Patent Owners' Oral Hearing Demonstratives

IPR2020-01299 – U.S. Patent No. 8,630,761

Before Sally C. Medley, Kalyan K. Deshpande, and Arthur M. Peslak,
Administrative Patent Judges

Agenda

- Key Points
- Technology Overview
- Claim Construction
- Ground 1 – Severinsky in View of Quigley
- Ground 2 – Severinksy in View of Nii
- Ground 3 – Severinksy in View of Graf

Key Points

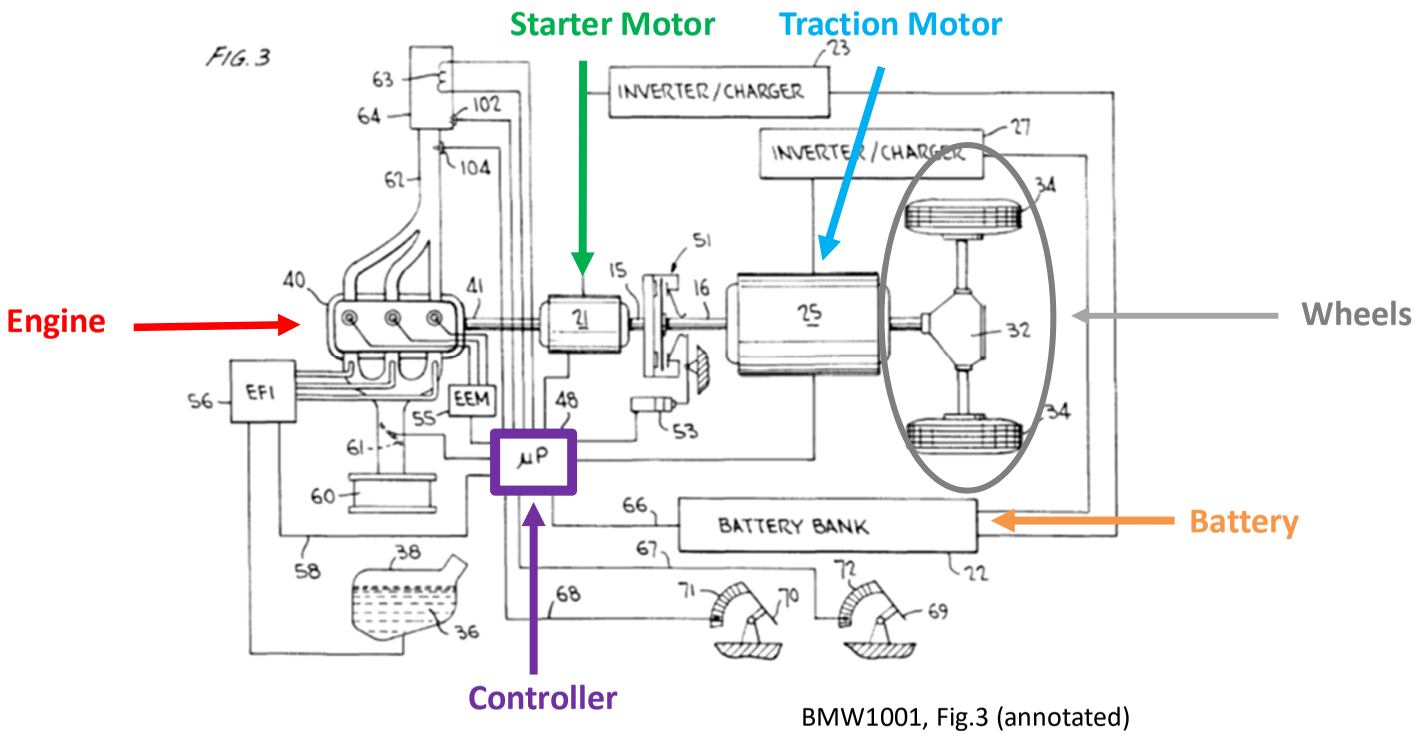
- **None of the prior art derives a predicted near-term pattern of operation as claims 1 and 7 require**
  - BMW agrees that Severinsky does not disclose this feature
  - The prior art (Quigley, Nii, Graf) at best derive a single predicted value
  - For this reason, BMW has repeatedly attempted to vitiate the word "pattern"
- **None of the prior art compares variations of patterns of road load experienced from day to day as claims 4 and 10 require**
  - The historical vehicle data in the prior art has nothing to do with road load
- **No motivation to combine**
  - In attempt to invalidate claims 4 and 10, BMW admits that ***only*** patterns of road load are useful for energy management
  - In doing so, BMW acknowledges that the prior art—which has nothing to do with patterns of road load—would not improve Severinsky's energy management

POR, 1-4, 16; Sur-reply, 1-2, 8

Technology Overview

Technology Background – Hybrid Architecture

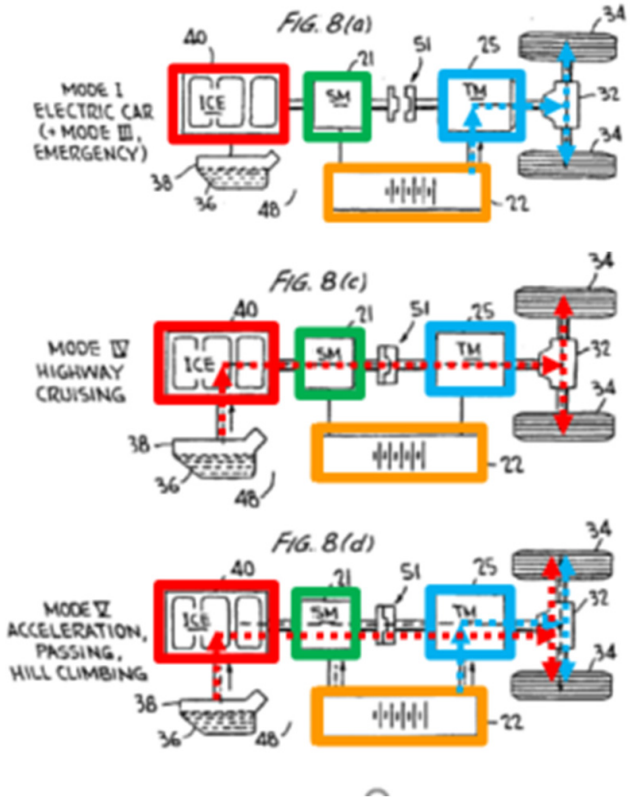
- The ’761 patent is directed to hybrid electric vehicles and the control thereof



BMW1001, Fig.3 (annotated)

POR, 5

Technology Background – Operating Modes

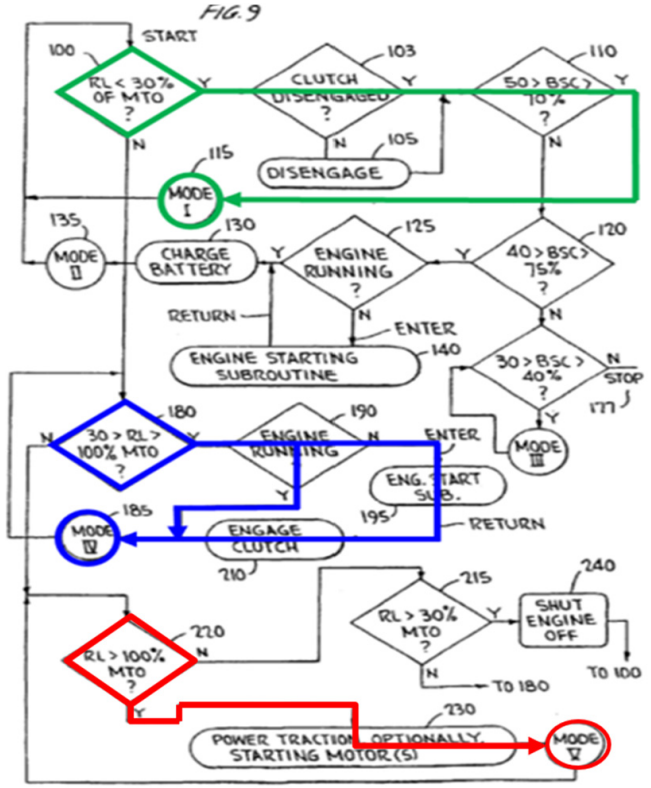


- The hybrid vehicle of the '761 patent can be operated in different "modes," i.e. different combinations of motor, engine, or both, to propel the vehicle:
  - Mode I: motor only propulsion
  - Mode IV: engine propulsion
  - Mode V: motor and engine propulsion

POR, 5-7

Technology Background – Mode Selection

- The ’761 patent selects modes by comparing “road load” (the instantaneous torque required to propel the vehicle) to the setpoint and MTO
  - RL < 30% MTO: Mode I
  - 30% MTO < RL < 100% MTO: Mode IV
  - RL > 100% MTO: Mode V

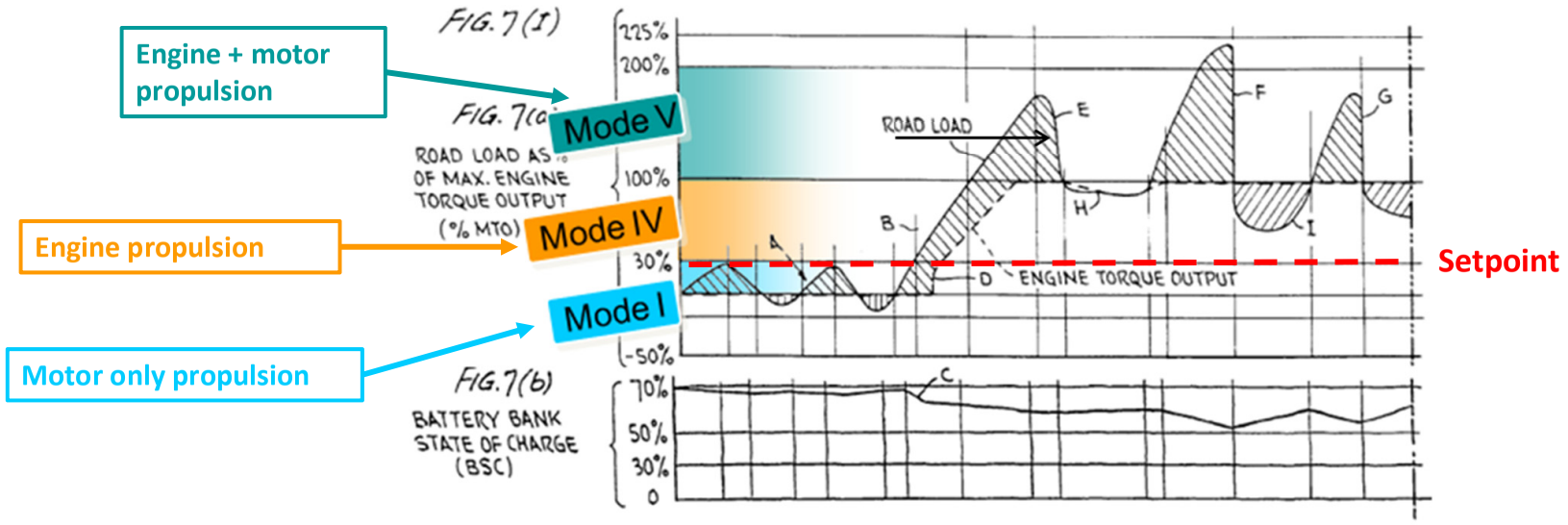


BMW1001, Fig. 9 (annotated)

POR, 7

Technology Background – Mode Selection

- The ’761 patent compares road load to the setpoint to select operating modes



PAICE2016, ¶38; POR, 6-7

BMW1001, Fig. 7 (annotated)

Technology Background: Pattern-Based Mode Switching

- The ’761 patent identifies and predicts patterns of hybrid vehicle operation
- For example, the ’761 patent identifies and predicts a sequence of changes in road load such as road load fluctuations above and below the setpoint

It is also within the scope of the invention for the microprocessor to monitor the vehicle's operation over a period of days or weeks and reset this important setpoint in response to a repetitive driving pattern. For example, suppose the operator drives the same route from a congested suburban development to a workplace about the same time every morning; typically the road load might remain under 20% of MTO for the first few minutes of each day, then vary between 0 and 50% of MTO for another few minutes as the operator passes through a few traffic lights, and then suddenly increase to 150% of MTO as the operator accelerates onto a highway. It is within the skill of the art to program a microprocessor to record and analyze such daily patterns, and to adapt the control strategy accordingly. For example, in response to recognition of a regular pattern as above, the transition point might be adjusted to 60% of MTO; this would prevent repetitive engine starts as the road load exceeded 30% of MTO for a few hundred yards at a time, as might often occur in suburban traffic. Similarly, the engine starting routine might be initiated after the same total distance had been covered each day.

BMW1001, 39:48-67 (annotated)

POR, 7-8

Technology Background: Pattern-Based Mode Switching

- The ’761 patent provides an exemplary pattern consisting of road load remaining under 20% MTO followed by road load varying between 0 and 50% MTO followed by road load increasing to 150% MTO

POR, 8, 27-28

Technology Background: Pattern-Based Mode Switching

- The ’761 file history confirms that the pattern must be predicted, *i.e.*, a future pattern
- Applicant distinguished Severinsky (“the ’970 patent”) in which the vehicle designer simply anticipates the vehicle will be driven in different modes

More particularly, independent claims 17 and 23 have both been amended hereby to recite that the controller performs the separate steps of monitoring vehicle operation to derive a predicted pattern of operation, and then controlling vehicle operation accordingly. The ‘970 patent discloses only that the vehicle is operated in different modes responsive to vehicle speed, makes this mode determination strictly in real time, and says nothing about predicting a pattern of operation, and altering vehicle operation accordingly.

Further, the ‘970 patent says nothing about the **controller** performing the step of monitoring vehicle operations in order to derive a predicted pattern or anticipate a pattern of operation of the vehicle. That is, as noted by the Examiner, highway operation and operation in traffic are predictable modes of operating any vehicle, and therefore any vehicle must be designed to accomplish both properly. But in this case, it is the vehicle designer who anticipates highway and low-speed driving, and incorporates the necessary components into the vehicle to permit the vehicle to perform in both modes. And, of course, the designer incorporates the necessary components well before the vehicle actually experiences these conditions. This is very different from the vehicle’s controller monitoring operation of the particular vehicle and using this data to predict future operational patterns accordingly, as claimed.

POR, 18

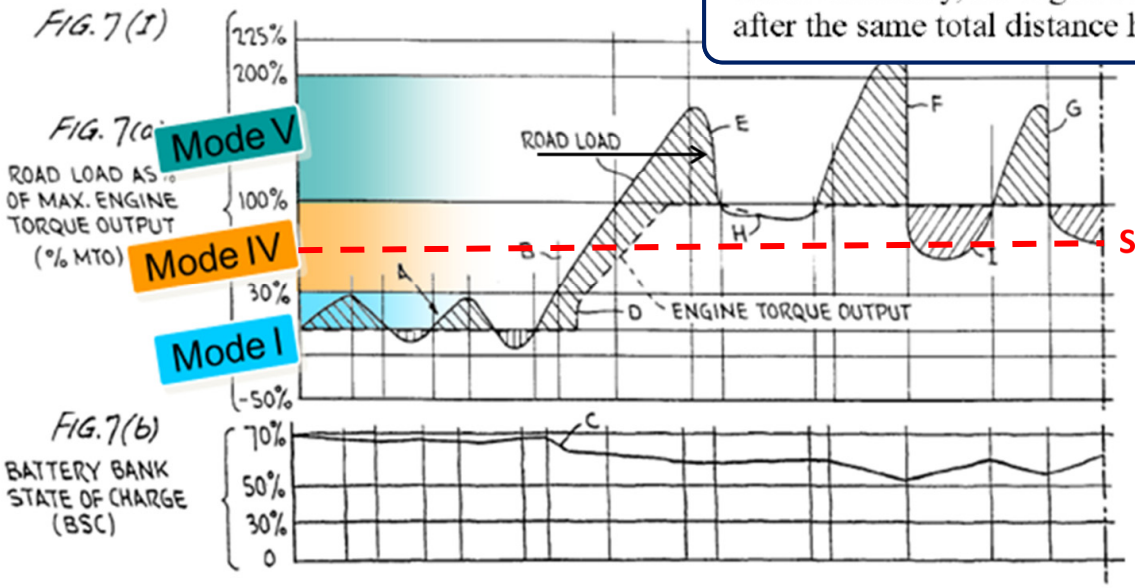
BMW1052, 58

Technology Background: Pattern-Based Mode Switching

- Based on the predicted pattern, the '761 patent adjusts the setpoint to 60% MTO

trol strategy accordingly. For example, in response to recognition of a regular pattern as above, the transition point might be adjusted to 60% of MTO; this would prevent repetitive engine starts as the road load exceeded 30% of MTO for a few hundred yards at a time, as might often occur in suburban traffic. Similarly, the engine starting routine might be initiated after the same total distance had been covered each day.

BMW1001, 39:60-67 (annotated)



BMW1001, Fig. 7 (annotated)

POR, 8-9

Claim Construction

Claim Construction – "predicted near-term pattern of operation"

1. A method of operation of a hybrid vehicle, comprising steps of:

storing and supplying electrical power from a battery bank,

applying torque to road wheels of said hybrid vehicle from one or both of an internal combustion engine and at least one traction motor, and

controlling flow of torque between said internal combustion engine, said at least one traction motor, and said road wheels, and controlling flow of electrical power between said battery bank and said at least one traction motor employing a controller, and

wherein said controller derives a predicted near-term pattern of operation of said hybrid vehicle by monitoring operation of said hybrid vehicle; and

controls operation of said at least one traction motor and said internal combustion engine for propulsion of said hybrid vehicle responsive to said derived near-term predicted pattern of operation of said hybrid vehicle.

BMW1001, Claim 1 (annotated)

Claim Construction – "predicted near-term pattern of operation"

- The Board construed the term as "expected pattern of operation"
  - The Board's construction correctly confirms that the claim term relates to derivation of a future pattern

controlling flow of torque between said internal combustion engine, said at least one traction motor, and said road wheels, and controlling flow of electrical power between said battery bank and said at least one traction motor employing a controller, and

wherein said controller derives a predicted near-term pattern of operation of said hybrid vehicle by monitoring operation of said hybrid vehicle; and

controls operation of said at least one traction motor and said internal combustion engine for propulsion of said hybrid vehicle responsive to said derived near-term predicted pattern of operation of said hybrid vehicle.

BMW1001, Claim 1 (annotated)

Past vehicle operation

Present vehicle operation

Future vehicle operation

ID, 12; POR, 15-18

Claim Construction – "predicted near-term pattern of operation"

- In its Reply, BMW does not challenge the Board's construction
- BMW agrees that the pattern must be predicted, *i.e.*, a future pattern

> *within the skill of the art.* BMW1001, 39:48-67; 40:41-43; 43:15-22. To distinguish Severinsky during prosecution, Applicants argued that, in contrast to a vehicle that determines its mode of operation "strictly in real time" based on a "vehicle designer's" anticipated mode of operation, the Challenged Claims require that the vehicle's controller monitor operation of the particular vehicle and use that data to predict future operational patterns and alter vehicle operation accordingly. BMW1052, 58-59.[1] To that end, the relevant claim language (amended in connection with that argument) only requires that the controller "derives a predicted pattern of operation … by monitoring operation" and "controls operation" of the motor or engine "responsive to" the pattern.

Reply, 3

Claim Construction – "predicted near-term pattern of operation"

- BMW's Petition is based on the wrong claim construction
  - BMW's proposed construction focuses on past vehicle operation, not future operation: "expected upcoming vehicle operation ***based on*** past repetitive driver behavior"

controlling flow of torque between said internal combustion engine, said at least one traction motor, and said road wheels, and controlling flow of electrical power between said battery bank and said at least one traction motor employing a controller, and

wherein said controller derives a predicted near-term pattern of operation of said hybrid vehicle by monitoring operation of said hybrid vehicle; and

controls operation of said at least one traction motor and said internal combustion engine for propulsion of said hybrid vehicle responsive to said derived near-term predicted pattern of operation of said hybrid vehicle.

BMW1001, Claim 1 (annotated)

Past vehicle operation

Present vehicle operation

Future vehicle operation

POR, 17

Claim Construction – "predicted near-term pattern of operation"

- BMW's Petition is based on the wrong claim construction
  - BMW's construction vitiates the word "pattern"
  - Unlike its District Court construction, BMW removed the word pattern by replacing "predicted near-term pattern of operation with "expected upcoming operation"

BMW's District Court Construction	BMW's IPR Construction
a pattern of operation of the vehicle expected *based on* monitoring the driver's repeated driving operations over time	expected upcoming vehicle operation *based on* past repetitive driver behavior

POR, 17

Claim Construction – "predicted near-term pattern of operation"

- The Board's construction is not broader than BMW's rejected construction
  - The Board's construction makes clear that the controller derive an "expected ***pattern*** of operation"
  - BMW's rejected construction only requires that the controller derive "expected upcoming vehicle operation"
- BMW removes the word "pattern" because the prior art does not derive any type of expected or predicted pattern

POR, 15-16; Sur-reply, 1; ID, 12; Reply, 2

BMW's Second Attempt To Vitiate the Word "Pattern"

The Word "Pattern" Must Have Meaning

- Because BMW does not challenge the Board's construction, BMW takes a second shot at vitiating the word "pattern" by interpreting "pattern" as a purely functional term governed by § 112, ¶ 6.

> expected "pattern" that are actually stored and maintained. Rather, a POSA would understand that a pattern need only contain sufficient information to allow the system to recognize characteristics concerning operation that would allow it to operate more efficiently. *Id.*; BMW1088, ¶21.

Sur-Reply, 8

Reply, 9

The Word "Pattern" Must Have Meaning

- BMW does not challenge Dr. Shahbakhti's testimony that the plain meaning of "pattern of operation" requires an order or sequence of driving operations

Dr. Mahdi Shahbakhti
Patent Owners' Expert

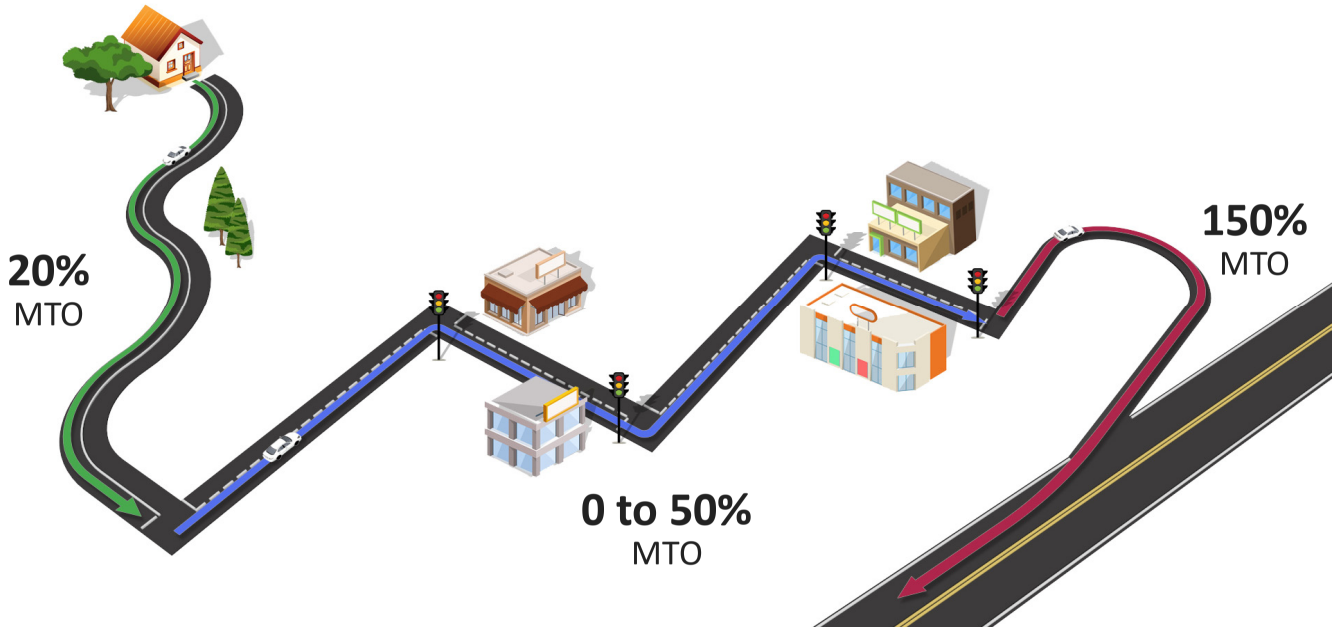
52. A person of ordinary skill in the art would understand a "pattern of operation of said hybrid vehicle" to require an order or sequence of driving operations. Ex. 2029 (defining "pattern" as a "regular or logical form, order, etc."); Ex. 2030, 3 (defining pattern as "[a]n established sequence of steps in a process"); Ex. 2031, 3 (defining pattern as "a regular or repetitive form, order, or arrangement"). There is no order or sequence with respect to a single measurement

PAICE2016, ¶ 52

Sur-Reply, 8-9

The Word "Pattern" Must Have Meaning

- The '761 patent shows that the "pattern of operation" consists of an order or sequence of driving operations



Sur-Reply, 5

So Why Is BMW Trying To Remove the Word "Pattern" from the Claims?

- The prior art only looks at past patterns of vehicle operation
- None of BMW's prior art predicts a pattern of operation

Past vehicle operation

Present vehicle operation

Future vehicle operation

POR, 17

Ground 1 – Severinsky in View of Quigley

Severinsky in View of Quigley Does Not Render Obvious Claims 1 and 7

- Neither Severinsky nor Quigley derives a predicted near-term pattern of operation
  - BMW agrees Severinsky does not disclose this feature
  - Quigley merely derives journey parameters, which are not a pattern of operation

1. A method of operation of a hybrid vehicle, comprising steps of:

storing and supplying electrical power from a battery bank,

applying torque to road wheels of said hybrid vehicle from one or both of an internal combustion engine and at least one traction motor, and

controlling flow of torque between said internal combustion engine, said at least one traction motor, and said road wheels, and controlling flow of electrical power between said battery bank and said at least one traction motor employing a controller, and

wherein said controller derives a predicted near-term pattern of operation of said hybrid vehicle by monitoring operation of said hybrid vehicle; and

controls operation of said at least one traction motor and said internal combustion engine for propulsion of said hybrid vehicle responsive to said derived near-term predicted pattern of operation of said hybrid vehicle.

BMW1001, Claim 1 (annotated)

POR, 22-26

Quigley Does Not Derive a "predicted near-term pattern of operation"

- Clearing up confusion regarding Quigley:
  - Quigley's "journey" is not a pattern of operation. It is merely total distance and duration of a total trip
  - Quigley does not use driver inputs to predict a "journey"

journey starts on a weekday between 7 and 8 a.m. *Id.* at 133. Quigley further discloses that if its controller "decides a journey is expected it can make an estimation of the expected journey parameters, and an appropriate optimized control strategy can be referenced from the controller's memory." *Id.* at 131.

Quigley, thus, discloses predicting a near-term pattern of operation, *i.e.*, a commuter journey, when the journey starts on a weekday between 7 and 8 a.m. This prediction is based on monitoring previous vehicle activity derived from driver inputs such as throttle and brake usage, as well as engine speed data and road speed.

ID, 20

POR, 23

27

Quigley Does Not Derive a "predicted near-term pattern of operation"

- Quigley merely derives predicted journey parameters
  - Quigley uses a GPS logger to track total distance and duration of previous trips
  - Quigley predicts total distance and duration of upcoming trip

Past vehicle operation

Present vehicle operation

Future vehicle operation

POR, 22-25

Quigley Does Not Derive a "predicted near-term pattern of operation"

- Quigley merely derives predicted parameters

2. HYBRID POWER TRAIN CONTROL

As previously stated, the proposed controller will allow journey parameters to be reliably estimated upon journey departure. In order to do this the information available to the controller could take one of two forms:-

To enable a hybrid electric power train controller to adapt to a wide variety of vehicle operation many parameters not normally used in vehicle control systems would be required , e.g. Journey duration, journey distance, time of departure, journey destination. Unfortunately most of these parameters are only known upon completion of a given journey. Therefore a means of intelligently estimating these parameters, based on the controller's past experience is needed.

If *it is a weekday,* ***and*** *the time is between 07.00-08.00 a.m.*

then

there is a high expectation of a journey of 1000 to 1300 seconds duration, with a distance around 14km.

POR, 22-25

BMW1054 (Quigley), 2, 5

Quigley Does Not Derive a "predicted near-term pattern of operation"

- BMW admits that Quigley merely predicts parameters

> Quigley teaches an intelligent controller for hybrid electric vehicles that looks at "habitual usage characteristics" to predict the parameters of an upcoming vehicle journey based upon the controller's analysis of past repetitive driver behavior and to select a corresponding control strategy that provides for optimal operation with respect to exhaust emissions and fuel consumption. BMW1054, 130-33; BMW1008, ¶¶127-128.

> Quigley "predict[s]" certain "parameters at the start of the journey using intelligent classification techniques and a knowledge base of previous journey histories." *Id.*

Petition, 18, 25

Quigley Does Not Derive a "predicted near-term pattern of operation"

- Quigley's journey parameters are single values, not a "pattern of operation"

Dr. Mahdi Shahbakhti
Patent Owners' Expert

arrangement"). There is no order or sequence with respect to a single measurement of time or distance or the starting time or a destination. Nor does the combination of these elements constitute a patter. For example, the total distance and duration can be used to calculate total average speed. But the average speed is just a parameter consisting of a single data point.

53. Moreover, these parameters such as duration and distance are parameters of the entire trip. They are not "near-term" or "expected" patterns of operation. The '761 patent describes such a "near-term" pattern consisting of road

POR, 24-25

PAICE2016, ¶¶ 52-53

Quigley Does Not Derive a "predicted near-term pattern of operation"

- Quigley's "journey" is not a pattern
- Quigley explicitly says that the "journey" consists of total duration and distance

> If the controller decides a journey is expected it can make an estimation of the expected journey parameters, and an appropriate optimized control strategy can be referenced from the controller's memory. If a journey is not expected, the controller will choose the use of a general purpose control strategy, thus providing reasonably efficient operation only. Figure 2. shows the decision process.

BMW1054 (Quigley), 3, 5

> ***If*** *it is a weekday,* ***and*** *the time is between 07.00-08.00 a.m.*
> ***then***
> *there is a high expectation of a journey of 1000 to 1300 seconds duration, with a distance around 14km.*

Sur-reply, 3-4

Quigley Does Not Derive a "predicted near-term pattern of operation"

- Quigley does not use vehicle inputs (e.g., throttle brake, etc.) to predict journey parameters
  - Quigley merely says these inputs are available in modern day vehicles
  - Quigley uses a GPS logger to predict journey parameters

Data is required throughout the project for investigation into methods of vehicle use prediction. This is achieved by the use of a data logger based around a GPS navigation system. Data recorded by the logger can be considered in terms of 1st or 2nd generation control data as follows:-

BMW1054 (Quigley), 2, 3; POR 24, 41

2. HYBRID POWER TRAIN CONTROL

As previously stated, the proposed controller will allow journey parameters to be reliably estimated upon journey departure. In order to do this the information available to the controller could take one of two forms:-

1st Generation Control

The essence of this type of control is that all information would only be available internally to the vehicle, from transducers belonging to the vehicle. A controller of this type, if implemented, would use signals derived from technology already present in modern day vehicles (e.g. electronic tachometer, engine management system).

Such information would include:-

a) Drivers Operational Inputs:- Throttle
Brake etc.

b) Time of day/year.

c) Engine Management Data:- Engine speed etc.

d) Road speed.

Severinsky in View of Quigley Does Not Render Obvious Claims 2 and 8

- BMW's Petition ignores the claim language
  - Claims 2 and 8 further describe the derived predicted pattern
  - BMW focuses only on past vehicle operation

> **2**. The method of claim **1**, wherein said derived predicted pattern of operation comprises at least one repetitive pattern of operation of said hybrid vehicle.

BMW1001, Claim 2 (annotated)

Past vehicle operation

Present vehicle operation

Future vehicle operation

POR, 36-37

Severinsky in View of Quigley Does Not Render Obvious Claims 2 and 8

- Neither Severinsky nor Quigley derives a ***repetitive*** predicted near-term pattern of operation

> **2**. The method of claim **1**, wherein said derived predicted pattern of operation comprises at least one repetitive pattern of operation of said hybrid vehicle.

BMW1001, Claim 1 (annotated)

- BMW merely argues that the predicted operation is ***based on*** a repetitive pattern

> during 7-8 am on weekdays. BMW1054, 132-33. Thus, Quigley's derived predicted pattern is based on at least one repetitive pattern.

POR, 36-37

Petition, 35

Severinsky in View of Quigley Does Not Render Obvious Claims 4 and 10

- Neither Severinsky nor Quigley monitors variation in road load or compare patterns of variation in road load experienced from day to day

> **4**. The method of claim **3**, wherein said controller monitors variation in road load experienced by said hybrid vehicle and compares patterns of variation in road load experienced from day to day in order to identify said repetitive patterns of operation of said hybrid vehicle.

BMW1001, Claim 4 (annotated)

POR, 37-42

Severinsky in View of Quigley Does Not Render Obvious Claims 4 and 10

- Neither Severinsky nor Quigley monitors variation in road load or compare patterns of variation in road load experienced from day to day
  - Severinsky merely considers the instantaneous torque
  - Quigley does not say anything about road load
  - Quigley merely states that the throttle could be used as an input

POR, 37-42

2. HYBRID POWER TRAIN CONTROL

As previously stated, the proposed controller will allow journey parameters to be reliably estimated upon journey departure. In order to do this the information available to the controller could take one of two forms:-

1st Generation Control

The essence of this type of control is that all information would only be available internally to the vehicle, from transducers belonging to the vehicle. A controller of this type, if implemented, would use signals derived from technology already present in modern day vehicles (e.g. electronic tachometer, engine management system).

Such information would include:-

a) Drivers Operational Inputs:- Throttle
Brake etc.

b) Time of day/year.

c) Engine Management Data:- Engine speed etc.

d) Road speed.

BMW1054 (Quigley), 2

Severinsky in View of Quigley Does Not Render Obvious Claims 4 and 10

- Dr. Davis's conclusory opinion cannot establish inherency

Dr. Davis's Testimony

28. Moreover, I disagree with his assertions about Quigley's road load related teachings. As I explained above and at my deposition, a person of ordinary skill in the art would understand Quigley's disclosure to include pattern information on road load because that would be required to manage the energy flow (referred to in the Abstract) through the hybrid drive train for optimum control. (*See* Paragraph 17 above).

POR, 37-42; Sur-reply, 16-17

BMW1088 (Davis Reply Dec.), ¶ 28

Quigley's Actual Disclosure

Data is required throughout the project for investigation into methods of vehicle use prediction. This is achieved by the use of a data logger based around a GPS navigation system. Data recorded by the logger can be considered in terms of 1st or 2nd generation control data as follows:-

A programme still very much in its infancy is the design of an intelligent controller. The proposed controller will allow journey parameters to be reliably estimated upon journey departure, and therefore allow for optimal operation with respect to exhaust emissions and fuel consumption.

BMW1054 (Quigley), 2

Severinsky in View of Quigley Does Not Render Obvious Claims 4 and 10

- Dr. Davis's conclusory opinion cannot establish inherency

"A claim limitation is inherent in the prior art if it is necessarily present in the prior art, not merely probably or possibly present."

Akamai Techs. v. Cable & Wireless Internet Servs., 344 F.3d 1186, 1192 (Fed. Cir. 2003)

POR, 37-42

Severinsky in View of Quigley Does Not Render Obvious Claims 4 and 10

- No evidence of comparing patterns of variation in road load experienced from day to day

Dr. Mahdi Shahbakhti
Patent Owners' Expert

64. Dr. Davis's opinion that "Quigley is basing its pattern data on variations in speed and operator inputs such as throttle or brake pedal" is incorrect. As I explain in Section VII.A.4, Quigley states that these inputs could be monitored but ultimately only monitors the "[t]ime of departure," "[j]ourney time elapse," and "[s]peed over ground, derived from latitude and longitude." Ex. 1054 (Quigley) at 3.[2] None of these are the same as road load or even provide sufficient data to be able to calculate road load. In addition, Quigley never discloses how one would use operator inputs such as throttle or brake pedal inputs to predict any parameters or any other information. Quigley simply says that these inputs could be monitored but never explains what to do with this information. Quigley instead uses a "data logger based around a GPS navigation system." Ex. 1054 (Quigley) at 3.

PAICE2016, ¶ 64

POR, 37-42

No Motivation To Combine Severinsky and Quigley

- No reason to modify Severinsky with Quigley's predicted journey parameters
  - BMW admits that **only** "pattern information on road load" is useful for managing the energy flow
  - Dr. Davis asserts without evidence that Quigley discloses pattern information on road load
  - But Quigley does not disclose any type of pattern information related to road load. Quigley explicitly uses "journey parameters" for "optimal operation"

POR, 37-42; Sur-reply, 2, 14

28. Moreover, I disagree with his assertions about Quigley's road load related teachings. As I explained above and at my deposition, a person of ordinary skill in the art would understand Quigley's disclosure to include pattern information on road load because that would be required to manage the energy flow (referred to in the Abstract) through the hybrid drive train for optimum control. (*See* Paragraph 17 above).

BMW1088 (Davis Reply Dec.), ¶ 28

A programme still very much in its infancy is the design of an intelligent controller. The proposed controller will allow journey parameters to be reliably estimated upon journey departure, and therefore allow for optimal operation with respect to exhaust emissions and fuel consumption.

BMW1054 (Quigley), 2

No Motivation To Combine Severinsky and Quigley

- BMW's reasons to combine are flawed
  1. BMW's generic, unexplained assertion that Quigley's "intelligent controller" will make Severinsky more efficient is deficient as a matter of law
  2. A POSA would not use Quigley's journey parameters to modify Severinsky as BMW suggests

42

POR, 30-36

BMW's Reasons To Combine Are Flawed

1. BMW's generic, unexplained assertion that Quigley's "intelligent controller" will make Severinsky more efficient is deficient as a matter of law

- BMW's conclusory statements do not explain "how" or "why" a POSA would combine Severinsky and Quigley

> of efficiency." BMW1013, 21:22-38. A POSA incorporating Quigley's teachings of an "intelligent controller" would have thus modified Severinsky's controller to similarly employ a more intelligent "control strategy" that determines the optimal mode of operation for an upcoming journey, which is determined "based on the controller's past experiences." Pet, 30-31; BMW 1054, 129; BMW1088, ¶38;

Sur-reply, 11-13

Reply, 13

BMW's Reasons To Combine Are Flawed

1. BMW's generic, unexplained assertion that Quigley's "intelligent controller" will make Severinsky more efficient is deficient as a matter of law

  – BMW's conclusory statements do not explain "how" or "why" a POSA would combine Severinsky and Quigley

> *"the Board 'must still be careful not to allow hindsight reconstruction of references . . . without any explanation as to **how or why** the references would be combined to produce the claimed invention.'"*

TriVascular, Inc. v. Samuels, 812 F.3d 1056, 1066 (Fed. Cir. 2016)(emphasis in original) (quoting *Kinetic Concepts, Inc. v. Smith & Nephew, Inc.*, 688 F.3d 1342, 1368 (Fed. Cir. 2012))

POR, 30; Sur-reply, 11-13

BMW's Reasons To Combine Are Flawed

2. A POSA would not use Quigley's journey parameters to modify Severinsky as BMW suggests

– BMW simply assumes that Quigley's journey parameters would improve Severinsky's efficiency

> Indeed, Quigley notes that "many cars will have habitual usage characteristics for a high percentage of their journeys," and that the estimation of upcoming journey parameters can allow "optimal operation with respect to exhaust emissions and fuel consumption." *Id.*, 130. A POSA would have likewise been motivated to optimize Severinsky's control scheme to incorporate such control based on predicted pattern of operation information to achieve the "optimal operation" of emissions and fuel consumption disclosed in Quigley. BMW1008, ¶¶197-198.

POR, 38; Sur-reply, 1, 11-13

Reply, 32

45

BMW's Reasons To Combine Are Flawed

2. A POSA would not use Quigley's journey parameters to modify Severinsky as BMW suggests

– Dr. Shahbakhti testified that Quigley's journey parameters have no use in Severinsky

Dr. Mahdi Shahbakhti
Patent Owners' Expert

80. Moreover, the journey parameters identified by Quigley are not useful in optimizing a control system in the parallel hybrid electric vehicle such as Severinsky's. The total distance and duration of a journey at best can inform the controller about average vehicle speed. But average vehicle speed is not useful in refining the control system in a hybrid electric vehicle, particularly in Severinsky's control system where the controller is optimizing how and when to use the electric motor and combustion engine.

PAICE2016, ¶ 80

POR, 32; Sur-reply, 11-13

BMW's Reasons To Combine Are Flawed

2. A POSA would not use Quigley's journey parameters to modify Severinsky as BMW suggests

– Textbook evidence shows that Quigley's journey parameters have no use in Severinsky because averages are not useful in complex systems like Severinsky's parallel hybrid architecture

47

> The average operating point method is able to yield reasonable estimates of the fuel consumption of *simple* powertrains (IC engine or battery electric propulsion systems). It is not well suited to problems in which complex propulsion systems must be optimized. In particular it does not offer the option of including the effect of energy management strategies in these computations.

PAICE2033, 38 (emphasis added)

POR, 38

BMW's Reasons To Combine Are Flawed

2. A POSA would not use Quigley's journey parameters to modify Severinsky as BMW suggests

– BMW admits that only "pattern information on road load" is useful for managing the energy flow

28. Moreover, I disagree with his assertions about Quigley's road load related teachings. As I explained above and at my deposition, a person of ordinary skill in the art would understand Quigley's disclosure to include pattern information on road load because that would be required to manage the energy flow (referred to in the Abstract) through the hybrid drive train for optimum control. (*See* Paragraph 17 above).

BMW1088, ¶ 28

Sur-reply, 2, 14

48

BMW's Reasons To Combine Are Flawed

2. A POSA would not use Quigley's journey parameters to modify Severinsky as BMW suggests

- BMW claims Quigley's "control strategy" would improve mode selection
- But Quigley expressly does not use predicted journey parameters for mode selection

BMW's Petition

> Since Severinsky's control scheme selects the mode of operation (i.e., motor only, engine only, motor plus engine) for maximum efficiency, a POSA incorporating Quigley's teachings would have modified the controller to similarly employ a "control strategy" that determines the optimal mode of operation based on expected upcoming journeys (e.g., near-term predicted pattern of operation).

Petition, 32

Quigley

> Using the electric motor or heat engine exclusively (modes 1 and 2) present a manageable control problem for the driver of the vehicle, but their combined use (mode 3) makes it very difficult for the driver to control optimally. Previous work at the University of Warwick (Farrall and Jones, 1993; Farrall, 1993) has investigated the use of fuzzy decision making for the management of energy flow within a hybrid electric vehicle in this third mode. It was concluded that fuzzy control could provide benefits over a limited range of operation, but in order to obtain better performance over the complete range of operation, a method of adapting the fuzzy rules would be required.

BMW1054 (Quigley), 2

POR, 42-43

Ground 2 – Severinsky in View of Nii

50

Severinsky in View of Nii Does Not Render Obvious Claims 1 and 7

- Neither Severinsky nor Nii derives a predicted near-term pattern of operation
  - BMW agrees Severinsky does not disclose this feature
  - Nii merely derives an average power value

1. A method of operation of a hybrid vehicle, comprising steps of:

storing and supplying electrical power from a battery bank,

applying torque to road wheels of said hybrid vehicle from one or both of an internal combustion engine and at least one traction motor, and

controlling flow of torque between said internal combustion engine, said at least one traction motor, and said road wheels, and controlling flow of electrical power between said battery bank and said at least one traction motor employing a controller, and

wherein said controller derives a predicted near-term pattern of operation of said hybrid vehicle by monitoring operation of said hybrid vehicle; and

controls operation of said at least one traction motor and said internal combustion engine for propulsion of said hybrid vehicle responsive to said derived near-term predicted pattern of operation of said hybrid vehicle.

BMW1001, Claim 1 (annotated)

POR, 44-50

Nii Does Not Derive a "predicted near-term pattern of operation"

- Nii merely derives the average power output of a generator
  - Nii calculates average generator output over previous trips
  - Nii predicts target power output for upcoming trip

Past vehicle operation

Present vehicle operation

Future vehicle operation

POR, 46-47

Nii Does Not Derive a "predicted near-term pattern of operation"

- The Board acknowledged that Nii predicts "power generation output"
- Power consumption is not evidence of a predicted pattern:
  - Power consumption and variations thereof is just the result of the driving conditions
  - Not related to a predicted pattern of operation

> Nii discloses that when a journey is performed many times, "a target generator output is stored by using the journey as a travel pattern." Ex. 1022, 6:43–46. Nii further discloses that "the travel pattern is recognized by the starting time and the output of the generator 20 is automatically set to the target generator output." *Id.* at 6:46–49. Although Nii predicts power generation output, Petitioner establishes sufficiently that a skilled artisan would recognize that Nii is deriving a predicted near-term pattern of operation, because Nii discloses that "the power consumption of an electric vehicle depends on the travel conditions. That is, when the electric vehicle travels on many upward slopes or repeatedly stops and starts because there are many traffic signals, the power consumption increases." *Id.* at 1:44–48.

ID, 27-28

POR, 45-46

Nii Does Not Derive a "predicted near-term pattern of operation"

- Nii merely derives predicted parameters as BMW's expert admits

> Moreover, it is preferable that the update means averages the accumulated in-travel-pattern power consumption including a detected in-travel-pattern power consumption and updates a target power generation in accordance with the calculated average value.
>
> As described above, it is possible to set the power generation in a travel pattern to a proper value by averaging the accumulated power consumption when updating a power consumption.

BMW1022 (Nii), 2:43-51

Dr. Gregory Davis
Petitioners' Expert

> Q All right. Turning to the Nii reference, n-i-i, Nii predicts what's referred to as a target generator output, right?
>
> A Yeah, I suppose you could describe it that way.

PAICE2034 (Davis Tr.), 44:19-23

POR, 45-46

Nii Does Not Derive a "predicted near-term pattern of operation"

- BMW admits that Nii merely predicts the target power value ***based on*** a pattern

> accurate." *Id.*, 6:9-13. Since Nii recognized travel patterns to set target outputs, a POSA would recognize that it is deriving a predicted near-term pattern of operation, as the target output is intended to cover the expected upcoming operation based on the detected pattern. BMW1008, ¶¶286-288. Nii thus meets the limitation of part [e].

Petition, 52

POR, 45-46

Nii Does Not Derive a "predicted near-term pattern of operation"

- Nii's target output value is a single value, not a "pattern of operation"

Dr. Mahdi Shahbakhti
Patent Owners' Expert

91. The target output of the generator is a single internal data point and not a pattern of operation as understood by a person of skill in the art. There is no regular sequence or order to a single data point such as an average power value. As I explain in Section VII.A.1, a person of ordinary skill in the art would understand a "pattern of operation of said hybrid vehicle" to require an order or sequence of driving operations. Ex. 2029 (defining "pattern" as a "regular or logical form, order, etc."); Ex. 2030, 3 (defining pattern as "[a]n established sequence of steps in a process"); Ex. 22031, 3 (defining pattern as "a regular or repetitive form, order, or arrangement"). And as I explained in Section VII.A.1, contemporaneous literature

PAICE2016, ¶91

POR, 45-46

Severinsky in View of Nii Does Not Render Obvious Claims 2 and 8

- BMW's Petition ignores the claim language
  - Claims 2 and 8 further describe the predicted pattern
  - BMW focuses only on past vehicle operation

> **2**. The method of claim **1**, wherein said derived predicted pattern of operation comprises at least one repetitive pattern of operation of said hybrid vehicle.

BMW1001, Claim 2 (annotated)

Past vehicle operation

Present vehicle operation

Future vehicle operation

POR, 59

Severinsky in View of Nii Does Not Render Obvious Claims 2 and 8

- Neither Severinsky nor Nii derives a ***repetitive*** predicted near-term pattern of operation

> **2**. The method of claim **1**, wherein said derived predicted pattern of operation comprises at least one repetitive pattern of operation of said hybrid vehicle.

BMW1001, Claim 1 (annotated)

- BMW merely argues that the predicted operation is based on a repetitive pattern

> Nii describes "recognizing a travel pattern when a [sic] travelling under the same condition is *repeated* a predetermined number of times or more…" BMW1022, 3:7-9; 6:43-51. Thus, Nii's derived predicted pattern includes at least one repetitive pattern of operation of the vehicle. BMW1008, ¶¶300.

Petition, 56

POR, 59

Severinsky in View of Nii Does Not Render Obvious Claims 4 and 10

- Neither Severinsky nor Nii monitors variation in road load or compare patterns of variation in road load experienced from day to day

> **4**. The method of claim **3**, wherein said controller monitors variation in road load experienced by said hybrid vehicle and compares patterns of variation in road load experienced from day to day in order to identify said repetitive patterns of operation of said hybrid vehicle.

BMW1001, Claim 4 (annotated)

59

POR, 59-61

Severinsky in View of Nii Does Not Render Obvious Claims 4 and 10

- Nii uses only average power
- Nii does not say anything about road load, much less comparing patterns of variation of road load
- BMW cannot rely on conclusory statements to establish inherency

> patterns based on *variation* in road load. *Id.* Thus, the optimization of the control strategy in Severinsky by using pattern information disclosed by Nii would necessarily be based on information concerning the variation in road load. *See also* Section VI.B.1.f-g.

> PO incorporates its arguments from Ground 1 concerning purported deficiencies with Severinsky. POR, 37-38, 60. However, again, Severinsky, when modified in view of Nii, would monitor and record road load, as doing so would be required for the controller to analyze the patterns of the road load and to adjust the controller strategy accordingly. BMW1088, ¶47.

Petition 57; Reply, 26

POR, 59-61

Severinsky in View of Nii Does Not Render Obvious Claims 4 and 10

- No evidence of comparing patterns of variation in road load experienced from day to day

Dr. Mahdi Shahbakhti
Patent Owners' Expert

106. Second, Dr. Davis fails to explain or provide any evidence supporting his assertion that "[o]ptimization of the control strategy in Severinsky by using pattern information [] would necessarily be based on information concerning the variation in road load" because Nii "determin[es] and stor[es] the frequency of vehicle power consumption in different zones." Nii's disclosure related to "zones" relates to "power consumption zone[s]" and "controlling a generator output to a target generator output corresponding to a power consumption zone with the highest usage frequency." Ex. 1022, 3:14-29. Thus, Nii is simply comparing the frequency of one average power "zone" with another. And as I explain above in Section VII.B.5, the average power is unrelated to any particular instantaneous value. Moreover, average power is unrelated to road load, which is the instantaneous torque required to propel the vehicle.

PAICE2016, ¶ 106

POR, 59-61

No Motivation To Combine Severinsky and Nii

- No reason to modify Severinsky with Nii's average power
  - BMW admits that only "pattern information on road load" is useful for managing the energy flow
  - Nii does not disclose any type of pattern information related to road load

62

28. Moreover, I disagree with his assertions about Quigley's road load related teachings. As I explained above and at my deposition, a person of ordinary skill in the art would understand Quigley's disclosure to include pattern information on road load because that would be required to manage the energy flow (referred to in the Abstract) through the hybrid drive train for optimum control. (*See* Paragraph 17 above).

Sur-reply, 1-2, 23

BMW1088, ¶ 28

No Motivation To Combine Severinsky and Nii

- BMW's reasons to combine are flawed

  1. BMW's generic, unexplained assertion that Nii's undefined "pattern information" will make Severinsky more efficient is deficient as a matter of law

  2. A POSA would not use Nii's "average power" information to modify Severinsky as BMW suggests

63

POR, 48-57

BMW's Reasons To Combine Are Flawed

1. BMW's generic, unexplained assertion that Nii's undefined "pattern information" will make Severinsky more efficient is deficient as a matter of law

  – BMW's conclusory statements do not explain "how" or "why" a POSA would combine Severinsky and Nii

64

BMW1013, 21:21-38. It would have been obvious to a POSA to use the derived predicted pattern data disclosed in Nii within Severinsky's controller to further optimize the control scheme based on such predicted pattern information.

BMW1008, ¶¶290-292. *See KSR*, 550 U.S. at 417; *Unwired Planet*, 841 F.3d at 1003.

Petition, 53 (annotated)

POR, 48-49

BMW's Reasons To Combine Are Flawed

2. A POSA would not use Nii's "average power" information to modify Severinsky as BMW suggests
   - BMW identifies "average power" as the so-called "pattern information"
   - Patent Owners' rebuttal on this point is not a "bodily incorporation" argument

65

¶¶295-296. For example, the hysteresis could be refined by eliminating the delay in turning off the engine when the controller knows from the expected pattern that the vehicle will stay at the lower power/speed for a sufficient duration such that the next engine start will not be a nuisance or by raising the engine turn on setpoint to keep the vehicle in motor only mode in recognition of a pattern of vehicle operation requiring low average power BMW1008, ¶¶295-296.

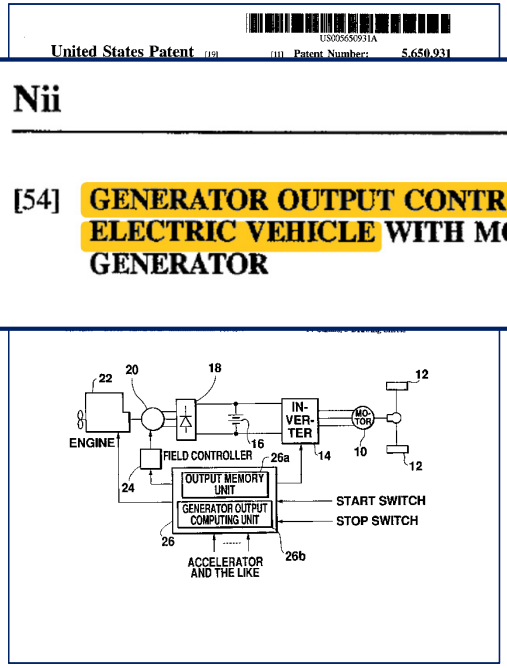
POR, 50-51

Petition, 54-55 (annotated)

BMW's Reasons To Combine Are Flawed

2. A POSA would not use Nii's "average power" information to modify Severinsky as BMW suggests

   – Using average power in Nii makes sense because the engine just keeps the battery charged



United States Patent [19] (11) Patent Number: 5,650,931

Nii

[54] **GENERATOR OUTPUT CONTROLLER FOR ELECTRIC VEHICLE WITH MOUNTED GENERATOR**

BMW1022 (Nii), Title (annotated); PAICE2016, ¶¶ 121-22

72. The primary reason for the engine in a "series" hybrid vehicle was to overcome the limited driving range associated with "pure" electric vehicles. By including an engine, drivers were able to "fill up" at gas-stations that are common throughout the United States. Without the engine, drivers would have needed to find an electrical source to recharge the battery. Not only were electrical sources less common than gas stations, it could also require hours to fully charge the battery.

BMW1008 (Davis Dec.), ¶ 72 (annotated)

POR, 11, 14, 49-51

BMW's Reasons To Combine Are Flawed

2. A POSA would not use Nii's "average power" information to modify Severinsky as BMW suggests

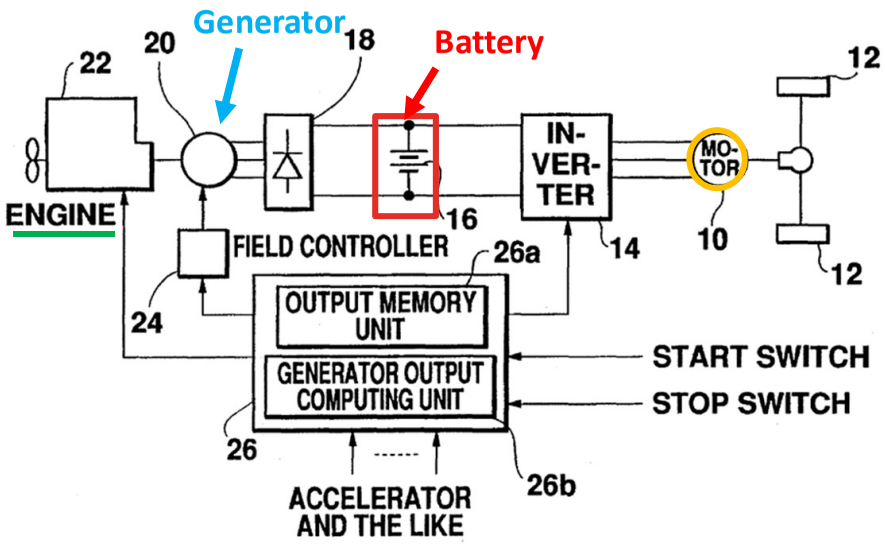
   – Using average power in Nii makes sense because the engine just keeps the battery charged

67

[57] **ABSTRACT**

An output memory unit **26***a* stores data for the necessary average output of a generator **20** for a pattern obtained from the past in-travel-pattern power consumption. Therefore, in the case of a travel pattern, the output of the generator **20** is set in accordance with the stored data. Moreover, the power consumption in the travel pattern is examined to update the necessary average output of the generator **20**.

BMW1022 (Nii), Abstract (annotated); PAICE2016, ¶¶ 119-21



BMW1022 (Nii), Fig. 1 (annotated)

Fig. 1

POR, 13-14, 49, 50; PAICE2016, ¶ 129

BMW's Reasons To Combine Are Flawed

2. A POSA would not use Nii's "average power" information to modify Severinsky as BMW suggests

- No dispute that Nii is a "series hybrid"
- BMW's expert admitted that the engine in a series hybrid is controlled independently of driving conditions

68

Dr. Gregory Davis
Petitioners' Expert

69. In other words, the **motor alone** provides the torque required to propel the vehicle. (BMW1029 at 6; BMW1033 at 15).

70. The engine, on the other hand, is **not mechanically connected** to the wheels and the engine is therefore controlled independently of driving conditions. (BMW1029 at 6; BMW1033 at 7).

BMW1008, ¶¶69-70 (annotated)

POR, 11, 13-14, 50; PAICE2016, ¶115

BMW's Reasons To Combine Are Flawed

2. A POSA would not use Nii's "average power" information to modify Severinsky as BMW suggests
   - Because Nii's engine is controlled independently of driving conditions, it can simply set the engine at a single constant value and use historical averages to set that value

To minimize harmful components in the exhaust gas of this type of hybrid vehicle, it is desirable to drive the engine at a constant load and a constant rotational speed so that the power generation is kept at a constant value.

However, the power consumption of an electric vehicle depends on the travel conditions. That is, when the electric vehicle travels on many upward slopes or repeatedly stops and starts because there are many traffic signals, the power consumption increases. Therefore, it is disclosed in Japanese Patent Application Laid-Open No. SHO-60-7437 (1985) (JP-A-60 007 437) that the electric power output of a generator is controlled in accordance with the state of charge of a battery.

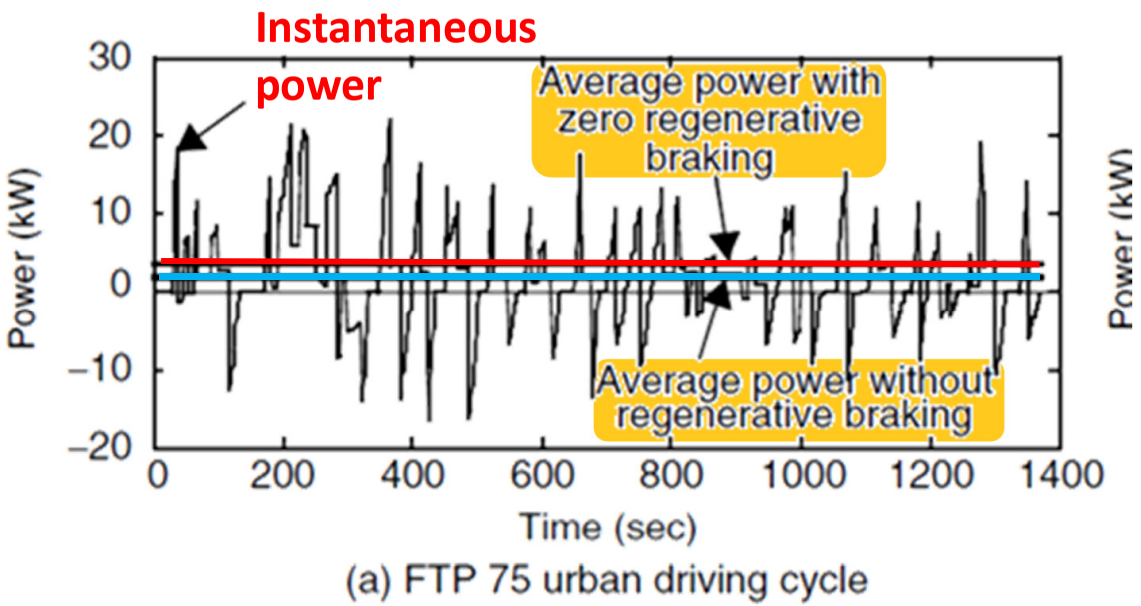
However, if the generator output is changed as described above, the engine output must also be fluctuated. Therefore, a problem occurs that harmful components in exhaust gas increase. Moreover, a problem occurs that the operation of an engine in the above way increases fuel consumption.

According to the present invention, the output of a generator is set to a generator output equal to the power consumption value corresponding to the travel pattern in the case of traveling according to a travel pattern. Therefore, it is possible to generate optimum electrical power at a constant value by a generator. Thus, it is possible to decrease harmful components in the exhaust gas of a generator and increase the power consumption of an engine for driving the generator. For example, for a regular travel pattern such as people commuting using a standard vehicle or taking people to and from their offices using a commercial vehicle, it is possible to minimize the power generation

BMW, 1022 (Nii) 1:40-57; 2:13-24 (annotated); PAICE2016, ¶¶ 126-27; POR, 50

BMW's Reasons To Combine Are Flawed

- A POSA will not use Nii's average power requirement to modify Severinsky
- The average power provides no information to the instantaneous torque requirement
- Instantaneous torque can be high when the average power is low



(a) FTP 75 urban driving cycle

PAICE2020, 83 (pg. 250 in original) (annotated); PAICE2016, ¶¶ 137-38; POR, 54

BMW's Reasons To Combine Are Flawed

2. A POSA would not use Nii's average power value to modify Severinsky as BMW suggests

– Textbook evidence shows that Nii's average power value has no use in Severinsky because averages are not useful in complex systems like Severinsky's parallel hybrid architecture

71

> The average operating point method is able to yield reasonable estimates of the fuel consumption of *simple* powertrains (IC engine or battery electric propulsion systems). It is not well suited to problems in which complex propulsion systems must be optimized. In particular it does not offer the option of including the effect of energy management strategies in these computations.

PAICE2033, 38 (emphasis added)

POR, 52

BMW's Reasons To Combine Are Flawed

2. A POSA would not use Nii's average power value to modify Severinsky as BMW suggests

– BMW's assertion that Severinsky would use average power to further vary a "setpoint" is unintelligible

> 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.

BMW 1013, 18:34-43 (annotated)

Sur-reply, 22-23

Ground 3 – Severinsky in View of Graf

Severinsky in View of Graf Does Not Render Obvious Claims 1 and 7

- Neither Severinsky nor Graf derives a predicted near-term pattern of operation

1. A method of operation of a hybrid vehicle, comprising steps of:

storing and supplying electrical power from a battery bank,

applying torque to road wheels of said hybrid vehicle from one or both of an internal combustion engine and at least one traction motor, and

controlling flow of torque between said internal combustion engine, said at least one traction motor, and said road wheels, and controlling flow of electrical power between said battery bank and said at least one traction motor employing a controller, and

wherein said controller derives a predicted near-term pattern of operation of said hybrid vehicle by monitoring operation of said hybrid vehicle; and

controls operation of said at least one traction motor and said internal combustion engine for propulsion of said hybrid vehicle responsive to said derived near-term predicted pattern of operation of said hybrid vehicle.

BMW1001, Claim 1 (annotated)

POR, 62-65

74

Graf Does Not Derive a "predicted near-term pattern of operation"

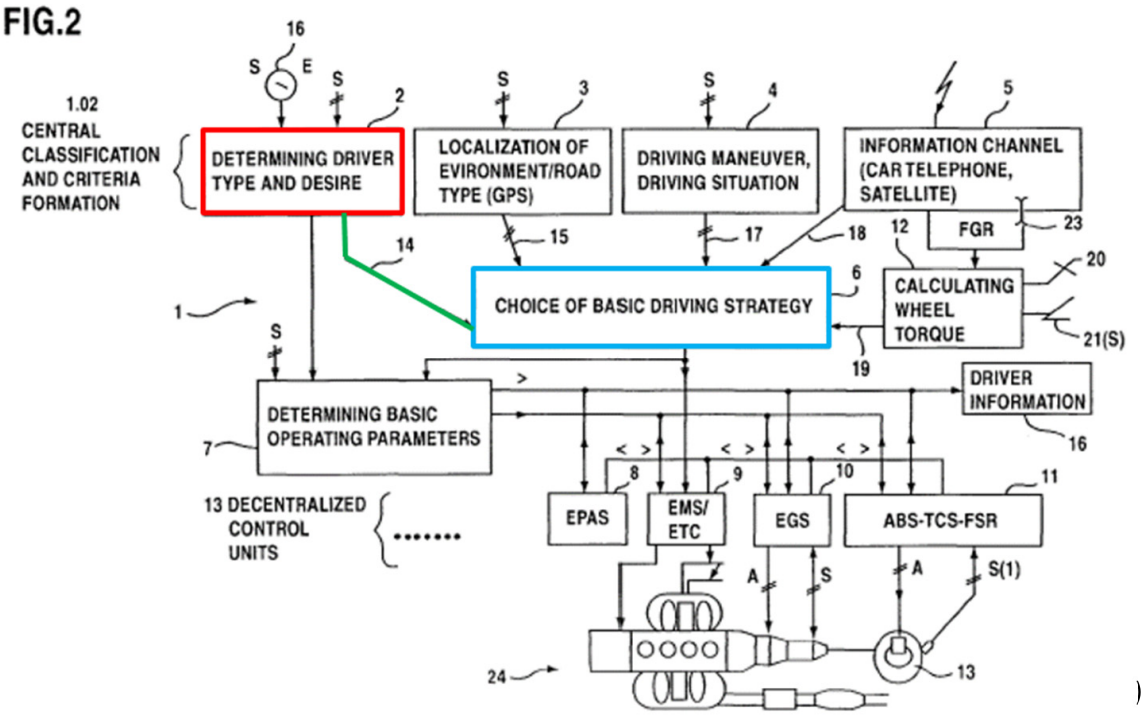
- BMW fails to show that Graf necessarily derives a predicted near-term pattern of operation

> where a choice of driving strategy is determined. Petitioner's contention "that characterizing the driver type or driving style of the driver [in Graf] would require '*deriv[ing] a predicted near-term pattern*'" (Pet. 65 (second alteration in original) (citing Ex. 1008 ¶¶ 352–353)) does not appear on this record to be supported by evidence from Graf.

ID, 35-36 (annotated)

Graf Does Not Disclose Monitoring Patterns of Vehicle Operation

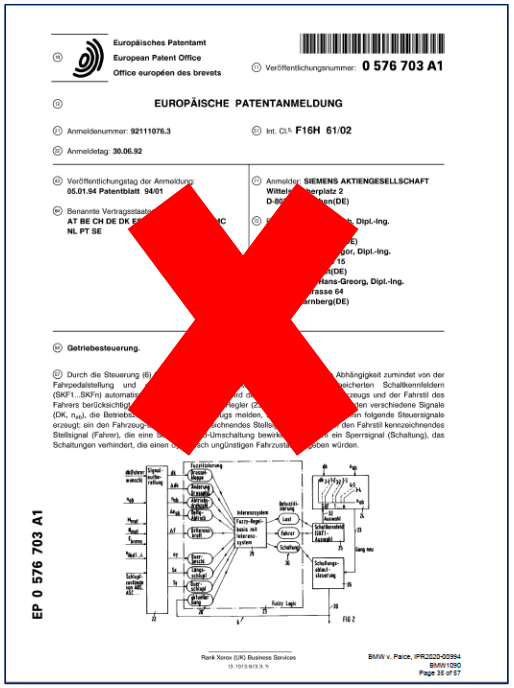
- Graf merely shows a box labeled “Determining Driver Type and Desire”
- BMW fails to show that Graf necessarily predicts a near-term pattern of operation



BMW1020, Fig. 2 (annotated); POR, 63-64

Graf Does Not Disclose Monitoring Patterns of Vehicle Operation

- BMW's newly introduced evidence, BMW1090, is improper, because BMW could have identified the evidence in its petition as it is referenced in Graf



*"We see **no error in the Board's rejection of Ariosa's reliance**, in its Reply submissions, **on previously unidentified portions of a prior-art reference** to make a meaningfully distinct contention."*

Ariosa Diagnostics v. Verinata Health, Inc., 805 F.3d 1359, 1367 (Fed. Cir. 2015) (emphasis added); *see also Nestle Purina Petcare Co. v. Oil-Dri Corp. of Am.*, IPR2015-00737, 2016 WL 4375267 (P.T.A.B. June 20, 2016) (holding that "Petitioner's arguments do more than merely address Patent Owner's argument" and instead provide new arguments and evidence not found in the petition)

Sur-reply, 24-25

Graf Does Not Disclose Monitoring Patterns of Vehicle Operation

- In any event, BMW1090 does not disclose any evidence of driving a predicted near-term pattern of operation

78

> Re RULE 0013:
> A sporty driver is detected in the case of high accelerator speed and high longitudinal acceleration.

BMW1090, 13:18-20; Sur-reply, 25-26

Thank You