Abstract:

Designated Applicant: BAE SYSTEMS CONTROLS INC, [US/US]; 1098 Clark Street, Endicott, New York 13760 (US).

Inventors: SCHULTE, Jurgen; 10726 Ballystock Ct., San Diego, California 92131 (US); MUGGEO, Filippo; 817 Catalina Blvd., Endwell, New York 13760 (US). MATHERWS, Derek; 1712 Campus Drive, Vestal, New York 13850 (US); PANCHERI, Brendan; 320 E. Buffalo St., Ste. 805, Milwaukee, Wisconsin 53202 (US).

Agent: GROLZ, Edward, W.; Scully, Scott, Murphy & Presser, 400 Garden City Plaza, Suite 300, Garden City, New York 11530 (US).


Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(H))
— as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(in))

Published:

— with international search report (Art. 21(3))

Title: RECUPERATIVE TRANSMISSION DOWN SHIFTING MULTIPLE GEARS AND ENGINE DECOUPLING

Abstract:

A hybrid electric drive system for a hybrid powered vehicle which includes a combustion engine, and a transmission. An electric machine and the combustion engine are coupled to the transmission in the hybrid electric drive system providing engine and/or electric machine drive power for the vehicle. A clutch is mechanically communicating with and positioned between the combustion engine and the transmission to decouple the combustion engine from the transmission. An energy storage system is configured to transfer and receive power with the electric machine, and is configured to recharge using power from the electric machine. A hybrid system controller is configured to respond to a regenerative braking mode of the vehicle. While the hybrid electric drive system is in the regenerative braking mode, the hybrid system controller is configured to initiate shifting of the transmission into one or more selected gears relating to one or more selected electric machine speeds.
RECUPERATIVE TRANSMISSION DOWN SHIFTING MULTIPLE GEARS AND
ENGINE DECOUPLING

FIELD OF THE INVENTION

[0001] The present invention relates to a hybrid electric drive system for a hybrid powered vehicle.

BACKGROUND OF THE INVENTION

[0002] Known hybrid power systems with hybrid drives or drive trains may include an internal combustion engine, and electric motor or machine combination. The engine may include a diesel or gasoline engine driving a power train and/or charging an energy storage system, for example, a high voltage battery, wherein the engine and the high voltage battery provide plural drive sources to a hybrid vehicle. It is also known to arrange an internal combustion engine and/or one or more electric machines in such a manner that they can be operatively connected to each other by gears, for example, planetary gear sets or the like, and couplings. Different operating states of the combustion engine and electric motor(s) can effect fuel consumption, dynamic performance of the vehicle, and pollutant emissions. These techniques focus on interactions between the engine, transmission and motor/generator during active driving.

[0003] In hybrid vehicles it is important to obtain higher more efficient use of fuel, and improve mileage per gallon of fuel consumed. This may be accomplished by a traction motor driving the vehicle as much as possible. In order to utilize the traction motor instead of burning fuel, it is necessary for a traction motor operating as a generator to recapture as much power as possible when the vehicle is being braked. Recapturing power is limited because a
transmission gear ratio is linked to the speed range of a combustion engine, even though traction motor operation during regeneration may have a wider range of operation speeds.

**SUMMARY OF THE INVENTION**

Therefore, a need exists for a system and method to operate an electric motor at a higher speed to maximize regenerative energy in a hybrid powered vehicle to minimize use of fuel. Additionally, a need exists for a system and method for enhancing the performance of an electric motor of a hybrid electric drive system without being limited by a combustion engine speed range.

In an aspect of the present invention, a hybrid electric drive system for a hybrid powered vehicle includes a combustion engine, and a transmission. An electric machine and the combustion engine are coupled to the transmission in a hybrid electric drive system which provides engine and/or electric machine drive power for a hybrid powered vehicle. A clutch is mechanically communicating with and positioned between the combustion engine and the transmission to decouple the combustion engine from the transmission. An energy storage system is configured to transfer and receive power to and from the electric machine, and is configured to recharge using power from the electric machine. A hybrid system controller is configured to respond to a regenerative braking mode of the vehicle. While the hybrid electric drive system is in the regenerative braking mode, the hybrid system controller is configured to initiate shifting of the transmission into one or more selected gears relating to one or more selected electric machine speeds.

In another aspect of the present invention, a method for providing a hybrid electric drive system for a hybrid powered vehicle includes: providing a combustion engine;
providing a transmission; coupling an electric machine and the combustion engine to the transmission in a hybrid electric drive system providing engine and/or electric machine drive power for a hybrid powered vehicle; mechanically communicating and positioning a clutch with and between the combustion engine and the transmission to decouple the combustion engine and the electric machine; configuring an energy storage system to transfer and receive power to and from the electric machine, and being configured to recharge using power from the electric machine; and configuring a hybrid system controller to respond to a regenerative braking mode of the vehicle, and while the hybrid electric drive system is in the regenerative braking mode, the hybrid system controller configured to initiate shifting of the transmission into one or more selected gears relating to one or more selected electric machine speeds.

[0007] In another aspect of the present invention, a method for providing power to an energy storage system of a hybrid powered vehicle during regenerative braking having a hybrid electric drive system includes a combustion engine, and a transmission. An electric machine and the combustion engine are coupled to the transmission for providing engine and/or electric machine drive power for the hybrid powered vehicle. The hybrid powered vehicle includes an energy storage system configured to transfer and receive power to and from the electric machine and is configured to recharge using power from the electric machine. The method comprising: decoupling the combustion engine and the transmission using a clutch mechanically communicating with and positioned between the combustion engine and the transmission; and shifting the transmission into one or more selected gears relating to one or more selected electric machine speeds during a regenerative braking mode using a hybrid system controller being configured to initiate the regenerative braking mode for the hybrid electric drive system.
BRIEF DESCRIPTION OF THE DRAWINGS
[0008] These and other objects, features and advantages of the present invention will become apparent from the following detailed description of illustrative embodiments thereof, which is to be read in connection with the accompanying drawings. The various features of the drawings are not to scale as the illustrations are for clarity in facilitating one skilled in the art in understanding the invention in conjunction with the detailed description. In the drawings:

[0009] FIG. 1 is a schematic block diagram of a hybrid electric drive system; and

[0010] FIG. 2 is a method for providing the hybrid electric drive system of FIG. 1 to a hybrid powered vehicle.

DETAILED DESCRIPTION OF THE INVENTION
[0011] Referring to FIG. 1, a hybrid electric drive system 10 (or alternatively described as a drive train), according to an embodiment of the invention, for a parallel hybrid powered vehicle 90 is described below. In the system 10, an electric machine is integrated between the engine and a transmission. For example, a transmission 40 is connected to a torque converter 20 which is positioned between the transmission 40 and an electric machine embodied as an electric motor 44. The torque converter 20 may optionally include a lock-up clutch 22. The optional lock-up clutch 22 may be closed during braking, that is, a negative torque request to the drive system. When the brake is released and the accelerator pedal engaged, that is, a positive torque request to the drive system, the optional lock-up clutch 22 may be opened. Depending on which gear the transmission has engaged and the speed of the
vehicle, the lock up clutch may optionally be opened when accelerating. Alternatively, under certain conditions, it may not be possible to lock up the clutch during braking.

[0012] A combustion engine 12 and the electric motor 44 are both mechanically coupled to the transmission 40 to provide engine and/or motor drive power for the vehicle 90. A clutch 24 mechanically communicates with, and is positioned between, the combustion engine 12 and the electric motor 44. An energy storage system (ESS) 140 (or alternatively described as an electrical power supply) is configured to transfer and receive power to and from the electric motor 44. The electrical power supply 140 is electrically communicating with a rechargeable high voltage (HV) battery 46 (e.g., transferring voltage and current back and forth) which is configured to recharge using power from the electric motor 44, using a motor power converter/controller 45 communicating with both the energy storage system 140 and motor 44. The hybrid system controller 47 communicates with the vehicle/engine controller 58, the transmission control logic 42 and the power converter 45 to optimize regenerative braking and to control voltage and current, in and out of the battery 46 of the energy storage system 140. The transmission 40 is connected, represented by arrow 48, to a differential 52 of the vehicle 90.

[0013] A motor controller/hybrid system controller 47 (also referred to as a hybrid system controller) is configured to respond to a regenerative braking mode (also referred to as a recuperative braking process) of the hybrid electric drive system 10 initiated by an operator command, such as an operator depressing a brake pedal to begin braking of the vehicle. The motor controller/hybrid system controller 47 initiates management of part of the regenerative braking mode and interacts with control logic 42 of the transmission by communicating with the transmission to set gear selection and a lock up clutch mode. Also, the vehicle/engine
controller 58 is configured to communicate with the hybrid system controller 47, as shown in FIG. 1.

[0014] In the regenerative braking mode, energy can be recuperated into the ESS. The motor controller/hybrid system controller 47 initiates shifting of the transmission 40 into a gear which allows for maximum electric motor 44 speed of an available plurality of speeds during the regenerative braking mode. Thus, a selected gear of the transmission 40, for example, a lower gear which would not be available as resulting in an RPM that is not typically used in conventional non-hybrid operation for the engine 12, may be used to maximize the electric machine speed, in this case, the electric motor 44 speed. Thereby, the electric motor 44 can run at a higher speed to optimize recuperative power (in the regenerative braking mode) from the motor to the ESS 140.

[0015] In alternative scenarios, motor controller/hybrid system controller 47 may initiate shifting of the transmission 40 into one or more gears which are the lower available gears, or lower than the presently used gear of the running vehicle. The controller may initiate selection of one or more of the electric motor 44 speeds to increase or maximize the motor speed. The speed of the electric motor 44 is higher than the speed of the electric motor when coupled to the engine, and thus, the clutch 24 allows the decoupling and increasing of the electric motor speed according to the disclosure herein.

[0016] In the embodiment of the invention discussed above, braking by an operator of the vehicle firstly initiates the regenerative braking mode, in response to which the motor controller/hybrid system controller 47 carries out the electro/mechanical implementation to initiate the regenerative braking mode. Upon receiving a command from the operator, the
Energy recaptured through regenerative braking will cease if battery is at full charge, or if the controller initiates re-coupling of the motor and the engine in response to the operator commands, for example, the operator pressing on the accelerator of the vehicle.

Referring to FIG. 2, a method 100 according to an embodiment of the invention regarding the system 10 shown in FIG. 1, includes positioning the electric motor 44 between the engine 12 and the transmission 40 in the parallel hybrid vehicle drive train 10, in step 104. The clutch 24 is positioned between the engine 12 and the electric motor 44 in the drive train as shown in FIG. 1, in step 108. The electrical storage system 140 is coupled to the drive train to transfer and receive power to and from the electric motor 44, in step 116. In step 120, during the regenerative braking mode, the clutch 24 is initiated to operatively decouple the engine 12 and the motor 44. In step 124, the motor controller/hybrid system controller 47 is configured to initiate shifting of the transmission 40 into a gear to maximize the electric motor 44 speed to optimize the recuperative energy storage to the ESS 140 from the motor 44. Re-coupling the engine and the motor may be initiated by the motor controller/hybrid system controller 47 in response to operator commands, including, for example, the operator depressing an accelerator. For example, modes of operation for the hybrid vehicle may include, re-coupling the engine and the motor upon depletion of the ESS, or when power demands are communicated, or a combination of power demands and ESS depletion.
Thereby, the invention as described in the embodiment above provides a system and method for maximizing utilization of an electric machine, i.e. electric motor/generator, during regenerative braking of the hybrid vehicle. In the present disclosure, a transmission shift strategy is directed to the electric motor's speed capability, and not limited by the engine speed. The system of the present disclosure decouples the internal combustion engine of a parallel hybrid vehicle from the transmission during regenerative braking, and optimizes the gear selection of the transmission to maximize the speed of the electric machine. The method for optimizing the gear selection includes requests made to the transmission for the lowest available gear. The actual gears selected may be left to control logic 42 of the transmission. The system and method of the present disclosure advantageously allows for replacement of transmission and electric machines with different models, as often occurs during the operational life of long-haul tractors, while still providing maximum utilization of the electric machine.

In the system 10 described above of a single machine parallel hybrid vehicle drive train, the machine, motor 44, is integrated between the engine 12 and the transmission 40 which advantageously enables designing the motor 44 smaller and lighter, which further saves cost. In the system 10, during driving conditions in which the vehicle is powered by the internal combustion engine the operational range of the motor (or generator) is limited by the internal combustion engine. During the energy recuperation phase (regenerative braking mode) of the hybrid vehicle, the engine is decoupled and the electric machine (embodied as motor 44) to allow the utilization of the full potential of the electric machine, within the limits of the remaining powertrain components and connections, thereby enabling greater power transfer to the ESS 140. The extended operating range of the electric machine is
possible since most transmissions allow a higher operating speed than a desired engine
maximum speed.

[0021] Thus, as the motor controller/hybrid system controller 47 enters the
regenerative braking mode, it shifts into the gear that allows for maximum electric machine
speed. Due to the wide operating range of the electric machine it is not necessary to shift into
every gear to achieve continuous recuperation power. Thereby, in the embodiment of the
invention described above, the transmission gearing is optimized to utilize the electric motors
unlike the transmission shift strategy in the prior art which is typically limited by engine
speed range. In the present invention, a transmission shift strategy is possible which selects
gearing based on using more of the electric motor's capacity. Also, the present invention is
entirely independent of the type or model of transmission and motor/generator used.

[0022] While the present invention has been particularly shown and described with
respect to preferred embodiments thereof, it will be understood by those skilled in the art that
changes in forms and details may be made without departing from the spirit and scope of the
present application. It is therefore intended that the present invention not be limited to the
exact forms and details described and illustrated herein, but falls within the scope of the
appended claims.
CLAIMS

What is claimed is:

1. A hybrid electric drive system for a hybrid powered vehicle, comprising:
   a combustion engine;
   a transmission;
   an electric machine and the combustion engine coupled to the transmission in a hybrid electric drive system which provides engine and/or electric machine drive power for a hybrid powered vehicle;
   a clutch mechanically communicating with and positioned between the combustion engine and the transmission to decouple the combustion engine from the transmission;
   an energy storage system configured to transfer and receive power to and from the electric machine, and being configured to recharge using power from the electric machine; and
   a hybrid system controller being configured to respond to a regenerative braking mode of the vehicle, and while the hybrid electric drive system is in the regenerative braking mode, the hybrid system controller being configured to initiate shifting of the transmission into one or more selected gears relating to one or more selected electric machine speeds.

2. The system of claim 1, wherein the electric machine positioned between and mechanically coupled to the combustion engine and the transmission in a hybrid electric drive system which provides engine and/or electric machine drive power for the hybrid powered vehicle.
3. The system of claim 1, wherein the clutch is mechanically communicating with and positioned between the combustion engine and the electric machine, and the clutch being configured to decouple the combustion engine and the electric machine.

4. The system of claim 1, wherein the energy storage system is electrically communicating with a rechargeable high voltage (HV) battery.

5. The system of claim 1, wherein a selected gear of the transmission allows for an electric machine speed which is a higher speed than a desirable operation range of speeds of the combustion engine.

6. The system of claim 1, wherein a selected gear of the transmission allows for an electric machine speed to be increased when the transmission is in the selected gear.

7. The system of claim 1, wherein the selected gear of the transmission is lower than a transmission gear engaged while the vehicle is not in the regenerative braking mode.

8. The system of claim 1, wherein the selected gear of the transmission is a lowest available gear determined by control logic in the transmission in response to the hybrid system controller.

9. The system of claim 1, wherein the electric machine recharges the energy storage system when the hybrid electric drive system is in the regenerative braking mode.
10. A method for providing a hybrid electric drive system for a hybrid powered vehicle, comprising:

 providing a combustion engine;

 providing a transmission;

 coupling an electric machine and the combustion engine to the transmission in a hybrid electric drive system providing engine and/or electric machine drive power for a hybrid powered vehicle;

 mechanically communicating and positioning a clutch with and between the combustion engine and the transmission to decouple the combustion engine and the electric machine;

 configuring an energy storage system to transfer and receive power to and from the electric machine, and being configured to recharge using power from the electric machine; and

 configuring a hybrid system controller to respond to a regenerative braking mode of the vehicle, and while the hybrid electric drive system is in the regenerative braking mode, the hybrid system controller configured to initiate shifting of the transmission into one or more selected gears relating to one or more selected electric machine speeds.

11. The method of claim 10, further comprising:

 selecting a gear of the transmission which allows for an electric machine speed which is a higher speed than a desirable operation range of speeds of the combustion engine.

12. The method of claim 10, further comprising:
selecting a gear of the transmission which allows for an electric machine speed to be increased when the transmission is in the selected gear maximum speed of the electric machine.

13. The method of claim 10, wherein the selected gear of the transmission is lower than a transmission gear engaged while the vehicle is not in the regenerative braking mode.

14. The method of claim 10, further comprising:

selecting a lowest available gear determined by control logic in the transmission in response to the hybrid system controller.

15. The method of claim 10, further comprising:

recharging the energy storage system using the electric machine when the hybrid electric drive system is in the regenerative braking mode.

16. A method for providing power to an energy storage system of a hybrid powered vehicle during regenerative braking having a hybrid electric drive system including a combustion engine, and a transmission, wherein an electric machine and the combustion engine are coupled to the transmission for providing engine and/or electric machine drive power for the hybrid powered vehicle, the hybrid powered vehicle including an energy storage system configured to transfer and receive power to and from the electric machine and being configured to recharge using power from the electric machine, the method comprising:

    decoupling the combustion engine and the transmission using a clutch mechanically communicating with and positioned between the combustion engine and the transmission; and
shifting the transmission into one or more selected gears relating to one or more selected electric machine speeds during a regenerative braking mode using a hybrid system controller being configured to initiate the regenerative braking mode for the hybrid electric drive system.

17. The method of claim 16, further comprising:
selecting a gear of the transmission which allows for an electric machine speed which is a higher speed than a desirable operation range of speeds of the combustion engine.

18. The method of claim 16, further comprising:
selecting a gear of the transmission which allows for an electric machine speed to be increased when the transmission is in the selected gear.

19. The method of claim 16, wherein the selected gear of the transmission is lower than a transmission gear engaged while the vehicle is not in the regenerative braking mode.

20. The method of claim 16, further comprising:
selecting a lowest available gear determined by control logic in the transmission in response to the hybrid system controller.
FIG. 2

104

POSITIONING THE ELECTRIC MOTOR BETWEEN THE ENGINE AND THE TRANSMISSION IN THE HYBRID ELECTRIC DRIVE TRAIN

108

POSITIONING THE CLUTCH BETWEEN THE ENGINE AND THE ELECTRIC MOTOR IN THE DRIVE TRAIN

116

COUPLING THE ENERGY STORAGE SYSTEM TO TRANSFER POWER TO AND FROM THE ELECTRIC MOTOR DURING THE RECUPERATIVE BRAKING PROCESS

120

DECOPLING THE ELECTRIC MOTOR FROM THE TRANSMISSION TO OPTIMIZE THE RECUPERATIVE BRAKING PROCESS.
**INTERNATIONAL SEARCH REPORT**

A. **CLASSIFICATION OF SUBJECT MATTER**

B60W 20/00(2006.01)i, B60W 10/04(2006.01)i, B60W 10/10(2006.01)i

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)

B60W 20/00; B60K 6/20; B60K 6/42; B60W 10/08; B60K 6/42; B60W 30/18; B60K 6/00; B60K 41/12; B60W 10/04; B60W 10/10

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal)

& Keywords: hybrid, regenerative braking, clutch, motor, speed, and downshift

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>US 2012-0103709 Al (MOCHIYAMA et al.) 03 May 2012 See paragraphs [0029], [0032], [0040], [0044], [0050], [0051]; and figure 1.</td>
<td>1-4, 6, 9, 10, 15, 16, 18</td>
</tr>
<tr>
<td>A</td>
<td>US 4691148 A (NICHOLLS et al.) 01 Sept ember 1987 See abstract; column 4, lines 16-41; and figure 3A.</td>
<td>1-4, 6, 9, 10, 15, 16, 18</td>
</tr>
<tr>
<td>Y</td>
<td>US 7976427 B2 (YAMAMOTO et al.) 12 July 2011 See abstract; column 5, line 53-co lumn 6, line 29; and figure 1.</td>
<td>1-20</td>
</tr>
<tr>
<td>A</td>
<td>EP 1970240 B1 (NISSAN MOTOR COMPANY LIMITED) 20 July 2011 See paragraph [0020]; and figure 1.</td>
<td>1-20</td>
</tr>
<tr>
<td>A</td>
<td>US 2010-0133026 Al (KIM et al.) 03 June 2010 See paragraphs [0028], [0029]; and figure 3.</td>
<td>1-20</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C.

See patent family annex.

*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

21 November 2013 (21.11.2013)

Date of mailing of the international search report

22 November 2013 (22.11.2013)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office

189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, R. Republic of Korea

Facsimile No. +82-42-472-7140

Authorized officer

SONG, Ho Keun

Telephone No. +82-42-481-5580

Form PCT/ISA/2.10 (second sheet) (July 2009)
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>US 2012-0103709 Al</td>
<td>03/05/2012</td>
<td>CN 102556049 A</td>
<td>11/07/2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 2447577 Al</td>
<td>02/05/2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 2447577 Bl</td>
<td>08/05/2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 2012-097813 A</td>
<td>24/05/2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KR 10-1302952 Bl</td>
<td>06/09/2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KR 10-2012-0046698 A</td>
<td>10/05/2012</td>
</tr>
<tr>
<td>US 4691148 A</td>
<td>01/09/1987</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 2067680 A3</td>
<td>05/08/2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 2009-137461 A</td>
<td>25/06/2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2009-0149295 Al</td>
<td>11/06/2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 1970240 A3</td>
<td>14/04/2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 5045431 B2</td>
<td>10/10/2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2008-0228363 Al</td>
<td>18/09/2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 8204659 B2</td>
<td>19/06/2012</td>
</tr>
<tr>
<td>US 2010-0133026 Al</td>
<td>03/06/2010</td>
<td>CN 101746248 A</td>
<td>23/06/2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KR 10-1000180 Bl</td>
<td>10/12/2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KR 10-2010-0062640 A</td>
<td>10/06/2010</td>
</tr>
</tbody>
</table>