

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VOLKSWAGEN GROUP OF AMERICA, INC.
Petitioner

v.

MICHIGAN MOTOR TECHNOLOGIES LLC
Patent Owner

Case IPR2020-00446
Patent No. 6,763,804

**DECLARATION OF GERALD J. MICKLOW, PH.D., PE, IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 6,763,804**

Mail Stop PATENT BOARD
Patent Trial and Appeal Board
U.S. Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

VW EX1003
U.S. Patent No. 6,763,804

TABLE OF CONTENTS

I.	Introduction.....	1
II.	Grounds of Unpatentability	2
III.	Qualifications.....	3
IV.	Materials Considered	7
V.	Legal Standards	9
	A. My Understanding of Claim Construction.....	9
	B. My Understanding of a Person of Ordinary Skill in the Art.....	10
	C. My Understanding of Obviousness.....	11
VI.	The '804 Patent.....	15
	A. To prevent a throttle valve motor from overheating, the system reduces the control effort to the motor when the control effort exceeds a threshold for a predetermined time period.	15
	B. Prosecution History of the '804 Patent	20
	C. Level of Ordinary Skill in the Art	22
	D. Claim Construction.....	24
VII.	Overview of the Technology	25
VIII.	Summary of the Applied References.....	36
	A. Itabashi discloses a throttle control system that limits the current to the motor when the current exceeds a threshold for a predetermined time period.	37
	B. Matsumoto discloses a control system that detects when the throttle valve is stuck, such as in a fully open or closed position.....	45
	C. Burney discloses a circuit to limit the control effort when the throttle motor stalls, including when the throttle is stuck.....	54
	D. Ritenour discloses a servomotor control system that reduces current when current exceeds a threshold for a time period.	61
	E. The GM Manual and the Chrysler Manual are reference manuals that show that a car battery typically supplies up to 14.5 volts.	62
	F. Ohta discloses a graph showing the relationship between throttle position, current, and time.....	63

IX.	Ground 1: Itabashi Renders Obvious Claims 1, 4, 7, 8, 11, 14, 15, and 18....	64
A.	Claim 1	64
1.	[1.P] “A method for controlling a positioning device of an internal combustion engine”	64
2.	[1.A] “providing an electric motor for actuating the positioning device”	65
3.	[1.B] “commanding the positioning device to change to a commanded position”	65
4.	[1.C] “detecting a control effort required to change to said commanded position”	67
5.	[1.D] “determining whether said control effort exceeds a threshold for a predetermined time period”	70
6.	[1.E] “reducing said control effort when said control effort exceeds said threshold for said predetermined time period”	74
7.	[1.F] “wherein commanding the positioning device to change to said commanded position comprises at least one of commanding the positioning device to open to a hold open mode and commanding the positioning device to dose [sic] to a hold close mode”	76
B.	Claim 4	80
C.	Claim 7	82
D.	Claim 8	82
E.	Claim 11	84
1.	[11.P] “A system for controlling a positioning device of an internal combustion engine to prevent overheat conditions”	84
2.	[11.A] “an electric motor for actuating the positioning device with a control effort”	84
3.	[11.B] “a control effort detector coupled to said electric motor and intended to detect said control effort”	85
4.	[11.C] “a controller coupled to said electric motor and said control effort detector, said controller including control logic operative to command the positioning device to change to a commanded position, detect a control effort required to change to said commanded position, determine	

	whether said control effort exceeds a threshold for a predetermined time period, and reduce said control effort when said control effort exceeds said threshold for said predetermined time period”	87
5.	[11.D] “wherein said controller further includes control logic operative to command the positioning device to close to said commanded position in a hold close mode”	89
F.	Claim 14	90
G.	Claim 15	90
H.	Claim 18	91
X.	Ground 2: Itabashi in View of the GM Manual and the Chrysler Manual Renders Obvious Claims 2, 5, 9, 12, 16, and 19.	91
A.	Claims 5, 9, 16, and 19.....	91
B.	Claims 2 and 12.....	95
XI.	Ground 3: Itabashi in View of Ohta Renders Obvious Claims 3, 6, 10, 13, 17, and 20.....	96
A.	Claims 3 and 13.....	96
B.	Claims 6, 10, 17, 20.....	99
XII.	Ground 4: Matsumoto in View of Burney and Ritenour Renders Obvious Claims 1, 4, 7, 8, 11, 14, 15, and 18.	101
A.	A POSA would have been motivated to combine Matsumoto, Burney, and Ritenour.	101
B.	Claim 1	107
1.	[1.P] “A method for controlling a positioning device of an internal combustion engine”	107
2.	[1.A] “providing an electric motor for actuating the positioning device”	107
3.	[1.B] “commanding the positioning device to change to a commanded position”	108
4.	[1.C] “detecting a control effort required to change to said commanded position”	112
5.	[1.D] “determining whether said control effort exceeds a threshold for a predetermined time period”	115

6.	[1.E] “reducing said control effort when said control effort exceeds said threshold for said predetermined time period”	121
7.	[1.F] “wherein commanding the positioning device to change to said commanded position comprises at least one of commanding the positioning device to open to a hold open mode and commanding the positioning device to dose [sic] to a hold close mode”	124
C.	Claim 4	126
D.	Claim 7	127
E.	Claim 8	128
F.	Claim 11	130
1.	[11.P] “A system for controlling a positioning device of an internal combustion engine to prevent overheat conditions”	130
2.	[11.A] “an electric motor for actuating the positioning device with a control effort”	131
3.	[11.B] “a control effort detector coupled to said electric motor and intended to detect said control effort”	131
4.	[11.C] “a controller coupled to said electric motor and said control effort detector, said controller including control logic operative to command the positioning device to change to a commanded position, detect a control effort required to change to said commanded position, determine whether said control effort exceeds a threshold for a predetermined time period, and reduce said control effort when said control effort exceeds said threshold for said predetermined time period”	132
5.	[11.D] “wherein said controller further includes control logic operative to command the positioning device to close to said commanded position in a hold close mode”	134
G.	Claim 14	136
H.	Claim 15	136
I.	Claim 18	136
XIII.	Ground 5: Matsumoto in View of Burney and Ritenour, Further in View of the GM Manual and the Chrysler Manual Renders Obvious Claims 2, 5, 9, 12, 16, and 19.....	137

A.	Claims 5, 9, 16, and 19.....	137
B.	Claims 2 and 12.....	141
XIV.	Ground 6: Matsumoto in View of Burney and Ritenour, Further in View of Ohta Renders Obvious Claims 3, 6, 10, 13, 17, and 20.	142
A.	Claims 3 and 13.....	142
B.	Claims 6, 10, 17, and 20.....	145
C.	Claims 3 and 13.....	150
D.	Claims 6 and 17.....	151
E.	Claims 10 and 20.....	152
XV.	Objective Indicia Do Not Support Patentability.....	152
XVI.	Conclusion	154

I. INTRODUCTION

I, Gerald J. Micklow, Ph.D., PE, declare as follows:

1. I have been retained on behalf of Volkswagen Group of America, Inc. (“VWGoA”) for the above-captioned *inter partes* review proceeding to provide my expert opinions and expert knowledge. I understand that this proceeding involves U.S. Patent No. 6,763,804 (“the ’804 patent”), which is titled “Electronic Throttle Servo Overheat Protection System” and currently assigned to Michigan Motor Technologies LLC (“MMT”). I understand that the petition submitted by VWGoA challenges claims 1-20 of the ’804 patent.

2. The ’804 patent describes a conventional throttle control system that reduces the control effort (e.g., voltage, current, duty cycle) to an electric motor when the control effort exceeds a threshold for a predetermined time period. I am familiar with the technology in the ’804 patent as of October 9, 2001—the filing date of the ’804 patent.

3. I have been asked to provide my independent technical review, analysis, insights, and opinions regarding the ’804 patent and the references that form the basis for the grounds of unpatentability for claims 1-20 of the ’804 patent.

4. I have reviewed and am familiar with the ’804 patent and its file history. I have also reviewed and am familiar with the documents I cite in this declaration. I understand that these documents have been provided as exhibits to the

inter partes review petition. I confirm that to the best of my knowledge the accompanying exhibits are true and accurate copies of what they purport to be and that an expert in the field would reasonably rely on them to formulate opinions such as those set forth in this declaration.

5. I am being compensated at my customary rate of \$450 per hour for my work on this case. My compensation is not dependent upon my opinions, my testimony, or the outcome of this case.

II. GROUNDS OF UNPATENTABILITY

6. In forming my opinions about the '804 patent, I have considered the following grounds of unpatentability. Based on my careful review of the references that form the basis of the grounds, it is my opinion that claims 1-20 of the '804 patent would have been obvious to a person of ordinary skill in the art as of the filing date of the '804 patent.

Ground	References	Basis	Claims
1	Itabashi	§103	1, 4, 7, 8, 11, 14, 15, 18
2	Itabashi and the GM Manual, and the Chrysler Manual	§103	2, 5, 9, 12, 16, 19
3	Itabashi and Ohta	§103	3, 6, 10, 13, 17, 20
4	Matsumoto, Burney, and Ritenour	§103	1, 4, 7, 8, 11, 14, 15, 18
5	Matsumoto, Burney, Ritenour, the GM Manual, and the	§103	2, 5, 9, 12, 16, 19

	Chrysler Manual		
6	Matsumoto, Burney, Ritenour, and Ohta	§103	3, 6, 10, 13, 17, 20

III. QUALIFICATIONS

7. In forming the opinions in this declaration, I have considered and relied on my education, background, and experience. My experience and education are detailed in my curriculum vitae (“CV”). *See* EX1004. My CV lists my publications and identifies parties on behalf of whom I have provided expert testimony.

8. I am an expert in throttle control systems. This expertise is directly applicable to the technological area of the ’804 patent, which relates to an electronic throttle servo overheat protection system. *See* EX1001, Title.

9. I have over forty-five years of experience in the design and analysis of automotive electromechanical systems, such as throttle control systems. I am currently a full professor of Mechanical and Civil Engineering at the Florida Institute of Technology, the head of Automotive Engineering, and the director of the Florida Center for Automotive Research (FCAR). I have been involved in throttle control fuel injection and combustion systems since 1988. For seven years, NASA Lewis Research Center funded my research in advanced gas turbine engine fuel injection and combustion systems. Since that time, I have also been involved in optimizing throttle and fuel injection and combustion systems for automotive and

trucking applications along with racing applications. I have also dyno tested and track tested complex throttle and fuel injection systems.

10. I have a Bachelor of Science degree in Aerospace Engineering and a Master of Science degree in Aerospace Engineering, both from Pennsylvania State University. In 1989, I received my Ph.D. in Mechanical Engineering from Virginia Polytechnic Institute and State University.

11. From 1988-1996, I was an assistant professor in the Mechanical Engineering department at the University of Florida. At the University of Florida, I taught classes in power production systems for automotive applications, including internal combustion engines, fluid dynamics, combustion, jet and rocket propulsion, gas turbine engines, advanced fan and compressor design, compressible gas dynamics, turbomachinery, and others. I was also the director of the internal combustion engine laboratory.

12. From 1996-2001, I was an associate professor in the Mechanical Engineering department at the University of Alabama. While at the University of Alabama, I helped start the Center for Advanced Vehicle Technology (CAVT), which researches electric vehicle components like throttle control systems. I was also the director of the internal combustion engine laboratory.

13. From 2001-2005, I was an associate professor in the Mechanical Engineering and Engineering Science department at the University of North

Carolina, Charlotte (UNCC). While at UNCC, I helped start the North Carolina Motorsports and Automotive Research Center (NCMARC) and was a key contributor to start the Motorsports Engineering program within the Mechanical Engineering department. With this program, I directly worked with four of the most competitive NASCAR teams in the country. I was also the director of the internal combustion engine laboratory.

14. From 2005-2012, I was a full professor and program director in the Mechanical Engineering department at East Carolina University, Greenville, NC. While at East Carolina University, I chaired the Mechanical Engineering Concentration Development Committee and the Promotion and Tenure Committee for engineering.

15. In 2012, I joined the Florida Institute of Technology (FIT) as a full professor of Mechanical and Aerospace Engineering. During my tenure at FIT, I have acted as the Head of Automotive Engineering and the Director of the Florida Center of Automotive Research. At FIT, I have also taught classes in automotive engineering, internal combustion engines, automotive powertrains, combustion, thermodynamics, fluid dynamics, advanced fan and compressor design, compressible gas dynamics, jet and rocket propulsion, turbomachinery, and others.

16. Also during the last eight years, I have chaired forty-five technical sessions for the Society of Automotive Engineers (SAE) in throttle and intake

systems, exhaust and particulate emission systems, direct injection spark and compression ignition engines, fuel injection and sprays, fuel economy, HCCI combustion, hybrid electric vehicle powertrains, high efficiency engine concepts, multidimensional engine modeling, on-board diagnostics, fuels and fuel additives, cold start characteristics, engine boosting systems, dual fuel combustion, and spark assisted compression ignition combustion. I am also an associate editor for the SAE International Journal of Fuels and Lubricants.

17. I have won numerous accolades throughout my professional career. To name a few, I was awarded the SAE Ralph Teetor Award for teaching excellence in 1995. In 2000, I was inducted into the U.S. Space Institute Innovative Technology Hall of Fame. In 2002, I received the NASA Space Act Award for work related to the Space Shuttle. In 2009, I received the SAE Faculty Advisor award. In 2016, I received the ASME Outstanding Professor of the Year award. And in 2017, I received the ASME Outstanding Research Professor of the Year award.

18. Based on my education and experience, I am an expert in the type of throttle control systems at issue in this case, and I have been an expert in this area since before the '804 patent was filed with the United States Patent and Trademark Office. I am also intimately familiar with how a person of ordinary skill would have used and understood the terminology found in the '804 patent at the time of its filing.

IV. MATERIALS CONSIDERED

19. In formulating my opinions, I have relied on my training, knowledge, and experience. Furthermore, I have specifically considered the following documents, in addition to any other documents cited in this Declaration.

Exhibit	Description
1001	U.S. Patent No. 6,763,804 to Pursifull (“’804 patent”)
1002	Prosecution File History of U.S. Patent No. 6,763,804 B2 (“’804 history”)
1005	U.S. Patent No. 4,850,319 to Imoehl, titled “Electronic Throttle Actuator,” issued July 25, 1989 (“Imoehl”)
1006	U.S. Patent No. 4,656,407 to Burney, titled “Electric Motor Servo Control System and Method,” issued April 7, 1987 (“Burney”)
1007	U.S. Patent No. 6,329,777 to Itabashi et al., titled “Motor Drive Control Apparatus and Method Having Motor Current Limit Function Upon Motor Lock,” filed Sept. 7, 1999 (“Itabashi”)
1008	U.S. Patent No. 6,073,610 A to Matsumoto et al., titled “Control Apparatus of Internal Combustion Engine Equipped with Electronic Throttle Control Device,” issued June 13, 2000 (“Matsumoto”)
1009	European Patent Pub. No. 0121938 B1 to Murakami, titled “Throttle Control System for Automotive Vehicle,” published Dec. 30, 1986 (“Murakami”)
1010	European Patent Application No. EP 0874148 A2 to Matsumoto et al., titled “Control Apparatus for a Vehicle,” published Oct. 28, 1998 (“Matsumoto II”)
1011	UK Patent Application No. GB 2339850 to Pursifull, titled “A Throttle Valve for an Internal Combustion Engine with a Limp Home Position,” published Feb. 9, 2000 (“Pursifull”)
1012	U.S. Patent No. 4,313,408 to Collonia, titled “Device for the Control of the Traveling Speed of a Motor Vehicle,” issued Feb. 2, 1982 (“Collonia”)
1013	U.S. Patent No. 5,078,110 A to Rodefled, titled “Method and Arrangement for Detecting and Loosening Jammed Actuators,” issued January 7, 1992 (“Rodefled”)
1014	U.S. Patent No. 4,854,283 to Kiyono et al., titled “Throttle Valve Control Apparatus,” issued Aug. 8, 1989 (“Kiyono”)
1015	U.S. Patent No. 6,286,481 to Bos et al., titled “Electronic Throttle Return

	Mechanism with a Two Spring and One Lever Default Mechanism,” issued Sept. 11, 2001 (“Bos”)
1016	U.S. Patent No. 4,771,850 to Matsuda, titled “Automotive Traction Control System with Feature of Enabling and Disabling Control Depending Upon Vehicle Speed,” issued September 20, 1988 (“Matsuda”)
1017	U.S. Patent No. 5,712,550 to Boll et al., titled “Apparatus for Controlling a Power Control Element of a Drive Unit of a Motor Vehicle,” issued Jan. 27, 1998 (“Boll”)
1018	U.S. Patent No. 5,749,343 to Nichols et al., titled “Adaptive Electronic Throttle Control,” issued May 12, 1998 (“Nichols”)
1019	William M. Erickson, Protecting Servomotors from Self Destruction, Machine Design (Sept. 1, 2000) (“Erickson”)
1020	U.S. Patent No. 4,982,710 to Ohta et al., titled “Electronic Throttle Valve Opening Control Method and System Therefor,” issued Jan. 8, 1991 (“Ohta”)
1021	Snap-on, BMW Reference Manual (Aug. 2001, 1st ed.) (“BMW Manual”)
1022	William L. Husselbee, Automotive Computer Control Systems, Harcourt Brace (1989) (“Husselbee”)
1023	Snap-on, General Motors Reference Manual (Apr. 1995, 7th ed.) (“GM Manual”)
1024	Chrysler Front Wheel Drive 1981-92 Repair Manual (1992) (“Chrysler Manual”)
1027	U.S. Patent No. 4,645,992 to Ritenour, titled “Electronically Controlled Servomotor Limit Stop,” issued Feb. 24, 1987 (“Ritenour”)
1028	U.S. Patent No. 4,364,111 to Jocz, titled “Electronically Controlled Valve Actuator,” issued Dec. 14, 1982 (“Jocz”)
1031	Milestones on the Automotive Information Super-Highway, Snap-on Diagnostics (Apr. 13, 2001), <i>available</i> at https://web.archive.org/web/20010413220224/http://www.snapondia.com/mileston.htm
1032	MT2500 Scanner Home, Snap-on Diagnostics (June 11, 2001), <i>available</i> at https://web.archive.org/web/20010611023000/http://www.snapondia.com:80/scanner.htm
1033	Domestic Combo Primary Cartridge, Snap-on Diagnostics (April 11, 2001), <i>available</i> at https://web.archive.org/web/20010411032033/http://www.snapondia.com/99combo.htm

V. LEGAL STANDARDS

20. I have also relied upon various legal principles (as explained to me by Volkswagen's counsel) in formulating my opinions. My understanding of these principles is summarized below.

21. I have been told the following legal principles apply to analysis of patentability. I also have been told that, in an *inter partes* review proceeding, a patent claim may be deemed unpatentable if it is shown by a preponderance of the evidence that the claim is anticipated by one prior art reference under 35 U.S.C. § 102, or rendered obvious by one or more prior art references under 35 U.S.C. § 103.

22. I understand that documents and materials such as printed publications or patents that qualify as prior art can be used to render a patent claim as anticipated or as obvious.

23. I understand that, once the claims of a patent have been properly construed, the second step in determining anticipation or obviousness of a patent claim requires a comparison of the properly construed claim language to the prior art on a limitation-by-limitation basis.

A. My Understanding of Claim Construction

24. I understand that during an *inter partes* review proceeding, claims are to be construed in light of the specification as would be read by a person of ordinary skill in the relevant art at the time of the purported priority date. I understand that

claim terms are given their ordinary and customary meaning as would be understood by a person of ordinary skill in the relevant art in the context of the entire disclosure. A claim term, however, will not receive its ordinary meaning if the patentee acted as his own lexicographer and clearly set forth a definition of the claim term in the specification. In this case, the claim term will receive the definition set forth in the patent.

B. My Understanding of a Person of Ordinary Skill in the Art

25. I understand that a person of ordinary skill in the relevant art (herein “POSA”) is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity—not an automaton.

26. I have been asked to consider the level of ordinary skill in the field that someone would have had at the time the alleged invention was made. In deciding the level of ordinary skill, I considered the following:

- the levels of education and experience of persons working in the field;
- the types of problems encountered in the field; and
- the sophistication of the technology.

27. I understand that the relevant time for considering whether a claim would have been obvious to a POSA is at the time of the alleged invention, which I have assumed to be October 9, 2001—the filing date of the ’804 patent.

28. Regardless if I use “I” or “POSA” during my technical analysis below, all of my statements and opinions are to be understood to be based on how a POSA would have understood or read a document at the time of the alleged invention.

C. My Understanding of Obviousness

29. I understand that a patent claim is unpatentable if the claimed invention would have been obvious to a person of ordinary skill in the art at the time of the alleged invention. I understand that this means that even if all of the elements of the claim cannot be found in a single prior art reference that would anticipate the claim, the claim can still be unpatentable.

30. It is my understanding that, to obtain a patent, a claimed invention must have been, as of its earliest possible priority date, non-obvious in view of the prior art in the field. I understand that a patent claim is obvious when the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious to a person of ordinary skill in the art at the time the alleged invention was made.

31. When considering the issues of obviousness, I have been told that I am to do the following:

- Determine the scope and content of the prior art;
- Ascertain the differences between the prior art and the claims at issue;
- Resolve the level of ordinary skill in the art; and

- Consider evidence of secondary indicia of non-obviousness (if available).

32. With respect to determining the proper scope of prior art to examine, I understand that in order for a prior art reference to be properly used in an obviousness ground under 35 U.S.C. § 103, the prior art reference must be analogous art to the claimed invention. I have been told that a reference is analogous art to the claimed invention only if: (1) the reference is from the same field of endeavor as the claimed invention; or (2) the reference is reasonably pertinent to the particular problem solved by the inventor.

33. I understand that factors relevant to determining the proper field of endeavor include the inventor's explanations of the subject matter (including the patent specification), as well as the claimed invention's structure and function. And I further understand that to be reasonably pertinent to the particular problem solved by the inventor, a prior art reference must logically commend itself to the inventor's attention in considering his or her problem.

34. I have been told that an analogous reference may be modified or combined with other analogous references or with the POSA's own knowledge if the person would have found the modification or combination obvious. I have also been told that a POSA is presumed to know all relevant, analogous prior art, and the

obviousness analysis may take into account the inferences and creative steps that a POSA would employ.

35. In determining whether a prior art reference would have been combined with another prior art reference or other information known to a POSA, I have been told that the following principles may be considered:

- A combination of familiar elements according to known methods is likely to be obvious if it yields predictable results;
- The simple substitution of one known element for another is likely to be obvious if it yields predictable results;
- The use of a known technique to improve similar devices, products, or methods in the same way is likely to be obvious if it yields predictable results;
- The application of a known technique to a prior art reference that is ready for improvement is likely obvious if it yields predictable results;
- Any need or problem known in the field and addressed by the reference can provide a reason for combining the elements in the manner claimed;
- A skilled artisan often will be able to fit the teachings of multiple references together like a puzzle; and

- The proper analysis of obviousness requires a determination of whether a POSA would have a “reasonable expectation of success”—not “absolute predictability” of success—in achieving the claimed invention by combining prior art references.

36. I understand that whether a prior art reference renders a claim unpatentable as obvious is determined from the perspective of a POSA. I have also been told that, while there is no requirement for the prior art to contain an express suggestion to combine known elements to achieve the claimed invention, a suggestion to combine known elements to achieve the claimed invention may come from the prior art as a whole or individually, as filtered through the knowledge of one skilled in the art. In addition, I have been told the inferences and creative steps a person of ordinary skill in the art would employ are also relevant to the determination of obviousness.

37. I also understand that when a work is available in one field, design alternatives and other market forces can prompt variations of it, either in the same field or in another. I have also been told that if a POSA can implement a predictable variation and would see the benefit of doing so, that variation is likely to be obvious. I have been told that in many fields, there may be little discussion of obvious combinations, and in these fields market demand—not scientific literature—may drive design trends. I have been told that, when there is a design need or market

pressure and there are a finite number of predictable solutions, a POSA has good reason to pursue those known options.

38. I have been told there is no rigid rule prescribing that a reference or combination of references must contain a “teaching, suggestion, or motivation” to combine references. But I also have been told that the “teaching, suggestion, or motivation” test can be a useful guide in establishing a rationale for combining elements of the prior art. I have been told this test poses the question as to whether there is an express or implied teaching, suggestion, or motivation to combine prior art elements in a way that realizes the claimed invention, and that it seeks to counter impermissible hindsight analysis.

VI. THE '804 PATENT

A. To prevent a throttle valve motor from overheating, the system reduces the control effort to the motor when the control effort exceeds a threshold for a predetermined time period.

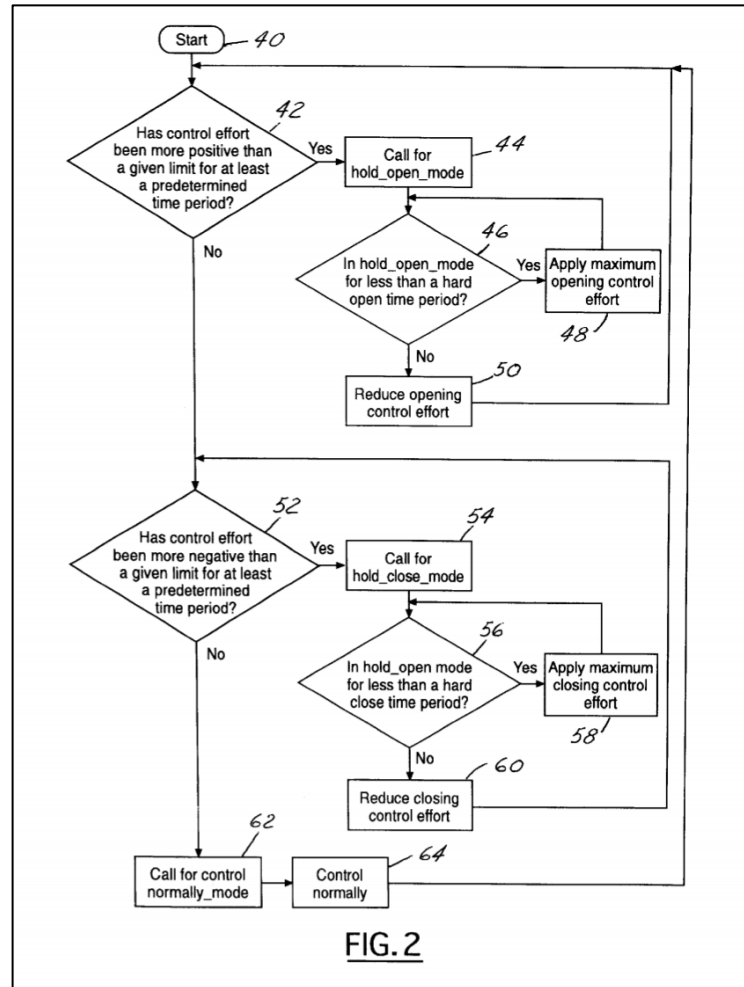
39. The '804 patent describes a system to control a motor for a throttle valve. EX1001, Abstract, 1:59-2:9. According to the '804 patent, applying a large and extended control effort (e.g., motor voltage, current, or duty cycle) to the throttle motor can overstress the motor's physical components: “Having a large control effort continuously available or available for maximum effort could possibly lead to overstressing the system's physical components if a blockage of the throttle plate occurs or the mechanism encounters a mechanical limit.” EX1001, 1:36-43.

“Specifically, the H-driver and the servomotor could overheat with sustained full control effort under some environmental conditions.” EX1001, 1:45-47.

40. To prevent the throttle motor from overheating, the system simply determines whether a control effort exceeds a threshold for a predetermined time period. EX1001, 2:6-7. “When the control effort exceeds the threshold for the predetermined time period, the control effort is reduced.” EX1001, 2:7-9.

41. The system in the '804 patent uses conventional hardware to limit the control effort when the control effort exceeds a threshold. The claims recite: (1) a positioning device (e.g., a throttle); (2) an electric motor for actuating the positioning device; (3) a control effort detector; and (4) a controller to change the position of the positioning device. Shown below, Figure 1 is “a block diagram of an electronic throttle servo overheat protection system in accordance with one embodiment of the present invention.” EX1001, 2:28-30. The figure shows (1) a positioning device 34 (also labeled throttle plate 34); (2) a motor 30 to change the position of the positioning device 34; (3) a sensor 38 to detect a control effort; and (4) both an electronic control unit 14 and a throttle control unit 28 to open and close the positioning device 34. EX1001, Abstract, 2:43-49, 3:4-13.

control effort exceeds a threshold for a predetermined time period, the system applies max effort and then reduces the control effort.



EX1001, FIG. 2.

43. The system performs a similar process when the control effort exceeds a negative control effort for a predetermined time period. At step 52, the system determines whether a control effort has been more negative than a given limit (e.g., -6V) for at least a predetermined time period (e.g., 300msec). EX1001, 4:16-21. If the control effort has been more negative than the given limit for the predetermined

time period, the system goes into a “hold close mode” (e.g., –14.5V) for a hard close time period (e.g., 30msec). See EX1001, 4:23-27.¹ Then, at step 60, the controller reduces the closing control effort. EX1001, 4:33-36. Accordingly, when the control effort exceeds a threshold for a predetermined time period, the system applies max effort and then reduces the control effort.

44. The '804 patent includes two independent claims—claim 1 and 11.

Claim 1 is a method claim and is reproduced below.

1. A method for controlling a positioning device of an internal combustion engine, the method comprising the steps of: - providing an electric motor for actuating the positioning device; - commanding the positioning device to change to a commanded position; - detecting a control effort required to change to said commanded position; - determining whether said control effort exceeds a threshold for a predetermined time period; and - reducing said control effort when said control effort exceeds said threshold for said predetermined time period; wherein commanding the positioning device to change to said commanded position comprises at least one of commanding the positioning device to open to a hold open mode and commanding the positioning device to close to a hold close mode.

¹ Step 56 in Figure 2 includes a typo—“hold_open_mode” should be “hold_close_mode.” The '804 patent states that “[a] hold close mode is initiated in step 54 and then immediately continued in step 56.” EX1001, 4:23-24. “In step 56, the controller preferably determines whether it has called for a hold close mode for less than a hard close time period.” EX1001, 4:24-26.

EX1001, 5:12-31.

45. Claim 11 is a system claim that has similar limitations but is limited to the hold close mode as shown below.

11. A system for controlling a positioning device of an internal combustion engine to prevent overhear conditions, the system comprising:
an electric motor for actuating the positioning device with a control effort;
a control effort detector coupled to said electric motor and intended to detect said control effort; and
a controller coupled to said electric motor and said control effort detector, said controller including control logic operative to command the positioning device to change to a commanded position, detect a control effort required to change to said commanded position, determine whether said control effort exceeds a threshold for a predetermined time period, and reduce said control effort when said control effort exceeds said threshold for said predetermined time period;
wherein said controller further includes control logic operative to command the positioning device to close to said commanded position in a hold close mode.

EX1001, 6:5-24 (annotated).

46. The dependent claims recite the specific threshold voltages and the predetermined time periods and the additional step of applying a maximum control effort. For example, claims 2 and 12 recite that the threshold has an absolute value of 6 volts. Claims 3 and 13 recite wherein the predetermined time period is 300 milliseconds. And claims 4-10 and 14-20 recite limitations related to the hold open mode and the hold close mode.

B. Prosecution History of the '804 Patent

47. During prosecution, the examiner raised only a single prior-art reference—JP03226283A to Fujiyoshi. The examiner rejected the then-pending

independent claims as being anticipated by Fujiyoshi and the then-pending dependent claims as being obvious in view of Fujiyoshi. EX1002, 0063-65.

48. I also understand that the examiner did not find that the recited voltages and time periods in the dependent claims were enough to overcome the art. The examiner stated—and I agree—that the parameters recited in at least claims 2, 3, 13, and 14 would have been an obvious design choice based on the specifications of the underlying components in the system:

The parameters of 6 volts and 300 milliseconds required in claims 2, 3, 13, 14 are threshold and time parameters which apply to the particular system which has been chosen by applicant. At the time the invention was made, it would have been an obvious matter of design choice to a person of ordinary skill in the art to use parameters of 6 volts and 300 milliseconds [because [sic] Applicant has not disclosed that parameters of 6 volts and 300 milliseconds provides an advantage, is used for a particular purpose, or solves a stated problem.

EX1002, 0064-65.

49. I also agree that the '804 patent does not explain any benefit for the specific voltages and time periods recited in the dependent claims. Indeed, the '804 patent states that “[a] person skilled in the art understands that the hard open time period may depend upon the voltage applied to the motor.” EX1001, 3:36-38. The '804 patent also states that typically an effort limit of 6 volts and a time period of 300 milliseconds are used but “[o]bviously, these values may vary as required.”

EX1001, 3:30-31; *see also* EX1001, 3:61-64 (stating that *obviously* the maximum control effort may vary as required). I understand that the applicant never disputed the examiner's conclusion that the voltages and time periods recited in the dependent claims would have been an obvious matter of design choice.

50. In response to the anticipation and obviousness rejections, the applicant amended the claims to include what the examiner considered to be allowable subject matter, specifically commanding the positioning device to open to a hold open mode or close to a hold close mode. *See* EX1002, 0067-73. The examiner then issued a Notice of Allowance without stating reasons for the allowance. EX1002, 0075-80.

C. Level of Ordinary Skill in the Art

51. The '804 patent relates to a basic throttle control system that uses a controller to receive feedback from an electronic motor to determine whether the control effort exceeds a threshold for a predetermined time period. In the context of this basic throttle control system, a POSA as of October 9, 2001 (the filing date of the '804 patent) would have had a B.S. degree in Mechanical Engineering or Electrical Engineering (or equivalent), as well as at least two to four years of academic or industry experience in the relevant field of engine control systems. Through this experience, the POSA would have worked with throttle control systems and would have understood feedback control systems for electric motors.

52. I am well qualified to determine the level of ordinary skill in the art.

First, I am very familiar with the technology of the '804 patent as of the 2001 timeframe. For example, during this 2001 timeframe, I was an associate professor in the Mechanical Engineering Department at the University of Alabama and had been a key member in starting the Center for Advanced Vehicle Technology (CAVT). CAVT is a University of Alabama Research Center dedicated to the advancement of vehicle technology. Based on unique, interdisciplinary research and education programs, CAVT strives to provide the vehicular industry with novel ideas, scientific consultation, and new generations of engineers and scientists formed in the latest technologies in this field. This included the experimental and computational optimization of throttle controls systems for current, new, and advanced engine concepts. Further, I was advising the tenth Society of Automotive Engineers (SAE) Formula Collegiate Design Series Competition vehicle. Here, a formula style racecar is completely designed, fabricated, and built in-house every year from the computer to finished vehicle. A key and crucial concept is the design, fabrication, and testing of a custom intake manifold/fuel injection/throttle control system. This was all done in-house under my advisement. I also taught the design concepts of these systems in a class I personally developed titled "Internal Combustion Engines" at both the undergraduate and graduate level. Further, for high performance applications on one end of the spectrum to fuel economy on the other end of the

spectrum, I have direct experience designing and modifying the fuel injection/throttle body control system found on 1991-2001 GM LT-1 engines. These design modification and programming changes were verified on engine dynamometers and road and track testing to improve both fuel economy and performance. These engines were found in 1992-96 Chevrolet Corvettes, 1993-98 Chevrolet Camaro Z-28s, 1993-97 Pontiac Firebird Trans Ams, 1994-96 Buick Roadmasters, 1994 -96 Chevrolet Caprices and Impala SS, and 1994-96 Cadillac Fleetwoods. In 1997 Chevrolet opted for “Throttle Actuator Control” (TAC) on its C5 Corvette.

53. As I explain in Section III and further show in my CV, I had acquired extensive experience related to throttle control systems by 2001.

D. Claim Construction

54. It is my understanding that the challenged claims of the '804 patent are to be given their ordinary and customary meaning as understood by a POSA at the time of the alleged invention in light of the specification and the prosecution history. Other than the word “dose” in claims 1 and 8, all terms should receive their plain and ordinary meaning in the context of the '804 patent specification.

55. The term “dose” should be construed as “close” to correct an apparent printing error in the claims. Claim 1 recites “wherein commanding the positioning device to change to said commanded position comprises at least one of commanding

the positioning device to open to a hold open mode and commanding the positioning device to *dose* to a hold close mode.” Claim 8 recites “applying a maximum control effort to the positioning device for a hard *dose* time period.” This error occurred during printing of the patent. *See* EX1002, 0069-71 (the allowed claims used the word “close”). Accordingly, I have interpreted the term “dose” as “close.”

VII. OVERVIEW OF THE TECHNOLOGY

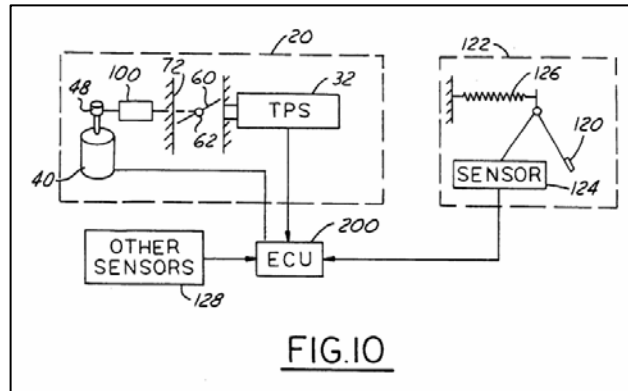
56. “Valve assemblies for engines and related systems typically utilize rotatable valve members in fluid flow passageways to assist in regulating fluid flow through them.” EX1015, Bose, 1:26-28; *see also* EX1018, Nichols, 1:11-14. “For example, throttle valve members are positioned in the air induction passageways into internal combustion engines.” EX1015, 1:28-30. “The valve assemblies are controlled either mechanically or electronically and utilize a mechanism which directly operates the valve member.” EX1015, 1:31-33. As I explain in Section VI.A, the ’804 patent describes an *electronic* throttle control system. *See also* EX1001, 2:43-45. “Typically in electronic throttle control, an electromechanical actuator is mechanically linked to the intake air valve and electrically driven to vary intake air valve position.” EX1018, 1:15-18. Electronic throttle control systems had been well known decades before the filing date of the ’804 patent. For example, U.S. Patent No. 4,313,408 disclosed an electronic control system for a throttle valve in the 1970s. EX1012, Collonia, 1:26-37, (22). By the time of the alleged invention

of the '804 patent (2001), electronic throttle control systems were ubiquitous in the industry.

57. As this Section shows, the components that comprise the alleged invention were all commonly used in existing electronic throttle control systems. From my experience working with electronic throttle control systems around this time, I can also confirm that the structure and function recited in the claims of the '804 patent were all well known.

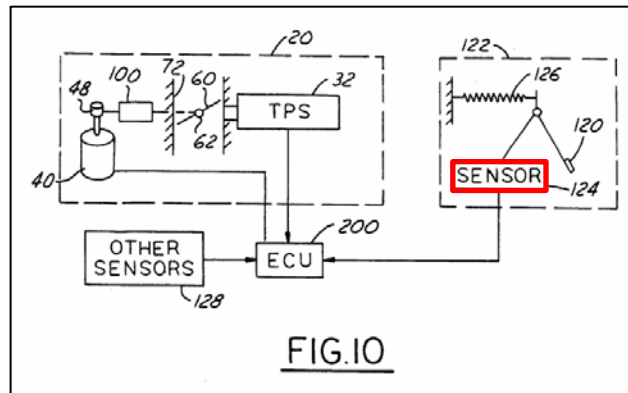
58. The '804 patent describes a motor interface 30 for displacing a throttle plate 34. EX1001, 3:7-13, FIG. 1. Conventional vehicles well before the '804 patent had a motor interface for displacing a throttle plate. *See, e.g.*, EX1006, Burney, 4:68-5:7, FIGS. 1, 3; EX1016, Matsuda, 4:4-15, FIG. 1; EX1013, Rodefled, 1:63-65, 2:3-5, FIG. 1; EX1008, Matsumoto, 4:7-10, 4:63-67, 6:62-7:3, 7:12-18, 7:51-60, FIG. 1; EX1009, Murakami, 3:46-57, 4:3-10, 5:1-9, 5:53-57, FIGS. 1, 2; EX1010, Matsumoto II, 14:18-27, 15:18-23, FIG. 1; EX1012, 4:28-35, 1:26-37, 4:47-56, 5:14-27, FIGS. 1-4; EX1014, Kiyono, 5:19-47, FIG. 1; EX1015, Bos, 5:44-54, FIG. 10; EX1007, Itabashi, 3:4-47, FIG. 1; EX1017, Boll, 2:31-41, 3:50-60, FIG. 1; EX1018, 2:50-59, FIG. 1. For example, U.S. Patent No. 6,286,481 to Bos *et al.* and assigned to Ford Global Technologies, Inc. ("Ford System" or "Bos") shows an interface for moving a throttle plate. *See* EX1015, 5:44-45, FIG. 10. Shown below,

the Ford System used an ECU 200 and electric motor 40 to move the throttle valve 60, as was typical.



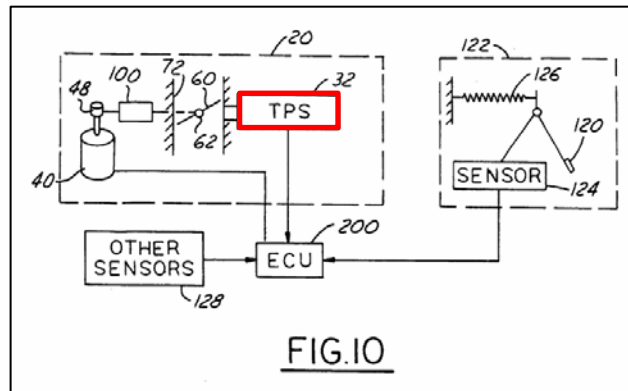
EX1015, FIG. 10.

59. The '804 patent refers to pedal position sensors 20 to sense the actuation of an accelerator pedal. See EX1001, 2:55-65, FIG. 1. These pedal position sensors were well known before the '804 patent. See, e.g., EX1008, 7:61-67, 8:4-13, FIG. 1; EX1016, 5:14-21, FIG. 1; EX1009, 3:46-59, 5:10-16, FIGS. 1-3; EX1010, 15:28-34, FIGS. 1, 2; EX1012, 1:26-29, FIGS. 1-4; EX1014, 5:10-19, 8:20-29, FIGS. 1, 2; EX1015, 5:35-38, FIG. 10; EX1007, 2:64-66, FIG. 1; EX1018, 3:17-22, FIG. 1. The Ford System used a sensor 124 to detect the force applied to the accelerator pedal 120, as was typical. See EX1015, 5:35-38, FIG. 10.



EX1015, FIG. 10 (annotated).

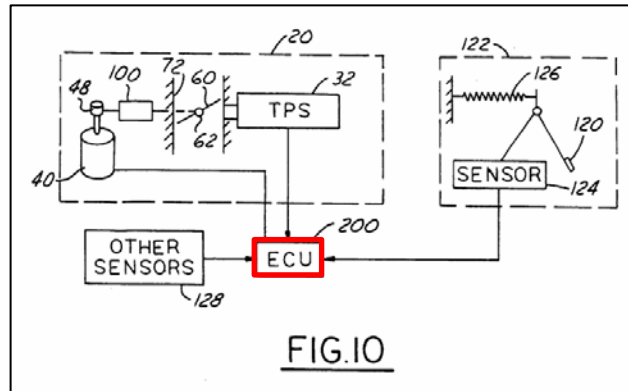
60. The '804 patent refers to throttle position sensors 24a and 24b to indicate the opening angle of the throttle plate 34. See EX1001, 2:66-3:4, FIG. 1. These throttle position sensors were well known before the '804 patent. See, e.g., EX1008, 7:4-11, 7:61-67, 8:20-24, 10:14-16, FIG. 1; EX1016, 4:58-5:5, FIG. 1; EX1013, 1:63-65; EX1009, 3:46-57, 5:1-9, 5:62-65, FIGS. 1, 2, 4; EX1010, 14:28-36; EX1012, 4:24-28, FIGS. 1-4; EX1005, Imoehl, 2:12-15, 3:61-68; EX1014, 6:31-36, 7:61-68, FIGS. 1, 2; EX1015, 3:10-14, FIG. 1; EX1007, 2:63-64, FIG. 1; EX1018, 2:65-67, FIG. 1. The Ford System used a throttle position sensor 32 to sense the position of the throttle valve, as was typical. See EX1015, 3:10-14, FIG. 10.



EX1015, FIG. 10 (annotated).

61. The '804 patent refers to an electronic control unit 14 to receive input from the redundant pedal position sensors 20 and the throttle position sensors 24a and 24b. EX1001, 2:63-67, FIG. 1. Electronic control units with input from conventional pedal position sensors and throttle position sensors also were well known before the '804 patent. *See, e.g.*, EX1008, 5:18-21, 8:14-20, FIG. 1; EX1016, 5:14-15, 5:30-33, FIG. 1; EX1013, 1:65-2:10, FIG. 1; EX1009, 1:52-2:4; EX1009, 3:46-57, 4:11-20, 4:47-50, FIG. 1; EX1010, 11:45-48, 15:18-27, 15:45-48, FIGS. 1, 2; EX1014, 6:9-18, FIG. 1; EX1014, 8:20-29, FIG. 2; EX1015, 3:10-14, 3:20-29, 5:35-38, FIGS. 1, 10; EX1007, 2:66-3:3; EX1018, 2:65-67, 3:17-22, FIG. 1. Additionally, these known electronic control units received input from powertrain sensors—just like the '804 patent. *Compare* EX1001, 2:49-60, 3:4-7, FIG. 1, with EX1008, 5:1-21; EX1010, 11:27-44, 14:44-47; EX1012, 4:24-28, FIGS. 1-4; EX1014, FIG. 3; EX1015, 5:40-43, FIG. 10; EX1018, 3:4-11, FIG. 1. Shown below, the ECU 200 in the Ford System receives inputs from accelerator pedal position

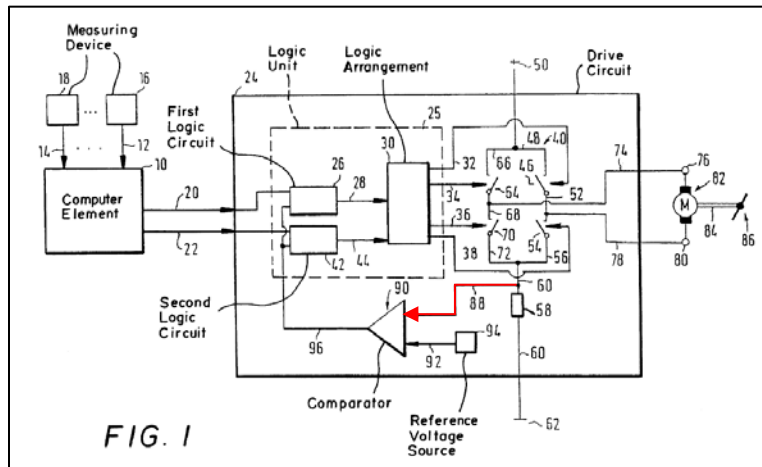
sensor 124, throttle position sensor 32, and other sensors 128, as was typical. See EX1015, 3:10-14, 5:35-43, FIG. 10.



EX1015, FIG. 10 (annotated).

62. The '804 patent refers to circuitry that receives feedback from the electric motor for the throttle valve 34. See EX1001, 3:15-20, FIG. 1. Receiving feedback from the servomotor was well known before the '804 patent. See, e.g., EX1006, 5:7-10, 7:55-63, FIG. 3; EX1007, 3:11-16, 3:42-47, FIG. 2; EX1017, 4:23-29, 5:2-8, 5:31-41, FIG. 1; EX1008, 4:63-67, 7:19-21, FIG. 1; EX1013, 2:5-10, FIG. 1; EX1012, 3:61-66, FIG. 2. For example, U.S. Patent No. 4,656,407 to Burney discloses a limit detection circuit that receives feedback from the electric motor for a throttle valve, as I explain in Section VIII.C. This feedback from the motor was used to protect servomotors from self-destruction. See EX1019, Erikson, pp. 1, 3-4. "To protect against a potentially dangerous transient overload condition, one can monitor the current supplied by the drive." EX1019, p. 4. "In the event of such an overload, the drive automatically reduces its current to a safe level—typically the continuous

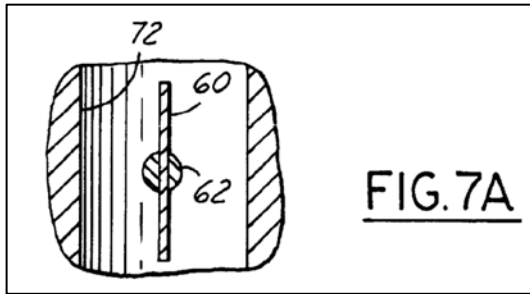
rating of the drive.” EX1019, p. 4. For example, as I explain in Section VIII.A, U.S. Patent No. 6,329,777 to Itabashi *et al.* feeds motor current back to a circuit to reduce the heat generation of the MOSFETs that drive the motor: “[T]he current flowing in the MOSFETs 22-25 can be limited to the lower level to reduce the heat generation of the MOSFETs 22-25.” EX1007, 8:28-30. Accordingly, the feedback circuit shuts off current “to protect semiconductor switching devices, when the motor lock is detected based on the condition that the throttle valve does not rotate to the target position within a predetermined time period.” EX1007, 1:30-33. Likewise, U.S. Patent No. 4,645,992 to Ritenour states: “A servosystem drive circuit includes means for sensing instances when the servomotor drive current exceeds a preset threshold level for a given time” EX1027, Ritenour, 1:30-35; *see also* EX1027, 2:34-40, 3:25-62, FIG. 2. And U.S. Patent No. 5,712,550 to Boll *et al.* receives feedback to limit the motor current to a threshold voltage as shown below. *See* EX1017, 4:23-27, 4:61-5:2. Accordingly, receiving feedback of the motor current was well known.



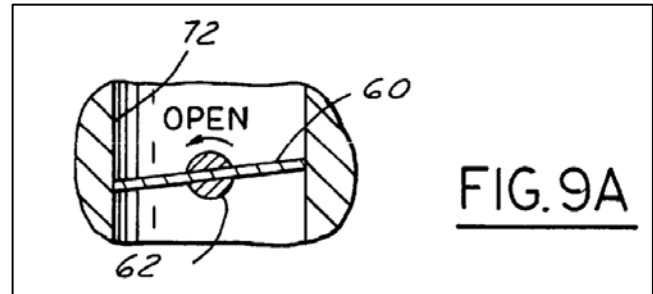
showing line 88
leading to comparator 90
to detect whether the
current flowing through the
drive circuit exceeds a
reference voltage source 94

EX1017, FIG. 1 (annotated).

63. The '804 patent refers to commanding the throttle plate 34 to move according to a hold open mode and a hold close mode. *See* EX1001, 3:33-36, 4:23-26, FIG. 2. A “hold open mode” and a “hold close mode” are not terms of art. According to the '804 patent, “[i]n the hold open mode, a typical opening control effort has a magnitude or +14.5 volts.” EX1001, 3:61-63, FIG. 2. When in the hold close mode, “the controller applies a maximum closing control effort to the motor.” EX1001, 4:30-31, FIG. 2. Typical throttle control systems well before the '804 patent commanded the throttle plate to move to the fully open and fully closed position. *See, e.g.*, EX1006, 11:7-11, 14:46-56; EX1016, 4:10-15, FIG. 2; EX1009, 4:14-20, 4:51-63, 6:11-14, 6:27-32, 6:40-45, FIGS. 5, 6; EX1011, Pursifull, (57), FIGS. 4A-4D; EX1005, Abstract, 1:25-29; EX1007, FIGS. 3, 4. Shown below, the ECU 200 in the Ford System commands the throttle valve 60 to fully open and to fully close.

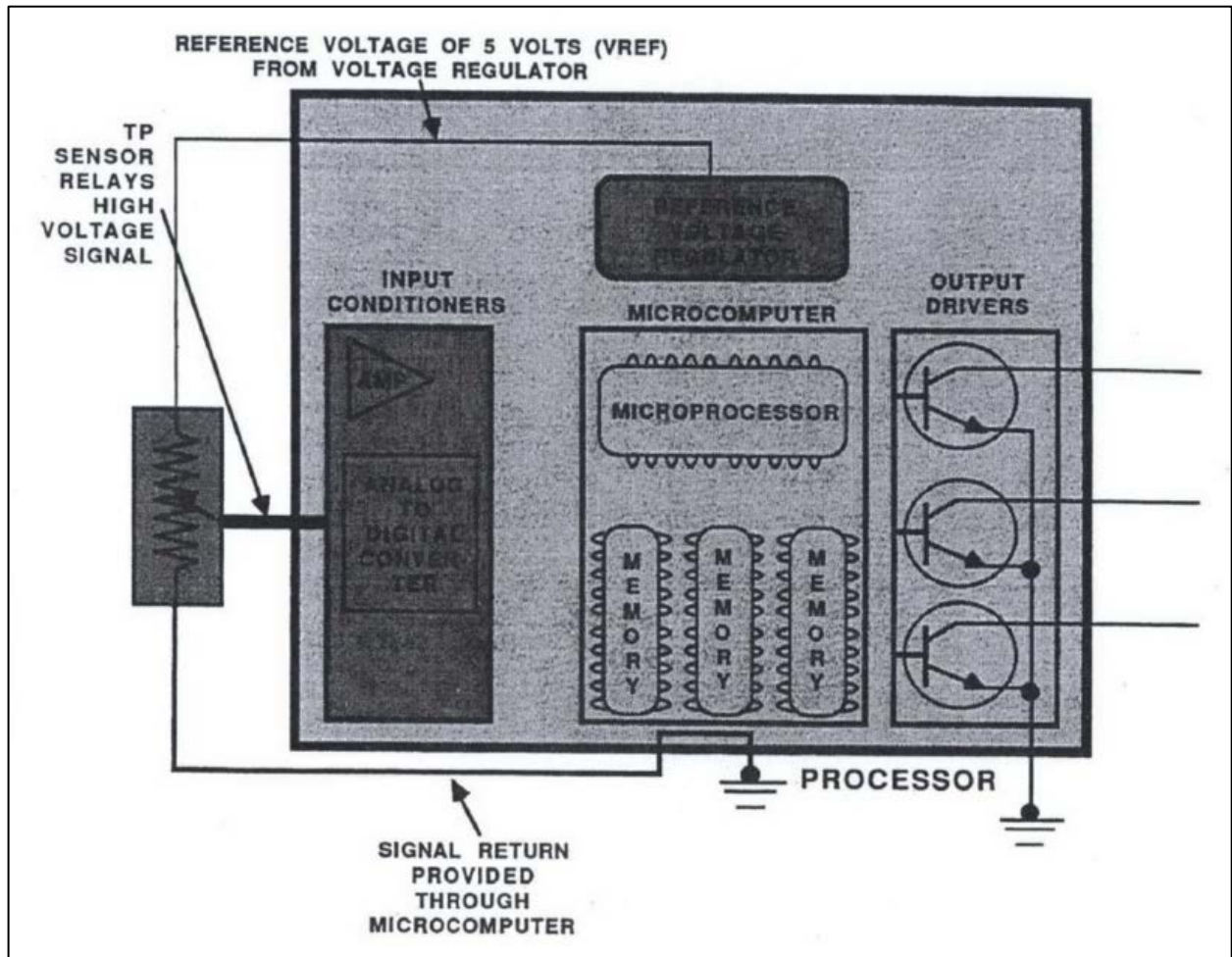


EX1015, FIG. 7A (fully open).



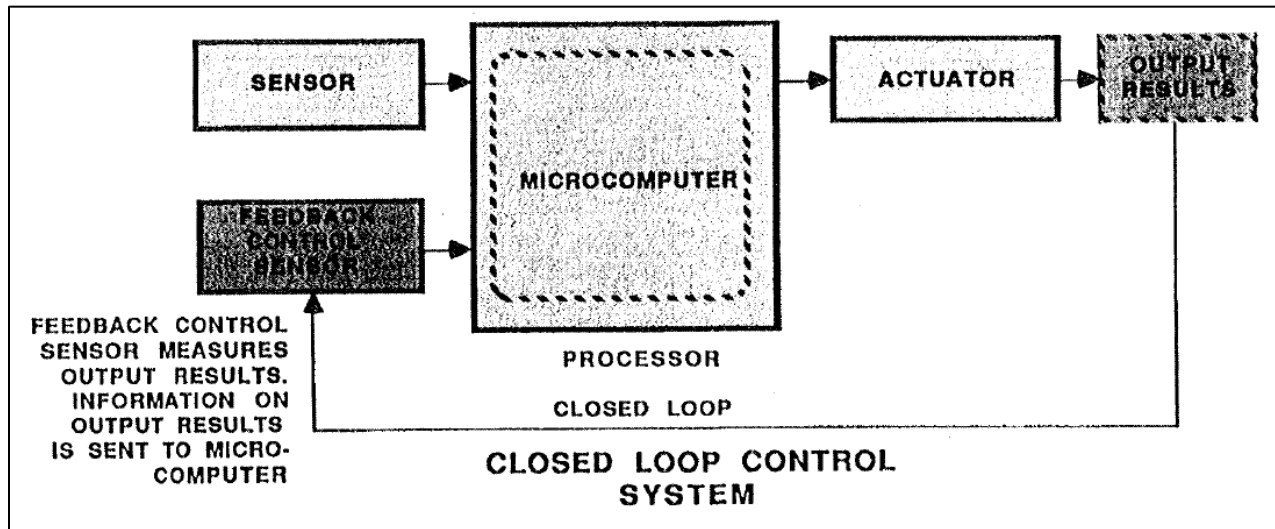
EX1015, FIG. 9A (fully closed).

64. These concepts were also taught in undergraduate coursework. For example, the textbook *Automotive Computer Control Systems* shows a schematic of the reference voltage source and a throttle position sensor. EX1022, Husselbee, 61; *see also* EX1022, p. 62 (showing the accelerator position sensor). Shown below, the system can command the throttle plate to fully open, partially close, and fully close. *See* EX1022, p. 61. The system also shows reference voltage and input conditioners. *See* EX1022, p. 61. The reference voltage and input conditioners use an amplifier, such as the amplifier taught in Burney and Itabashi, that limit the drive current when the drive current causes the voltage to exceed the reference voltage. *Compare* EX1022, p. 61, *with* Sections VIII.C (Burney), VIII.A (Itabashi).



EX1022, p. 61.

65. The textbook also explains how conventional automotive computer control systems used actuators in a closed loop with feedback based on both sensor measures and output results. See EX1022, pp. 80-81, 83. As this textbook shows, a POSA with a B.S. degree in Mechanical Engineering or Electrical Engineering (or equivalent), as well as at least 2-4 years of academic or industry experience in the relevant field of engine control systems would have understood electronic throttle control systems and closed loop control systems.



EX1022, p. 81.

66. A motor interface for displacing a throttle plate was well known. Redundant pedal position sensors to sense the actuation of an accelerator pedal were well known. Throttle position sensors that indicated the opening angle of the throttle plate were well known. Electronic control units to receive input from the pedal position sensors, throttle position sensors, and powertrain sensors were well known. Throttle control units that received feedback from the servomotor for the throttle were well known. Commanding the throttle plate to move to a fully open or fully closed position was well known. And, as the following sections explain, systems already had protective measures to prevent the throttle's servomotor from stalling for an extended period of time. These protective measures were well known in the art and met every element of the '804 patent's claims.

VIII. SUMMARY OF THE APPLIED REFERENCES

67. Each applied reference discloses elements of a control system for a vehicle engine and are in the same field of endeavor as the '804 patent. For example, as I explain in more detail below, Itabashi discloses a throttle control system that limits the current to the motor when the current exceeds a threshold for a predetermined time period. *See* Section VIII.A. Matsumoto discloses a throttle control system that detects when the throttle valve is stuck. *See* Section VIII.A. Burney discloses a circuit that limits the control effort to an electric motor for a throttle when the throttle valve is fully open or fully closed. *See* Section VIII.C. Ritenour discloses a servomotor control system that reduces current when current exceeds a threshold for a time period. *See* Section VIII.D. And the GM Manual, the Chrysler Manual, and Ohta are about throttle systems. *See* Sections VIII.E-VIII.F.

68. The applied references would have also been reasonably pertinent to problems faced by the inventor of the '804 patent. For example, the inventor of the '804 patent referred to problems associated with overstressing the electric motor for the throttle. *See* EX1001, 1:36-43. Likewise, Itabashi describes a “motor drive control apparatus and method having motor current limit function upon motor lock.” EX1007, Title. Matsumoto discloses a system that detects when a failure occurs in a throttle valve to prevent overstressing of the electric motor. *See* EX1008, 1:7-12, 3:33-36, 20:14-22:8, FIG. 4. Burney describes a system to detect when the

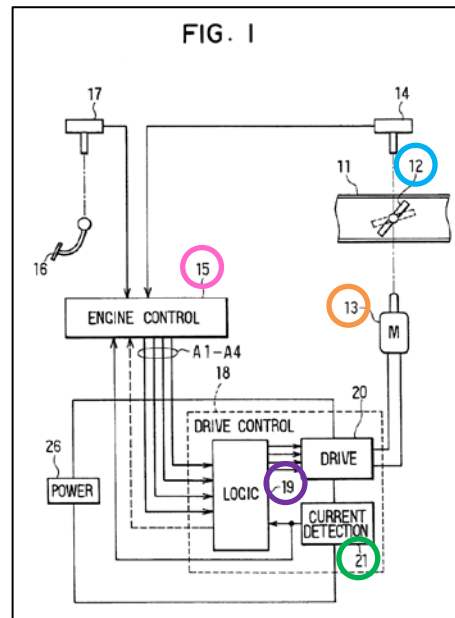
servomotor is stalling so that the system can modify the motor's operation to prevent damage to the motor and gear reduction system. *See* EX1006, 1:8-15, 4:11-14. Ritenour discloses a control system that limits current to a servomotor such that the motor does not get destroyed. *See* EX1027, 1:16-19, 1:30-35, 3:25-39, FIG. 2. And the GM Manual, the Chrysler Manual, and Ohta provide details that are pertinent about the voltage and timing elements of limit detection circuits. Accordingly, these applied references would have been pertinent to the problems associated with detecting a control effort applied to an electric motor and reducing the control effort to prevent overstressing of the electric motor.

A. Itabashi discloses a throttle control system that limits the current to the motor when the current exceeds a threshold for a predetermined time period.

69. Itabashi discloses “a motor drive control apparatus and method having a motor current limit function, which can be applied to a motor driven throttle valve control in an internal combustion engine.” EX1007, 1:13-16. Itabashi recognized that excessive current is applied to the motor when the motor locks: “The current increases excessively when the motor locks due to jamming of foreign obstacles with the throttle valve.” EX1007, 1:27-29. To limit excessive motor current, Itabashi's system has a current detection circuit 21.

70. Itabashi discloses the same structure as the '804 patent. Shown below, Itabashi's system has: (1) an electronic controlled throttle valve 12; (2) a direct

current motor 13; (3) a current detection circuit 21 to detect motor current; and (4) both an engine control circuit 15 and a drive logic circuit 19 to open and close the throttle valve 12. EX1007, 2:63-3:10, 3:48-55, 5:44-59, FIGS. 1, 2.

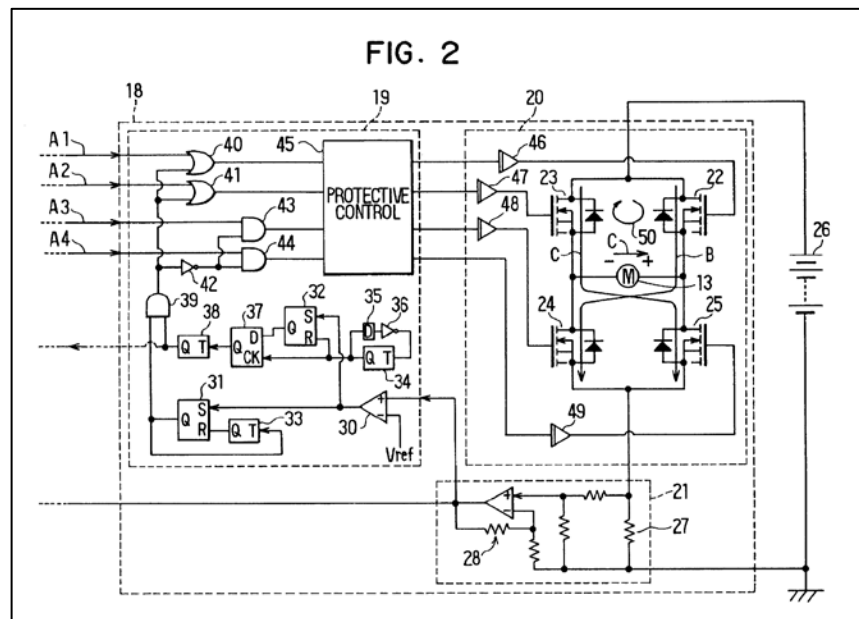


EX1007, FIG. 1 (annotated).

71. As Figure 1 shows above, the system has a throttle valve 12 coupled to an electrically-driven DC motor 13. EX1007, 2:48-50, FIG. 1. The system also has a throttle sensor 14 to detect a throttle position and an accelerator sensor 17 to detect an accelerator position. EX1007, 2:62-66, FIG. 1. “The output signals of the throttle sensor 14 and the accelerator sensor 17 are applied to an engine control circuit 15, which in turn controls the throttle valve 12 through the motor 13....” EX1007, 2:66-3:3, FIG. 1. In response to signals from the throttle sensor 14 and the accelerator sensor 17, the engine control circuit 15 sends drive command signals A1-A4 to the

drive control circuit 18. EX1007, 3:4-7. “Thus, the drive control circuit 18 drives the motor 13 to rotate the throttle valve 12 to a target position corresponding to the detected actual accelerator position.” EX1007, 3:7-10.

72. The drive control circuit 18 includes: (1) a drive logic circuit 19; (2) a drive circuit 20; and (3) a current detection circuit 21. Figure 2 shows the circuitry for these elements of the drive control circuit 18. See EX1007, 3:30-31, FIG. 2.

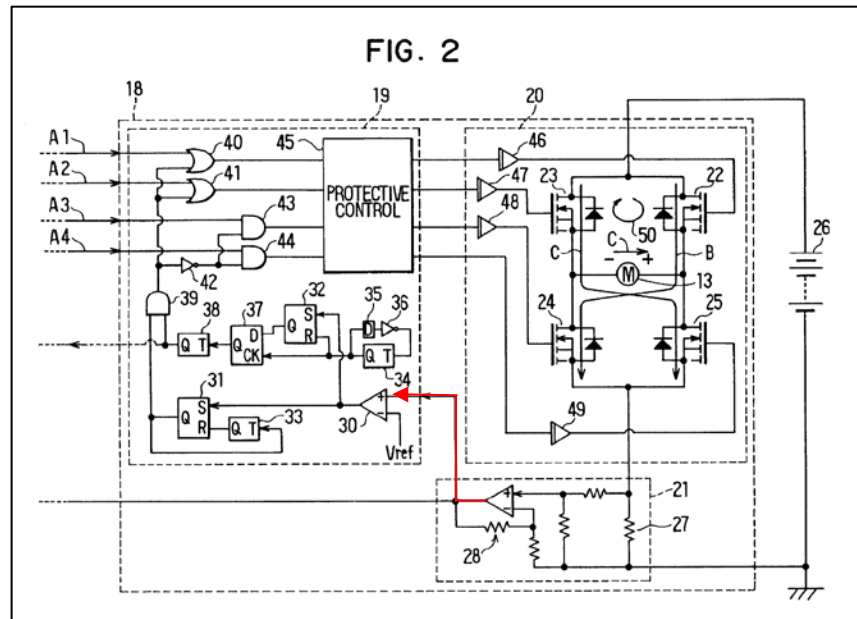


EX1007, FIG. 2.

73. As Figure 2 shows above, the drive logic circuit 19 includes logic to output four drive command signals A1-A4 to the drive circuit 20. EX1007, 3:11-16, FIG. 2. “In the drive circuit 20, four semiconductor switching devices such as MOSFETs 22-25 are connected in H-bridge type.” EX1007, 3:31-33, FIG. 2. These MOSFETs 22-25 receive the command signals A1-A4 to drive the motor 13. See

EX1007, 3:11-16, FIG. 2. The drive control circuit 18 also includes a current detection circuit 21 to determine whether the drive current for the motor is excessively high. EX1007, 3:11-16, 3:48-51. Shown above, “[t]he current detection circuit 21 includes a resistor 27 and a differential amplifier circuit 28.” EX1007, 3:42-44, FIG. 2. “The output signal of the current detection circuit 21 [is] indicative of the motor current flowing in the motor 13 [and] is applied to the drive logic circuit 19.” EX1007, 3:44-47.

74. Figure 2 shows the current detection circuit 21 sending the current indicator to the drive logic circuit 19. *See* EX1007, 3:44-47, FIG. 2. “In the drive logic circuit 19, a comparator 30 is provided to compare the output signal of the current detection circuit 21 with a reference signal V_{ref} , which is set to correspond to the maximum limit level of the motor current.” EX1007, 3:48-51. “[T]his limit level is set low to protect the MOSFETs 22-25 from breaking” EX1007, 3:52-55.

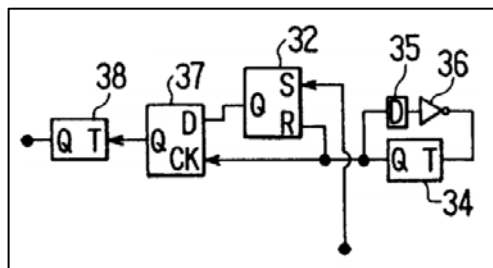


EX1007, FIG. 2 (annotated).

75. When the output signal of the current detection circuit 21 is higher than V_{ref} , the output of comparator 30 becomes high. EX1007, 3:48-51, 3:58-59, FIG. 2. This high output of the comparator 30 will eventually cause the drive logic circuit 19 to reduce the motor current. As Figure 2 shows above, the output of comparator 30 is tied to set terminals S of reset-set type RS-latches 31 and 32, and output signals of timers 33 and 34 are applied to reset terminals R of the RS-latches 31 and 32. EX1007, 3:60-63. In response to the high level signal of the comparator 30, the R-latch 31 outputs a high level output signal from its terminal Q to AND gate 39. EX1007, 3:64-4:1; *see also* EX1007, FIG. 4 (LATCH 31).

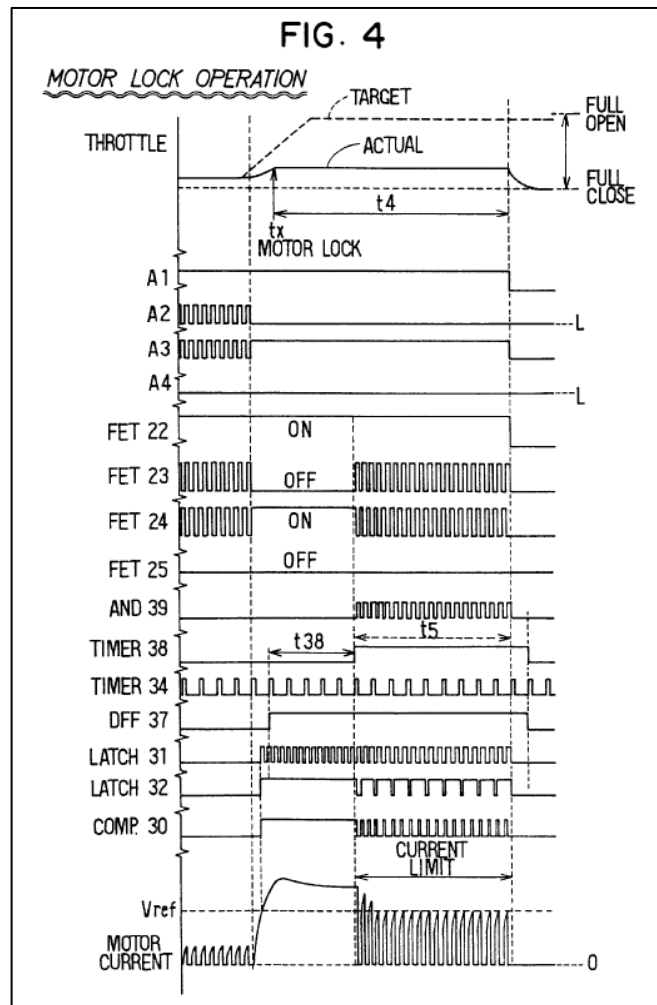
76. The system does not immediately reduce the motor current when the motor current exceeds V_{ref} . *Compare* EX1007, FIG. 4 (LATCH 31), *with* EX1007,

FIG. 4 (MOTOR CURRENT). Rather, the system allows the motor current to exceed V_{ref} for a predetermined time period t_{38} . See EX1007, 1:58-2:6, 5:21-35, 8:16-24, FIG. 4. To allow the motor current to exceed V_{ref} for a certain time period, the system uses the following circuitry. To summarize this circuitry, timer 34 produces a pulse signal based on a predetermined time period t_{34} . See EX1007, 4:18-39, FIGS. 3, 4. This pulse signal is input to the R terminal of RS-latch 32 and a clock input terminal CK of a D-type flip-flop (DEF) 37. EX1007, 4:18-21, 4:40-44. “When the RS-latch 32 receives at its set terminal S the high level signal from the comparator 30 indicating that the motor current is in excess of the limit level, the RS-latch 32 is set to produce a high level output signal from its output terminal Q to the data input terminal D of the D-type flip-flop 37.” EX1007, 4:45-50. The D-type flip-flop 37 then produces a high output signal to an input terminal T of timer 38. EX1007, 4:55-65. After a predetermined time period— t_{38} —the output Q of timer 38 becomes high. EX1007, 5:8-16, FIG. 4.



EX1007, FIG. 2 (excerpted).

78. As Figure 4 shows below, the motor current exceeds V_{ref} for a predetermined time period t_{38} . See EX1007, FIG. 4. After the predetermined time period expires, the system reduces the current. See EX1007, FIG. 4. Then, if another predetermined time period t_4 expires, the system determines that the motor is locked and terminates current supply to the motor. See EX1007, 7:60-8:15, FIG. 4.



EX1007, FIG. 4.

79. By limiting the motor current, Itabashi's system reduces the temperature to the MOSFETs—just like how the system in the '804 patent reduces the control effort for overheat protection. Itabashi states:

[T]he motor current is limited to a lower level, when the motor current continues to exceed the limit level for more than the predetermined period t38 during the period of the motor drive starting (or motor braking). Thus, the current flowing in the MOSFETs 22-25 can be limited to the lower level to *reduce the heat generation* of the MOSFETs 22-25.

EX1007, 8:25-30.²

80. Itabashi therefore discloses the structure recited in the claims of the '804 patent. Itabashi also reduces the motor current when the motor current exceeds V_{ref} for a predetermined time period. And Itabashi uses its current detection circuit 21 for the same purpose as the '804 patent—as an overheat protection system.

B. Matsumoto discloses a control system that detects when the throttle valve is stuck, such as in a fully open or closed position.

81. Matsumoto discloses “an internal combustion engine equipped with an electronic throttle control device for electrically driving a throttle valve [and a] failure detecting means for detecting a failure of the electronic throttle control device.” EX1008, Abstract. Matsumoto explains that a throttle valve can get stuck:

² Emphasis added throughout unless indicated.

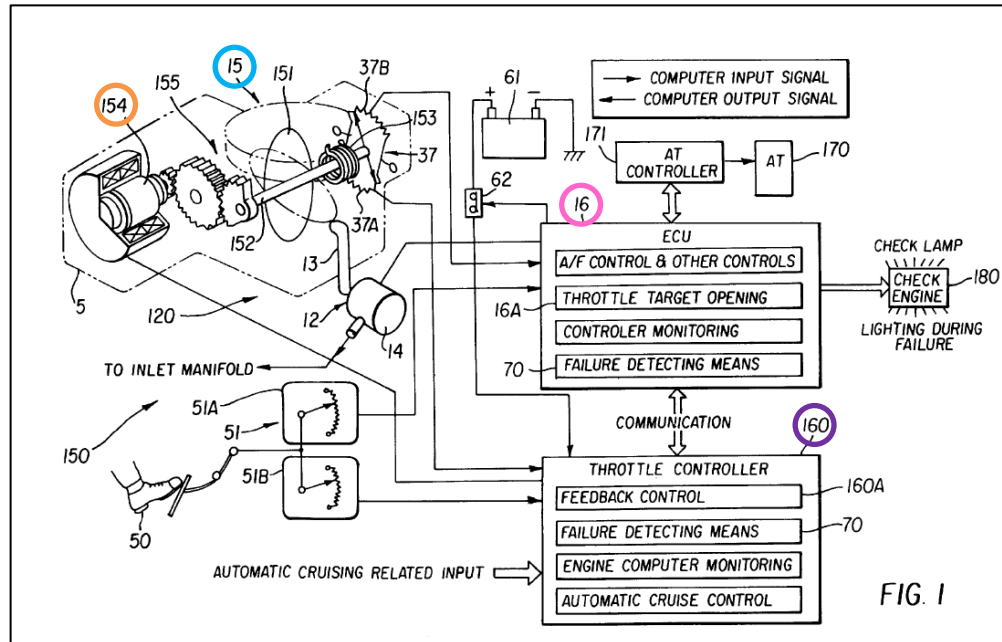
“a failure of DBW may occur when the throttle valve controlled by DBW is stuck or fixed at a certain position because of foreign matters, such as dust, contained in exhaust gases recirculated by an exhaust gas recirculation system, or blow-by gas.” EX1008, 2:66-3:3.³ This teaching in Matsumoto about foreign matter causing the throttle valve to become stuck is consistent with the '804 patent, which states that small debris can obstruct movement of the throttle plate. See EX1001, 4:10-12, 4:45-47. In Matsumoto's system, “[i]f the DBW system fails, the opening of the throttle valve cannot be appropriately controlled by the DBW system” EX1008, 3:4-7. Accordingly, “an object of the present invention [in Matsumoto is] to provide a control apparatus of an internal combustion engine with an electronic throttle control device, wherein the burden on the driver can be reduced during running of the vehicle when the electronic throttle control device fails.” EX1008, 3:13-18.

82. Matsumoto discloses the generic structure in the '804 patent. Shown below in Figure 1, Matsumoto's system has: (1) an electronic controlled throttle valve 15; (2) an electric motor (throttle actuator) 154 that detects current from the throttle controller; and (3) an engine control computer (ECU) 16 and a throttle

³ A DBW is a drive-by-wire system—a system where the accelerator pedal and throttle valve are not mechanically connected and that uses both the position of the accelerator pedal and other parameters to control the throttle. EX1008, 1:16-27.

control computer (throttle controller) 160 to open/close the throttle valve 15.

EX1008, 3:63-4:6, 4:60-67, 5:18-21, 6:62-7:3.

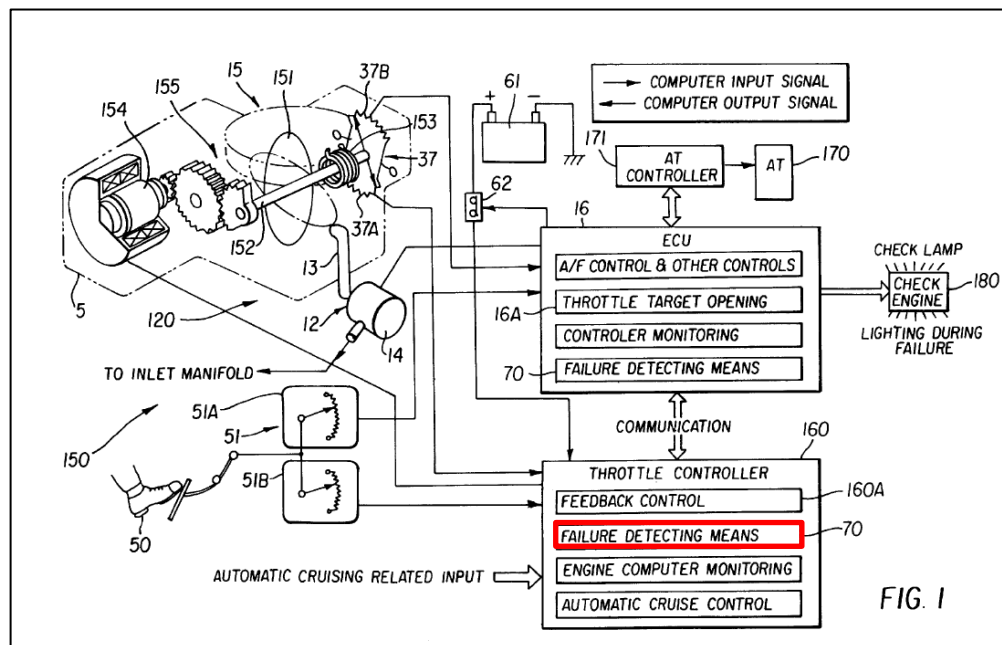


EX1008, FIG. 1 (annotated).

83. Shown above, “[t]he throttle body 5 is provided with an electronic controlled throttle valve 15 which is electrically controlled, and the opening of this electronic controlled throttle valve 15 is controlled by means of a throttle control computer (throttle controller) 160” EX1008, 3:63-67. “The target opening (target throttle opening) of the throttle valve 15 is determined by an engine control computer (engine ECU) 16 . . . depending upon an amount of depression of an accelerator pedal 60 (accelerator pedal position) detected by an accelerator position sensor (APS1) 51A, and operating conditions of the engine.” EX1008, 3:67-4:6. “The electronic controlled throttle valve 15, engine ECU (control means) 16, throttle

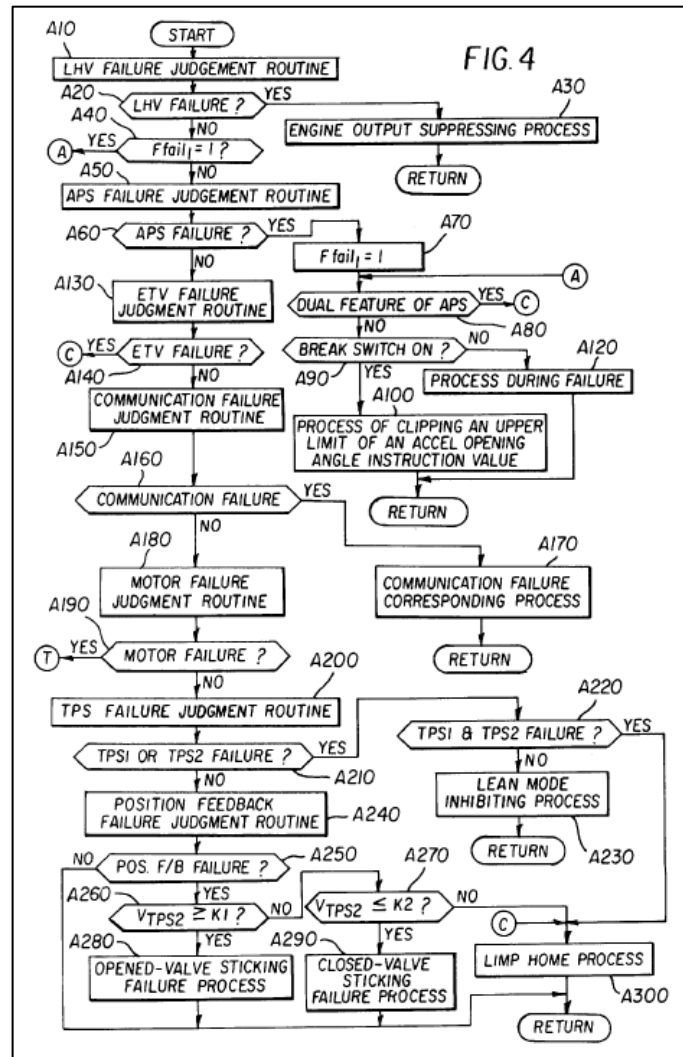
controller 160 and others constitute an electronic throttle control device (namely, drive-by-wire (DBW) 150 shown in FIG. 1).” EX1008, 4:7-10.

84. As outlined in red below, the throttle controller 160 has a failure detecting means 70 that detects whether the throttle is stuck. EX1008, 8:39-9:67, 14:35-39. The failure detecting means 70 detects a failure when the difference between a target throttle opening and the actual throttle opening is “greater than a predetermined opening (for example 1°) over a predetermined time (for example, 500 ms).” EX1008, 14:41-52.



EX1008, FIG. 1 (annotated).

85. Figure 4 shows Matsumoto’s process for detecting a failure in the throttle valve. The failure detecting means 70 detects a failure in the throttle valve at step A250. See EX1008, 20:1-40, FIG. 4.



EX1008, FIG. 4.

86. After the system detects a failure in the throttle valve at step A250, Matsumoto's system performs: (1) the opened-valve sticking failure process, (2) the closed-valve sticking failure process, or (3) the limp home process based on the voltage of a throttle position sensor (V_{TPS2}). EX1008, 20:17-39, FIG. 4. If the voltage of the throttle position sensor is greater than or equal to K1, Matsumoto's system performs the opened-valve sticking failure process. EX1008, 20:22-25, FIG.

4. If the voltage of the throttle position sensor is less than or equal to K2, Matsumoto's system performs the closed-valve sticking failure process. EX1008, 20:26-35, FIG. 4. And if the voltage of the throttle position sensor is between K1 and K2, Matsumoto's system performs the limp home process. EX1008, 20:36-39, FIG. 4.

87. During the opened-valve sticking failure process (A280), Matsumoto's system performs the following remedial measures:

(1) the air bypass valve 12 is turned off (closed), so as to restrict the amount of intake air, (2) the fuel injection mode is limited to the first lean-burn mode (compression stroke injection mode), (3) the fuel supply or injection into part of cylinders (for example, three cylinders in the case of a six-cylinder engine) is stopped, namely, fuel cut is conducted with respect to part of the cylinders, (4) EGR control is stopped (EGR cut), (5) the fuel supply or injection into all of the cylinders is stopped (fuel cut) when the engine speed N_e is in a certain range of high-speed rotation ($N_e \geq 3000$ rpm), so as to avoid an excessively large engine output, and (6) those of accessories driven by the engine, which may be stopped without adversely influencing the operation of the engine, are turned off and their operations are stopped (in this embodiment, the air conditioner is turned off).

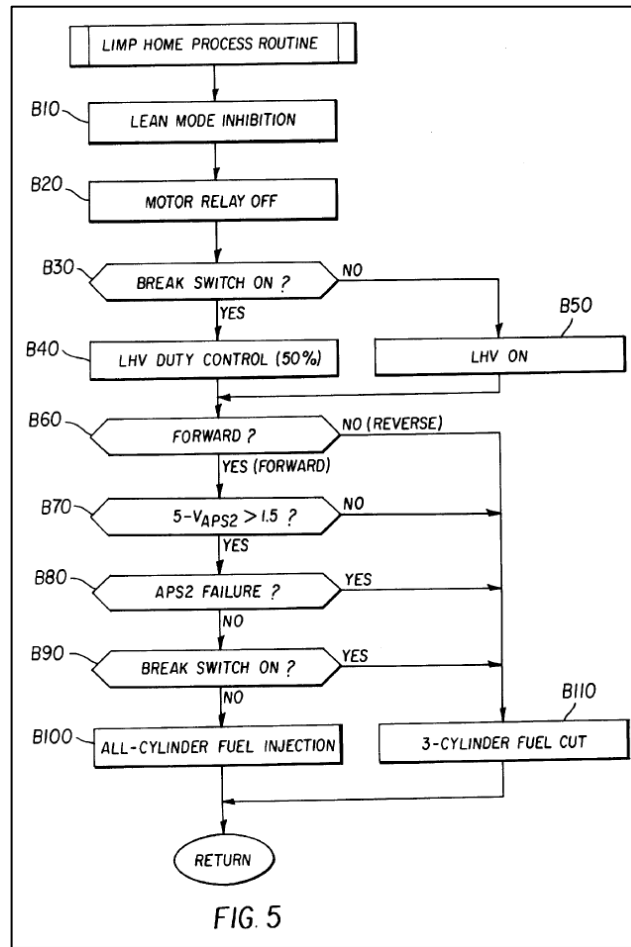
EX1008, 20:40-57.

88. During the closed-valve sticking failure process (A290), Matsumoto's system uses an air bypass valve to ensure a sufficient amount of intake air. *See* EX1008, 4:11-22, 21:22-26. Matsumoto explains:

[A]n air bypass valve device 12 is provided in parallel with the electronic control throttle valve 15. This air bypass valve device 12 serves to supply air so as to accomplish combustion in the engine while the electronic controlled throttle valve is at fault (for example, the valve is stuck at its closed position) as described later. The air bypass valve device 12 consists of a bypass passage 13 provided upstream of the surge tank 8 so as to bypass the electronic controlled throttle valve 15, and an air bypass valve body 14 mounted in this bypass passage 13. The air bypass valve body 14 is driven by a linear solenoid (not shown) that is controlled by the engine control computer (engine ECU) 16

EX1008, 4:11-22.

89. During the limp home process (A300), Matsumoto's system cuts off power to the throttle controller. *See* EX1008, 22:16-21. "FIG. 5 shows a routine of the air bypass operation performed in step A300." EX1008, 22:9-10.



EX1008, FIG. 5.

90. At step B10, the system inhibits a lean-burn mode to avoid the need for highly accurate throttle control. EX1008, 22:11-15. Then, at step B20, the system turns off motor relay (power supply relay) 62. EX1008, 22:16-17. “As a result, no power is supplied to the throttle controller 160, and the throttle valve 15 is no longer controlled by means of the throttle controller 160.” EX1008, 22:18-20. “Thus, only the air bypass valve 14 is controlled so as to adjust the amount of intake air.” EX1008, 22:20-22. After the electric motor for the throttle valve is shut off, the

system determines at step B30 whether the brake switch is ON (i.e., whether the driver is applying the break). EX1008, 22:23-24. “If the break switch is OFF, step B50 is then executed to place the air bypass valve 14 in the ON state.” EX1008, 22:46-47. “If the break switch is ON, step B40 is executed to control the air bypass valve 14 at a certain duty cycle for a predetermined period of time (for example, 2 seconds).” EX1008, 22:25-27. “By limiting the duty control of the air bypass valve 14 to within the predetermined time, the solenoid of the valve 14 exhibits high durability.” EX1008, 22:43-45. The remaining steps B60-B110 determine whether the system should cut the fuel by looking at whether the vehicle is moving in reverse and the voltage of an accelerator position sensor (V_{APS2}). EX1008, 22:49-23:17. “During the air bypass operation, an alarm lamp 180 is turned on.” EX1008, 23:18-19. This alarm lamp 180 is a conventional check engine light. *See* EX1008, FIG. 1.

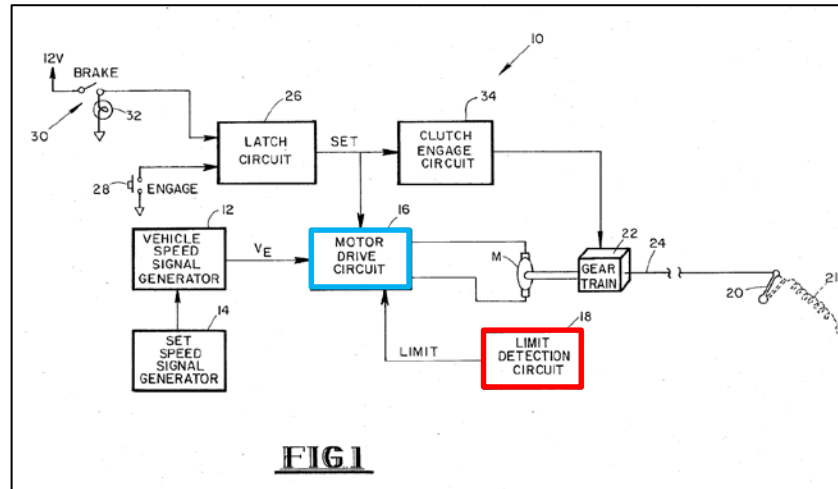
91. Matsumoto discloses the structure recited in the claims of the '804 patent and a process that detects when the throttle valve is stuck. When the throttle is stuck between a fully open and fully closed position (between K1 and K2), the system turns off power to the electric motor. To the extent Matsumoto's system does not reduce a control effort when the control effort exceeds a threshold for a predetermined time period, Burney and Ritenour both provide this teaching.

C. Burney discloses a circuit to limit the control effort when the throttle motor stalls, including when the throttle is stuck.

92. Burney discloses a cruise control system that has an electric servomotor for moving a throttle. EX1006, 1:5-15, 2:17-24. The system includes a method for “detecting when the servo motor is running in a stall position so the motor’s operation can be modified to prevent damage to the motor and gear reduction system.” EX1006, 1:8-15. In Burney’s system, “[w]hen the servo motor moves a vehicle’s throttle to its full-throttle position, so that operational travel of the servo motor is inhibited, the drive current of the servo motor will increase.” EX1006, 3:24-28. “This increase is sensed by limit detection circuitry to produce a limit signal that is used by the motor drive circuit to terminate the drive current.” EX1006, 3:28-30. “A similar circuit may be provided to terminate the drive current when the servo is in the idle position” EX1006, 3:30-35. “[B]y sensing the stall condition of the servo motor, the servo motor can be limited or terminated, even though the full-throttle or idle position is not reached.” EX1006, 4:11-14.

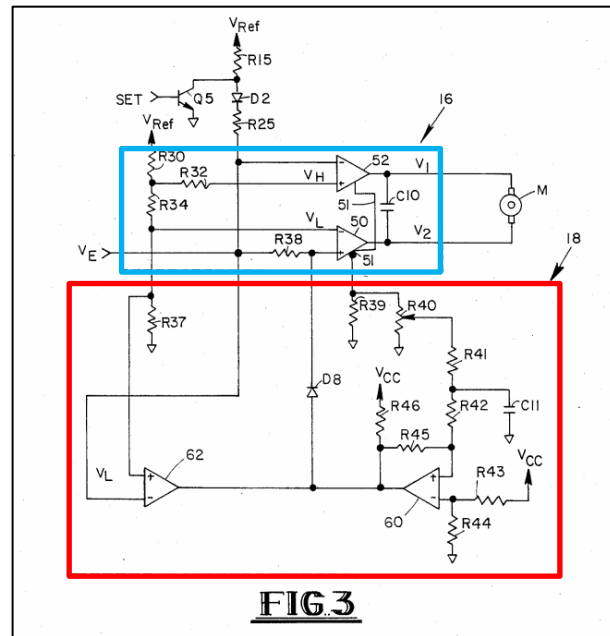
93. “FIG. 1 is a block diagram of an electric motor servo control system” EX1006, 4:32-33. “If the error between the actual vehicle speed and desired vehicle speed is large enough, the throttle valve (not shown) will be moved to its full throttle position by the rotational movement of motor M.” EX1006, 7:51-55. When the throttle is fully open and the motor is in a stall condition, “[l]imit detection circuit 18 will sense this condition, and generate the LIMIT signal.” EX1006, 7:55-

57; *see also* EX1006, 4:11-14, 5:7-10, FIG. 1. “Responding to the LIMIT signal, the motor driven circuit will terminate drive current to the motor M” EX1006, 7:57-63.



EX1006, FIG. 1 (annotated).

94. Figure 3 (reproduced below) shows an embodiment of the motor drive circuit (outlined in blue) and the limit detection circuit 18 (outlined in red). EX1006, 4:36-38, 9:16-23. I explain the circuit for each in turn below.



EX1006, FIG. 3.

95. Shown above, the motor drive circuit uses two amplifiers 50 and 52 to control whether the throttle opens or closes. See EX1006, 9:16-29, 9:58-10:16; see also EX1006, 1:8-15, 2:16-21, 5:4-7 (driving the motor M moves the throttle). A voltage V_E (shown on the far left of the motor drive circuit) is received from a vehicle speed generator 12 and a set speed signal generator 14. EX1006, 4:68-5:4, FIGS. 1-2. This voltage V_E is coupled to the inverted (–) input of amplifier 52 and non-inverted (+) input of amplifier 50. See EX1006, 9:25-28, FIG. 3. The non-inverted (+) input of amplifier 52 is coupled to a reference voltage V_H , and the inverted (–) input of amplifier 50 is coupled to a reference voltage V_L . See EX1006, 9:25-28, FIG. 3. If the voltage V_E is less than V_L , the output of amplifier 52 (V_1) is HIGH, and the output of amplifier 50 (V_2) is LOW. See EX1006, 9:66-10:6, 10:61-

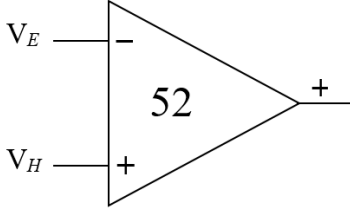
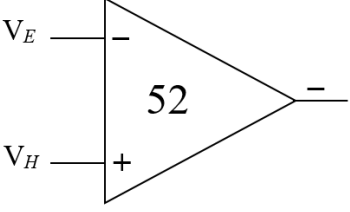
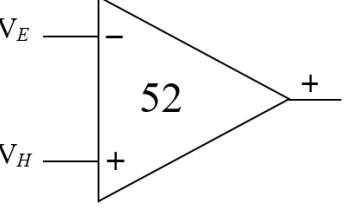
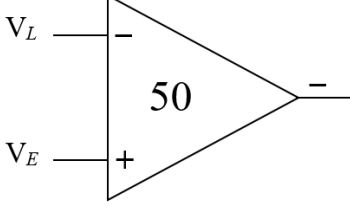
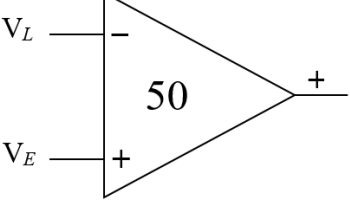
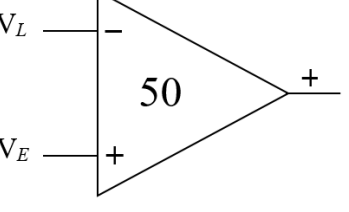
67, FIG. 3.⁴ This difference in voltage between V_1 and V_2 causes the motor M to actuate. EX1006, 10:6-8, 11:2-6. If the voltage V_E is greater than V_H , the output of amplifier 52 (V_1) is LOW, and the output of amplifier 50 (V_2) is HIGH. EX1006, 10:8-14, FIG. 3. This difference in voltage between V_1 and V_2 causes the motor M to actuate, this time in the reverse direction. EX1006, 10:11-14. Finally, if the voltage V_E is greater than V_L but less than V_H , the vehicle is traveling at the desired speed. See EX1006, 9:58-65, FIG. 3. In this situation, the output of amplifier 52 (V_1)

⁴ At the citation 9:66-68, a POSA would have understood that “greater than” should be “less than.” See, e.g., EX1006, 12:31-13:4, FIGS. 5a-5c. A POSA would have also understood, reading Burney as a whole, that the sentence at 10:67-11:2 should read: “The error voltage V_E will be *less than* the voltage levels V_H and V_L , causing the output voltage V_2 of amplifier 50 to be *LOW* while the output voltage V_1 of the amplifier 52 will be *HIGH*.” A POSA would have had this understanding because when the motor stalls in the fully open throttle position, Burney states that amplifier 60 in the LIMIT detection circuit 18 turns from LOW to HIGH, which causes the output of amplifier 50 to also turn from LOW to HIGH. See EX1006, 11:7-31; see also EX1006, 14:19-27 (when V_E is less than V_L , the system supplies current to the motor to open the throttle valve), 11:35-42, 14:46-56 (when V_E is greater than V_H , the system supplies current to the motor to *close* the throttle valve).

is HIGH, and the output of amplifier 50 (V_2) is HIGH. EX1006, 9:58-63, FIG. 3.

Because there is no difference between V_1 and V_2 , the motor M does not actuate.

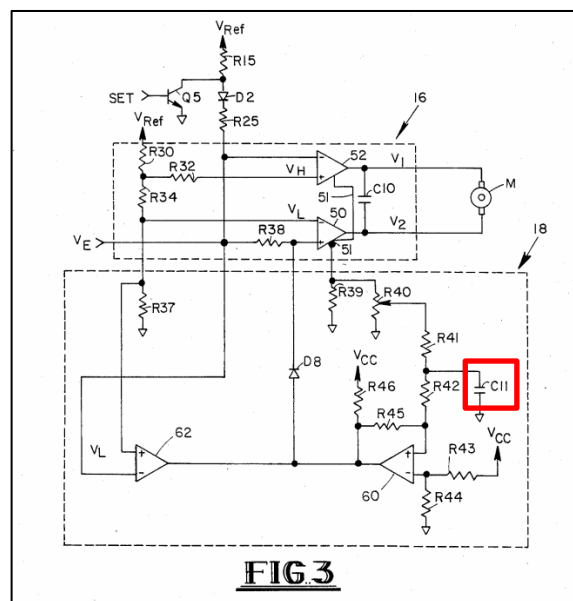
EX1006, 9:63-65. For convenience, I have produced a figure that shows the various states of amplifiers 50 and 52.

$V_E < V_L$ Speed Up / Open Throttle Valve	$V_E > V_H$ Slow Down / Close Throttle Valve	$V_L < V_E < V_H$ Maintain Current Throttle Position
		
		

96. The limit detection circuit 18 includes an amplifier 60 to determine when the control effort exceeds a threshold. See EX1006, 10:17-43, FIG. 3. The inverted (−) input of amplifier 60 is coupled to a threshold voltage V_{cc} . See EX1006, 10:25-29, FIG. 3. The noninverted (+) input of amplifier 60 “is directly related to the drive current of the motor M.” EX1006, 10:29-34. When the drive current of the motor M exceeds the threshold voltage V_{cc} —e.g., when the throttle motor stalls in a fully open position—the output of the amplifier 60 switches from LOW to HIGH.

See EX1006, 10:34-39, 11:15-25, 13:5-27. This HIGH output is coupled to the noninverting (+) input of amplifier 50 of the motor drive circuit 16, which makes the output of amplifier 50 positive. EX1006, 10:39-41, 11:26-29. “Because the output of amplifier 52 is also positive, the motor M will cease to rotate.” EX1006, 10:41-43, 11:29-31. Burney’s system therefore limits the drive current to the motor M when the motor M is stalling in the fully open position.

97. Burney’s limit detection circuit reduces the drive current when the control effort exceeds a threshold (the voltage at the inverted (–) terminal of amplifier 60) *after a predetermined time period* because, as Figure 3 shows below, the limit detection circuit includes “an integrating filter, formed by resistor R41 and capacitor C11.” EX1006, 10:21-24. This capacitor C11 defines the time the circuit takes before comparing the drive current with the threshold at amplifier 60.



EX1006, FIG. 3 (annotated).

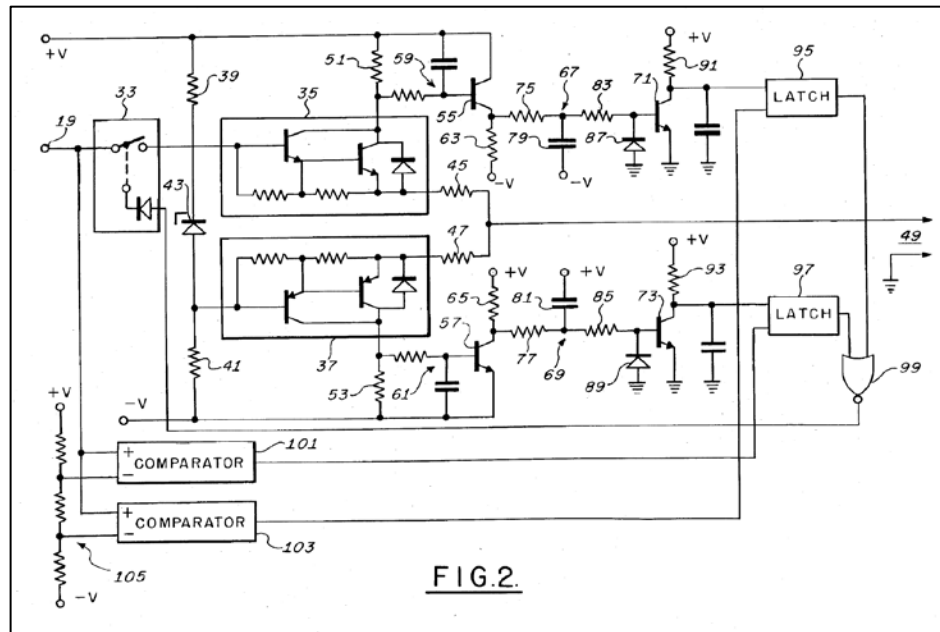
98. Burney's system can also limit the drive current when the motor M is stalling in the fully closed position. As Burney explains, "[a] similar circuit may be provided to terminate the drive current when the servo is in the idle position" EX1006, 3:30-35; *see also* EX1006, 13:31-36 (stating that multiple limit detection circuits can control the motor M when the throttle reaches both the idle and full throttle position). A POSA would have understood that the similar circuit would still limit the drive current when the drive current exceeds a threshold voltage V_{cc} while trying to open the throttle valve. *See* EX1006, 11:7-25. The similar circuit, however, will also limit the drive current when the drive current exceeds a threshold voltage V_{cc} while trying to close the throttle valve. *See* EX1006, 3:30-35. As Burney explains, the system will close the throttle when the voltage V_E is greater than V_H —i.e., the vehicle is traveling faster than desired. EX1006, 11:35-42. In this case, V_1 will be LOW and V_2 will be HIGH. EX1006, 11:35-39. If the system continues to remain in a state where V_E is greater than V_H (e.g., when driving down a steep decline), the motor M can actuate the throttle to its fully closed position and thereafter stall. *See* EX1006, 13:9-27, 14:46-56. When the motor stalls, the drive current will increase, which will cause the output of amplifier 60 to turn from LOW to HIGH. *See* EX1006, 11:7-25, 13:20-27. In the similar circuit, a POSA would have understood that the LIMIT signal will cause the motor M to terminate. *See*

EX1006, 11:29-31, 12:38-41. Accordingly, Burney's system limits the drive current to the motor M when the motor M is stalling in the fully closed position.

99. For these reasons, Burney's system limits the drive current (the control effort) when the drive current exceeds a threshold for a predetermined time period.

D. Ritenour discloses a servomotor control system that reduces current when current exceeds a threshold for a time period.

100. Ritenour discloses "[a] servosystem drive current [that] includes means for sensing instances when the servomotor drive current exceeds a preset threshold level for a given time, and means for terminating the flow of current until a sufficiently strong command signal attempts to reverse the direction of rotation of the servomotor." EX1027, 1:30-35. Figure 2 (reproduced below) is a circuit diagram illustrating a typical drive circuit employing these principles. EX1027, 1:30-35. As the circuit shows below, abnormally high current "will cause the transistor 55 [or 57] to conduct, thereby beginning to charge the timing capacitor 79 [or 81]." EX1027, 3:33-35, FIG. 2. Once the capacitor is charged, the circuit terminates the current by opening switch 33: "If the amplifier 35 remains 'ON' long enough, it will charge the capacitor 79 sufficiently to switch the transistor 71 'ON' so as to produce a digital signal suitable to set the latch 95 and coupled a logic '1' or NOR gate 99 thereby opening the switch 33." EX1027, 3:35-39, FIG. 2. Ritenour thus terminates the current when the current exceeds a threshold for a predetermined time period.



EX1027, FIG. 2.

E. The GM Manual and the Chrysler Manual are reference manuals that show that a car battery typically supplies up to 14.5 volts.

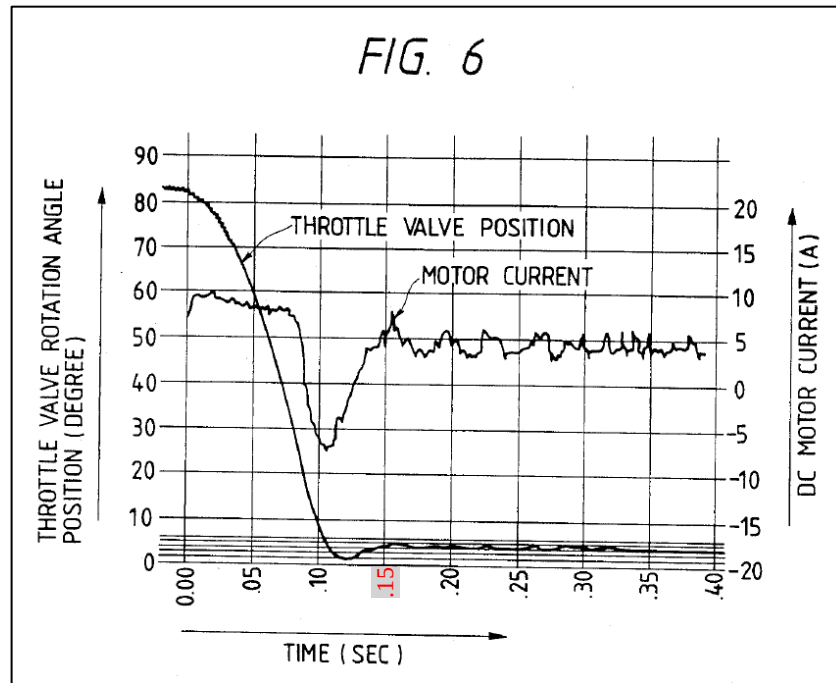
101. Several dependent claims of the '804 patent recite the voltages used in the throttle control system. The GM Manual states that a car battery typically supplies up to 14.5 volts. EX1023, GM Manual, p. 94; *see also* EX1021, BMW Manual, p. 39. The Chrysler Manual also states that a car battery supplies up to 14.6 volts. EX1024, Chrysler Manual, p. 3-9.

102. Exhibit 1021 (BMW Manual) and Exhibit 1023 (GM Manual) are true copies of the manuals in my collection and were publicly available before the October 9, 2001 filing date of the '804 patent. *See* EX1021, p. 0002 (August 2001); EX1023, p. 0002 (April 1995). Exhibits 1021 and 1023 are manuals that came with the Snap-on MT2500 scanner. The MT2500—also commonly called the “Red

Brick”—was the first handheld diagnostic tool to enable mechanics to diagnose trouble codes. It was widely used throughout the certified Automobile technician sector at least in the early 1990s and is still used today. *See* EX1031, pp. 1-2; EX1032, p. 2. It was one of the most common and familiar scanners used with the onboard diagnostics OBD II systems from 1995 onward. The complete “kit” package included both the MT2500 scanner and the manuals. *See* EX1033, p. 1 (“Kit includes new cartridge, 5 new manuals . . .”). The manuals, including Exhibits 1021 and 1023, were also available for purchase separately from Snap-on. Accordingly, a POSA would have been well aware of and know where to locate these Snap-on manuals. A POSA would have also been aware that technicians in the field of art commonly used these manuals.

F. Ohta discloses a graph showing the relationship between throttle position, current, and time.

103. Several dependent claims of the '804 patent recite the time periods used in the throttle control system. Ohta discloses, in Figure 6 (reproduced below), the time a throttle valve takes to move from an open position to a closed position.



EX1020, FIG. 6 (annotated to correct a typo).

IX. GROUND 1: ITABASHI RENDERS OBVIOUS CLAIMS 1, 4, 7, 8, 11, 14, 15, AND 18.

A. Claim 1

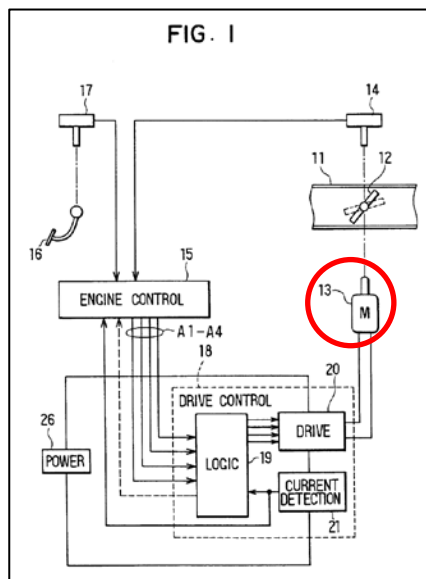
1. [1.P] “A method for controlling a positioning device of an internal combustion engine”

104. To the extent the preamble is limiting, Itabashi discloses the preamble.

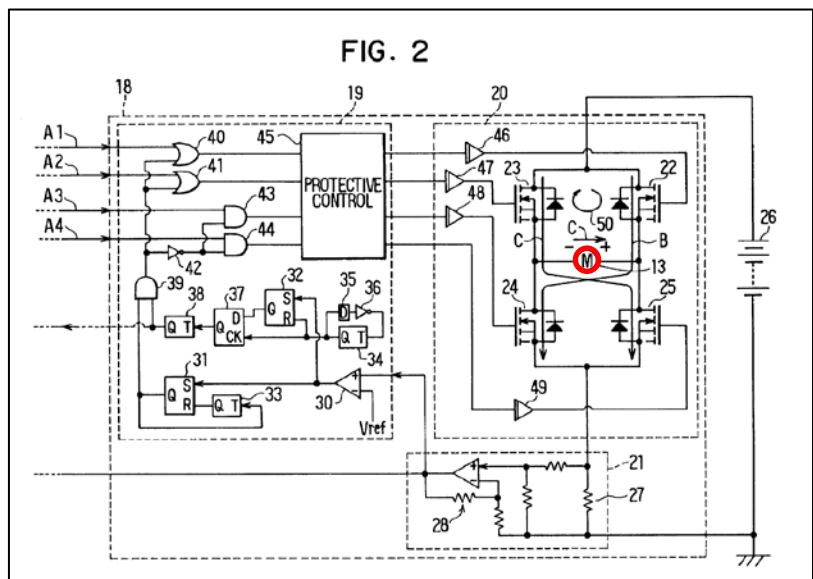
As Itabashi states, its “invention relates to a motor drive control apparatus and method having a motor current limit function, which can be applied to a motor driven throttle valve control in an internal combustion engine.” EX1007, 1:13-16; *see also* EX1007, 8:16-36.

2. [1.A] “providing an electric motor for actuating the positioning device”

105. Itabashi discloses this element because the system provides “an electrically-driven direct current motor 13.” EX1007, 2:48-50. The motor 13 is for actuating the positioning device because “the motor 13 is required to produce a torque for driving the throttle valve 12 in the opening direction against the return spring.” EX1007, 2:54-56. As shown below, “the drive control circuit 18 drives the motor 13 to rotate the throttle valve 12 to a target position corresponding to the detected actual accelerator pedal position.” EX1007, 3:7-10.



EX1007, FIG. 1 (annotated).

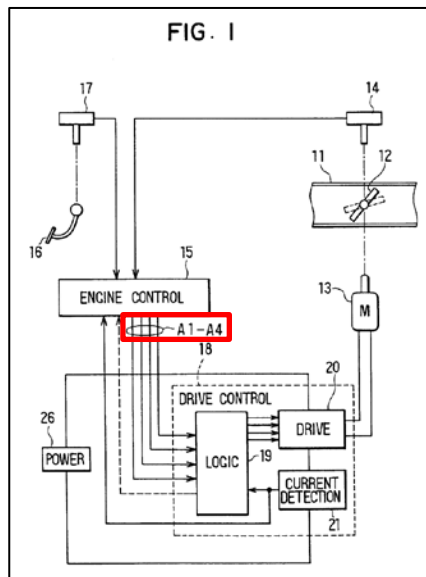


EX1007, FIG. 2 (annotated).

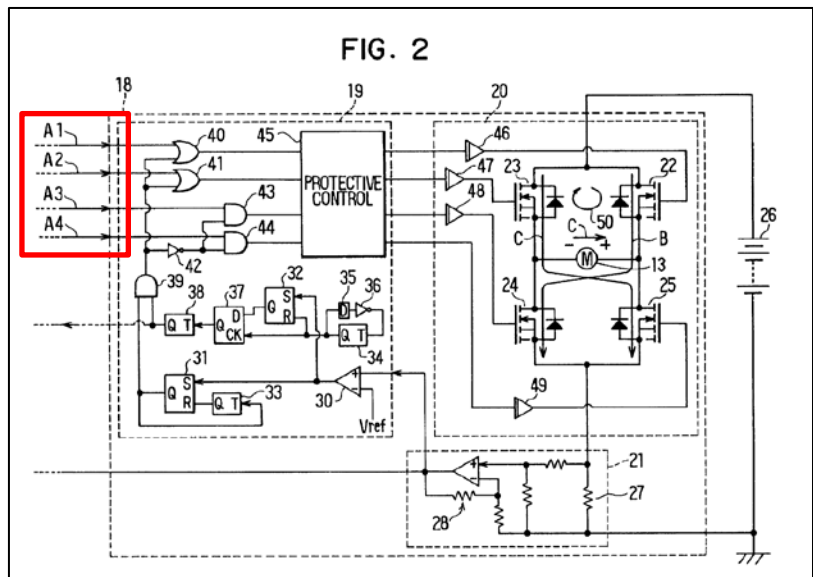
3. [1.B] “commanding the positioning device to change to a commanded position”

106. Itabashi discloses this element. Shown below, “[t]he engine control circuit 15 produces drive command signals A1-A4 to a drive control circuit 18 in

correspondence with the output signals of the throttle sensor 14 and the accelerator sensor 17.” EX1007, 3:4-7. The command signals A1-A4 command the throttle to move to a commanded position because “the drive control circuit 18 drives the motor 13 to rotate the throttle valve 12 *to a target position* corresponding to the detected actual accelerator position.” EX1007, 3:7-10; *see also* EX1007, 8:6-36.

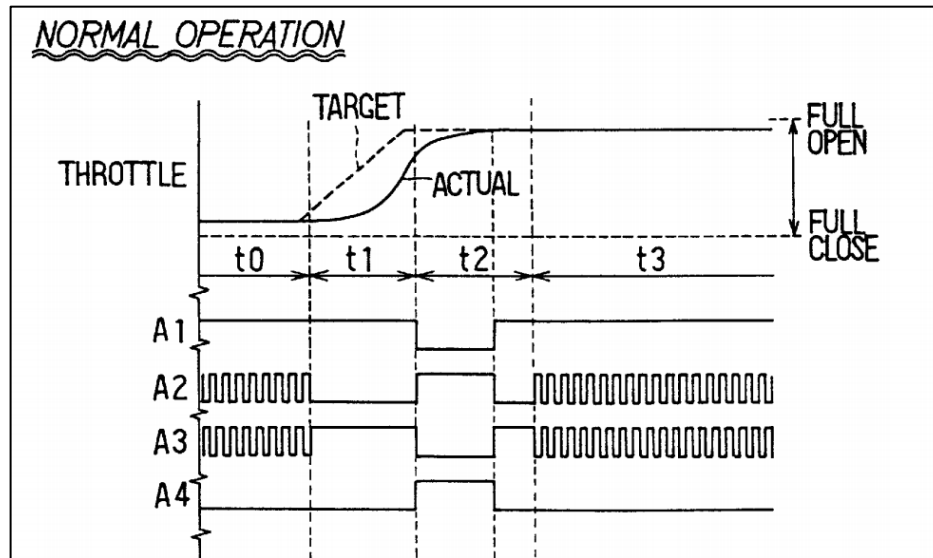


EX1007, FIG. 1 (annotated).



EX1007, FIG. 2 (annotated).

107. During normal operation, command signals A1-A4 cause the throttle valve 12 to move to the target position, as the timing diagram shows below.



EX1007, FIG. 3 (excerpted); *see also* EX1007, 6:28-57.

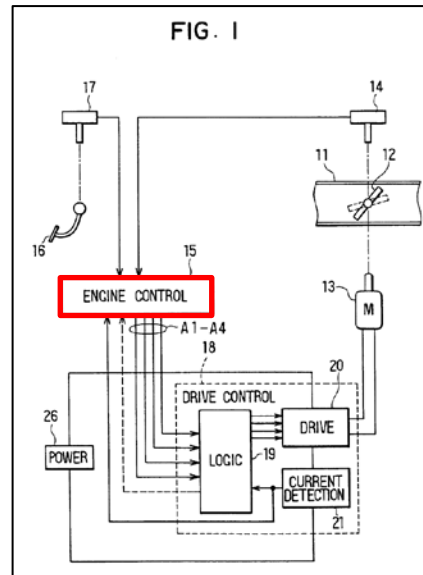
4. [1.C] “detecting a control effort required to change to said commanded position”

108. The '804 patent explains that “motor voltage, current, [and] duty cycle” are examples of a “control effort”: “Typically, the actuator or servomotor used to position the throttle plate is designed to have the maximum control effort available (*motor voltage, current, duty cycle*) to enhance throttle plate position response.”

EX1001, 1:36-39. With this understanding, Itabashi discloses “detecting a control effort required to change to said commanded position” in several different ways.

109. First, Itabashi’s system has an engine control circuit 15 that detects control effort from the throttle sensor 14 and the accelerator sensor 17: “The output signals of the throttle sensor 14 and the accelerator sensor 17 are applied to an engine control circuit 15, which in turn controls the throttle valve 12 through the motor 13....” EX1007, 2:66-3:3. The engine control circuit 15 then determines the

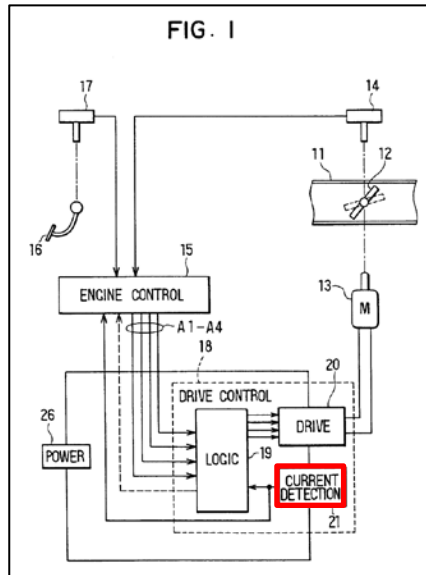
control effort required to change the throttle to the commanded position: “The engine control circuit 15 produces drive command signals A1-A4 to a drive control circuit 18 in correspondence with the output signals of the throttle sensor 14 and the accelerator sensor 17.” EX1007, 3:4-7.



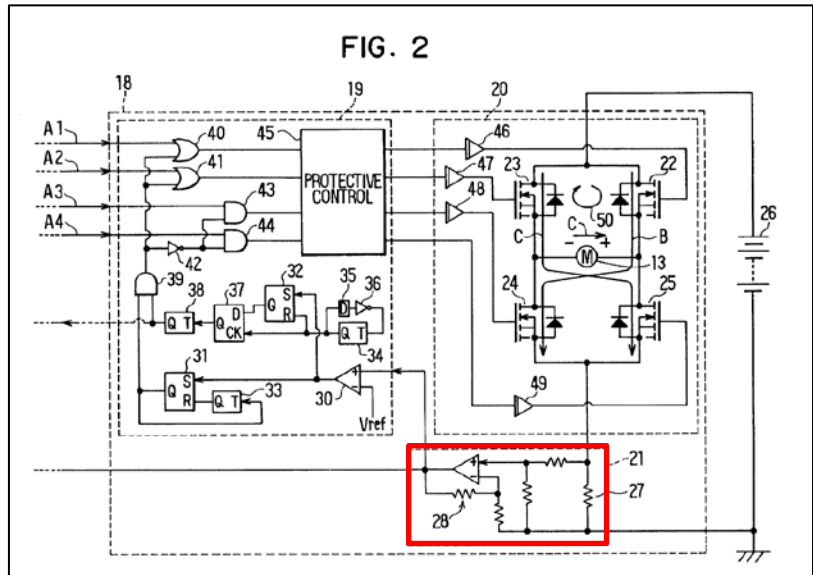
EX1007, FIG. 1 (annotated).

110. Second, Itabashi’s system has “a current detection circuit 21 which detects a motor current, i.e., an electric current supplied from the drive circuit 20 to the motor 13.” EX1007, 3:11-16. The detected motor current is required to move the throttle to the commanded position because “the engine control circuit 15 drives the motor 13 with the motor current of 100% duty ratio during the time period t1 so that the actual throttle position approaches the target throttle position in a short period of time.” EX1007, 6:46-51. Then, “[t]he motor current flows in the forward direction

indicated by an arrow B in FIG. 2 to maintain the opening position of the throttle valve 12 against the return spring.” EX1007, 6:36-39.



EX1007, FIG. 1 (annotated).



EX1007, FIG. 2 (annotated).

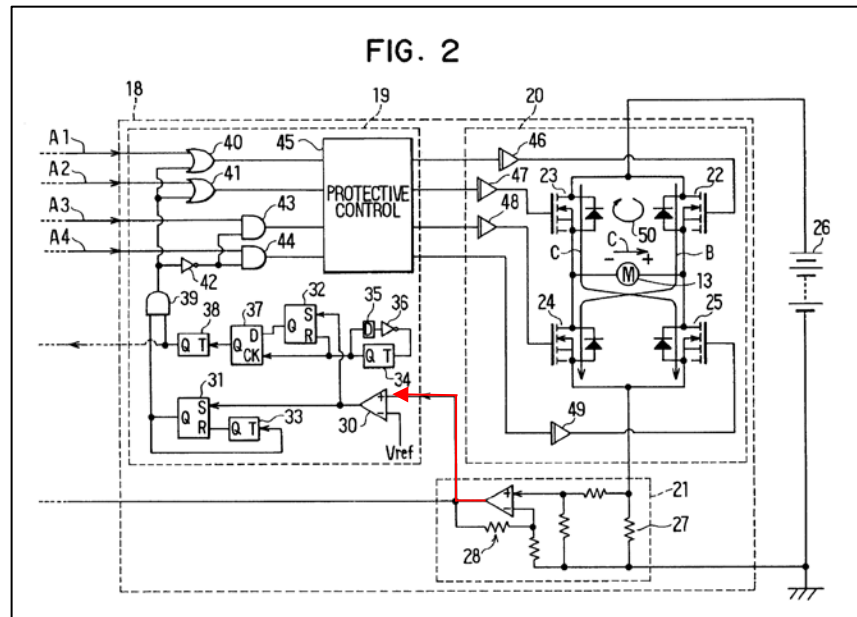
111. Third, the drive circuit 20 uses MOSFETs 22-25 to detect the control effort required to move the throttle to the commanded position. MOSFETs 22-25 are coupled to the electric motor 13. EX1007, 3:33-42. And MOSFETs 22-25 are intended to detect the drive current (the control effort) because the MOSFETs 22-25 selectively turn on to supply the motor current to the electric motor 13. EX1007, 6:1-5, 6:66-7:3. For a MOSFET, there are three terminals. See EX1007, FIG. 2. The source with an input current I_S , the drain with output current I_D , and the gate with voltage V_G , that modulates the channel conductivity and therefore the output drain current, I_D , to drain to source voltage. In Itabashi, the MOSFETs detect the voltage V_G (the control effort) from the drive logic circuit 19. See EX1007, FIG. 3.

112. For these reasons, Itabashi's system detects a control effort required to change the throttle to the commanded position. *See also* EX1007, 3:48-51, 6:19-24.

5. [1.D] “determining whether said control effort exceeds a threshold for a predetermined time period”

113. Itabashi discloses this element. As I explain in Section VIII.A, Itabashi determines whether the motor current (the control effort) exceeds V_{ref} (a threshold) for a predetermined time period t_{38} .

114. Figure 2 (annotated below) shows the current detection circuit 21 sending the current indicator to the drive logic circuit 19. *See* EX1007, 3:44-47, FIG. 2. “The output signal of the current detection circuit 21 [is] indicative of the motor current flowing in the motor 13” EX1007, 3:44-47. “In the drive logic circuit 19, a comparator 30 is provided to compare the output signal of the current detection circuit 21 with a reference signal V_{ref} , which is set to correspond to the maximum limit level of the motor current.” EX1007, 3:48-51.

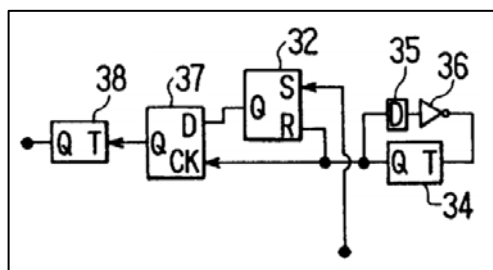


EX1007, FIG. 2 (annotated).

115. A POSA would have understood that V_{ref} is a threshold. When the output signal of the current detection circuit 21 is higher than V_{ref} , the output of comparator 30 becomes high. EX1007, 3:48-51, 3:58-59, FIG. 2. When the output of comparator 30 becomes high, the drive logic circuit 19 determines that the motor current (the control effort) exceeds V_{ref} (a threshold).

116. The drive logic circuit also determines whether the motor drive current (the control effort) exceeds V_{ref} (a threshold) *for a predetermined time period*. As I explain in Section VIII.A, the system does not immediately reduce the motor current when the motor current exceeds V_{ref} . *Compare* EX1007, FIG. 4 (LATCH 31), *with* EX1007, FIG. 4 (MOTOR CURRENT). Rather, the system allows the motor current to exceed V_{ref} for a predetermined time period t_{38} (e.g., during the initial stage of

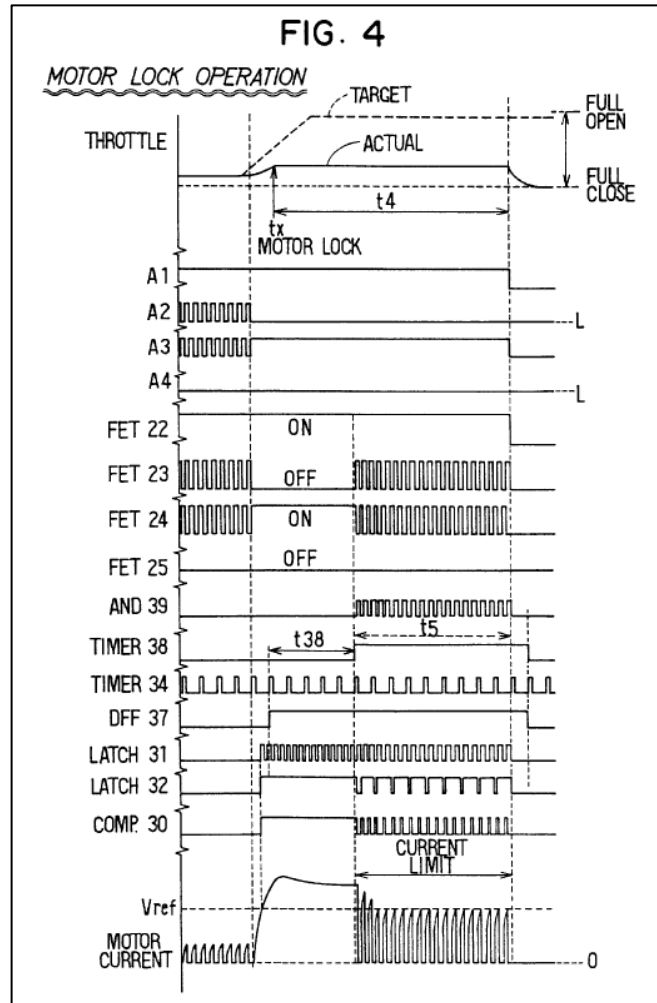
motor drive or the initial stage of motor brake). See EX1007, 1:58-2:6, 5:21-35, 8:16-24, FIG. 4. To allow the motor current to exceed V_{ref} for a certain time period, the system uses the following circuitry. In the circuitry, timer 34 produces a pulse signal based on a predetermined time period t_{34} . See EX1007, 4:18-39, FIGS. 3, 4. This pulse signal is input to the R terminal of RS-latch 32 and a clock input terminal CK of a D-type flip-flop (DEF) 37. EX1007, 4:18-21, 4:40-44. “When the RS-latch 32 receives at its set terminal S the high level signal from the comparator 30 indicating that the motor current is in excess of the limit level, the RS-latch 32 is set to produce a high level output signal from its output terminal Q to the data input terminal D of the D-type flip-flop 37.” EX1007, 4:45-50. The D-type flip-flop 37 then produces a high output signal to an input terminal T of timer 38. EX1007, 4:55-65. After the predetermined time period of timer 38— t_{38} —the output Q of timer 38 becomes high. EX1007, 5:8-16, FIG. 4.



EX1007, FIG. 2 (cropped).

117. The drive logic circuit 19 therefore determines whether the motor current exceeds V_{ref} for a predetermined time period (t_{38}). As Figure 4 shows

below, the system determines that the motor current exceeds the low level V_{ref} for a predetermined time period t_{38} . See EX1007, FIG. 4.

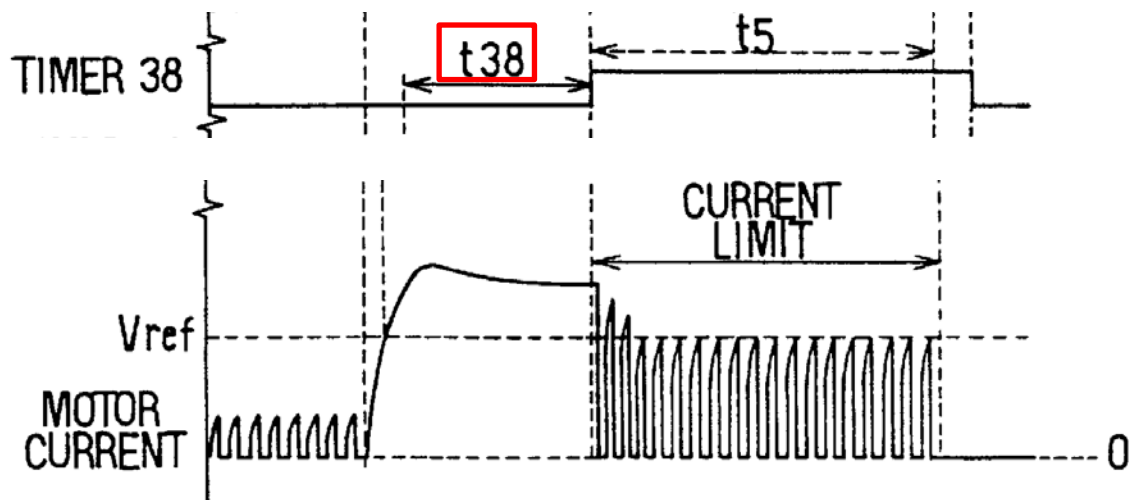


EX1007, FIG. 4.

118. For these reasons, Itabashi discloses a system that determines whether the control effort exceeds a threshold for a predetermined time period.

6. [1.E] “reducing said control effort when said control effort exceeds said threshold for said predetermined time period”

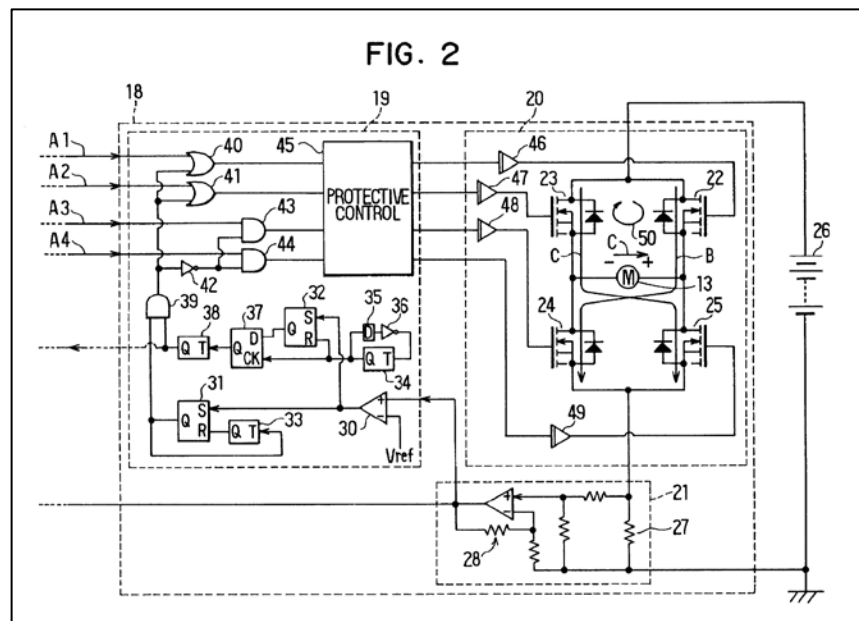
119. Itabashi discloses this element because after the motor current exceeds V_{ref} for predetermined time period t_{38} , Itabashi’s system reduces the motor current as the timing diagram shows below. See EX1007, FIG. 4.



EX1007, FIG. 4 (excerpted and annotated).

120. Figure 2 shows how Itabashi’s system reduces the motor current when the motor current exceeds V_{ref} for time period t_{38} . After time period t_{38} , the output of timer 38 becomes high, which causes AND gate 39 to turn high (the other input of AND gate 39 was already high from the output of latch 31). EX1007, 5:36-38, 7:28-30, FIG. 4. As Figure 2 shows below, the output of AND gate 39 changes the commands A1-A4 via OR gates 40 and 41 and AND gates 43 and 44. EX1007, 5:44-48, FIG. 4. When the output of AND gate 39 is high, the commands A1 and A2 cause MOSFETs 22 and 23 to turn on. See EX1007, 5:51-59, 7:44-48, FIG. 4. Also,

when the output of AND gate 39 is high, the commands A3 and A4 cause MOSFETs 24 and 25 to turn off. See EX1007, 5:60-65, 7:31-43, FIG. 4. This causes the motor supply to temporarily shut off after limiting the current during t5. EX1007, 5:53-59, 6:6-18, FIG. 4. This triggers the “current limit operation,” which limits the current during t5 (creating the sawtooth wave during “CURRENT LIMIT”). EX1007, 5:53-59, 6:6-18, 8:25-30 (“Further, the motor current is limited to a lower level, when the motor current continues to exceed the limit level for more than the predetermined period t38 during the period of the motor drive starting (or motor breaking).”), FIG. 4.



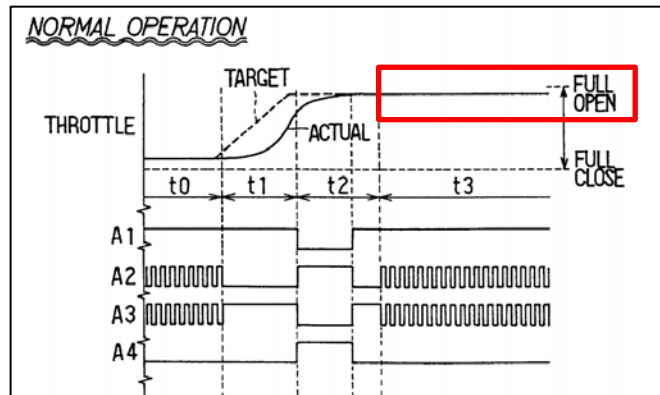
EX1007, FIG. 2.

121. For these reasons, Itabashi’s system reduces the control effort when it exceeds the threshold Vref for the predetermined time period t38.

7. **[1.F] “wherein commanding the positioning device to change to said commanded position comprises at least one of commanding the positioning device to open to a hold open mode and commanding the positioning device to dose [sic] to a hold close mode”**

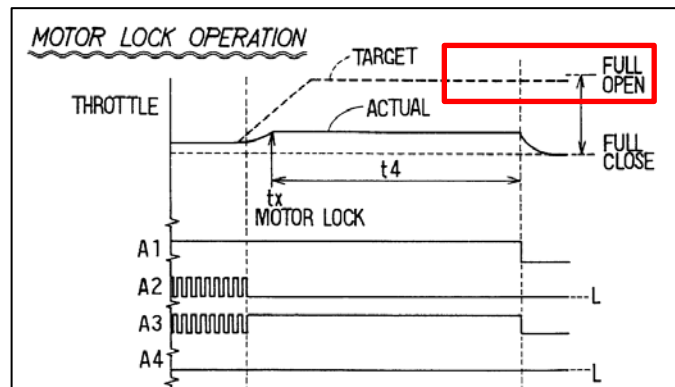
122. Itabashi discloses or suggests this element. As explained for element [1.C], “[t]he engine control circuit 15 produces drive command signals A1-A4 to a drive control circuit 18 in correspondence with the output signals of the throttle sensor 14 and the accelerator sensor 17.” EX1007, 3:4-7. These command signals A1-A4 command the throttle to move to a commanded position because “the drive control circuit 18 drives the motor 13 to rotate the throttle valve 12 *to a target position* corresponding to the detected actual accelerator position.” EX1007, 3:7-10.

123. The command signals A1-A4 likewise command the throttle to open to a hold open mode because the command signals A1-A4 command the throttle to move to and hold at the full open position as the timing diagram shows below. The command signals A1-A4 hold the throttle open because “[a]s long as the throttle valve 12 is maintained at the target position during the period t3, the motor 13 is driven with the duty-controlled motor current in the same manner as in the period t0.” EX1007, 7:10-13; *see also* EX1007, 6:36-39 (“The motor current flows in the forward direction indicated by an arrow B in FIG. 2 to maintain the opening position of the throttle valve 12 against the return spring.”).



EX1007, FIG. 3 (excerpted and annotated); *see also* EX1007, 6:28-57.

124. The timing diagram for the motor lock operation in Figure 4 likewise shows that the target throttle position is fully open, and held open.



EX1007, FIG. 4 (excerpted and annotated).

125. Command signals A1-A4 can also command the throttle to close to a hold close mode. As the timing diagrams show above, the range of movement of the throttle valve is from "FULL OPEN" to "FULL CLOSE." *See* EX1007, FIGS. 3, 4.

126. Itabashi refers to moving the throttle from the open position to a closed position as "braking." *See, e.g.,* EX1007, 1:66-2:6, 5:21-35, 8:16-36. For example, Itabashi states that "[t]he motor 13 is driven with the motor current of 100% duty

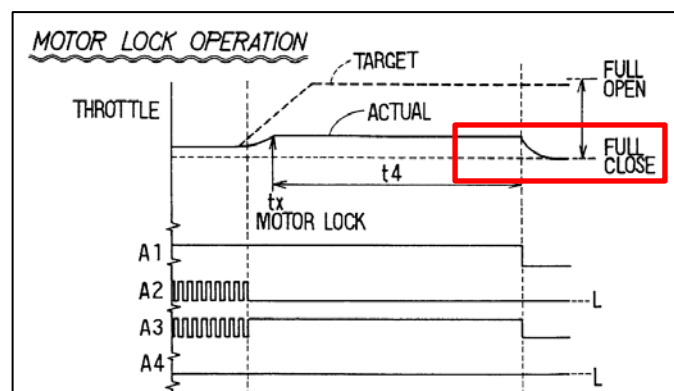
ratio *in the reverse direction* (C) to break the throttle valve 12.” EX1007, 7:57-59.

Itabashi also explains that the current detection circuit likewise functions to reduce excessive motor current when commanding to close, and hold close, the throttle:

Although the motor current supply is controlled as described above and shown in FIG. 4 when the motor locks at the time of the motor drive starting, *the motor current supply is controlled in the similar manner when the motor locks at the time of motor braking.*

EX1007, 8:11-15.

127. To the extent Itabashi does not explicitly state that the command signals A1-A4 command the throttle to close to a hold close mode, a POSA would have found it obvious to command the throttle to close, and remain closed. Itabashi itself shows that the throttle has a FULL CLOSE position as Figure 4 shows below.



EX1007, FIG. 4 (excerpted and annotated).

128. Not only does Itabashi's throttle already have a FULL CLOSE position, a POSA would have appreciated that conventional electronic throttle control systems at the time commanded the throttle to close. EX1006, 11:7-11,

14:46-56; EX1016, 4:10-15, FIG. 2; EX1009, 4:14-20, 4:51-63, 6:11-14, 6:27-32, 6:40-45, FIGS. 5, 6; EX1011, (57), FIGS. 4A-4D; EX1005, Abstract, 1:25-29. For example, a POSA would have understood that a throttle control system would command the throttle to a fully closed position when traveling too fast down a steep decline. *See* EX1006, 13:9-23. Because commanding throttles to close was well known in the art, a POSA would have been able to configure Itabashi such that the system commanded the throttle to close to a hold close mode. For example, the high side MOSFET's 22 and 23 would turn on when high side command drive signals A1 and A2 are high and off when A1 and A2 are low. In a similar fashion, low side MOSFET's 24 and 25 would turn on if A3 and A4 are high. If allowing current to flow through the positive side of the motor opens the throttle, then to close the throttle, the current would flow from the negative side. To accomplish this flow in the H-bridge circuit, MOSFET's 23 and 25 would be turned on or open and MOSFET's 22 and 24 would turn off or close. A1 would be low, A2 would be high, A3 would be low, and A4 would be high.

129. A POSA would have also been motivated to use current detection circuit 21 when commanding the throttle to close to a hold close mode. A POSA would have understood that motor drive current can likewise increase undesirably when commanding the throttle to close: "As with the full-throttle position, if the drive current 16 continues to supply motor current to the motor M, damage to the

motor M, the clutch C, gear train 22, or any combination of these elements can occur.” EX1006, 13:23-27. To prevent damage to the MOSFETs 22-25 and the motor, a POSA would have been motivated to use the current detection circuit 21 and drive logic circuit 19 to limit the current when it exceeds a threshold, as Itabashi itself suggests.

130. For these reasons, Itabashi discloses or suggests commanding the throttle to open to a hold open mode. Itabashi also discloses or suggests—and it would have been obvious to—command the throttle to close to a hold close mode.

* * *

131. Itabashi discloses or suggests every element of independent claim 1. Accordingly, Itabashi renders obvious claim 1.

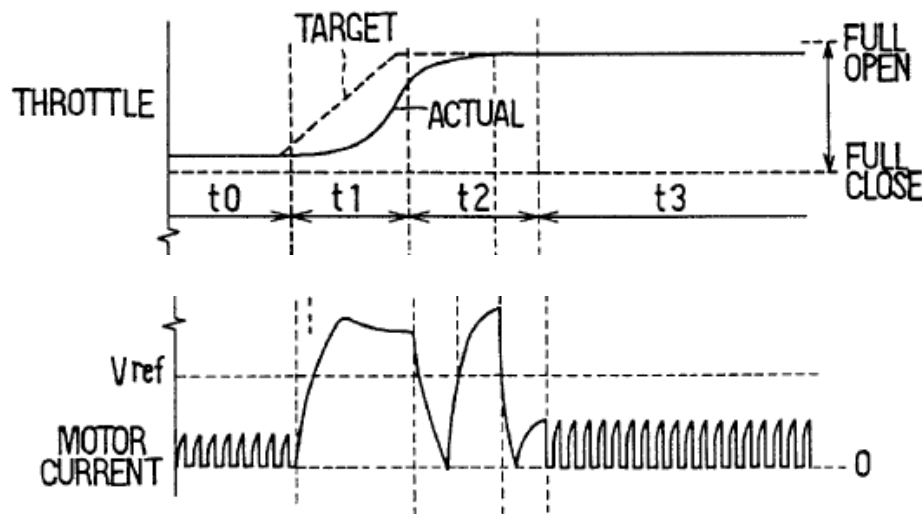
B. Claim 4

132. Claim 4 depends from claim 1 and further recites “the step of applying a maximum control effort to the positioning device for a hard open time period.” Itabashi discloses this element.

133. Before explaining why Itabashi discloses this element, I note that claim 4 does not associate this step of applying a maximum control effort to the prior steps in claim 1. I understand that this element in claim 4 is met by simply showing that the method for controlling the positioning device applies a maximum control effort

for a period of time (a hard open time period). This hard open time period, unlike the other time period in claim 1, is not “predetermined.”

134. Itabashi discloses the element in claim 4 because in Itabashi “the engine control circuit 15 drives the motor 13 with the motor current of *100% duty ratio* during the time period t_1 so that the actual throttle position approaches the target throttle position in a short period of time.” EX1007, 6:46-51; *see also* EX1007, 9:6-8. Examples of a control effort include motor voltage, current, and duty cycle. EX1001, 1:36-39. Accordingly, as shown below, Itabashi applies a maximum control effort (the motor current of 100% duty cycle) for a hard open time period (t_1) to move the throttle to FULL OPEN.



EX1007, FIG. 3 (excerpted).

135. For these reasons, Itabashi discloses applying a maximum control effort to the throttle for a hard open time period.

C. Claim 7

136. Claim 7 depends from claim 1 and further recites “wherein the step of commanding the positioning device to change to said commanded position, comprises commanding the positioning device to close to said commanded position in a hold close mode.” Itabashi discloses this element for the same reasons Itabashi discloses or suggests the nearly identical language in element [1.F]. *See* Section IX.A.7.

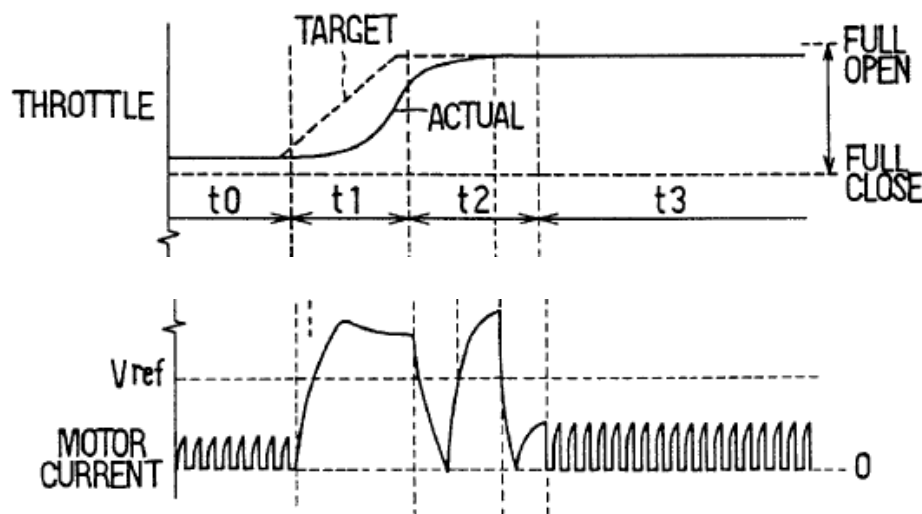
D. Claim 8

137. Claim 8 depends from claim 7 and further recites “the step of applying a maximum control effort to the positioning device for a hard dose [sic] time period.” Itabashi discloses or suggests this element.

138. Before explaining why Itabashi discloses this element, I note that claim 8 does not associate this step of applying a maximum control effort to the prior steps in claims 1 and 7. I understand that this element in claim 8 is met by simply showing that the method for controlling the positioning device applies a maximum control effort for a period of time (a hard close time period). This hard close time period, unlike the other time period in claim 1, is not “predetermined.” I also note that the “maximum” control effort does not have to be a positive value because claim 9 further defines the maximum control effort as -14.5 volts. The maximum control effort for claim 8 is therefore the control effort used to close the throttle valve to the

fully closed or idle position. See EX1001, 4:30-33 (“[T]he controller applies a maximum closing control effort to the motor A typical maximum closing control effort has a magnitude of -14.5 volts.”).

139. Itabashi discloses this element because Itabashi not only uses its system to command the throttle to open but also to *close*: “A direct current motor for an engine throttle control is driven with a motor current of 100% duty ratio, when a throttle valve is to be moved from one throttle position to another or when the movement of the throttle valve is to be braked.” EX1007, Abstract, 6:63-7:3, 7:57-59, 8:11-15. Accordingly, a POSA would have understood that when Itabashi tries to *close* the throttle, a maximum control effort (a motor current of 100% duty cycle) is likewise applied to the throttle for a hard close time period t_1 . The timing diagram would be the inverse of the following timing diagram because the system would close the throttle instead of opening the throttle.



EX1007, FIG. 3 (excerpted).

140. For these reasons, Itabashi discloses or suggests applying a maximum control effort to the throttle for a hard close time period.

E. Claim 11

1. [11.P] “A system for controlling a positioning device of an internal combustion engine to prevent overhear conditions”

141. To the extent the preamble is limiting, Itabashi discloses the preamble for the same reasons Itabashi teaches element [1.P]. See Section IX.A.1 (identifying a throttle servo system that performs the method in claim 1). Additionally, Itabashi’s system prevents overhear conditions:

[T]he motor current is limited to a lower level, when the motor current continues to exceed the limit level for more than the predetermined period t38 during the period of the motor drive starting (or motor braking). Thus, the current flowing in the MOSFETs 22-25 can be limited to the lower level to *reduce the heat generation* of the MOSFETs 22-25.

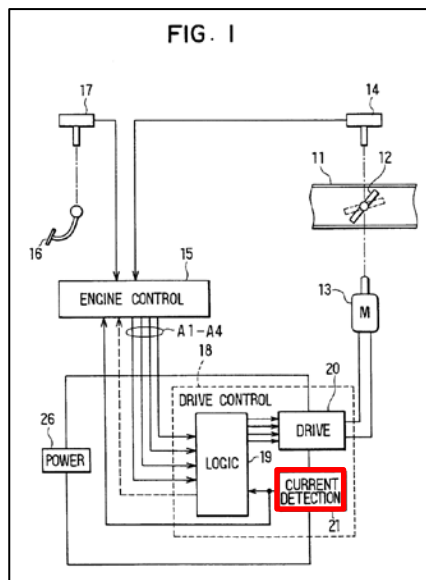
EX1007, 8:25-30.

2. [11.A] “an electric motor for actuating the positioning device with a control effort”

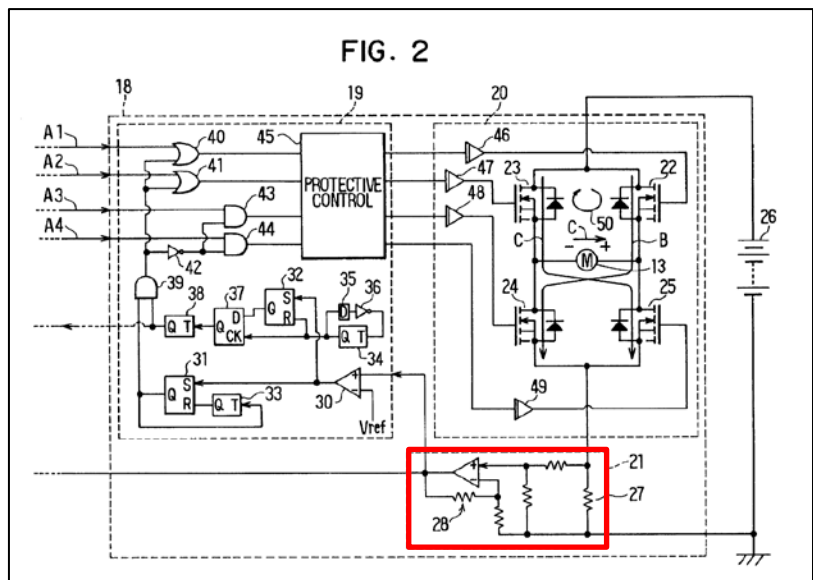
142. Itabashi discloses this element for the same reasons Itabashi discloses element [1.A]. See Section IX.A.2. Additionally, Itabashi’s electric motor actuates the throttle with a control effort because the motor actuates the throttle with a motor current. EX1007, 2:48-3:10, FIGS. 1-4.

3. [11.B] “a control effort detector coupled to said electric motor and intended to detect said control effort”

143. Itabashi discloses this element for the same reasons Itabashi discloses element [1.C]. See Section IX.A.4. Specifically, the current detection circuit 21 outlined below in red is a control effort detector. See EX1007, 3:11-16, 6:46-51.



EX1007, FIG. 1 (annotated).



EX1007, FIG. 2 (annotated).

144. The current detection circuit 21 (control effort detector) is coupled to the electric motor 13 via MOSFETs 24 and 25:

The positive (+) and negative (−) terminals of the motor 13 is connected to a junction between the MOSFETs 22 and 25 and to a junction between the MOSFETs 23 and 24, respectively. The high-side (MOSFETs 22 and 23) of the drive circuit 20 is connected to the positive (+) terminal of an electric power source 26 such as a storage battery 26. The low-side (MOSFETs 24 and 25) of the drive circuit 20

is connected to the negative (–) or grounded terminal of the battery 26 through the current detection circuit 21.

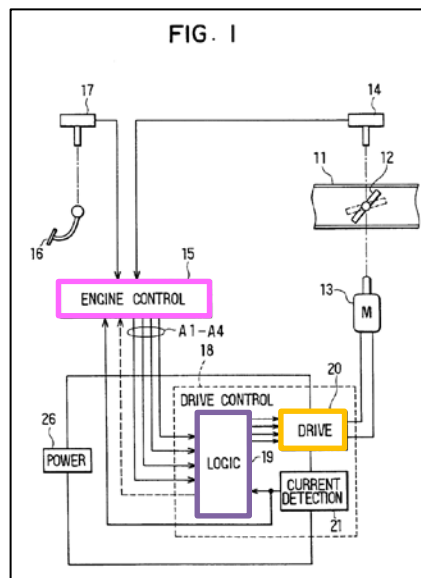
EX1007, 3:33-42.

145. Additionally, the drive circuit 20 is also a control effort detector coupled to the electric motor and intended to detect the control effort. MOSFETs 22-25 of the drive circuit are coupled to the electric motor 13. EX1007, 3:33-42. And MOSFETs 22-25 are intended to detect the drive current (the control effort) because the MOSFETs 22-25 selectively turn on to supply the motor current to the electric motor 13. EX1007, 6:1-5, 6:66-7:3. For a MOSFET, there are three terminals. *See* EX1007, FIG. 2. The source with an input current I_S , the drain with output current I_D , and the gate with voltage V_G , that modulates the channel conductivity and therefore the output drain current, I_D , to drain to source voltage. In Itabashi, the MOSFETs detect the voltage V_G (the control effort) from the drive logic circuit 19. *See* EX1007, FIG. 3.

146. For these reasons, Itabashi discloses a control effort detector coupled to electric motor 13 and intended to detect the motor current.

4. [11.C] “a controller coupled to said electric motor and said control effort detector, said controller including control logic operative to command the positioning device to change to a commanded position, detect a control effort required to change to said commanded position, determine whether said control effort exceeds a threshold for a predetermined time period, and reduce said control effort when said control effort exceeds said threshold for said predetermined time period”

147. Itabashi discloses this element. As Sections IX.A.3-IX.A.6 explain and Figure 1 shows below, Itabashi has a control circuit with control logic. A POSA would have understood that the drive logic circuit 19 (alone or in combination with the engine control circuit 15 and the drive circuit 20) is a controller that has control logic. EX1007, 3:48-6:5.



EX1007, FIG. 1 (annotated).

148. As Figure 1 shows above and Figure 2 shows below, the engine control circuit 15, the drive logic circuit 19, and the drive circuit 20 are coupled to the

electric motor 13 and the control effort detector (e.g., current detection circuit 21).

The engine control circuit 15 is coupled to the drive logic circuit 19, and the drive

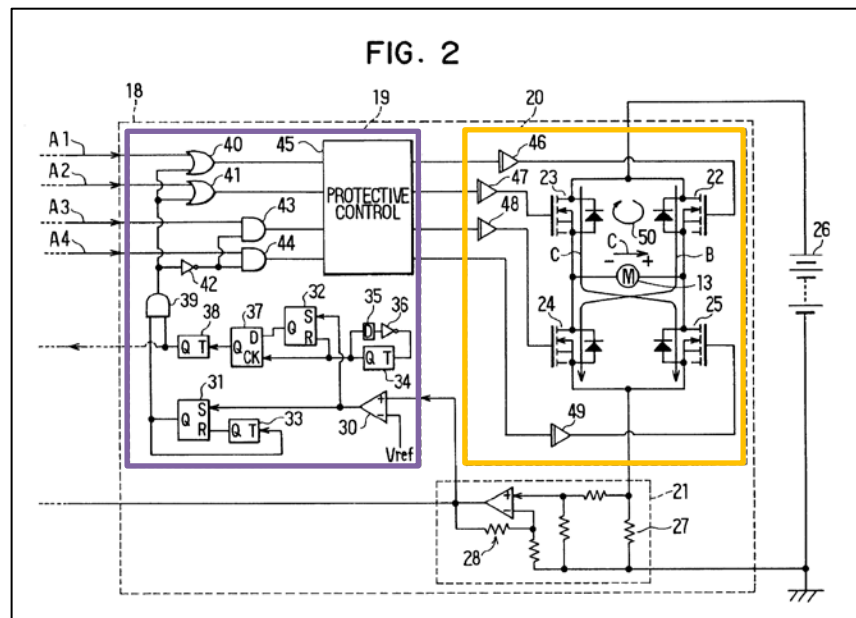
logic circuit 19 is coupled to the electric motor 13 via drive circuit 20 (including

MOSFETs 22-25). EX1007, 5:48-51; EX1007, 5:60-62. The drive logic circuit 19 is

also coupled to the control effort detector because “[i]n the drive logic circuit 19, a

comparator 30 is provided to compare the output signal of the current detection

circuit 21 with a reference signal V_{ref}” EX1007, 3:48-51.⁵



EX1007, FIG. 7 (annotated).

⁵ The “control effort detector” in element [11.B] can be within the controller in element [11.C] because the controller has “control logic operative to . . . detect a control effort required to change to said commanded position.”

149. As I explain in Sections IX.A.3-IX.A.6, the engine control circuit 15, the drive logic circuit 19, and the drive circuit 20 have control logic to “command the positioning device to change to a commanded position, detect a control effort required to change to said commanded position, [and] determine whether said control effort exceeds a threshold for a predetermined time period, and reduce said control effort when said control effort exceeds said threshold for said predetermined time period.” Additionally, the control logic circuit 19 detects a control effort required to change to said commanded position because “a comparator 30 is provided to compare the output signal of the current detection circuit 21 with a reference signal V_{ref} ” EX1007, 3:48-51. And “[t]he protective control circuit 45 includes various logic for preventing an excessive current from flowing continuously through the motor 13 due to turning on of the MOSFETs 22-25 connected to both terminals of the motor 13, and for forcing the MOSFETs 22-25 to turn off when the excessive current continues to flow.” EX1007, 6:19-24.

150. For these reasons, Itabashi discloses this element.

5. [11.D] “wherein said controller further includes control logic operative to command the positioning device to close to said commanded position in a hold close mode”

151. Itabashi discloses or suggests this element. As I explain in Section IX.A.7, Itabashi discloses an engine control circuit 15 that produces drive command signals A1-A4, which command the throttle to close to a hold close mode. To the

extent Itabashi does not disclose this element, a POSA would have found it obvious to command the throttle to close to the commanded position in a hold close mode, as I explain in Section IX.A.7.

* * *

152. Itabashi discloses every element of independent claim 11. Accordingly, Itabashi renders obvious claim 11.

F. Claim 14

153. Claim 14 depends from claim 11 and further recites “wherein said controller further includes control logic operative to command the positioning device to open to said commanded position in a hold open mode.” Itabashi discloses this element. As I explain in Section IX.A.7, the controller has control logic not only to command the positioning device to close to said commanded position in a hold close mode but also to command the positioning device to open to said commanded position in a hold open mode—i.e., fully open.

G. Claim 15

154. Claim 15 depends from claim 14 and further recites “wherein said controller further includes control logic operative to apply a maximum control effort to the positioning device for said hard open time period.” Itabashi discloses this element. As I explain in Section IX.B (claim 4), the controller in Itabashi “appl[ies] a maximum control effort to the positioning device for a hard open time period.”

H. Claim 18

155. Claim 18 depends from claim 11 and further recites “wherein said controller further includes control logic operative to command application of a maximum control effort to the positioning device for a hard close time period.”

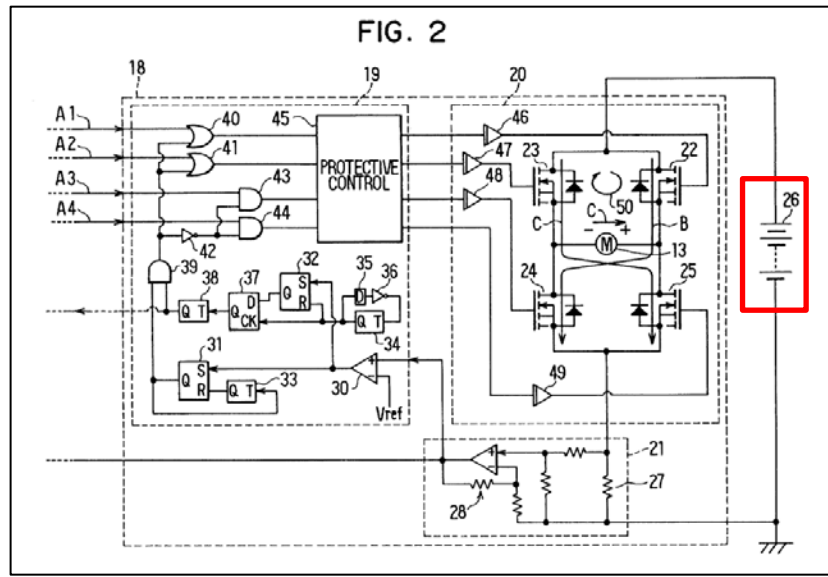
Itabashi discloses this element. As I explain in Section IX.D (claim 8), the controller in Itabashi “appl[ies] a maximum control effort to the positioning device for a hard close time period.”

X. GROUND 2: ITABASHI IN VIEW OF THE GM MANUAL AND THE CHRYSLER MANUAL RENDERS OBVIOUS CLAIMS 2, 5, 9, 12, 16, AND 19.

A. Claims 5, 9, 16, and 19

156. Claims 5 and 16 depend from claims 4 and 15, respectively, and recite “wherein said maximum control effort is +14.5 volts.” Claims 9 and 19 depend from claims 8 and 18, respectively, and recite “wherein said maximum control effort is −14.5 volts.” Itabashi in view of the GM Manual and the Chrysler Manual discloses or suggests these elements.

157. Figure 2 of Itabashi shows a storage battery 26 that supplies power to the drive circuit 20 and the current detection circuit 21. EX1007, 3:37-42, FIG. 2.



EX1007, FIG. 2 (annotated).

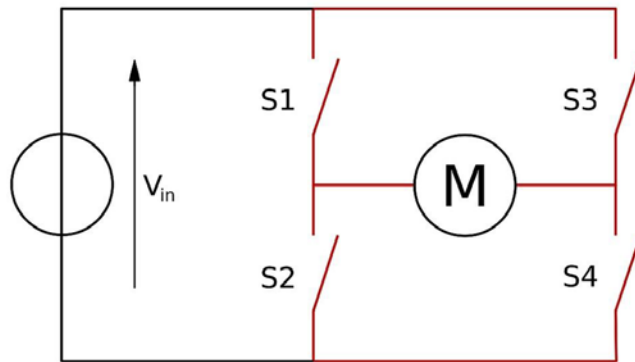
158. Itabashi does not specify the voltage that the storage battery 26 provides to the motor drive circuit. A POSA would have therefore looked for the voltage levels of typical automobile power supplies from multiple major automobile manufactures. The POSA would have been led to the GM Manual, which states that voltage during idle is typically 13.5 to 14.5 volts. EX1023, p. 94; *see also* EX1021, p. 39. The POSA would have also been led to the Chrysler Manual, which states that a typical voltage regulator supplied 13.9-14.6 volts. EX1024, p. 110. For cross compatibility, the POSA would have accounted for these overlapping ranges.

159. In the context of Itabashi, a POSA would have been motivated to use the maximum available voltage to unjam the throttle when stuck in a *closed* position. The maximum voltage would have provided the greatest chance of quickly releasing the jam. Given typical batteries reached a maximum voltage of around

14.5 volts, a POSA would have been motivated to apply +14.5 volts for the hard open time period.

160. Likewise, when trying to unjam a throttle stuck in an *open* position, a POSA would have been motivated to use the maximum available voltage. But when trying to close the throttle, the POSA would have used negative polarity. EX1007, 6:66-7:3, FIG. 2. Given typical batteries reached a maximum voltage of around 14.5 volts, a POSA would have therefore been motivated to apply –14.5 volts for the hard close time period.

161. A POSA would have been motivated to use negative polarity because Itabashi uses an H-Bridge circuit to control the motor, such as the H-Bridge circuit below. EX1007, 3:11-21. Many automobiles at the time of the alleged invention used an H-bridge circuit to control the throttle motor. Using an H-bridge circuit allowed for accurate control in both directions. See EX1007, 3:11-21. The term “H-bridge” is derived from the typical graphical representation of the circuit. An H-bridge is built with four switches (solid-state or mechanical). When the switches S1 and S4 (according to the first figure) are closed (and S2 and S3 are open), a positive voltage is applied across the motor. By opening S1 and S4 switches and closing S2 and S3 switches, the voltage is reversed, allowing reverse operation of the motor.



162. Using ± 14.5 volts as the maximum control effort would have combined prior art elements (a typical battery supply) according to known methods to yield predictable results. Additionally, these specific voltages would have been an obvious matter of design choice that a POSA would have made with a reasonable expectation of success. In the '804 patent, the specific values provide no novel or unexpected result and solve no stated problem. The specific voltages recited in the claims also do not recite different structure or achieve a different purpose. And neither the '804 patent nor its prosecution history articulates a single benefit for selecting this value as the maximum control effort.

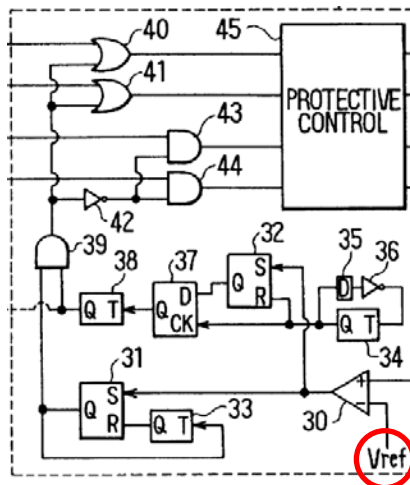
163. The '804 patent confirms that $\pm 14.5V$ was an obvious design choice. It explains that a POSA would have understood that there is a relationship between the amount of voltage that could be applied to a servo motor and the duration such voltage could be applied without overheating the motor, and provides a table of example voltage-duration pairs for "a given servo motor." EX1001, 3:36-54. The patent further admits, "Obviously, the magnitude of the effort may vary as

required.” EX1001, 3:63-64. These admissions confirm that a POSA would have understood the conditions (amount of control effort and duration) under which the motor could operate without overheating, and that applying $\pm 14.5\text{V}$ was a design choice within known operating conditions.

B. Claims 2 and 12

164. Claims 2 and 12 depend from claims 1 and 11, respectively, and recite “wherein said threshold has an absolute value of 6 volts.” Itabashi in view of the GM Manual and the Chrysler Manual discloses or suggests this element.

165. As Figure 2 of Itabashi shows below, a voltage V_{ref} is applied to comparator 30. EX1007, 3:48-51, FIG. 2. Itabashi does not specify the voltage of V_{ref} .



EX1007, FIG. 2 (excerpted and annotated).

166. Given the typical supply voltage was 14.5 volts, a POSA would have at least configured V_{ref} to be less than 14.5 volts. Selecting $|6|$ volts as the threshold

would have been an obvious design choice. In the '804 patent, this specific value provides no novel or unexpected result and solves no stated problem. The specific threshold voltage recited in the claims also does not recite different structure or achieve a different purpose. Indeed, the '804 patent admits |6| volts as a threshold was *typical*. EX1001, 3:28-30, 4:19-21. And neither the '804 patent nor its prosecution history articulates a single benefit for selecting |6| volts as the threshold voltage.

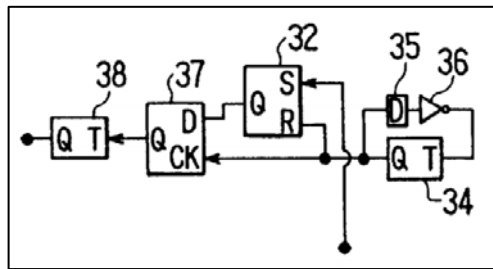
167. The '804 patent states: “*Typically*, an effort limit of approximately +6 volts and a contiguous time interval of about 300 milliseconds are used.” EX1001, 3:28-30, 4:19-21 (same statement but opposite polarity). To the extent this statement is an admission about what was “typical” in the industry, it follows that it was obvious to a POSA to use |6| volts. At the least, the next sentence, “[o]bviously, these values may vary as required,” confirms that |6| volts would have been an obvious design choice. EX1001, 3:30-31.

XI. GROUND 3: ITABASHI IN VIEW OF OHTA RENDERS OBVIOUS CLAIMS 3, 6, 10, 13, 17, AND 20.

A. Claims 3 and 13

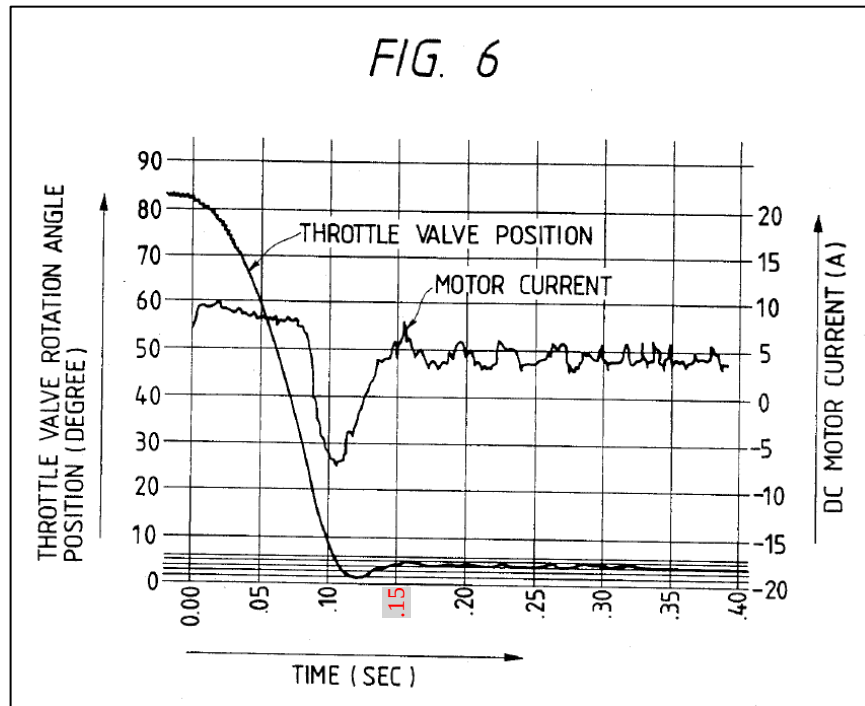
168. Claims 3 and 13 depend from claims 1 and 11, respectively, and recite “wherein said predetermined time period is 300 milliseconds.” Itabashi in view of Ohta discloses or suggests this element.

169. As I explain for element [1.D], Itabashi uses a timer 38 to determine whether the motor current exceeds a threshold for a predetermined time period. EX1007, 5:8-35, FIG. 4. Itabashi does not state the number of milliseconds for timer 38. Rather, Itabashi states: “[T]his time period t38 is set a little longer than the period of motor drive starting or motor braking under the normal condition, that is, under the condition of no lock.” EX1007, 5:24-27.



EX1007, FIG. 2 (excerpted).

170. To determine the amount of time to use for the predetermined time period in element [1.E], a POSA would have looked for the time it takes a typical motor to drive the valve from fully open to fully closed and vice versa. A POSA would have looked for this time period because if the throttle valve is not moved to the target position after this amount of time, the throttle valve is likely stuck. Looking for this value, the POSA would have been led to Ohta, which shows that the normal time period for moving the throttle from open to close is approximately 150 milliseconds, as Figure 7 shows below. EX1020, FIG. 6.



EX1020, FIG. 6 (annotated to correct typo).

171. In view of Ohta, a POSA would have used a time period of at least 150 milliseconds. The POSA, however, would have been motivated to use a time *higher* than 150 milliseconds to build in tolerance, account for the additional time the system would take to move against the bias force of the throttle spring, and account for instances where the system takes a while to unjam the throttle valve.

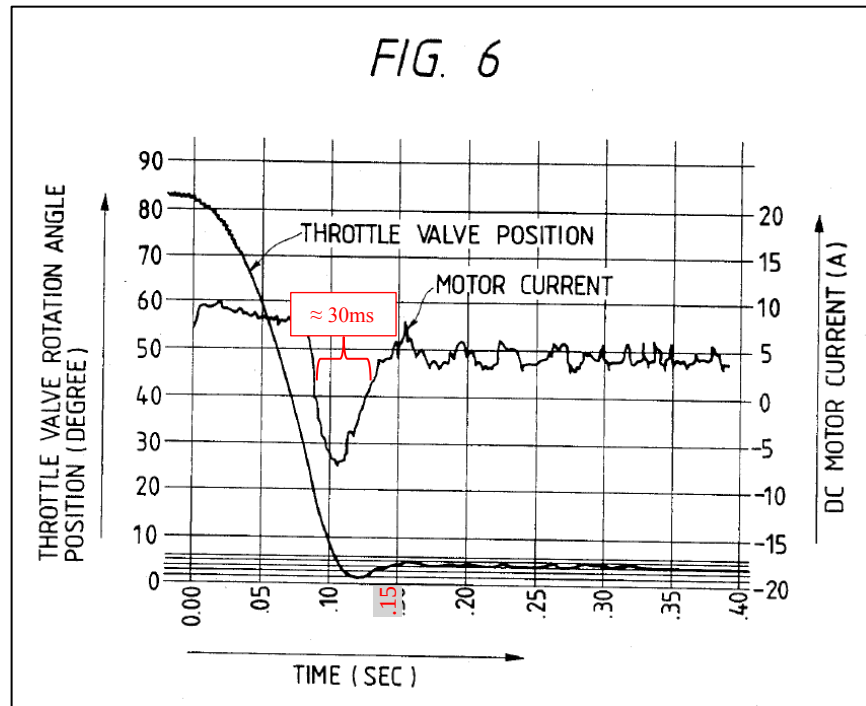
172. Selecting 300 milliseconds would have been an obvious design choice. In the '804 patent, this specific value provides no novel or unexpected result and solves no stated problem. The specific time period recited in the claims also does not recite different structure or achieve a different purpose. Indeed, the '804 patent admits 300 milliseconds was *typical*. EX1001, 3:28-30, 4:19-21. And neither the

'804 patent nor its prosecution history articulates a single benefit for selecting 300 milliseconds for the predetermined time period.

173. The '804 patent states: “*Typically*, an effort limit of approximately +6 volts and a contiguous time interval of about 300 milliseconds are used.” EX1001, 3:28-30, 4:19-21. To the extent this statement is an admission about what was “typical” in the industry, it follows that it was obvious to a POSA to use 300 milliseconds. At the least, the next sentence, “[o]bviously, these values may vary as required,” confirms that 300 milliseconds would have been an obvious design choice. EX1001, 3:30-31.

B. Claims 6, 10, 17, 20

174. Claims 6 and 17 depend from claims 4 and 15, respectively, and recite “wherein said hard open time period is 30 milliseconds.” Claims 10 and 20 depend from claims 8 and 18, respectively, and recite “wherein said hard close time period is 30 milliseconds.” Itabashi in view of Ohta discloses or suggests this element. Again, Itabashi does not specify the time periods. This would have led the POSA to Ohta. Shown below, approximately 30 milliseconds of maximum current is used to drive the throttle valve from a fully open position to a fully closed position.



EX1020, FIG. 6 (annotated to correct typo).

175. A POSA would have been motivated to use 30 milliseconds as the period for the hold open mode and the hold close mode because this is the minimum amount of time the control system needs to initiate throttle movement. The POSA would have understood that any additional time of applying maximum control effort would risk harming the motor circuit. To avoid harming the motor circuit, the POSA would have used the minimum amount of time needed to initiate movement—30 milliseconds.

176. Additionally, selecting 30 milliseconds for both the hard open time period and hard close time period would have been an obvious design choice. In the '804 patent, this specific value provides no novel or unexpected result and solves no

stated problem. The specific time period recited in the claims also does not recite different structure or achieve a different purpose. Indeed, the '804 patent admits 30 milliseconds was *typical*. EX1001, 4:26-27. And neither the '804 patent nor its prosecution history articulates a single benefit for selecting 30 milliseconds for the hard open and hard close time periods. Accordingly, 30 milliseconds would have been an obvious design choice.

XII. GROUND 4: MATSUMOTO IN VIEW OF BURNEY AND RITENOUR RENDERS OBVIOUS CLAIMS 1, 4, 7, 8, 11, 14, 15, AND 18.

177. Ground 4 combines Matsumoto's throttle control system and Burney's limit detection circuit to reduce the control effort when the control effort exceeds a threshold. Ritenour would have informed or rendered obvious to a POSA that Burney's limit detection circuit reduces the threshold after *a predetermined time period*. Additionally, Ritenour's system from the 1980s shows how using a circuit to reduce current when current exceeds a threshold for a predetermined time period was well known and obvious by 2001.

A. A POSA would have been motivated to combine Matsumoto, Burney, and Ritenour.

178. A POSA would have been motivated to use Burney's limit detection circuit to protect Matsumoto's throttle motor. Matsumoto teaches that a throttle can become stuck. EX1008, 4:13-16, 9:1-5, 9:15-67, 14:53-15:11. When the throttle is stuck in the fully open position ($V_{TPS2} \geq K1$), Matsumoto's system enters an opened-

valve sticking failure process (A280). EX1008, 20:17-25, FIG. 4. When the throttle is stuck in the fully closed position ($V_{TPS2} \leq K2$), Matsumoto's system enters a closed-valve sticking failure process (A290). EX1008, 20:26-35, FIG. 4. And when the throttle is stuck between fully open and fully closed ($K1 \geq V_{TPS2} \geq K2$), Matsumoto's system enters a limp home process (A300). EX1008, 20:36-39, FIG. 4. The opened-valve sticking failure process and the closed-valve sticking failure process include several remedial steps. EX1008, 9:30-59, 20:41-22:8. But these remedial steps do not protect the motor from excessive current, which Matsumoto explains can damage the motor. EX1008, 10:1-12, 19:16-23. To protect the motor in cases where the throttle is stuck in the fully open or fully closed position, a POSA would have looked for ways to limit excessive current to the throttle motor. This would have led the POSA to Burney.

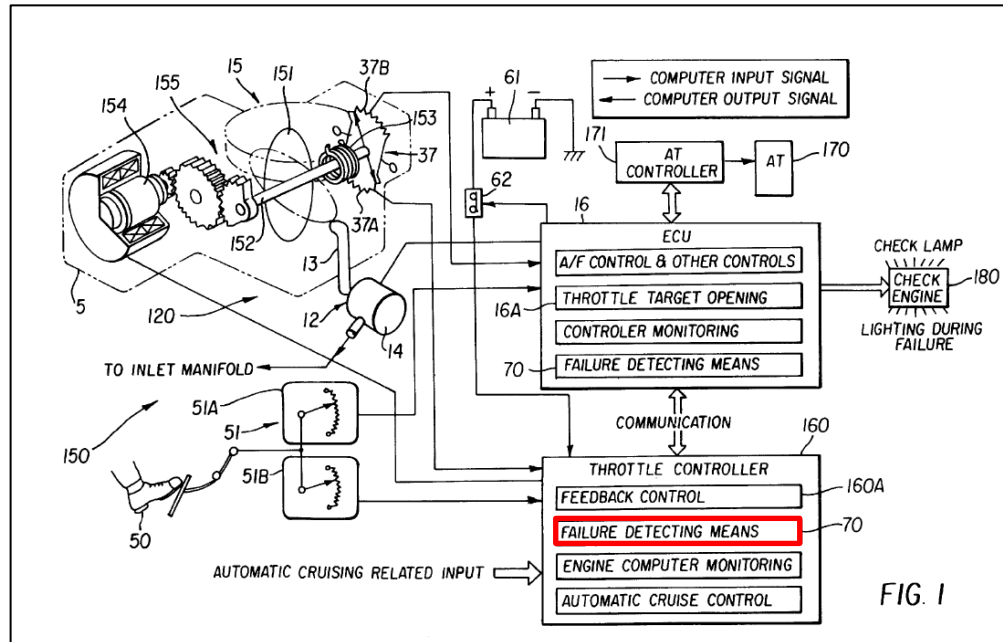
179. Like Matsumoto, Burney teaches that excessive current can damage the throttle motor. EX1006, 2:24-31, 4:7-11, 13:23-27; *see also* EX1027, 1:15-18. To prevent damage to the motor, Burney uses a limit detection circuit:

When the servo motor moves a vehicle's throttle to its full-throttle position, so that operational travel of the servo motor is inhibited, the drive current of the servo motor will increase. This increase is sensed by limit detection circuitry to produce a limit signal that is used by the motor drive circuit to terminate the drive current. A similar circuit may be provided to terminate the drive current when the servo is in the idle position

EX1006, 3:24-35. Burney's limit detection circuit not only limits excessive current when the throttle is in the fully open or fully closed position but also limits the drive current when the throttle motor stalls between fully open and fully closed. EX1006, 4:1-14. Burney therefore discloses a way to protect the throttle motor in Matsumoto steps A280, A290, and A300.

180. A POSA would have been motivated to use Burney's limit detection circuit to determine when the drive current exceeds a threshold for a predetermined time period. Matsumoto's system already has a throttle controller with a failure detecting means 70 to determine when the target position for the throttle valve and the actual position exceeds 1° for a predetermined time period (e.g., 500ms)—i.e., when the throttle valve is stuck. EX1008, 14:35-52, FIG. 1. A POSA would have been motivated to use Matsumoto's existing failure detecting means 70 to not only detect whether the throttle position exceeded a threshold (e.g., 1°) for a predetermined time period (e.g., 500ms) but also determine whether *the control effort* exceeded a threshold for this predetermined time period. Indeed, this protective measure of determining whether the control effort exceeds a threshold for a predetermined time period and thereafter reducing the control effort to protect the motor was well known. EX1027, 1:30-35; EX1007, 5:36-65, 6:6-18, 7:28-48, FIG. 4; EX1017, 4:23-27, 4:61-5:2, FIG. 1. A POSA would have therefore been motivated to implement Burney's limit detection circuit to prevent damage to the

motor and gear reduction system. EX1006, 1:8-15, 2:28-31, 2:58-64, 4:7-14, 13:23-27; EX1009, 2:25-41.



EX1008, FIG. 1 (annotated).

181. A POSA would have been motivated to reduce the drive current when the drive current exceeds a threshold *for the predetermined time period* in Matsumoto's failure detecting means 70 to prevent the system from reducing the control effort prematurely. Ritenour discloses that it was known in the art for systems to use a time period to monitor excessive current:

Since the abnormally high currents encountered when the servo-motor motion is blocked are relatively long term phenomena, the components in the network can be chosen to provide a considerable time delay thereby providing highly accurate identification of overload conditions in the signal being monitored.

EX1027, 2:34-40. Systems used a time period because, for example, during normal operation, current would temporarily spike when moving the throttle from a stationary position. EX1007, FIG. 3; EX1020, FIGS. 7, 11. To prevent Matsumoto's system from prematurely reducing or terminating the control effort to the motor, a POSA would have therefore been motivated to use the predetermined time period before reducing current to the motor.

182. A POSA would have also been motivated to use Burney's limit detection circuit as a redundant safety measure. Matsumoto recognizes that automobile control systems included redundancy to protect passengers in cases of component malfunction. EX1008, 7:4-11, 7:61-67; EX1005, 2:41-52, 3:51-54. For example, Matsumoto uses two throttle position sensors (TPS1 and TPS2) because throttle position sensors were prone to failure over time. EX1008, 7:4-11; *see also* EX1009, 2:25-41. Matsumoto, however, does not have a backup if both throttle position sensors fail or not calibrated correctly. As a suitable backup, Burney's limit detection circuit can determine whether the throttle is stuck without using throttle position sensors. EX1006, 4:1-14. Accordingly, a POSA would have been motivated to use Burney's limit detection circuit to determine whether Matsumoto's throttle is stuck in step A250, adding additional redundancy and safety.

183. Using Burney's limit detection circuit in Matsumoto's system to reduce the drive current when the drive current exceeds a threshold for a predetermined

time period would have combined prior art elements according to known methods to yield predictable results. On October 9, 2001—the effective filing date of the '804 patent—the hardware for throttle control systems was well-known and understood. *See* Section VII. Adding Burney's limit detection circuit to Matsumoto's throttle control system would have used conventional electrical components (e.g., resistors, amplifiers, transistors) to make a closed-loop servomotor with feedback from Burney's limit circuit. Such a closed-loop system was conventional and well understood. *See* Section VII. Indeed, Matsumoto's throttle control system already includes feedback from position sensors. EX1008, 7:19-21, 7:51-60. Adding another feedback signal back to the failure detecting means 70 would have simply applied known techniques (feedback signaling) to a known device (a throttle control system) in the same way.

184. A POSA would have also had a reasonable expectation of success. Not only are Matsumoto and Burney similar throttle control systems with similar hardware, but Burney also discloses its limit detection circuit with vast implementation details. For example, Burney shows its amplifiers at both the level of the schematic diagram in Figure 3 and the transistor level in Figure 4. EX1006, 9:16-29, 9:30-10:16, FIGS. 3, 4. Burney also states that the amplifiers are “manufactured by National Semiconductor under the Part No. LM2877.” EX1006, 9:30-32. The combination uses conventional servomotor techniques, Burney shows

its circuitry in vast detail, a POSA would have known where to find the necessary components, and a POSA had the requisite knowledge, education, and experience to make this combination. For at least these reasons, a POSA would have a reasonable expectation of success in implementing a limit detection circuit in Matsumoto to reduce drive current to the motor when the drive current exceeds a threshold for a predetermined time period.

B. Claim 1

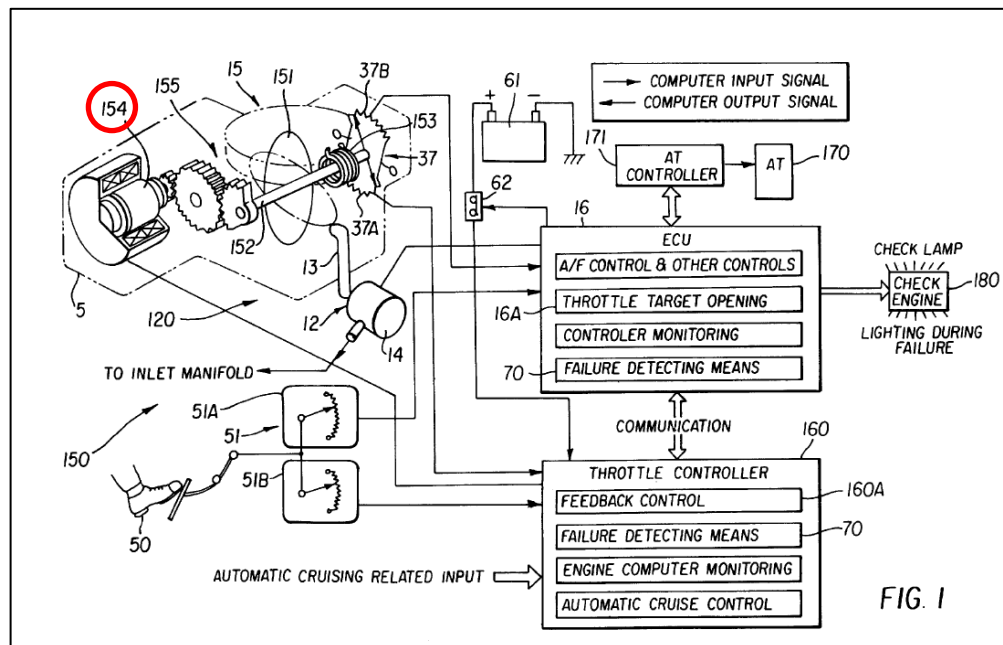
1. [1.P] “A method for controlling a positioning device of an internal combustion engine”

185. To the extent limiting, Matsumoto discloses the preamble: “[i]n an internal combustion engine equipped with an electronic throttle control device for electrically driving a throttle valve, a control apparatus includes failure detecting means for detecting a failure of the electronic throttle control device” EX1008, Abstract; *see also* EX1008, Title, 1:7-12, 3:22-25, 3:37-41, 3:45-4:10. Burney also discloses [1.P]. EX1006, Abstract, 3:5-21.

2. [1.A] “providing an electric motor for actuating the positioning device”

186. Matsumoto discloses this element because Matsumoto’s system includes an electric motor (throttle actuator) 154 for actuating the throttle (positioning device): “The electronic controlled throttle valve 15 that constitutes the DBW 150 includes a butterfly valve 150 that is disposed in the intake passage 5A of

the throttle body 5, a return spring 153 fitted on a shaft 152 that supports the butterfly valve 151, for applying a bias force to the butterfly valve 150 toward its closed position, *an electric motor (throttle actuator) 154 for rotating/driving the shaft 152*, and a gear mechanism 155 interposed between the actuator 154 and the shaft 152.” EX1008, 6:62-7:3. The electric motor (throttle actuator) 154 is shown in Figure 1 below.



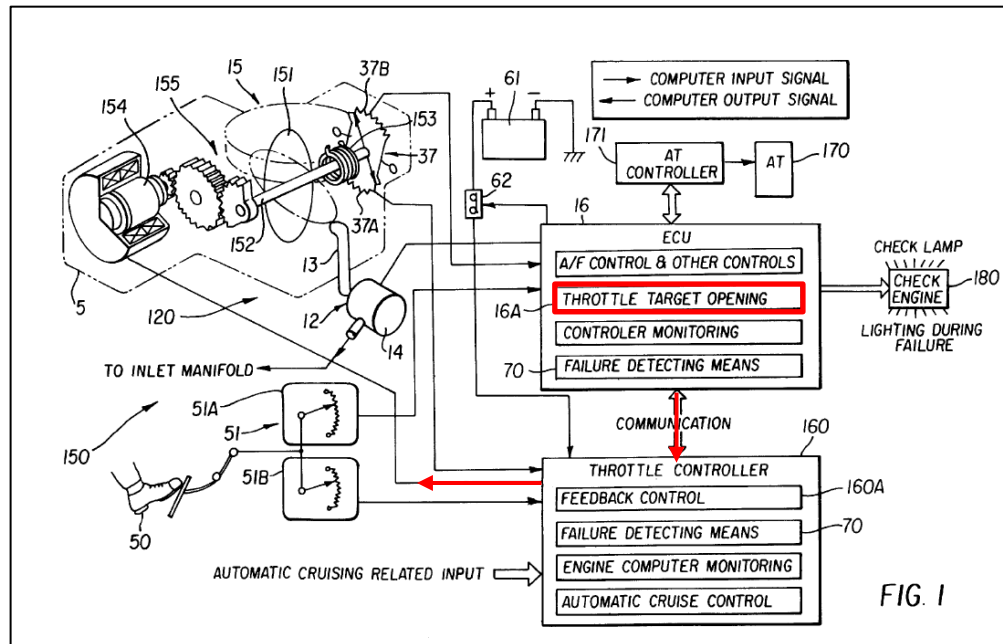
EX1008, FIG. 1 (annotated).

187. Burney and Ritenour also disclose [1.A]. EX1006, Abstract, 5:26-38, 7:45-63, FIG. 1; EX1027, 1:45-51, FIG. 1.

3. [1.B] “commanding the positioning device to change to a commanded position”

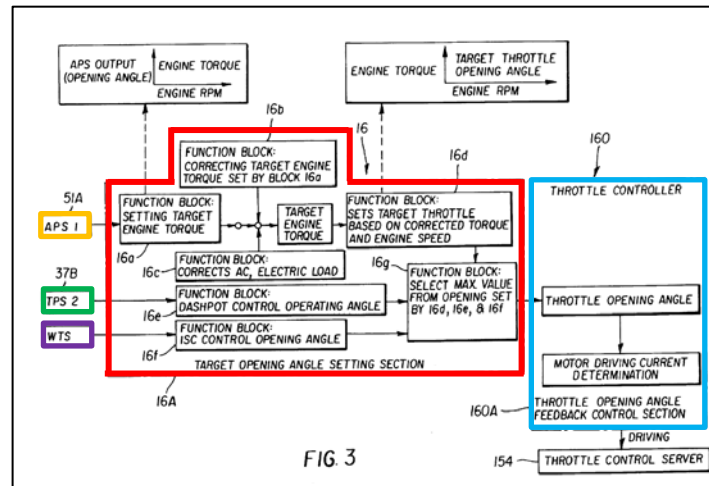
188. Matsumoto discloses this element because the engine control computer (ECU) in Matsumoto commands the throttle controller to move the throttle to a

target position. In Matsumoto, “[t]he throttle body 5 is provided with an electronic controlled throttle valve 15 which is electrically controlled, and the opening of this electronic controlled throttle valve 15 is controlled by means of a throttle control computer (throttle controller) 160.” EX1008, 3:63-67. In operation, an engine control computer (ECU) 16 sets the target throttle position based on the amount of depression of an accelerator pedal 60 and the operating conditions of the motor: “The target opening (target throttle opening) of the throttle valve 15 is determined by an engine control computer (engine ECU) 16 that will be described later, depending upon an amount of depression of an accelerator pedal 60 (accelerator pedal position) detected by an accelerator position sensor (APS1) 51A, and operating conditions of the engine.” EX1008, 3:67-4:6. After the ECU 16 determines the throttle target opening, the ECU 16 communicates the target opening to the throttle controller 160 as shown below. *See* EX1008, 7:12-60. The throttle controller 160 then drives the throttle actuator 154 to position the throttle to the commanded position. *See* EX1008, 7:12-60.



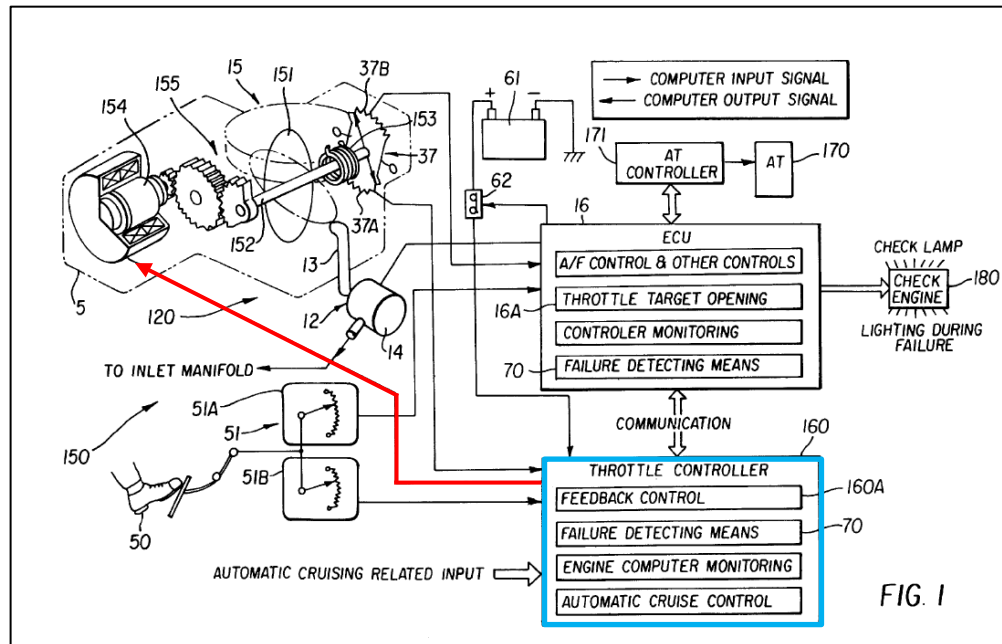
EX1008, FIG. 1 (annotated).

189. Figure 3 of Matsumoto also shows the engine control computer (ECU) 16 commanding the throttle controller 160 to move the throttle to a target position. See EX1008, 7:22-23, FIG. 3. As Figure 3 shows below, the target opening setting portion 16A of the engine ECU 16 (outlined in red) sets the target throttle opening for the throttle controller 160 based on an accelerator position sensor 51A (outlined in orange), a throttle position sensor 37B (outlined in green), and other sensors (a water temperature sensor outlined in purple). See EX1008, 3:29-50, 5:1-13. In response to the signal sent by the ECU 16, the throttle controller 160 (outlined in blue) determines the motor driving current to drive the actuator 154 to the target position. EX1008, 7:12-18, 7:51-60, FIG. 3.



EX1008, FIG. 3 (annotated).

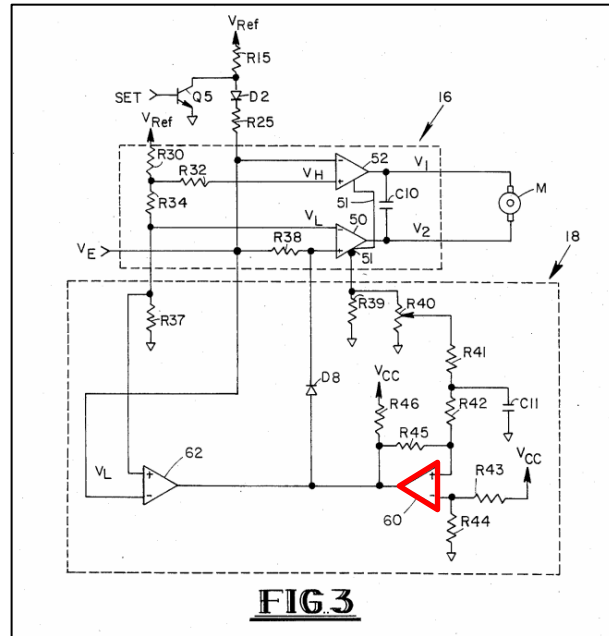
190. Matsumoto therefore teaches this element. Indeed, the configuration of Matsumoto's ECU 16 and throttle controller 160 is identical to the configuration of the electronic control unit 14 and the throttle control unit 28 in the '804 patent. Shown below, the engine control unit 14 (outlined in red) likewise determines the target throttle position based on pedal position sensors 20 (outlined in orange), throttle position sensors 24a and 24b (outlined in green), and other sensors 19 (outlined in purple). See EX1001, 2:67-3:11. The engine control unit 14 then commands the throttle control unit 28 to move the throttle to the target position. See EX1001, 3:7-11, FIG. 1 (communication links).



EX1008, FIG. 1 (annotated).

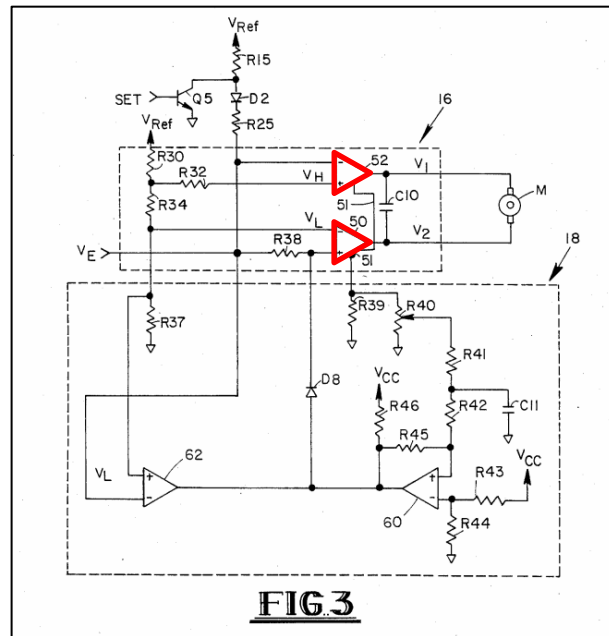
193. To control the opening of throttle valve 15, the throttle controller 160 drives the throttle actuator 154 with a drive current. *See* EX1008, 7:51-56, FIGS. 1, 3. The throttle actuator 154 therefore “detects” the presence and magnitude of the drive current and uses that current to move the throttle. *See also* EX1008, 7:51-56 (the controller determining motor drive current).

194. Additionally, Burney’s limit detection circuit 18 detects a control effort required to change to said commanded position. For example, Burney’s limit detection circuit 18 includes an amplifier 60. EX1006, 10:21-24, FIG. 3. Amplifier 60 detects the control effort required to change to said commanded position because the voltage applied to the noninverting (+) input “is directly related to the drive current of the motor M.” EX1006, 10:29-34.



EX1006, FIG. 3 (annotated).

195. Burney’s amplifiers 50 and 52 also detect a control effort required to change to said commanded position. In Burney, “the error voltage V_E is received from R35 (FIG. 2) and is compared by each of the amplifiers 50 and 52 to DC voltage levels produced by a voltage divider” EX1006, 9:16-23. When the error voltage V_E drops below the low voltage level V_L , “a motor current flows through the motor M to cause it to rotate.” EX1006, 9:66-10:8. And when the error voltage V_E is greater than the high level voltage V_H , a motor current causes “motor M to rotate in an opposite direction.” EX1006, 10:8-14. The amplifiers 50 and 52 therefore detect the motor current (the control effort) required to change the throttle to the commanded position.



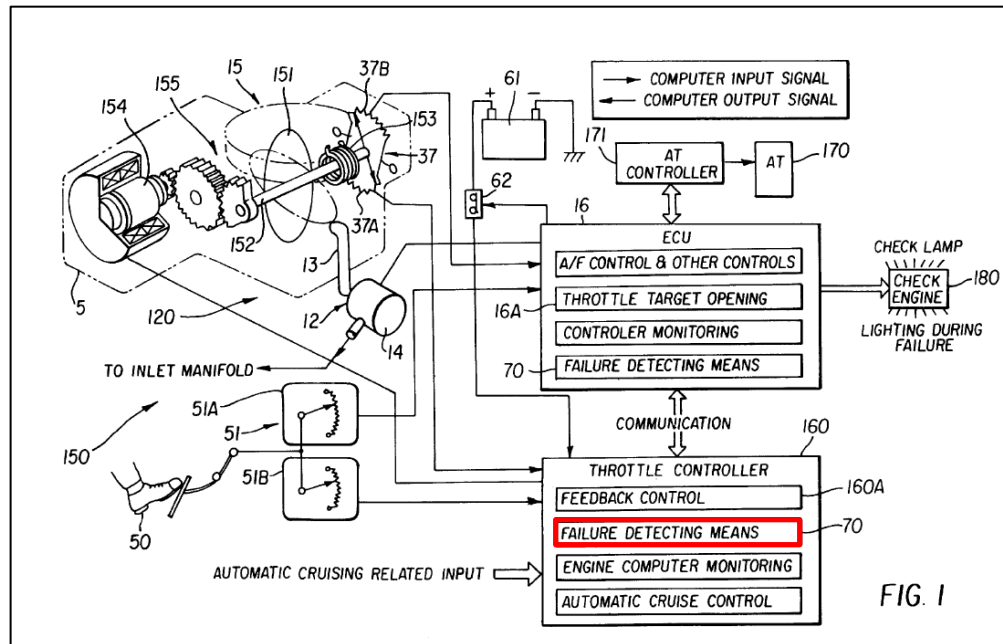
EX1006, FIG. 3 (annotated).

196. Ritenour also discloses this element. EX1027, 1:30-35, 2:12-40.

197. For these reasons, Matsumoto, Burney, and Ritenour each disclose this element.

5. [1.D] “determining whether said control effort exceeds a threshold for a predetermined time period”

198. Matsumoto in view of Burney and Ritenour discloses or suggests this element. Matsumoto’s system has a failure detecting means 70 to determine whether the throttle valve is stuck. See EX1008, 8:62-9:67, 14:35-40. Figure 1 of Matsumoto shows the failure detecting means 70.



EX1008, FIG. 1 (annotated).

199. The failure detecting means 70 determines that the throttle valve is stuck when the difference between the throttle's target position and the throttle's actual position remains greater than 1° for a predetermined time period:

The failure detecting means 70 reads the target opening that is set based on detected information from the accelerator position sensor 51A, and also reads the opening of the electronic controlled throttle valve 15 detected by the second throttle position sensor (TPS2) 37B. The failure detecting means 70 then compares the opening of the electronic controlled throttle valve 15 with the target opening, and determines that *a failure arises due to sticking of the electronic controlled throttle valve 15 if a difference between these target and actual openings is kept being greater than a predetermined opening (for example, 1°) over a predetermined time (for example, 500 ms).*

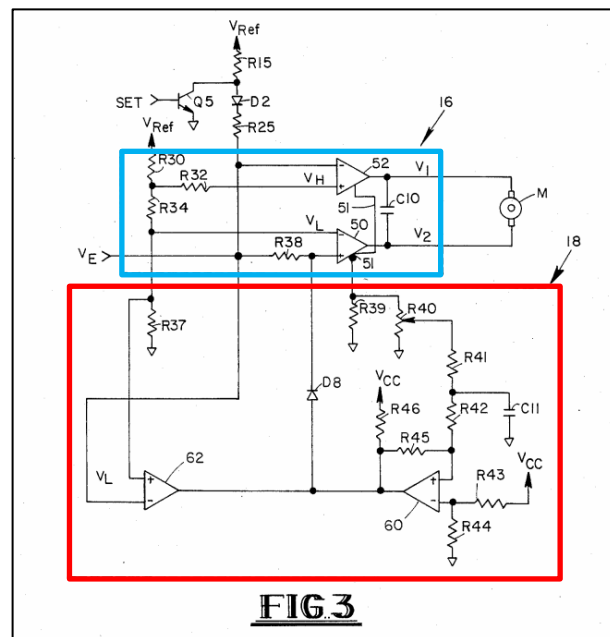
EX1008, 14:41-52. The failure detecting means 70 therefore determines whether a difference between the target throttle position and the actual throttle position exceeds a threshold for a predetermined time period. EX1008, 14:45-52.

200. To the extent Matsumoto's failure detecting means 70 does not determine whether *the control effort* exceeds a threshold for the predetermined time period, Burney provides this teaching. Burney's circuit likewise determines whether the throttle valve is stuck or in the fully open or fully closed positions because Burney "detect[s] when the servo motor is running in a stall position" EX1006, 1:8-15; *see also* EX1006, 4:1-14. Rather than using throttle position sensors, Burney's system monitors the drive current:

When the servo motor moves a vehicle's throttle to its full-throttle position, so that operational travel of the servo motor is inhibited, the drive current of the servo motor will increase. *This increase is sensed by limit detection circuitry to produce a limit signal* that is used by the motor drive circuit to terminate the drive current. A similar circuit may be provided to terminate the drive current when the servo is in the idle position

EX1006, 3:24-35; *see also* EX1006, 4:1-14 (monitoring the stall condition to limit or terminate the drive current when the throttle is stuck between fully open and fully closed).

201. Figure 3 of Burney shows the motor drive circuit 16 (outlined in blue) and the limit detection circuit 18 (outlined in red). EX1006, 9:16-23. Shown below, a reference voltage V_E , which indicates whether the vehicle needs to speed up or slow down, is applied to amplifiers 50 and 52. EX1006, 9:16-23. The output of the amplifiers 50 and 52— V_1 and V_2 —drive the motor. *See* EX1006, 9:63-10:16, FIG. 3. If the vehicle needs to speed up, the voltage V_1 is higher than V_2 . *See* Section VIII.C (explaining the operation of motor drive circuit 16). If the vehicle needs to slow down, the voltage V_1 is lower than V_2 . *See* Section VIII.C (explaining the operation of motor drive circuit 16).



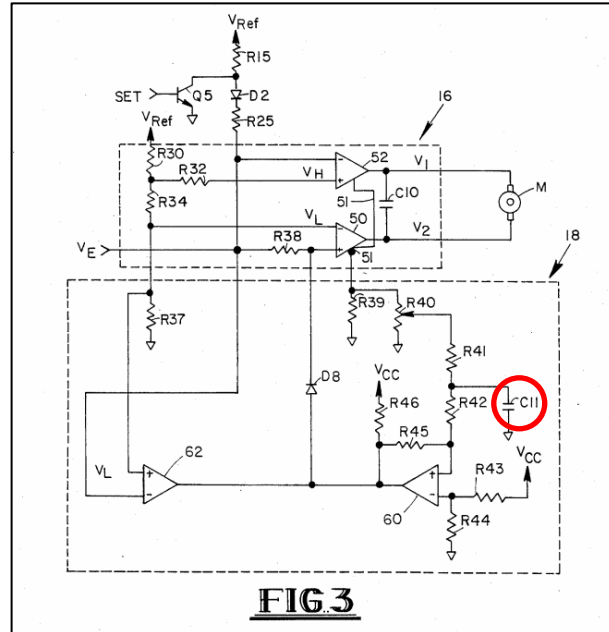
EX1006, FIG. 3 (annotated).

202. The limit detection circuit 18 determines whether the drive current exceeds a threshold. Shown above, the limit detection circuit 18 includes an

amplifier 60. EX1006, 10:21-24, FIG. 3. The noninverted (+) input of amplifier 60 is coupled, through a resistance network, to the ground terminal of amplifiers 50 and 52. EX1006, 10:17-20. This noninverted (+) input “is directly related to the drive current of the motor M.” EX1006, 10:29-34. Also shown above, a small voltage is applied to the inverted (–) input of amplifier 60 to create a normal output state of LOW. EX1006, 10:25-29. When the drive current of the motor exceeds the drive current threshold (i.e., the voltage at the inverted (–) input of amplifier 60)—e.g., when the throttle motor stalls in a fully open or closed position—the output state of amplifier 60 switches from LOW to HIGH. See EX1006, 10:34-39, 11:15-25, 13:5-27. This HIGH output is coupled to the noninverting (+) input of amplifier 50 to change the output of amplifier 50 to HIGH. See EX1006, 10:39-41, 11:26-29. “Because the output of amplifier 52 is also positive, the motor M will cease to rotate.” EX1006, 10:41-43, 11:29-31. Accordingly, when the drive current exceeds a threshold (the voltage at the inverted (–) input of amplifier 60), Burney’s system reduces the control effort (the drive current) to the motor.

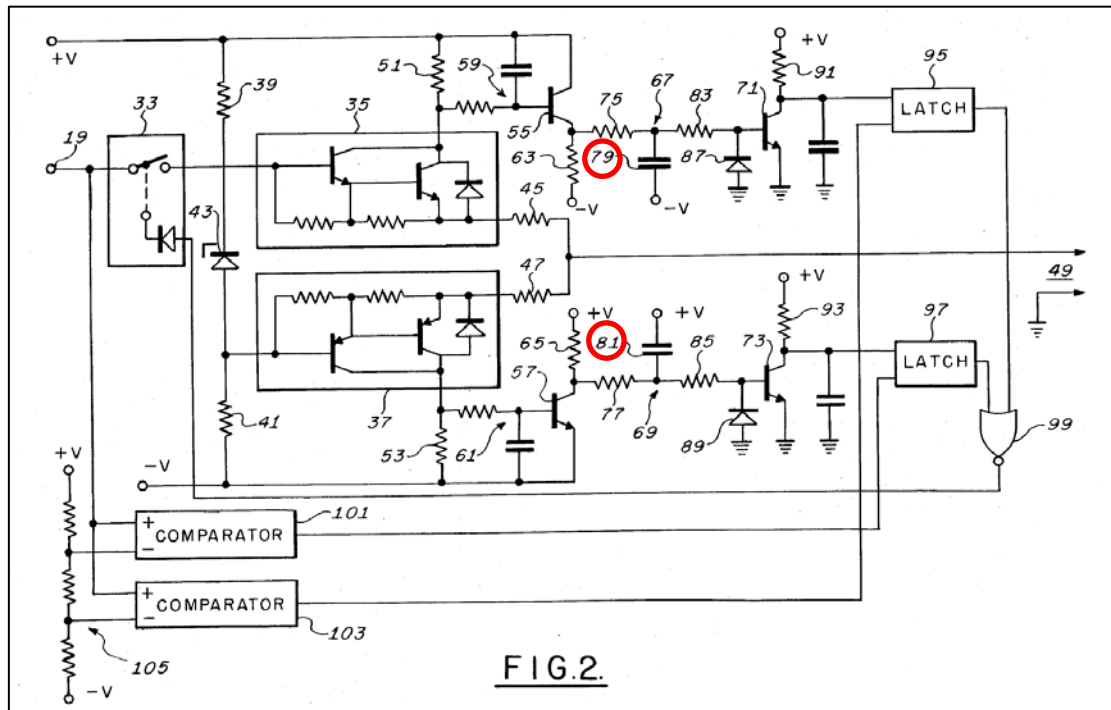
203. Burney also determines whether the drive current exceeds a threshold *for a predetermined time period* because the limit detection circuit 18 includes a timing capacitor as outlined in red below. Burney states: “The wiper arm of the potentiometer R40 is coupled via an integrating filter, formed by resistor R41 and capacitor C11, to the noninverting input of amplifier 60 via resistance R42.”

EX1006, 10:21-24. The time period is the amount of time it takes to charge capacitor c11.



EX1006, FIG. 3 (annotated).

204. Servomotor protection circuits had used timing capacitors like the one in Burney for decades. For example, Ritenour discloses “[a] servosystem drive circuit [that] includes means for sensing instances when the servomotor drive current exceeds a preset threshold level *for a given time*....” EX1027, 1:30-35. Shown below, the circuit uses timing capacitors 79 and 81 to perform this function. EX1027, 3:28-39, FIG. 2.



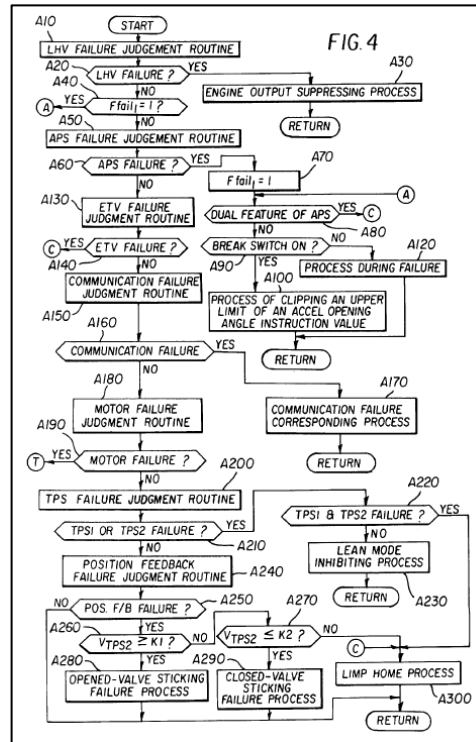
EX1027, FIG. 2 (annotated).

205. Accordingly, a POSA would have understood that Burney's limit detection circuit 18 determines whether the control effort exceeds a threshold for a predetermined time period. And as Section XII.A explains, a POSA would have been motivated to combine Matsumoto and Burney to determine whether the control effort exceeds a threshold for the predetermined time period.

6. [1.E] "reducing said control effort when said control effort exceeds said threshold for said predetermined time period"

206. Matsumoto in view of Burney discloses or suggests this element. Figure 4 (reproduced below) shows Matsumoto's fail-safe operations. EX1008, 3:33-36. When using Burney's limit detection circuit with a timing capacitor, a POSA would have understood that the determination of whether the control effort

exceeds a threshold for the predetermined time period occurs in steps A280, A290, and A290.



EX1008, FIG. 4.

207. Shown above in Figure 4, Matsumoto's system performs an opened-valve sticking failure process (step A280), a closed-valve sticking failure process (step A290), and a limp home process (step A300). See EX1008, 20:1-40, FIG. 4. When Matsumoto's system uses Burney's limit detection circuit with a timing capacitor, Matsumoto's system reduces the control effort when the control effort exceeds the threshold for the predetermined time period. For example, in step A280, "[w]hen the servo motor moves a vehicle's throttle to its full-throttle position, so that operational travel of the servo motor is inhibited, the drive current of the servo

motor will increase.” EX1006, 3:24-28. When the increased drive current surpasses the threshold for the predetermined time period, the control effort is reduced: “This increase is sensed by limit detection circuitry to produce a limit signal that is used by the motor drive circuit to terminate the drive current.” EX1006, 3:28-30. The combined system would also reduce the control effort when exceeding a threshold in step A290 because “[a] similar circuit may be provided to terminate the drive current when the servo is in the idle position....” EX1006, 3:30-35; *see also* EX1006, 10:39-43. Also, like Matsumoto, the combination would reduce the drive current when the throttle valve is stuck between the open and closed positions in step A300:

If for whatever reason, throttle travel is mechanically stopped (as by jamming or other means that inhibits throttle travel) before the full-throttle position is reached, the invention will react accordingly to terminate motor current [B]y sensing the stall condition of the servo motor, *the servo motor can be limited or terminated*, even though the full-throttle or idle position is not reached.

EX1006, 4:3-7; *see also* EX1006, 10:39-43, 11:26-31, 14:19-15:2.

208. Ritenour also discloses this element. EX1027, 3:25-45, 3:57-62.

209. Matsumoto in view of Burney and Ritenour therefore discloses or suggests this element. And as Section XII.A explains, a POSA would have been

motivated to combine Matsumoto, Burney, and Ritenour to reduce the control effort when the control effort exceeds a threshold for a predetermined time period.

7. [1.F] “wherein commanding the positioning device to change to said commanded position comprises at least one of commanding the positioning device to open to a hold open mode and commanding the positioning device to dose [sic]⁶ to a hold close mode”

210. Matsumoto, Burney, and Ritenour all disclose this element. In Matsumoto, the commanding step comprises at least one of commanding the positioning device to open to a hold open mode or close to a hold close mode. In Matsumoto, the ECU 16 determines the target throttle opening and commands the throttle controller 160 to position the throttle valve to the target opening. See EX1008, 3:67-4:6, 5:31-35. Closed and open positions were standard positions for a throttle, so a POSA would have understood that the ECU 16, in certain situations, commands the throttle valve to move to a maximum open position (hold open mode) or a maximum closed position (hold close mode). For example, the ECU 16 would command the throttle valve to move to a maximum open position when the vehicle needs to accelerate up a steep incline. See EX1006, 11:7-11, 14:19-27. Conversely, the ECU 16 would command the throttle valve to move to a maximum closed position when the vehicle needs to decelerate down a steep decline. See EX1006,

⁶ As I explain in Section I.D, I have interpreted “dose” as “close.”

13:9-23, 14:46-56. Indeed, the throttle valve can get stuck in its fully open position and its fully closed position, indicating, or at least suggesting, the ECU 16 commands the throttle valve to move to these positions to begin with. *See* EX1008, 9:1-29. Additionally, a POSA would have known that typical controllers in drive-by-wire systems commanded the throttle valve to fully open and fully close. *See, e.g.,* EX1006, 7:57-63, 11:7-15, 13:5-23, 14:23-27, 14:46-56; *see also* Section VII. A POSA would not have understood Matsumoto's throttle valve to deviate from a typical range of movement from fully open to fully closed. Matsumoto therefore discloses that the commanding step comprises commanding the throttle to open to a hold open mode or close to a hold close mode.

211. Burney also discloses that the DC servo motor (M) moves the throttle to positions between, and including, the throttle valve's mechanical limits (i.e., fully open and fully closed). EX1006, Abstract, 5:65-6:2 ("when the throttle is full open or full closed"), 7:45-63.

212. Ritenour also discloses this element. EX1027, 3:25-45 (high limit of travel), 3:57-62 (low limit of travel).

213. Matsumoto, Burney, and Ritenour therefore disclose this element.

* * *

214. Matsumoto in view of Burney, further in view of Ritenour discloses every element of independent claim 1. A POSA would have also been motivated to

combine these references and would have had a reasonable expectation of success. *See* Section XII.A. Matsumoto in view of Burney and Ritenour therefore renders obvious claim 1.

C. Claim 4

215. Claim 4 depends from claim 1 and further recites “the step of applying a maximum control effort to the positioning device for a hard open time period.” Matsumoto and Burney both disclose this element.

216. Before explaining why Matsumoto and Burney both disclose this element, I note that claim 4 does not associate this step of applying a maximum control effort to the prior steps in claim 1. I understand that this element in claim 4 is met by simply showing that the method for controlling the positioning device applies a maximum control effort for a period of time (a hard open time period). This hard open time period, unlike the other time period in claim 1, is not “predetermined.”

217. Matsumoto discloses this additional element in claim 4. Matsumoto’s throttle control system uses a butterfly valve 151, which opens according to the control effort the throttle controller 160 applies to it. *See* EX1008, 6:62-7:18, 7:51-56. When the throttle controller 160 applies the control effort corresponding to the fully open position, a POSA would have understood this control effort to be the “maximum” control effort the throttle actuator 154 applies to the throttle valve. To

maintain this fully open position (e.g., when driving up a steep incline), the throttle actuator 154 applies this maximum control effort for a period of time—a hard open time period. Otherwise the throttle valve would immediately move toward a closed position. *See* EX1008, 6:62-7:3 (using a spring 153 to bias the throttle valve to its closed position).

218. Burney also discloses this element. In Burney, “[i]f the error voltage V_E so developed is sufficiently large, the motor drive circuit will provide a motor current that causes the motor M to open the throttle valve (not shown) to the full-throttle position.” EX1006, 14:23-27; *see also* EX1006, 12:10-13:4 (the system can modulate the pulses provided to the motor to control the motor’s movement, confirming that Burney provides maximum control effort to effect maximum movement). A POSA would have understood that in such a situation the motor M would apply a maximum control effort to the throttle for a period of time—a hard open time period. Accordingly, both Matsumoto and Burney disclose the additional element in claim 4.

D. Claim 7

219. Claim 7 depends from claim 1 and further recites “wherein the step of commanding the positioning device to change to said commanded position, comprises commanding the positioning device to close to said commanded position in a hold close mode.” Matsumoto, Burney, and Ritenour disclose this element for

the same reasons they disclose the nearly identical language in element [1.F]. See Section XII.B.7.

E. Claim 8

220. Claim 8 depends from claim 7 and further recites “the step of applying a maximum control effort to the positioning device for a hard dose [sic] time period.” Matsumoto and Burney both disclose this element.

221. Before explaining why Matsumoto and Burney both disclose this element, I note that claim 8 does not associate this step of applying a maximum control effort to the prior steps in claims 1 and 7. I understand that this element in claim 8 is met by simply showing that the method for controlling the positioning device applies a maximum control effort for a period of time (a hard close time period). This hard close time period, unlike the other time period in claim 1, is not “predetermined.” I also note that the “maximum” control effort does not have to be a positive value because claim 9 further defines the maximum control effort as -14.5 volts. The maximum control effort for claim 8 is therefore the control effort used to close the throttle valve to the fully closed or idle position. See EX1001, 4:30-31 (“[T]he controller applies a maximum closing control effort to the motor A typical maximum closing control effort has a magnitude of -14.5 volts.”).

222. Matsumoto discloses this additional element in claim 8. Matsumoto’s throttle control system uses a butterfly valve 151, which closes according to the

control effort the throttle controller 160 applies to throttle actuator 154. *See* EX1008, 6:62-7:18, 7:51-56. When the throttle controller 160 applies the control effort corresponding to the fully closed position, a POSA would have understood this control effort to be the “maximum” control effort the throttle actuator 154 applies to the throttle valve. To maintain this fully closed position (e.g., when idling), the throttle actuator 154 applies this maximum control effort for a period of time—a hard close time period.

223. Burney also discloses this element. In Burney, “assume that while in the cruise control mode the vehicle encounters a downhill incline.” EX1006, 13:11-12. “The vehicle speed will increase, causing a concomitant increase in the error voltage V_E above the threshold V_H and causing the output voltage V_1 to go Low (while V_2 remains HIGH).” EX1006, 13:13-16. “The motor M will rotate in a direction that releases the throttle arm 20 (FIG. 1) toward the force of the bias spring 21, allowing the throttle valve (not shown) to move to the idle position.” EX1006, 13:16-19; *see also* EX1006, 12:10-13:4 (the system modulates the pulses provided to the motor to control the motor’s movement, confirming that Burney’s system provides maximum control effort to effect maximum movement). Accordingly, Matsumoto and Burney both disclose the additional element in claim 8.

F. Claim 11

1. [11.P] “A system for controlling a positioning device of an internal combustion engine to prevent overhear conditions”

224. To the extent limiting, Matsumoto discloses the preamble for the same reasons Matsumoto teaches element [1.P]. *See* Section XII.B.1 (showing a method performed in a system—an electronic throttle control device). Additionally, Matsumoto in view of Burney and Ritenour would prevent overhear conditions because the system would prevent the electric motor for the throttle valve from stalling, which would reduce heat and prevent the motor from getting damaged. Specifically, stall current is the maximum current draw of the motor, when the motor is applying its maximum torque because the throttle is being prevented from moving entirely. At this time, the motor’s rotational speed is zero. Accordingly, the power output of the motor (the motor rotational speed in radians per second times the torque) is zero. However, the power input (the current times the voltage) is maximized. Thus, all of the power input into the motor is lost or dissipated into heat the same as an electrical resistance heater. This results in overheating the motor.

225. Burney also discloses this preamble. *See* element [1.P]. As does Ritenour. EX1027, 1:30-35, FIG. 1.

2. [11.A] “an electric motor for actuating the positioning device with a control effort”

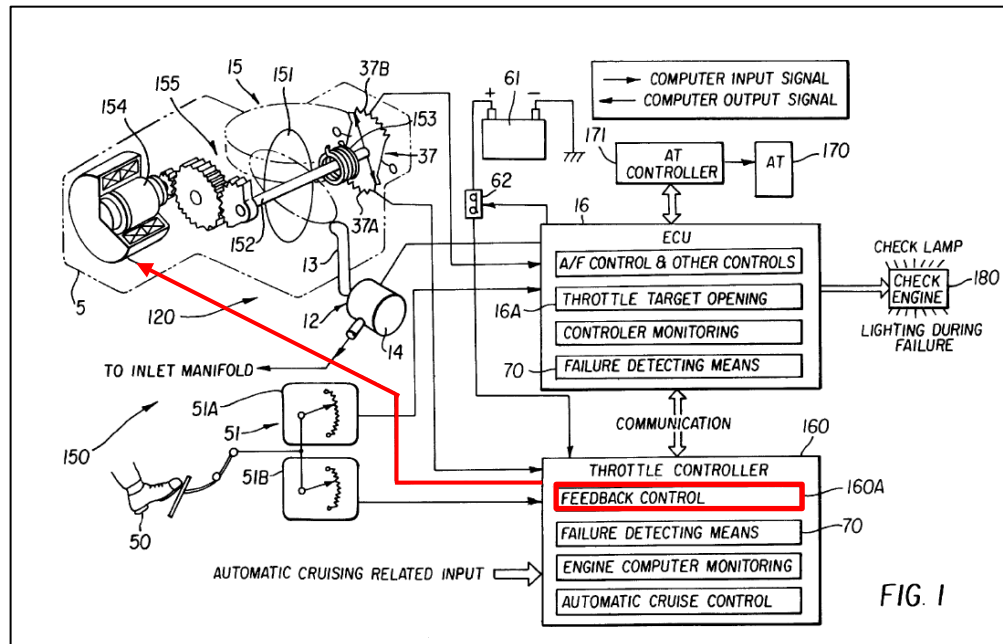
226. Matsumoto discloses this element for the same reasons Matsumoto teaches element [1.A]. *See* Section XII.B.2. Matsumoto’s electric motor actuates the throttle with a control effort:

The throttle controller 160 has a throttle opening feedback control portion 160A which determines motor driving current according to the target opening of the throttle valve received from the engine ECU 16, and controls driving of the actuator (also called throttle control servo) 154 with the current thus determined.

EX1008, 7:51-56; *see also* EX1008, 6:62-7:3, FIG. 1 (the actuator 154 positions the throttle valve). Burney and Ritenour also disclose element [11.A]. EX1006, Abstract, 5:26-38, 7:45-63, 9:16-10:14, FIGS. 1, 3; EX1027, 1:45-68.

3. [11.B] “a control effort detector coupled to said electric motor and intended to detect said control effort”

227. Matsumoto discloses this element. As Section XII.B.4 explains, Matsumoto’s throttle actuator 154 includes hardware to detect the presence and magnitude of the drive current and to use that current to move the throttle accordingly.



EX1008, FIG. 1 (annotated).

228. Burney's system also includes a control effort detector coupled to an electric motor. As I explain in Section XII.B.5, Burney includes amplifiers 50, 52, and 60. And as I explain for element [1.C], these amplifiers detect a control effort for positioning a throttle and are coupled to the motor. Matsumoto and Burney therefore disclose this element. Ritenour also discloses a system that includes a control effort detector coupled to an electronic motor. EX1027, 1:30-35, 2:12-40. And as Section XII.A explains, a POSA would have been motivated to combine Matsumoto and Burney to detect control efforts.

4. [11.C] "a controller coupled to said electric motor and said control effort detector, said controller including control logic operative to command the positioning device to change to a commanded position, detect a control effort required to change to said commanded position, determine whether said control

231. The ECU 16 and throttle controller 160 are also coupled to the control effort detector recited in element [11.B]. The ECU 16 and throttle controller 160, for example, are coupled to the hardware in actuator 154 that receives the drive current from the throttle controller 160. When combined with Burney, this hardware comprises amplifiers 50 and 52 from Burney's motor drive circuit. *See* Section XII.F.3. The ECU 16 and throttle controller 160 are also coupled to the throttle opening feedback control portion 160A (and would be coupled to Burney's amplifier 60) because the throttle opening feedback control portion 160A is located within the throttle controller 160. Finally, as I explain in Sections XII.B.3-XII.B.6, Matsumoto in view of Burney and Ritenour discloses the controller having control logic to "command the positioning device to change to a commanded position, detect a control effort required to change to said commanded position, determine whether said control effort exceeds a threshold for a predetermined time period, and reduce said control effort when said control effort exceeds said threshold for said predetermined time period." Matsumoto in view of Burney and Ritenour therefore discloses this element.

5. [11.D] "wherein said controller further includes control logic operative to command the positioning device to close to said commanded position in a hold close mode"

232. Matsumoto, Burney, and Ritenour disclose or suggest this element. As I explain in Section XII.B.7, for example, Matsumoto's ECU 16 determines the

target throttle opening and commands the throttle controller 160 to position the throttle valve to the target opening. *See* EX1008, 3:67-4:6, 5:31-35. A POSA would have understood that the ECU 16, in certain situations, commands the throttle valve to move to a maximum closed position (hold close mode). For example, the ECU 16 would command the throttle valve to move to a maximum closed position when the vehicle needs to decelerate down a steep decline. *See* EX1006, 13:9-23, 14:46-56. Indeed, the throttle valve can get stuck in its fully closed position, which suggests the ECU 16 commands the throttle valve to move to this position to begin with. *See* EX1008, 9:1-29. Additionally, typical controllers in drive-by-wire systems commanded the throttle valve to fully close. *See, e.g.,* EX1006, 13:5-23, 14:46-56. A POSA would not have understood Matsumoto's system to deviate from the typical commands to move the throttle with range of movement from fully open to fully closed. Matsumoto therefore discloses that the controller has control logic operative to command the positioning device to close in a hold close mode. Burney and Ritenour also disclose or suggest this element. EX1006, Abstract, 5:65-6:2, 7:45-63; EX1027, 3:25-45, 3:57-62.

* * *

233. Matsumoto in view of Burney discloses every element of independent claim 11. A POSA would have also been motivated to combine these two references

and would have had a reasonable expectation of success. *See* Section XII.A.

Matsumoto in view of Burney therefore renders obvious claim 11.

G. Claim 14

234. Claim 14 depends from claim 11 and further recites “wherein said controller further includes control logic operative to command the positioning device to open to said commanded position in a hold open mode.” Matsumoto in view of Burney discloses this element. As I explain in Section XII.B.7, the controller has control logic not only to command the positioning device to close to said commanded position in a hold close mode but also to command the positioning device to open to said commanded position in a hold open mode—i.e., fully open.

H. Claim 15

235. Claim 15 depends from claim 14 and further recites “wherein said controller further includes control logic operative to apply a maximum control effort to the positioning device for said hard open time period.” Matsumoto in view of Burney discloses this element. As I explain in Section XII.C (claim 4), the controllers in both Matsumoto and Burney “apply[] a maximum control effort to the positioning device for a hard open time period.”

I. Claim 18

236. Claim 18 depends from claim 11 and further recites “wherein said controller further includes control logic operative to command application of a

maximum control effort to the positioning device for a hard close time period.”

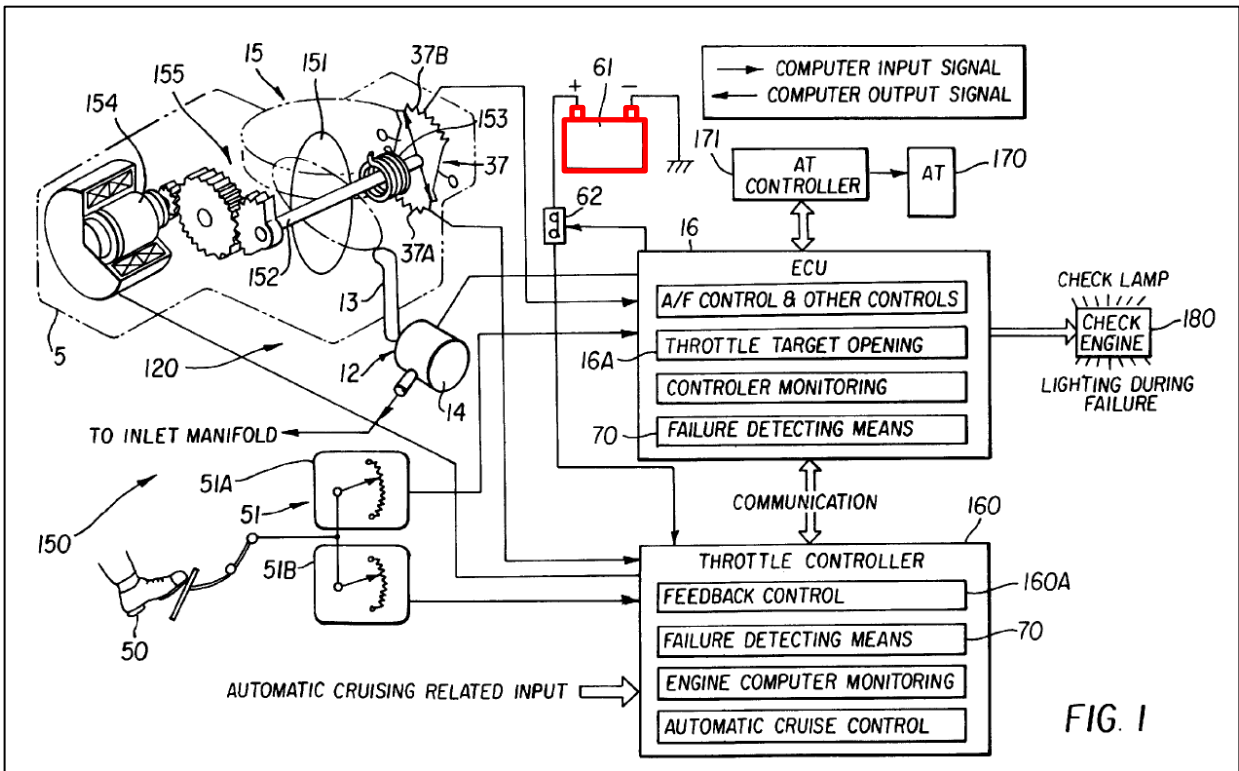
Matsumoto in view of Burney discloses this element. As I explain in Section XII.E (claim 8), the controllers in both Matsumoto and Burney “apply[] a maximum control effort to the positioning device for a hard close time period.”

XIII. GROUND 5: MATSUMOTO IN VIEW OF BURNEY AND RITENOUR, FURTHER IN VIEW OF THE GM MANUAL AND THE CHRYSLER MANUAL RENDERS OBVIOUS CLAIMS 2, 5, 9, 12, 16, AND 19.

A. Claims 5, 9, 16, and 19

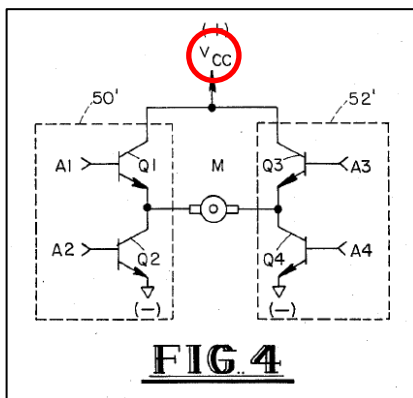
237. Claims 5 and 16 depend from claims 4 and 15, respectively, and recite “wherein said maximum control effort is +14.5 volts.” Claims 9 and 19 depend from claims 8 and 18, respectively, and recite “wherein said maximum control effort is –14.5 volts.” Matsumoto in view of Burney, Ritenour, the GM Manual, and the Chrysler Manual discloses or suggests these elements.

238. Figure 1 of Matsumoto shows a battery 61 that supplies power to the throttle controller 160. EX1008, 8:46-53, FIG. 1.



EX1008, FIG. 1 (annotated).

239. Similarly, Burney uses a voltage V_{cc} to supply power to the motor drive circuit as Figure 4 shows below. EX1006, 9:30-45, FIG. 4.



EX1005, FIG. 4 (annotated).

240. Neither Matsumoto nor Burney specifies the voltage that battery 61 or V_{cc} provides to the motor drive circuit. A POSA would have therefore looked for the voltage levels of typical automobile power supplies from multiple major automobile manufacturers. The POSA would have been led to the GM Manual, which states that voltage during idle is typically 13.5 to 14.5 volts. EX1023, p. 94; *see also* EX1021, p. 39. The POSA would have also been led to the Chrysler Manual, which states that a typical voltage regulator supplied 13.9-14.6 volts. EX1024, p. 110. For cross compatibility, the POSA would have accounted for these overlapping ranges.

241. In the context of Matsumoto, Burney, and Ritenour, a POSA would have been motivated to use the maximum available voltage to unjam the throttle when stuck in a *closed* position. The maximum voltage would have provided the greatest chance of quickly releasing the jam. Given typical batteries reached a maximum voltage of around 14.5 volts, a POSA would have been motivated to apply +14.5 volts for the hard open time period.

242. Likewise, when trying to unjam a throttle stuck in an *open* position, a POSA would have been motivated to use the maximum available voltage. But when trying to close the throttle, the POSA would have used negative polarity. EX1006, FIG. 4; EX1027, FIG. 2. Given typical batteries reached a maximum voltage of around 14.5 volts, a POSA would have therefore been motivated to apply -14.5 volts for the hard close time period.

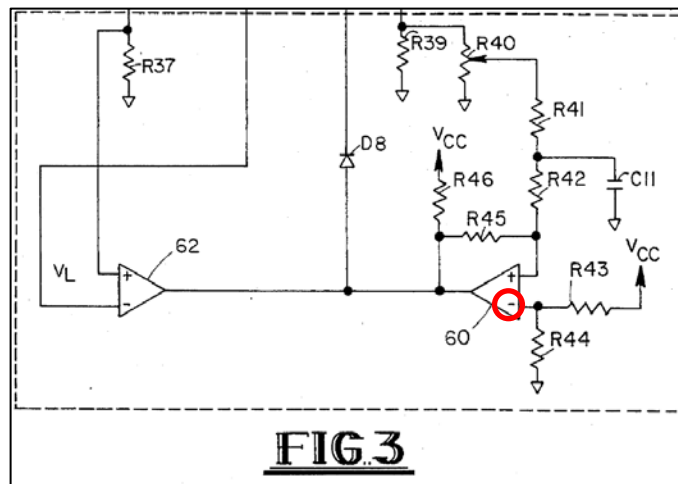
243. Using ± 14.5 volts as the maximum control effort would have combined prior art elements (a typical battery supply) according to known methods to yield predictable results. These specific voltages would have also been an obvious matter of design choice. In the '804 patent, the specific values provide no novel or unexpected result and solve no stated problem. The specific voltages recited in the claims also do not recite different structure or achieve a different purpose. Indeed, the '804 patent admits that the voltage is an obvious matter of design choice: "Obviously, the magnitude of the effort may vary as required." EX1001, 3:63-64. Neither the '804 patent nor its prosecution history articulates a single benefit for selecting this value as the maximum control effort.

244. The '804 patent confirms that $\pm 14.5V$ was an obvious design choice. It explains that a POSA would have understood that there is a relationship between the amount of voltage that could be applied to a servo motor and the duration such voltage could be applied without overheating the motor, and provides a table of example voltage-duration pairs for "a given servo motor." EX1001, 3:36-54. The patent further admits, "Obviously, the magnitude of the effort may vary as required." EX1001, 3:63-64. These admissions confirm that a POSA would have understood the conditions (amount of control effort and duration) under which the motor could operate without overheating, and that applying $\pm 14.5V$ was a design choice within known operating conditions.

B. Claims 2 and 12

245. Claims 2 and 12 depend from claims 1 and 11, respectively, and recite “wherein said threshold has an absolute value of 6 volts.” Matsumoto in view of Burney, Ritenour, the GM Manual, and the Chrysler Manual discloses or suggests this element.

246. Figure 3 of Burney shows the threshold voltage of the limit detection circuit 18 at the inverted (–) terminal of amplifier 60. Burney, however, never states what this voltage is, only that the voltage is relatively small. EX1006, 10:25-29.



EX1006, FIG. 3 (excerpted and annotated).

247. Given the threshold voltage at the negative (–) terminal of amplifier 60 would be relatively small and the typical V_{cc} would be 14.5 volts, a POSA would have at least configured the circuit such that the voltage at the inverted (–) terminal of amplifier 60 was less than half of V_{cc} —less than 7.25 volts.

248. Selecting |6| volts as the threshold would have been an obvious design choice. In the '804 patent, this specific value provides no novel or unexpected result and solves no stated problem. The specific threshold voltage recited in the claims also does not recite different structure or achieve a different purpose. Indeed, the '804 patent admits |6| volts as a threshold was *typical*. EX1001, 3:28-30, 4:19-21. And neither the '804 patent nor its prosecution history articulates a single benefit for selecting |6| volts as the threshold voltage.

249. The '804 patent states: “*Typically*, an effort limit of approximately +6 volts and a contiguous time interval of about 300 milliseconds are used.” EX1001, 3:28-30, 4:19-21 (same statement but opposite polarity). To the extent this statement is an admission about what was “typical” in the industry, it follows that it was obvious to a POSA to use |6| volts. At the least, the next sentence, “[o]bviously, these values may vary as required,” confirms that |6| volts would have been an obvious design choice. EX1001, 3:30-31.

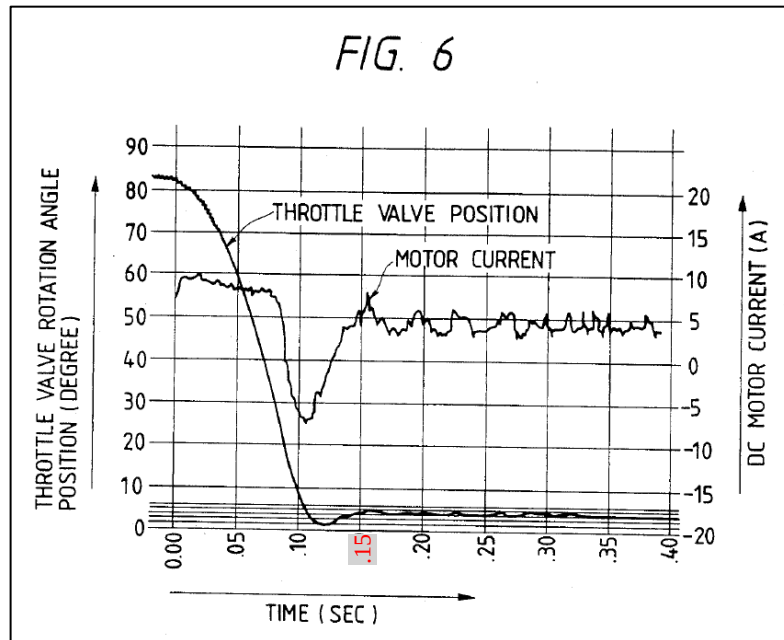
XIV. GROUND 6: MATSUMOTO IN VIEW OF BURNEY AND RITENOUR, FURTHER IN VIEW OF OHTA RENDERS OBVIOUS CLAIMS 3, 6, 10, 13, 17, AND 20.

A. Claims 3 and 13

250. Claims 3 and 13 depend from claims 1 and 11, respectively, and recite “wherein said predetermined time period is 300 milliseconds.” Matsumoto in view of Burney, Ritenour, and Ohta discloses or suggests this element.

251. As I explain for element [1.D], Matsumoto determines a throttle failure after a predetermined time period of 500 milliseconds. EX1008, 14:41-52. Burney and Ritenour also determine whether the control effort exceeds a threshold for a predetermined time period. However, neither Burney nor Ritenour specifies the number of milliseconds the circuit takes before reducing the threshold based on exceeding the control effort.

252. To determine the amount of time to use for the predetermined time period in element [1.E], a POSA would have looked for the time it takes a typical motor to drive the valve from fully open to fully closed and vice versa. A POSA would have looked for this time period because if the throttle valve is not moved to the target position after this amount of time, the throttle valve is likely stuck. Looking for this value, the POSA would have been led to Ohta, which shows that the normal time period for moving the throttle from open to close is approximately 150 milliseconds, as Figure 7 shows below. EX1012, FIG. 6.



EX1020, FIG. 6 (annotated to correct typo).

253. In view of Ohta, a POSA would have used a time period of at least 150 milliseconds. The POSA, however, would have been motivated to use a time *higher* than 150 milliseconds to build in tolerance, account for the additional time the system would take to move against the bias force of the throttle spring, and account for instances where the system takes a while to unjam the throttle valve.

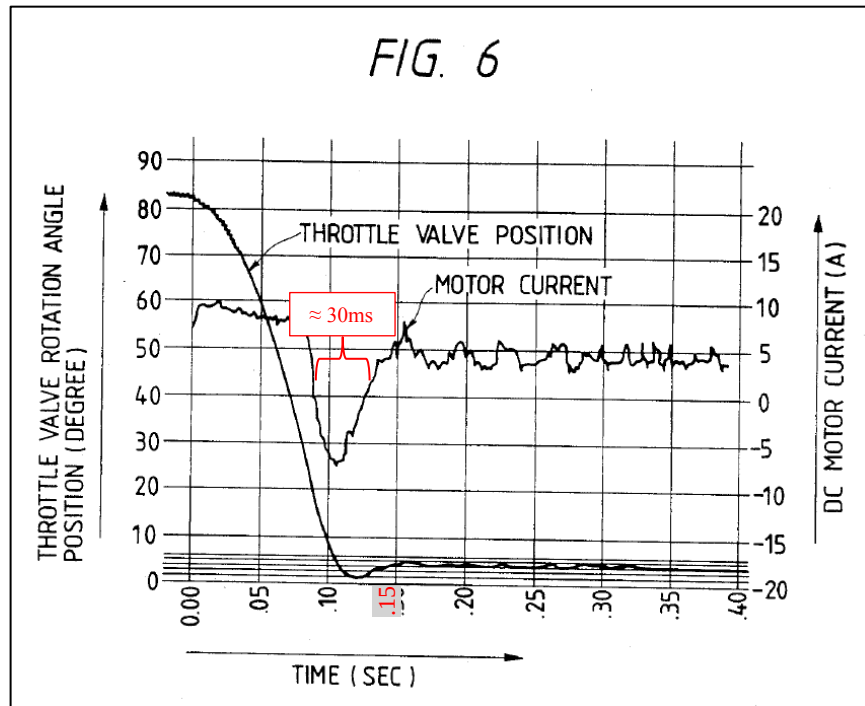
254. Selecting 300 milliseconds would have been an obvious design choice. In the '804 patent, this specific value provides no novel or unexpected result and solves no stated problem. The specific time period recited in the claims also does not recite different structure or achieve a different purpose. Indeed, the '804 patent admits 300 milliseconds was *typical*. EX1001, 3:28-30, 4:19-21. And neither the

'804 patent nor its prosecution history articulates a single benefit for selecting 300 milliseconds for the predetermined time period.

255. The '804 patent states: "*Typically*, an effort limit of approximately +6 volts and a contiguous time interval of about 300 milliseconds are used." EX1001, 3:28-30, 4:19-21. To the extent this statement is an admission about what was "typical" in the industry, it follows that it was obvious to a POSA to use 300 milliseconds. At the least, the next sentence, "[o]bviously, these values may vary as required," confirms that 300 milliseconds would have been an obvious design choice. EX1001, 3:30-31.

B. Claims 6, 10, 17, and 20

256. Claims 6 and 17 depend from claims 4 and 15, respectively, and recite "wherein said hard open time period is 30 milliseconds." Claims 10 and 20 depend from claims 8 and 18, respectively, and recite "wherein said hard close time period is 30 milliseconds." Matsumoto in view of Burney, Ritenour, and Ohta discloses or suggests this element. Again, Burney does not specify the time periods that are used in the system. This would have led the POSA to Ohta. Shown below, approximately 30 milliseconds of maximum current is used to drive the throttle valve from a fully open position to a fully closed position.



EX1020, FIG. 6 (annotated to correct typo).

257. A POSA would have been motivated to use 30 milliseconds as the period for the hold open mode and the hold close mode because this is the minimum amount of time the control system needs to initiate throttle movement. The POSA would have understood that any additional time of applying maximum control effort would risk harming the motor circuit. To avoid harming the motor circuit, the POSA would have used the minimum amount of time needed to initiate movement—30 milliseconds.

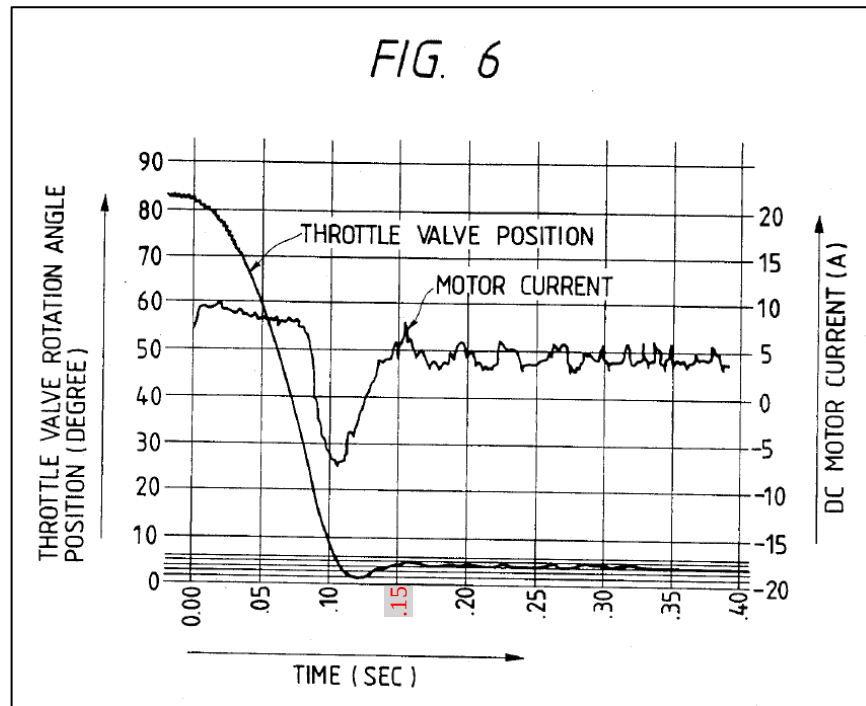
258. Additionally, selecting 30 milliseconds for both the hard open time period and hard close time period would have been an obvious design choice. In the '804 patent, this specific value provides no novel or unexpected result and solves no

stated problem. The specific time period recited in the claims also does not recite different structure or achieve a different purpose. Indeed, the '804 patent admits 30 milliseconds was *typical*. EX1001, 4:26-27. And neither the '804 patent nor its prosecution history articulates a single benefit for selecting 30 milliseconds for the hard open and hard close time periods. Accordingly, 30 milliseconds would have been an obvious design choice.

259. As Section XII.A explains, a POSA would have been motivated to combine Matsumoto, Burney, and Ritenour. A POSA would have also been motivated to use a predetermined time period of 300 milliseconds. As I explain for element [1.D], Matsumoto's system determines a throttle failure after a predetermined time period of 500 milliseconds. *See* EX1008, 14:41-52. Burney's system also determines whether the control effort exceeds a threshold for a predetermined time period. However, Burney does not specify the number of milliseconds the circuit takes before reducing the threshold based on exceeding *the control effort*.

260. To determine the amount of time to use for the predetermined time period in element [1.E], a POSA would have looked for the time it takes for a typical motor to drive the valve from fully open to fully closed and vice versa. A POSA would have looked for this time period because if the throttle valve is not moved to the target position after this amount of time, the throttle valve would likely

be stuck. Looking for this value, the POSA would have been led to Ohta, which shows that the normal time period for moving the throttle from open to close is a little over 150 milliseconds as Figure 7 shows below. See EX1012, FIG. 6.

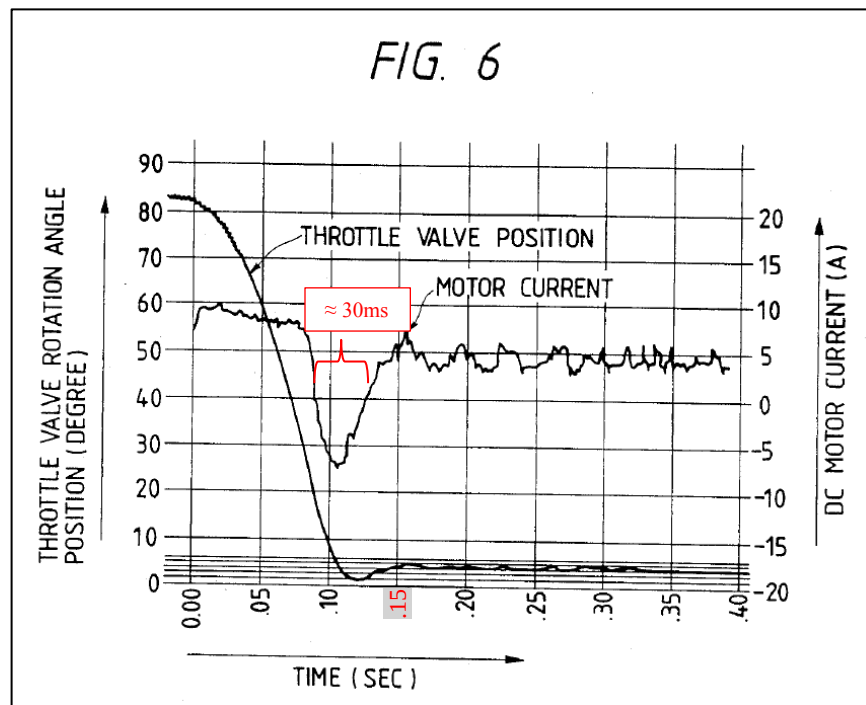


EX1020, FIG. 6 (annotated to correct a typo).

261. In view of Ohta, a POSA would have used a time period of at least 150 milliseconds. The POSA, however, would have been motivated to use a time higher than 150 milliseconds to build in tolerance, account for the additional time the system would take to move against the bias force of the throttle spring, and account for instances where the system takes a while to unjam the throttle valve. The POSA would have therefore been motivated to try time periods sufficiently greater than 150 milliseconds but still short enough to prevent damage to the motor. 300

milliseconds—twice the typical time period for shutting the throttle valve from fully open to fully closed—would have been obvious to try. A POSA would have also had a reasonable expectation of success. For these reasons, a POSA would have been motivated to use 300 milliseconds as a simple design choice.

262. A POSA would have also been motivated to use a hard open time period and a hard close time period of 30 milliseconds. Again, Burney does not specify the time periods that are used in the system. This would have led the POSA to Ohta. Shown below, approximately 30 milliseconds of maximum current is used to drive the throttle valve from a fully open position to a fully closed position.



EX1020, FIG. 6 (annotated to correct a typo).

263. A POSA would have been motivated to use 30 milliseconds as the period for the hold open mode and the hold close mode because this is the minimum amount of time the control system needs to initiate movement of the throttle. The POSA would have understood that any additional time of applying maximum control effort would risk harming the motor circuit. To avoid harming the motor circuit, the POSA would have therefore used the minimum amount of time needed to initiate movement—30 milliseconds.

C. Claims 3 and 13

264. Claim 3 depends from claim 1 and further recites “wherein said predetermined time period is 300 milliseconds.” Claim 13 depends from claim 11 and recites the same element. Matsumoto in view of Burney, further in view of Ohta discloses or suggests this element. As I explain in Section XIV.A, Matsumoto and Burney disclose a predetermined time period but do not specify the number of milliseconds. The POSA would have therefore looked to other references to find an acceptable time period. This would have led the POSA to Ohta, which suggests that a POSA would have tried a time period of 300 milliseconds. Additionally, as I explain in Section XIV.A, a POSA would have been motivated to try, as a simple design choice, a time period of 300 milliseconds. Itabashi in view of Ohta therefore discloses this element.

265. I also note that during prosecution the examiner determined that this 300 milliseconds for the predetermined time period was a design choice. EX1002, pp. 0064-65. The examiner also stated, and I agree, that the applicant has not disclosed any advantage for setting the predetermined time period to 300 milliseconds. The applicant did not dispute the examiner's findings during prosecution. *See* EX1002, pp. 0067-73.

266. For these reasons, Itabashi in view of Ohta teaches every element of claims 3 and 13 and renders the claims obvious.

D. Claims 6 and 17

267. Claim 6 depends from claim 4 and further recites "wherein said hard open time period is 30 milliseconds." Claim 17 depends from claim 15 and recites the same element. Matsumoto in view of Burney, further in view of Ohta discloses or suggests this element. As I explain in Section XII.C (claim 4), Matsumoto in view of Burney discloses the step of applying a maximum control effort for a hard open time period. The combination, however, does not specify the number of milliseconds of the hard open time period. The POSA would have therefore looked to other references to find an acceptable time period. This would have led the POSA to Ohta, which suggests that a POSA would have tried a time period of 30 milliseconds as I explain in Section XIV.A. Additionally, as I also explain in Section XIV.A, a POSA would have been motivated to try, as a simple design

choice, a time period of 30 milliseconds. Matsumoto in view of Burney, further in view of Ohta therefore discloses this element and renders obvious claims 6 and 17.

E. Claims 10 and 20

268. Claim 10 depends from claim 8 and further recites “wherein said hard close time period is 30 milliseconds.” Claim 20 depends from claim 18 and recites the same element. Matsumoto in view of Burney, further in view of Ohta discloses or suggests this element. As I explain in Section XII.E (claim 8), Matsumoto in view of Burney discloses the step of applying a maximum control effort for a hard close time period. The combination, however, does not specify the number of milliseconds of the hard close time period. The POSA would have therefore looked to other references to find an acceptable time period. This would have led the POSA to Ohta, which suggests that a POSA would have tried a time period of 30 milliseconds as I explain in Section XIV.A. Additionally, as I also explain in Section XIV.A, a POSA would have been motivated to try, as a simple design choice, a time period of 30 milliseconds. Matsumoto in view of Burney, further in view of Ohta therefore discloses this element and renders obvious claims 10 and 20.

XV. OBJECTIVE INDICIA DO NOT SUPPORT PATENTABILITY.

269. I understand that the obviousness analysis includes considering evidence of secondary indicia of nonobviousness (if available). I understand that any secondary indicia of nonobviousness must have a nexus, or a close connection, to

the novel aspects of the claimed invention. I understand that secondary indicia of nonobviousness include the following: commercial success, long-felt but unmet need, failure of others, copying, praise in the industry, and unexpectedly superior results as compared with the closest prior art.

270. Considering the information I have reviewed, my general knowledge of the field of engine control systems, and publications within that and related fields, I am unaware of any objective evidence that might support the patentability of the claims of the '804 patent. Further, from my review of the prosecution history of the '804 patent (EX1002), the applicant never raised secondary indicia of nonobviousness. I am not otherwise aware of any publicly available evidence of secondary indicia of nonobviousness. Should any alleged secondary indicia of nonobviousness be presented, I reserve the right to provide an opinion thereon.

XVI. CONCLUSION

In signing this declaration, I recognize that this declaration will be filed as evidence in an *inter partes* review 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, I will appear for cross-examination within the United States during the time allotted.

I hereby declare that all statements made herein are made of my own knowledge and 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.

Executed on this 11th day of February, 2020.

A handwritten signature in black ink, appearing to read 'Gerald J. Micklow', with a stylized flourish at the end.

Gerald J. Micklow, PhD, PE