UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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FORD MOTOR COMPANY
Petitioner,

v.

PAICE LLC & ABELL FOUNDATION, INC.
Patent Owner.

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U.S. Patent No. 7,237,634
IPR Case No.: IPR2015-00758

U.S. Patent No. 7,237,634
IPR Case No.: IPR2015-00785

U.S. Patent No. 7,237,634
IPR Case No.: IPR2015-00801

U.S. Patent No. 8,214,097
IPR Case No.: IPR2015-00792

U.S. Patent No. 7,237,634
IPR Case No.: IPR2015-00800

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**NOTICE OF FILING FORD MOTOR COMPANY'S DEMONSTRATIVE EXHIBITS (GROUP 3)**

Attached please find Ford's demonstrative exhibits to be used at the trial hearing on June 29, 2016 at 10:45 AM in regard to Case Nos. IPR2015-00758, -00785, -00801, -00792, and -00800 (Group 3).

Dated: June 24, 2016

Respectfully submitted,

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# Certificate of Service

The undersigned hereby certifies that on June 24, 2016 a complete and entire copy of **NOTICE OF FILING FORD MOTOR COMPANY'S DEMONSTRATIVE EXHIBITS (GROUP 3)**, was served via electronic mail by serving the correspondence email address of record as follows:

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# FORD DEMONSTRATIVES:

*FORD MOTOR COMPANY, PETITIONER v.*
*PAICE LLC & ABELL FOUNDATION, PATENT OWNERS*
*Inter Partes Review* Consolidated Oral Hearing,
Group 1 (Ibaraki ‘882): IPR2015-00722, -784, -787, -790, -791, -794, -795
Group 2 (PCT): IPR2015-00606 and IPR2015-00799
Group 3 (Severinsky / Bumby): IPR2015-00758, -785, -792, -800, -801

**Before Sally C. Medley, Kalyan K. Deshpande,**
**Carl M. DeFranco and Jameson Lee**
**Administrative Patent Judges**
**Oral Argument: June 28-29, 2016**

# Group 3 Issues:

| # | Slide(s) | Issue | IPR2015-00758 (US 7,237,634) | IPR2015-00785 (US 7,237,634) | IPR2015-00801 (US 7,237,634) | IPR2015-00792 (US 8,214,097) | IPR2015-00800 (US 7,237,634) |
|---|---|---|---|---|---|---|---|
| 1 | 4 | **CC / abnormal & transient conditions in city traffic** | N/A | New | New | New | N/A |
| 2 | 5 | **Lateur discloses cruise** | N/A | New | New | N/A | N/A |
| 3 | 6 | **Rationale to combine + Suga** | N/A | N/A | New | N/A | N/A |
| 4 | 9 | **Vittone discloses limiting ROC of engine torque & stoich + motor supp** | N/A | N/A | Old - IPR2014-00875 (Reply at 19) | N/A | N/A |
| 5 | 10 | **Rationale to combine + Vittone and Paice’s repeated T/A arguments** | N/A | N/A | See - IPR2014-00875 (Reply at 20-23) | N/A | N/A |
| 6 | 11 | **Anderson discloses limiting ROC of engine torque & stoich + motor supp.** | N/A | Old - IPR2014-01415 (Reply at 13-15.) | N/A | N/A | N/A |
| 7 | 12 | **Anderson discloses "when"** | N/A | See - IPR2014-01415 | N/A | N/A | N/A |
| 8 | 13 | **Rationale to combine + Anderson and Paice’s repeated T/A arguments** | N/A | Old - IPR2014-01415 (Reply at 17-19.) | N/A | N/A | N/A |
| 9 | 14-18 | **Severinsky discloses RL/SP and Paice's admissions** | Old - IPR2014-01416 (Reply at 6-8.) | Old - IPR2014-00904 (Reply at 7-9.) | Old - IPR2014-00904 (Reply at 6-8.) | Old - IPR2014-01415 (Reply at 7-9.) | N/A |
| 10 | 19 | **RL is related to engine output torque** | Old - IPR2014-00904 (Reply at 8-9.) | Old - IPR2014-00904 (Reply at 10.) | Old - IPR2014-00904 (Reply at 9.) | Old - IPR2014-01415 (Reply at 9-10.) | N/A |
| 11 | 20 | **Severinsky + Frank disclose hysteresis** | Old - IPR2014-01416 (Reply at 9.) | Old - IPR2014-01416 (Reply at 21.) | Old - IPR2014-01416 (Reply at 23-24.) | N/A | N/A |
| 12 | 21 | **Rationale to combine + Frank and Paice’s repeated T/A arguments** | N/A | Old - IPR2014-01416 (Reply at 23.) | Old - IPR2014-01416 (Reply at 24-25.) | N/A | N/A |
| 13 | 22-23 | **Takaoka discloses limiting ROC . . . and Paice's admissions** | N/A | N/A | N/A | Old - IPR2014-01415 (Reply at 14-17.) | N/A |
| 14 | 24 | **Rationale to combine + Takaoka and Paice’s repeated T/A arguments** | N/A | N/A | N/A | Old - IPR2014-01415 (Reply at 18-19, 21.) | N/A |
| 15 | 26 | **Rationale to combine + Yamaguchi and Paice’s repeated T/A arguments** | N/A | N/A | Old - IPR2014-01415 (Reply at 12-14.) | Old - IPR2014-01415 (Reply at 21.) | N/A |
| 16 | 27 | **Bumby discloses comparing RL to SP** | N/A | N/A | N/A | N/A | Old - IPR2014-00579 (Reply at 14-15.) |
| 17 | 28 | **Rationale to combine Bumby I-V** | N/A | N/A | N/A | N/A | Old - IPR2014-00579 (Reply at 21-22.) |

# Severinsky discloses the “*abnormal and transient conditions*” limitations.

**IPR2015-00801**
**Ex. 1852 (Stein) ¶¶293-303**

## Claim 7 (‘097 Patent):

*“. . . operating the engine at torque output levels less than SP under abnormal and transient conditions.”*

**IPR2015-00792**
**Ex. 1201 (’097 Patent) claim 7**
***See also* claims 17, 27 and 37**

## Claim 290 (‘634 Patent):

*“. . . operating the engine at torque output levels less than the SP under abnormal and transient conditions to satisfy drivability and/or safety considerations.”*

**IPR2015-00801**
**Ex. 1851 (’634 Patent) claim 290**
***See also* claims 112, 145 and 265**

The Boards construction of “abnormal and transient conditions as including “starting the engine and stopping the engine” should be maintained.

**IPR2015-00801**
**Reply at 4-6**
**Institution Decision at 13-14, 22**

## Severinsky:

It is within the scope of the invention to operate the engine 40 outside its most fuel efficient operating range, on occasion. For example, if the torque transfer unit

* * *

efficient operating range. In these circumstances, it is preferable to use the engine somewhat inefficiently rather than to discharge the batteries excessively, which would substantially reduce the battery lifetime.

**IPR2015-00801**
**Ex. 1854 (Severinsky) at 18:23-33**
**Ex. 1852 (Stein) ¶¶301-302**

# "*Abnormal and transient conditions*" may occur in city traffic.

**IPR2015-00801**
**Reply at 4-6; 9-11**
**Ex. 1889 (Reply Decl.) ¶¶16-22**

## POR quoting '097 FH:

operation." During the prosecution of the '097 patent, the patentee distinguished "abnormal and transient conditions" from "city traffic and reverse operation:"

> [T]he Examiner interprets "abnormal and transient conditions" wherein the engine can be run at output levels less than SP, the minimum power output of the engine under normal circumstances, as "in traffic or city driv[ing] too many traffic light so too many stops and reverse operation." In fact, city traffic and reverse operation are normal conditions and are explicitly provided for. In both, the vehicle typically operates as an electric car, with the traction motor providing the torque necessary to propel the vehicle, and with the ICE operated to charge the battery when it is discharged. The "abnormal and transient conditions" referred to are such conditions as starting the engine, during which operation it must necessarily be operated at less than SP for a short time.

**IPR2015-00801**
**POR at 11 quoting Ex. 2801 ('097 File History) at 238**
***See* Ex. 1889 (Reply Decl.) ¶19**

## PTAB:

Patent Owner asserts that Petitioner's open-ended construction causes confusion, and urges that the Board make clear that "abnormal and transient conditions" does not include "city traffic and reverse operation." Prelim. Resp. 13–15. Patent Owner notes that it had made that distinction in the prosecution history of a related patent, i.e., U.S. Patent No. 8,214,097 B2 (Ex. 2801, 238). Prelim. Resp. 14. It appears, however, unsupported to exclude operation in city traffic and reverse operation in their entirety including any abnormal and transient conditions which may occur within them. It is also uncertain just precisely what constitutes city traffic.

**IPR2015-00801**
**Institution Decision at 13**

Paice urges us to reject Ford's construction and, instead, adopt a construction of "abnormal and transient conditions" that does not include "city traffic and reverse operation." Prelim. Resp. 17–19. Paice notes that it argued that distinction during prosecution of the '097 patent. *Id.* (citing Ex. 1210, 238). We decline Paice's invitation for the simple reason that abnormal and transient conditions, such as starting the engine, may very well occur in city traffic and reverse operation.

**IPR2015-00792**
**Institution Decision at 9**

# Lateur discloses the “cruise control” limitations.

**IPR2015-00801**
**Ex. 1852 (Stein) ¶¶317-335**
**Ex. 1889 (Reply Decl.) ¶¶32-38**

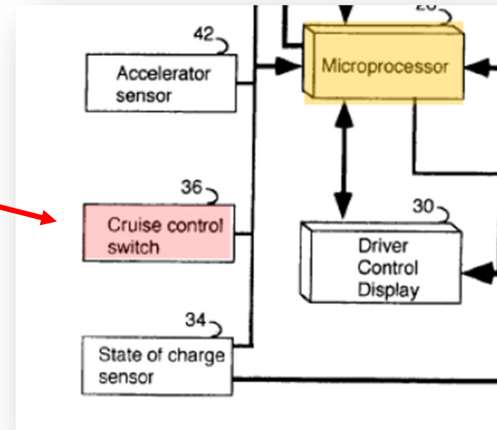
## Claim 283 (‘634 Patent):

[283.1] *“. . . receiving operator input specifying a desired cruising speed;”*

[283.2] *“controlling instantaneous engine torque output and operation of the at least one electric motor in accordance with variation in the RL to maintain the speed of the hybrid vehicle according to the desired cruising speed.”*

**IPR2015-00801**
**Ex. 1851 (‘634 Patent) claim 283**
***See also* claims 97, 130, 257**

## Lateur:




**IPR2015-00801**
**Ex. 1856 (Lateur) Figure 1 (annotated)**
**Ex. 1852 (Stein) ¶¶320-321**

Similarly, when microprocessor **26** determines that the present speed should be maintained but the load required to maintain that speed changes, e.g., the vehicle starts going up a hill, microprocessor **26** sends a signal to power controller **16** causing it to make the appropriate changes to the current flowing in the first and second motor/generators **12**,**14** to change the torque being applied to output shaft **62** such that the desired speed is maintained.

**IPR2015-00801**
**Ex. 1856 (Lateur) at 10:36-43**
**Ex. 1852 (Stein) ¶¶332-334**
**Ex. 1889 (Reply Decl.) ¶¶37-38**

# A POSA would have been motivated to combine Severinsky and Suga, e.g., to target a ZEV classification

**IPR2015-00801**
**Petition at 42**
**Ex. 1852 (Stein) ¶¶398-403,382-397**
**Ex. 1889 (Reply Decl.) ¶¶43-45**

## Claim 291 (‘634 Patent):

[291] *“. . . wherein the at least one electric motor is sufficiently powerful to provide acceleration of said vehicle sufficient to conform to the Federal urban cycle driving fuel mileage test without use of torque from the engine to propel the vehicle.”*

**Ex. 1851 (‘634 Patent) claim 291;**
***See also* claim 266**

## Dr. Stein (Decl.):

A POSA “would have understood that these tests [Suga] would assess whether the motor’s power performance was sufficient for a hybrid-vehicle during times that the vehicle is being propelled by the motor alone without the use of torque form the engine, *i.e.*, within Severinsky ’970’s low speed mode.”

**Ex. 1852 (Stein) ¶395**
***See also* Ex. 1857 (Suga) at 4:6-17, Fig. 1, 3**

## Severinsky:

FIG. 4 illustrates operation in low speed circumstances, e.g., in city traffic or reversing. As noted, the

* * *

motor 20 to the wheels 34. Under these circumstances, electric motor 20 provides all of the torque needed to move the vehicle. Other combinations of torque and

* * *

56, respectively. Low-speed acceleration—up to about 25 mph—is powered by the motor 20 alone.

**Ex. 1854 (Severinsky) at 10:52-68; 14:35-36**
**Ex. 1852 (Stein) ¶¶393-394**

# PTAB: "[W]e decline to import 'external torque requirements' into our interpretation of 'road load,'. . . "

**IPR2015-00801**
**Ex. 1894 ('875 Final Decision) at 10-11; Paper 23 (Resp. to Obs.) at 2**
***See also* Ex. 1889 (Reply Decl.) ¶¶49-50**

Undisputed "*Road load*" claim construction: "the amount of instantaneous torque required to propel the vehicle, be it positive or negative."

**Institution Decision at 7-8**

## Dr. Stein:

"[T]he challenged claims do not require determining 'the amount of instantaneous torque required to propel the vehicle' based on rolling resistance or wind resistance, but not based on accelerator pedal, as argued by Mr. Hannemann."

**Ex. 1889 (Reply Decl.) ¶50**

## Paice:

JUDGE DeFRANCO: Do you agree with the Petitioner's position that the '347 patent does not disclose how road load is determined?

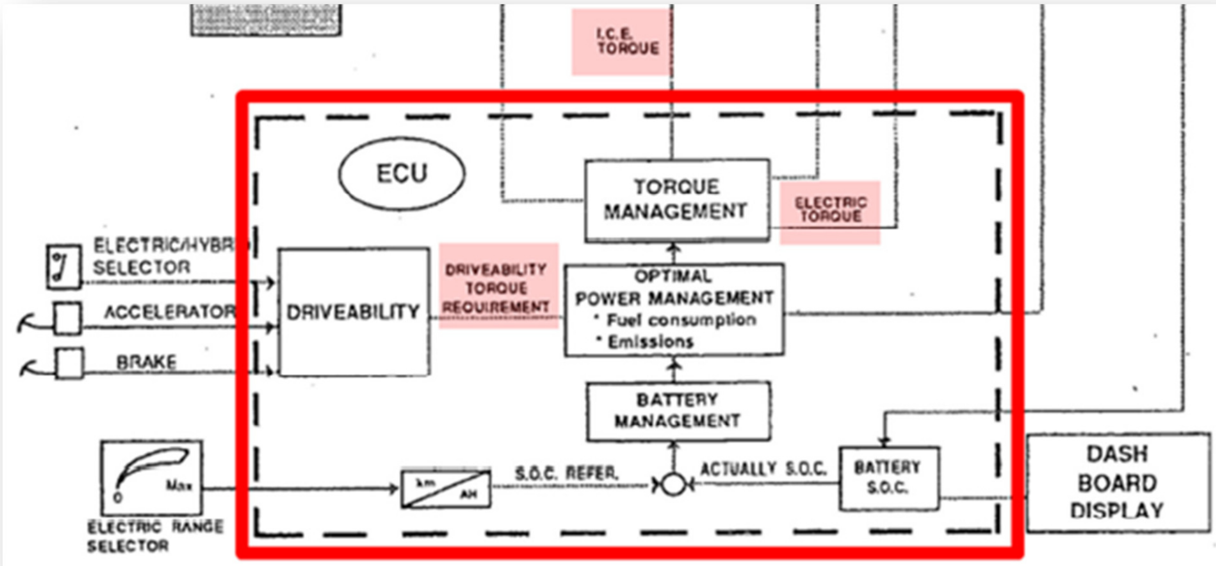
MR. CORDELL: It does not have the formula for road load, that is true. So, yes, I do agree with that.

**Ex. 1900 (Oral Hearing Tr. 2015) at 41:10-14**
**Paper 23 (Resp. to Obs.) at 2-3**

PTAB: "[W]e are persuaded by Petitioner that 'driveability torque requirement' and 'total traction torque' represent the instantaneous torque required to propel the vehicle and, therefore, Vittone discloses 'road load.' "

IPR2015-00801
Ex. 1894 ('875 Final Decision) at 11, emphasis added
Paper 23 (Resp. to Obs.) at 2
*See also* Ex. 1852 (Stein) ¶¶483-486

**Vittone:**




Ex. 1858 (Vittone) at 32, Fig. 5 (annotated)
Ex. 1852 (Stein) ¶483

driveability torque requirement = instantaneous torque required to propel the vehicle

Ex. 1852 (Stein) ¶486

PTAB: A POSA “would have understood that Vittone’s ‘steady state management’ of the thermal engine meets the limitation of the ‘rate of change of torque output of said engine is limited to a threshold value.’ ” IPR2015-00801

Ex. 1894 (‘875 Final Decision) at 12; Reply at 19
*See also* Ex. 1852 (Stein) ¶¶483-493; 501-506

# Claim 241 (‘634 Patent):

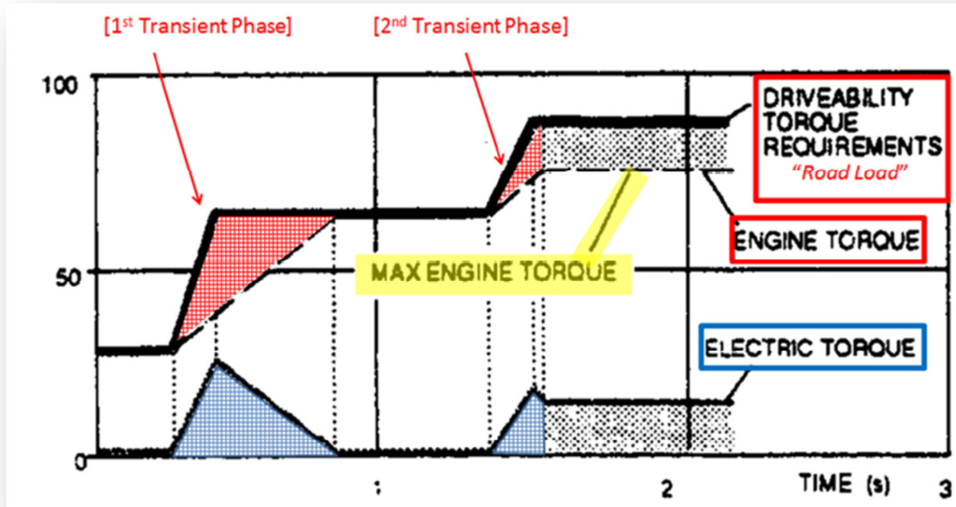
[241.5] *“. . . wherein said controlling the engine comprises limiting a rate of change of torque output of the engine;”*

[241.6] *“. . . supplying additional torque from the at least one electric motor.”*

[241.5] *“. . . controlling said engine such that combustion of fuel within the engine occurs substantially at a stoichiometric ratio. . .”*

Ex. 1851 (‘634 Patent) claim 241

# Vittone:




Ex. 1858 (Vittone) at 33 (annotated), Fig. 8; Ex. 1852 (Stein) ¶¶489-491

A further contribution to the emission reduction is achieved through the “steady state” management of the thermal engine in transient phases, while the torque demand is assured by the electric motor support (Fig. 8).

Ex. 1858 (Vittone) at 29; Ex. 1852 (Stein) ¶501

- Thermal engine

* * *

The software of the electronic unit (WEBER IAW) has been modified to implement new control strategies in the transients and to achieve the stoichiometric control over the whole working range.

Ex. 1858 (Vittone) at 28; Ex. 1852 (Stein) ¶¶487-488

# Severinsky and Vittone do not "Teach Away."

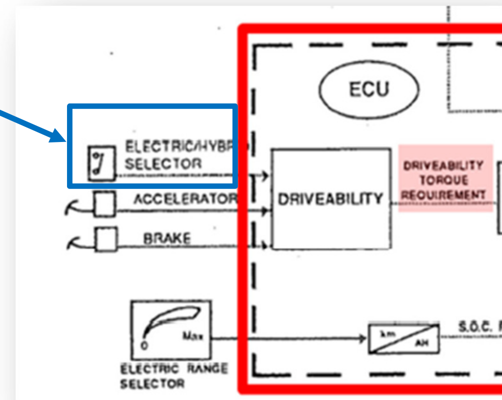
**IPR2015-00801**
**Ex. 1852 (Stein) ¶¶510-520**
**Ex. 1889 (Reply Decl.) ¶¶84-104**

## Severinsky:

To lower the toxic hydrocarbon and carbon monoxide emissions from combustion, the engine 40 will be operated in lean burn mode (that is, air will be supplied slightly in excess of the amount required for stoichiometric combustion) to achieve complete combustion. To lower nitrogen oxide emissions, the engine will be operated at a lower temperature and thus at slightly

Ex. 1854 (Severinsky) at 12:13-33
Ex. 1889 (Reply Decl.) ¶¶99-100

## Vittone:




Ex. 1858 (Vittone) at 32, Fig. 5 (annotated)
Ex. 1889 (Reply Decl.) ¶¶87-88

## Mr. Hannemann:

So at the point when nox became important, then the lean burn strategies diminished, and pretty much everything went to stoichiometric strategy.

Q When was that?

A Probably in the 1980s, I would say.

Ex. 1896 (Hannemann Tr. IPR2014-00570 ) at 54:19-23
Ex. 1889 (Reply Decl.) ¶100

## Bosch Handbook:

Table 1. Emissions limits under USA-FED (49 States) and California FTP 75 test cycle.

| Model year | Region | CO g/mile | NMHC[1]) g/mile | $NO_x$ g/mile | Evaporation g/test |
|---|---|---|---|---|---|
| 1993 | CAL | 3.4 | 0.25 | 0.4 | 2.0 |
| 1994 | FED | 3.4 | 0.25 | 0.4 | 2.0 |
| 2003 (Proposal) | FED | 1.7 | 0.125 | 0.2 | |

[1]) NMHC: Non-methane Hydrocarbons (total hydrocarbons less methane content).

Ex. 1897 (Bosch) at 11 (annotated)
Ex. 1889 (Reply Decl.) ¶95

## Issue 6 – Anderson discloses limiting ROC of engine torque & stoich + motor supp. ‘785(G1, 4)

PTAB: “Anderson’s ‘slow transients’ strategy would have suggested to a skilled artisan a hybrid control strategy that limits the engine’s output torque ‘to less than [its] inherent maximum rate of increase of output torque.’”

**IPR2015-00785**
**Ex. 1388 (‘1415 Final Dec.) at 17; Reply at 14**
***See also* Ex. 1352 (Stein) ¶¶199-218**

# Claim 241 (‘634 Patent):

[241.5] *“. . . controlling said engine such that combustion of fuel within the engine occurs substantially at a stoichiometric ratio. . .”*

[241.5] *“. . . wherein said controlling the engine comprises limiting a rate of change of torque output of the engine;”*

[241.6] *“. . . supplying additional torque from the at least one electric motor.”*

**Ex. 1351 (‘634 Patent) claim 241**

# Anderson:

Emissions - Frequently, one of the principle aims of a hybrid vehicle is to reduce vehicle emissions to ULEV (Ultra Low Emission Vehicle) levels. Consequently, APU emissions are very important for system success. In general, emissions are minimized when a stoichiometric air to fuel ratio is maintained by a closed loop feedback system (using an oxygen sensor for feedback). In some operating regimes, such as engine starts and transients, the stoichiometric ratio is very difficult to maintain resulting in an increase in emissions.

Transients present an emissions problem that is largely related to the speed of the transient. The closed loop feedback system that maintains the stoichiometric air fuel ratio is sufficient during quasi-steady state modes, however, it can only react as fast as the $O_2$ levels can be sensed. If the transient is too fast, the engine may run rich, increasing CO and HC emissions, or lean, increasing NOx emissions. Some of this effect can be reduced using a hybrid strategy that only allows slow transients, but this places greater strain on the LLD.

**Ex. 1355 (Anderson) at 11**
**Ex. 1352 (Stein) ¶¶199; 203-204; 216-217**

IPR2015-00785
Ex. 1384 (Reply Decl.) ¶¶24-28

## Claim 241 (‘634 Patent):

241. A method for controlling a hybrid vehicle, comprising:

determining instantaneous road load (RL) required to propel the hybrid vehicle responsive to an operator command;

operating at least one electric motor to propel the hybrid vehicle when the RL required to do so is less than a setpoint (SP);

operating an internal combustion engine of the hybrid vehicle to propel the hybrid vehicle when the RL required to do so is between the SP and a maximum torque output (MTO) of the engine, wherein the engine is operable to efficiently produce torque above the SP, and wherein the SP is substantially less than the MTO; and

operating both the at least one electric motor and the engine to propel the hybrid vehicle when the torque RL required to do so is more than the MTO;

controlling said engine such that combustion of fuel within the engine occurs substantially at a stoichiometric ratio, wherein said controlling the engine comprises limiting a rate of change of torque output of the engine; and

if the engine is incapable of supplying instantaneous torque required to propel the hybrid vehicle, supplying additional torque from the at least one electric motor.

Ex. 1851 (‘634 Patent) claim 241

## Anderson:

Transient Capabilities - A battery can change power levels almost instantaneously, unlike the APU which is limited by its mechanical inertia. When the APU cannot respond quickly enough to fluctuations in power demand, the battery must make up the difference. The battery must be able to sustain output at a peak power during these transients until the APUs power output reaches the commanded power.

Transients present an emissions problem that is largely related to the speed of the transient. The closed loop feedback system that maintains the stoichiometric air fuel ratio is sufficient during quasi-steady state modes, however, it can only react as fast as the $O_2$ levels can be sensed. If the transient is too fast, the engine may run rich, increasing CO and HC emissions, or lean, increasing NOx emissions. Some of this effect can be reduced using a hybrid strategy that only allows slow transients, but this places greater strain on the LLD.

Ex. 1355 (Anderson) at 10, 11
Ex. 1352 (Stein) ¶¶216-217
Ex. 1384 (Reply Decl.) ¶¶26-27

PTAB: Paice's argument that Anderson's teachings are limited to series "would require us to ignore Anderson's clear indication to the reader that her ensuing discussion of the optimum control strategy applies equally to both parallel and series-type vehicles."

IPR2015-00785
Ex. 1388 ('1415 Final Dec.) at 27; Reply at 18
*See also* Ex. 1352 (Stein) ¶¶314-325, Ex. 1384 (Reply Decl.) ¶¶41-81

## Anderson:

A hybrid control strategy is an algorithm that determines

Ex. 1355 (Anderson) at 7
Ex. 1352 (Stein) ¶324, Ex. 1384 (Reply Decl.) ¶43

The thought processes presented in this paper are sufficiently general that they can be applied to any type of vehicle. To fully explore the flexibility allowed by the hybrid

Ex. 1355 (Anderson) at 8-9
Ex. 1352 (Stein) ¶317, Ex. 1384 (Reply Decl.) ¶48
Ex. 1392 (Stein Tr.) at 179:22-182:14

The other extreme commands the APU to follow the actual wheel power whenever possible (similar to a conventional automobile). Using this strategy, the LLD cycling will diminish, and the losses associated with charge and discharge will be minimized. The APU, however, must then operate over its entire range of power levels and perform fast power transients, both of which can adversely affect engine efficiency and emissions characteristics. Figure 6 shows the APU and LLD power requirements generated by this "following" mode for the same wheel power curve shown in figure 4. It should be noted that this is the mode a parallel hybrid vehicle always uses.

For most of the APUs and LLDs under consideration, neither of these strategies would be the optimum strategy. The

Ex. 1355 (Anderson) at 9
Ex. 1384 (Reply Decl.) ¶71

## Severinsky:

the operator's control inputs. Microprocessor 48 monitors the operator's inputs and the vehicle's performance, and activates electric motor 20 when torque in excess of the capabilities of engine 40 is required. Conversely, if

Ex. 1354 (Severinsky) at 14:15-18

To lower the toxic hydrocarbon and carbon monoxide emissions from combustion, the engine 40 will be operated in lean burn mode (that is, air will be supplied slightly in excess of the amount required for stoichiometric combustion) to achieve complete combustion. To lower nitrogen oxide emissions, the engine will be operated at a lower temperature and thus at slightly

Ex. 1354 (Severinsky) at 12:13-17
Ex. 1384 (Reply Decl.) ¶¶79-81
*See also* Ex. 1391 (Hannemann Tr.) at 54:10-23

# The Claimed Control Strategy

## Claim 80 (‘634 Patent) (w/RL):

80. A method for controlling a hybrid vehicle, comprising:

* * *

**Low – Speed / Load Operation Mode I (“Motor mode”)**

**IPR2015-00801 - Ex. 1851 (‘634 Patent) at 35:63-36:1; 43:29-35**

operating at least one electric motor to propel the hybrid vehicle when the RL required to do so is less than a setpoint (SP);

* * *

**Highway Cruising Operation Mode IV (“Engine mode”)**

**IPR2015-00801 - Ex. 1851 (‘634 Patent) at 36:31-36; 37:42-44**

operating an internal combustion engine of the hybrid vehicle to propel the hybrid vehicle when the RL required to do so is between the SP and a maximum torque output (MTO) of the engine, wherein the engine is operable to efficiently produce torque above the SP, and wherein the SP is substantially less than the MTO; and

* * *

**Acceleration Operation Mode V (“Engine-motor mode”)**

**IPR2015-00801 - Ex. 1851 (‘634 Patent) at 36:37-43**

operating both the at least one electric motor and the engine to propel the hybrid vehicle when the torque RL required to do so is more than the MTO.

**IPR2015-00801**
**Ex. 1851 (‘634 Patent) claim 80;**
***See also* claims 114, 241 and 267**

## Claim 1 (‘097 Patent) (w/o RL):

1. A method for controlling a hybrid vehicle, said vehicle comprising a battery, a controller, wheels, an internal com-

* * *

operating said at least one electric motor to provide additional torque when the amount of torque provided by said engine is less than the amount of torque required to operate the vehicle; and

* * *

operating said internal combustion engine to provide torque to the hybrid vehicle when the torque required to operate the hybrid vehicle is between a setpoint SP and a maximum torque output (MTO) of the engine, wherein the engine is operable to efficiently produce torque above SP, and wherein SP is substantially less than MTO;

* * *

operating both the at least one electric motor and the engine to provide torque to the hybrid vehicle when the torque required to operate the hybrid vehicle is more than MTO;

**IPR2015-00792**
**Ex. 1201 (‘097 Patent) claim 1;**
***See also* claims 11 and 21**

## Issue 9 - RL/SP – Severinsky discloses "RL" ‘758 (G1-3), ‘785(G1-5), ‘792(G1-2), ‘801(G1-6, 8)

PTAB: "Although Severinsky describes the use of ‘speed’ as a factor considered by the microprocessor, Severinsky makes clear that the microprocessor also uses the vehicle's ‘torque’ requirements in determining when to run the engine."

**IPR2015-00801**
**Ex. 1892 (‘904 Final Decision) at 13-14, citing Ex. 1854 (Severinsky) at 17:11-15; Reply at 7**
***See also* Ex. 1852 (Stein) ¶¶134-152**

Undisputed "*Road load*" claim construction: "the amount of instantaneous torque required to propel the vehicle, be it positive or negative."

**IPR2015-00801**
**Institution Decision at 7-8**

# Claim [80.1] (‘634 Patent):

[80.1]: *". . . determining instantaneous road load (RL) . . . "*

**IPR2015-00801**
**Ex. 1851 (‘634 Patent) claim 80**
***See also* claims 114, 241 and 267**

***See also* IPR2015-00792**
**Ex. 1201 (‘097 Patent) claim 21**

# Severinsky:

Thus, at all times the microprocessor 48 may determine the load ( if any) to be provided to the engine by the motor, responsive to the load imposed by the vehicle's propulsion requirements, so that the engine 40 can be operated in its most fuel efficient operating range.

**IPR2015-00801**
**Ex. 1854 (Severinsky) at 17:11-15**
**Ex. 1852 (Stein) ¶136**

PTAB: "Severinsky's disclosure of an 'operational point' for the engine is no different than the claimed 'setpoint.' "

**IPR2015-00801**
**Ex. 1892 ('904 Final Decision) at 14-15; Reply at 8**
***See also* Ex. 1852 (Stein) ¶¶153-192**

## Claim 80 ('634 Patent):

[80.4]: "*operating an . . . engine . . . to propel the hybrid vehicle when the RL required to do so is between the SP and a . . . (MTO) of the engine . . .*"

[80.3]: "*operating at least one electric motor to propel the hybrid vehicle when the RL required to do so is less than a setpoint (SP)*"

[80.4]: "*. . . wherein the engine is operable to efficiently produce torque above the SP, and wherein the SP is substantially less than the MTO*"

**IPR2015-00801**
**Ex. 1851 ('634 Patent) claim 80**
***See also* claims 114, 241 and 267**

***See also* IPR2015-00792**
**Ex. 1201 ('097 Patent) claims 1, 11 and 21**

## Severinsky '970:

More particularly, according to the invention, the internal combustion engine is operated only under the most efficient conditions of output power and speed. When the engine can be used efficiently to drive the vehicle forward, e.g. in highway cruising, it is so employed. Under other circumstances, e.g. in traffic, the electric motor alone drives the vehicle forward and the internal combustion engine is used only to charge the batteries as needed. No transmission is required, thus

* * *

It will be appreciated that according to the invention the internal combustion engine is run only in the near vicinity of its most efficient operational point, that is, such that it produces 60–90% of its maximum torque whenever operated.

**IPR2015-00801**
**Ex. 1854 (Severinsky) at 7:8-16; 20:63-67**
**Ex. 1852 (Stein) ¶¶159-160**

# Paice's admissions are binding for determinations of anticipation and obviousness. *See PharmaStem Therapeutics, Inc. v. Viacell, Inc.*

**IPR2015-00785**
**Reply at 12**

Mode selection based on the engine's sweet spot:

Engine mode

Motor mode

Engine + motor mode

According to an important aspect of the invention of the '970 patent, substantially improved efficiency is afforded by operating the internal combustion engine only at relatively high torque output levels, typically at least 35% and preferably at least 50% of peak torque. When the vehicle operating conditions require torque of this approximate magnitude, the engine is used to propel the vehicle; when less torque is required, an electric motor powered by electrical energy stored in a substantial battery bank drives the vehicle; when more power is required than provided by either the engine or the motor, both are operated simultaneously. The same advantages are provided by the system of the present invention, with further improvements and enhancements described in detail below.

**IPR2015-00801**
**Ex. 1851 ('634 Patent) at 25:11-24; Ex. 1852 (Stein) ¶162**

Mode selection based on the "torque required":

Turning now to detailed discussion of the inventive control strategy according to which the hybrid vehicles of the invention are operated: as in the case of the hybrid vehicle system shown in the '970 patent, and as discussed in further detail below, the vehicle of the invention is operated in different modes depending on the torque required, the state of charge of the batteries, and other variables.

**IPR2015-00801**
**Ex. 1851 ('634 Patent) at 35:3-9**
**Ex. 1852 (Stein) ¶151**

Motor + engine when "RL" > MTO:

trailer, or driving up a long hill. Where the road load exceeds the engine's maximum torque for a relatively short period less than T, the traction motor (and possibly also the starting

motor) are used to provide additional torque, as in the '970 patent and above. According to a further aspect of the

**IPR2015-00801**
**Ex. 1851 ('634 Patent) at 44:65-45:2**
**Ex. 1852 (Stein) ¶151**

# *Clearwater Systems Corp. v. Evapco, Inc.*, is not on point

**IPR2015-00785**
**Reply at 12-13**

- *Clearwater:*
  - The Federal Circuit reversed a district court that found inherency by anticipation at summary judgment.
  - The district court found that the claimed method was anticipated by a prior art device based solely on disclosure in the patent in suit stating that the prior art device could be used to practice the claimed method.
- Here:
  - Inherency by anticipation is not at issue.
  - Ford relies on Severinsky.

**IPR2015-00785**
**Reply at 12-13**

PTAB: Paice’s “argument fails for the simple reason that, like Severinsky, the claims themselves express ‘road load’ as a torque *output*, not an input.”

IPR2015-00801
Ex. 1892 (‘904 Final Decision) at 18,
citing claim 16 of the ‘634 Patent
Reply at 9

**Claim 16 (‘634 Patent):**

16. The hybrid vehicle of claim 1, wherein the controller is operable to implement a plurality of operating modes responsive to road load (RL) and the SP, wherein both the RL and the SP are expressed as percentages of the MTO of the engine when normally-aspirated, and wherein the operating modes comprise:

IPR2015-00801
Ex. 1851 (‘634 Patent) claim 16

PTAB: “[W]e disagree with Paice’s attempt to characterize the claimed ‘road load’ as a torque ‘input’ when the ’097 patent itself expressly states otherwise.”

IPR2015-00792
Ex. 1238 (‘1415 Final Decision) at 25,
citing the ‘097 Patent at 37:57-58; 36:25-27
Reply at 10

**The ‘097 Patent:**

trol strategy.) The road load is expressed as a function of the engine’s maximum torque output. Where the road load

IPR2015-00792
Ex. 1201 (‘097 Patent) at 37:57-58

PTAB: “Severinsky’s disclosure of a *torque*-based setpoint for starting and stopping the engine, when combined with Frank’s teaching of a time-delay with an on-off threshold for an engine, would have suggested to a skilled artisan the features of claims 80 and 114.”

**IPR2015-00785**
**Ex. 1386 (‘1416 Final Decision) at 22**
**Reply at 21**
***See also* Ex. 1352 (Stein) ¶¶469-486; 615-624**

## Claim [114.4] (‘634 Patent):

*“operating the at least one electric motor to propel the hybrid vehicle is performed when the RL < the SP for at least a predetermined amount of time”*

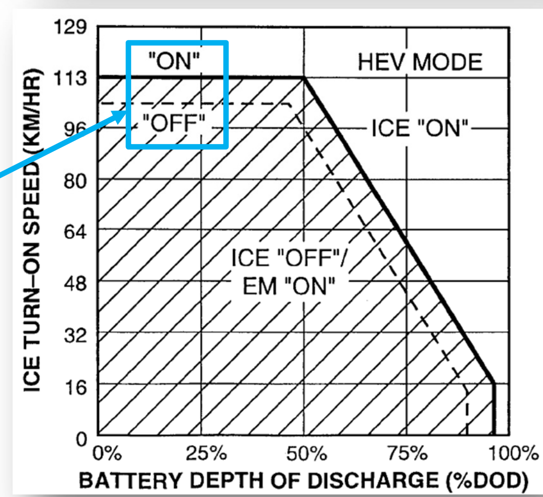
## Claim [80.5] (‘634 Patent):

[80.5] “. . . *wherein said operating the internal combustion engine to propel the hybrid vehicle is performed when:*
*[a] the RL>the SP for at least a predetermined time; or*
*[b] the RL>a second setpoint (SP2) . . . .”*

**IPR2015-00785**
**Ex. 1351 (’634 Patent) claims 80 and 114**

## Frank:

operates in a ZEV mode. The control band between the “on” threshold curve and the “off” threshold curve prevents undesirable or excessive cycling of the ICE 14 due to fluctuations in sensed speed and depth of discharge. As an alternative to separate “on” and “off” thresholds, a single threshold could be used in combination with a time delay between the “on” and “off” modes to prevent frequent cycling.




**IPR2015-00785**
**Ex. 1357 (Frank) 7:66-8:11; Fig. 4**
**Ex. 1352 (Stein) ¶¶475, 484**

PTAB: "[t]hat Severinsky also may disclose this 'hysteresis' time-delay as being 'speed-responsive' does not negate or detract from its overall teaching of applying a time delay to an on-off setpoint to prevent frequent cycling between the engine and motor in a hybrid vehicle."

IPR2015-00785
Ex. 1386 ('1416 Final Decision) at 21
Reply at 23
See also Ex. 1352 (Stein) at ¶¶734-740

**Severinsky:**

At moderate speeds, as experienced in suburban driving, the speed of the vehicle on average is between 30–45 mph. The vehicle will operate in a highway mode with the engine running constantly after the vehicle reaches a speed of 30–35 mph. The engine will continue to run unless the engine speed is reduced to 20–25 mph for a period of time, typically 2–3 minutes. This speed-responsive hysteresis in mode switching will eliminate nuisance engine starts.

IPR2015-00801
Ex. 1854 (Severinsky) at 18:34-42

PTAB: “[W]e find that the combination of Severinsky and Takaoka teaches ‘limit[ing] the rate of change of torque produced by the engine’ so that fuel combustion ‘occurs at a substantially stoichiometric ratio,’ as required by claim 30.”

IPR2015-00792
Ex. 1238 (‘1415 Final Dec.) at 35; Reply at 14-16
*See also* Ex. 1202 (Stein) ¶¶204-239, Ex. 1237 (Reply Decl.) ¶¶27-38

## Claim 21 (‘097 Patent):

[21.6] *“if the engine is incapable of supplying instantaneous torque required to propel the hybrid vehicle, supplying additional torque from the at least one electric motor, and”*

[21.5] *“employing said controller to control the engine such that a rate of increase of output torque of the engine is limited to less than said inherent maximum rate of increase of output torque, and,”*

[21.7] *“wherein said step of controlling the engine . . . is performed such that combustion of fuel within the engine occurs at a substantially stoichiometric ratio; and”*

Ex. 1201 (‘097 Patent) claim 21, see also claims 1, 11, 30

## Takaoka:

(3) Emissions levels much lower than the current standard values were attained by optimum control of the motor and engine.

Ex. 1206 (Takaoka) at 8
Ex. 1202 (Stein) ¶451; Ex. 1237 (Reply Decl.) ¶28

(2) By allocating a portion of the load to the electric motor, the system is able to reduce engine load fluctuation under conditions such as rapid acceleration. This makes it possible to reduce quick transients in engine load so that the air-fuel ratio can be stabilized easily.

Ex. 1206 (Takaoka) at 6
Ex. 1202 (Stein) ¶¶205, 227, 233
Ex. 1237 (Reply Decl.) ¶29

(2) In order to achieve a major reduction in emissions, the engine would operate with $\lambda = 1$ over its entire range, and the exhaust system would use a 3-way catalyst.

Ex. 1206 (Takaoka) at 2
Ex. 1202 (Stein) ¶234

# Paice's admissions regarding Takaoka are binding.

IPR2015-00792
Petition at 48, Reply at 17-18

## Claim 21 ('097 Patent):

[21.5] "*employing said controller to control the engine such that a rate of increase of output torque of the engine is limited to less than said inherent maximum rate of increase of output torque, and,*"

[21.7] "*wherein said step of controlling the engine . . . is performed such that combustion of fuel within the engine occurs at a substantially stoichiometric ratio; and*"

Ex. 1201 ('097 Patent) claim 21, *see also* claims 1, 11, 30

## Takaoka:

(2) By allocating a portion of the load to the electric motor, the system is able to reduce engine load fluctuation under conditions such as rapid acceleration. This makes it possible to reduce quick transients in engine load so that the air-fuel ratio can be stabilized easily.

Ex. 1206 (Takaoka) at 6
Ex. 1202 (Stein) ¶¶205, 227, 233; Ex. 1237 (Reply Decl.) ¶29

## Paice re Takaoka:

Takaoka et al, in "A High-Expansion-Ratio Gasoline Engine for the Toyota Hybrid System", discuss the details of an ICE designed for use in a hybrid vehicle. This paper states that "By using the supplementary drive power of the electric motor, the system eliminates the light-load range, where concentrations of hydrocarbons in the emissions are high and the exhaust temperature is low." (p. 57; a similar statement is made on p. 59) and "By allocating a portion of the load to the electric motor, the system is able to reduce engine load fluctuation under conditions such as rapid accleeration. This makes it possible to reduce quick transients in engine load so that the air-fuel ratio can be stabilized easily." (p. 58). The former statement simply emphasizes the fact that engines are operated more efficiently at higher loads, and the latter that stoichiometric combustion can be more nearly obtained if the engine's speed and/or load is varied as slowly as possible.

Ex. 1212 ('347 FH) at 23
Petition at 48, Reply at 17-18

PTAB: "[W]e conclude that modifying the hybrid control strategy of Severinsky to incorporate the additional strategy of reducing quick transients in engine load, as taught by Takaoka, would have been obvious to a skilled artisan because both Severinsky and Takaoka are concerned with improving fuel economy and reducing emissions in hybrid vehicles, as argued by Ford."

IPR2015-00792
Ex. 1238 ('1415 Final Dec.) at 35; Reply at 18-20
*See also* Ex. 1202 (Stein) ¶¶444-456, Ex. 1237 (Reply Decl.) ¶¶39-49

## Severinsky:

To lower the toxic hydrocarbon and carbon monoxide emissions from combustion, the engine 40 will be operated in lean burn mode (that is, air will be supplied slightly in excess of the amount required for stoichiometric combustion) to achieve complete combustion. To lower nitrogen oxide emissions, the engine will be operated at a lower temperature and thus at slightly

Ex. 1205 (Severinsky) at 12:13-33
Ex. 1202 (Stein) ¶¶ 453-454, Ex. 1237 (Reply Decl.) ¶¶40-41

Dr. Stein: "Severinsky '970 teaches that stoichiometric combustion is important to lower emissions and provides a balanced view of the tradeoffs associated with a lean burn strategy."

Ex. 1237 (Reply Decl.) ¶40

## Mr. Hannemann:

So at the point when nox became important, then the lean burn strategies diminished, and pretty much everything went to stoichiometric strategy.

Q When was that?

A Probably in the 1980s, I would say.

Ex. 1244 (Hannemann Tr.) at 54:10-23
Ex. 1237 (Reply Decl.) ¶43

Dr. Stein: "It was well known to a person of ordinary skill in the art that hybrid vehicles typically used smaller engines than conventional vehicles. . . . Even if Takaoka's engine is 'underpowered' as compared to conventional vehicles, it is comparable to the engine disclosed by Severinsky '970."

Ex. 1237 (Reply Decl.) ¶¶48-49

PTAB: “Yamaguchi discloses rotating an engine to 600 rpm before starting it, and then starting the engine once it reaches a predetermined temperature. . . . [and] Dr. Stein, testifies that this process amounts to heating the engine before igniting it.”

**IPR2015-00801**
**Ex. 1893 (‘1415 Final Decision) at 30**
***See also* Ex. 1852 (Stein) ¶¶203-208**

# Claim 3 (‘097 Patent):

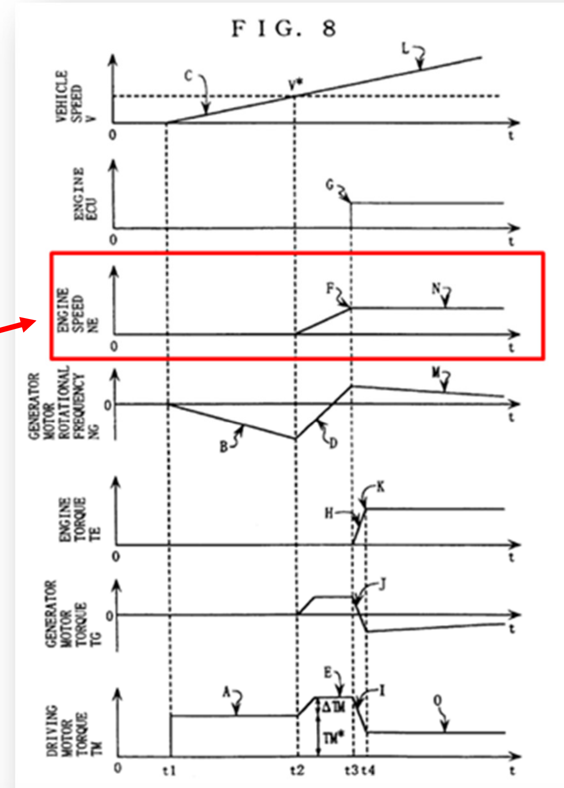
[3] “. . . *wherein when it is desired to start said engine, said engine is rotated at at least 300 rpm, whereby the engine is heated prior to supply of fuel for starting the engine.*”

**IPR2015-00792**
**Ex. 1201 (‘097 Patent) claim 3,**
***see also* claims 13, 23, 32**

# Claim 267 (‘634 Patent):

[267.5] “. . . *rotating the engine before starting the engine such that its cylinders are heated by compression of air therein.*”

**IPR2015-00801**
**Ex. 1851 (‘634 Patent) claim 267,**
***see also* claims 264, 111, 144**




At time t3, when the engine rotational speed NE exceeds the predetermined value NE*, for example 600 rpm (Arrow F in FIG. 8), the engine ECU is switched to ON to allow the engine to ignite (Arrow G). Thereafter, the engine torque TE starts increasing (Arrow H in FIG. 8), so that the output of the driving motor 4 decreases (Arrow I in FIG. 8). At this

**IPR2015-00801**
**Ex. 1855 (Yamaguchi) Fig. 8 (annotated), 8:62-67**
**Ex. 1852 (Stein) ¶¶203-204**

# PTAB: "[W]e are persuaded that Severinsky's modified control strategy would not have been viewed by a skilled artisan as 'teaching away' from being combined with Yamaguchi's teaching of heating the engine prior to starting it."

IPR2015-00801
Ex. 1893 ('1415 Final Decision) at 31; Reply at 13
*See also* Ex. 1852 (Stein) ¶¶304-316, Ex. 1889 (Reply Decl.) ¶¶25-31, 106-111

## Severinsky:

To lower the toxic hydrocarbon and carbon monoxide emissions from combustion, the engine 40 will be operated in lean burn mode (that is, air will be supplied slightly in excess of the amount required for stoichiometric combustion) to achieve complete combustion. To lower nitrogen oxide emissions, the engine will be operated at a lower temperature and thus at slightly reduced thermodynamic efficiency (e.g., 2–3% lower) than is a conventional engine. Only 2 or 3 cylinders will be used in this engine to maintain a high volume-to-surface area ratio within its cylinders, in order to further reduce toxic emissions. That is, because the cylinder

IPR2015-00801
Ex. 1854 (Severinsky) at 12:13-24
Ex. 1889 (Reply Decl.) ¶¶30-31

## Vittone:

- To reduce the emissons:
  - the vehicle has been equipped with a heated catalyst, by which the warm-up of the main catalyst is performed while the thermal engine works at minimum r.p.m.;

IPR2015-00801
Ex. 1858 (Vittone) at 29; Ex. 1889 (Reply Decl.) ¶¶107-110

# The Bumby references disclose comparing a predetermined torque value ("*setpoint*") to the instantaneous torque required to propel the vehicle, be it positive or negative ("*road load*")

Petition 23-31
Ex. 1903 (Davis Decl.) ¶¶247-277
Ex. 1951 (Davis Reply Decl.) ¶¶33-39

Consequently, a suboptimal control policy can be defined, which defines an engine operating box as shown in Fig. 16. This box region is defined by an upper and lower torque bound and an upper and lower speed bound, the values of which are dependent on the particular hybrid philosophy. Within this box, engine-only oper-

ation is favoured while, when the operating point is outside this box, the selected mode of operation depends

on the actual torque and speed values. Below the lower torque bound and the lower speed bound, all-electric operation is favoured. This eliminates inefficient use of the engine. Above the upper torque bound, true hybrid operation is used with the electric motor supplying the excess torque above the maximum available from the engine. To implement this control, the suboptimal control algorithm converts the instantaneous power and speed requirement into a torque and speed demand, at the torque split point for each available gear ratio. If one of this family of operating points falls within the engine operating box, then that gear and IC engine operation is selected. If more than one set of conditions define an operating point within the box, then the box is shrunk towards the engine maximum efficiency point, and that gear ratio which produces an operating point within this new region is selected. This ensures maximum engine efficiency. For all-electric operation, the gear ratio that puts

Ex. 1906 (Bumby II) at 10-11
*See also*, Ex. 1907 (Bumby III) at 7-8

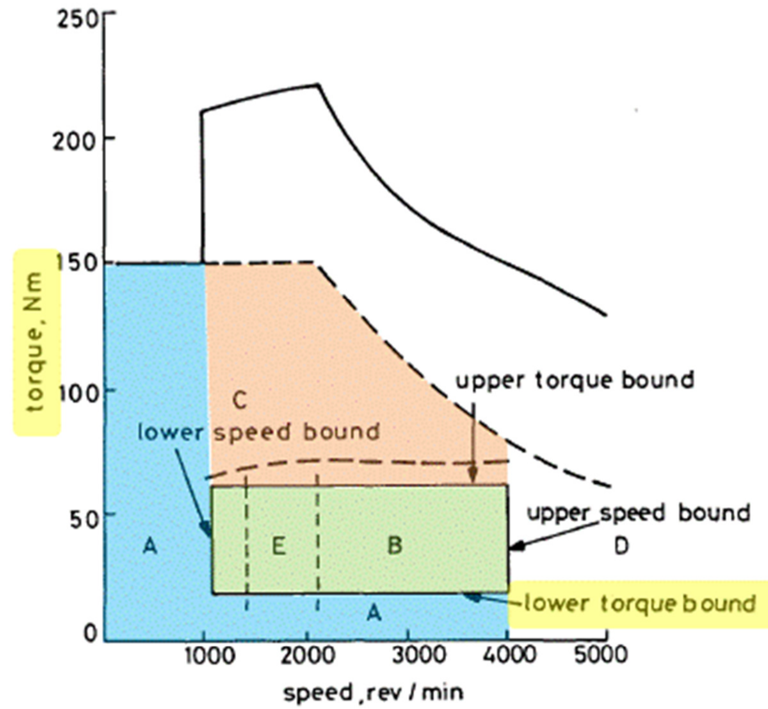



**Fig. 16** *Parallel hybrid suboptimum control operating regions*
(A) All electric region
(B) All IC engine
(C) Hybrid region
(D) Operation not allowed
(E) Reduced suboptimum region

Ex. 1906 (Bumby II) at 11, Fig. 16
*See also*, Ex. 1907 (Bumby III) at 8, Fig. 8

# The Board has held that Ford adequately provided a motivation to combine as Bumby I - Bumby V expressly cross-cite and chronologically detail a hybrid project developed at the University of Durham in the 1980's

**IPR2015-00800**
**Petition at 12-21**
**Reply at 21-22**

After considering the evidence and arguments presented, we find that Bumby IV and V do not teach away from using the sub-optimal control strategy taught by Bumby II and III. To the contrary, we find that a skilled artisan would have viewed the five Bumby references as describing various phases of the same development effort for implementing an operable control strategy for a hybrid vehicle, and, thus, would have been led to combine their respective teachings.

**IPR2015-00800, Ex. 1945 (‘579 Decision) at 19**

We have explained above that, in the special circumstance of this case, Petitioner has adequately combined the teachings of Bumby I, Bumby II, Bumby III, Bumby IV, and Bumby V, to apply them collectively as stemming from a single source without separately accounting for a reason to combine with respect to each individual claim limitation being addressed.

**IPR2015-00800, Institution Decision (Paper 13) at 18**

# Bumby II does not show results of a hybrid car with worse fuel consumption than a conventional non-hybrid car

IPR2015-00800
Reply at 24
Ex. 1951 (Davis Reply) ¶¶38-42

**Table 3A: IC engine vehicle performance data**

| Vehicle description | ECE-15 | | | 90 km/h | | | 120 km/h | | | Overall fuel consumption | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fuel used, l/100 km | Efficiency of IC engine, % | Engine load factor | Fuel used, l/100 km | Efficiency of IC engine, % | Engine load factor | Fuel used, l/100 km | Efficiency of IC engine, % | Engine load factor | 1/3 : 1/3 : 1/3 | 40/50/10 |
| (a) Base configuration | 8.8 (32) | 12 | 0.17 | 6.0 (47) | 21 | 0.28 | 7.6 (37) | 25 | 0.44 | 8.1 (35) | 7.1 (40) |
| (b) a + optimum gear change | 7.8 (36) | 13 | 0.23 | 6.0 (47) | 21 | 0.28 | 7.6 (37) | 25 | 0.44 | 7.1 (40) | 6.7 (42) |
| (c) b + six-speed | 7.6 (37) | 14 | 0.25 | 4.5 (62) | 27 | 0.46 | 6.3 (45) | 30 | 0.73 | 5.9 (48) | 5.7 (50) |
| (d) b + CVT | 7.6 (37) | 15 | 0.28 | 4.4 (64) | 30 | 0.75 | 6.6 (43) | 31 | 0.85 | 5.9 (48) | 5.5 (51) |
| (e) d + reduced idle fuel consumption | 6.6 (43) | 18 | 0.28 | 4.4 (64) | 30 | 0.75 | 6.6 (43) | 31 | 0.85 | 5.7 (50) | 5.3 (53) |
| (f) d + fuel shut off at idle & overrun | 5.7 (50) | 21 | 0.28 | 4.4 (64) | 30 | 0.75 | 6.6 (43) | 31 | 0.85 | 5.4 (52) | 5.0 (56) |
| (g) f + reduced engine size | 5.3 (53) | 21 | 0.3 | 4.4 (64) | 30 | 0.8 | 6.3 (45) | 32 | 0.88 | 5.2 (54) | 4.9 (58) |
| (h) g + 3-cylinder engine | 4.6 (61) | 24 | 0.37 | 4.4 (64) | 30 | 0.8 | 6.1 (46) | 33 | 0.9 | 5.0 (57) | 4.6 (61) |

Values in round brackets denotes fuel consumption in mile/gallon
Load factor ≡ load torque expressed as a fraction of engine maximum torque

**Table 3B: Energy-saving parallel hybrid performance data**

| Vehicle description | ECE-15 | | | 90 km/h | | | 120 km/h | | | Overall fuel consumption | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fuel used, l/100 km | Efficiency of IC engine, % | Engine load factor | Fuel used, l/100 km | Efficiency of IC engine, % | Engine load factor | Fuel used l/100 km | Efficiency of IC engine, % | Engine load Factor | 1/3 : 1/3 : 1/3 | 40/50/10 |
| (a) Base configuration | 6.7 (42) | 21 | 0.33 | 5.3 (53) | 27 | 0.56 | 7.8 (36) | 28 | 0.84 | 6.6 (43) | 6.0 (47) |
| (b) a + six-speed | 6.7 (42) | 21 | 0.33 | 5.3 (53) | 27 | 0.56 | 7.8 (36) | 28 | 0.84 | 6.6 (43) | 6.0 (47) |
| (c) a + Ni/Zn battery | 5.8 (49) | 24 | 0.41 | 5.3 (53) | 27 | 0.56 | 7.8 (36) | 28 | 0.84 | 6.1 (46) | 5.7 (50) |
| (d) a + 3-cylinder engine | 6.1 (46) | 24 | 0.36 | 5.0 (56) | 29 | 0.58 | 7.1 (40) | 30 | 0.85 | 6.1 (46) | 5.7 (50) |
| (e) d + Ni/Zn + 3-cylinder engine | 5.2 (54) | 26 | 0.39 | 5.0 (56) | 29 | 0.58 | 7.1 (40) | 30 | 0.85 | 5.8 (49) | 5.3 (53) |

Values in round brackets denotes fuel consumption in mile/gallon

Ex. 1906 (Bumby II) at 12, Table 3A and 3B

# Bumby V states the “arbitrary [speed-based] strategy is intended purely to demonstrate that the fully integrated control system is capable of following the dictates” of the sub-optimal control strategy

**IPR2015-00800, Reply at 23**
**Ex. 1951 (Davis Reply) ¶¶57-60**

### 6.2 Computer speed control

To test the performance of the algorithms in the control system it is necessary to exercise the drive train over standard driving cycles such as the European ECE15 urban cycle. Although this can be achieved with manual pedal inputs to the hybrid-mode controller, complete computer control offers the advantage of a higher degree of consistency between tests. Computer

control is made possible by adding an outer speed feedback loop to the existing vehicle control system of Fig 16. When completed, the new system appears as in Fig 18, with the components of Fig 16 represented by the block labelled ‘vehicle control system’. The job of the P+I speed controller is to map varying speed demands to appropriate torque demands.

**Ex. 1909 (Bumby V) at 15 (highlighted)**

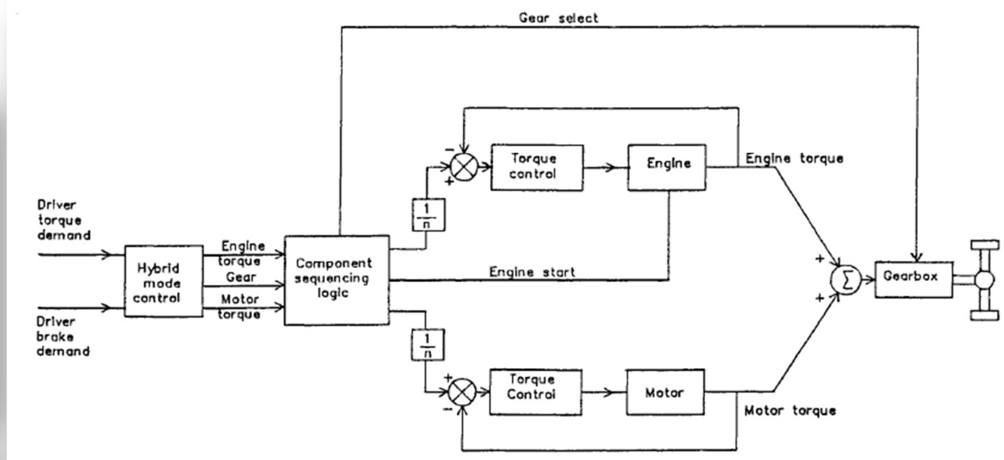



Fig 16 Complete vehicle component control system

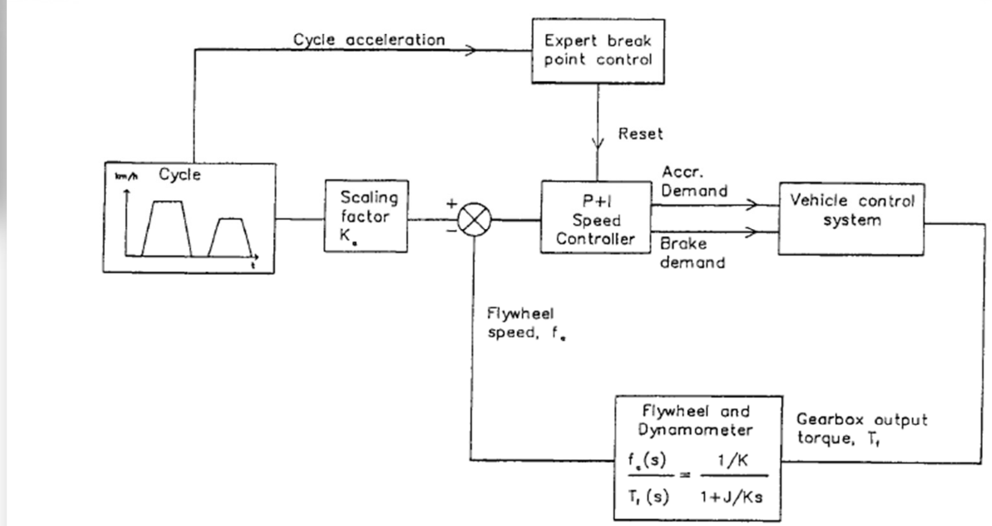



Fig 18 Block diagram for automatic-cycle speed control

**Ex. 1909 (Bumby V) at 13-Fig. 16 & 15-Fig. 18**

# Issue 1 – Cross-reference for other Group 3 IPRs

| Slide(s) | Paper/Exhibit | IPR2015-00758 (US 7,237,634) | IPR2015-00785 (US 7,237,634) | IPR2015-00801 (US 7,237,634) | IPR2015-00792 (US 8,214,097) | IPR2015-00800 (US 7,237,634) |
|---|---|---|---|---|---|---|
| 3 | **Ford Expert Decl.** | N/A | Ex. 1352 ¶¶303-313 | **Ex. 1852 ¶¶293-303** | Ex. 1202 ¶¶424-436 | N/A |
| 3 | **Institution Decision** | N/A | Paper 13 at 13-15, 23-24 | **Paper 12 at 13-14, 22** | Paper 13 at 8-9, 14-15 | N/A |
| 3 | **Reply** | N/A | Paper 19 at 4-6 | **Paper 17 at 4-6** | Paper 18 at 4-5 | N/A |
| 3 | **Severinsky** | N/A | Ex. 1354 at 18:23-33<br>Ex. 1352 ¶¶311-312 | **Ex. 1854 at 18:23-33<br>Ex. 1852 ¶¶301-302** | Ex. 1205 at 18:23-33<br>Ex. 1202 ¶¶433-434 | N/A |
| 4 | **Ford Expert Reply Decl.** | N/A | Ex. 1384 ¶¶16-22 | **Ex. 1889 ¶¶16-22** | Ex. 1237 ¶¶20-26 | N/A |
| 4 | **POR** | N/A | Paper 15 at 9-10<br>Ex. 1384 ¶19 | **Paper 15 at 11<br>Ex. 1889 ¶19** | Paper 16 at 12-13<br>Ex. 1237 ¶23 | N/A |
| 4 | **'097 Patent File History** | N/A | Ex. 2301 at 238 | **Ex. 2801 at 238** | Ex. 1210 at 238 | N/A |
| 4 | **Institution Decision** | N/A | Paper 13 at 13 | **Paper 12 at 13** | **Paper 13 at 9** | N/A |
| 4 | **Reply** | N/A | Paper 19 at 4-6; 10-12 | **Paper 17 at 4-6; 9-11** | Paper 18 at 4-5; 10-12 | N/A |

# Issue 2 – Cross-reference for other Group 3 IPRs

| Slide(s) | Paper/Exhibit | IPR2015-00758 (US 7,237,634) | IPR2015-00785 (US 7,237,634) | IPR2015-00801 (US 7,237,634) | IPR2015-00792 (US 8,214,097) | IPR2015-00800 (US 7,237,634) |
|---|---|---|---|---|---|---|
| 5 | **Ford Expert Decl.** | N/A | Ex. 1352 ¶¶326-344 | **Ex. 1852 ¶¶317-335** | N/A | N/A |
| 5 | **Ford Expert Reply Decl.** | N/A | Ex. 1384 ¶¶82-88 | **Ex. 1889 ¶¶32-38** | N/A | N/A |
| 5 | **Lateur** | N/A | Ex. 1356 at Fig. 1; 10:36-43<br>Ex. 1352 ¶¶329-330; 341-343<br>Ex. 1384 ¶¶87-88 | **Ex. 1856 at Fig. 1; 10:36-43<br>Ex. 1852 ¶¶320-321; 332-334<br>Ex. 1889 ¶¶37-38** | N/A | N/A |

# Issues 9-10 – Cross-reference for other Group 3 IPRs

| Slide(s) | Paper/Exhibit | IPR2015-00758 (US 7,237,634) | IPR2015-00785 (US 7,237,634) | IPR2015-00801 (US 7,237,634) | IPR2015-00792 (US 8,214,097) | IPR2015-00800 (US 7,237,634) |
|---|---|---|---|---|---|---|
| 14 | **Challenged Patent ('634/'097)** | Ex. 1201 at 35:63-36:1, 43:29-35;<br>36:31-36, 37:42-44;<br>36:37-43 | Ex. 1351 at 35:63-36:1, 43:29-35;<br>36:31-36, 37:42-44;<br>36:37-43 | **Ex. 1851 at 35:63-36:1, 43:29-35;<br>36:31-36, 37:42-44;<br>36:37-43** | Ex. 1216 at 35:14-19, 42:37-42;<br>35:48-53, 36:57-59;<br>35:54-60 | N/A |
| 15 | **904 Final Decision** | Ex. 1254 at 13-14 | Ex. 1385 at 13-14 | **Ex. 1892 at 13-14** | Ex. 1242 at 13-14 | N/A |
| 15 | **Reply** | Paper 18 at 6 | Paper 19 at 7-8 | **Paper 17 at 7** | Paper 18 at 7 | N/A |
| 15 | **Ford Expert Decl.** | Ex. 1207 ¶¶183-199 | Ex. 1352 ¶¶129-147 | **Ex. 1852 ¶¶134-152** | Ex. 1202 ¶¶142-159 | N/A |
| 15 | **Institution Decision** | Paper 12 at 6 | Paper 13 at 8 | **Paper 12 at 7-8** | Paper 13 at 6 | N/A |
| 15 | **Severinsky** | Ex. 1203 at 17:11-15<br>Ex. 1207 ¶186 | Ex. 1354 at 17:11-15<br>Ex. 1352 ¶131 | **Ex. 1854 at 17:11-15<br>Ex. 1852 ¶136** | Ex. 1205 at 17:11-15<br>Ex. 1202 ¶143 | N/A |
| 16 | **904 Final Decision** | Ex. 1254 at 14-15 | Ex. 1385 at 14-15 | **Ex. 1892 at 14-15** | Ex. 1242 at 14-15 | N/A |
| 16 | **Reply** | Paper 18 at 7 | Paper 19 at 9 | **Paper 17 at 8** | Paper 18 at 9 | N/A |
| 16 | **Ford Expert Decl.** | Ex. 1207 ¶¶200-223; 224-237 | Ex. 1352 ¶¶148-158; 159-171 | **Ex. 1852 ¶¶153-163** | Ex. 1202 ¶¶160-169; 170-182 | N/A |
| 16 | **Severinsky** | Ex. 1203 at 7:8-16; 20:63-67<br>Ex. 1207 ¶204 | Ex. 1354 at 7:8-16; 20:63-67<br>Ex. 1352 ¶¶154-155 | **Ex. 1854 at 7:8-16; 20:63-67<br>Ex. 1852 ¶¶159-160** | Ex. 1205 at 7:8-16; 20:63-67<br>Ex. 1202 ¶¶165-166 | N/A |
| 17,18 | **Reply** | Paper 18 at 12-13 | Paper 19 at 12-13 | **Paper 17 at 11-13** | Paper 18 at 12-13 | N/A |
| 17 | **Challenged Patent ('634)** | Ex. 1201 at 25:11-24; 35:3-9; 44:65-45:2<br>Ex. 1207 ¶¶197-198 | Ex. 1351 at 25:11-24; 35:3-9; 44:65-45:2<br>Ex. 1352 ¶¶280-281, 416 | **Ex. 1851 at 25:11-24; 35:3-9; 44:65-45:2<br>Ex. 1852 ¶¶151, 162** | Ex. 1216 at 24:47-60; 34:22-28; 44:2-5<br>Ex. 1202 ¶¶158, 168 | N/A |
| 19 | **904 Final Decision** | Ex. 1254 at 18 | Ex. 1358 at 18 | **Ex. 1892 at 18** | Ex. 1242 at 18 | N/A |
| 19 | **1415 Final Decision** | N/A | Ex. 1388 at 25 | Ex. 1893 at 25 | **Ex. 1238 at 25** | N/A |
| 19 | **Reply** | Paper 18 at 8 | Paper 19 at 10 | **Paper 17 at 9** | **Paper 18 at 10** | N/A |
| 19 | **Challenged Patent ('634/'097)** | Ex. 1201 at cl. 16; 38:43-44 | Ex. 1351 at cl. 16; 38:43-44 | **Ex. 1851 at cl. 16**; 38:43-44 | **Ex. 1201 at 37:57-58** | N/A |

# Issues 11-12 – Cross-reference for other Group 3 IPRs

| Slide(s) | Paper/Exhibit | IPR2015-00758 (US 7,237,634) | IPR2015-00785 (US 7,237,634) | IPR2015-00801 (US 7,237,634) | IPR2015-00792 (US 8,214,097) | IPR2015-00800 (US 7,237,634) |
|---|---|---|---|---|---|---|
| 20 | **1416 Final Decision** | Ex. 1256 at 22 | **Ex. 1386 at 22** | Ex. 1890 at 22 | N/A | N/A |
| 20 | **Reply** | Paper 18 at 9 | **Paper 19 at 21** | Paper 17 at 24 | N/A | N/A |
| 20 | **Ford Expert Decl.** | Ex. 1207 ¶¶362-376, 415-416 | **Ex. 1352 ¶¶469-486, 615-624** | Ex. 1852 ¶¶652-670, 728-737 | N/A | N/A |
| 20 | **Frank** | Ex. 1204 at 7:66-8:11, Fig. 4<br>Ex. 1207 ¶¶347, 415 | **Ex. 1357 at 7:66-8:11, Fig. 4**<br>**Ex. 1352 ¶¶475,484** | Ex. 1859 at 7:66-8:11, Fig. 4<br>Ex. 1852 ¶¶659, 668 | N/A | N/A |
| 21 | **1416 Final Decision** | Ex. 1256 at 21 | **Ex. 1386 at 21** | Ex. 1890 at 21 | N/A | N/A |
| 21 | **Reply** | Paper 18 at 10 | **Paper 19 at 23** | Paper 17 at 25 | N/A | N/A |
| 21 | **Ford Expert Decl.** | Ex. 1207 ¶¶345-349 | **Ex. 1352 ¶¶734-740** | Ex. 1852 ¶¶807-820, 776-782 | N/A | N/A |
| 21 | **Severinsky** | Ex. 1203 at 18:34-42 | **Ex. 1354 at 18:34-42** | Ex. 1854 at 18:34-42 | N/A | N/A |

# Issue 15 - Cross-reference for other Group 3 IPRs

| Slide(s) | Paper/Exhibit | IPR2015-00758 (US 7,237,634) | IPR2015-00785 (US 7,237,634) | IPR2015-00801 (US 7,237,634) | IPR2015-00792 (US 8,214,097) | IPR2015-00800 (US 7,237,634) |
|---|---|---|---|---|---|---|
| 25 | **1415 Final Decision** | N/A | N/A | **Ex. 1893 at 30** | Ex. 1238 at 30 | N/A |
| 25 | **Ford Expert Decl.** | N/A | N/A | **Ex. 1852 ¶¶203-208** | Ex. 1202 ¶¶461-466 | N/A |
| 25 | **Yamaguchi** | N/A | N/A | **Ex. 1855 at 8:62-67, Fig. 8**<br>**Ex. 1852 ¶¶203-204** | Ex. 1209 at 8:62-65, Fig. 8<br>Ex. 1202 ¶¶461-462 | N/A |
| 26 | **1415 Final Decision** | N/A | N/A | **Ex. 1893 at 31** | Ex. 1238 at 31 | N/A |
| 26 | **Ford Expert Decl.** | N/A | N/A | **Ex. 1852 ¶¶304-316** | Ex. 1202 ¶¶457-466 | N/A |
| 26 | **Ford Expert Reply Decl.** | N/A | N/A | **Ex. 1889 ¶¶25-31, 106-111** | N/A | N/A |
| 26 | **Reply** | N/A | N/A | **Paper 17 at 13** | N/A | N/A |
| 26 | **Severinsky** | N/A | N/A | **Ex. 1854 at 12:13-24**<br>**Ex. 1889 ¶¶30-31** | Ex. 1205 at 12:13-24 | N/A |
| 26 | **Vittone** | N/A | N/A | **Ex. 1858 at 29**<br>**Ex. 1889 ¶¶107-110** | Ex. 1233 at 29 | N/A |