Patent Owners' Oral Hearing Demonstratives

IPR2020-00994 – U.S. Patent No. 7,104,347

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

PAICE 2030
BMV v. PAICE
IPR2020-00994

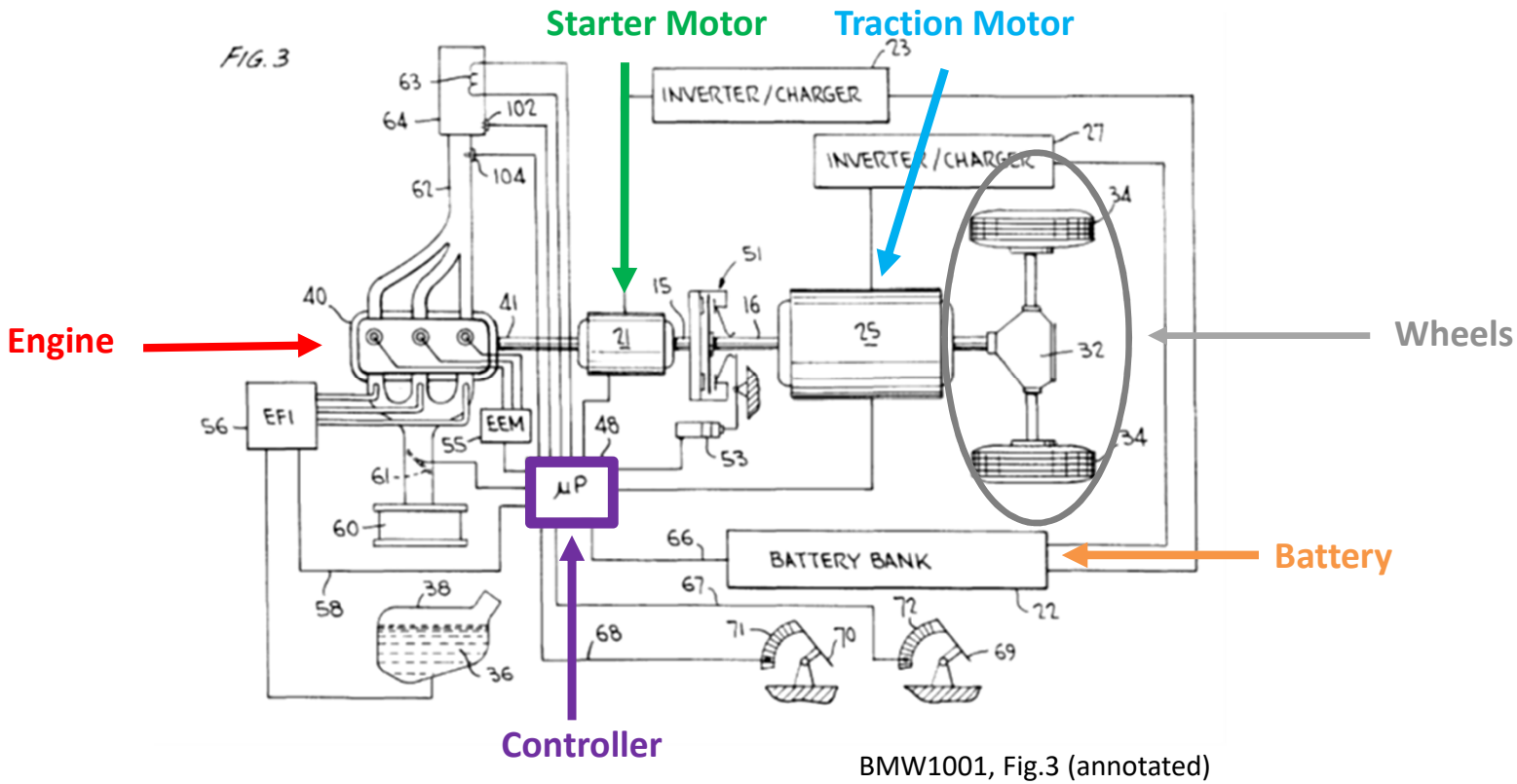
Agenda

- **Claims 2 and 24 Are Not Obvious**
  - Patented Technology Overview – Pattern-Based Mode Switching
  - Severinsky/Nii (Grounds 3a and 3b)
  - Severinsky/Graf (Grounds 1a and 2a)
  - The Bumby References/Graf (Ground 4a)
- **Claims 11 and 13 Are Not Obvious**
  - Patented Technology Overview – Coordinated Turbocharger and Traction Motor
  - Severinsky/Ma (Grounds 1b and 2b)
  - The Bumby References/Ma (Ground 4b)
- **Claim 17 Is Not obvious**
  - Severinsky/Ehsani (Ground 2c)
  - The Bumby References/Ehsani (Ground 4c)
- **Claim 38 Is Not obvious**
  - Severinsky/Ehsani (Ground 1c)
  - The Bumby References/Ehsani (Ground 4c)
- **BMW's Motion To Exclude Should Be Denied**

Claim 2 and 24 Are Not Obvious

Technology Background A – Hybrid Architecture

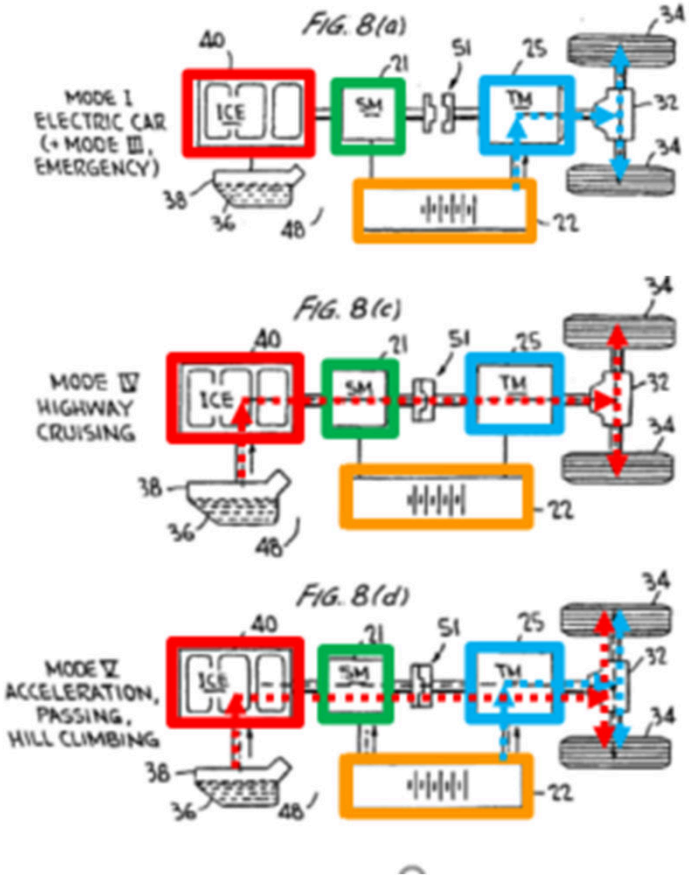
- The '347 patent is directed to hybrid electric vehicles and the control thereof



BMW1001, Fig.3 (annotated)

POR, 6

Technology Background A – Operating Modes

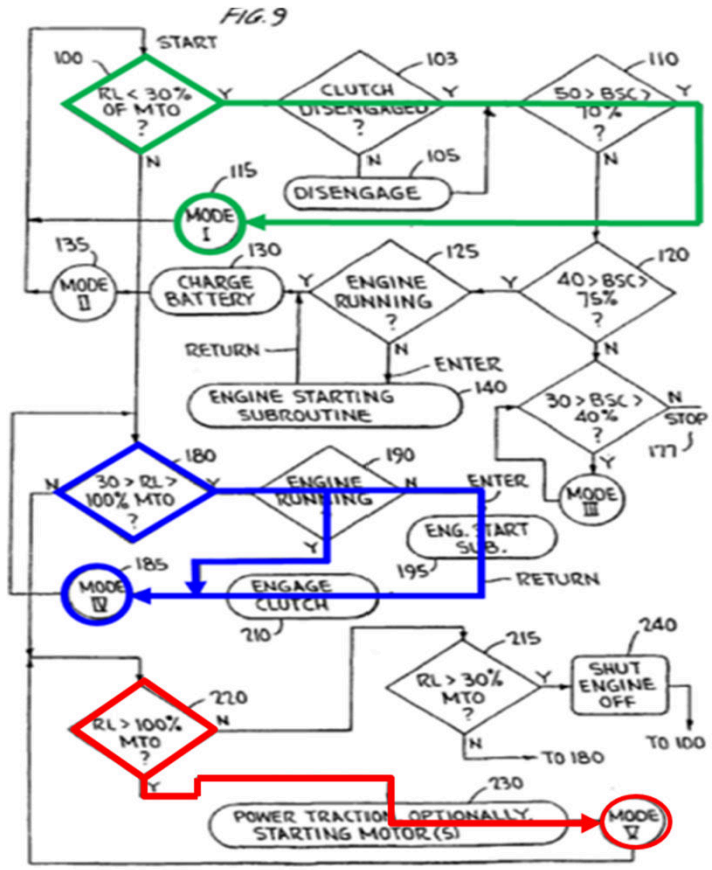


- The hybrid vehicle of the '347 patent can be operated in different "modes," i.e. different combinations of motor, engine, or both, to propel the vehicle:
  - Mode I: motor only propulsion
  - Mode IV: engine propulsion
  - Mode V: motor and engine propulsion

POR, 7

Technology Background A – Mode Selection

- The ’347 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

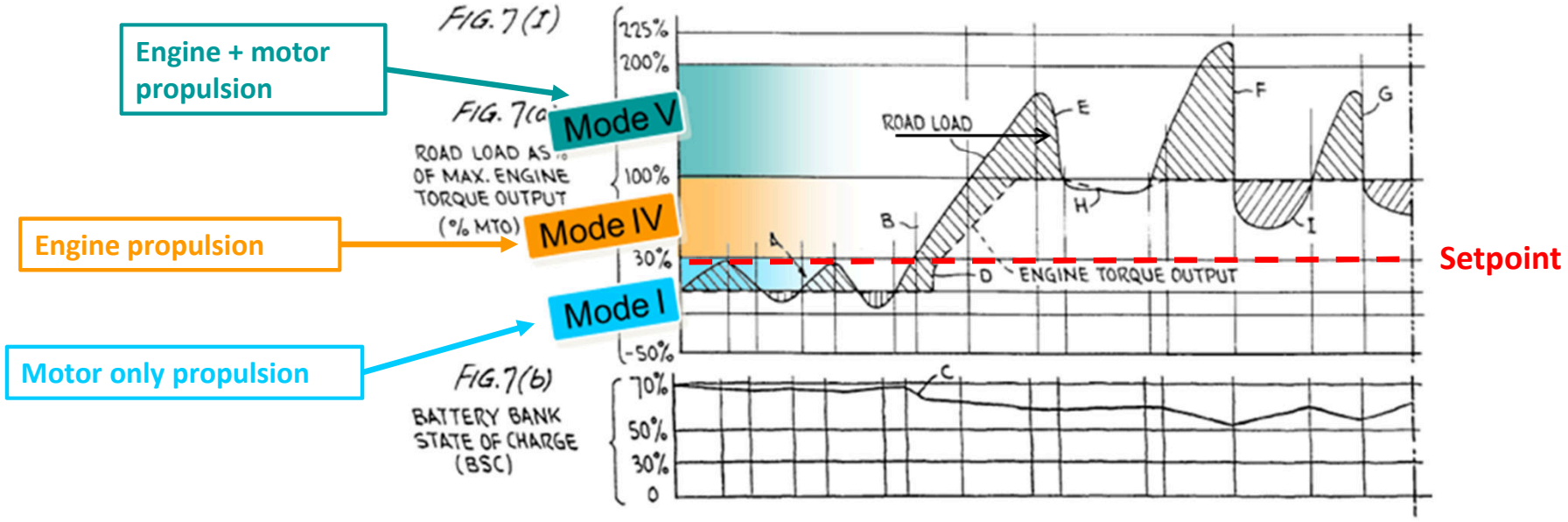


BMW1001, Fig. 9 (annotated)

POR, 8

Technology Background A – Mode Selection

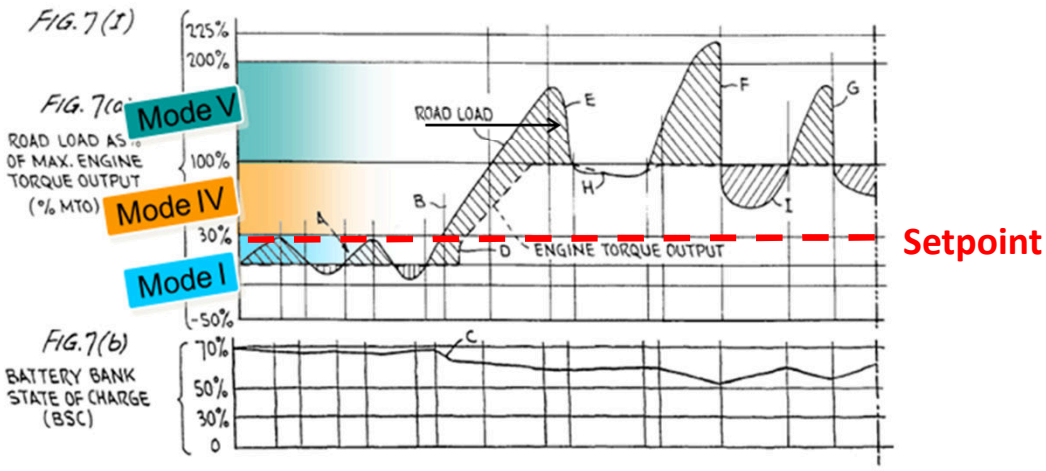
- The '347 patent compares road load to the setpoint to select operating modes



BMW1001, Fig. 7 (annotated)

Technology Background A: Pattern-Based Mode Switching

- The ’347 patent looks for patterns such as road load fluctuations above and below the setpoint



Setpoint

BMW1001, Fig. 7 (annotated)

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, 40:47-41:9 (annotated)

POR, 8-9

Technology Background A: Pattern-Based Mode Switching

- The ’347 patent looks for patterns such as road load fluctuations above and below the setpoint

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

BMW1001, 40:47-41:9 (annotated)

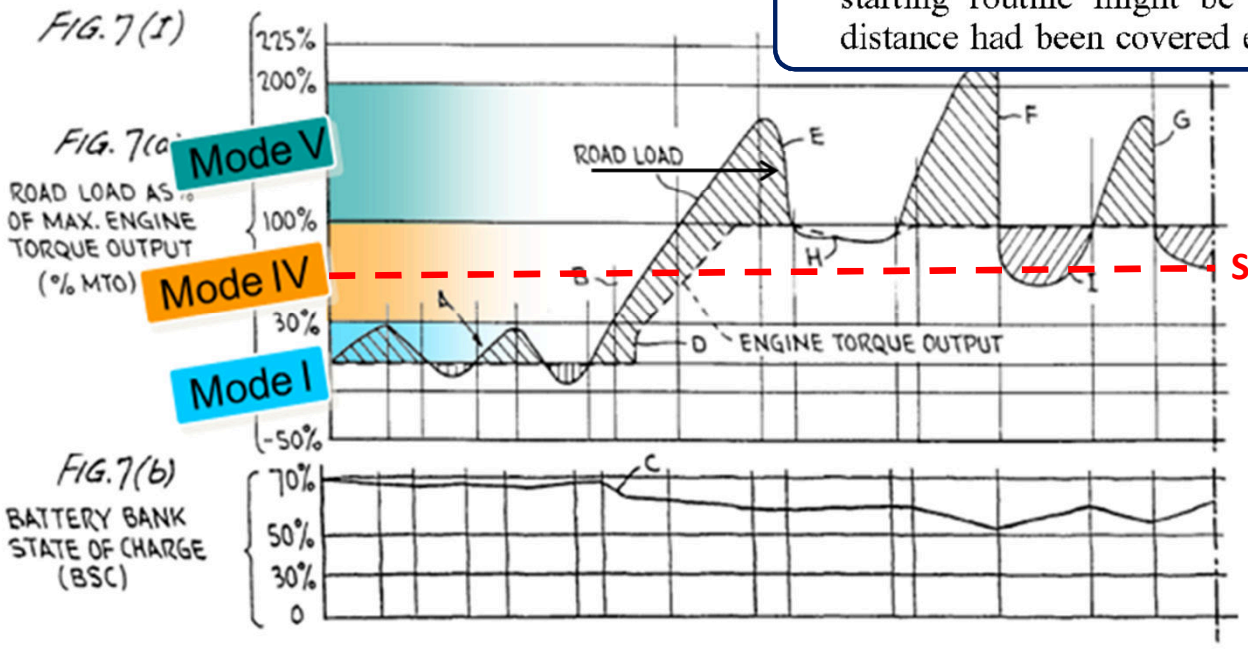
POR, 8-9

Technology Background A: Pattern-Based Mode Switching

- To avoid RL fluctuations between 0 and 50% MTO, the '347 patent adjusts the setpoint to 60% MTO

> 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, 40:47-41:9 (annotated)



BMW1001, Fig. 7 (annotated)

POR, 8-9

Claims 2 and 24 Vary the Setpoint Based on Monitoring Patterns of Vehicle Operation

23. A method of control of a hybrid vehicle, said vehicle ...

motor for applying torque thereto, said method comprising the steps of:

determining the instantaneous torque RL required to propel said vehicle responsive to an operator command;

monitoring the state of charge of said battery;

employing said at least one electric motor to propel said vehicle when the torque RL required to do so is less than said lower level SP;

employing said engine to propel said vehicle when the torque RL required to do so is between said lower level SP and MTO;

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

employing said engine to propel said vehicle when the torque RL required to do so is less than said lower level SP and using the torque between RL and SP to drive said at least one electric motor to charge said battery when the state of charge of said battery indicates the desirability of doing so; and

wherein the torque produced by said engine when operated at said setpoint (SP) is substantially less than the maximum torque output (MTO) of said engine.

- The controller:
  - compares road load to the setpoint and
  - varies the setpoint based on monitored patterns of vehicle operation

24. The method of claim **23**, comprising the further step of employing said controller to monitor patterns of vehicle operation over time and vary said setpoint SP accordingly.

BMW1001, Claim 24 (annotated)

Severinsky and Nii Do Not Render Claims 2 and 24 Obvious (Grounds 3a and 3b)

- No prior art disclosure of varying the claimed "setpoint":
  - Severinsky discloses only a fixed setpoint (60% MTO)
    - The 60% MTO value is never varied during vehicle operation (*i.e.*, in real time)
  - Nii does not disclose the claimed "setpoint"
    - Nii is only concerned with setting the engine at a constant output for battery charging
- No motivation to modify Severinsky with Nii's "pattern information"
  - BMW cannot explain ***how or why*** a POSA would adjust Severinsky's 60% MTO in view of Nii's disclosure, which has nothing to do with mode switching

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

- BMW (and the Board) have identified 60% MTO as the only claimed "setpoint" in Severinsky
- There is no evidence that Severinsky varies the 60% setpoint to another value (*e.g.*, 55% or 65% of MTO)

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. This in itself will yield improvement in fuel economy on the order of 200–300%. More

BMW 1013, 20:63-68 (annotated)

When the microprocessor determines that the torque required to propel the vehicle ("*the torque RL*") is less than 60% of the engine's maximum torque ("*less than said lower SP*"), the "electric motor alone drives the vehicle forward and the internal combustion engine is used only to charge the batteries as needed." BMW1013, 7:8-19; 6:19-35;

Petition, 18 (annotated)

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

- BMW's reliance on a **separate** disclosure about "speed-responsive hysteresis" is unrelated to varying the claimed (torque) "setpoint"
  1. "Speed-responsive hysteresis" does not result in variation of any kind
  2. No evidence linking "speed-responsive hysteresis" to the torque-based setpoint
  3. Even if "speed-responsive hysteresis" could result in running the engine inefficiently, that is not the same as varying the setpoint

> 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)

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

1. **"Speed-responsive hysteresis" does not result in variation of any kind**
   - Uses one fixed threshold for turning engine on and one fixed threshold for turning engine off
   - Use of simple time delay does not vary either threshold

Fixed threshold for turning engine on

Fixed threshold for tuning engine off

> 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)

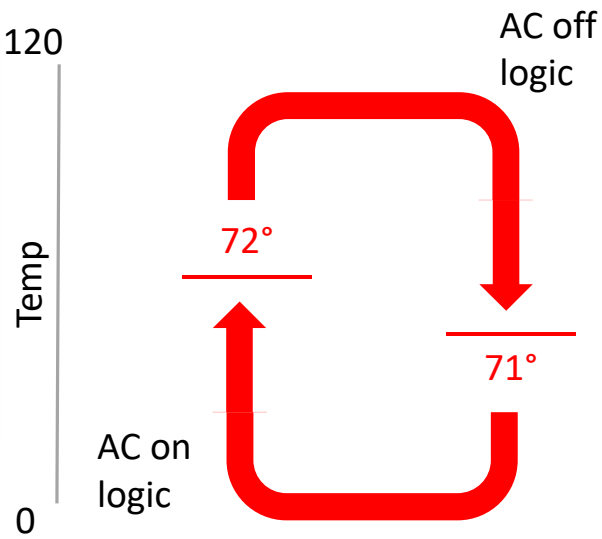
PAICE2016, ¶¶ 110-11; POR, 18-20; Sur-reply, 4-6

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

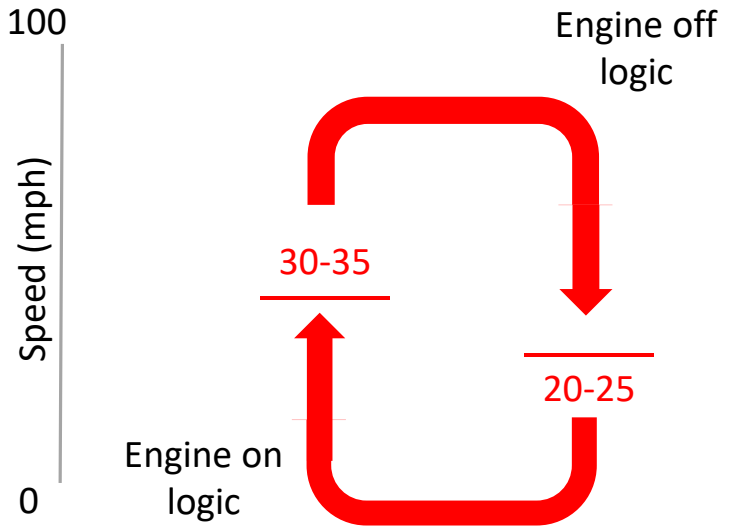
1. "Speed-responsive hysteresis" does not result in variation of any kind

- Uses fixed threshold for turning engine on and fixed threshold for turning engine off
- Similar to thermostat

Thermostat



Speed-responsive hysteresis



PAICE2016, ¶¶ 110-11; Sur-reply, 4-5

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

1. **"Speed-responsive hysteresis" does not result in variation of any kind**
   - The '347 patent separately claims using different setpoints for turning the engine on/off
   - Using two different setpoints for two different purposes is not the same as varying the setpoint

Claim 25 (not challenged)

25. The method of claim **23**, comprising the further step of employing said controller to monitor RL over time, and to control transition between propulsion of said vehicle by said motor(s) to propulsion by said engine such that said transition occurs only when RL>SP for at least a predetermined time, or when R>SP2, wherein SP2 is a larger percentage of MTO than SP.

BMW1001, Claim 25 (annotated)

Claim 24 (challenged)

24. The method of claim **23**, comprising the further step of employing said controller to monitor patterns of vehicle operation over time and vary said setpoint SP accordingly.

BMW1001, Claim 24 (annotated)

Sur-reply, 6

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

1. **"Speed-responsive hysteresis" does not result in variation of any kind**
   - Dr. Shahbakhti explained that these on/off thresholds are written into source code during vehicle development and do not change during vehicle operation
   - No variation in real time

Dr. Mahdi Shahbakhti
Patent Owners' Expert

> 111. Severinsky does not contain any disclosure that either of these speed thresholds change during vehicle operation. Moreover, there is no disclosure that either the upper speed range or the lower speed range change based on monitoring operation of the vehicle, much less observed pattern of vehicle operation. As I discuss above, the separate values for the upper speed range and the lower speed range would both be written into the source code when the controller is programmed. These values remain fixed and do not change in real-time.

PAICE2016, ¶ 111 (annotated); POR, 20

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

1. "Speed-responsive hysteresis" does not result in variation of any kind

– BMW admits that each of these thresholds are factory-set values

> Third, a POSA would have understood how to implement Nii's pattern-monitoring functionality into Severinsky's controller to alter the vehicle's setpoints, since it would only require modifying Severinsky's logic to use the actual-usage pattern information to define the setpoints, rather than Severinsky's factory-set parameters. (BMW1008, ¶614.) The '347 Patent confirms that such a

Reply, 3 (annotated)

Sur-reply, 5

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

2. No evidence linking "speed-responsive hysteresis" to the torque-based setpoint
   - BMW has identified no evidence in Severinsky connecting these disparate disclosures

Setpoint disclosure
(column 20)

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. This in itself will yield improvement in fuel economy on the order of 200–300%. More

BMW1013, 20:63-68 (annotated)

"Speed-responsive hysteresis" disclosure
(column 18)

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.

BMW1013, 18:34-43 (annotated)

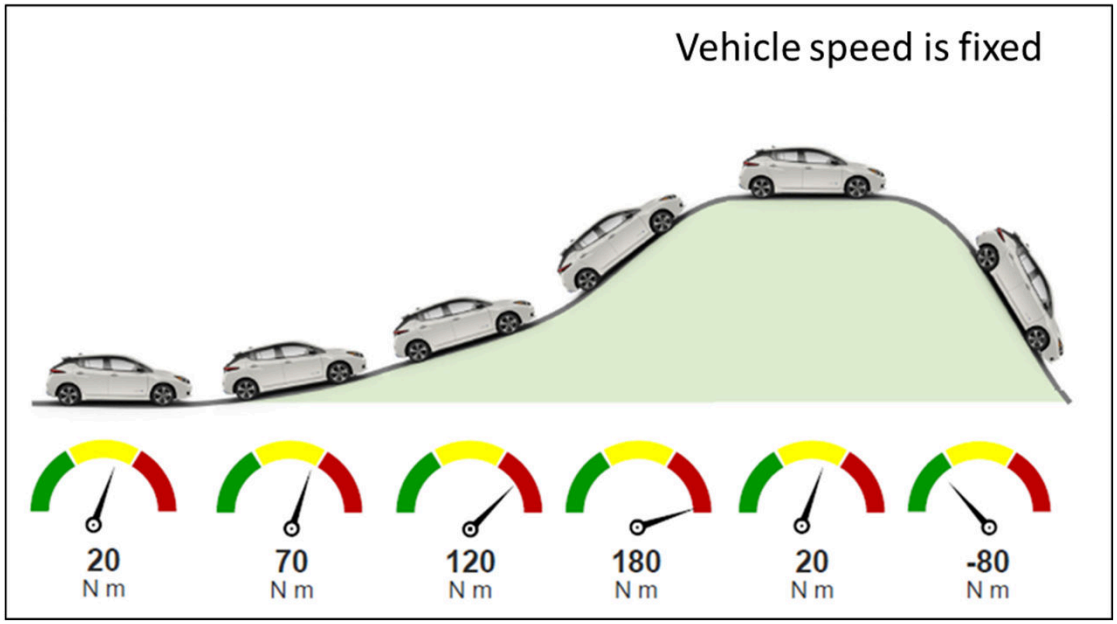
POR, 20-22; Sur-reply, 7-8

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

2. No evidence linking "speed-responsive hysteresis" to the torque-based setpoint
   - What do the experts say?

Dr. Mahdi Shahbakhti
Patent Owners' Expert

"While it is true the torque required to propel the vehicle and vehicle speed are not mutually exclusive of one another, they are both independent variables that under many conditions do not vary proportionately." PAICE2016, ¶ 116.



PAICE2016, ¶ 119; POR, 22-23

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

2. No evidence linking "speed-responsive hysteresis" to the torque-based setpoint
   - What do the experts say?

Dr. Mahdi Shahbakhti
Patent Owners' Expert

"Thus, a person of skill in the art would understand that Severinsky would need to arbitrate between the speed based algorithm and the torque-based algorithm and may often prioritize one over the other." PAICE2016, ¶ 116.

Driving conditions	Speed-based algorithm	Torque-based algorithm
Vehicle traveling at low speed up a hill	Low speed → engine off	High required torque → engine on
Vehicle coasting at high speed down a hill	High speed → engine on	Low required torque → engine off
Vehicle accelerating on a flat surface at low speed	Low speed → engine off	High required torque → engine on
Vehicle decelerating on a flat surface at high speed	High speed → engine on	Low required torque → engine off

PAICE2016, ¶ 120; POR, 21

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

2. No evidence linking "speed-responsive hysteresis" to the torque-based setpoint
   - What do the experts say?
   - Unsupported testimony that "the speed-based thresholds in Severinsky correlate to torque-based thresholds, and vice versa." BMW1088, ¶ 9.

Dr. Gregory Davis
Petitioners' Expert

*"**Untethered to any supporting evidence**, much less any contemporaneous evidence, **Dr. Tellado's ipse dixit declaration 'fail[s] to provide any meaningful explanation for why one of ordinary skill in the art would be motivated to combine** these references at the time of this invention.'… Indeed, the only support for Dr. Tellado's assertions is found in the description of the invention of the patents-in-suit."*

TQ Delta, LLC v. CISCO Sys., Inc., 942 F.3d 1352, 1362 (Fed. Cir. 2019) (emphasis added)

Sur-reply, 8

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

2. No evidence linking "speed-responsive hysteresis" to the torque-based setpoint
   - BMW cannot rewrite Severinsky by replacing the word "speed" with "torque"

Severinsky's actual disclosure

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)

BMW's rewrite

when describing operating modes).) Severinsky's so-called "speed-based" hysteresis is somewhat of a misnomer; it may be based on speed, but is also based on other considerations, including torque. (BMW1088, ¶¶8-26; *e.g.*, BMW1089,

Reply, 9 (annotated)

Sur-reply, 8

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

2. No evidence linking "speed-responsive hysteresis" to the torque-based setpoint
   - The Board never found in the Ford IPR that "speed" and "torque" are the same thing

> Paice also points to Severinsky's disclosure of "speed-responsive hysteresis" to argue that Severinsky's control strategy is based on speed, not road load. PO Resp. 27–28. According to Paice, "it simply makes no sense for Severinsky to use 'speed responsive-hysteresis' if Severinsky uses road load to control engine starts and stops." *Id.* at 27. But Severinsky only discusses the implementation of speed-responsive hysteresis for purposes of eliminating "nuisance engine starts." Ex. 1003, 18:40–42. That Severinsky may additionally teach a speed-responsive hysteresis feature as a way to check and control unintended engine starts does not preclude it from also teaching the use of road load as a way to determine when to employ the engine in the first instance, i.e., turn the engine on. We find persuasive the

BMW1003 (IPR2014-00571 FRD), 18 (annotated); POR, 22; POPR, 30

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

3. Even if "speed-responsive hysteresis" could result in running the engine inefficiently, that is not the same as varying the setpoint

– BMW incorrectly asserts that the engine's actual operating point is the claimed "setpoint"

during transit. BMW1008, ¶611. Severinsky's hysteresis methodology utilizes an arbitrary speed range ("20-25 mph") over an arbitrary time period ("typically 2-3 minutes") to lower the setpoint for running the engine outside of its most efficient operating range. BMW1013, 18:36-40.

Petition, 46 (annotated)

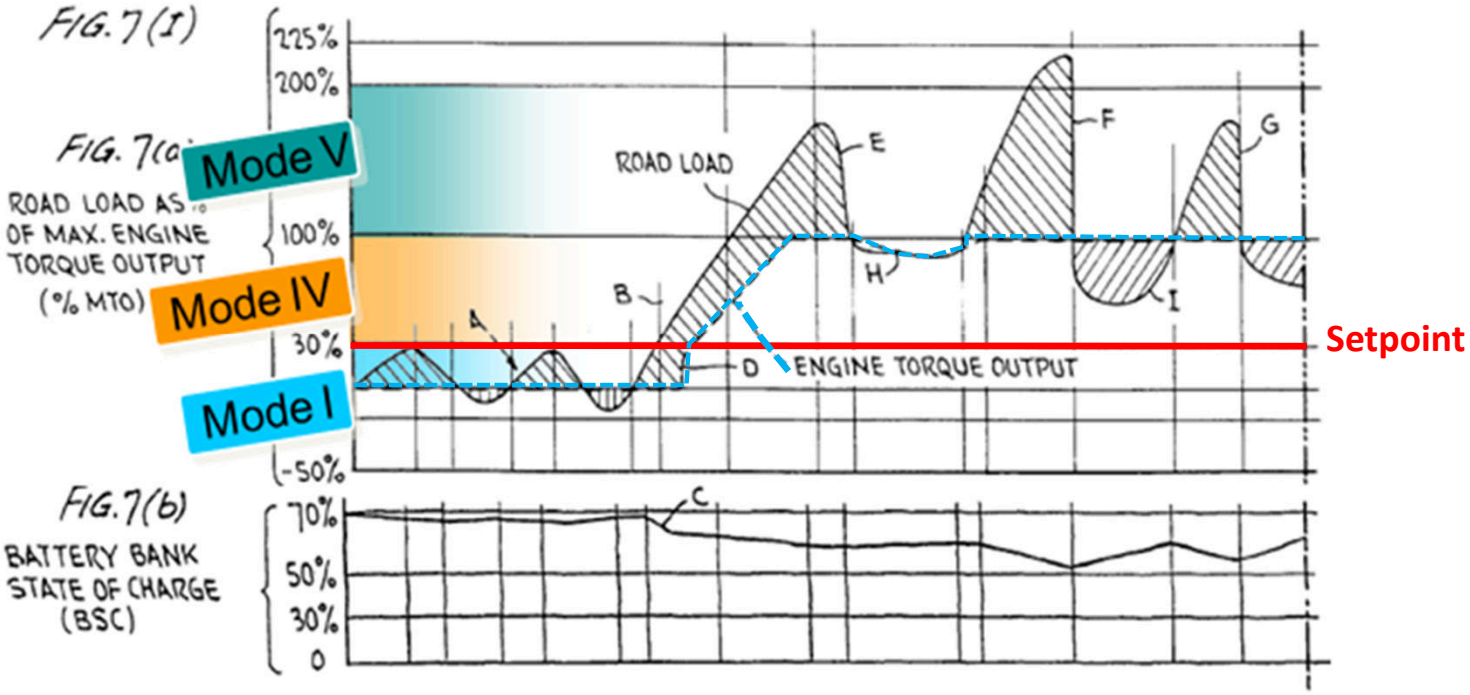
Severinsky teaches a POSA that its setpoint may be varied. Severinsky's engine will normally be operated above 60% MTO—i.e., the claimed "*setpoint*" (ID, 23)—but Severinsky *also* teaches operating its engine "outside its most fuel efficient operating range, on occasion," as the Board previously found.

Reply, 8 (annotated)

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

3. Even if "speed-responsive hysteresis" could result in running the engine inefficiently, that is not the same as varying the setpoint

– The operating point of the engine (blue dashed line) is not the same as the setpoint (red line)

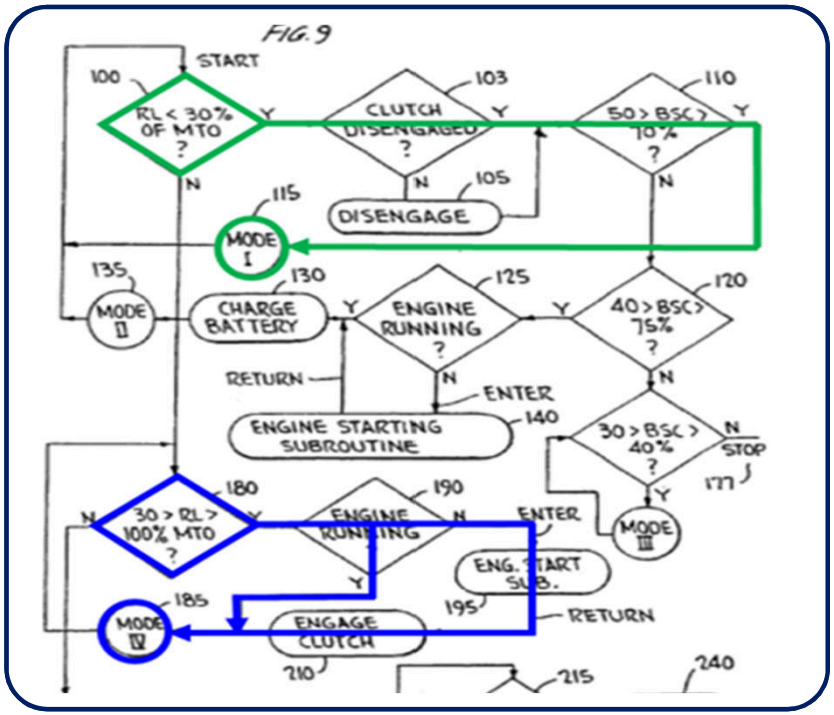


BMW1001, Fig. 7(a) (annotated); Sur-reply, 3-4; ; PAICE2016, ¶ 126

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

3. Even if "speed-responsive hysteresis" could result in running the engine inefficiently, that is not the same as varying the setpoint

– Dr. Davis admitted that the operating point of the engine is not the same as the setpoint



BMW1001, Fig. 9 (annotated)

Q But the set point itself used by the controller is not literally the current output torque of the engine, right?

A Yes, you're looking at the current road load requirements of the vehicle and comparing those with that set point in diamond 100.

PAICE2029 (Davis Tr.), 49:12-17 (annotated)

Sur-reply, 2-3

No Prior Art Disclosure of Varying the Setpoint: Severinsky Does Not Vary the Setpoint

3. Even if "speed-responsive hysteresis" could result in running the engine inefficiently, that is not the same as varying the setpoint

– The '347 patent claims show the operating point of the engine is not the same as the setpoint

> **41**. The method of claim **23**, wherein said engine can be operated at torque output levels less than SP under abnormal and transient conditions, said conditions comprising starting and stopping of the engine and provision of torque to satisfy drivability or safety consideration.

BMW1001, Claim 41 (annotated); Sur-reply, 4

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

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

> In other words, Severinsky discloses using a hysteresis method to alter the setpoint to avoid overly frequent switching between engine and motor operation during transit. BMW1008, ¶611. Severinsky's hysteresis methodology utilizes an arbitrary speed range ("20-25 mph") over an arbitrary time period ("typically 2-3 minutes") to lower the setpoint for running the engine outside of its most efficient operating range. BMW1013, 18:36-40.
>
> A POSA would have understood that these arbitrary parameters for varying the engine's setpoint can be improved based on the pattern information disclosed by Nii. BMW1008, ¶612. Such a person would have been motivated to do so in

Petition, 46 (annotated)

POR, 28

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

*"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

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

– Dr. Davis's declaration does not explain what "pattern information from Nii" a POSA would use to improve Severinsky, or how such "pattern information" would more closely align Severinsky's setpoint with the "vehicle's actual torque requirements"

> *"Untethered to any supporting evidence, much less any contemporaneous evidence,* ***Dr. Tellado's ipse dixit declaration 'fail[s] to provide any meaningful explanation for why one of ordinary skill in the art would be motivated to combine*** *these references at the time of this invention.'"*

TQ Delta, LLC v. CISCO Sys., Inc., 942 F.3d 1352, 1362 (Fed. Cir. 2019) (emphasis added)

POR, 38

BMW's Reasons To Combine Are Flawed

- Nii does not disclose using "vehicle patterns" to:
  - select between electric motor propulsion and engine propulsion;
  - control engine or electric motor operation based on the instantaneous driving conditions;
  - determine whether engine operation or electric motor operation would be more efficient; or
  - determine any information about the instantaneous vehicle requirements.

POR, 33-34; ; PAICE2016, ¶ 154

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 only identifies "average power" as the so-called "pattern information"
- Patent Owners' rebuttal on this point is not a "bodily incorporation" argument

> "somewhat inefficiently." BMW1013, 8:30-33; BMW1008, ¶612. Incorporating the pattern information from Nii to do so would increase the overall efficiency of the vehicle—for example, by immediately turning off the engine in recognition of a pattern of vehicle operation requiring low average power—which is a goal of both Severinsky and Nii, and well known principles within the art. BMW1013, 5:24-30; BMW1022, 2:13-24; BMW1008, ¶612.

Petition, 47 (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

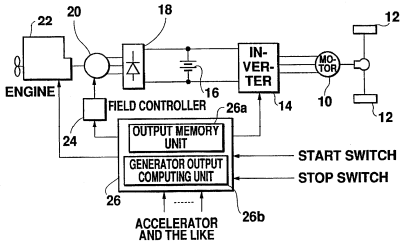
– Using average power in Nii makes sense because the engine just keeps the battery charged

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

US005650931A

Nii

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



BMW1022, Title (annotated); PAICE2016, ¶ 147

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.

BMW1088 (Davis Dec.), ¶ 72 (annotated)

POR, 31

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

[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, Abstract (annotated); PAICE2016, ¶ 147

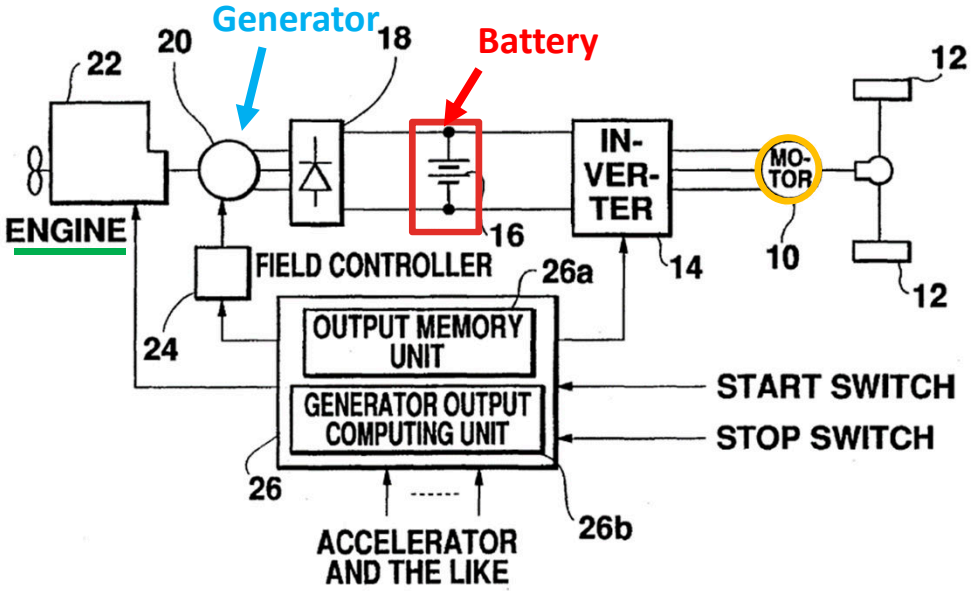


Fig. 1

BMW1022, Fig. 1 (annotated)

POR, 31

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

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, 13

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

BMW1022, 1:40-57; 2:13-24 (annotated); PAICE2016, ¶¶ 147-52; Sur-reply, 13

BMW's Reasons To Combine Are Flawed

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

- Nii's "average power" solution ignores instantaneous driving conditions
- It has no use for adjusting setpoints for comparison to the ***instantaneous*** torque required to propel the vehicle

23. A method of control of a hybrid vehicle, said vehicle ...

motor for applying torque thereto, said method comprising the steps of:

determining the instantaneous torque RL required to propel said vehicle responsive to an operator command;

monitoring the state of charge of said battery;

employing said at least one electric motor to propel said vehicle when the torque RL required to do so is less than said lower level SP;

employing said engine to propel said vehicle when the torque RL required to do so is between said lower level SP and MTO;

...

24. The method of claim **23**, comprising the further step of employing said controller to monitor patterns of vehicle operation over time and vary said setpoint SP accordingly.

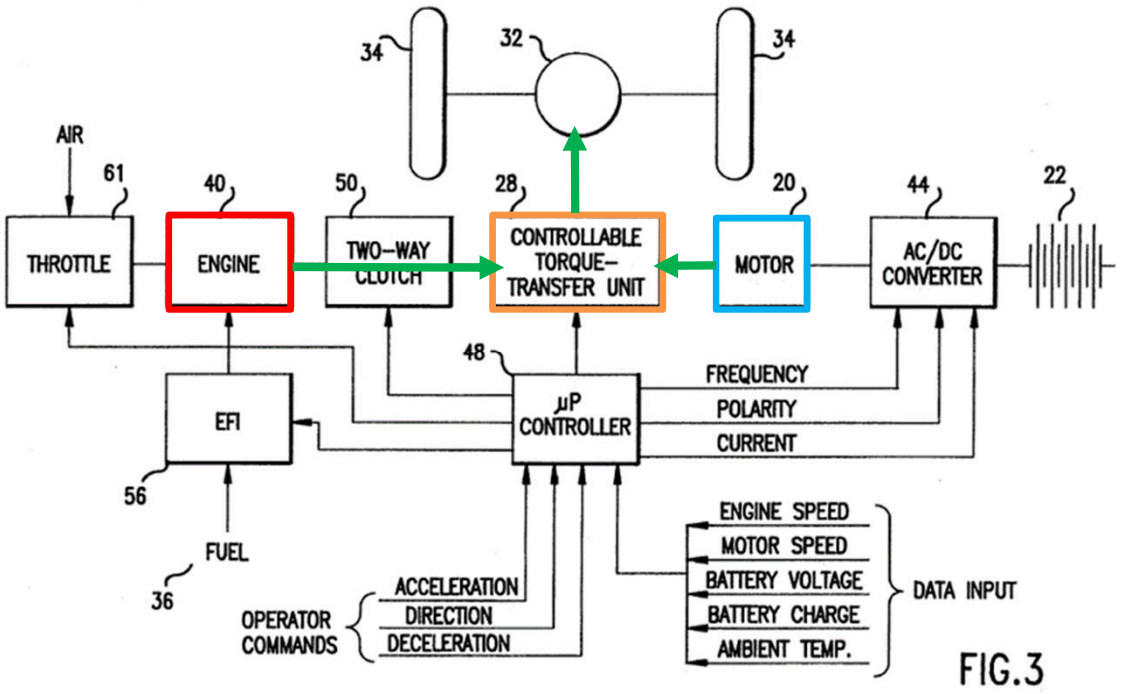
BMW1001, Claim 24 (annotated)

POR, 31, 35

BMW's Reasons To Combine Are Flawed

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

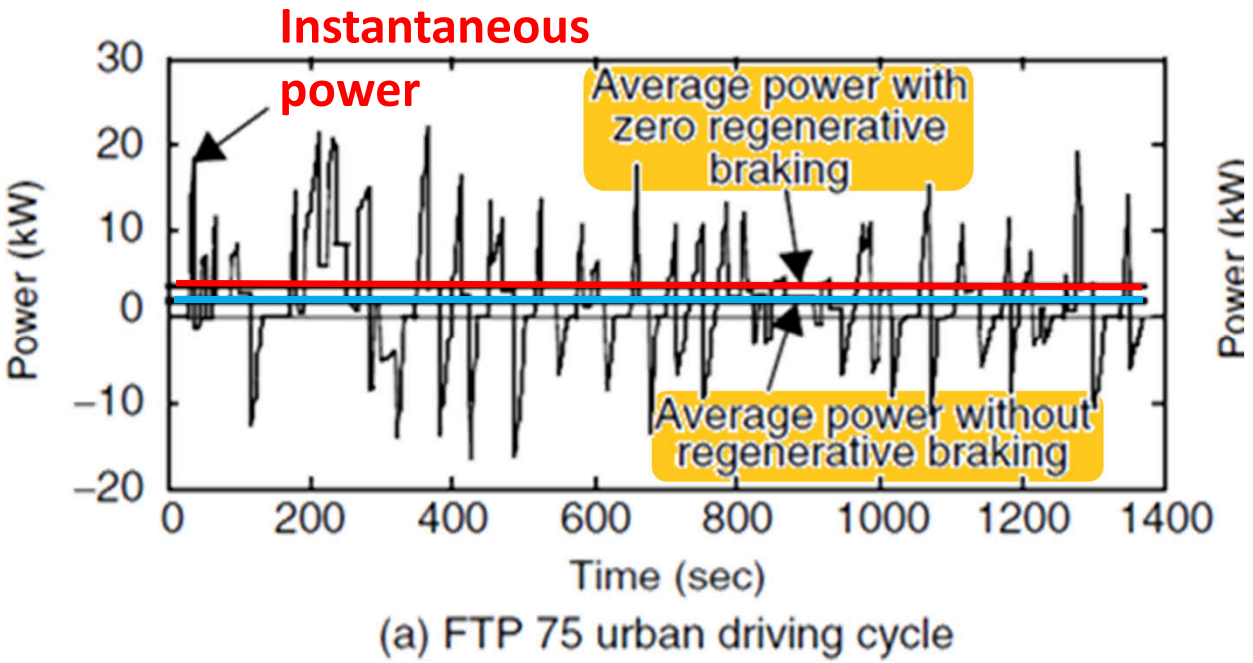
- Nii's "average power" solution ignores instantaneous driving conditions
- It has no use for determining when to connect the engine to the drive train for propelling the vehicle in a parallel hybrid based on instantaneous torque



BMW1013, Fig. 3 (annotated); PAICE2016, ¶¶ 145-52 POR, 35-36

BMW's Reasons To Combine Are Flawed

- A POSA will not use Nii's average power requirement to adjust Severinsky's thresholds for turning on/off the engine
- 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, ¶¶ 160-62; POR, 36-37

BMW's Reasons To Combine Are Flawed

- Only the '347 patent looks for patterns that assist in deriving a better setpoint

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

BMW1001, 40:47-41:9 (annotated)

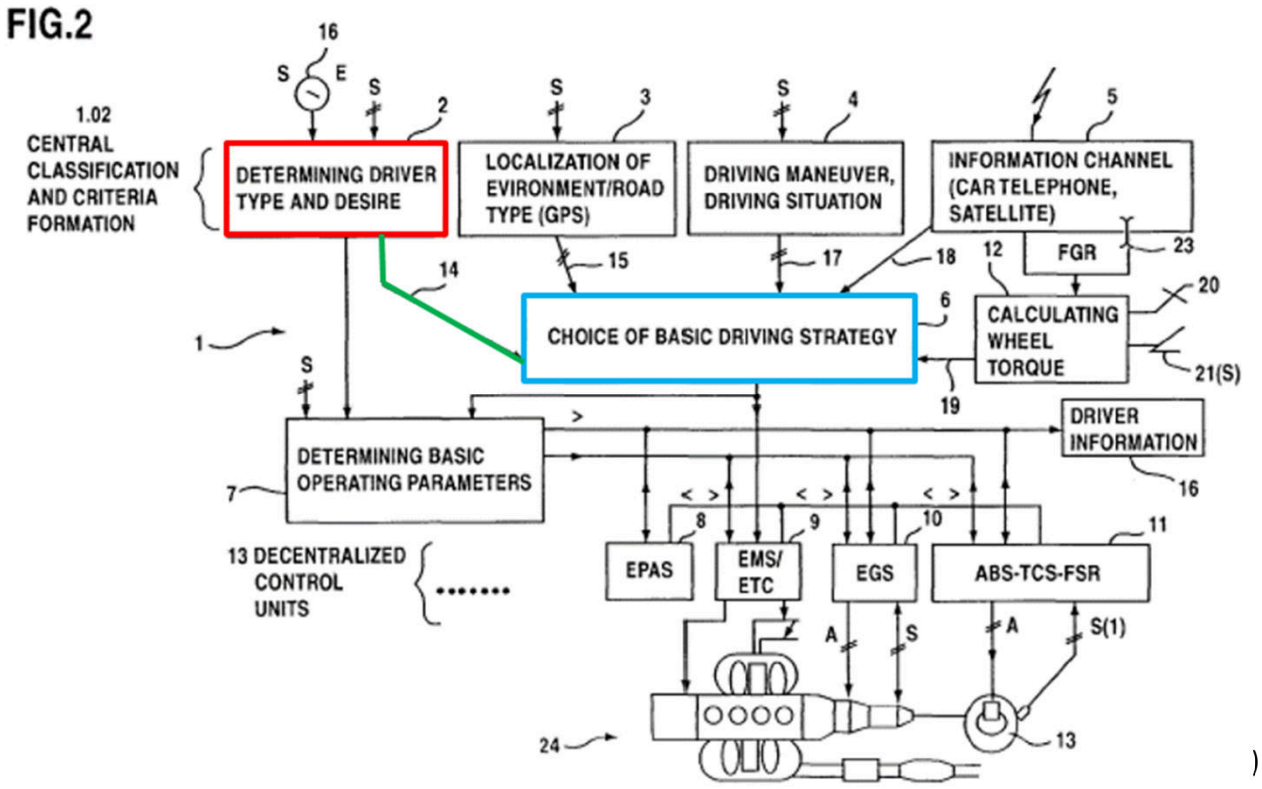
POR, 32

Severinsky and Graf Do Not Render Claims 2 and 24 Obvious (Grounds 3a and 3b)

- No prior art disclosure of varying the setpoint:
  - Severinsky discloses only a fixed setpoint (60% MTO)
  - Graf does not disclose any setpoints
- Graf does not "monitor patterns of vehicle operation over time"

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 monitors a driver’s repeated driving operations over time to determine the driving style



BMW1020, Fig. 2 (annotated); POR, 41-42

Graf Does Not Disclose Monitoring Patterns of Vehicle Operation

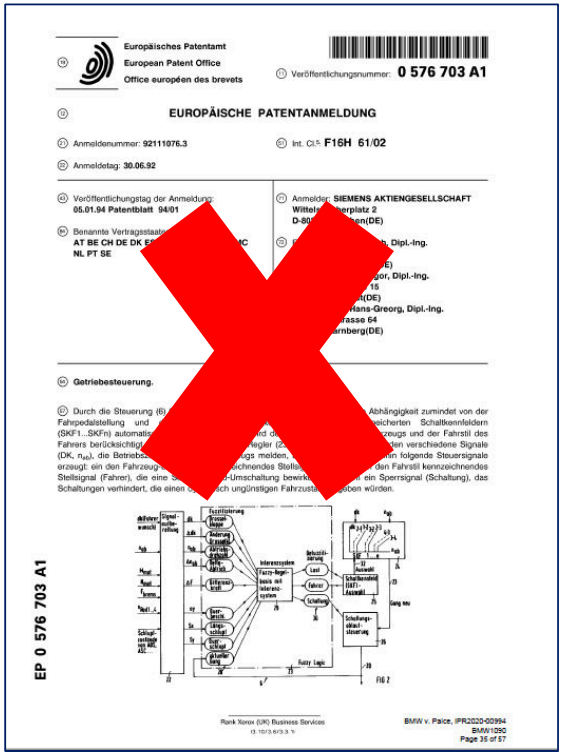
- BMW fails to show that Graf necessarily monitors a driver's repeated driving operations over time to determine the driving style

determined. Rather, as Patent Owner correctly notes, Graf does not provide any explicit disclosure as to how the driving style of performance or economy modes is determined in Figure 2. Given that the signals from block 4 are sent to block 6, not block 2, it appears, based on the current record, that any monitoring of a driver's operation does not result in an input to block 2 where the determination of the driving style is made or that Graf monitors a driver's "repeated driving operations." Petitioner's contention "that 'characterizing the driver style of the driver' [in Graf] would require '*monitoring a driver's repeated driving operations over time*'" (Pet. 23 (citing Ex. 1008 ¶ 408)) does not appear on this record to be supported by evidence from Graf.

ID, 28 (annotated)

Graf Does Not Disclose Monitoring Patents 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



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EP 0 576 703 A1

BMW v. Paice, IPR2020-00994
BMW1090
Page 35 of 57

*"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, 17-18

Graf Does Not Disclose Monitoring Patterns of Vehicle Operation

- In any event, BMW1090 does not disclose any evidence of "monitoring patterns of vehicle operation over time"

> 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, 19

Claim 2 and 24 Are Not Obvious In View of Bumby and Graf (Ground 4a)

- The Bumby References/Graf combination suffers from the same problems as the Severinsky/Graf combination
  - No prior art disclosure of varying the setpoint:
    - The Bumby References disclose only a fixed setpoint
    - Graf does not disclose any setpoints
  - Graf does not "monitor patterns of vehicle operation over time"

Claim 11 and 33 Are Not Obvious

Technology Background B: Controllable On-Demand-Turbocharger

- The '347 patent discloses incorporating a controllable turbocharger into a hybrid vehicle to work alongside the electric motor to provide additional torque
- The '347 patent's arrangement overcomes the problem of "turbo lag" experienced by conventional turbochargers
- "Turbo lag" is a "slow response to sudden increase in torque required"

As discussed above, according to a further embodiment of the invention, additional flexibility is provided to the hybrid vehicle as described above by providing a turbocharger **100**, also controlled by the microprocessor **48**, so as to be operated when useful in further improving vehicle efficiency and drivability and not at other times. Providing the "turbocharger-on-demand" allows the engine to function efficiently in different torque output ranges, as needed.

BMW1001, 44:60-44:67 (annotated)

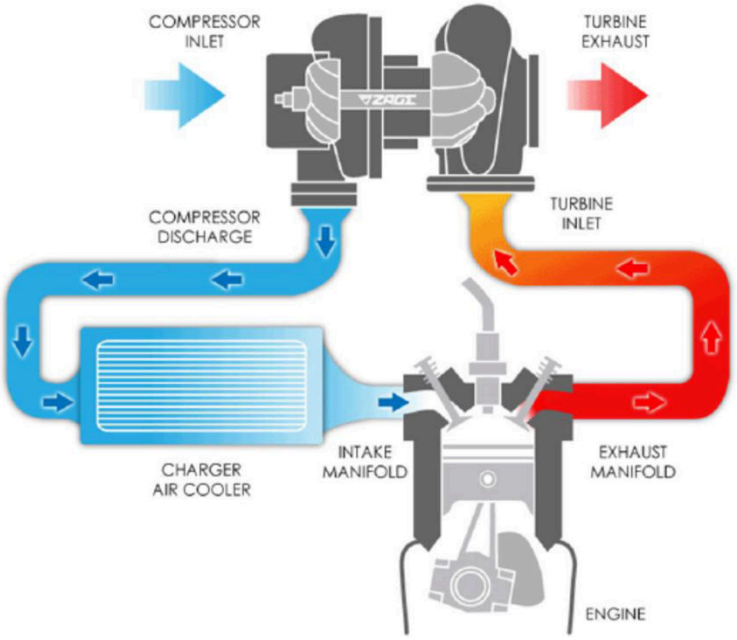
practice of the present invention. Moreover, turbocharged engines typically suffer "turbo lag", that is, slow response to sudden increase in torque required. As discussed further below, this particular problem is overcome by use of the turbocharger in a hybrid vehicle according to the invention.

BMW1001, 46:7-46:11 (annotated)

POR, 9

Technology Background B: Controllable On-Demand Turbocharger

- Turbochargers respond slowly to sudden increases in torque demand due to principle of operation
- Exhaust from engine provides rotational force to spin the turbine of the turbocharger, which is often insufficient to spin the turbine at low engine output
- Conventional engines experience delay as fuel is introduced to match increased airflow
- Turbocharger cannot increase air pressure to supply additional torque quickly enough to meet driver's demand for more torque

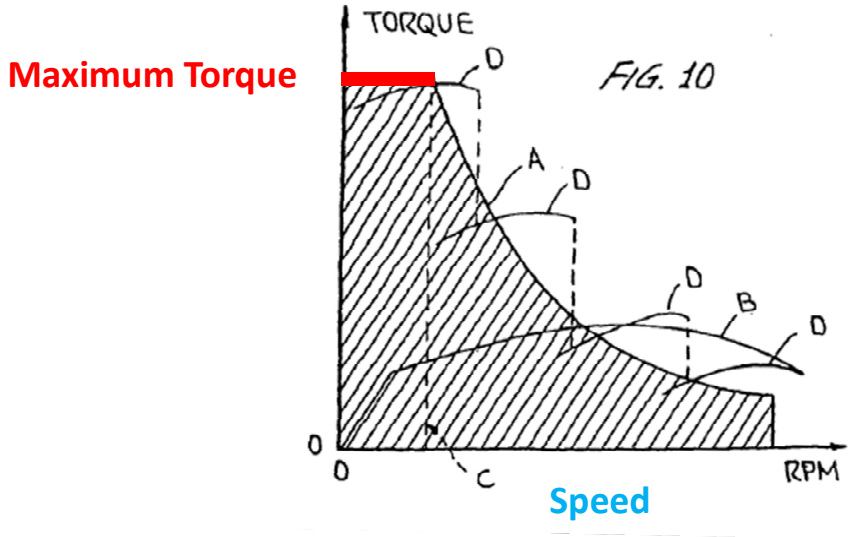


Turbo Dynamics, https://www.turbodynamics.co.uk/technical/understanding-turbochargers/

POR, 9-10; PAICE2016, ¶¶26-33.

Technology Background B: Controllable On-Demand-Turbocharger

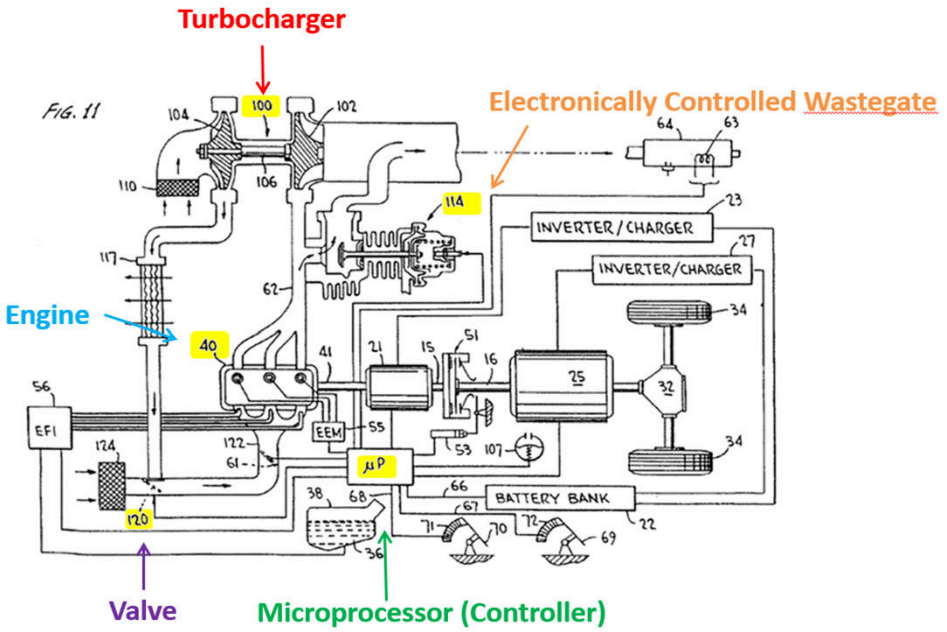
- Electric motor provides instantaneous, maximum torque at low rotational speeds, but cannot consistently provide high torque
- Too much reliance on the electric motor tends to drain the battery such that use of the turbocharger instead of the electric motor can help preserve the battery bank



PAICE2016, ¶¶48-49; BMW1001, Fig. 10 (annotated)

Technology Background B: Controllable On-Demand-Turbocharger

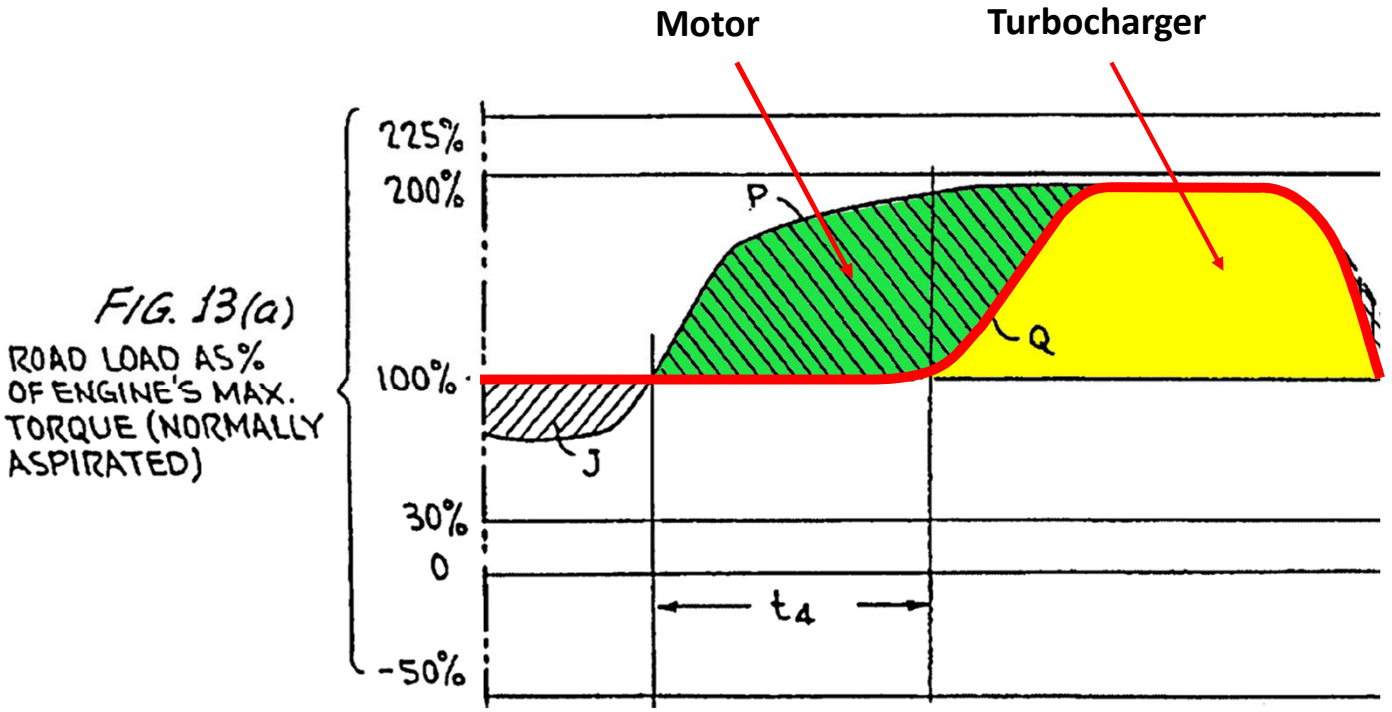
- "On-demand-turbocharger"
  - Electric motor provides additional torque when needed; turbocharger helps preserve battery bank
  - The microprocessor uses the wastegate and the valve to control the turbocharger, allowing the vehicle to select when the motor and the turbocharger will contribute torque
  - This arrangement enables the motor and the turbocharger to work in a ***complementary*** fashion



POR, 10-12, PAICE2016, ¶¶49-52; BMW1001, Fig. 11 (annotated)

Technology Background B: Controllable On-Demand-Turbocharger

- Thus, after the motor provides instantaneous torque, the turbocharger will continue to provide additional torque



BMW1001, Fig. 13a (annotated)

Claim 11 and 33 Are Not Obvious In Light of Severinsky and Ma (Grounds 1b and 2b)

- Claims 11 and 33 requires a "turbocharger operatively and controllably coupled" to the engine in a hybrid electric vehicle for use in a "sustained high-power turbocharged mode"

11. The vehicle of claim **7**, further comprising a turbocharger operatively and controllably coupled to said internal combustion engine for being operated and thereby increasing the maximum torque output of said internal combustion engine to more than MTO when desired, and wherein said controller controls selection of the operational mode of said vehicle between a low-load mode I, a cruising mode IV, an acceleration mode V, and a sustained high-power turbocharged mode VI, in response to monitoring the instantaneous torque requirements (RL) of the vehicle over time.

BMW1001, Claim 11 (annotated)

Claim 11 and 33 Are Not Obvious In Light of Severinsky and Ma (Grounds 1b and 2b)

- Severinsky in view of Ma does not make claim 11 and 33 obvious, because
  1. The benefits of Ma's turbocharger have been achieved by Severinsky alone;
  2. Ma's disclosure does not provide a reason to combine a turbocharger and a motor; and
  3. The addition of a turbocharger to Severinsky comes at significant cost

POR, 48-62, PO Sur-reply, 19-22, PAICE2016, ¶¶34-68.

1. The Benefits of Ma Have Been Achieved by Severinsky Alone

- Each of BMW's alleged reasons for combining Ma with Severinsky fall short because the supposed benefits of Ma's turbocharger are redundant to Severinsky's benefits

BMW'S ALLEGED BENEFITS TO COMBINE	SEVERINSKY'S DISCLOSED BENEFITS
Motor provides additional torque	operating range. The electric motor, which is substantially equally efficient at all operating speeds, is used to supply additional power as needed for acceleration and hill climbing, and is used to supply all power at low speeds, where the internal combustion engine is particularly inefficient, e.g., in traffic.
Allows for a smaller engine	FIG. 2 is similar to FIG. 1, and illustrates the operational characteristics of the same 3,300 pound car if driven by a relatively small engine having a maximum horsepower rating of about 45 horsepower at 4,000 RPM. The power requirement of the vehicle during
Allows engine to operates in most efficient range	According to one aspect of the invention, the internal combustion engine of a hybrid vehicle is sized to supply adequate power for highway cruising, preferably with some additional power in reserve, so that the internal combustion engine operates only in its most efficient operating range. The electric motor, which is substan-

POR, 48-50, PAICE2016, ¶¶56-72; BMW1013, 8:52-8:56, 9:47-9:52, 9:52-9:57 (annotated).

1. The Benefits of Ma Have Been Achieved by Severinsky Alone

- Federal Circuit and PTAB precedent dictate there is no reason to combine Severinsky and Ma because Severinsky alone achieves the purported benefits of Ma's turbocharger

South-Tek Systems, LLC v. Engineered Corrosion Solutions, LLC, 2018 WL 4520013, *3-*4 (Fed. Cir. 2018) (affirming Board's non-obviousness finding where the primary reference had a vent such that adding a different vent taught by second reference would be redundant)

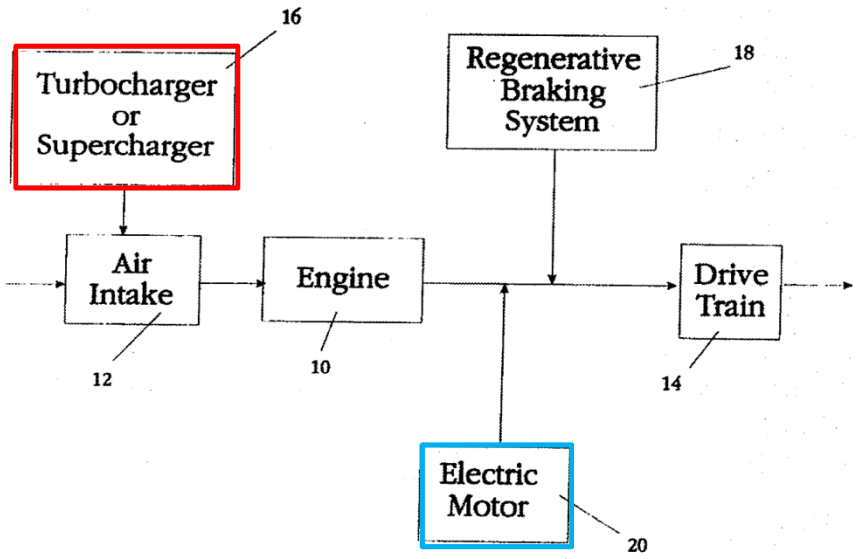
Kinetic Concepts, Inc. v. Smith & Nephew, Inc., 688 F.3d 1342, 1369 (Fed. Cir. 2012) (finding no reason to combine where the prior art references "independently accomplish similar functions" and "each device independently operates effectively")

Stryker Corp. v. Karl Storz Endoscopy America, Inc., IPR2015-00764, Paper 13, 13 (PTAB September 2, 2015) ("[W]e fail to see … why it would be obvious to add a translator to redundantly perform the function that Petitioner maintains is performed by the interconnect devices ….").

POR, 51

2. Ma's Disclosure Does Not Provide a Reason To Combine a Turbocharger and a Motor To Perform the Same Task

- While Ma's Figure 1 shows that a motor and a turbocharger ***can be combined***, it provides no reason as to why a POSA would use both sources of supplemental torque when just one is sufficient, especially when Severinsky's motor alone is adequate to supplement the engine



BMW1021, Fig. 1 (annotated)

POR, 52

2. Ma's Disclosure Does Not Provide a Reason To Combine a Turbocharger and a Motor To Perform the Same Task

- It is not sufficient to establish obviousness by merely demonstrating that a turbocharger and a motor ***can be combined*** in the same system, rather that a POSA ***would have been motivated to combine*** them in the same system

*"VGo's expert also succumbed to hindsight bias in her obviousness analysis. Dr. Yanco's testimony primarily consisted of conclusory references to her belief that one of ordinary skill in the art **could combine** these references, not that they **would have been motivated** to do so."*

InTouch Techs., Inc. v. VGO Comm'ns, Inc., 751 F.3d 1327, 1352 (Fed. Cir. 2014) (emphasis added)

POR, 52

2. Ma's Disclosure Does Not Provide a Reason To Combine a Turbocharger and a Motor To Perform the Same Task

- Board's rationale in the ID fundamentally does not address the redundant nature of BMW's proposed combination
- While a turbocharger can supplement an engine to provide torque above its MTO and permit engine downsizing, Severinksky's electric motor already performs these exact same functions
- The Board's recognition that Ma "discloses using an electric motor operating in parallel with a turbocharged engine in the embodiment shown in Ma's Figure 1" (Paper 19, 38) does not change the fact that BMW failed to show why a POSA would have combined Severinsky and Ma

POR 50, PAICE2016, ¶¶58-63.

2. Ma's Disclosure Does Not Provide a Reason To Combine a Turbocharger and a Motor To Perform the Same Task

- As background information, Severinsky's motor can propel the vehicle on its own, while Ma's motor is used only to supplement the engine
  - A "Limited Motor Assist" like Ma is a form of Mild HEV and vastly different than a Full HEV with "Full Power-Assist" and "Electric-Only Mode" like Severinsky

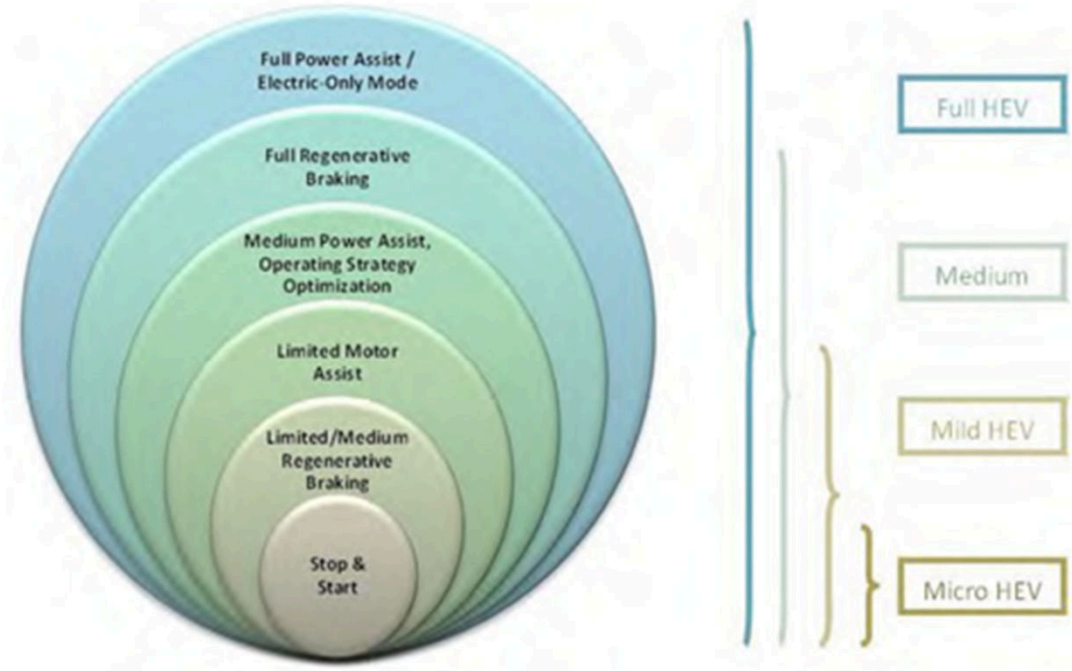


Figure 5.226 Electric Drive Configuration Capabilities

PAICE2022, Fig. 5.226; PAICE2016, ¶75, POR, 53

2. Ma's Disclosure Does Not Provide a Reason To Combine a Turbocharger and a Motor To Perform the Same Task

- Moreover, Ma discloses that the turbocharger and the motor are used ***interchangeably to perform the same function***, so it is unclear why a POSA would use both the motor and the turbocharger in the same system as the '347 patent discloses

> In one embodiment of the invention, the means for supplementing the total output torque include means for increasing the air mass trapped in the cylinders as compared with the mass of air trapped in a naturally aspirated engine. A turbocharger or supercharger may be used for this purpose.
>
> In a second embodiment of the invention, the means for supplementing the total output torque include an electric motor driven by a battery which is charged by the engine during idling and cruising conditions.

BMW1021, 5 (annotated); PAICE2016, ¶¶78-79, POR, 54

2. Ma's Disclosure Does Not Provide a Reason To Combine a Turbocharger and a Motor To Perform the Same Task

- BMW's additional reason to combine is based on hindsight rather than actual evidence
  - The reason to combine is found in the '347 patent, rather than in the prior art, and is based on conclusory expert testimony

provide better engine efficiency, resulting in improved fuel economy. A POSA would have been particularly motivated to achieve these efficiency benefits during extended periods of driving during which the instantaneous torque required to propel the vehicle exceeds the engine's MTO. BMW1008, ¶¶481-82. Using a turbocharger to provide additional torque during such circumstances would also help preserve battery charge, by taking some of the torque generation burden away from the motor. A POSA would have therefore been motivated to include a

Petition, 32 (annotated)

Essentially, the turbocharger **100** is employed only when the vehicle's torque requirements, the "road load" as above, exceeds the engine's normally-aspirated maximum torque capacity for a relatively extended period T of time, for example, during extended high-speed driving, towing a 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 invention, the period T is controlled in response to the state of charge of the battery bank; when the, battery bank is relatively depleted, the turbocharger is activated sooner than otherwise, so as to preserve the battery bank.

BMW1001, 45:1-14 (annotated)

POR, 56

3. The Addition of a Turbocharger To Severinsky Comes at a Significant Cost

- A POSA would not have added a turbocharger to Severinsky's parallel hybrid because the disadvantages of such arrangement significantly outweigh BMW's reasons to combine
  - Adding a turbocharger to Severinsky's naturally-aspirated engine would cause "engine knock," which can cause major engine damage and unacceptable engine noise
  - Reducing the compression ratio of Severinsky's engine to address the knock will lead to a reduction of engine efficiency

POR, 58-62.

3. The Addition of a Turbocharger To Severinsky Comes at a Significant Cost

- Turbocharged engines are also less efficient than naturally-aspirated engines, and only improve efficiency at low loads where Severinsky does not use the engine at all

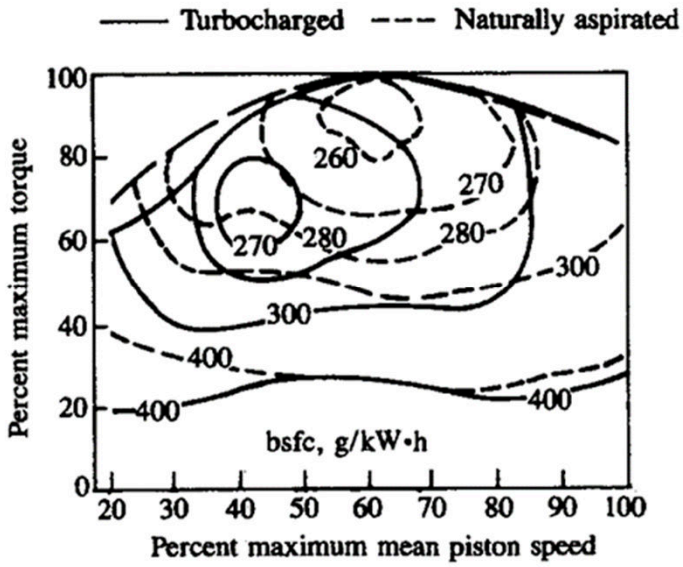


FIGURE 15-38
Comparison of bsfc contours (in grams per kilowatt-hour) on performance maps of turbocharged and naturally aspirated versions of the same spark-ignition engine, scaled to the same maximum torque and mean piston speed.[53]

POR, 59-61, PAICE2019, Fig. 15-38; *see also* PAICE2024, 396.

POR, 60

3. The Addition of a Turbocharger To Severinsky Comes at a Significant Cost

- Adding a turbocharger to a parallel hybrid vehicle also means…
  - Added weight, resulting in reduced system efficiency
  - Packaging problems
  - Unnecessary complications involving engine control and calibration
  - Extra, unnecessary components

POR, 60-62.

BMW Fails To Show "How" or "Why" a POSA Would Combine Severinsky and Ma

- Ultimately, BMW's Petition and Reply confirm:
  - Ma's turbocharger is redundant of Severinsky's powerful electric motor
  - BMW's reliance on Ma Fig. 1's inclusion of a turbocharger and motor is insufficient
  - BMW's efforts to downplay the disadvantages of turbochargers are off base
- Therefore, BMW has failed to show ***how or why*** a POSA would have combined Severinsky and Ma

*"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))

Claim 11 and 33 Are Not Obvious In Light of Bumby and Ma

- Bumby in view of Ma does not make claim 11 and 33 obvious, because
  - Bumby already teaches that using a motor permits the use of an engine smaller than required in an IC engine vehicle
  - So there is no reason to add a turbocharger to further reduce the size of the engine

POR, 69-70.

Claim 17 Is Not Obvious

Claim 17 Is Not Obvious in View of Severinsky and Ehsani (Ground 2c)

- Claim 17 discloses motor placement on different axles
- Severinsky in view of Ehsani does not make claim 17 obvious
  - BMW fails to explain why a POSA would combine Severinsky and Ehsani; and
  - BMW's new argument is improper

> **17**. The vehicle of claim **1**, wherein the engine and first electric motor are controllably coupled to a first set of road wheels of said vehicle and said second electric motor is coupled to a second set of road wheels of said vehicle.

BMW1001, Claim 17

1. BMW Fails To Explain Why a POSA Would Combine Severinsky and Ehsani

- BMW does not explain why and how a POSA would place Severinsky's engine and a second propelling motor on different wheels, where Severinsky relies on a torque transfer unit to combine the engine and motor torque into a single output

- BMW's conclusory "design choice" argument about four-wheel drive is deficient when Severinsky already has four-wheel driving capability

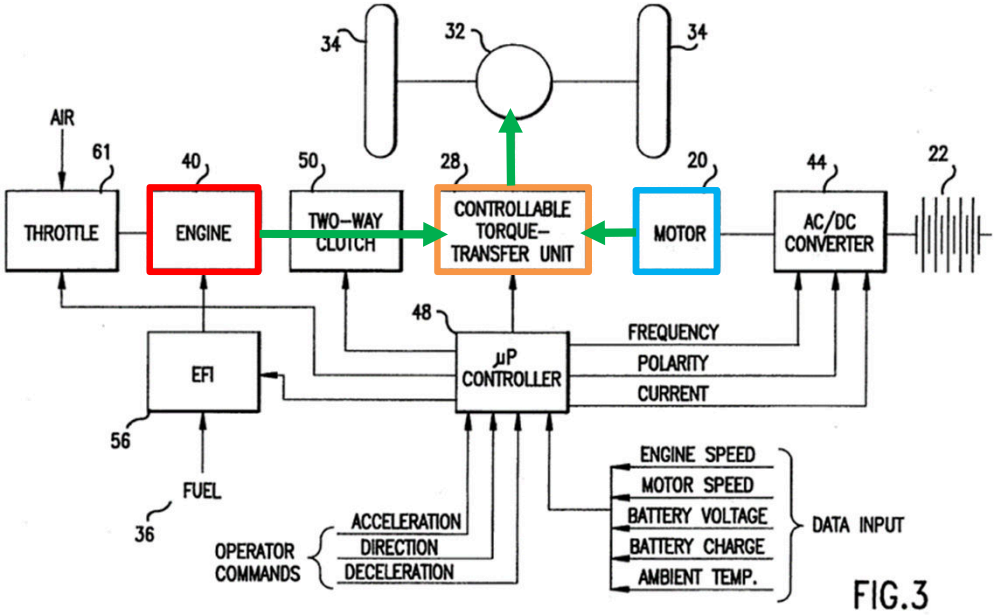


FIG.3

> The output torque from motor **20** is transmitted by way of torque transfer unit **28** through a conventional differential **32** to the vehicle drive wheels **34**, which may be the front or the rear wheels of the vehicle, or all four wheels. An exemplary embodiment of the control-

BMW1013, Fig. 3 (annotated); 11:53-57; POR, 65-68

2. BMW's New Argument Is Improper

- BMW's new argument that Severinsky's four-wheel drive requires additional components and Ehsani's "simpler" solution provides a reason to combine is improper new argument that should have been presented in its petition

"The Board did not abuse its discretion in declining to consider the cited paragraphs in Dr. Karger's reply declaration. See J.A. 271–72. The declaration raises a new obviousness argument for this limitation that could have been made in the petition. The Board correctly noted this argument was not made in the petition, which proposed that Shoubridge rendered obvious a number of other claim limitations. ***Blizzard, as petitioner, had an opportunity to present this argument in its petition, but chose not to.***"

Acceleration Bay, LLC v. Activision Blizzard Inc., 908 F.3d 765, 775 (Fed. Cir. 2018) (emphasis added)

Sur-reply 23-25

Claim 17 Is Not Obvious in View of Bumby and Ehsani (Ground 4c)

- BMW fails to explain how and why a POSA would move Bumby's motor for propelling the vehicle to the rear wheels
  - Conclusory statements are not enough

> Petitioner also contends that the limitations of claim 17 "would have been an obvious design choice (in view of Ehsani)." Pet. 43. Dr. Davis offers similar testimony. Ex. 1008 ¶ 603. However, "[m]erely stating that a particular placement of an element is a design choice does not make it obvious" but rather, Petitioner "must offer a reason for why a person of ordinary skill in the art would have made the specific design choice." *Cutsforth, Inc. v. MotivePower, Inc.*, 636 F. App'x 575, 578 (Fed. Cir. 2016). Based on this record, Petitioner does not sufficiently explain the reasons why the limitations of claim 17 would have been an obvious design choice.

ID, 52 (annotated)

Sur-reply, 27-28

Claim 38 Is Not Obvious

Claim 38 Is Not Obvious in View of the Bumby References and Ehsani

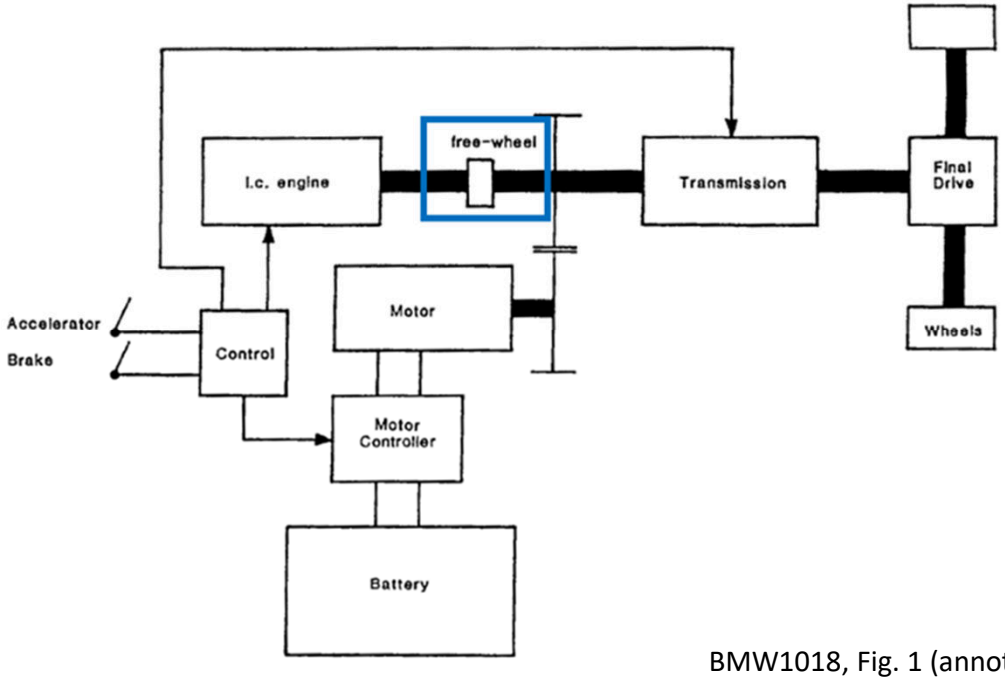
- Claim 38 discloses control for engine/motor output shaft speed alignment
- The Bumby References in view of Ehsani does not render claim 38 obvious
  - Neither the Bumby References nor Ehsani control shaft speeds to be "substantially equal"

> **38**. The method of claim **23**, wherein a clutch connects a first output shaft of or driven by said engine and/or first motor with a second output shaft of or driven by said second motor connected to said wheels, and wherein the speeds of said engine and/or first motor and of said second motor are controlled such that when said clutch is engaged the speeds of the first and second output shafts are substantially equal, whereby said shafts may be connected by a non-slipping clutch.

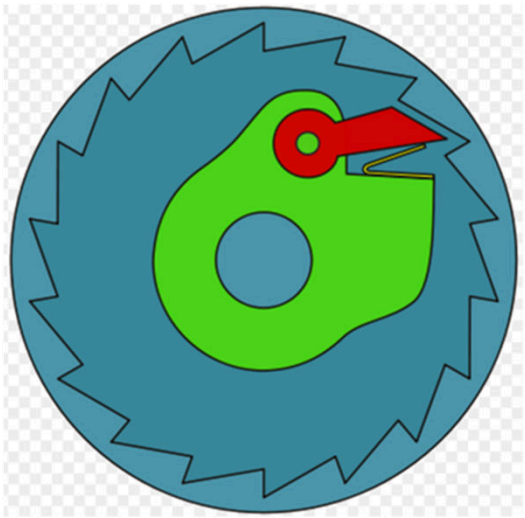
BMW1001, Claim 38 (annotated)

Claim 38 Is Not Obvious in View of the Bumby References and Ehsani

- Bumby V uses a "free-wheel unit", as opposed to a conventional two-way clutch, such that it has no need to control the engine and motor's speeds such that the shaft speeds are "substantially equal"



BMW1018, Fig. 1 (annotated)



U.S. Patent No. 88,238 at Fig. 2

POR, 71-73

Claim 38 Is Not Obvious in View of the Bumby References and Ehsani

- No evidence that a 45 rpm difference as disclosed in Bumby V is "substantially equal"
- Such a disparity would result in extensive slipping that is incompatible with a non-slipping clutch

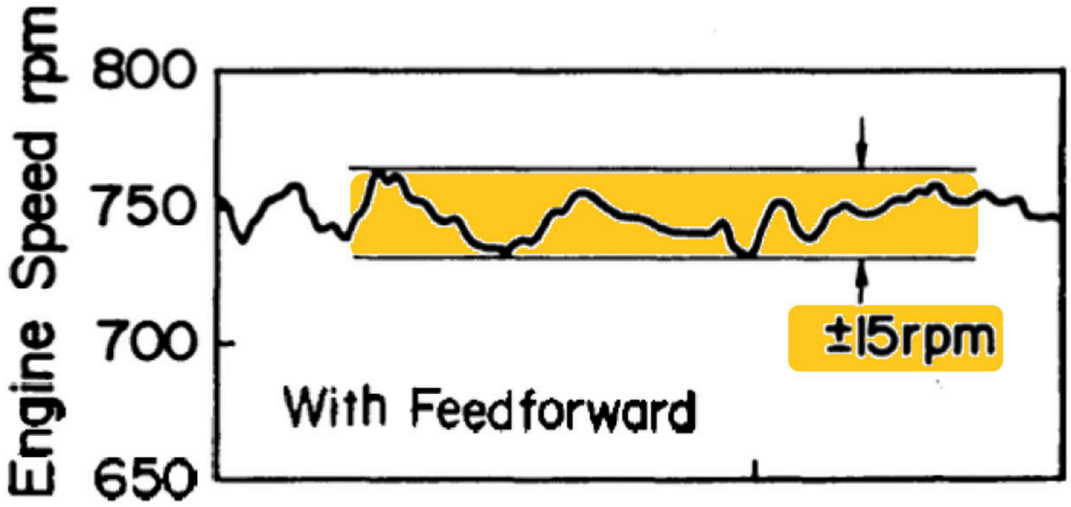
to fire. This is adjudged to happen when the engine speed passes 490 rev/min. Above this speed the starter motor is turned off and the speed control algorithm is entered to run the engine up to the drive-train speed. Synchronisation is deemed complete when the engine speed is within 45 rev/min of the drive-train speed which in this case is achieved within 0.7 s of the original command to start. At this stage, torque control is

BMW1018, 6 (annotated)

POR, 71, 74; PAICE2016, ¶197

Claim 38 Is Not Obvious in View of the Bumby References and Ehsani

- No evidence that a 45 rpm difference as disclosed in Bumby V is "substantially equal"
  - Contemporaneous evidence shows controllers could control engine speed to within 15 rpm



PAICE2026, Fig. 9 (annotated); PAICE 2016, ¶ 190

POR, 71

Claim 38 Is Not Obvious in View of the Bumby References and Ehsani

- No evidence that a 45 rpm difference as disclosed in Bumby V is "substantially equal"
  - BMW's evidence showing speeds of 50-100 rpms is for a slipping (friction) clutch as Dr. Davis admits

warranty costs. In normal driving conditions the precision and the speed of electronic control leads to lower clutch wear than with the average human driver. For this reason CMS can use controlled slip to reduce noise and still comply with clutch wear standards. This has been proven by tests on cars as well as on durability benches.

BMW1097 (Norgard), 138 (annotated)

And so by controlling that value, synchronizing to a value when you're re-engaging to go to second gear, by controlling to a value of 50 to 100 rpm, you're synchronized so then you can complete the shift without causing potential damage to the drive line which could include the gearbox as If you're really too large in terms of your slip, so it's a very high slip value, then you're going to cause undue wear on the friction clutch and you'll wear out the clutch.

PAICE2029, 24:20 – 25:5 (annotated)

Sur-reply, 26-27

Claim 38 Is Not Obvious in View of Severinsky and Ehsani

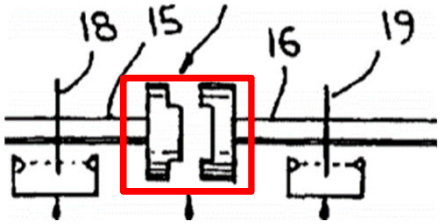
- Claim 38 discloses control for engine/motor output shaft speed alignment
- Severinsky in view of Ehsani does not render claim 38 obvious
  - Neither Severinsky nor Ehsani control shaft speeds

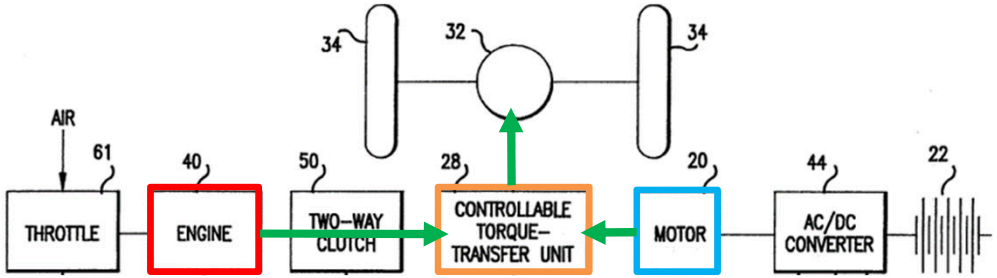
38. The method of claim **23**, wherein a clutch connects a first output shaft of or driven by said engine and/or first motor with a second output shaft of or driven by said second motor connected to said wheels, and wherein the speeds of said engine and/or first motor and of said second motor are controlled such that when said clutch is engaged the speeds of the first and second output shafts are substantially equal, whereby said shafts may be connected by a non-slipping clutch.

BMW1001, Claim 38 (annotated)

Claim 38 Is Not Obvious in View of Severinsky and Ehsani

- Severinsky discloses nothing about control
  - Severinsky merely closes the clutch and locks the torque transfer unit to mechanically force together the engine and motor shafts





When gears **98** and **100** are fixed with respect to housing **92**, the torque transfer unit **28** is said to be "locked" or in the "parallel" mode of operation. In this mode, with clutch **50** operated such that engine output shaft **41** is engaged with input shaft **86**, both shafts **86** and **26** rotate at the same rate, and the sum of the input torque provided from engine **40** and motor **20** is transferred to wheels **34** by drive shaft **30**.

BMW1013, Fig. 3; Fig. 4; 15:64 – 16:3 (annotated); Sur-reply, 22-23

BMW's Motion To Exclude Should Be Denied

Dr. Shahbakhti Is Properly Qualified To Opine on Hybrid Electric Vehicles

Dr. Mahdi Shahbakhti
Patent Owners' Expert

- Professor of Mechanical Engineering at the University of Alberta
- Adjunct Associate Professor of Mechanical Engineering at Michigan Technological University
- Taught courses and conducted research in hybrid electric vehicle technologies for over a decade
  - Built hybrid electric powertrain platform
  - Designed and modeled internal combustion engines
- Ph.D. in Mechanical Engineering from the University of Alberta in 2009

Dr. Shahbakhti Is Properly Qualified To Opine on Hybrid Electric Vehicles

- Dr. Shahbakhti need not be a POSA as of September 1998

"In holding that, to testify as an expert under FRE 702, one must be qualified as an expert in the pertinent art, the Federal Circuit has not placed temporal restrictions, such as requiring an expert be qualified in the pertinent art at the time of the invention."

T. Rowe Price Inv. Servs., Inc. v. Secure Axcess, LLC, CBM2015-00027, Paper 31 at 19-23 (PTAB June 13, 2016)

Dr. Shahbakhti Is Properly Qualified To Opine on Hybrid Electric Vehicles

- Dr. Shahbakhti relied on documents after 1998 to describe fundamental properties of math, physics, and vehicle architectures that are as true today as they were in 1998
- Neither BMW nor Dr. Davis dispute these fundamental principles

"Based on the statutory scheme, the PTO's own regulations, and prior Board decisions, ***the Board can rely on evidence other than just prior art***…. The Board has recognized that non-prior art evidence of what was known "cannot be applied, independently, as teachings separately combinable" with other prior art, but "can be relied on for their proper supporting roles, e.g., indicating the level of ordinary skill in the art, what certain terms would mean to one with ordinary skill in the art, and how one with ordinary skill in the art would have under-stood a prior art disclosure." Dominion Dealer Sols., LLC v. AutoAlert, Inc., IPR2014-00684, 2014 WL 5035359, at *5 (P.T.A.B. Oct. 6, 2014)."

Yeda Research v. Mylan Pharms. Inc., 906 F.3d 1031, 1041 (Fed. Cir. 2018)

Thank You