

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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**JTEKT CORPORATION**

Petitioner,

v.

**GKN AUTOMOTIVE LTD.**

Patent Owner.

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Case IPR2016-00046

U.S. Patent No. 8,215,440

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**DECLARATION OF STEVEN J. BECKER**

I, Steven J. Becker, declare as follows:

**I. Background and Qualifications**

1. I have studied and practiced in the field of mechanical engineering, including, in particular, drive trains in vehicles for over twenty years.

2. I received my Bachelor of Science (B.S.) degree in Mechanical Engineering in 1992 from Worcester Polytechnic Institute and my Masters in Business Administration in 2007 from Syracuse University.

3. I am currently employed by Robson Forensic Incorporated, where I provide technical investigations and analysis involving vehicle collisions, vehicle design issues, acoustics, mechanical defects and malfunctions, and vehicle repair. In this role I have worked on over 250 cases, including analyzing defective repairs of numerous vehicle systems including transmissions, axle systems, drive shafts, and universal joints. I am also employed at Fournier Robson, where I provide vehicle engineering design and test consulting engineering.

4. Prior to joining Robson Forensic, I worked at Magna Powertrain for over a decade as an engineering test services manager, and quality engineer. In this role I – among other things – managed and trained engineers and mechanics in product design and development engineering for transmissions, four-wheel drive (“4WD”) and all-wheel drive (“AWD”) transfer cases, power transfer units (“PTUs”), and axles.

5. I worked at Chrysler Corporation from 1994-1997 as a Scientific Laboratory Engineer, responsible for design, testing and data analysis of various vehicle systems. From 1993-1994 I worked at New Venture Gear as a Product Engineer where I designed geared systems for automotive transmissions and experimented and tested various vehicle systems.

6. I am a member of the Society of Automotive Engineers, and have published several articles with them.

7. A copy of my latest CV is attached to this declaration as Appendix A.

## **II. Description of the Relevant Field and the Relevant Timeframe**

8. I have carefully reviewed Patent No. 8,215,440 (hereinafter, the '440 patent).

9. For convenience, all of the information that I considered in arriving at my opinions is listed in Appendix B. Based on my review of these materials, I believe that the relevant field for purposes of the '440 patent is manually connected four-wheel drive systems with a power transfer unit (PTU) in vehicles. I have been informed that the relevant timeframe is on or before May 6, 2008.

10. As described in Section I above and as shown in my CV, I have extensive experience in mechanical engineering. Based on my experience ,

education, and training (both academic and professional), I am well versed of the relevant field in the relevant timeframe.

### **III. The Person of Ordinary Skill in the Relevant Field in the Relevant Timeframe**

11. I have been asked to provide my opinion regarding the “level of ordinary skill in the art” at the time of the invention, which I have been told is on or before May 6, 2008.

12. I understand that the hypothetical person of ordinary skill in the art is considered to have the normal skills and knowledge of a person in a certain technical field. I understand that factors that may be considered in determining the level of ordinary skill in the art include: (1) the education level of the inventor; (2) the types of problems encountered in the art; (3) the prior art solutions to those problems; (4) rapidity with which innovations are made; (5) the sophistication of the technology; and (6) the education level of active workers in the field. I also understand that “the person of ordinary skill” is a hypothetical person who is presumed to be aware of the universe of available prior art.

13. I understand that “a person of ordinary skill in the relevant field” is a hypothetical person to whom an expert in the relevant field could assign a routine task with reasonable confidence that the task would be carried out successfully. I have been informed that the level of skill in the art is evidenced by prior art

references. The prior art discussed herein demonstrates that a person of ordinary skill in the field, at the time the '440 patent was effectively filed, was aware of various aspects of vehicle drive trains.

14. Based on my experience, I have an understanding of the capabilities of a person of ordinary skill in the relevant field. I have supervised and directed many such persons over the course of my career. Further, I, myself, had those capabilities at the time the '440 patent was effectively filed. Unless stated otherwise, my opinions herein are provided from the viewpoint of one of ordinary skill in the art in May 2008, *i.e.*, at the time of the earliest priority date claimed by the '440 patent.

#### **IV. The '440 Patent**

15. The '440 patent is directed to a manually connected four-wheel drive train for a vehicle comprising a primary axle permanently driven by a primary drive train and a secondary axle connectable to the primary axle by a switch-on device, which can be driven by a secondary drive train, whereby the switch-on device has a switch-on mechanism via which the secondary drive train can be integrated in the drive train transferring the overall drive output, and whereby the secondary drive train output is conveyed via side shaft couplings into side shafts of

the secondary axle when the secondary axle is connected and is transferred to drive wheels of the secondary axle. (Ex. 1001, 1:20-29.)

16. The '440 patent acknowledges that these types of drive trains are "known in automobile construction in particular as manually connected four-wheel drive." (*Id.* at 1:33-34.) The '440 patent discloses that drive trains are also known which enable connection during travel: "A connectable secondary axle is also designated as a 'hang-on' axle. Here the secondary drive wheels are uncoupled from the vehicle drive by a coupling provided in the whole drive train. Frictionally engaged couplings, which enable connecting of the secondary axle during travel, are used here in particular." (*Id.* at 1:55-60.)

17. The '440 patent discloses that "countless factors diminish the net drive output actually available in operation, therefore that part of the overall drive-side available drive output, which actually can be utilized for propelling the vehicle, and also whenever the secondary axle not is connected. In this case the secondary axle drive train is interrupted at a point between the primary axle and the drive wheels by the switch-on device, such that no drive power is transmitted to the secondary axle drive wheels. The components of the secondary drive train however are still being driven either by the vehicle drive via the primary axle and/or by the secondary drive wheels or respectively dragged along passively, without transmitting drive power. This gives rise to friction losses (bearing friction,

churning losses, friction of gearwheel engagement, etc.) and the rotating masses of the secondary driven train components (differential, intermediate shaft, couplings, etc.) are to be accelerated or respectively retarded constantly with the vehicle during dynamic driving.” (*Id.* at 2:19-36, parentheses in original.) Therefore, the ‘440 patent admits that it is a known disadvantage to have the components of the secondary drive train rotating when not being driven.

18. The ‘440 patent then concludes that there is a need to provide a four wheel drive train that minimizes power loss when the secondary drive train is uncoupled. (*Id.* at 2:53-55.)

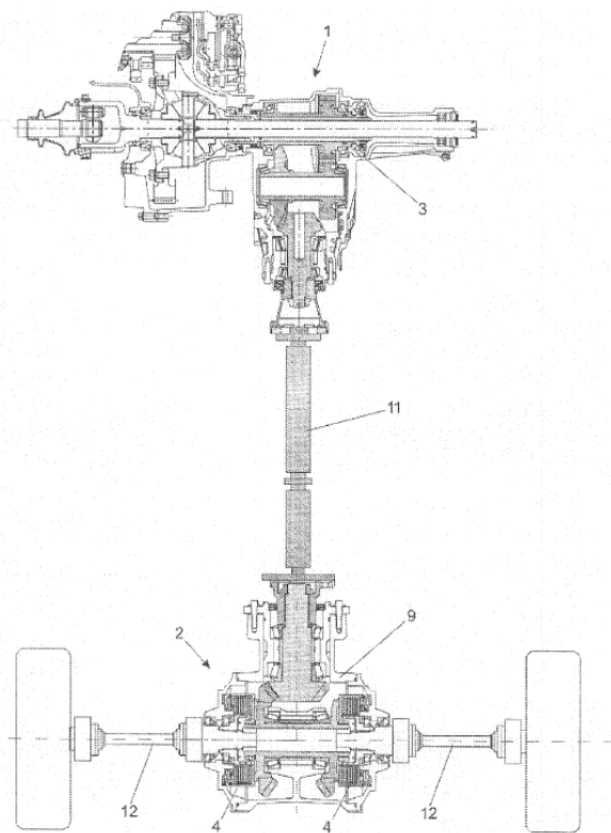
19. To overcome the above-described disadvantages the ‘440 patent discloses a “drive train of a vehicle...which comprises a permanently driven primary axle and a secondary axle connectable to the primary axle via a switch-on device with a switch-on mechanism, whereby the secondary drive train output via side shaft couplings is transferred to the drive wheels of the secondary axle. Because the switch-on mechanism and/or the side shaft couplings have frictionally engaged couplings, it can be that when the secondary axle is uncoupled, the shutdown section of the secondary drive train located between the switch-on device and the side shaft coupling is uncoupled both from the primary axle and from the secondary drive wheels.” (*Id.* at Abstract.)

20. The '440 patent discloses a switch-on mechanism and side shaft couplings that have at least one frictionally engaged coupling. (*Id.* at 2:66-3:1.) When the secondary drive train is disconnected, the section of the secondary drive train between the connection unit and the side shaft couplings (*i.e.*, the “shutdown section”) is uncoupled from the primary axle and the secondary drive wheels when power is provided from only the primary axle. (*Id.* at 3:1-19). On the other hand, when the secondary drive train is connected, both the side shaft couplings and the switch-on device are coupled, enabling the secondary drive output flow from the primary axle to the secondary axle. (*Id.*) Frictionally engaged couplings are used in order to match the speed of the components of the secondary drive train with the speed of the drive wheels of the secondary axle prior to coupling. (*Id.* at 3:20-30.)

21. Fig. 3 (below) of the '440 patent shows a drive train with permanently driven primary axle 1 and connectable secondary axle 2, the section of the secondary drive train of which located between side shaft couplings 4 and switch-on device 3 is inoperative. (*Id.* at 6:34-37.) The axle drive unit 9 of FIG. 3 is designed without differential. Two frictionally engaged working side shaft couplings 4 transmit the secondary drive output to the side shafts 12 of the secondary axle 2. The drive torque and slippage to be transferred are freely adjusted by side shaft couplings 4, such that with this axle drive functions of longitudinal differential and of active-yaw differential can be shown in addition to



the functions of transverse differential. (*Id.* at 6:39-46.) “To shut down the secondary drive train the side shaft couplings 4 are opened and the secondary drive train is uncoupled from the permanently driven part of the drive train via the switch-on device 3. Taken by itself, neither the side shaft couplings 4 nor the switch-on device 3 could execute the fundamental inventive idea; with respect to the invention rather they cooperate synergistically.” (*Id.* at 6:49-56.) The ‘440 patent acknowledges that the couplings 4 and the switch-on device 3 individually are known in the art.



**FIG. 3**

Figure 3 of the ‘440 patent

22. Fig. 4 of the '440 patent illustrates the switch-on device 3 in detail. The switch-on device 3 is a switchable angular gear, in which the tight fit occurs from a spur gear step 14 engaging with a connecting shaft 15, which is permanently driven by the drive basket 17 of the primary axle differential, by means of a switch-on mechanism, formed by synchronizing 16. (*Id.* at 7:7-11.) The '440 patent discloses that “when the secondary drive is switched off the spur gear step 14 does not rotate along with the permanently driven primary drive train. The coupling point between permanently driven primary drive train and connectable secondary drive train is therefore the synchronizing 16.” (*Id.* at 7:12-16.) However, the '440 patent states that “It is of course also feasible to provide other positive or also non-positive connecting mechanisms in addition to the positively working synchronizing illustrated in FIG. 4. A frictionally engaged coupling can also ensure the secondary drive output flow from the connecting shaft 15 to the spur gear step 14 in place of synchronizing [16].” (*Id.* At 7:36-41.) Accordingly, when the switch-on device 3 is disengaged, the intermediate shaft 11 and the secondary axle 2 is not driven by the engine.

23. “When the secondary drive train is connected the spur gear step 14 transmits the secondary drive train output first via a transverse shaft 18 to a crown wheel which delivers the drive power in turn via a pinion shaft 19 to the intermediate shaft 11 and thus forwards it to the secondary axle.” (*Id.* at 7:16-21.)

24. Figs. 5 and 6 show the secondary axle drive in detail. Fig. 5 shows the state when the secondary axle is switched off (couplings 4 are open, “opened coupling”) and Fig. 6 shows the state when the secondary axle is connected to the primary axle (couplings 4 are closed, “coupled”). (*Id.* at 7:46-49.) Fig. 5 “illustrates that in the switched-off mode only a few components of the rear axle rotate and the losses are kept to a minimum. When the secondary drive (Fig. 5 opened coupling) is switched off only the inner plate carrier 7 with the inner plates 5 connected thereto rotate from the coupling packet, and a few bearing components. The outer plate carrier 8 with the outer plates 6 and the pressure piston 22 are stationary.” (*Id.* at 8:4-10.) The outer carrier plate is coupled in a torque proof manner to crown wheel carrier shaft 21 which is connected to the drive sprocket 20 attached to intermediate shaft 11. (*Id.* at 7:50-57.) Therefore, when the secondary drive is switched off by the couplings 4, the intermediate shaft 11 and the drive sprocket 20 are not driven by the rear axle 12.

25. Accordingly, the ‘440 patent discloses that when the secondary drive train is disconnected, the section of the secondary drive train between the connection unit and the side shaft couplings (*i.e.*, the “shutdown section”) is uncoupled from the primary axle and the secondary drive wheels when power is provided from only the primary axle. (*Id.* at 3:1-19). On the other hand, when the secondary drive train is connected, both the side shaft couplings and the switch-on

device are coupled, enabling the secondary drive output flow from the primary axle to the secondary axle. (*Id.*)

## **V. Prosecution History of the ‘440 Patent**

26. The ‘440 patent was filed on April 30, 2009 claiming priority to German applications DE 10 2008002844 (filed on May 6, 2008) and DE 10 2008057272 (filed on November 13, 2008).

27. On April 30, 2009, the Patent Owner filed a preliminary amendment to address formality issues in the specification and amend claims 1-12 to reflect language more in keeping with U.S. Patent Law.

28. On September 1, 2011, the USPTO issued an Office Action rejecting claims 1-12 under 35 U.S.C. § 112 as indefinite, noting that “there are several instances of indefinite claim language throughout the claims, which (like the entire present application) appears to be a crudely translated foreign document.” The Examiner rejected claims 1-12 as anticipated by U.S. Patent Application Publication No. 2002/0144851 to Porter (“Porter”). The Examiner also made several objections to the specification, claims, and drawings.

29. In explaining the rejection applying Porter, the Examiner noted that Porter teaches a drive train for a vehicle comprising at least a primary axle that is permanently driven by a primary drive train and a secondary axle that is operably

connectable to the primary drive train and axle via a switch-on device. As such, the secondary drive train can be integrated with the primary drive train, and when connected, drive output to the secondary drive train is conveyed to side shaft couplings and transmitted to the drive wheels. The Examiner further asserted that the system in Porter also uses frictionally engaged couplings.

30. On February 27, 2012, the Patent Owner amended the claims to address the objections and indefiniteness rejections. In addition, claim 1 was amended “to make clear that a shutdown section of the secondary drive train is decoupled from the primary drive train and from the wheels of the secondary axle when the primary drive train does not provide power to the wheels of the secondary axle.” In conjunction with this amendment, the Patent Owner argued that the novel feature of the application was the fact that, when the vehicle is in two-wheel drive mode, the shutdown section does not rotate or move. In contrast, the Patent Owner argued that, in Porter, all components of the drive train are in motion at all times whenever the vehicle is moving, regardless of whether the vehicle is in two-wheel mode or four-wheel mode. Based on this amendment and argument, the Examiner issued a Notice of Allowance without providing any commentary.

31. The allowance of the claims based on this feature is inconsistent with prior art patents and publications as detailed in the references applied below. The

Examiner appears to have not been made aware of the relevant prior art that teaches this fact during the examination of the claims.

## VI. Claim Interpretation

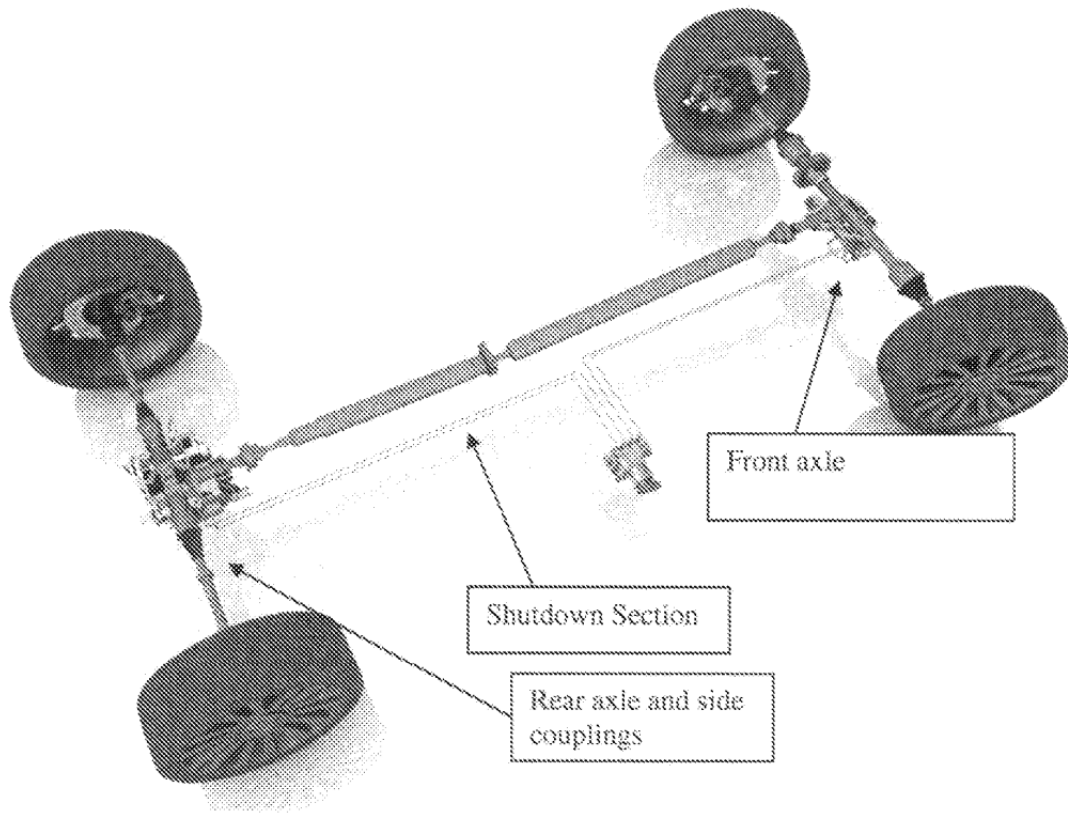
32. In proceedings before the USPTO, I understand that the claims of an unexpired patent are to be given their broadest reasonable interpretation in view of the specification from the perspective of one skilled in the art during the relevant timeframe. I have been informed that the '440 patent has not expired. In comparing the claims of the '440 patent to the known prior art, I have carefully considered the '440 patent and the '440 patent file history based upon my experience and knowledge in the relevant field. In my opinion, the broadest reasonable interpretations of the claim terms of the '440 patent are generally consistent with the terms' ordinary and customary meaning, as one skilled in the relevant field would understand them. However, I have provided constructions for several terms based on the language in the specification of the '440 patent.

33. A “**shutdown section**” should be construed as any portion of a secondary drive train which can be decoupled from both the primary axle and the wheels of the secondary axle.

34. A person of ordinary skill in the art would have reached this conclusion in light of the disclosure at Ex. 1001 at 6:34-56 which states:

FIG. 3 shows a drive train with permanently driven primary  
35 axle 1 and connectable secondary axle 2, the section of the  
secondary drive train of which located between side shaft  
couplings 4 and switch-on device 3 is inoperative. In contrast  
to the axle drive units 9 of FIG. 1 and FIG. 2 the axle drive unit  
9 of FIG. 3 is designed without differential. Here two fric-  
40 tionally engaged working side shaft couplings 4 transmit the  
secondary drive output to the side shafts 12 of the secondary  
axle 2. The drive torque and slippage to be transferred are  
freely adjusted by these freely adjustable side shaft couplings  
4, such that with this axle drive functions of longitudinal  
45 differential and of active-yaw differential can be shown in  
addition to the functions of transverse differential. When  
compared to the axle drive units 9 of FIGS. 1 and 2 the axle  
drive unit 9 in FIG. 3 is designed substantially less complex  
and clearly lighter in the structural sense. To shut down the  
50 secondary drive train the side shaft couplings 4 are opened  
and the secondary drive train is uncoupled from the perma-  
nently driven part of the drive train via the switch-on device 3.  
Taken by itself, neither the side shaft couplings 4 nor the  
switch-on device 3 could execute the fundamental inventive  
55 idea; with respect to the invention rather they cooperate syn-  
ergistically.

35. Consistent with the '440 specification, *see also* the discussion in the  
February 27, 2012 response (Ex. 1007 at 11) to the September 1, 2011 Office  
Action (Ex. 1006) that a central shaft which does not rotate or move in two wheel  
drive mode can constitute a shut-down section.



In this publication, the front and rear axles rotate. The shutdown section is the central shaft that connects the front and rear axles between the switch-on device and the side shaft couplings. In two wheel drive mode, only the wheels on the primary axle is provided with power to propel the vehicle forward. The shutdown section does not rotate or move. It does not impose a load on the system. No extra power or braking force is required to accelerate or decelerate the shutdown section during driving. The rear wheels are rolling on the ground and any components attached to the rear wheels are also still rotating up to the side shaft coupling. In four wheel drive mode, the shutdown section is not shut down but is rotating. Power is delivered to all four wheels through the central shaft.

36. A “**switch-on device**” should be construed as a structure designed to couple/decouple the shutdown section.

37. A person of ordinary skill in the art would have reached this conclusion in light of the disclosure at Ex. 1001, 10: 5-10 which states:



5     As mentioned, the invention is described within the scope  
of a drive train concept, wherein switching off the all-wheel  
drive is done at the rear axle via both couplings. The drive  
train to the rear axle gearbox is uncoupled at the PTU (power  
take off unit) via a switch-on device 3 which preferably has  
10 synchronizing 16.

38.     A “**switch-on mechanism**” should be construed as a point (*e.g.*, a clutch) of the switch-on device between the primary drive train and the secondary drive train which can couple/decouple the shutdown section.

39.     A person of ordinary skill in the art would have reached this conclusion in light of the disclosure at, among other places, Ex. 1001 at 7:14-16 which states “The coupling point between permanently driven primary drive train and connectable secondary drive train is therefore the synchronizing 16.” It was well known during the pertinent time frame that a dog clutch, for example, could be used as a synchronizing mechanism to engage and disengage two rotatable structures.

## **VII. Discussion of Relevant Prior Art**

40.     I have been asked to consider the teachings of the prior art cited in the accompanying petition in view of the knowledge held by one of ordinary skill, and whether the skilled practitioner would have combined the references as applied in the petition.

41.     It is my opinion that the drive train in claims 1-7 are nothing more

than the combination of familiar elements according to known methods, each performing the same function it had been known to perform, yielding predictable results.

42. Discussed in detail below, Claims 1, 4, and 5 of the ‘440 patent are at least anticipated by Japanese Patent Application Publication No. 2002-370557 to Teraoka et. al “Teraoka” (Ex. 1002) under 35 U.S.C. § 102(b). Claims 2 and 3 of the ‘440 patent are at least rendered obvious by Teraoka (Ex. 1002) in view of Japanese Patent Application Publication No. H02-57725 to Watanabe et. al. “Watanabe” (Ex. 1003) under 35 U.S.C. § 103. Claims 6 and 7 of the ‘440 patent are at least rendered obvious by Teraoka (Ex. 1002) in view of Great Britain Patent No. 2407804 to Burrows et. al. “Burrows” (Ex. 1004) under 35 U.S.C. § 103.

**A. Claims 1, 4, and 5 are Unpatentable under 35 U.S.C. § 102(b) As Anticipated by Teraoka**

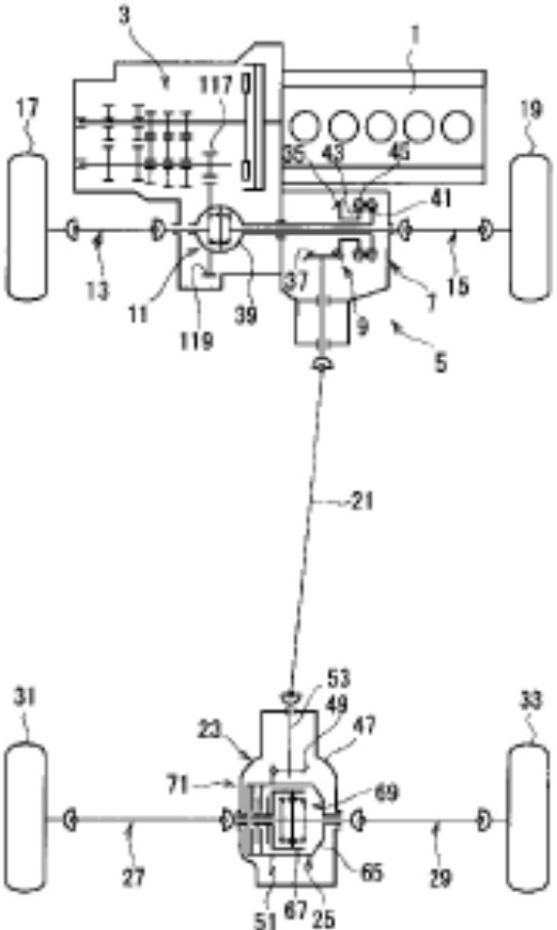
43. Each and every element of claims 1, 4, and 5 is found in the disclosure of Teraoka, including the allegedly novel feature of having a shutdown section (*i.e.*, any portion of a secondary drive train which can be decoupled from both the primary axle and the wheels of the secondary axle) that does not rotate or move when the vehicle is in two-wheel drive mode. (*See, e.g.*, 1002 at ¶¶ [0074]-[0080].) Teraoka specifically states that the rotation “due to drag rotation of the rear wheels 31, 33 is disconnected” and “in this way, the rotation of the power transmission system from the two-four switching mechanism 7 to the outer plates

121, 123 of the clutch mechanism 71 stops ...” (*Id.* at [0077] and [0078].) In other words, Teraoka discloses a drive train system including a portion that allows the secondary drive train to be decoupled from the rest of the system so that a portion of the secondary drive train (at least from the front axle switching mechanism 7 to the rear axle clutch mechanism 71) does not rotate or move when the vehicle is in two-wheel mode – precisely the allegedly novel feature of the ‘440 patent.

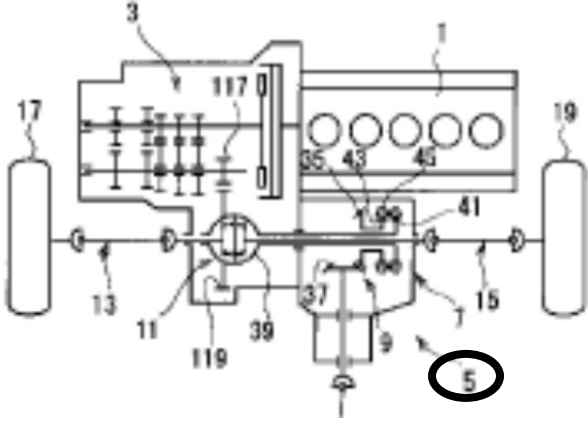
44. The following claim chart demonstrates how Teraoka anticipates the subject matter of claims 1, 4, and 5:

The ‘440 Patent	Teraoka (Ex. 1002)
<b>1.a.</b> A drive train of a vehicle, comprising a primary drive train and a secondary drive train, further comprising:	Teraoka discloses at Fig 1 a four wheel drive (“4WD”) vehicle including a primary front drive train including: engine 1, transmission 3, differential 11, axles 13 and 15 and a secondary rear drive train including: final gear set 23, differential 25, and axles 27 and 29. (Ex. 1002, [0040].)
<b>1.b.</b> a primary axle which is permanently driven via the primary drive train; and	Teraoka discloses a primary axle 13 (and 15) from which driving force of engine 1 is non-selectively transmitted through the transmission 3 and front differential 11. (Ex. 1002, [0073].)
<b>1.c.</b> a secondary axle as part of the secondary drive train;	Teraoka discloses a secondary axle 27 (and 29) which are part of the secondary rear drive train. (Ex. 1002, [0040], [0074], and [0075], Fig. 1.)
<b>1.d.</b> wherein the secondary axle is connectable to the primary axle via a switch-on mechanism of a switch-on	Teraoka discloses a transfer case 5 ( <i>i.e.</i> , a switch-on device) which includes a dog clutch (or 2-4 switching mechanism) 7

The '440 Patent	Teraoka (Ex. 1002)
<p>device in order to allow the integration of the secondary drive train into the drive train so that the overall drive train power is transferred over both the primary axle and the secondary axle, and</p>	<p>(<i>i.e.</i>, a switch-on mechanism). (Ex. 1002, [0071] and Fig. 1).</p> <p>When the 2-4 switching mechanism 7 is engaged, “and the driving force of the engine 1 is transmitted through differential case 39, transfer case 5 (two-four switching mechanism 7 and direction changing gear set 9) and propeller shaft 21 to final speed reduction gear set 23 and is subjected to speed reduction, after which it is transmitted via clutch mechanism 71 to rear differential 25 and is further distributed through pinion shaft 77 and pinion gear 79 to side gears 81, 83 and is transmitted via rear axles 27, 29 to left and right rear wheels 31, 33.” (Ex. 1002, [0074].) Therefore, in the 4WD mode, both the front axles 13/15 and rear axles 27/29 are driven.</p>
<p><b>1.e.1</b> wherein when the secondary axle is connected to the primary axle, the secondary drive train power is conveyed via at least one side shaft couplings into side shafts of the secondary axle and is transmitted to wheels of the secondary axle and is transmitted to wheels of the secondary axle</p>	<p>Teraoka discloses a clutch mechanism 71 (<i>i.e.</i>, at least one side shaft coupling) integral with the rear gear set 23. (Ex. 1002, Figs. 1 (reproduced below) and 2.)</p>

The '440 Patent	Teraoka (Ex. 1002)
	<p style="text-align: center;"><b>[FIG. 1]</b></p>  <p>Teraoka states “[w]hen the clutch mechanism 71 is coupled in this manner, the driving force of the engine 1 is transmitted from outer case 65 to inner case 67 (differential mechanism 69) and is distributed through pinion shaft 77, pinion gear 79 and side gears 81, 83 to left and right rear wheels 31, 33” (Ex. 1002, [0066].)</p>
<p><b>1.e.2</b> the secondary drive train having a shutdown section located between the switch-on device and the at least one side shaft coupling, whereby:</p>	<p>Fig. 1 of Teraoka illustrates that intermediary propeller shaft 21 and final gear 23 (<i>i.e.</i>, a shutdown section) are between clutch mechanism 71 (<i>i.e.</i>, the at least one side shaft coupling) and the transfer case 5 (<i>i.e.</i>, the switch-on device).</p>

The '440 Patent	Teraoka (Ex. 1002)
	<p>(See also Ex. 1002 [0076]-[0078].)</p> <p>Teraoka states: “due to uncoupling of the two-four switching mechanism 7, rotation of the power transmission system (especially the large mass propeller shaft 21) stops from the two-four switching mechanism 7 to outer case 65, which is the input side member of the clutch mechanism 71, and to the outer plates 121, 123 of the main clutch 89 and pilot clutch 97.” (Ex. 1002 at [0076].)</p>
<p><b>1.f.</b> the switch-on mechanism and/or the side shaft couplings comprise at least one frictionally engaged coupling and</p>	<p>Teraoka illustrates in Fig. 2 that the clutch mechanism 71 (<i>i.e.</i>, the at least one side shaft coupling) includes frictionally engaged wet multiple disc main clutch 89. (See also Ex. 1002, [0055].)</p>
<p><b>1.g.</b> when the secondary axle is disconnected from the primary axle in order to transfer the overall drive train power via the primary axle only, the shutdown section of the secondary drive train is decoupled from both the primary axle of the primary drive train and the wheels of the secondary axle.</p>	<p>Teraoka discloses that the clutch mechanism 71 and the two-four switching mechanism 7 of transfer case 5 (<i>i.e.</i>, the switch-on device) are each disengaged for the two wheel drive (“2WD”) mode where only front axles 13/15 are driven. (Ex. 1002, [0075].)</p> <p>In this 2WD mode, the intermediary propeller shaft 21 and the final gear 23 (<i>i.e.</i>, the shutdown section) are stopped (<i>i.e.</i> shut down). (Ex. 1002, [0076].)</p>
<p><b>4.</b> The drive train as claimed in claim 1, wherein the switch-on device comprises a positively working power transmission gearing having an angular gear working via cogged wheels.</p>	<p>Teraoka discloses that the transfer case 5 (<i>i.e.</i>, the switch-on device) includes two-four switching mechanism 7 in the form of a dog clutch and direction changing (<i>i.e.</i>, angled) gear set 9. (Ex. 1002, [0040].)</p>

The '440 Patent	Teraoka (Ex. 1002)
	<p>The dog clutch 7 is positively engaging and the changing gear 9 is angled to change the direction to the rear axles. (Ex. 1002, Fig. 1.)</p> <p>Teraoka states “[t]he transmitted driving force of the engine is converted in direction by the direction changing gear set 9 and transmitted toward the rear wheels.” (Ex. 1002, [0041].)</p>
<p>5. The drive train as claimed in claim 4, wherein the switch-on device is arranged on the primary axle and the secondary drive train output is, when the secondary drive train is connected to the primary axle, engaged to the primary drive train by the switch-on mechanism.</p>	<p>Figure 1 of Teraoka illustrates the transfer case 5 (<i>i.e.</i>, the switch-on device) being arranged on the primary front axles 13/15:</p> <p style="text-align: center;"><b>[FIG. 1]</b></p>  <p>The transfer case 5 connects the rear axles 27/29 to the front axles 13/15 when the switching mechanism 7 of transfer case 5 is engaged.</p>

**B. Claims 2 and 3 are Unpatentable Under 35 U.S.C. § 103 As  
Rendered Obvious by Teraoka in View of Watanabe**

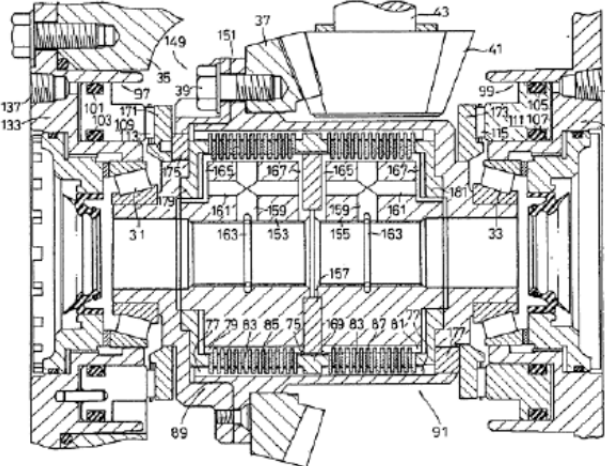
45. Teraoka does not disclose side shaft couplings for each side shaft of the secondary axle. However, it would have been obvious to replace the clutch 71 and differential 25 of Teraoka with a side-shaft coupling on each side of the secondary axle without differential gearing in between, as doing so would achieve the well-known goals of eliminating the bevel gear differential, therefore reducing the weight and fuel consumption of the vehicle. As described above, independent Claim 1 of the '440 patent merely requires a four wheel drive system that includes at least one side shaft coupling. Claims 2 and 3 merely recite a combination of well-known alternative components that are joined in a conventional manner.

46. It would have been a matter of simple substitution to replace the rear, secondary drive train with the rear, secondary drive train of Watanabe to yield the predictable result of reducing mass and rotating losses.

47. The following claim chart illustrates how the combined teachings of Teraoka and Watanabe meet all of the elements of claims 2 and 3 of the '440 patent.

<b>The '440 Patent</b>	<b>Teraoka (Ex. 1002) and Watanabe (Ex. 1003)</b>
<b>2.</b> The drive train as claimed in claim 1, having a side shaft coupling for each side shaft of the secondary axle and wherein when the secondary axle is connected to the primary axle, the	Figure 2 of Watanabe illustrates a rear differential 11 that distributes drive force differentially to a right rear wheel 27 and a left rear wheel 25 via rear axles 23 and 21, respectively. (Ex. 1003 at Fig. 2.)



The '440 Patent	Teraoka (Ex. 1002) and Watanabe (Ex. 1003)
<p>side shaft couplings allow a driving power distribution without a differential gearing between the drive wheels of the secondary axle to ensure transverse compensation.</p>	<p>Figure 3 of Watanabe illustrates the differential 11 includes multiple plate clutches 89 and 91, as side shaft couplings, on each side of the differential 11, each connected to axle 23 and 21, respectively. (Ex. 1003 at Fig. 3.)</p> <p>As seen in Figure 3 below, the multiple plate clutches 89 and 91 allow power distribution without differential gearing between the drive wheels. (Ex. 1003 at Fig. 3.)</p>  <p>FIG 3</p> <p>Further, Watanabe states, “And by increasing or decreasing the tightening force individually for the multiple plate clutches 89 and 91, the distribution ratio of the drive power between the right and left rear wheels 25 and 27 can be adjusted and the differential rotation can be controlled.” (Ex. 1003, p.147, lines 37-40.)</p> <p>Therefore, Watanabe discloses transverse compensation by the clutches 89 and 91.</p>

The '440 Patent	Teraoka (Ex. 1002) and Watanabe (Ex. 1003)
<p>3. The drive train as claimed in claim 1, having a side shaft coupling for each side shaft of the secondary axle and wherein when the secondary axle is connected to the primary axle, the side shaft couplings allow a drive power distribution without differential gearing between the primary axle and the secondary axle, to ensure longitudinal compensation.</p>	<p>Figure 2 of Watanabe illustrates a rear differential 11 that distributes drive force differentially to a right rear wheel 27 and a left rear wheel 25 via rear axles 23 and 21, respectively. (Ex. 1003 at Fig. 2.)</p> <p>Figure 3 of Watanabe illustrates the differential 11 includes multiple disc clutches 89 and 91, as side shaft couplings, on each side of the differential 11, each connected to axle 23 and 21, respectively. As seen in Figure 3 above, the clutches 89 and 91 allow power distribution without differential gearing between the drive wheels. (Ex. 1003 at Fig. 3.)</p> <p>Further, Watanabe states "... during cornering there is a stronger cornering force effect from the rear wheels 25 and 27, creating a tendency to under-steer. If the drive power distribution to the rear wheels 25 and 27 is increased to reduce the cornering force thereof, the under-steering typical of such vehicles can be corrected. (Ex. 1003, p. 148, lines 22-27.)</p> <p>Therefore, Watanabe discloses longitudinal compensation by the clutches 89 and 91.</p>

**C. Claims 6 and 7 are Unpatentable Under 35 U.S.C. § 103 As Rendered Obvious by Teraoka in View of Burrows**

48. Teraoka discloses a switch-on mechanism including a dog clutch 7 which provides a mechanical engagement and a clutch 71 (a wet multiple disc clutch) which provides friction engagement and possibly provides speed synchronization. The '440 patent itself explicitly states that frictionally engaged clutch could be substituted for the synchronizing 17 in the switch-on mechanism. (Ex. 1002, 7:36-41.) However, Teraoka does not expressly claim that speed synchronization is provided.

49. However, it would have been obvious to provide rear axle speed synchronization in light of the structure disclosed by Teraoka. It was well known in the art that positively connected gearing (*e.g.* a dog clutch) requires speed synchronization of the input and output sides to reduce wear and prevent failure. One such way to provide speed synchronization is by use of a friction clutch which allows a speed transition by slipping the clutch.

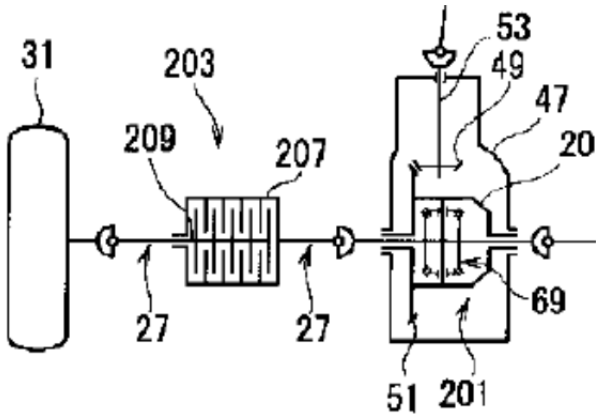
50. Burrows discloses an example of this principle in which a multi-plate wet clutch is connected remotely via a drive shaft, and is used to speed synchronize a dog clutch. Similarly, Teraoka discloses how the “clutch mechanism 71, constructed using pilot clutch 97 and main clutch 89, which is a wet multi-plate clutch, does not require a synchronizer mechanism and eliminates the need to

allow for the volume of the synchronizer mechanism,” (Ex. 1002, [0091]), as the multi-plate clutch provides the synchronization.

51. It would have been obvious to one of ordinary skill in the art to synchronize the switching mechanism 7 of Teraoka using the clutch mechanism 71 connected by propeller shaft 21, as taught by Burrows, to perform synchronization without the use of additional equipment.

52. The following claim chart illustrates how the combined teachings of Teraoka and Burrows meet all of the elements of claims 6 and 7 of the ‘440 patent.

<b>The ‘440 Patent</b>	<b>Teraoka (Ex. 1002) and Burrows (Ex. 1004)</b>
<p><b>6.</b> The drive train as claimed in claim 5, wherein a speed synchronization in the switch-on mechanism of the power transmission gearbox for the establishment of a positive lock is supported by the at least one side shaft couplings.</p>	<p>Burrows discloses a multi-plate wet clutch 22 connected to a longitudinally extending main drive shaft 23 through a transmission assembly 24. (Ex. 1004, p. 4, lines 21-24.)</p> <p>The main drive shaft 23 transmits torque to a free running differential 40 which includes a dog clutch. (Ex. 1004, p. 7, line 21 – p. 8, line 5.) Burrows discloses, “[a] control strategy for operation of a dog clutch for a dynamic change in two wheel drive mode causes the clutch 22 to spin-up the auxiliary driveline 21 to the best estimated synchronisation [sic] speed for connection to the rear wheels 14, 15. The clutch 22 would then 10 disengage quickly whilst simultaneously the synchroniser [sic] device would smoothly engage</p>

The '440 Patent	Teraoka (Ex. 1002) and Burrows (Ex. 1004)
	the dog clutch.” (Ex. 1004, p. 8, lines 7-11.)
<p>7. The drive train as claimed in claim 6, wherein the at least one side shaft couplings is formed by a frictionally engaged multiple disc clutch, whereby the friction plates connected in a torque-proof way to the secondary drive wheels cooperate as inner plates with an inner plate carrier and whereby the friction plates located on the drive train-side of the vehicle cooperate with an outer plate carrier as outer plates.</p>	<p>Teraoka discloses a second embodiment in Fig. 3 which includes the clutch mechanism 203 with wet multiple disc main clutch 89 disposed between the rotating case 207 and the inner shaft 209. (Ex. 1002, [0102]).</p> <p>The main clutch 89 includes inner plates connected in a torque-proof way to the inner shaft 209 which is connected to the wheel 31 by left axle 27. (Ex. 1002, [0106], portion of Fig. 3, below.)</p>  <p>The clutch 89 also includes outer plates connected in a torque proof way to the case 207 which is connected to differential mechanism 201. (Ex. 1002, [0112].)</p> <p>Although paragraphs [0106] and [0112] do not explicitly describe the relation between the clutch plates and the inner shaft of the case, Teraoka explains that the outer case and the outer plates cooperate with each</p>

The '440 Patent	Teraoka (Ex. 1002) and Burrows (Ex. 1004)
	other, and that the inner case and inner plates cooperate with each other. (Ex. 1002, [0076]-[0077]; <i>see also</i> Fig. 3.)

#### **VIII. Availability for Cross-Examination**

53. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross examination in the case and that cross examination will take place within the United States. If cross examination is required of me, I will appear for cross examination within the United States during the time allotted for cross examination.

#### **IX. Right to Supplement**

54. I reserve the right to supplement my observations in the future to respond to any arguments that the patent owner raises and to take into account new information as it becomes available to me.

**X. Jurat**

55. I, Steven J. Becker, declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

56. I declare under penalty of perjury that the foregoing is true and correct.

Executed on October 12, 2015



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Steven J. Becker

## APPENDIX A

### **Robson Forensic**

Engineers, Architects, Scientists & Fire Investigators

STEVEN J. BECKER

#### PROFESSIONAL EXPERIENCE

2009 to present     **Robson Forensic, Inc.**  
*Associate*

- Provide technical investigations, analysis, reports and testimony towards the resolution of commercial and personal injury litigation involving vehicle collisions, pedestrians, vehicle design issues, acoustics, mechanical defects and malfunctions, and vehicle repair issues for: ATVs, UTVs (side by side ATVs), golf carts, bicycles, motorcycles, passenger cars, SUVs, light trucks and tractor trailers.
- Experienced case work on over 250 investigations and testimony involving: scene diagramming, evidence collection, gunshot acoustics, environmental acoustics, sirens and backup alarms, manufacturing and test machine design, pedestrian knockdown, bicycle collisions, low speed collisions, occupant dynamics and restraint, black box (CDR, EDR, ACM, PCM) download and data analysis, automotive design/engineering and defective repair for: oil changes, lighting systems, engines, transmissions, brake systems, steering and suspension systems, axle systems, driveshafts and universal joints, throttle systems, vehicle structure, bumpers, vehicle dynamics and collision simulations.
- Digital imagery and video analysis in determining distances and imagery content. Imagery enhancement and photogrammetric measurement.

2009 to present     **Fournier, Robson & Associates, LLC**  
*Associate*

- Provide acoustic and vibration monitoring and problem diagnosis involving building acoustics, environmental noise, and machine vibrations.
- Test, data analysis, and instrumentation including: accelerometers, microphones, strain gauges, torque cell, speedometers, thermocouples, position sensors, etc.
- Vehicle engineering and test development consulting.
- Computer aided design (CAD), Animation and Simulation.

1997 to 2009     **Magna Powertrain – New Process Gear Division**  
*Engineering Test Services Manager* 1999-2009

- An active project engineer and manager for three worldwide manufacturing and two engineering sites' noise and vibration activities; project approval, purchasing, timing, and methodology.
- Managed and trained engineers and mechanics in product development, vehicle and component testing, data analysis, control module testing and data analysis.
- Product design and development engineering for gears, sprockets, chains, shift actuators, control modules, transmissions, 4WD and AWD transfercases, PTUs, and axles.
- Negotiation of customer product specifications relating to noise and durability



# Robson Forensic

Engineers, Architects, Scientists & Fire Investigators

## STEVEN J. BECKER

with Audi, BMW, Chrysler, Ford, GM, Honda, Land Rover, Nissan, Porsche, Toyota, and Volkswagen.

- Test vehicle fleet management of use, repair, and inspection.
- Design of the machine, driveshafts and joints, test enclosure, quality and test plan for product end of line test.
- Developed the capability for electrodynamic shaker durability testing, HALT.
- Performed vehicle dynamics testing and durability development for traction control systems.
- Developed and taught a course on Design for Test Engineering for powertrain products.
- Used problem solving techniques; Six Sigma, Shainin, Taguchi, Root Cause.

### *Quality Engineer*

1997-1999

- Implemented the quality process for assembly line First Time Capability improvement, and defect repair.
- Provided for the safety of the end of line operators on powertrain test machines.
- Designed methods of noise and imagery analysis for production inspection and repair of manual transaxles, gears sets, power take-off units, and transfer cases.
- Performed process audits and verification of all design changes throughout production that affect noise (FMEA, APQP).
- Designed test apparatus including; motors, controls, shafting, and fixtures.

1994 to  
1997

### **Chrysler Corporation**

#### *Sci Lab Engineer from Modern Engineering*

- Product instrumentation, testing, and data analysis for Chrysler vehicles including; sound package design, design and development of engine mount systems, induction resonators, control modules, vibration dampers, and various structural components.
- Design, performance, and crash testing for the stiffness of structural components and joints of the vehicle body, including bumpers and the unibody.
- Powertrain and drivetrain noise and vibration specialist.
- Design and testing for Viper, Sebring, Neon, PT cruiser, Grand Cherokee, and Minivan.
- Coordinated shift assignments for engineers, mechanics and technicians.

1993 to  
1994

### **New Venture Gear**

#### *Product Engineer from CDI Corporation*

- Designed geared systems for automotive transmissions.
- Established a method of experimentation with accelerometers and microphones and computer simulation.
- Performed acoustic and vibration instrumentation, testing, and analysis of gears, bearings, and shift actuators.

# Robson Forensic

Engineers, Architects, Scientists & Fire Investigators

## STEVEN J. BECKER

1989 to Alliant Computer

1991 *Computer Network Engineer*

- Local Area Network design
- Performed trouble shooting between mini-super computers, terminals, workstations and various PCs with Ethernet and RS232 communications. Re-routing of physical cabling and development of a digital graphics network.
- Back-ups and shell scripts for a Mini-Super computer manufacturer.

## PROFESSIONAL CREDENTIALS

Certified Inspection Mechanic, Class 1 (passenger car / light truck): Commonwealth of Pennsylvania

## EDUCATION

M.B.A. Syracuse University, Syracuse, NY, 2007

B. S., Mechanical Engineering (with Aerospace), Worcester Polytechnic Institute, Worcester, MA, 1992

### *Continuing Education:*

Traffic Crash Reconstruction - 2, Northwestern University Center for Public Safety, 2015

Timken Tech Series on Bearings - Certificate 2015

Siemens: Durability and Fatigue, Fundamentals of Sound, Driving Dynamics, 2014

Photomodeler Photogrammetry, 2014

CDR Data Analyst Certification, 2013

PC-Crash Software Crash Simulation and Animation Skills, 2011, 2013, 2014

Traffic Crash Reconstruction 1&2, Northwest University Center for Public Safety, 2010

Leika Total Station, Digital Laser Survey Techniques, 2010 & 2012

Polytec Non-contact Laser Doppler Vibrometry, 2008

Bruel & Kjaer Operational Deflection Shapes Analysis, 2006

Six Sigma Yellow Belt training, 2006

OSHA Compliance, 2003

LMS Modal Testing, 2003

Labview Systems Engineering, 2002

Shainin Red X Apprentice training, 2001

New Venture Gear Off-Road Driving Techniques, 1999

Small Engine Maintenance and Repair, 1999

Emergency Responder and Hazardous Substances, 1997

Chrysler Performance Driving Techniques, 1996

Dale Carnegie-Effective Communication & Human Relations, 1996

# Robson Forensic

Engineers, Architects, Scientists & Fire Investigators

## STEVEN J. BECKER

Gear Dynamics and Gear Noise, and LDP analysis, Ohio State University, 1994  
Applications in Parallel Axis Gear Design, Drive Systems Technology, 1993

### PROFESSIONAL MEMBERSHIPS

Society of Automotive Engineers (SAE)  
Pedestrian and Bicycle Information Center  
American Whitewater  
Audio Engineering Society

### PUBLICATIONS

Parking Brake Use Study, SAE, 2013-01-0199  
Tire Friction Comparison of Three Tire Types, SAE, 2013-01-0783  
The NP244 Transference Chain Noise Reduction Using a Gemini HyVo Chain System, SAE, 2005-01-2298  
1<sup>st</sup> Order Boom Noise Relationship to Driveline Imbalance, SAE, 2005-01-2299  
Measurement of Transference Imbalance, SAE, 2005-01-2297  
Gear Noise Rating Prediction Based on Objective Measurements, SAE, 1999-01-1721  
Objective Rating of Gear Whine, SAE, 1999-01-1720

### OTHER

Boy Scout and Cub Scout Den Leader, 2011-present  
Mountaineering and technical rock climber, 1990-present  
Twisted Axles 4WD Club, Founding member, 1999-2004  
WPI Computer lab monitor/instructor, 1988-1992  
Soccer and Track coach – various  
Whitewater Kayaking  
Kayaker, 1993-present  
Instructor - teaching river safety, Eskimo roll, self-rescue, and swift water rescue, 1998-present  
River rafting guide, Whitewater Challengers, 2015-present

## **APPENDIX B**

### List of Information Considered

- 1001 U.S. Patent No. 8,215,440
  - 1002 Certified English translation of Japanese Patent Application  
Publication No. 2002-370557 and original document
  - 1003 Certified English translation of Japanese Patent Application  
Publication No. H02-57725 and original document
  - 1004 Great Britain Patent No. 2407804
- Prosecution history of U.S. Patent No. 8,215,440 (including Ex. 1006 and 1007)