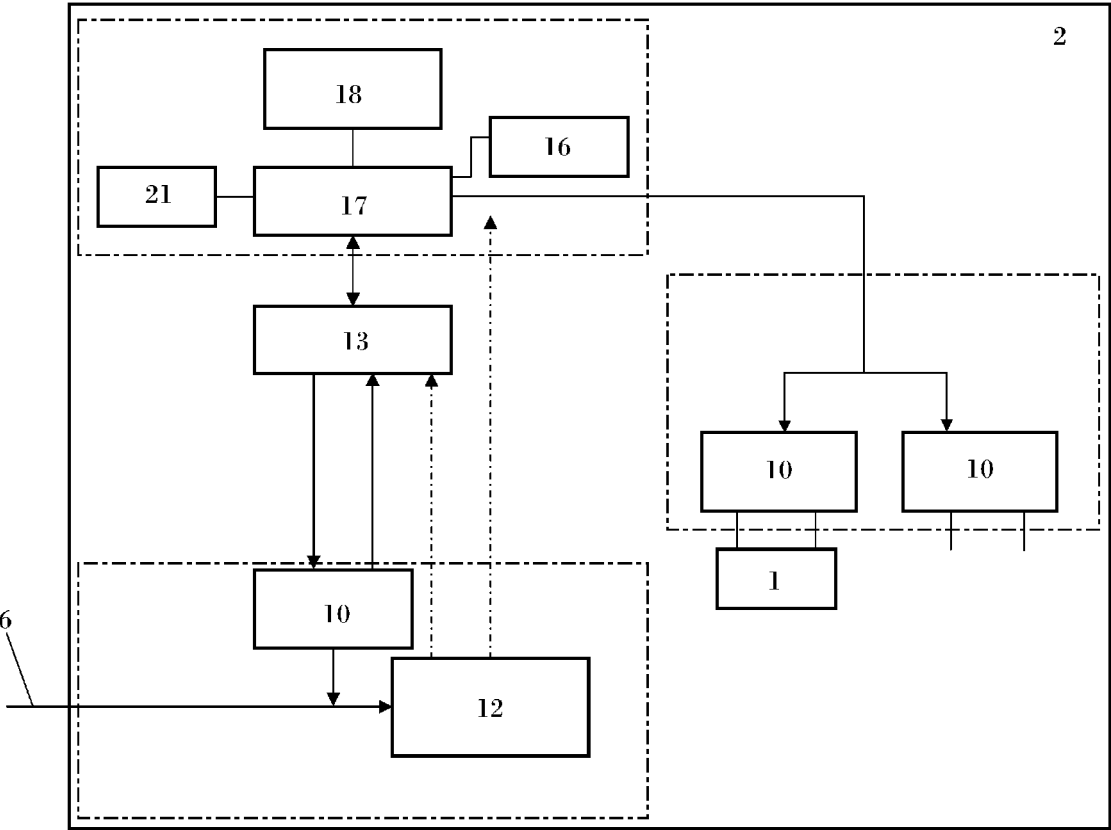


FIG. 1

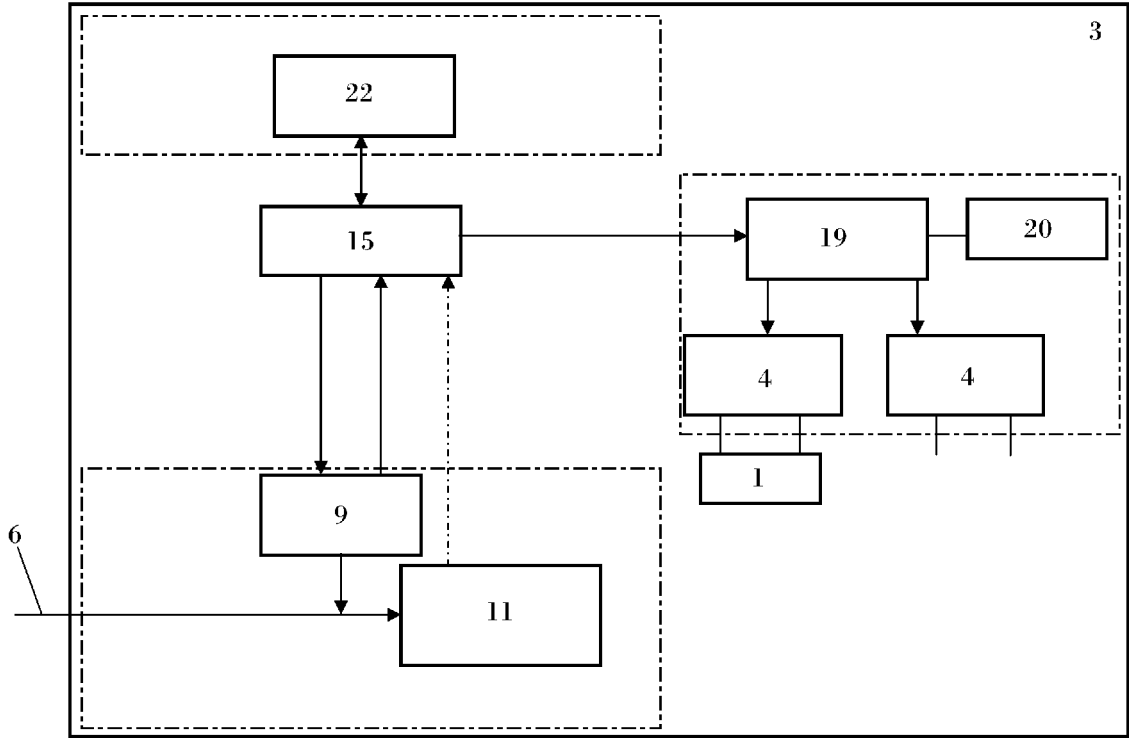


FIG. 2

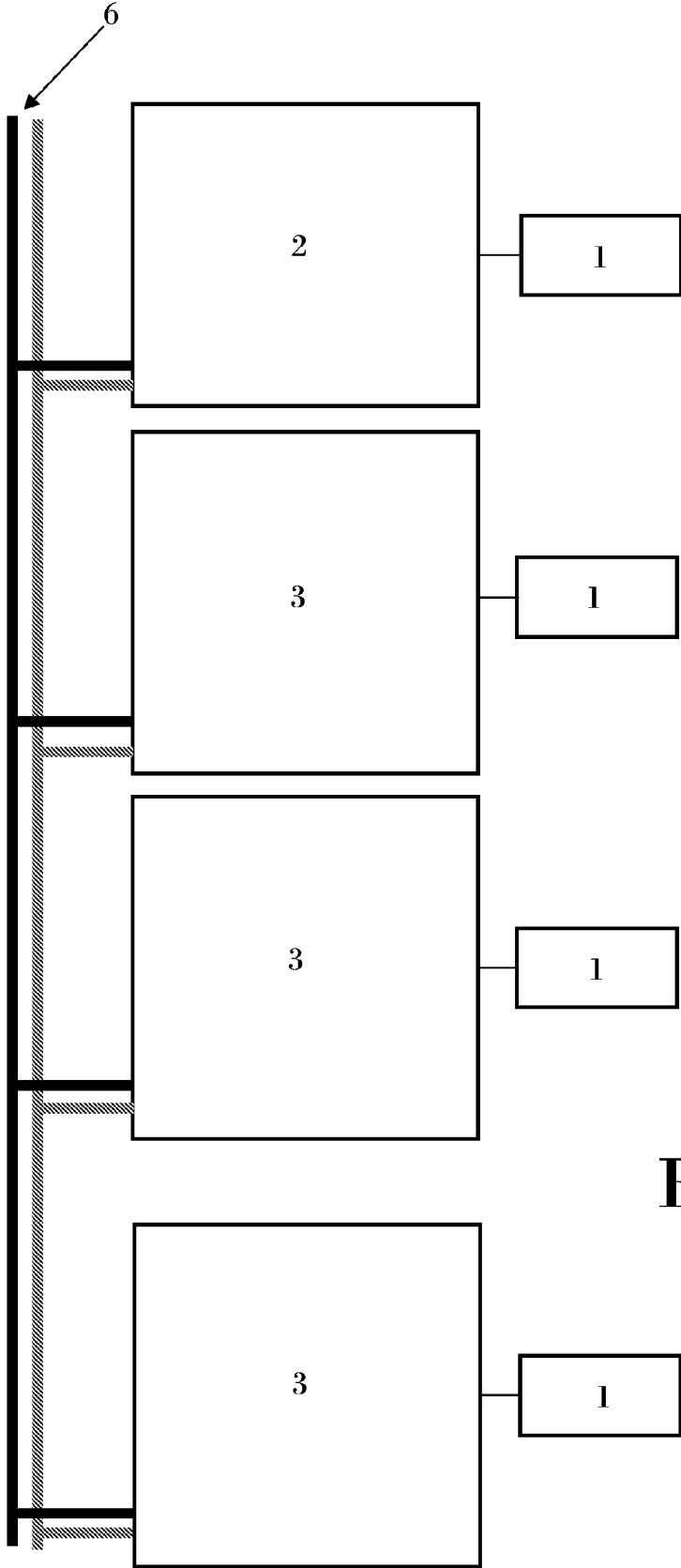


FIG. 3



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Application Number  
EP 09 15 4087

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                               |                                                  |                                         |
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| <p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone<br/>Y : particularly relevant if combined with another document of the same category<br/>A : technological background<br/>O : non-written disclosure<br/>P : intermediate document</p> <p>T : theory or principle underlying the invention<br/>E : earlier patent document, but published on, or after the filing date<br/>D : document cited in the application<br/>L : document cited for other reasons<br/>.....<br/>&amp; : member of the same patent family, corresponding document</p> |                                                                                                               |                                                  |                                         |

EPO FORM 1503.03.82 (P04C01)

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