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(71) Applicant: **INSTYTUT ŁĄCZNOŚCI PAŃSTWOWY INSTYTUT BADAWCZY** [PL/PL]; ul.Szachowa 1, PL-04-894 Warszawa (PL).

(72) Inventors: **GODLEWSKI, Paweł**; ul. Jałowcowa 27 m.6, PL-04-955 Warszawa (PL). **KOBUS, Ryszard**; ul.Pablo Nerudy 5 m.20, PL-01-926 Warszawa (PL). **CHOJNACKI, Bogdan**; ul.Powstańców Śląskich 85 m.32, PL-01-355 Warszawa (PL). **NIECHODA, Kazimierz**; ul.Pułtuska 6/10 m.6, PL-04-331 Warszawa (PL). **OLECHOWSKI, Krzysztof**; ul.Umińskiego 10 m.3, PL-03-909 Warszawa (PL).

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(54) **Title**: SYSTEM FOR AUTOMATION OF MEASUREMENT OF BACKUP-BATTERIES CAPACITY IN A TELECOMMUNICATIONS POWER STATION

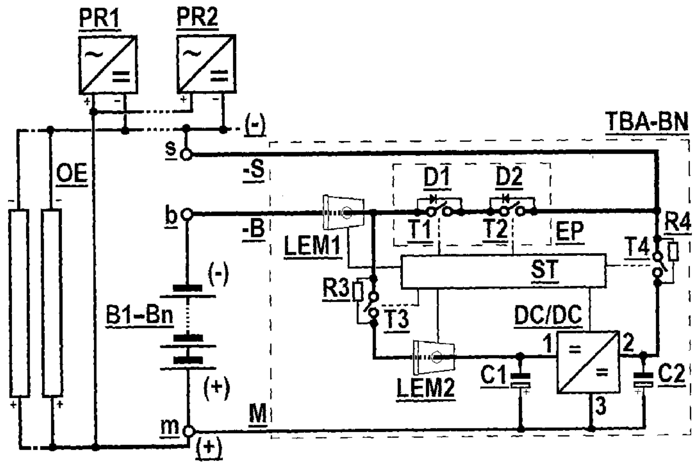

Fig. 1

(57) **Abstract**: System applicable to automate measurement of batteries capacity in a telecommunications power station, the batteries providing a reserve of energy to the telecommunications equipment. In this system, between the negative pole (-) of each of the batteries (Bl- Bn) with a terminal (b), and the negative bus (-) of the power station, either directly or through a common low-voltage contactor (WP), a control device (TBA-BN) dedicated for each of the batteries is connected, wherein the first input (-B) of the control device (TBA-BN) is connected to the first terminal (b) connected to the battery, the second input (-S) of the control device (TBA-BN) is connected to the second terminal (s) connected to the battery, and the third input (M) of this control device (TBA-BN) is connected to the system positive bus (+), whereas the first input (-B) of the control device (TBA-BN) is connected internally within the device, through the electronic contactor (EP) connected to the control system (ST), to the second input (-S) of the control device (TBA-BN).

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SYSTEM FOR AUTOMATION OF MEASUREMENT OF BACKUP-BATTERIES CAPACITY IN A TELECOMMUNICATIONS POWER STATION

The present invention relates to a system designed to automate the measurement of the batteries capacity in the telecommunications power station, which are the reserve of energy for the telecommunications equipment.

To ensure continuous operation of the technical infrastructure in the telecommunications network, uninterrupted power supply even in case of power failure in the power grid 230/400V is required. Therefore, a typical power system for the telecommunications equipment installed in the facility consists of the power station with the mains voltage rectifiers fed with 230/400V and the backup power source consisting of several chains of batteries, usually of nominal voltage of 48 V, connected for example by fuses and common low-voltage switch to the outputs of rectifying units and to the inputs of the energy receivers, i.e. the loads.

In a normal operating state the rectifiers provide so called "buffering voltage" to the loads and the batteries, and then the batteries fed with small preservative current are not discharged. In case of power failure in the power grid delivery of energy to the loads is taken by the batteries, and after returning of voltage the rectifiers again provide power to the loads while charging the batteries. Security of the power supply to the facility depends on availability of energy in the power grid, and in the absence thereof - of the energy stored in the batteries. Depending on the technology applied, the manufacturers determine the battery life time on 5-10-20 years, but disadvantageous operating conditions cause their degradation, i.e. reduction of available capacity below 80% of nominal capacity, often after half this time. The batteries should therefore be either exchanged frequently, which is an expensive procedure, or checked and replaced if out of order.

The most accurate method of assessing available capacity of the battery (accuracy of about ±1%) is a controlled discharge with a preset current, usually with so-called 10-hours current or 20-hours current. With this method the manufacturers determine the nominal capacity of manufactured batteries. This method is commonly used to measure the battery available capacity, when disconnected "manually" from the loads by the discharge rheostats maintaining a constant discharge current or by automatic devices TBA-IL. The staff needs to be involved at least at the stages of disconnection and connection of tested battery. The inventions known from the patents discussed hereinafter enable remote initiation of the battery discharge in the power stations adapted to such functions.

From the Polish patent PL201960 the converter system for the telecommunications DC power station with two batteries is known. This system eliminates the need for participation of the servicing personnel. According to the description, during controlled discharge-charge procedure with the DC programmed current, the converter disconnects through its two relays with switchable contacts the selected battery from the power station circuits and connects it to the inverter built from the transistors, capacitors, and inductor. A well-known drawback of this solution is a large current flowing through the relay contacts inside the device in the state of the loads supply from the battery and also the need to switch-off both batteries for disassembly of the appliance for repair or maintenance.

The Polish patent application PL390982 discloses a method and a system for remote diagnostics of the batteries, especially in the ICT systems. According to this solution, in the power station an additional separated bus is connected to the batteries through individual lines, by another contactor to the rectifier units, through another contactor to a group of selected energy loads, and through yet another contactor it is connected during normal bus operation to the system negative bus of the power station. The disadvantage of this solution is a large number of high-current power contactors connecting the loads, complicated procedure of discharging controlled battery with the DC current by adjusting the output current in a separate, tailored to that function group of rectifiers, and requirement for a group of loads that do not require guaranteed supply.

From the American patent application US2009021216 A1 a solution is known for charging and remotely managed, controlled discharging of two batteries, where individual electronic contactors, made of transistors, are used to connect the loads to the rectifiers and to each of the batteries, and individual for each battery charging systems. The disadvantage of this solution is that the value of the discharging current is determined by the loads which may change over time, instead of the preferred 10-hours current or 20-hours current, and inability to use the energy of controlled battery to sustain the load in case of the power failure in the power grid, because one cannot directly connect two batteries with different levels of charge/discharge to the energy receivers.

Another Polish patent application P 398 791 discloses a method and a system for remote controlling of available capacity of the batteries in the telecommunications power station, where for individual control of each battery the system negative rail of the power station is connected to the batteries through individually-controlled high-current contactors, replacing the common low-voltage switch, and where the controlled battery is connected through the low-current contactor to the input of the controlling-measuring device TBA-ST, permanently installed in the power station. On demand from the centralized monitoring system this device measures the capacity of the battery using the constant current controlled discharge. The disadvantage of this solution is that it is only suitable for use in new power stations delivered to operators, and cannot be used to automate testing of the battery in the power plants already in operation.

The invented system for automation of measurement of the batteries capacity in the telecommunications power station is characterized in that between the negative pole of each battery with a terminal, and the negative bus (-) in the power station, either directly or through a common low-current contactor and an individual battery fuse, a control device dedicated for each of the batteries is connected, wherein the first input of the control device is connected to the terminal connected to the battery, the second input of the control device is connected to the terminal of the battery fuse, and the third input of this control device is connected to the system positive bus (+) in the power station, wherein the first input of the control device is connected internally in this device through an electronic contactor connected to the control system and comprising the electronic connectors, first and second, connected serially and parallelized with the diodes, first and second, with connected cathodes, to the second input of the control device. The first input of the control device is also connected through the third resistor connected in parallel with the third electronic connector, and further connected to the negative terminal of the capacitor and the first input of a bidirectional additive-subtractive inverter. The second input of the bidirectional additive-subtractive inverter is connected to the negative terminal of the second capacitor and the fourth electronic connector which is connected in parallel to the fourth resistor, connected to the second input of the control device. The third input of the control device is connected internally to the third input of the bidirectional additive-subtractive inverter, the positive terminal of the first capacitor and the positive terminal of the second capacitor, wherein the electronic connectors the first - the fourth and the bidirectional additive-subtractive inverter are connected to the control system.

Preferably, a first current measuring device is connected in the control device between the first input and the first electronic connector of the electronic contactor, its output connected to the control system of the control device.

It is advantageous when in the control device between its first input and the first input of the bidirectional additive-subtractive inverter, directly before the third electronic connector or directly behind the third electronic connector, a second current measuring device is connected, its output connected to the control system of the control device.

In preferred embodiment, the MOS transistors are used as the first, second, third and fourth electronic connectors in the control device.

In another embodiment, the relays are used as the first, second, third and fourth electronic connectors in the control device.

In also recommended embodiment, the contactors are used as the first, second, third and fourth electronic connectors in the control device.

The advantage of proposed invention is a possibility to automate the control of the batteries capacity, with a method of controlled discharge, in the telecommunications power stations working with previously used electrical systems, through simple installation of the control device in the circuit of each of the batteries, without interrupting exploitation of the telecommunications equipment. This solution is particularly suitable for small power stations, with the batteries of capacity of 80 - 200 Ah and working with the loads currents of up to about 100 A.

Preferred embodiment of the system for automated measurement of the batteries capacity in the telecommunications power station, according to the invention, is illustrated on the drawing showing a block diagram of the system.

The system for automation of measurement of the batteries capacity in the telecommunications power station, in particular in the traditional (not modified) telecommunications power station supplying the DC current, the system positive bus (+) is connected to the positive terminals of all rectifying units PR1-PRn, all energy receivers (loads) OE and all batteries B1-Bn, whereas the system negative bus (-) is connected to the negative terminals of all rectifying units PR1-PRn, all loads OE, and through optional common low-current contactor

WP to the negative poles (-) of each battery B1-Bn, according to the invention is constructed as follows: between the second terminal s, and the negative poles (-) of each battery B1-Bn with the first terminal b, dedicated to each battery B1-Bn the control device TBA-BN is connected as follows: the first input B of the control device TBA-BN is connected to the first terminal b connected to the battery, the second input -S of the control device TBA-BN is connected to the second terminal s connected to the battery B1-Bn, and the third input M of this control device TBA-BN is connected to the system positive bus (+). The first input -B of the control device TBA-BN is connected internally in the device, through the ST-controlled electronic contactor EP containing two electronic connectors: the third connector T3 and the fourth connector T4, with its second input -S. The first input -B of the control device TBA-BN is connected also to the third resistor R3, connected in parallel with the third electronic connector T3 connected to the negative terminal of the first capacitor C1 and the first input 1 of the bidirectional additive-subtractive inverter DC/DC, which through the second input 2 is connected to the negative terminal of the second capacitor C2 and the fourth electronic connector T4, connected in parallel with the fourth resistor R4, which in turn is connected to the second input -S of the control device TBA-BN. The third input M of the control device TBA -BN is connected internally to the third input 3 of the bidirectional additive-subtractive inverter DC/DC, to the positive terminal of the first capacitor C1 and the positive terminal of the second capacitor C2.

Preferably the first current measuring subsystem LEM 1, with its output connected to the control subsystem ST of the control device TBA-BN is connected in the control device TBA-BN between the first input -B and the first transistor T1 of the electronic contactor EP.

It is advantageous when the second current measuring subsystem LEM 2, with its output connected to the control system ST of the control device TBA-BN, is connected in the control device TBA-BN between the first input -B, and the first input 1 of the bidirectional additive-subtractive inverter DC/DC, immediately before the third electronic connector T3 or immediately behind the third electronic connector T3.

It is also recommended to use the MOS transistors, relays or contactors in the control device TBA-BN as the first electronic connector T1, the second electronic connector T2, the third electronic connector T3, and the fourth electronic connector T4.

During normal operation, each of the batteries is connected to the system negative bus of the power station through the electronic contactors EP, comprised in the control devices TBA-BN. When selected battery is to be controlled, i.e. its capacity is to be measured with the controlled discharge method, the control system ST of the designated control device TBA-BN switches-off the second electronic connector T2 of the electronic contactor EP and switches-on the third electronic connector T3 and the fourth electronic connector T4 in the circuits of the bidirectional additive-subtractive inverter DC/DC (disconnected at rest, the third and the fourth electronic connectors T3 and T4 allow for smooth charging of the first capacitor C1 and the second capacitor C2 through the third resistor R3 and the fourth resistor R4, when installing the device), and the operation of the inverter is controlled to discharge and/or to charge the controlled battery with a constant current. If during the inspection of the battery the network voltage of 230/400V fails and the voltage on the system negative rail and on the loads OE decreases, the powering is supported with the energy contained in the controlled battery by the current flow in the electronic contactor EP through the second diode D2 of switched-off the second electronic connector T2 and switched-on the first electronic connector T1, while the current flow is not limited by the current capacity of the bidirectional additive-subtractive inverter DC/DC of the control device TBA-BN.

Claims

1. A system for automation of measurement of the batteries capacity in the telecommunications power station where the system positive bus is connected to the positive terminals of all rectifying units, all loads and all batteries, and the system negative bus is connected to the negative terminals of all rectifying units, all loads and through a common low-voltage contactor and the individual battery fuses to the negative poles of all batteries, **characterized in that** between the negative pole (-) of each of the batteries (B1-Bn) with the terminal (b) and the negative bus (-) of the power station, either directly or through a common low-voltage contactor (WP), a dedicated to each battery (B1-Bn) control device (TBA-BN) is connected, where the first input (-B) of the control device (TBA-BN) is connected to the first terminal (b) connected to the battery, the second input (-S) of the control device (TBA-BN) is connected to the second terminal (s) connected to the battery (B1-Bn), and the third input (M) of this control device (TBA-BN) is connected to the system positive bus (+), and where the first input (-B) of the control device (TBA-BN) is connected internally in the device, through an electronic contactor (EP) controlled by a control system (ST), to the second input (-S) of the control device (TBA-BN), wherein the electronic contactor (EP) comprises two electronic connectors, the first electronic connector (T1) and the second electronic connector (T2), connected serially and parallelized with the diodes, the first diode (D1) and the second diode (D2), with connected cathodes, and the first input (-B) of the control device (TBA-BN) is also connected through the third resistor (R3) connected in parallel with the third electronic connector (T3), and further connected to the negative terminal of the capacitor (C1) and the first input (1) of a bidirectional additive-subtractive inverter (DC/DC), whereas the second input (2) of the bidirectional additive-subtractive inverter (DC/DC) is

connected to the negative terminal of the second capacitor (C2) and the fourth electronic connector (T4), connected in parallel with the fourth resistor (R4) connected to the second input (-S) of the control device (TBA-BN), while the third input (M) of the control device (TBA-BN) is internally connected to the third input (3) of the bidirectional additive-subtractive inverter (DC/DC), to the positive terminal of the first capacitor (C1) and the positive terminal of the second capacitor (C2), wherein the electronic switches the first - the fourth (T1-T4) and the bidirectional additive-subtractive inverter (DC/DC) are connected to the control system (ST).

2 The system according to claim 1, **characterized in that** a first current measuring device (LEM 1) is connected in the control device (TBA-BN) between the first input (-B) and the first electronic connector (T1) of the electronic contactor (EP), and its output connected to the control system (ST) of the control device (TBA-BN).

3 The system according to claim 1, **characterized in that** in the control device (TBA-BN) between its first input (-B) and the first input of the bidirectional additive-subtractive inverter (DC/DC), directly before the third electronic connector (T3) or directly behind the third electronic connector (T3), a second current measuring device (LEM 2) is connected, its output connected to the control system (ST) of the control device (TBA-BN).

4 The system according to claim 1, **characterized in that** the MOS transistors are used as the electronic connectors; the first (T1), the second (T2), the third (T3) and the fourth (T4) electronic connectors in the control device (TBA-BN).

5 The system according to claim 1, **characterized in that** the relays are used as the electronic connectors; the first (T1), the second (T2), the third (T3) and the fourth (T4) electronic connectors in the control device (TBA-BN).

6 The system according to claim 1, **characterized in that** the contactors are used as the electronic connectors; the first (T1), the second (T2), the third (T3) and the fourth (T4) electronic connectors in the control device (TBA-BN).

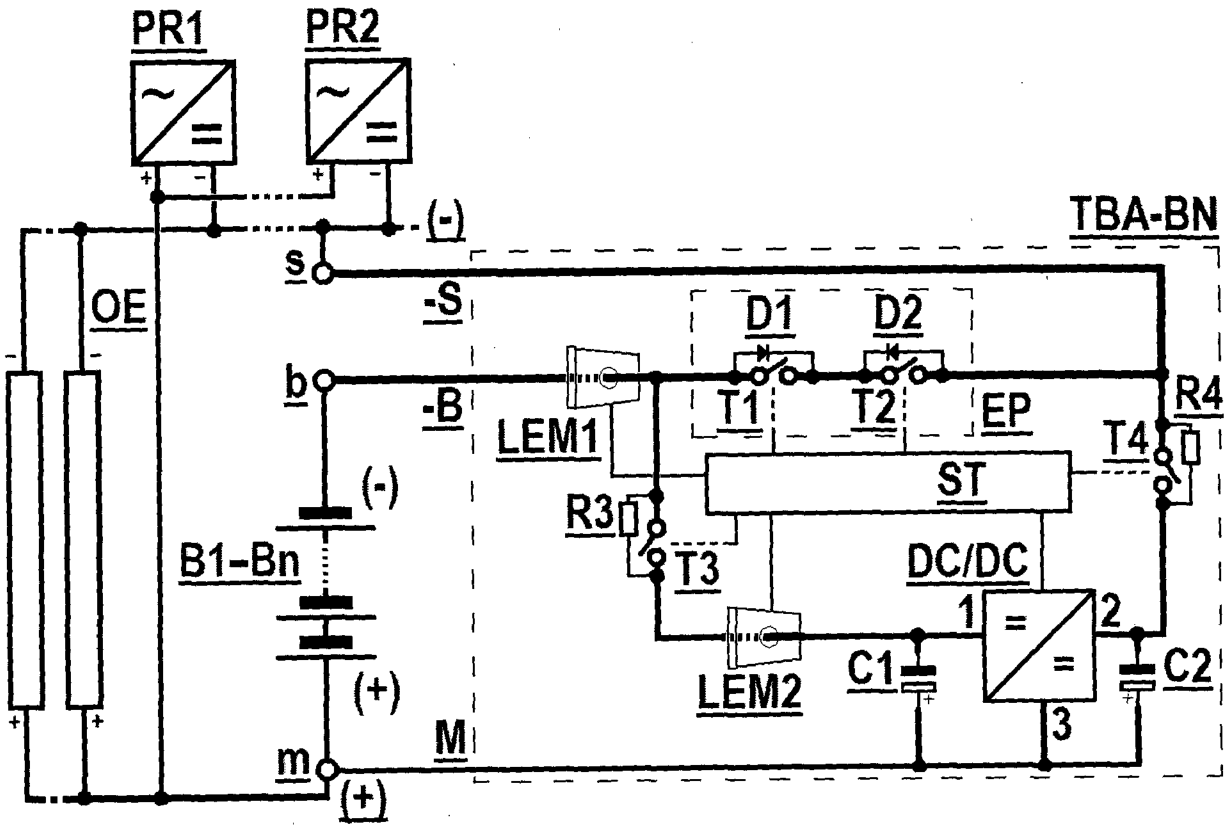
PR1
PR2
(-)
TBA-BN
s
-S
OE
D1
D2
b
-B
LEM1
T1
T2
EP
R4
T4
ST
(-)
R3
T3
B1-Bn
DC/DC
1
2
LEM2
C1
C2
(+)
3
M
m
(+)

Fig.

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
INV. G01R31/36 H02J7/34 H02J9/06
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)
G01R H02J

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.
X	"TBA160-IL PORTABLE DEVICE", , 1 July 2011 (2011-07-01), XP055112094, Retrieved from the Internet: URL:http://www.itl.waw.pl/images/stories/oferta/urzadzenia_i_systemy/img/TBA160/Manual_TBA160-IL.pdf [retrieved on 2014-04-04] page 3 - page 4 figures 1,2 -----	1-6
A	US 2003/107859 A1 (PAN KUANG-HUA [TW] ET AL) 12 June 2003 (2003-06-12) figure 1 -----	1

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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
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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	Hof, Klaus-Dieter

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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 98/58271 A1 (PECO II INC [US]) 23 December 1998 (1998-12-23) figures 1,2,3 page 3, line 19 - page 4, line 23 page 7, line 12 - last line page 8, line 14 - page 9, line 3 page 12, line 14 - page 14, line 2 page 16, line 6 - line 16 -----	1
A	DE 299 13 613 U1 (SIEMENS AG [DE]) 28 September 2000 (2000-09-28) figure 1 paragraphs [0009], [0012] - paragraph [0020] -----	1
A	WO 2009/091395 A1 (HEWLETT PACKARD DEVELOPMENT CO [US]; MCCOLLUM PETER L [US]) 23 July 2009 (2009-07-23) abstract; figures 2,4a,4b -----	1
A	US 2012/098498 A1 (ASAI TAKANORI [JP]) 26 April 2012 (2012-04-26) figure 2 paragraph [0042] -----	1
A	WO 2004/049540 A2 (TIAX LLC [US]; CHERTOK ALLAN [US]; FOWLER THOMAS J [US]; KING DARRELL) 10 June 2004 (2004-06-10) figure 6b page 22, line 22 - page 23, last line -----	1-6
A	US 2010/007506 A1 (FISCHER STEVE [US]) 14 January 2010 (2010-01-14) the whole document -----	1-6

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/PL2013/000136

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2003107859 A1	12-06-2003	TW 539934 B	01-07-2003
		US 2003107859 A1	12-06-2003
WO 9858271 A1	23-12-1998	US 5886503 A	23-03-1999
		WO 9858271 A1	23-12-1998
DE 29913613 U1	28-09-2000	AT 280952 T	15-11-2004
		DE 29913613 U1	28-09-2000
		EP 1074851 A1	07-02-2001
		ES 2230010 T3	01-05-2005
WO 2009091395 A1	23-07-2009	US 2010295513 A1	25-11-2010
		WO 2009091395 A1	23-07-2009
US 2012098498 A1	26-04-2012	CN 102472795 A	23-05-2012
		JP 2011017619 A	27-01-2011
		US 2012098498 A1	26-04-2012
		WO 2011004788 A1	13-01-2011
WO 2004049540 A2	10-06-2004	AU 2003295715 A1	18-06-2004
		EP 1568114 A2	31-08-2005
		JP 4343173 B2	14-10-2009
		JP 2006507790 A	02-03-2006
		US 2004135544 A1	15-07-2004
		US 2004135545 A1	15-07-2004
		US 2004135546 A1	15-07-2004
		US 2008191663 A1	14-08-2008
		WO 2004049540 A2	10-06-2004
US 2010007506 A1	14-01-2010	EP 2313793 A1	27-04-2011
		US 2010007506 A1	14-01-2010
		WO 2010006307 A1	14-01-2010