



US007237634B2

(12) **United States Patent**
Severinsky et al.

(10) **Patent No.:** **US 7,237,634 B2**
(45) **Date of Patent:** ***Jul. 3, 2007**

(54) **HYBRID VEHICLES**

(75) Inventors: **Alex J. Severinsky**, Washington, DC (US); **Theodore Louckes**, Holly, MI (US)

(73) Assignee: **PAICE LLC**, Bonita Springs, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/229,762**

(22) Filed: **Jan. 13, 2006**

(65) **Prior Publication Data**
US 2006/0100057 A1 May 11, 2006

Related U.S. Application Data

(60) Division of application No. 10/382,577, filed on Mar. 7, 2003, now Pat. No. 7,104,347, which is a division of application No. 09/822,866, filed on Apr. 2, 2001, now Pat. No. 6,554,088, which is a continuation-in-part of application No. 09/264,817, filed on Mar. 9, 1999, now Pat. No. 6,209,672, said application No. 10/382,577 and a continuation-in-part of application No. 09/392,743, filed on Sep. 9, 1999, now Pat. No. 6,338,391.

(60) Provisional application No. 60/122,296, filed on Mar. 1, 1999, provisional application No. 60/100,095, filed on Sep. 14, 1998.

(51) **Int. Cl.**
B06K 6/02 (2006.01)

(52) **U.S. Cl.** **180/65.2**; 180/65.4; 180/701; 180/54

(58) **Field of Classification Search** 180/65.2, 180/65.3, 65.4, 65.8, 165; 477/2, 3; 701/54
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

913,846 A 3/1909 Pieper
1,824,014 A 9/1931 Froelich
2,666,492 A 1/1954 Nims et al.

(Continued)

FOREIGN PATENT DOCUMENTS

DE 2517110 10/1975

(Continued)

OTHER PUBLICATIONS

Winkelman et al, SAE paper 730511, "Computer Simulation . . ." (1973).

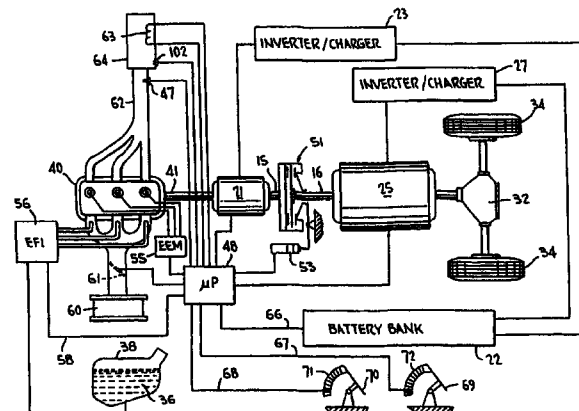
(Continued)

Primary Examiner—David R. Dunn
(74) *Attorney, Agent, or Firm*—Michael de Angeli

(57) **ABSTRACT**

A hybrid vehicle comprises an internal combustion engine, a traction motor, a starter motor, and a battery bank, all controlled by a microprocessor in accordance with the vehicle's instantaneous torque demands so that the engine is run only under conditions of high efficiency, typically only when the load is at least equal to 30% of the engine's maximum torque output. In some embodiments, a turbo-charger may be provided, activated only when the load exceeds the engine's maximum torque output for an extended period; a two-speed transmission may further be provided, to further broaden the vehicle's load range. A hybrid brake system provides regenerative braking, with mechanical braking available in the event the battery bank is fully charged, in emergencies, or at rest; a control mechanism is provided to control the brake system to provide linear brake feel under varying circumstances.

306 Claims, 17 Drawing Sheets



| U.S. PATENT DOCUMENTS | | | | | |
|-----------------------|--|--|-----------|---|----------------------------------|
| | | | 4,862,009 | A | 8/1989 King |
| | | | 4,923,025 | A | 5/1990 Ellers |
| | | | 4,951,769 | A | 8/1990 Kawamura |
| | | | 4,953,646 | A | 9/1990 Kim |
| | | | 5,000,003 | A | 3/1991 Wicks |
| | | | 5,053,632 | A | 10/1991 Suzuki et al. |
| | | | 5,081,365 | A | 1/1992 Field et al. |
| | | | 5,117,931 | A | 6/1992 Nishida |
| | | | 5,120,282 | A | 6/1992 Fjällström |
| | | | 5,125,469 | A | 6/1992 Scott |
| | | | 5,141,173 | A | 8/1992 Lay |
| | | | 5,172,784 | A | 12/1992 Varela, Jr. |
| | | | 5,176,213 | A | 1/1993 Kawai et al. |
| | | | 5,193,634 | A | 3/1993 Masut |
| | | | 5,212,431 | A | 5/1993 Origuchi et al. |
| | | | 5,242,335 | A | 9/1993 Kutter |
| | | | 5,249,637 | A | 10/1993 Heidl et al. |
| | | | 5,253,929 | A | 10/1993 Ohoi |
| | | | 5,255,733 | A | 10/1993 King |
| | | | 5,258,651 | A | 11/1993 Sherman |
| | | | 5,264,764 | A | 11/1993 Kuang |
| | | | 5,283,470 | A | 2/1994 Hadley et al. |
| | | | 5,291,960 | A | 3/1994 Brandenburg et al. |
| | | | 5,301,764 | A | 4/1994 Gardner |
| | | | 5,318,142 | A | 6/1994 Bates et al. |
| | | | 5,323,688 | A | 6/1994 Walker |
| | | | 5,323,868 | A | 6/1994 Kawashima |
| | | | 5,326,158 | A | 7/1994 Ohoi |
| | | | 5,327,987 | A | 7/1994 Abdelmalek |
| | | | 5,327,992 | A | 7/1994 Boll |
| | | | 5,336,932 | A | 8/1994 Barske |
| | | | 5,337,848 | A | 8/1994 Bader |
| | | | 5,343,970 | A | 9/1994 Severinsky 180/65.2 |
| | | | 5,345,154 | A | 9/1994 King |
| | | | 5,345,761 | A | 9/1994 King et al. |
| | | | 5,346,031 | A | 9/1994 Gardner |
| | | | 5,350,031 | A | 9/1994 Sugiyama et al. |
| | | | 5,371,412 | A | 12/1994 Iwashita |
| | | | 5,372,213 | A | 12/1994 Hasebe et al. |
| | | | 5,384,521 | A | 1/1995 Coe |
| | | | 5,403,244 | A | 4/1995 Tankersley |
| | | | 5,406,126 | A | 4/1995 Hadley et al. |
| | | | 5,412,251 | A | 5/1995 Furutani |
| | | | 5,412,293 | A | 5/1995 Minesawa et al. |
| | | | 5,415,245 | A | 5/1995 Hammond |
| | | | 5,415,603 | A | 5/1995 Tuzuki et al. |
| | | | 5,427,196 | A | 6/1995 Yamaguchi et al. |
| | | | 5,428,274 | A | 6/1995 Furutani et al. |
| | | | 5,433,282 | A | 7/1995 Moroto et al. |
| | | | 5,441,122 | A | 8/1995 Yoshida |
| | | | 5,457,363 | A | 10/1995 Yoshii et al. |
| | | | 5,463,294 | A | 10/1995 Valdivia |
| | | | 5,473,228 | A | 12/1995 Nii |
| | | | 5,476,151 | A | 12/1995 Tsuchida et al. |
| | | | 5,489,001 | A | 2/1996 Yang |
| | | | 5,492,189 | A | 2/1996 Krieglner et al. |
| | | | 5,492,190 | A | 2/1996 Yoshida |
| | | | 5,492,192 | A | 2/1996 Brooks et al. |
| | | | 5,495,906 | A | 3/1996 Furutani |
| | | | 5,495,907 | A | 3/1996 Data |
| | | | 5,495,912 | A | 3/1996 Gray, Jr. et al. |
| | | | 5,497,941 | A | 3/1996 Numazawa et al. |
| | | | 5,513,718 | A | 5/1996 Suzuki et al. |
| | | | 5,513,719 | A | 5/1996 Moroto et al. |
| | | | 5,515,937 | A | 5/1996 Adler et al. |
| | | | 5,539,318 | A | 7/1996 Sasaki |
| | | | 5,545,928 | A | 8/1996 Kotani |
| | | | 5,547,433 | A | 8/1996 Yang |
| | | | 5,549,524 | A | 8/1996 Yang |
| | | | 5,550,445 | A | 8/1996 Nii |
| | | | 5,558,173 | A | 9/1996 Sherman |

| | | | | | | | | |
|-----------|---|---------|--------------------|-----------|---|---------|----------------------|----------|
| 5,558,595 | A | 9/1996 | Schmidt et al. | 5,791,427 | A | 8/1998 | Yamaguchi et al. | |
| 5,562,565 | A | 10/1996 | Moroto et al. | 5,799,744 | A | 9/1998 | Yamaguchi et al. | |
| 5,562,566 | A | 10/1996 | Yang | 5,801,497 | A | 9/1998 | Shamoto et al. | |
| 5,565,711 | A | 10/1996 | Hagiwara | 5,804,947 | A | 9/1998 | Nii et al. | |
| 5,566,774 | A | 10/1996 | Yoshida | 5,806,617 | A | 9/1998 | Yamaguchi et al. | |
| 5,568,023 | A | 10/1996 | Grayer et al. | 5,816,358 | A | 10/1998 | Adler et al. | |
| 5,569,995 | A | 10/1996 | Kusaka et al. | 5,818,116 | A | 10/1998 | Nakae | |
| 5,570,615 | A | 11/1996 | Westphal et al. | 5,820,172 | A | 10/1998 | Brigham et al. | |
| 5,586,613 | A | 12/1996 | Ehsani | 5,823,280 | A | 10/1998 | Lateur | 180/65.2 |
| 5,588,498 | A | 12/1996 | Kitada | 5,823,281 | A | 10/1998 | Yamaguchi et al. | |
| 5,589,743 | A | 12/1996 | King | 5,826,671 | A | 10/1998 | Nakae et al. | |
| 5,608,308 | A | 3/1997 | Kiuchi et al. | 5,831,341 | A | 11/1998 | Selfors et al. | |
| 5,614,809 | A | 3/1997 | Kiuchi et al. | 5,833,022 | A | 11/1998 | Welke | |
| 5,621,304 | A | 4/1997 | Kiuchi et al. | 5,833,570 | A | 11/1998 | Tabata | |
| 5,623,194 | A | 4/1997 | Boll | 5,839,530 | A | 11/1998 | Dietzel | |
| 5,632,352 | A | 5/1997 | Jeanneret et al. | 5,839,533 | A | 11/1998 | Mikami et al. | |
| 5,635,805 | A | 6/1997 | Ibaraki et al. | 5,841,201 | A | 11/1998 | Tabata et al. | |
| 5,637,977 | A | 6/1997 | Saito et al. | 5,842,534 | A | 12/1998 | Frank | 180/65.2 |
| 5,637,987 | A | 6/1997 | Fattic et al. | 5,844,342 | A | 12/1998 | Miyatani et al. | |
| 5,643,119 | A | 7/1997 | Yamaguchi et al. | 5,845,731 | A | 12/1998 | Buglione et al. | 180/65.2 |
| 5,644,200 | A | 7/1997 | Yang | 5,846,155 | A | 12/1998 | Taniguchi et al. | |
| 5,650,713 | A | 7/1997 | Takeuchi et al. | 5,847,469 | A | 12/1998 | Tabata | |
| 5,650,931 | A | 7/1997 | Nii | 5,851,698 | A | 12/1998 | Reichmann et al. | |
| 5,653,302 | A | 8/1997 | Edye et al. | 5,856,047 | A | 1/1999 | Venkatesan et al. | |
| 5,656,921 | A | 8/1997 | Farrall | 5,856,709 | A | 1/1999 | Ibaraki et al. | |
| 5,660,077 | A | 8/1997 | Nekola | 5,862,497 | A | 1/1999 | Yano et al. | |
| 5,664,635 | A | 9/1997 | Koga et al. | 5,865,263 | A | 2/1999 | Yamaguchi et al. | |
| 5,667,029 | A | 9/1997 | Urban et al. | 5,873,426 | A | 2/1999 | Tabata | |
| 5,669,842 | A | 9/1997 | Schmidt | 5,875,691 | A | 3/1999 | Hata | |
| 5,672,920 | A | 9/1997 | Donegan et al. | 5,883,484 | A | 3/1999 | Akao | |
| 5,675,203 | A | 10/1997 | Schulze et al. | 5,883,496 | A | 3/1999 | Esaki et al. | |
| 5,675,222 | A | 10/1997 | Fliege | 5,887,670 | A | 3/1999 | Tabata et al. | |
| 5,678,646 | A | 10/1997 | Fliege | 5,887,674 | A | 3/1999 | Gray | |
| 5,679,087 | A | 10/1997 | Lutz | 5,890,470 | A | 4/1999 | Woon | |
| 5,680,050 | A | 10/1997 | Kawai et al. | 5,890,555 | A | 4/1999 | Miller | |
| 5,685,798 | A | 11/1997 | Lutz | 5,893,895 | A | 4/1999 | Ibaraki | |
| 5,691,588 | A | 11/1997 | Lutz | 5,895,100 | A | 4/1999 | Ito et al. | |
| 5,697,466 | A | 12/1997 | Moroto et al. | 5,895,333 | A | 4/1999 | Morisawa | 180/65.2 |
| 5,698,905 | A | 12/1997 | Ruthlein et al. | 5,898,282 | A | 4/1999 | Drozdz et al. | |
| 5,698,955 | A | 12/1997 | Nii | 5,899,286 | A | 5/1999 | Yamaguchi et al. | |
| 5,704,440 | A | 1/1998 | Urban et al. | 5,904,631 | A | 5/1999 | Morisawa et al. | |
| 5,705,859 | A | 1/1998 | Karg et al. | 5,905,360 | A | 5/1999 | Ukita | |
| 5,713,425 | A | 2/1998 | Buschhaus et al. | 5,907,191 | A | 5/1999 | Sasaki et al. | |
| 5,713,426 | A | 2/1998 | Okamura | 5,908,077 | A | 6/1999 | Moore | |
| 5,713,427 | A | 2/1998 | Lutz | 5,909,720 | A | 6/1999 | Yamaoka | |
| 5,713,814 | A | 2/1998 | Hara et al. | 5,914,575 | A | 6/1999 | Sasaki | |
| 5,714,851 | A | 2/1998 | Antony et al. | 5,915,488 | A | 6/1999 | Fliege | |
| 5,722,502 | A | 3/1998 | Kubo | 5,915,489 | A | 6/1999 | Yamaguchi | |
| 5,722,911 | A | 3/1998 | Ibaraki et al. | 5,923,093 | A | 7/1999 | Tabata | |
| 5,725,064 | A | 3/1998 | Ibaraki et al. | 5,924,395 | A | 7/1999 | Moriya et al. | |
| 5,755,302 | A | 5/1998 | Lutz | 5,927,415 | A | 7/1999 | Ibaraki et al. | |
| 5,755,303 | A | 5/1998 | Yamamoto et al. | 5,927,417 | A | 7/1999 | Brunner et al. | 180/65.6 |
| 5,757,151 | A | 5/1998 | Donegan et al. | 5,928,301 | A | 7/1999 | Soga et al. | |
| 5,767,637 | A | 6/1998 | Lansberry | 5,929,594 | A | 7/1999 | Nonobe et al. | |
| 5,771,478 | A | 6/1998 | Tsukamoto | 5,931,271 | A | 8/1999 | Haka | |
| 5,773,904 | A | 6/1998 | Schiebold et al. | 5,934,395 | A | 8/1999 | Koide et al. | 180/65.2 |
| 5,775,449 | A | 7/1998 | Moroto et al. | 5,935,040 | A | 8/1999 | Tabata et al. | |
| 5,778,326 | A | 7/1998 | Moroto et al. | 5,943,918 | A | 8/1999 | Reed, Jr. et al. | |
| 5,778,997 | A | 7/1998 | Setaka et al. | 5,944,630 | A | 8/1999 | Omote | |
| 5,785,136 | A | 7/1998 | Falkenmayer et al. | 5,947,855 | A | 9/1999 | Weiss | |
| 5,785,137 | A | 7/1998 | Reuyl | 5,951,115 | A | 9/1999 | Sakai et al. | |
| 5,785,138 | A | 7/1998 | Yoshida | 5,951,118 | A | 9/1999 | Soejima | |
| 5,786,640 | A | 7/1998 | Sakai et al. | 5,951,614 | A | 9/1999 | Tabata | |
| 5,788,003 | A | 8/1998 | Spiers | 5,964,309 | A | 10/1999 | Kimura et al. | |
| 5,788,004 | A | 8/1998 | Friedmann et al. | 5,967,940 | A | 10/1999 | Yamaguchi et al. | |
| 5,788,006 | A | 8/1998 | Yamaguchi et al. | 5,969,624 | A | 10/1999 | Sakai et al. | 340/636 |
| 5,788,597 | A | 8/1998 | Boll et al. | 5,971,088 | A | 10/1999 | Smith | |
| 5,789,823 | A | 8/1998 | Sherman | 5,971,092 | A | 10/1999 | Walker | |
| 5,789,877 | A | 8/1998 | Yamada et al. | 5,973,460 | A | 10/1999 | Taga et al. | |
| 5,789,881 | A | 8/1998 | Egami et al. | 5,973,463 | A | 10/1999 | Okuda et al. | |
| 5,789,882 | A | 8/1998 | Ibaraki et al. | 5,979,158 | A | 11/1999 | Kaiser | |

| | | | | | | | |
|-----------|----|---------|-----------------------------|-----------|-----------|---------|------------------------------|
| 5,983,740 | A | 11/1999 | Salecker et al. | 6,281,660 | B1 | 8/2001 | Abe |
| 5,984,034 | A | 11/1999 | Morisawa | 6,291,953 | B1 | 9/2001 | Lovatt et al. |
| 5,984,432 | A | 11/1999 | Otomo et al. | 6,300,735 | B1 | 10/2001 | Stemler |
| 5,986,376 | A | 11/1999 | Werson | 6,306,057 | B1 | 10/2001 | Morisawa |
| 5,988,307 | A | 11/1999 | Yamada et al. | 6,307,276 | B1 | 10/2001 | Bader |
| 5,991,683 | A | 11/1999 | Takaoka et al. | 6,315,068 | B1 * | 11/2001 | Hoshiya et al. 180/65.2 |
| 5,993,169 | A | 11/1999 | Adachi et al. | 6,317,665 | B1 | 11/2001 | Tabata et al. |
| 5,993,350 | A | 11/1999 | Lawrie et al. | 6,318,487 | B2 | 11/2001 | Yanase et al. |
| 5,993,351 | A | 11/1999 | Deguchi et al. 477/5 | 6,321,150 | B1 | 11/2001 | Nitta |
| 5,996,347 | A | 12/1999 | Nagae et al. | 6,328,122 | B1 | 12/2001 | Yamada |
| 6,003,626 | A | 12/1999 | Ibaraki et al. | 6,328,670 | B1 | 12/2001 | Minowa |
| 6,005,297 | A | 12/1999 | Sasaki et al. | 6,328,671 | B1 | 12/2001 | Nakajima |
| 6,006,149 | A | 12/1999 | Salecker et al. | 6,330,498 | B2 * | 12/2001 | Tamagawa et al. 701/22 |
| 6,006,620 | A | 12/1999 | Lawrie et al. | 6,332,257 | B1 | 12/2001 | Reed, Jr. et al. |
| 6,007,443 | A | 12/1999 | Onimaru | 6,334,498 | B1 | 1/2002 | Morisawa |
| 6,007,451 | A | 12/1999 | Matsui et al. | 6,338,391 | B1 | 1/2002 | Severinsky et al. |
| 6,009,365 | A | 12/1999 | Takahara et al. | 6,340,339 | B1 | 1/2002 | Tabata |
| 6,018,198 | A | 1/2000 | Tsuzuki et al. | 6,344,008 | B1 | 2/2002 | Nagano |
| 6,018,694 | A | 1/2000 | Egami et al. 701/102 | 6,357,541 | B1 | 3/2002 | Matsuda et al. |
| 6,019,698 | A | 2/2000 | Lawrie et al. | 6,359,404 | B1 * | 3/2002 | Sugiyama et al. 318/432 |
| 6,026,921 | A | 2/2000 | Aoyama et al. 180/65.2 | 6,387,007 | B1 | 5/2002 | Fini |
| 6,032,753 | A | 3/2000 | Yamazaki et al. | 6,394,209 | B1 | 5/2002 | Goehring et al. |
| 6,041,877 | A | 3/2000 | Yamada et al. | 6,435,296 | B1 | 8/2002 | Arai |
| 6,044,922 | A | 4/2000 | Field | 6,470,983 | B1 * | 10/2002 | Amano et al. 180/65.2 |
| 6,048,289 | A | 4/2000 | Hattori et al. 477/15 | 6,481,516 | B1 | 11/2002 | Field et al. |
| 6,053,841 | A | 4/2000 | Koide et al. | 6,563,230 | B2 | 5/2003 | Nada |
| 6,053,842 | A | 4/2000 | Kitada et al. 477/5 | 6,592,484 | B1 | 7/2003 | Tsai |
| 6,054,844 | A | 4/2000 | Frank 322/16 | | | | |
| RE36,678 | E | 5/2000 | Moroto et al. | | | | |
| 6,059,059 | A | 5/2000 | Schmidt-Brucken | | | | |
| 6,059,064 | A | 5/2000 | Nagano et al. | DE | 1905641 | 6/1976 | |
| 6,064,161 | A | 5/2000 | Takahara | DE | 19814402 | 3/1998 | |
| 6,067,801 | A | 5/2000 | Harada et al. | DE | 19838853 | 8/1998 | |
| 6,070,680 | A | 6/2000 | Oyama | EP | 136055 | 3/1985 | |
| 6,074,321 | A | 6/2000 | Maeda et al. | EP | 0136055 | 3/1985 | |
| 6,077,186 | A | 6/2000 | Kojima et al. | EP | 510582 | 10/1992 | |
| 6,081,042 | A | 6/2000 | Tabata et al. | EP | 0510582 | 12/1995 | |
| 6,087,734 | A | 7/2000 | Maeda et al. | EP | 0743211 | 5/1996 | |
| 6,090,007 | A | 7/2000 | Nakajima | EP | 0769403 | 4/1997 | |
| 6,098,733 | A | 8/2000 | Ibaraki et al. | EP | 0839683 | 10/1997 | |
| 6,109,025 | A | 8/2000 | Murata et al. | FR | 2419832 | 3/1978 | |
| 6,110,066 | A | 8/2000 | Nedungadi et al. | JP | S 4849115 | 10/1971 | |
| 6,116,363 | A | 9/2000 | Frank | JP | S 5030223 | 7/1973 | |
| 6,119,799 | A | 9/2000 | Morisawa | JP | 4864626 | 9/1973 | |
| 6,123,163 | A | 9/2000 | Otsu et al. | JP | 4929642 | 8/1974 | |
| 6,123,642 | A | 9/2000 | Saito | JP | 51103220 | 8/1976 | |
| 6,131,538 | A | 10/2000 | Kanai | JP | 5355105 | 5/1978 | |
| 6,131,680 | A | 10/2000 | Nii et al. | JP | 55069724 | 11/1978 | |
| 6,135,914 | A | 10/2000 | Yamaguchi et al. | JP | 55110328 | 8/1980 | |
| 6,142,907 | A | 11/2000 | Minowa | JP | H 564531 | 9/1984 | |
| 6,146,302 | A | 11/2000 | Kashiwase | JP | 62113956 | 5/1987 | |
| 6,155,364 | A | 12/2000 | Nagano et al. | JP | 6382283 | 6/1988 | |
| 6,158,541 | A | 12/2000 | Tabata | JP | 3124201 | 10/1989 | |
| 6,161,384 | A | 12/2000 | Reinbold et al. | JP | 04274926 | 2/1991 | |
| 6,166,499 | A | 12/2000 | Kanamori et al. | JP | 3273933 | 5/1991 | |
| 6,170,587 | B1 | 1/2001 | Bullock | JP | 467703 | 3/1992 | |
| 6,176,807 | B1 | 1/2001 | Oba et al. | JP | 5319110 | 5/1992 | |
| 6,183,389 | B1 | 2/2001 | Tabata et al. | JP | 4244658 | 9/1992 | |
| 6,190,282 | B1 | 2/2001 | Deguchi et al. | JP | 4297330 | 10/1992 | |
| 6,203,468 | B1 | 3/2001 | Nitta | JP | 06080048 | 11/1992 | |
| 6,204,636 | B1 | 3/2001 | Kinoshita et al. | JP | 06144020 | 11/1992 | |
| 6,209,672 | B1 | 4/2001 | Severinsky | JP | 6245317 | 2/1993 | |
| 6,225,784 | B1 | 5/2001 | Kinoshita et al. | JP | 7172196 | 9/1994 | |
| 6,231,135 | B1 | 5/2001 | Bower et al. | JP | 754983 | 2/1995 | |
| 6,232,733 | B1 | 5/2001 | Obayashi et al. | JP | 7268922 | 10/1995 | |
| 6,232,748 | B1 | 5/2001 | Kinoshita et al. | JP | 9170533 | 5/1996 | |
| 6,247,437 | B1 | 6/2001 | Yamaguchi et al. | JP | 8214592 | 8/1996 | |
| 6,253,865 | B1 | 7/2001 | Suzuki | JP | 1066383 | 3/1998 | |
| 6,258,001 | B1 | 7/2001 | Wakuta | JP | 11082260 | 3/1999 | |
| 6,260,644 | B1 | 7/2001 | Otsu | JP | 11082261 | 3/1999 | |
| 6,265,692 | B1 | 7/2001 | Umebayahi et al. | JP | 11122712 | 4/1999 | |

FOREIGN PATENT DOCUMENTS

| | | |
|----|-----------|---------|
| DE | 1905641 | 6/1976 |
| DE | 19814402 | 3/1998 |
| DE | 19838853 | 8/1998 |
| EP | 136055 | 3/1985 |
| EP | 0136055 | 3/1985 |
| EP | 510582 | 10/1992 |
| EP | 0510582 | 12/1995 |
| EP | 0743211 | 5/1996 |
| EP | 0769403 | 4/1997 |
| EP | 0839683 | 10/1997 |
| FR | 2419832 | 3/1978 |
| JP | S 4849115 | 10/1971 |
| JP | S 5030223 | 7/1973 |
| JP | 4864626 | 9/1973 |
| JP | 4929642 | 8/1974 |
| JP | 51103220 | 8/1976 |
| JP | 5355105 | 5/1978 |
| JP | 55069724 | 11/1978 |
| JP | 55110328 | 8/1980 |
| JP | H 564531 | 9/1984 |
| JP | 62113956 | 5/1987 |
| JP | 6382283 | 6/1988 |
| JP | 3124201 | 10/1989 |
| JP | 04274926 | 2/1991 |
| JP | 3273933 | 5/1991 |
| JP | 467703 | 3/1992 |
| JP | 5319110 | 5/1992 |
| JP | 4244658 | 9/1992 |
| JP | 4297330 | 10/1992 |
| JP | 06080048 | 11/1992 |
| JP | 06144020 | 11/1992 |
| JP | 6245317 | 2/1993 |
| JP | 7172196 | 9/1994 |
| JP | 754983 | 2/1995 |
| JP | 7268922 | 10/1995 |
| JP | 9170533 | 5/1996 |
| JP | 8214592 | 8/1996 |
| JP | 1066383 | 3/1998 |
| JP | 11082260 | 3/1999 |
| JP | 11082261 | 3/1999 |
| JP | 11122712 | 4/1999 |

WO WO9924280 11/1997

OTHER PUBLICATIONS

- Berman et al, IEEE VT-23, No. 3, pp. 61-72 "Propulsion Systems . . ." (1974).
- Berman SPC-TUE-2 "Battery Powered Regenerative SCR Drive" (1970).
- Gelb et al "Performance Analyses . . ." ACS pub (1972), pp. 997-988.
- Berman SPC-TUE-1 "Design Considerations . . ." (1971).
- Berman SPC-TUE-2 "All Solid State Method . . ." (1971).
- Minorikawa et al, "Current Status and Future Trends . . ." (Undated).
- Baum et al "Semiconductor Technologies . . ." (Undated).
- Chen "Automotive Electronics in the Year 2000 . . ." (Apparently 1992).
- Brusaglino, SAE paper 910244 "Electric Vehicle Development . . ." (1991).
- Anderson et al, SAE paper 910246 "Integrated Electric . . ." (1991).
- Burke, SAE paper 911914 "Battery Availability for Near-Term . . ." (1991).
- Chang, IEEE AES Magazine (1993) "Recent Developments of Electric . . .".
- Kamiyama et al, IEEE 0-7803-0582-5 (1992) "Application Trends . . .".
- Sen, IEEE Trans. Ind. Elec. (1990) "Electric Motor Drives . . .".
- Wang et al, PCSC '71 Record, "Analysis of SCR Chopper Drive" (1971).
- EPRI Report TR-101264 Assessment of Electric Motor Technology (1992).
- Berman et al, SAE paper 720111 "Electric Car Drives . . ." (1972).
- Gelb et al, "The Application of Solid Electrolyte Batteries . . ." (Undated).
- Miller, "Integrated Power Module Requirements for Automotive . . ." (Undated).
- Vukosavic et al, IEEE Trans. Ind. App. "SRM Inverter Topologies . . ." (1991).
- Published application US 2001/0037905, Nogi et al., Nov. 2001.
- Published patent application US 2003/0085577 of Takaoka et al, May 8, 2003.
- Mayrhofer et al "A Hybrid Drive Based on a Structure Variable Arrangement" (1994).
- "Diesel-Electric VW", *Popular Science*, Dec. 1990, p. 30.
- "Electric Vehicles Only", *Popular Science*, May 1991, pp. 76-81 and 110.
- "Lightweight, High-Energy Lead/Acid Battery" *NASA Tech Briefs*, Apr. 1991, 22-24.
- Yamaguchi et al, "Dual System—Newly Developed Hybrid System" (incomplete).
- Takaoka et al "A High-Expansion-Ratio Gasoline Engine for the Toyota Hybrid System", *Toyota Technical Review* vol. 47, No. 2, Apr. 1998.
- Sasaki et al, "Toyota's Newly Developed Electric-Gasoline Hybrid Powertrain System" (publication data not available).
- Ehsani et al "Propulsion System Design of Electric and Hybrid Vehicles", *IEEE Trans. Ind. Elec.*, 44 1 (1997).
- Ehsani et al, "Parametric Design of the Drive Train of an Electrically Peaking Hybrid (ELPH) Vehicle", SAE paper 970294 (1997).
- Yamaguchi et al, "Development of a New Hybrid System—Dual System", SAE papers 960231 (1996).
- Simanaitis, "Electric Vehicles", *Road & Track*, May 1992, pp. 126-136.
- Reynolds, "AC Propulsion CRX", *Road & Track*, Oct. 1992, pp. 126-129.
- Kalberlah, "Electric Hybrid Drive Systems . . .", SAE Paper No. 910247, 1991.
- Bullock, "The Technological Constraints of Mass, Volume, Dynamic Power Range and Energy Capacity . . ." SAE Paper No. 891659 1989.
- Wouk, "Hybrids: Then and Now", *IEEE Spectrum*, vol. 32, 7, Jul. 1995.
- Bates, "Getting a Ford HEV on . . .", *IEEE Spectrum*, vol. 32, 7, Jul. 1995.
- King et al, "Transit Bus takes . . .", *IEEE Spectrum*, vol. 32, 7, Jul. 1995.
- Yamaguchi, "Toyota readies gasoline/electric hybrid system", *Automotive Engineering*, Jul. 1997, pp. 55-58.
- Wilson, "Not Electric, Not Gasoline . . ." *Autoweek*, Jun. 2, 1997, pp. 17-18.
- Bulgin, "The Future Works, Quietly", *Autoweek*, Feb. 23, 1998 pp. 12-13.
- "Toyota Electric and Hybrid Vehicles", a Toyota brochure.
- Trial and deposition transcripts of witnesses relied upon to assert invalidity of parent patents in Civil Docket No. 2:04-CV-211-DF (E. D. Texas).
- Claim construction order entered Sep. 28, 2005 in Civil Docket No. 2:04-CV-211-DF (E. D. Texas).
- Toyota Hybrid System, Toyota Press Information, Tokyo, 1997.
- Prius Hybrid EV, Toyota brochure, undated.
- Miller et al, "Starter-Alternator for Hybrid Electric Vehicle . . ." (1996).
- Johnston et al, "The Design and Development of the (UC Davis) . . ." (No date).
- Johnston et al, "The Design and Development of the (UC Davis) . . ." 1997.
- Alexander et al, "A Mid-Sized Sedan Designed for High Fuel . . ." (No date).
- "PRIUS New Car Features", (Toyota manual) (1998).
- TRW Systems Group, "Analysis and Advanced Design Study . . ." (1971).
- Gelf, "An Electromechanical Transmission for Hybrid Vehicle . . ." (1971).
- Hirose et al, "The New High Expansion Ratio Engine . . ." (1997).
- Hong, "Toyota's Hybrid Program", *Road & Track*, Aug. 1997.
- Law, "Toyota Tech", *Car & Driver*, Aug. 1997.
- "Dual-Engine Fuel Saver", *Popular Mechanics*, Jul. 1997.
- "Toyota Launches Break-Through Hybrid EV", *Motor Trend*, Sep. 1997.
- "Toyota touts advances in safety, emissions", *Automotive News*, Apr. 28, 1997.
- "'96 North Wind Performance", undated.
- Wakefield, "History of the Electric Automobile—Hybrid Electric Vehicles" (1998).
- "Escort 92-94", undated.
- "Near-Term Hybrid Vehicle Program", General Electric Company (1979).
- "Electric and Hybrid Vehicle Design Studies", SAE SP-1243 (1997).
- Gleb, "The case for Constant Speed Accessory Drives", (1975).
- Sasaki, "Toyota's Newly Developed Hybrid Powertrain", (1998).
- "Near-Term Hybrid Vehicle Program, Phase 1", General Electric Co. (1979).
- "Near-Term Hybrid Vehicle Program, Phase 1, App. A.", Gen'l Elec. (1979).
- Joint Feasibility Study of Hybrid Vehicle, Final Report (1982).
- North American Technology Seminar plans, Apr. 1997.
- Hernance, THS Technical Explanation (undated).
- "Toyota" brochure describing Prius (undated).
- Hernance, "Toyota Hybrid System" (undated).
- Cuddy et al, "Analysis of the Fuel Economy Benefit . . ." SAE 970289 (1997).
- "Team Paradigm Shines in FutureCar Competition" (1996).
- Takaoka et al, "Study of the Engine Optimized for Hybrid System" (undated).
- Gelb et al, "Cost and Emission Studies of a Heat Engine/Battery . . ." (1972).
- Gelb et al, "Design and Performance Characteristics . . ." SAE 690169 (1969).
- "Electric/Hybrid Vehicles: Alternative Powerplants . . ." SAE SP-1284 (1997).

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.