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[Continued on next page]

(54) Title: POWER SUPPLY AND CONTROL CIRCUIT FOR MOTOR-DRIVEN CONVEYING ROLLERS

(57) Abstract: The invention is intended for industry as component of cargo conveyors. In it the relevant commutation electronics is located outside the roller body. The invention provides that only four wires pass through the axial element for easy assembling, using four-terminal connectors. Roller (1) has a hollow body (3), in which an electric motor (4) is located, coupled to the body by driving and torque transferring (5). A cable (6) with terminals (7) from the coils (8) of the motor (4) and a first-potential terminal (9) powers the position sensors (10). Power to sensors is applied by first (9) and second-potential (12). The sensor signal terminals (11) are connected to a digital encoding device (17), powered by the first (9) and second (12) potential. This encoding device has one common encoded output (19) connected to the first potential terminal (9).

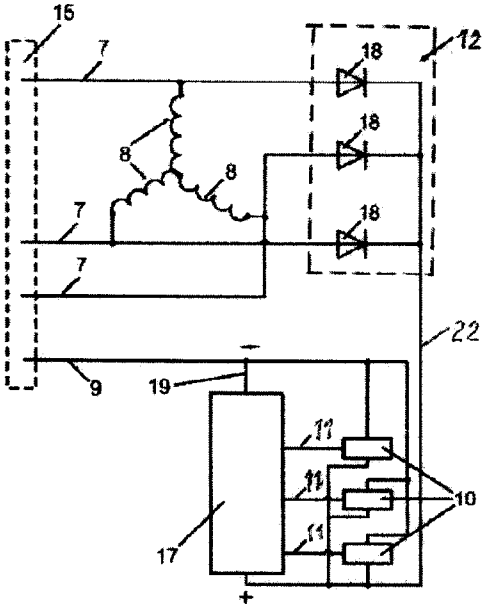

Fig. 5

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POWER SUPPLY AND CONTROL CIRCUIT FOR A MOTOR-DRIVEN CONVEYING ROLLER

TECHNICAL FIELD

The invention relates to a power supply and control circuit for a motor-driven conveying roller, which will find a broad application in industry, and more specifically as a major component of conveyors designed for conveying various cargo and/or products.

BACKGROUND ART

It is known from EP 1671901 that there exists a circuit for the supply of power and for controlling of a conveyor roller, driven by an electric motor, which circuit includes a hollow body, in which an electric motor is located, and where the hollow body rotates on an axis. The electric motor is coupled to the roller body by components used to drive the said roller body and to transfer torque, and by a power supply cable supplying power to the electric motor, and by at least two, and preferably three position sensors. An electronic commutation device is also provided, which electronic device may be incorporated in the roller or in the electric motor, or may be an external device. The position sensors are designed to generate signals related to the position of the stator in relation to the position of the rotor of the electric motor. The used electric motor is of the brushless three-phase type with an internal rotor. The bearing element of the electric motor, which represents a hollow shaft component, usually is integrated with a cable and a connector. The connector is designed to connect the electric motor to the control device. The connector incorporates three connecting terminals to the coils, two terminals for supplying power to the position sensors, as well as one output signal terminal for each position sensor. Thus, the number of terminals used in the connector amounts to eight, which is exceptionally impractical and results in a number of deficiencies of the known conveying roller driven by an electric motor; these deficiencies are related to difficult assembly and a lack of assembly space. Thus, in a version using an external commutation device, the main deficiency is related to limitations on the selection of the power output of the electric motor depending on the thickness of the power supply wires and the large number of terminals, as described above, and to the maximum admissible assembly orifice for the assembly of the hollow shaft component of the bearing element of the electric motor to the supporting element of the conveyor. With the option with an

internal commutation device, higher operational loads result in the transfer of a substantial quantity of heat into the roller body from the electric motor located therein, which heat cannot be discharged to a sufficient degree because of the encapsulation of the roller. This substantially limits the admissible operational loads.

SUMMARY OF THE INVENTION

The problem to be solved by the invention is to create a circuit for power supply and control of a conveying roller driven by an electric motor, which would allow the use of high-power electric motors while the dimensions of the rollers and of the bearing and connecting elements remain unchanged.

The problem is solved by a power supply and control circuit for a motor-driven conveying roller, where the conveying roller incorporates a hollow body of the roller rotating on an axis. In the hollow body an electric motor is incorporated and coupled to the interior of the hollow body of the roller by elements driving the roller body and transferring torque. In the hollow body a cable is also incorporated with the respective terminals, connected to the connector, from the coils of the electric motor, and with one terminal for first potential for supplying power to the position sensors with signal outputs. According to the invention, the number of position sensors with signal outputs may be at least one. Position sensors are supplied with power from the first potential terminal and by the second potential. This second potential is generated by an additional circuitry, connected to at least one of the coils of the electric motor with the objective to provide for the second potential.

It is provided for the output signals of the position sensors to be connected to a digital encoding device, supplied with power by the first and the second potential, which digital encoding device has one common encoded signal output, connected to the first potential used for supplying power to the sensors. The electric characteristics of the first potential are changed by the encoded signal.

The circuitry used to generate the second potential includes at least one rectifying element.

The encoded signal generates information from the position sensors as well as additional information about the characteristics of the motor, in the digital encoding device.

One of the embodiments provides that the signal outputs of the position sensors to have terminals, incorporated in the cable.

The advantages of the invention are that the power supply for the position sensors as well as the specific manner of connection of the digital encoding device allows the electronics, required for controlling and commutation of the motor, to be located outside the roller body using a connector with a smaller number of terminals, thus removing the electronic circuit out of the temperature influence of the electric motor. This allows both higher operational loads and eases the cooling of the electronics. According to the invention, it becomes possible to pass through the hollow shaft component of the conveying roller only four wires – the three phases of the electric motor and one power supply terminal to the position sensors – thus assuring the application of widely used four-terminal connectors and an easier assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 represents a partial general view of the conveying roller powered according to the present invention;

Fig. 2 – a longitudinal section of the conveying roller shown on Fig. 1;

Fig. 3 – general power supply and control circuit diagram of a brushless electric motor of a conveying roller, according to this invention;

Fig. 4 – connection circuit diagram of the electric motor and of the position sensors power supply, according to the first embodiment of this invention;

Fig. 5 – example for creating a second positive potential for supplying power to the position sensors using the three coils of the electric motor;

Fig. 6 – example for creating a second negative potential for supplying power to the position sensors from the three coils of the electric motor;

Fig. 7 – example for creating a second positive potential for supplying power to the position sensors from the common point of the coils of the electric motor;

Fig. 8 - example for creating a second negative potential for supplying power to the position sensors from the common point of the coils of the electric motor;

DESCRIPTION OF THE EMBODIMENTS

A power supply and control circuit for a motor-driven conveying roller, which circuit includes a hollow body 3 of the roller 1, rotating on the axis 2, in which hollow body

3 an electric motor 4 is located as shown on fig. 1 and fig. 2. The electric motor 4 is coupled to the interior of the hollow body 3 of the roller 1 by elements 5 for driving the roller body and transferring torque. A cable 6 is provided, fitted with connector 15, to which the respective terminals 7 of the coils 8 of the electric motor 4 are connected together with one terminal for a first potential 9, used to supply power to the position sensors 10, as shown on fig. 3 to fig. 8. The provided position sensors 10 have signal outputs 11. According to the invention the number of position sensors 10 with signal outputs 11 may be at least one. The position sensors 10 are supplied with power from the first potential 9 and second potential 22 terminals, where the said second potential is generated by an additional circuitry 12, used to provide the second potential and connected to at least one of the coils 8 of the electric motor 4. The electric motor 4 may be selected out of the known types – brushless, with two or more coils.

The second potential 22 may be generated by the terminals 7 of the coils 8 of the electric motor 4, as shown of fig. 3 to 6, or from the common point 13 of these coils 8, as shown on fig. 7 and fig. 8.

In the implementation version shown on fig. 4, the cable 6 incorporates the terminals 7 of the coils 8 of the electric motor 4, the first potential 9 terminal, and terminals 14 from the signal outputs 11 of the position sensors 10. Respectively, all the said terminals 7, 9 and 14 are connected to the connector 15, which in its turn is connected to an external commutation device 16, as shown on fig. 3 and fig. 4.

According to this invention, the second potential 22, together with the first potential 9, is used to supply power to the position sensors 10. The position sensors 10 may be of various types, for instance Hall-effect sensors, solid magneticresistors, as well as optical, capacitance, laser or other sensors, suitable for this purpose.

According to the preferred embodiment of the invention, the signal outputs 11 of the position sensors 10 are connected to a digital encoding device 17, supplied with power by the first (9) and second (22) potential, where the second potential 22, as shown above, is generated by the additional circuitry (12), connected to at least one of the coils 8 of the electric motor 4 with the purpose to provide second potential 22. This is illustrated on fig. 3 and on fig. 5 to fig. 8. The digital encoding device 17 has one common encoded signal output 19, connected to the terminal of the first potential terminal 9 used to supply power to the sensors 10, and that the electric characteristics of the first potential (9) are changed by the encoded signal.

Various methods – amplitude, frequency, phase, synchronous or asynchronous encoding – may be used in the digital encoding device 17 for encoding and superimposing the signal on the first potential.

The number of terminals, which must be connected to the connector 15 for establishing a link to the external commutation device 16 is substantially reduced by connecting the signal outputs 11 from the position sensors 10 to the digital encoding device 17. Thus, even if three position sensors 10 are used, the total number of terminals, provided for connecting to connector 15, is four, including the three terminals 7 from the coils 8 of the electric motor 4.

It is suitable to have the circuitry 12 providing a second potential 22 include at least one rectifying element 18, as illustrated on fig. 3 to fig. 8. The rectifying elements 18 may be diodes, transistors or other components known and used by person skilled in the art. According to this invention, the encoded signal generates information about the position sensors, as well as additional information about the electric motor characteristics.

The options to create a second potential 22 are illustrated in more details on fig. 3, 5, 6, 7 and 8. Thus, for instance, the creation of a negative second potential 22 for supplying power to position sensors 10 is shown on fig. 3 and fig. 6. This negative potential is formed under the condition that the external commutation device 16 allows at any time connecting to a "minus" terminal of at least one of the coils 8 of the electric motor 4. At that, the first potential 9 supplied through connector 15 is positive. There are three rectifying elements 18 connected to each of the coils 8 of the electric motor 4 in this example.

The creation of a positive second potential 22 for supplying power to position sensors 10 is shown in a different embodiment illustrated on fig. 5. This positive potential is formed under the condition that the external commutation device 16 allows connecting to a "plus" terminal at any time of at least one of the coils 8 of the electric motor 4. At that, the first potential 9 supplied through connector 15 is negative. There are three rectifying elements 18 connected to each of the coils 8 of the electric motor 4 in this example.

It is possible to create a negative second potential 22 for supplying power to position sensors 10 by using a single rectifying element 18, connected to the common point of the coils 8 of the electric motor, as shown on fig. 7. This negative potential is created under the condition that the external commutation device 16

provides continuous commutation of at least two of the coils 8 of the electric motor 4. At that, the first potential 9 supplied through connector 15 is positive.

The creation of a second positive potential 22 for supplying power to position sensors 10 by using a single rectifying element 18, connected to the common point of the coils 8 of the electric motor, as shown on fig. 8. This positive second potential 22 is created under the condition that the external commutation device 16 provides continuous commutation of at least two of the coils 8 of the electric motor 4. At that, the first potential 9 supplied through connector 15 is negative.

The invention operates as follows:

After the external commutation device 16 is powered up it applies voltage of the respective polarity - positive according to fig. 3 - to the first potential terminal 9 connected to the connector 15. The voltage with the polarity required to form the second potential 22 – negative according to fig. 3 – is applied through the commutation device 16 to at least one of the coils 8 of the electric motor 4. The first potential 9 and the second potential 22, generated in this manner, supply power to the position sensors 10 and to the digital encoding device 17. The digital encoding device 17 starts operating and transfers the information from the position sensors 10, as well as the additional information, to the encoding device 16 by superimposing the digital signal on the first potential 9.

Thus, the superimposed signal is decoded, through the power supply unit 20 and the decoding device 21 connected to the external commutation device 16, and the decoded information from the position sensors 10 is used for commutation of the voltage applied to the coils 8 of the electric motor 4 in order to initiate the motor's rotation. The additional information transmitted by the digital encoding device 17 to the commutation device 16 is used for diagnostic purposes.

An example of such additional information is the temperature inside the body of the motor and the conveying rollers.

PATENT CLAIMS

1. A power supply and control circuit for a motor-driven conveying roller, where the conveying roller incorporates a hollow body of the roller rotating on an axis, in which hollow body an electric motor is incorporated and coupled to the hollow body of the roller by elements for driving the roller body and for the transfer of torque, in which body a cable is also incorporated with the respective terminals, connected to a connector, from the coils of the electric motor, and with one first potential terminal for supplying power to the included position sensors with signal outputs, **characterized by that** that the number of position sensors (10) with signal outputs (11) may be at least one, which position sensors (10) are supplied with power from the first potential terminal (9) and a second potential (22), generated by an additional circuitry (12), connected to at least one of the coils (8) of the electric motor (4) with the objective to provide for the second potential (22).

2. A power supply and control circuit according to claim 1, **characterized by that** that the output signals (11) from the position sensors (10) are connected to a digital encoding device (17), supplied with power from the first (9) and the second potential (22), which digital encoding device (17) has one common encoded signal output (19), connected to the first potential (9) used for supplying power to the position sensors (10), and that the electric characteristics of the first potential (9) are changed by the encoded signal.

3. A power supply and control circuit according to claim 1 or 2, which **is characterized by that** that the circuitry (12) used to generate the second potential (22) includes at least one rectifying element (18).

4. A power supply and control circuit according to claim 2 or 3, **characterized by that** that the encoded signal generates information about the position sensors (10), as well as additional information relevant to the characteristics of the electric motor (4), in the digital encoding device (17).

5. A power supply and control circuit according to claim 1, **characterized by that** that the signal outputs (11) of the position sensors (10) are applied to terminals (14), incorporated in cable (6).

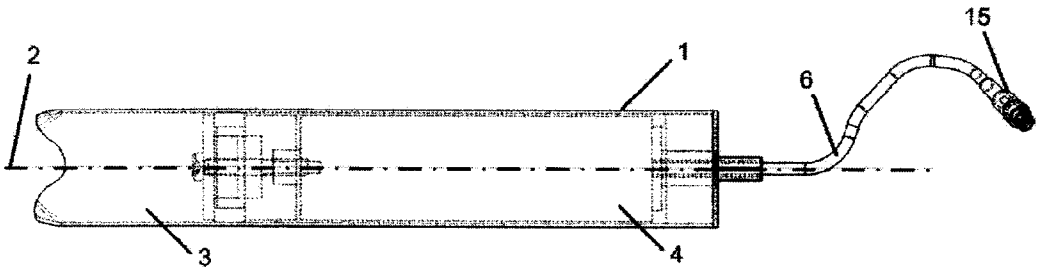

Fig. 1

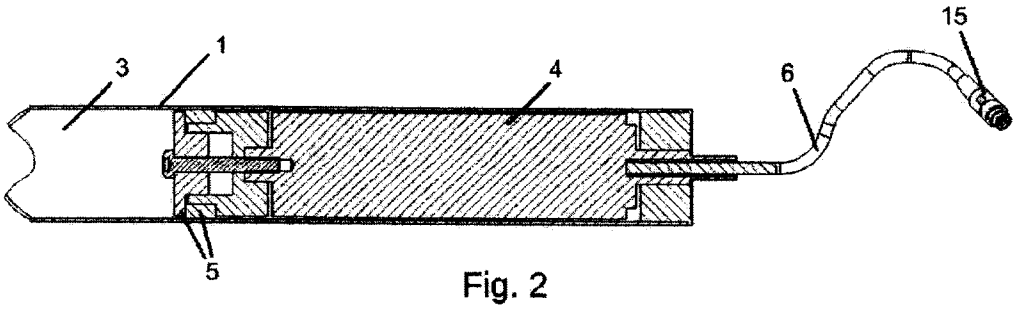

Fig. 2

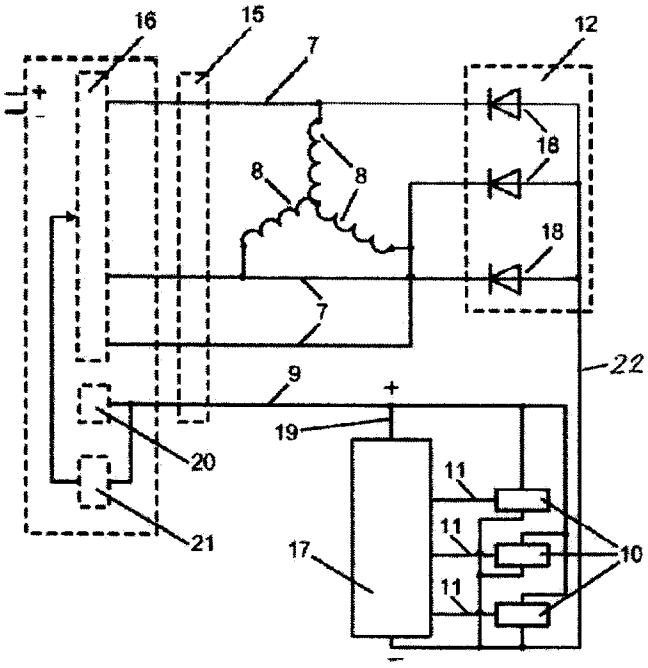
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Fig. 3

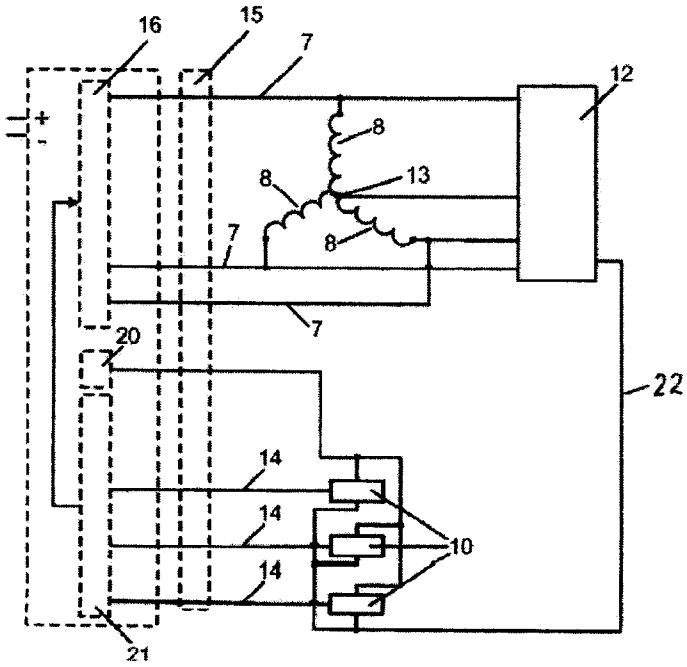
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Fig. 4

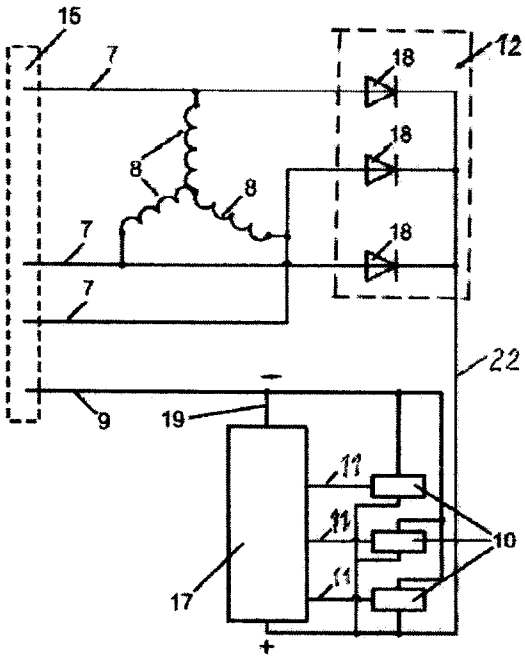
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Fig. 5

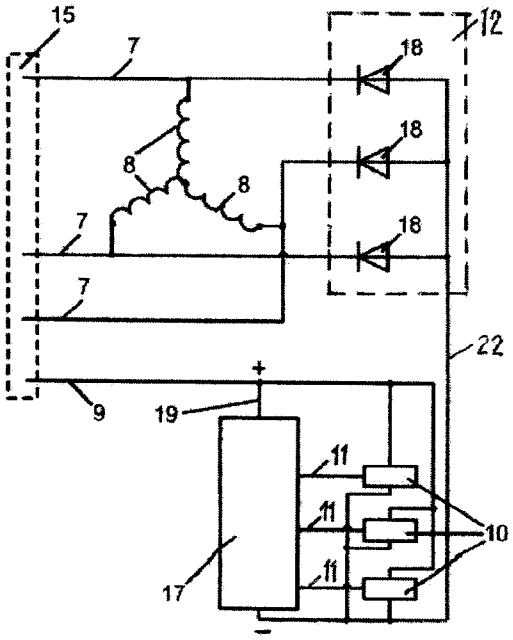
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Fig. 6

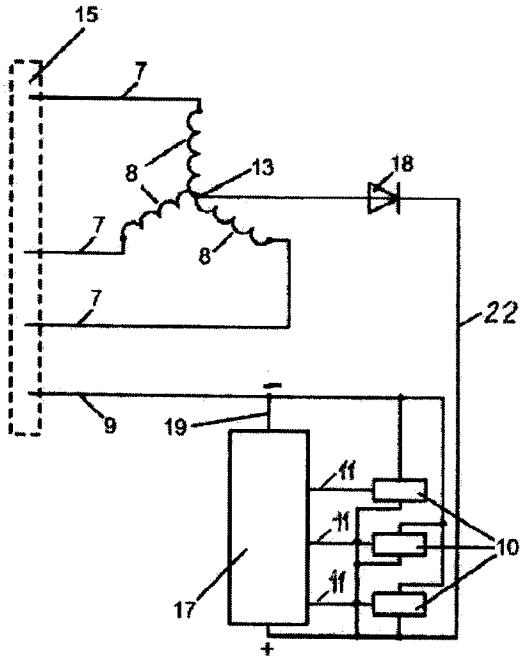
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Fig. 7

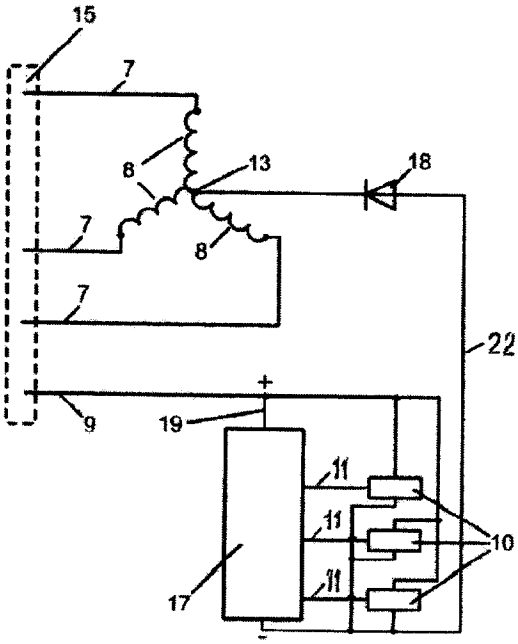
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Fig. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/BG2014/000005

A. CLASSIFICATION OF SUBJECT MATTER
INV. H02K29/06 H02P6/16 H02K11/00
ADD. B65G23/08

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)
B65G H02K H02P

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

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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Y	DE 10 2008 047494 A1 (CONTINENTAL TEVES AG & CO OHG [DE]) 15 April 2010 (2010-04-15) paragraphs [0008], [0010], [0012]; claim 1; figure 1	1-5
A	US 2004/108189 A1 (ITOH KAZUO [JP] ET AL) 10 June 2004 (2004-06-10) paragraph [0065]; figure 2	1-5
A	US 5 905 366 A (WILSON MALCOLM PHILIP [GB]) 18 May 1999 (1999-05-18) column 2 lines 1-63; figure 2	1-5

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
24 June 2015	06/07/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Fernandez, Victor

1

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

INTERNATIONAL SEARCH REPORT

International application No
PCT/BG2014/000005

C(Continuation). 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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1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/BG2014/000005

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