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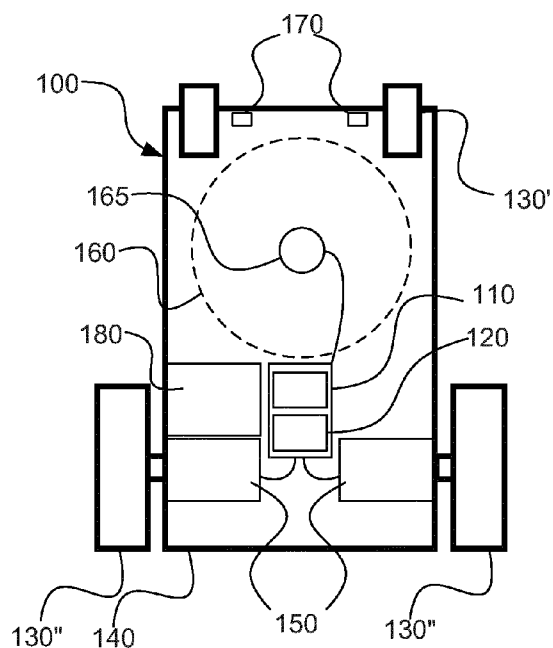


Fig. 1

(57) Abstract: A robotic work tool system comprising a robotic work tool (100), said robotic work tool (100) comprising a motor (150, 165) and a motor housing arranged to house said motor (150, 165), wherein said motor (150, 165) comprises a drive shaft extending through said motor housing and which robotic work tool system is characterized in that said motor housing comprises a treated textile arranged to enclose said drive shaft to seal the motor housing.

IMPROVED ROBOTIC WORKING TOOL

TECHNICAL FIELD

This application relates to a robotic work tool system for improved encasing of a motor housing, and in particular to a robotic work tool system for improved sealing of a motor housing.

BACKGROUND

Robotic work tools such as robotic lawnmowers commonly operate in outdoor environments and are thus affected by the weather such as rainfall. Some robotic work tools, for example robotic lawnmowers, may also be arranged to operate simultaneously as an irrigation or watering systems. At least, it would be beneficial if for example a football field could be cut and watered at the same time. Furthermore, many robotic work tools usually operate in dirty environments or are subjected to various debris, such as cut grass. As such, the robotic work tools should be cleaned regularly.

To enable an robotic work tool to be properly cleaned and also to operate outside irrespective of the current weather, the motor, being electric needs to be properly sealed to prevent water from coming into the motor housing, potentially damaging the motor.

Traditionally such encasings are done by rubber gaskets or grommets, however, as the motor shaft is rotating at high speed this causes friction which is unwanted as it increases the power consumption, increases the wear of the robotic work tool, reduces the efficiency of the robotic work tool and also may potentially lead to overheating.

There is thus a need for a robotic work tool system having a sealed motor housing that does not suffer from the disadvantages noted above.

SUMMARY

It is an object of the teachings of this application to overcome the problems listed above by providing a robotic work tool system comprising a robotic work tool, said robotic

work tool comprising a motor and a motor housing arranged to house said motor, wherein said motor comprises a drive shaft extending through said motor housing and which robotic work tool system is characterized in that said motor housing comprises a treated textile arranged to enclose said drive shaft to seal the motor housing.

In one embodiment the textile is a felt. In one embodiment the treated textile is oil-soaked.

In one embodiment, the motor is for driving a work tool of said robotic work tool. As work tools often operate at a high rotating frequency, they may generate more friction around a motor shaft when being arranged in a sealed housing. The teachings herein find particular use when sealing motor shafts that are designed to rotate at high revolutions per minute.

In one embodiment the robotic work tool is a robotic lawnmower, and in one such embodiment, the work tool is the grass cutter, for example a rotating blade. In one embodiment the robotic work tool is a farming equipment. In one embodiment the robotic work tool is a golf ball collecting tool. The robotic work tool may also be a vacuum cleaner, a floor cleaner, a street sweeper, a snow removal tool, a mine clearance robot or any other robotic work tool that is required to operate in a work area in a methodical and systematic or position oriented manner.

The inventors of the present invention have realized, after inventive and insightful reasoning, that the motor housing of a robotic work tool may simply and elegantly be sealed using a textile treated to become smoother, such as by oil coating or wax coating the textile, the textile for example being a felt. An oil-soaked felt is easy and cheap to both manufacture and to mount in a motor housing. It can also be exchanged in a simple manner, or for example, be maintained by simply soaking it in more oil during maintenance of the robotic work tool.

Other features and advantages of the disclosed embodiments will appear from the following detailed disclosure, from the attached dependent claims as well as from the drawings.

Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the [element, device, component, means, step, etc]" are to be interpreted openly as referring to at least one instance of the element, device,

component, means, step, etc., unless explicitly stated otherwise. The steps of any method disclosed herein do not have to be performed in the exact order disclosed, unless explicitly stated.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be described in further detail under reference to the accompanying drawings in which:

Figure 1 shows a schematic overview of a robotic work tool according to one embodiment of the teachings of this application;

Figure 2 shows a schematic view of a robotic working tool system according to one embodiment of the teachings of this application; and

Figure 3 shows a cut perspective view of a motor housing according to one embodiment of the teachings of this application.

DETAILED DESCRIPTION

The disclosed embodiments will now be described more fully hereinafter with reference to the accompanying drawings, in which certain embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided by way of example so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

Figure 1 shows a schematic overview of a robotic work tool 100 having a body 140 and a plurality of wheels 130. In the exemplary embodiment of figure 1 the robotic work tool 100 has 4 wheels 130, two front wheels 130' and the rear wheels 130''. At least some of the wheels 130 are drivably connected to at least one electric motor 150. It should be noted that even if the description herein is focussed on electric motors, combustion engines may alternatively be used possibly in combination with an electric motor.

In the example of figure 1, the rear wheels 130'' are connected to each an electric motor 150. This allows for driving the rear wheels 130'' independently of one another which, for example, enables steep turning.

The robotic work tool 100 also comprises a controller 110. The controller 110 is configured to read instructions from a memory 120 and execute these instructions to control the operation of the robotic work tool 100. The robotic work tool 100 further has at least one sensor 170, in the example of figure 1 there are two sensors 170, arranged to detect a magnetic field (not shown). The sensors are connected to the controller 110 and the controller 110 is configured to process any signals received from the sensors 170. The sensor signals may be caused by the magnetic field caused by a control signal being transmitted through a boundary wire (for more details on charging stations, control signals and boundary wires, see the description below with reference to figure 2).

The controller 110 is connected to the motors 150 for controlling the propulsion of the robotic work tool 100 which enables the robotic work tool 100 to service an enclosed area without leaving the area.

The robotic work tool 100 also comprises a work tool 160, which may be a grass cutting device, such as a rotating blade 160 driven by a cutter motor 165. The cutter motor 165 is connected to the controller 110 which enables the controller 110 to control the operation of the cutter motor 165. The robotic work tool 100 is, in one embodiment, a robotic lawnmower. As is known, to provide an efficient mowing of a lawn, the rotating blade 160 needs to be driven at a high frequency or revolutions per minute. This is also true for other robotic work tools having other work tools 160, driven by work tool motors 165.

The robotic work tool 100 may also have (at least) one battery 180 for providing power to the motors 150 and the cutter motor 165. Connected to the battery 180 are two charging connectors, for receiving a charging current from a charger (referenced 220 in figure 2) of the charging station (referenced 210 in figure 2). Alternatively, the batteries may be solar charged.

Alternatively, the robotic work tool and/or the cutter may be driven by an engine.

Figure 2 shows a schematic view of a robotic working tool system 200 comprising a charging station 210 and a boundary wire 250 arranged to enclose a working area 205, the working area 205 not necessarily being a part of the robot system 200.

The robotic work tool 100 of figure 2 is a robotic work tool 100 such as disclosed with reference to figure 1. A charging station 210 has a charger 220 coupled to, in this embodiment, two charging connectors 230. The charging connectors 230 are arranged to co-operate with corresponding charging connectors 185 of the robotic work tool 100 for charging the battery 180 of the robotic work tool 100.

The charging station 210 also has, or may be coupled to, a signal generator 240 for providing a control signal 255 (for more details see figure 3) to be transmitted through the boundary wire 250. As is known in the art, the current pulses 255 will generate a magnetic field around the boundary wire 250 which the sensors 170 of the robotic work tool 100 will detect. As the robotic work tool 100 (or more accurately, the sensor 170) crosses the boundary wire 250 the direction of the magnetic field will change. The robotic work tool 100 will thus be able to determine that the boundary wire has been crossed.

To protect the cutter motor 165, and possibly also the motor 150 or other motor(s) comprised in the robotic work tool, from water both during operation and also during maintenance such as washing, the cutter motor 165 is encased in a housing 310. Figure 3 shows a cut perspective view of such a motor housing 310 according to one embodiment of the teachings of this application. The cutter motor 165 is encased in the motor housing 310 and a drive shaft 155 extends from the cutter motor 165 out through the housing 310. The drive shaft will rotate at high speed during operation and would therefore suffer from a high friction were it to be sealed using for example a rubber O-ring. However, the inventors have realized that by sealing the opening for the drive shaft 155 with a treated textile 320 the motor housing 310 may be sealed without suffering from the disadvantages associated with a high friction as discussed in the background section. The textile 320 is treated, by for example being lubricated, to reduce the friction, but also to impregnate the textile to seal the housing 310.

Examples of such textiles 320 are felt, wool and nylon.

In one embodiment the textile 320 is treated by being wax-coated. In one embodiment the textile 320 is treated by being oil-soaked. In one embodiment the textile 320 is an oil-soaked felt. In one embodiment the oil is a mineral oil. In another embodiment the oil is a synthetic oil. In one embodiment, the oil is a semi-synthetic oil.

As can be seen in figure 3, the treated textile 320 is arranged to enclose the drive shaft 155 and the treated textile 320 creates a barrier for any water so that the water can not get into the motor housing 310, thereby sealing the motor housing 310.

To allow any entrapped water or humidity to escape the motor housing 310 a one-way air filter 330 may be arranged in the motor housing 310.

By encasing the cutter motor 165 (and possibly the motor 150 or other motor(s)) in (each) a motor housing 310, the cutter motor 165 may be made from non-stainless steel components, thereby reducing the cost of the cutter motor 165.

Other parts of the housing 310 that need to be sealed, such as an opening for cabling and/or a top lid 350, may be sealed by rubber grommets and gaskets 355.

The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims.

CLAIMS

1. A robotic work tool system (200) comprising a robotic work tool (100),
said robotic work tool (100) comprising a motor (150, 165) and a motor housing (310)
arranged to house said motor (150, 165), wherein said motor (150, 165) comprises a
5 drive shaft (155) extending through said motor housing (310) and which robotic work
tool system (200) is characterized in that said motor housing (310) comprises a treated
textile (320) arranged to enclose said drive shaft (155) to seal the motor housing (310).
2. The robotic work tool system (200) according to claim 1, wherein said
10 textile (320) is a felt.
3. The robotic work tool system (200) according to claim 1 or 2, wherein
said treated textile (320) is oil-soaked.
- 15 4. The robotic work tool system (200) according to any preceding claim,
wherein said motor (165) is for driving a work tool (160) of said robotic work tool
(100).
5. The robotic work tool system (200) according to claim 4, wherein said
20 motor (165) is a cutter motor (165) and said work tool (160) is a rotating blade (160).
6. The robotic work tool system (200) according to any preceding claim,
wherein said robotic work tool (100) is a robotic lawnmower.

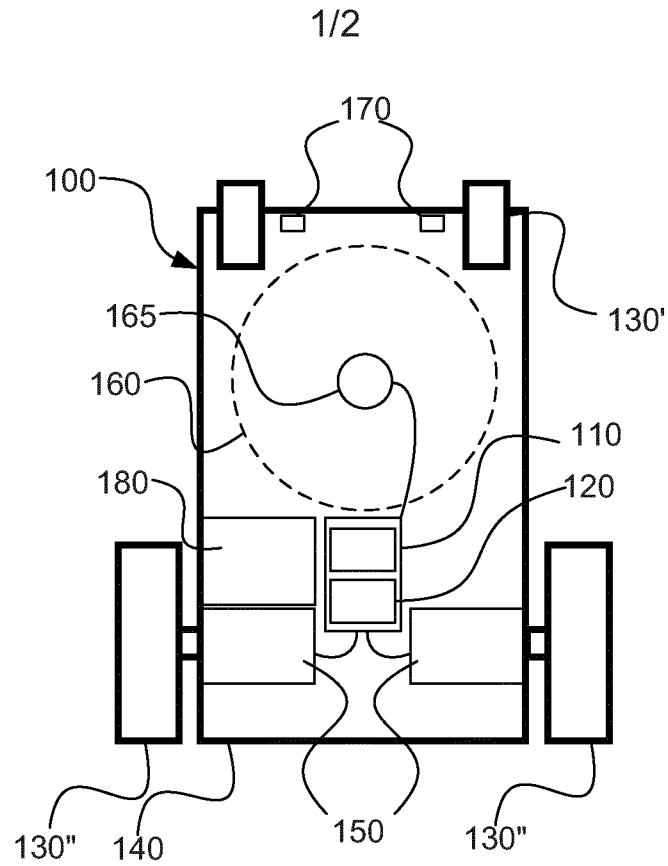


Fig. 1

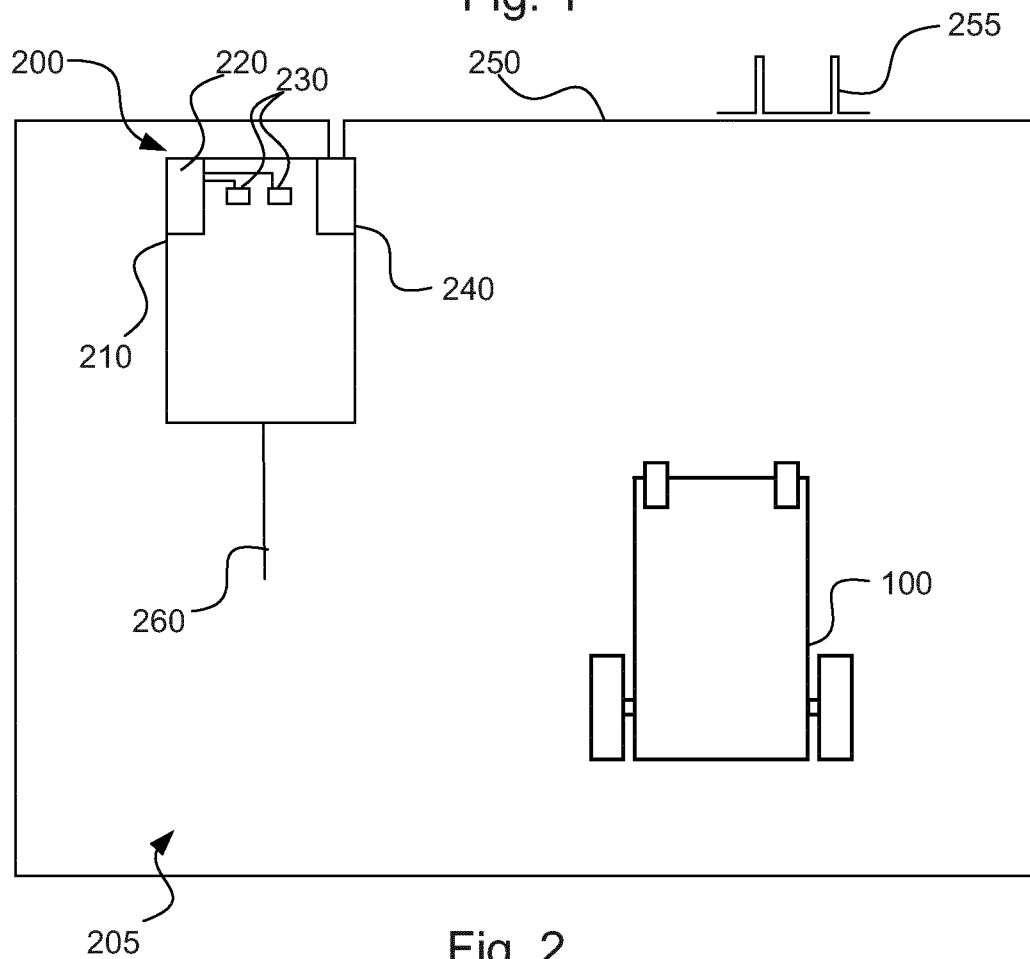


Fig. 2

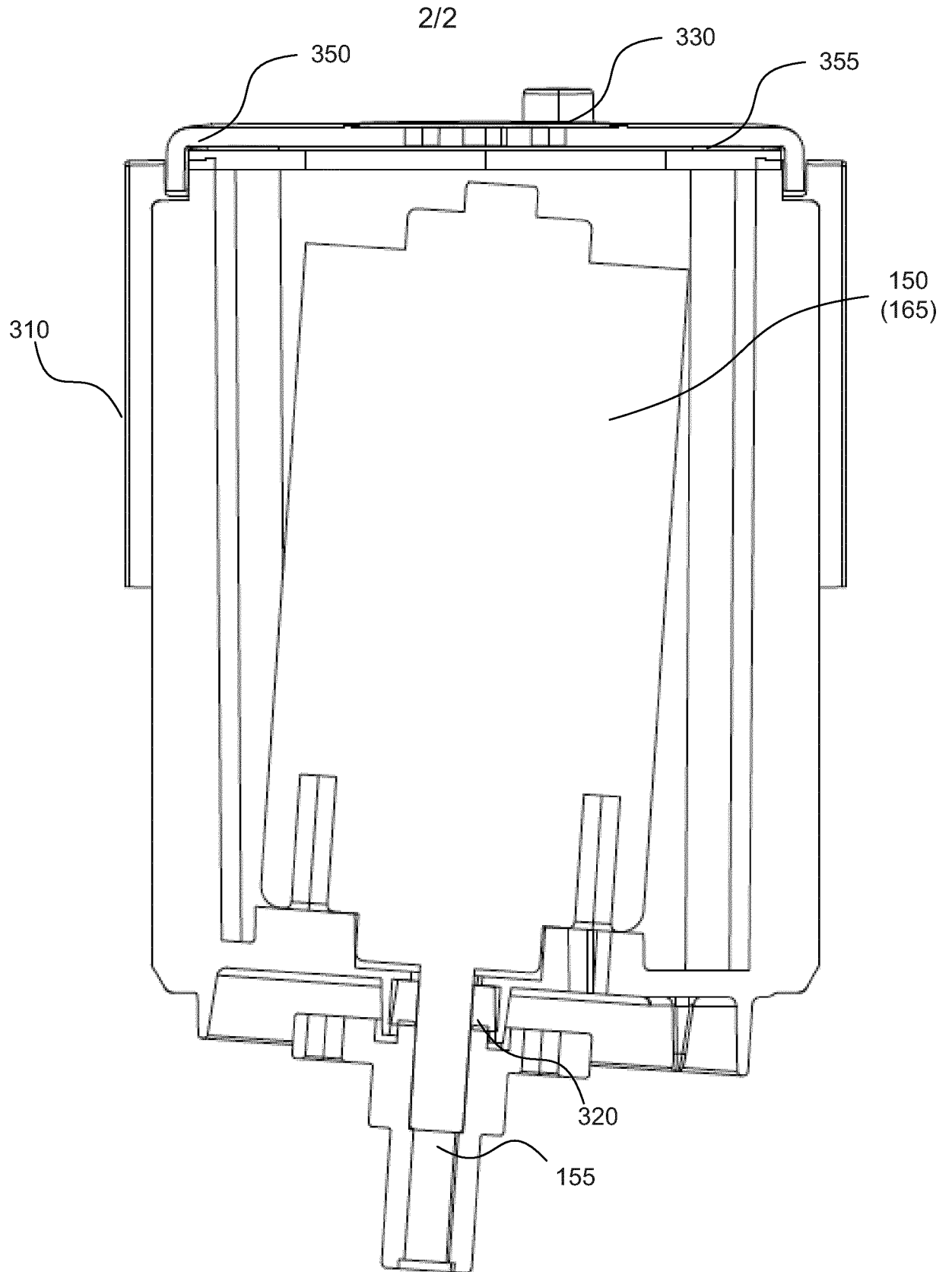


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER		
INV.	B60L1/00 A01D34/00	B60L3/00 A01D69/02
	B60L8/00 H02K5/124	B60L11/18 B60L15/20
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) B60L A01D G05D H02K		
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.
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☒ Further documents are listed in the continuation of Box C. ☒ 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 application or patent 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 12 January 2015		Date of mailing of the international search report 26/01/2015
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Törgyeges, Szabolcs

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International application No
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