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MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
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(54) Title: COMMUNICATION SYSTEM BETWEEN THE DOOR AND THE BODY OF THE OVEN

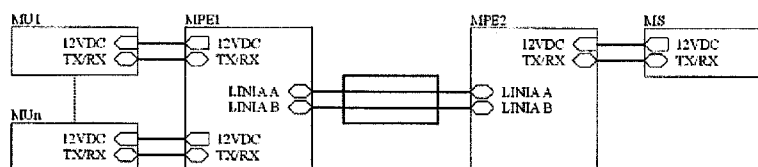


Fig. 2

(57) **Abstract:** Communication system between the door and the body of the oven, comprising an electronic control unit located in the body of the oven and an electronic user module located in the oven door, characterized in that the electronic control unit (MS) is electrically connected to at least one electronic user module (MU), wherein between the control unit (MS) and the user module (MU) there are the signal processing modules (MPE1 and MPE2) electrically connected to each other via a two-wire line (A, B) comprising the electrically connected, isolated from the body (2) of the oven (1) hinge housings (6) and metal components of the door (7).

Communication system between the door and the body of the oven

The present invention is a communication system between the door and the body of the oven, intended for bidirectional transmission of information between an electronic module that controls the operation of the appliance, located in its body, and electronic modules located in the door or door handle of the oven, receiving signals from the user of the appliance and transmitting these signals to the electronic control unit, and allowing for the transmission of signals from the electronic control unit, informing the user on status of the appliance.

In known solutions used in household appliances, communication between the door and the body of the appliance is enabled by the wireless transmission modules installed in the communicating components of the appliance or data are transmitted via dedicated wire bundle. The international patent WO2016105312A describes a dishwasher, which has a capacity touch sensor on the door cover. When the user touches the door cover, the sensor transmits a signal to the control system, which enables the door opening mechanism. The capacity touch sensor and the control unit are located in the appliance door. In the description of the solutions, the connection method between the sensor and the power supply system inside the body of the dishwasher is not indicated, thus it is assumed that they are connected via a dedicated wire bundle.

In the European patent application EP3136002 we find a description of the oven, wherein data between the door and the body of the appliance are transmitted via wireless communication Wi-Fi, Bluetooth or ZigBee. Power to the module installed in the door is supplied through a contact strip, which connects to the body of the oven with the door when the door is closed. Upon opening the door, there is no electrical connection between the door and the body of the appliance.

Data transfer between the body and the door via a dedicated wire bundle complicates the oven design, makes it impossible to dismantle the door, for example, to clean the appliance. In addition, wire bundle connecting the door and the body of the appliance is subject to repeated bending during door opening and closing, which significantly reduces the life of the connecting cables.

The use of wireless communication requires that electronic modules must be equipped with systems enabling wireless communication, which complicates their design. In order to supply power to the electronic module in the door of the oven, it is also required to install an additional power source, such as battery. In addition, wireless communication is more susceptible to interference and increases the congestion of ISM bands used by Wi-Fi, Bluetooth or ZigBee.

The purpose of the present invention is to develop a system for electronic modules communication, where one module is located in the

body and the other in the oven door, using the existing components and electrical connections of the oven.

This objective has been achieved by using the existing electric circuit to transfer data between the body and door of the oven, connected to the power source in the body of the oven and supplying power to electrical receivers in the door of the oven described in the Polish patent PL 227417.

Communication system between the door and the body of the oven according to the invention comprises an electronic control unit located in the body of the oven and an electronic user module that receives signals from the user and showing the user the status of the appliance, which is located in the door of the oven, and transmits signals to the control unit and also receives signals from the control unit. The control unit is supplied with an alternating voltage of 230 VAC, taken from the power grid, converted to DC voltage of 12 VDC, which is wire-transmitted to hinge housings insulated from the oven housing, mounted inside the body of the oven, connected by means of hinges to the oven door and further through a conductive element connecting the hinge housings to metal door components, electrically connected to the user electronic module. Communication system between the door and the body of the oven is characterized in that the electronic control unit is electrically connected to the at least one electronic unit of the user who can receive signals from the user to present his state of the device, between said control module and user module is enabled processing modules signals, electrically connected to each other via a two-wire power

line receivers in the oven door, using existing components of the oven, such as isolated from the body holder hinge, the conductive connecting elements of the hinges cast structural metal door. Signal processing units connected to each other create a communication path between the control units and the user electronic module in the oven door.

The solution according to the invention allows for the use of the existing components and electrical connections of the oven to transmit information. Thus, the functionality of the appliance is improved after minor changes in the design of the oven door.

The subject of this invention is described in detail on the embodiment in the figure, where fig. 1 shows a general view of the oven from the front with schematically indicated components of the communication system between the door and the body of the oven, figure 2 shows a block diagram of the communication system between the door and the body of the oven, and fig. 3 is a simplified schematic diagram of the data transmission path.

Oven **1** is equipped with an electronic unit controlling the operation of the appliance **MS** located in the body of the oven **2** and an electronic module **MU** in the door **3** closing the oven cavity, receiving signals from the user and transmitting them to the control unit **MS**, and at the same time, allowing the user to see on the module **MU** the appliance status sent by the module **MS**. The oven supply voltage is taken from the power grid 230 VAC and supplied to the control unit **MS**, where it is converted to a DC voltage

of 12 VDC and transmitted via electrical conductors **4 and 5** isolated from the housing of the oven **1** hinge housings **6** mounted inside the oven housing **1** on both sides of the door **3** closing the oven cavity. Hinge housings are hinged to the oven door **3**. Voltage from the hinge housings **6** is further transmitted via a conducting element connecting hinge housings **6** to metal door elements **7**, electrically connected by means of connecting elements **8** to the electronic module **MU** installed in the oven door. The circuit supplying the electronic control unit **MS** located in the body **2** of the oven **1** and an electronic module **MU** located in the door **3** of the oven, includes **MPE1** and **MPE2 signal processing modules**. Electronic modules **MPE1** and **MPE2** are electrically connected to each other via the two-wire line **AB** using the existing components of the oven **1** such as: hinge housings **6**, conductive side strips of the oven door **7** and the interconnecting conductive elements, and they create a communication path between the control units **MS** and the user module **MU**. Lines **A** and **B** allow transfer of both power from the control unit **MS** to the user module **MU**, as well as signals that serve as carriers of information, bidirectionally from the **MS** module to **MU** and vice versa. Transmission of power supply and information via the same electrical connection, lines **A** and **B** is achieved by applying on the supply voltage of 12V DC, an AC voltage VAC, which is the result of modulation of the carrier signal by the TX signal representing data being transmitted.

Power supply from the control unit **MS** through the filter system **L2**, **C4** goes to the line (connection) **A**. Line **B** is permanently connected to the 0V potential. In this way, between the lines **A** and **B** there is a constant potential difference, which for the DC gives **A** line voltage relative to line **B** of 12VDC. At the same time, elements **L2** and **C4** block signals of varying waveform, modulated transmission signal, in order to prevent passage of the signal towards the power source and to prevent interference in the supply system. On the **MPE1** system side, elements **L1**, **C1** filter out the varying component of the waveform applied on the supply signal so that, after passing through these elements a supply voltage of 12V is obtained, which then supplies the user module **MU**.

Digital data transmitted from the control unit **MS** pass on the **TX input** of the 3-state buffer **U2**. High state, logic state '1' unlocks the buffer and transfers to its output a carrier signal of a defined frequency. In a situation when there is a low state at the input, logic '0', the 3-state buffer is locked and the carrier signal is not transmitted to the buffer output. The buffer output is connected by means of **R2**, **C5** to line **A** of the transmission path through which the information signal is applied on a constant supply voltage gets to the input of the module **MPE1**. At the input of the module **MPE1** the signal, by means of **C3** is filtered out from the waveform constant component and the signal goes further to the input of **MU**, that on the basis of this signal produces binary data signal transmitted by the control unit **MS**.

if data is transmitted by the user module **MU**, the situation is similar, wherein data from the module **MU** goes to the input of the 3-state buffer **U1**, where the modulation is performed to generate an alternating signal of a defined frequency, which via elements **R1**, **C2** is further passed to line **A** of the transmission path. Similarly, this signal at the input of the module **MPE2** is filtered out by **C6** and further goes to the input of the module **MS**, where it is converted into a binary signal carrying data transmitted by the module **MU**.

Both **MS** control unit and the user module **MU** detect collision in the transmission to enable two-way communication in the half-duplex mode.

The list of designations in the drawing:

- 1 - oven,
- 2 - body of the oven,
- 3 - door of the oven,
- 4 - electrical connection between the hinge and the electronic module in line A in Fig. 3.
- 5 - electrical connection between the hinge and the electronic module in line B in Fig. 3.
- 6 - door hinge housing,
- 7 - metal component of the door,
- 8 - electrical connection between the metal component of the door and the electronic module **MU**.
- MS** - electronic module controlling the operation of the appliance,

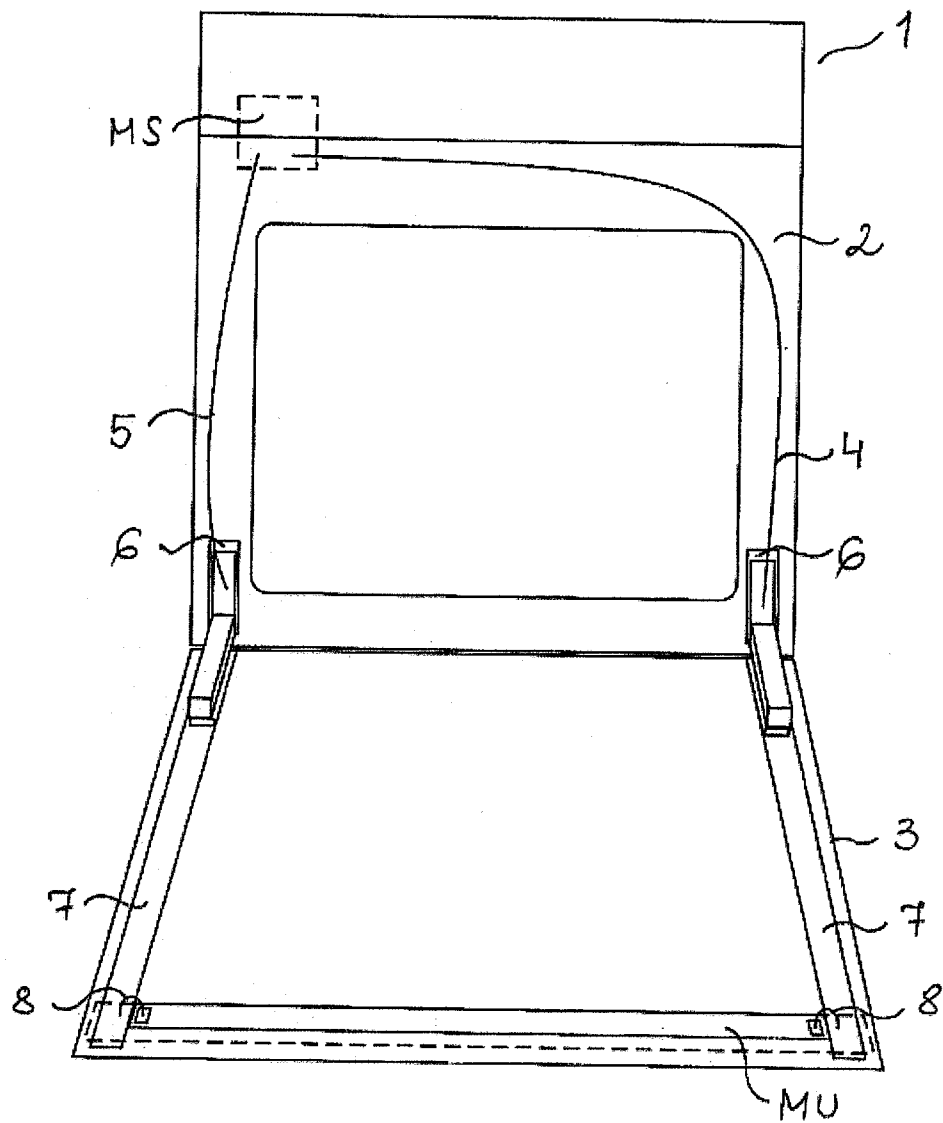
MU - electronic module receiving signals from the user and/or presenting data on the appliance status, provided by the MS unit.

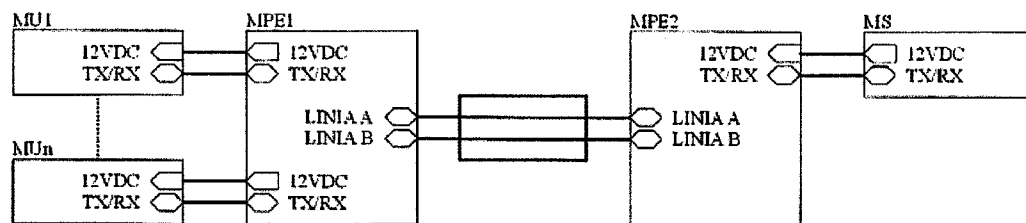
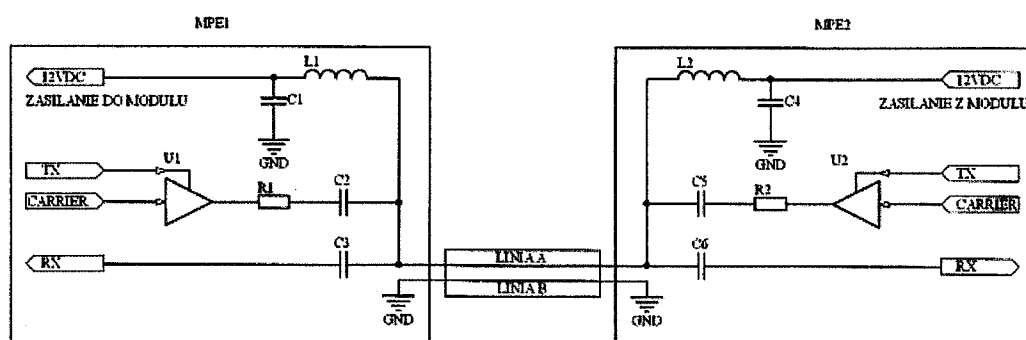
MPE1 and MPE2- signal processing modules.

A, B - two-wire electric line, connecting signal processing modules MPE1 and MPE2.

Claims

1. Communication system between the door and the body of the oven, comprising an electronic control unit located in the body of the oven and an electronic user module, wherein the control unit takes from the power grid AC voltage of 230 VAC and after conversion to DC voltage of 12 VDC, transmits it to the isolated from the oven housing hinge housings mounted inside the body of the oven hinged to the oven door and further through the conductive element connecting hinge housings to metal door components that are electrically connected to the user electronic module, **characterized in that** the electronic control unit (MS) is electrically connected to the at least one user electronic module (MU) in the door (3) of the oven (1), wherein between the control unit (MS) and the user module (MU) there are the signal processing modules (MPE1 and MPE2) connected to each other electrically via the two-wire line (A, B), transmit power supply and the applied signals carrying the transmitted data, forming with the signal processing modules (MPE1 and MPE2) a path of communication between the control unit (MS) and the user module (MU), wherein the two-wire line (A, B) comprises the electrically connected, isolated from the body (2) of the oven (1) hinge housings (6) and metal components of the door (7).

**Fig. 1**

**Fig. 2****Fig. 3**

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
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ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04B H05B

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 3 348 909 A1 (SAMSUNG ELECTRONICS CO LTD [KR]) 18 July 2018 (2018-07-18) paragraphs [0131] - [0134] -----	1
A	US 5 089 974 A (DEMEYER PIERRE [FR] ET AL) 18 February 1992 (1992-02-18) abstract -----	1



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INTERNATIONAL SEARCH REPORT

Information on patent family members

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