Abstract:
An electric all-terrain vehicle has a range-extender in the form of an on-board gasoline engine. The engine drives an alternator, the electricity from which is available for driving the ATVs propulsion motor, and/or for re-charging the ATVs battery-pack. The nominal output of kilowatts of the range-extender is about one quarter of the nominal output of kilowatts of the ATVs propulsion motor.
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments
Title: RANGE EXTENDER FOR ELECTRIC VEHICLE

[001] That an electric vehicle may be equipped with a range-extender in the form of a secondary power-source is known to designers. The system as described herein focusses mainly on the applicability of range-extenders to electric off-road vehicles, or all-terrain vehicles (ATVs).

[002] For present purposes, an electric vehicle is defined as a vehicle in which the energy for powering the vehicle is derived from an on-board primary electrical energy storage station, for example a battery-pack.

[003] Also, for present purposes, an electric vehicle is defined as a vehicle in which the road wheels of the vehicle are driven by an electric motor, which is supplied with energy from the on-board energy storage station. Also, an electric vehicle is one in which the rotary armature of the electric motor is coupled mechanically to the driven road wheel or wheels.

[004] Although electric vehicles typically use batteries as their primary re-chargeable power source, other technologies, such as ultra capacitors, can be used as the primary re-chargeable power source. When they use batteries, vehicles typically use (heavy) lead-acid batteries, for cost reasons. The technology described herein can be applied to other kinds of primary re-chargeable power source.

[005] For present purposes, an off-road all-terrain vehicle is defined as follows. Statutory definitions of ATVs (in safety regulations, etc) are generally along the lines of "a vehicle that is propelled by motorised power and is adapted for travel both on and off a highway." Insofar as that statutory definition suffices, that is the definition used herein.

[006] As to its physical structure, an ATV is distinguished from other vehicles mainly by its tires. The tires of an ATV have knobbly treads; when the tire, properly inflated, and on the vehicle, is making a contact patch with a flat smooth surface, typically about half the area of the contact patch is occupied by chunky knob elements of the tire tread, and the other half is occupied by open spaces between the knob elements.

[007] Also, the tires of an ATV are soft. In an ATV, the air pressure in the tire, when the tire is properly inflated, and on the vehicle, is about ten pounds per square inch, or less. ATVs
may be open or enclosed, in that the seat or seats of the ATV may be open to the elements, or enclosed within bodywork.

[008] Generally, with electric vehicles, including electric ATVs, the amount of energy that can reasonably and conveniently be stored in electrical batteries carried on board the vehicle is, as a general rule, barely enough to drive the vehicle more than a few tens of kilometres.

[009] A range-extender provides a system for extending the range of an electric vehicle. A range-extender is distinguished from the primary energy source of the vehicle (usually, a battery-pack) and associated re-charging system (which might or might not be carried on-board the electric vehicle). A range-extender, for present purposes, involves the addition to an electric vehicle of an on-board secondary source of electrical energy.

[0010] Typically, the range-extender, or on-board secondary source of electrical energy, includes an internal combustion engine and associated fuel tank, coupled with an alternator or other generator. The electricity from the alternator is made available in such manner as to re-charge the primary batteries, or as to assist directly in supplying power to the propulsion motors, or as a combination of the two.

GENERAL FEATURES OF THE INVENTION

[0011] The range-extender described herein includes a secondary quantity of energy, and a secondary energy-storage-station on board the vehicle, for storing the secondary energy. For example, the secondary energy-storage-station can be a quantity of gasoline, stored in a suitable tank that is provided for the purpose on board the vehicle. The secondary energy-storage-station also includes a system for converting the secondary quantity of stored energy into current electricity.

[0012] An electric vehicle already includes a primary drive-controller, which is operationally effective to receive electricity from the primary on-board energy-storage-station and to feed that electricity to the propulsion motor in an efficient manner, under the control of the vehicle operator.

[0013] When the vehicle includes a range-extender, a secondary drive-controller can be added, or can be incorporated into the primary drive-controller, to control the transference of
the secondary energy from the secondary energy-storage-station.

[0014] The secondary drive-controller of the range-extender should be arranged to present the secondary electricity to the on-board primary-electrical-energy-storage-station in such manner that the secondary energy is added to the stock of energy stored in the primary station. For example, where the primary electrical energy storage-station is a battery-pack, the drive-controller uses electricity from the electricity-generator (and thus from the secondary energy-storage-station) to re-charge the batteries.

[0015] The secondary drive-controller can also be arranged to be effective to transfer all, or some of, the energy from the secondary energy-storage-station to be used directly to drive the propulsion motor(s) of the vehicle. The controller can also be arranged to coordinate on-board sensors that sense various parameters of the electrical system of the vehicle ~ in order, for example, to control automatically when, and whether or not, energy is to be taken from the range-extender, and if so at what kilowatts.

[0016] The range-extender, or secondary energy system, provided by the technology described herein preferably is applied, as mentioned, to off-road ATVs. It is recognised that the differences in running conditions, or operational usage conditions, between e.g on-road cars and off-road ATVs mean that certain savings can be made in the case of ATVs. As a result, range-extenders can be added more economically to ATVs than to on-road vehicles. Further consideration of these aspects is described below.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0017] The technology will now be further described with reference to the accompanying drawing, which is a diagram of an electric ATV.

[0018] The scope of the patent protection sought herein is defined by the accompanying claims. The apparatuses and procedures shown in the accompanying drawings and described herein are examples.

[0019] The electric ATV 21 of Fig.1 has an on-board primary energy-storage-station in the form of a battery-pack 23. Wires 25 conduct electricity from the battery pack 23, via a primary drive-controller 27, to an electric propulsion motor (in this example, actually two propulsion
devices 29), the armatures of which are mechanically direct-coupled to the road-wheels 30.

[0020] In this example, four batteries 32 are set up in series to deliver a nominal forty-eight volts to the propulsion motor 29. The batteries have a capacity of 245ampere-hours. At 48v, this represents an on-board stored-energy capacity of almost twelve kilowatt-hours.

[0021] The ATV is provided with a plug-in mains-charger 34 (which might or might not be carried on board the ATV). The mains-charger 34 derives its power from a simple domestic 110v 15amp supply, and the mains-charger 34 conveys DC electrical energy into the depleted batteries 32 at a voltage of 50v or 55v and a current of around 30amps, i.e. at an energy-transfer rate of about 1.5 kilowatts. At that, a 245amp-hour (12kW-hour) battery-pack can be restored from depleted to re-charged in about eight hours.

[0022] The two electric propulsion devices of the ATV 21 have a nominal maximum power draw rating of ten kilowatts each, for an aggregate motor rating of twenty kilowatts. That is the maximum power the propulsion system can deliver; most of the time, the energy needed to power the vehicle is drawn from the batteries at a lower rate than that.

[0023] (It will be understood that the figures mentioned herein are idealised to 100%-efficiency. Skilled designers of electric ATV propulsion systems can be credited with knowing how to make allowance for the inevitable inefficiencies.)

[0024] On board the ATV 21 is a range-extender 36, or secondary energy storage-system, which includes a tank for storing gasoline. The gasoline feeds an internal combustion engine 38, which is direct-coupled to an alternator 40. In the example, the alternator 40 is rated at five kilowatts, and the designer should see to it that the i.c.engine 38 is capable and suitable for powering the alternator 40 to produce up to its nominal maximum output.

[0025] I.c.engines can be made to run very economically when constrained to a constant running speed, and that is easy to arrange in the case of the range-extender 36. However, the designer might wish to include engine running-speed as one of the variables of a drive-control system, which is aimed at maximising the overall efficiency and economy of the range-extender, and the primary power system, as a whole system.

[0026] Wires 43 convey the current generated by the alternator 40 to the secondary drive-controller 45, in coordination with the primary-drive-controller 27, from which the generated
current is conveyed to either the drive-motor 29 or to the battery pack 23, or to both.

[0027] A five-kilowatt range-extender, working at 48v, can produce a maximum of about 100amps of electricity. It may be noted that the size of (copper) wires needed to conduct such an amperage, on a continuous basis, is in the 2-AWG to 0-AWG range. Such currents, and the wire size needed to conduct them, though common in electric vehicles, are outside the range that can conveniently and safely be accommodated in domestic mains wiring systems. However, such currents and wire sizes are not problematic on an electric vehicle.

[0028] The regular 1.5 kilowatt mains-charger 34 of the vehicle is not able to perform the task of extending the range of the vehicle, in the sense of extending the distance that can be travelled in a single journey, or in a single series of journeys that are separated by only short periods of time.

[0029] Generally for electric vehicles (and especially for off-road ATVs), conveniently-spaced service-stations, in which large charging currents are available, are not (yet) in existence. But even if they were, still the vehicle users would not wish to wait, with the vehicle parked, while the batteries were being re-charged. Even if the available charging current at the service-station is higher than 30amps - say a hundred amps or more - still it would take some hours to re-charge the batteries, and the ATV would have to remain parked during that time.

[0030] To be useful, the range-extender needs to re-charge the batteries while the vehicle (or rather, its electric propulsion motor) continues running. Now, a range-extender might be regarded as useful, to an extent, even if it were only capable of feeding some small secondary energy into the propulsion motors, and thus contributing to relieving the battery-pack from further depletion. In order for the range-extender to function simply to supplement the electrical power being fed to the propulsion motors, the range-extender only needs to supply power at a small rate of kilowatts.

[0031] But it is much preferred that the range-extender should be capable of re-charging the batteries. In order for the range-extender to re-charge the batteries, while the vehicle is running, the range-extender needs to supply electricity from the on-board energy-storage station at a greater rate of kilowatts than the propulsion motor 29 is drawing electricity from the batteries.

[0032] Thus, if at a particular moment, the propulsion motor is drawing electricity at e.g twelve
kilowatts, the designer had better see to it that the range-extender supplies electricity at a rate of say thirteen kilowatts, or more, in order for the range-extender to be effective to start to re-charge the batteries. The more kilowatts the range-extender can supply, in excess of the kilowatts needed to drive the motor, the faster the batteries will be re-charged.

[0033] Now, when a vehicle is running, the proportion of the running time that is spent with the propulsion motor running at, or even near, its maximum (nominal) power draw is (usually) very small. The range-extender does not need to be so powerful that it can re-charge the batteries all the time, including when the propulsion motor is drawing its full power.

[0034] The power draw of the propulsion motor, though subject to peaks and troughs, moment by moment, averages out over a period of driving, and a number can be computed as to the average rate at which power was consumed by the propulsion motor, over the whole journey.

[0035] Thus, the important aspect, if the range-extender is to be a useful addition to the electric vehicle, is that the kilowatts produced by the range-extender should exceed ~ not the maximum power draw of the propulsion motor, but - this averaged-out kilowatts drawn by the propulsion motor, and should exceed it by a sufficient margin preferably to bring the batteries up to full charge, or at least to make a significant contribution in that direction.

[0036] Now, of course, the averaged-out kilowatts drawn by the propulsion motor of an electric vehicle will be different for different drivers, and for different types of journey. The averaged kilowatt-draw will even be different for the same driver doing the same journey on different days. Nevertheless, the designers of the drive system for an electric vehicle, seeking to decide what power output is needed from the range-extender, must have knowledge of the magnitude of the averaged-out power draw of the motor.

[0037] If the designers provide only a small range-extender, the small range-extender might be able to supply enough power to make a contribution to reducing the depletion rate of the batteries. But, again, that really is not good enough - it is highly preferable that the range-extender should have enough excess power, over the averaged-out power draw of the propulsion motor, to significantly re-charge the primary batteries.

[0038] At the other end of the scale, it is equally possible for the power output of the range-extender to be too large. It becomes uneconomical to provide an over-large range-extender,
not only in terms of the initial cost of the range-extender, but in providing the on-board infrastructure, on the vehicle, to accommodate it.

[0039] Of course, a range-extender adds cost to the electric vehicle. In order for that excess cost to be regarded as worthwhile on the part of the owner, and prospective purchaser, the designer must balance the advantage of being able to re-charge the batteries with the increasing marginal cost of providing a range-extender with enough power to do that.

[0040] It is recognised that, in the case of an on-road car, for example, a range-extender should have a nominal maximum power output, in kilowatts, that is about half of the nominal maximum power drawn by the propulsion motor. If the range-extender on an on-road electric car were to be smaller than that, the range-extender would, unfortunately, be perceived merely as a limp-home aid, rather than as a means for extending the time and distance over which the car can maintain the normal level of performance for which the vehicle was purchased. A perception on the part of users and purchasers that a particular on-road car has been provided with (and therefore needs) a limp-home aid, would generally be regarded as undesirable.

[0041] The same is true of an electric ATV, of course. However, it is recognised that, in the case of an electric off-road ATV, the corresponding power output that the designer should aim for, when designing the range-extender, is about half what it needs to be for the corresponding on-road car.

[0042] To compare some actual figures, consider the case of an electric vehicle that has a propulsion motor having a maximum nominal power draw of twenty kilowatts. If the vehicle is a 20kW on-road car, that car would need to be equipped with a 10kW range-extender. But if the vehicle is a 20kW off-road ATV, that ATV now only needs to be equipped with a 5kW range-extender, to achieve a similarly-effective level of usefulness of the range-extender.

[0043] It will be understood that this difference is highly significant. One of the major factors inhibiting the advancement of electric cars is the shortness of the range of on-road electric cars for a given cost, and weight, of the on-board primary energy source. A reasonably economical range-extender would improve the advancement of acceptance of electric cars, if only such a range-extender were practicable. It might not be too much to say that the need, with on-road cars, for the range-extender to be half as powerful as the propulsion motor, is a prohibitively large barrier to the acceptance of electric on-road cars.
In the case of ATVs, however, the range-extender only needs to be half what is needed for a car, i.e. the range-extender for a 20kW ATV need only be a quarter of the output kilowatts of the propulsion motor, i.e. only a 5kW range-extender is needed on a 20kW ATV. A range-extender that small can be very cost-effective. That is to say, an off-road ATV can indeed be provided with an effective range-extender at an economical cost.

Such a low-powered range-extender on an on-road car would likely (and justifiably) be disdained as being hardly more than a limp-home aid. On an ATV, such a low-powered (and low cost) addition to the ATV can be perceived as indeed a very effective range-extender.

This difference in required power output of the range-extender, between a car and an ATV can mean this: that it is economical to provide a range-extender on an off-road ATV, but it is not economical to provide a range-extender on an on-road vehicle. And, given that the provision of an economical range-extender, when it comes to electric vehicles generally, can be of the essence, this difference might be regarded as crucial to the larger question of which types of vehicle are more suitable for the move to electric propulsion.

The reasons for this difference, between electric on-road cars and electric off-road ATVs, as to the performance of the range-extender, will now be reviewed.

Of course, not all on-road car drivers use all on-road cars with the same power-usage pattern, and the same observation can be made in respect of ATV drivers. However, it is recognised that the usage patterns of off-road ATVs and of on-road cars do differ so generally, and to such an extent, that the designers indeed are enabled to make different choices, when it comes to engineering the range-extender, as between the two types of vehicle.

Comparing an off-road all-terrain electric vehicle with an on-road electric car, the energy-draw is generally, on the average, greater for an ATV than for the corresponding on-road car at the same speed. On the other hand, operating speeds are generally slower for an ATV. Also, the moment-by-moment variations in energy-draw are generally significantly wider for an ATV than for a car.

But one of the key differences between on-road cars and off-road ATVs is that the propulsion motor of an on-road car can be working at a significantly-higher fraction of its nominal maximum power rating for long periods. This can occur, for example, when the car is cruising along the highway. An ATV, on the other hand, is hardly ever driven in such manner
that the propulsion motors are drawing a prolonged significantly-high fraction of their maximum nominal power.

[0051] ATV usage does not, as an averaging generality, include long periods of relatively high-power cruising. It may be noted that it is not really practicable for the car driver to avoid prolonged high-power draws. If the drivers' route involves highway cruising, the drivers do not want to hear that they should slow down, in order to conserve battery power; rather, car drivers refrain from purchasing electric cars, because electric cars cannot cruise for long periods at higher speeds.

[0052] It is recognised that, in order for a range-extender to be practical and useful, in the case of an electric on-road car, the range-extender should be capable of delivering almost as much power as the propulsion motors, in order to have any chance of having enough power left over for charging the batteries, during a typical car journey. Typically, when an electric car is fitted with a range-extender that is powerful enough that it can significantly re-charge the batteries, the number of kilowatts of rated power output from the range-extender has to be about half the rated kilowatts of the car's propulsion motor.

[0053] An electric off-road ATV, however, is not subject to such a heavy compromise. In an ATV, because of the different average driving-usage patterns, a range-extender can be as effective, at a quarter of the power of the propulsion motor, as, in a car, an extender having half the power of the propulsion motor. On an ATV, a range-extender as small as a quarter of the motor power is economical enough to be actually considered, even by economy-conscious ATV designers, for inclusion on the ATV.

[0054] The following point might also be considered. It may be surmised that the usage-pattern for an open-seat ATV is mainly one of recreational driving, whereas the usage pattern of a covered or enclosed ATV might well include journey travel, i.e. travelling for the purpose of reaching a remote destination. Thus, the usage pattern of a covered ATV might approach the prolonged-high-speed-cruising usage of the on-road car, by comparison with an open ATV. For this reason, it might be the case that the open ATV, as a class of vehicle, is able to get way with smaller range-extenders than the enclosed ATV.

[0055] It has been mentioned that, for an ATV, the range-extender preferably should have a power rating (REK kilowatts) of about one quarter of the power rating of the propulsion motor (PMK kilowatts). It is preferred not to depart too much from this one-quarter figure, for the
reasons as described above. Thus, the range-extender might be regarded as approaching being uneconomically large if the REK kilowatts figure were to exceed about forty percent of the PMK figure. On the other hand, the range-extender might be regarded as approaching being too small to be useful, as described herein, if the REK kilowatts figure were to be less than about fifteen percent of the PMK figure.

[0056] The expression "motor" should be construed herein to include the plural; that is to say, if, in a particular vehicle, there are two devices on the vehicle both of which do or can convert electricity to rotary motive power for propelling the vehicle, the expression "motor" in that case would encompass the aggregation of those two devices.

[0057] The numerals used in the drawing may be summarised as:-

21 ATV
23 battery-pack
25 wires connecting 23 to 27
27 primary drive-controller
29 propulsion motor
30 road wheels
32 batteries
34 mains charger
36 range extender
38 i.c.engine
40 alternator
43 wires connecting 40 to 45
45 secondary drive-controller
CLAIM 1. Electric vehicle, wherein:

[2] the vehicle has an electric propulsion motor, which is coupled mechanically to the driven road wheel or wheels;

[3] the propulsion motor has an aggregate maximum power rating of PMK kilowatts;

[4] the vehicle has an on-board primary electricity-storage-station;

[5] the vehicle has a drive-controller, which is arranged to convey electricity from the primary energy-storage-station, via the drive-controller, to the propulsion motor, to propel the vehicle;

[6] the vehicle includes an on-board range-extender;

[7] the range-extender includes an on-board secondary energy-storage-station;

[8] the range-extender includes an energy-convertor, for converting energy from the energy-storage-station into electricity;

[9] the range-extender includes a secondary drive-controller, which is arranged to convey electricity from the energy-storage-station, via the secondary drive-controller:-

[10] (a) to the propulsion motor, to propel the vehicle; or

[11] (b) to the primary electricity-storage-station, to add to the stock of energy therein;

[12] (c) or to both;

[13] the energy-convertor has a maximum power rating of REK kilowatts;

[14] the REK kilowatts figure is about forty percent of the PMK kilowatts figure, or less.

Claim 2. As in claim 1, wherein the REK kilowatts figure is about one quarter of the PMK kilowatts figure.

Claim 3. As in claim 1, wherein the vehicle is an electric all-terrain vehicle, or ATV, being an electric vehicle that is structurally suitable for travel both on and off a highway.

Claim 4. As in claim 3, wherein the vehicle is an ATV in that the vehicle has tires, in respect of each of which, when the tire, properly inflated, and on the vehicle, makes a contact patch with a flat smooth surface:-

[2] approximately about half the area of the contact patch is occupied by tread knobs or elements of the tire; and

[3] the remainder of the contact patch is occupied by open spaces between the tread elements.
Claim 5. As in claim 3, wherein the vehicle is an ATV in that the vehicle has tires, in respect of each of which, the tire, properly inflated, and on the vehicle, has a tire pressure of about ten pounds per square inch, or less.

Claim 6. As in claim 3, wherein the driver's seat of the ATV is open to the elements.

Claim 7. As in claim 1, wherein the primary electricity-storage-station is a pack of rechargeable batteries.

Claim 8. As in claim 1, wherein the vehicle includes a mains-battery-charger, which has the capability to be plugged into mains electricity, and to transfer electricity therefrom to the battery pack, and thereby to re-charge the batteries in the battery-pack.

Claim 9. As in claim 1 wherein:
[2] the on-board secondary energy-convertor of the range-extender includes an internal-combustion engine, and includes an electrical alternator driven by the engine; and
[3] the secondary energy-storage-station includes a stock of fuel for the engine, stored on board the ATV.

Claim 10. As in claim 1, wherein the REK kilowatts figure is about one fifth of the PMK kilowatts figure, or more.

Claim 11. As in claim 4, wherein:
[2] the primary electricity-storage-station is a pack of rechargeable batteries, having an energy capacity of about twelve kilowatt hours;
[3] the propulsion motor of the ATV is rated at a nominal maximum power draw of about twenty kilowatts;
[4] the range-extender of the ATV has capacity to produce electricity at a nominal maximum power rating of five kilowatts.

Claim 12. As in claim 1, wherein the REK kilowatts figure is high enough that the range extender can supply electricity:-
[2] (a) to the propulsion motor, to propel the vehicle; and
[3] (b) to the primary electricity-storage-station, to add to the stock of energy therein;
[4] (c) both at the same time.
A. CLASSIFICATION OF SUBJECT MATTER

IPC: B60L 11/00 (2006.01), B60L 11/12 (2006.01), B60L 11/18 (2006.01), B60L 15/00 (2006.01)

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)

IPC (2006.01): B60L

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

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


Keywords: electric*, vehicle, hybrid, range, extend*, energy, convert*, stor*, controller, kilowatt.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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<td>US 5 559 420 (Kohchi), 24 September 1996 (24-09-1996) *See whole document</td>
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[ ] Further documents are listed in the continuation of Box C. [X] 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
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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

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<tr>
<td></td>
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<td>WO 2005073006A1</td>
<td>11-08-2005</td>
</tr>
<tr>
<td>US 7237634B2</td>
<td>03-07-2007</td>
<td>AT 2831.79T</td>
<td>15-12-2004</td>
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<tr>
<td></td>
<td></td>
<td>AU 6019299A</td>
<td>03-04-2000</td>
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<td></td>
<td>AU 2002307045A1</td>
<td>15-10-2002</td>
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<td>BR 9913684A</td>
<td>27-11-2001</td>
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<tr>
<td></td>
<td></td>
<td>CA 2343056A1</td>
<td>23-03-2000</td>
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<td>CA 2343056C</td>
<td>09-01-2007</td>
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<td>CA 25561.95A1</td>
<td>23-03-2000</td>
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<td>DE 69922221.D1</td>
<td>30-12-2004</td>
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<td>DE 69922221.T2</td>
<td>02-03-2006</td>
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<td>DE 69922221.T8</td>
<td>24-08-2006</td>
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<td>EP 1113943A2</td>
<td>11-07-2001</td>
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<td></td>
<td>EP 1113943A4</td>
<td>04-12-2002</td>
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<td>EP 1113943B1</td>
<td>24-11-2004</td>
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<td>EP 1522450A2</td>
<td>13-04-2005</td>
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<td>EP 1522450A3</td>
<td>22-06-2005</td>
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<td>EP 1932704A2</td>
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<td>EP 1932704A3</td>
<td>26-11-2008</td>
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<td>27-07-2005</td>
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