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Title: AIR CONDITIONING SYSTEM FOR AN OPEN
MOTORIZED VEHICLE

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DECLARATION OF ROELOF H. DEVRIES

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LISTING OF CHALLENGED CLAIMS

Claim 1	
[1.pre]	An enclosure system for a lawnmower, the system comprising:
[1.1]	a cab assembly having a front wall, a first sidewall, a second sidewall, and a ceiling that collectively define an interior volume,
[1.2]	wherein the cab assembly is adapted to secure to a mower frame of the lawn mower such that a user may occupy the interior volume while operating the lawn mower; and
[1.3]	an air conditioning unit configured to produce conditioned air,
[1.4]	wherein the air conditioning unit is adapted to be powered in part by rotary motion transmitted from an engine of the lawn mower,
[1.5]	the air conditioning unit being secured in relation to the cab assembly such that conditioned air produced by the air conditioning unit is emitted directly into the interior volume,
[1.6]	wherein one or more components of the air conditioning unit define a rear wall disposed opposite the front wall,
[1.7]	wherein the cab assembly includes a lower frame adapted to be secured to the mower frame such that when the lower frame is secured to the mower frame the front wall is disposed in front of an operator seat of the lawn mower and the rear wall is disposed behind the operator seat; and
[1.8]	wherein the cab assembly has a height that increases as the cab assembly extends from the rear wall to the front wall.
Claim 3	
3	The system of claim 1, wherein the first sidewall and the second sidewall each have a first end proximal to the front wall and a second end opposite the first end, wherein a height of the first sidewall and the second sidewall decreases as each sidewall extends from the first end to the second end.
Claim 4	
4	The system of claim 1, wherein at least one of the first sidewall, the second sidewall, and the front wall is semi-transparent.

I, Roelof H. deVries, declare as follows:

I. INTRODUCTION

1. I have been retained as a technical expert by Curtis Industries, LLC (“Curtis”/“Petitioner”). I understand that Curtis is requesting that the Patent Trial and Appeal Board institute an *inter partes* review (“IPR”) proceeding with respect to U.S. Patent No. 10,632,815 (“the ’815 patent”) (Ex. CI-1001).

2. I have been asked to provide my independent analysis of the ’815 patent in light of certain publications, and I have done so based on my personal knowledge and experience.

3. Based on my independent analysis of the ’815 patent and the publications cited in this Declaration, as well as my personal knowledge and experience, it is my opinion that the systems described in claims 1, 3, and 4 of the ’815 patent would have been obvious to a person having ordinary skill in the art at the time of the alleged invention, for the reasons I explain below.

4. I am not, and never have been, an employee of Curtis. I received no compensation for this Declaration beyond my normal hourly rate based on my time actually spent analyzing the ’815 patent, the prior-art publications cited below, and various issues related thereto. I will not receive any added compensation based on the outcome of any IPR or other proceeding involving the ’815 patent.

II. QUALIFICATIONS

5. In formulating my opinions, I have relied on my knowledge, training, and experience in the relevant field. My education and experience are described more fully in the attached curriculum vitae (Appendix A). For ease of reference, I have highlighted certain information below.

6. I am both a mechanical engineer and an agricultural engineer with approximately 30 years of engineering experience, approximately eight years of which is experience with the grounds maintenance equipment industry.

7. I received a Bachelor of Science in Mechanical Engineering from Lafayette College in 1981.

8. I received a Master of Science in Agricultural Engineering, with a concentration in Power and Machinery, from Cornell in 1987.

9. My work experience includes working as a Design Engineer at Ford New Holland, where I worked on industrial tractors. I was the lead engineer on the “D Series” Industrial Tractor-Loaders, which included a new cab. I was the lead engineer on the “C Series” Industrial Tractors, which included a new operator platform. I also worked on product improvement for the whole line of industrial tractor products, which included cabs with air conditioning.

10. I spent more than 8 years as Engineering Manager at Steiner Turf Equipment, Inc., where I worked on new product development and product

improvement for grounds maintenance equipment. I managed a project that took the design of the Bunton Zero-Turn Mowers, made some improvements, and re-branded two models as Steiner. This project included a patented design for mower deck height adjustment.

11. I was also Engineering Manager and Chief Engineer for J&J Truck Bodies and Trailers for four years. At J&J, I managed a department of 10 – 15 employees, including engineering, research and development, and programming. My department was responsible for development of new products, including truck bodies, trailers, and specials. All of the trucks we worked with had air-conditioned cabs.

12. I have been the principal at deVries Engineering for the last 16 years. In that capacity, and as an Associate with Lapina Associates for 8 years, I have done forensic engineering for a wide variety of product liability cases. Several of these cases have involved determining the field of vision from the operator position.

13. In all of my experience in the design and analysis of mobile equipment, ergonomics has been a significant factor. An engineer working with equipment operated by persons always needs to consider how design decisions affect the operator experience, ease of use, and safety.

14. Since 2008, I have also been an Assistant Professor at the University of Pittsburgh at Johnstown, and I have taught several courses, including Machine

Design, Introduction to Engineering Analysis, Introduction to Mechanical Engineering Design, Strengths of Materials, Strengths of Materials Lab, Fluid Mechanics Lab, Computer Aided Design and Drafting, Vehicle Dynamics, and Fluid Power.

III. LEGAL PRINCIPLES

15. In forming my analysis and conclusions expressed in this Declaration, I have applied the legal principles described in the following paragraphs, which were provided to me by counsel for the Petitioner.

A. Person of Ordinary Skill in the Art

16. I understand that the factors considered in determining the ordinary level of skill in a field of art include: the level of education and experience of persons working in the field; the types of problems encountered in the field; the teachings of the prior art regarding solutions to such problems; and the sophistication of the technology at the time of the alleged invention. I understand that a person of ordinary skill in the art (also referred to herein as a “skilled artisan”) is not a specific real individual, but rather is a hypothetical individual having the qualities reflected by the factors above and knowledge of all relevant prior-art references, including the references I cite below.

B. Obviousness

17. I have been informed that a patent claim is invalid as “obvious” in light of one or more prior-art references if it would have been obvious to a skilled artisan

at the time of the alleged invention, taking into account (1) the scope and content of the prior art, (2) the differences between the prior art and the claims, (3) the level of ordinary skill in the art, and (4) any so called “secondary considerations” of non-obviousness, which include: (i) “long-felt but unresolved need” for the claimed invention, (ii) commercial success attributable to the claimed invention, (iii) unexpected results of the claimed invention, and (iv) “copying” of the claimed invention by others.

18. The '815 patent's earliest possible effective filing date is July 18, 2013. For purposes of my obviousness analysis, I have assumed (but do not concede) that the claims are entitled to claim priority to that date.

19. I have been informed that a claim can be obvious in light of a single prior-art reference or multiple prior-art references. To be obvious in light of a single prior-art reference or multiple prior-art references, there must be a reason that would have prompted a skilled artisan to modify or supplement the single prior-art reference, or to combine two or more references, in a manner that provides the elements of the claimed invention. This reason may come from a teaching, suggestion, or motivation to combine, either explicitly or implicitly from the reference(s) themselves, the knowledge or “common sense” of a skilled artisan, or the nature of the problem to be solved. The reason may also come from a design need or market pressure to solve a problem, provided there are a finite number of

identified, predictable solutions. I have been informed that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. I also understand it is improper to rely on hindsight in making the obviousness determination.

20. I understand that an obviousness determination also requires that a skilled artisan would have had a reasonable expectation of success. This concept has been explained to me as relating to the relative likelihood or predictability—from the perspective of a skilled artisan—of successfully modifying the prior art in a manner that would meet the claimed limitations of the patent being challenged. I understand that the expectation of success need only be “reasonable” and, thus, does not require the absolute certainty gleaned from physically creating the proposed prior art modification.

C. Claim Interpretation

21. I understand that, for purposes of my analysis in this *inter partes* review proceeding, the terms appearing in the patent claims should be interpreted according to their “ordinary and customary meaning.” In determining the ordinary and customary meaning, I understand that the words of a claim are first given the plain meaning they would have had to a person of ordinary skill in the art at the time of the alleged invention. I also understand that the specification and file history may be used to construe a claim term. Moreover, I understand that even treatises and

dictionaries may be used, albeit under limited circumstances, to determine the meaning attributed by a person of ordinary skill in the art to a claim term.

22. I have been informed by counsel for Petitioner that the parties proposed constructions for certain claim terms of the '815 patent in the co-pending litigation. I address the parties' proposed constructions in my obviousness analysis below in Section VII and VIII.

IV. PERSON OF ORDINARY SKILL IN THE ART

23. Based on my knowledge and experience in the field and my review of the '815 patent and its file history, I believe that a skilled artisan would have had a Bachelor of Science degree in mechanical engineering or a related discipline and at least one year of professional experience in a field related to off-road vehicles. Such experience could be obtained through research and study in a graduate program or through comparable exposure through industry employment, and additional years of experience could substitute for education (and vice versa).

24. Accordingly, my analysis and conclusions expressed in this Declaration are based on the perspective of a skilled artisan having this level of knowledge and skill. My education, technical expertise, and personal knowledge discussed in Section II shows that I meet the qualifications of a skilled artisan. Furthermore, I have significant experience working with, training and educating persons meeting

the qualifications of a skilled artisan, and am familiar with the perspective of a skilled artisan.

V. MATERIALS CONSIDERED

25. As part of my independent analysis for this Declaration, I have considered the following: the '815 patent (Ex. CI-1001) and its prosecution history (Ex. CI-1002); the background knowledge/technologies that were commonly known to persons of ordinary skill; my own knowledge and experience gained from my work in the field; my experience in teaching and advising others in this field; and my experience working with others involved in this field. In addition, I have analyzed the publications and materials listed herein and in Curtis's Petition for *inter partes* review of the '815 patent.

26. My citations to patent literature use the column/line numbers or paragraph numbers. Unless indicated otherwise, all emphasis (bold/italics/underline) in any quoted text are ones I have added.

27. Although I cite and quote to selected portions of various references in this Declaration, the reader should understand that these citations are merely representative examples. A skilled artisan would have viewed each reference in its entirety and in combination with other references. Accordingly, I intend the references identified in this Declaration to be viewed as incorporated in their entireties.

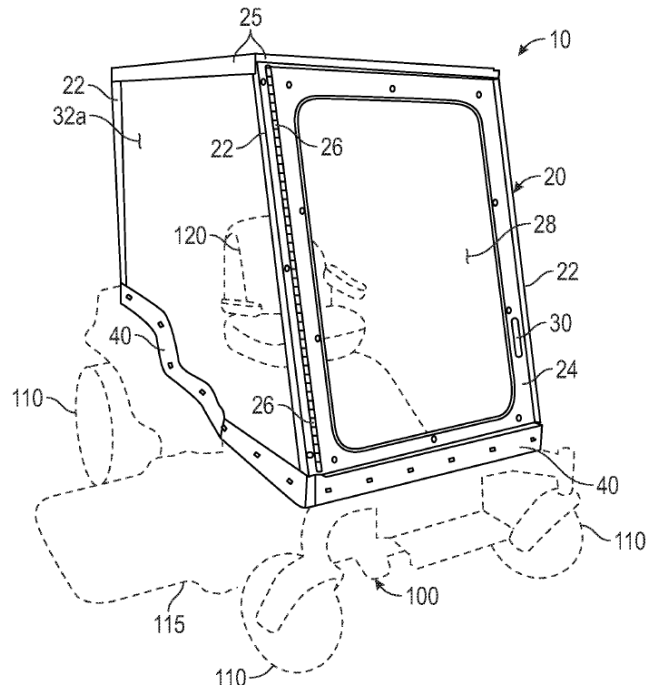
VI. OVERVIEW OF THE '815 PATENT

A. Background of the Technology

28. Air-conditioned vehicles have existed since at least the 1930s. Ex. CI-1018 at 45. The general idea of the air-conditioned lawn mower has existed since at least the 1950s. Ex. CI-1019. By the time of the '815 patent's earliest possible effective filing date (July 18, 2013), air-conditioned lawn mowers and air-conditioned cabs for working vehicles were not only known, but already commercially available. *See, e.g.*, Ex. CI-1004; Ex. CI-1005.

B. Description of the '815 Patent

29. The '815 patent “relates generally to conditioned air systems, and more particularly to an air conditioning system for an open motorized vehicle, such as a riding mower.” Ex. CI-1001 at 1:16-18. According to the '815 patent, “there [was] a need for a means by which an open vehicle can be operated in hot weather.” *Id.* at 1:43-45. The '815 patent describes a system that includes a cab assembly and an A/C unit. *Id.* at 4:44-46. The patent claims a cab assembly with a front wall, two sidewalls, and a ceiling. *Id.* at 10:4-6. The claimed A/C unit defines the rear wall and is powered in part by rotary motion transmitted from the lawn mower's engine. *Id.* at 10:11-18. The cab assembly also has a lower frame that is secured to the lawn mower frame using, for example, a plurality of fasteners (e.g., bolts, screws, or the like). *Id.* at 5:1-4. The cab assembly's height also increases from back to front. *Id.* at 10:25-27.



Id., Fig. 1.

VII. GROUND 1: TORO VIDEO, TORO MANUAL, AND JUDICE

A. Overview of Toro Video (Ex. CI-1004)

30. Toro Video is a YouTube video advertising the Toro Groundsmaster 5910, a lawn mower equipped with an air-conditioned operator cab:



Ex. CI-1004.

31. Toro Video highlights the A/C system of the Toro Groundsmaster 5910:

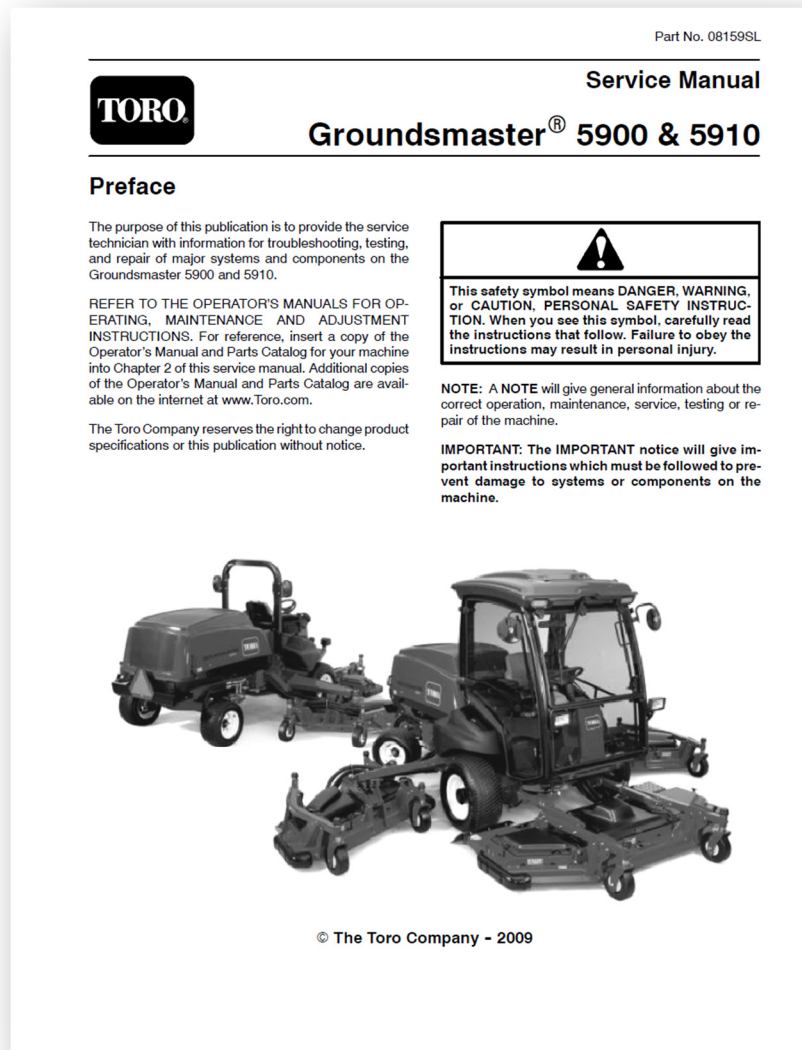


Id. at 0:35-43.

32. Toro Video also shows the Groundsmaster 5900, which does not include an air-conditioned cab. In my obviousness analysis, I do not rely on any portion of Toro Video that depicts only the Groundsmaster 5900.

B. Overview of Toro Manual (Ex. CI-1005)

33. Toro Manual is a service manual for the same Toro lawn mowers shown in Toro Video, the Toro Groundsmaster 5900 and 5910:



Ex. CI-1005 at Cover.

34. Toro Manual provides “information for troubleshooting, testing, and repair of major systems and components on the Groundsmaster 5900 and 5910.” Ex. CI-1005 at 1. In my obviousness analysis, I do not rely on any portion of Toro Manual that pertains only to the Groundsmaster 5900.

35. I note that persons of ordinary skill in the art before the earliest possible effective filing date would have been aware of Toro as a leading manufacturer of lawn mowers. Persons of ordinary skill would have turned to Toro’s website to find information on the latest developments in lawn mowers. Persons of ordinary skill would have found such information by, for example, searching for Toro’s website through a search engine or using the search function on Toro’s website.

C. Overview of Judice (Ex. CI-1006)

36. Judice is an article from Farm Show Magazine describing an air-conditioned lawn mower that Robert Judice built in 2001:



Robert Judice built this zero turn riding mower. It has an air conditioned cab and a 5-ft. deck that automatically raises or lowers according to mowing conditions.

He Mows Grass In Air-Conditioned Comfort

"I built this zero turn riding mower equipped with a 5-ft. deck two years ago. It has air conditioning and a deck that automatically raises or lowers according to mowing conditions,"

the front wheels, and the third powers a motor that belt-drives the mower blades. All of the pumps are located under the cab's floor-board, which lifts up for easy access.

Ex. CI-1006 at 27.

37. Unlike the Toro Groundsmaster 5910, the Judice mower has its A/C unit on the rear wall of the cab. *Id.* ("The evaporator coil is off an old Ford car and is located in back, just above the rear window.").

D. A Skilled Artisan Would Have Combined the Toro References

38. A skilled artisan at the time of the earliest possible effective filing date would have been motivated to combine Toro Video's and Toro Manual's teachings. Because Toro Video and Toro Manual describe the same lawn mower, the Toro Groundsmaster 5910, a skilled artisan would have thought to combine the references.

See generally Ex. CI-1004; Ex. CI-1005. For example, a skilled artisan seeking to understand, replicate, or improve upon the Groundsmaster 5910 would have looked to both references to paint a complete picture of the mower in his mind. Indeed, Toro Video provides details that Toro Manual does not, and vice versa. For instance, Toro Manual provides only one front facing view of the complete Groundsmaster 5910, Ex. CI-1005 at Cover, whereas Toro Video shows the mower in action from multiple viewpoints, *see generally* Ex. CI-1004. Likewise, Toro Video only shows the exterior of the mower, Ex. CI-1005 at 1, whereas Toro Manual describes the internal components of the mower including circuitry and electrical connections, *see generally* Ex. CI-1005.

39. A skilled artisan also would have had a reasonable expectation of success in combining Toro Video and Toro Manual. Because both references describe the same lawn mower and show it in operation, a skilled artisan would have known that combining the references was not only achievable, but also had already been achieved by others. A skilled artisan also would have viewed this combination as requiring no more than routine skill, at least because it had already been done by Toro. Thus, a skilled artisan would have had a reasonable expectation of success in achieving the combination.

E. A Skilled Artisan Would Have Modified the Toro Combination in View of Judice

40. A skilled artisan would have been motivated to modify the air-conditioned lawn mower of the Toro references in view of Judice by repositioning the A/C unit from the roof to the rear wall.

41. As an initial matter, a skilled artisan would have looked to the Toro references and Judice together because they are in the same technical field (air-conditioned lawn mowers) and address the same problem (operator comfort). For example, Judice discloses a zero-turn riding mower with an air-conditioned cab that allows the user to “mow[] grass in air-conditioned comfort.” Ex. CI-1006 at 27 (capitalization normalized). Likewise, the Toro references disclose a lawn mower with a “climate-controlled operator space” for a “happy, comfortable operator.” Ex. CI-1004 at 0:00-17.

42. Furthermore, a skilled artisan would have recognized that positioning the A/C unit on the rear wall, as disclosed in Judice, would yield several advantages compared to positioning the A/C unit on the roof, as disclosed in the Toro references:

43. ***First***, this modification would reduce the overall height of the cab, which a skilled artisan would have wanted to do because lawn mowers are often operated under trees and stored in small storage areas, such as sheds. Indeed, Toro Video suggests that “increased clearance under trees and storage areas” was desirable. Ex. CI-1004 at 0:35-43.

44. ***Second***, a skilled artisan would have also recognized that positioning the A/C unit on the rear wall would protect it from branch strikes and other damage from overhead obstacles, which were a known problem. For example, a 2010 lawn mower manual warns of low hanging branches. Ex. CI-1020 at 9.

45. ***Third***, a skilled artisan would have known that moving the A/C unit from the roof to the rear wall would shorten the coolant lines to and from the compressor located in the engine compartment, which decreases both cost and the probability of coolant leaks. *See* Ex. CI-1005 at 9-2 and 9-9 (showing the compressor of the Toro A/C unit is in the engine compartment and has coolant lines (“A/C hose”) to the condenser and from the evaporator). It was commonly known before the earliest possible effective filing date that leaks were a common issue in A/C units. *See, e.g.*, Ex. CI-1021 at 4-2, 4-3. A skilled artisan at the earliest possible effective filing date also would have known that the likelihood of a leak in a fluid line increases as length increases because each additional length creates additional potential for leakage. Thus, decreasing the length of the coolant lines would decrease the probability of leaks and decrease the cost of maintenance of the lawn mower to the customer while also decreasing the cost of the coolant lines as well.

46. ***Fourth***, a skilled artisan would have recognized that moving the A/C unit from the roof to the rear wall would lower the mower’s center of gravity and therefore decrease the risk of rollover, which was a well-known concern. For

example, Toro Video acknowledges this concern by touting its rollover protection system. Ex. CI-1004 at 0:18-24. As another example, it was known that rollover injuries were a common source of injuries from riding mowers, second only to falling off the mower. Ex. CI-1022 at 374. One way to decrease rollover risk is to lower the center of gravity. Anyone who's taken high-school physics would have known this fact. For instance, to reduce the likelihood of a rollover, NIOSH developed an "AutoROPS" with a lower center of gravity than then-conventional ROPS. Ex. CI-1023. Thus, a skilled artisan would have been motivated to move the Toro A/C unit from the roof to the rear wall, as Judice teaches, to decrease the risk of rollover.

47. ***Fifth***, a skilled artisan would have recognized that in the event of a rollover, having the A/C unit on the rear wall would minimize the likelihood of it being crushed. Because rollovers were a known issue, a skilled artisan would have thought not only to minimize the risk of rollover, but also to minimize the extent of the damage that would result from a rollover. A skilled artisan also would have known that an A/C unit on the roof would likely be crushed or severely damaged following a rollover, and that moving the A/C unit to the rear wall would reduce the probability of such damage.

48. Relocating the Toro A/C unit from the roof to the rear wall also would have been obvious to try. I understand that a modification would have been obvious

to try if there was a design need or market pressure to solve a problem and only a finite number of identified, predictable solutions within a skilled artisan's technical grasp. Here, the Toro references and Judice show (1) there was a design need or market pressure to equip lawn mower cabs with A/C units, and (2) there were only a finite number of identified, predictable solutions: position the A/C unit on either the roof or the rear wall. *See generally* Ex. CI-1004; Ex. CI-1005; Ex. CI-1006. A skilled artisan would not have considered locating the A/C unit on the front or side walls a feasible solution because it would have obstructed the driver's view and thus increased the risk of accident. A skilled artisan would also have recognized that zero-turn mowers, such as the Toro mower, have less need of rear visibility than most vehicles, since zero-turn mowers can easily turn around instead of backing up.

49. A skilled artisan would have reasonably expected a successful outcome from moving the Toro A/C unit to the rear wall as Judice teaches. Air-conditioned lawn mowers were known at the time of the '815 patent and had been successfully demonstrated in the real world by then, as evidenced by at least the Toro references and Judice. Moreover, this modification would have been a routine design change because it merely relocates the existing A/C unit of Toro to a different part of the cab, without changing its function or operating principles. Judice demonstrates that this modification could be done from scavenging parts from an old car. Ex. CI-1006 at 27. Having seen these disclosures implemented in the real world, a skilled artisan

would have had confidence that their principles were sound and could be combined in the manner I’ve proposed in this Declaration. Thus, the result of the Toro-Judice combination would have been predictable to a skilled artisan, and a skilled artisan would have expected it to work.

F. Obviousness Analysis

1. Claim 1

[1.pre] An enclosure system for a lawn mower, the system comprising:

50. The Toro-Judice combination satisfies the preamble of claim 1. For example, Toro Video discloses a “Fully Enclosed Cab” (*enclosure system*) for a “mowing” vehicle (*lawn mower*):



Ex. CI-1004 at 0:21; *see also id.* at 0:00-03 (stating the vehicle is for “mowing”).

51. Moreover, Toro Video shows a vehicle that a skilled artisan would recognize as a riding lawn mower. For example, a skilled artisan viewing the above

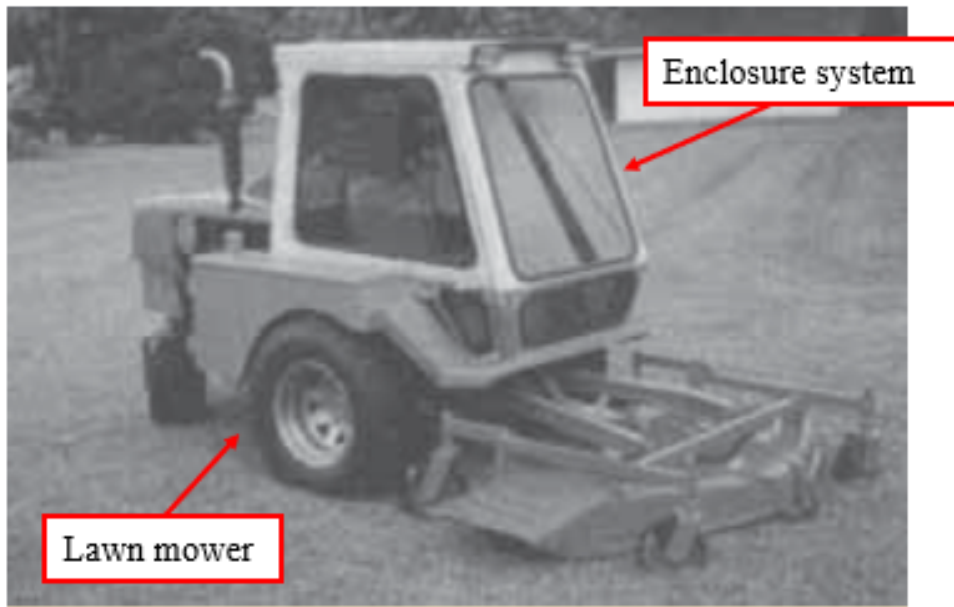
screenshot of Toro Video would recognize the front and side mower decks, which house the blades for mowing a lawn. A skilled artisan would also recognize the engine located in the rear of the vehicle, a common design for riding lawn mowers. Additionally, a skilled artisan would recognize the cab and its interior, which contains the steering column and other common controls for operating a lawn mower.

52. Toro Manual describes the same lawn mower, which also independently satisfies this limitation:



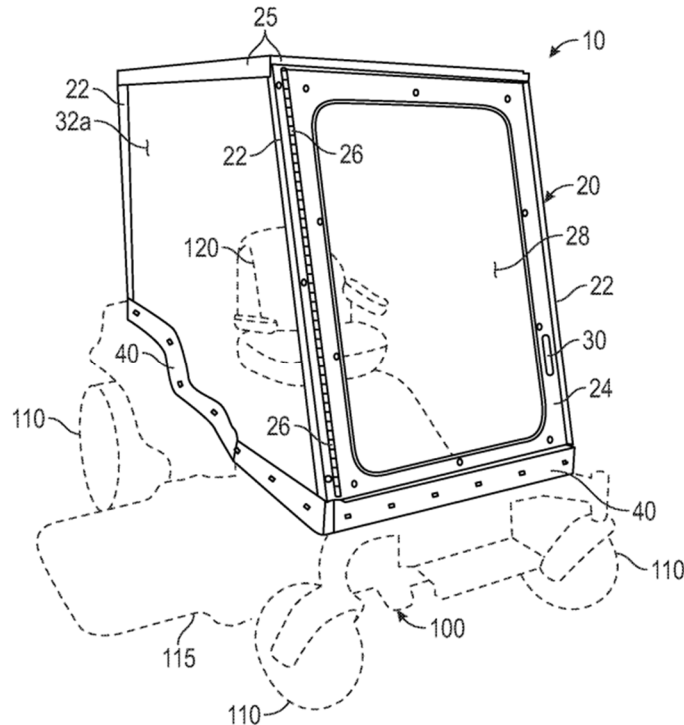
Ex. CI-1005 at Cover.

53. Additionally, Judice discloses a fully enclosed “cab” (*enclosure system*) for a “zero turn riding mower” (*lawn mower*):



Ex. CI-1006 (annotations added).

54. Notably, the above images resemble Figure 1 of the '815 patent, which “is an environmental view of one embodiment of the disclosed air conditioning system for an open motorized vehicle according to the present invention”:



Ex. CI-1001 at Fig. 1, 2:38-40.

55. This resemblance confirms my conclusion that the Toro references and Judice disclose *an enclosure system for a lawn mower*.

[1.1] a cab assembly having a front wall, a first sidewall, a second sidewall, and a ceiling that collectively define an interior volume,

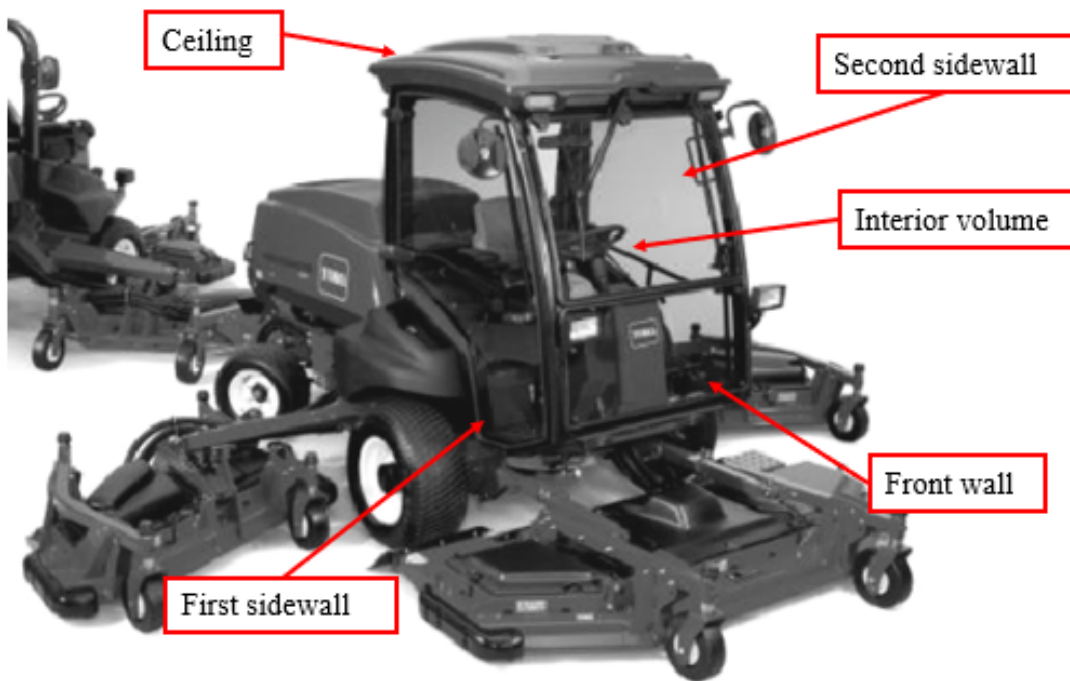
56. The Toro-Judice combination discloses this limitation. Both the Toro and Judice enclosure systems comprise a cab assembly having a front wall, two sidewalls (*a first sidewall and a second sidewall*), and a ceiling that collectively define an interior volume:



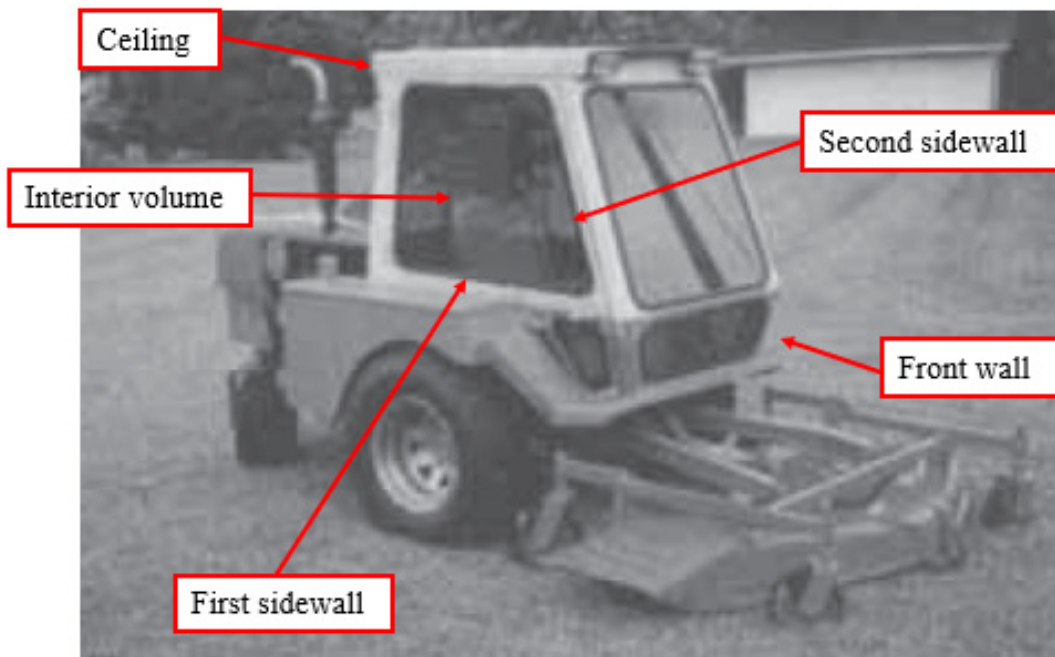
Ex. CI-1004 at 1:14 (annotations added).



Id. at 1:24 (annotations added).

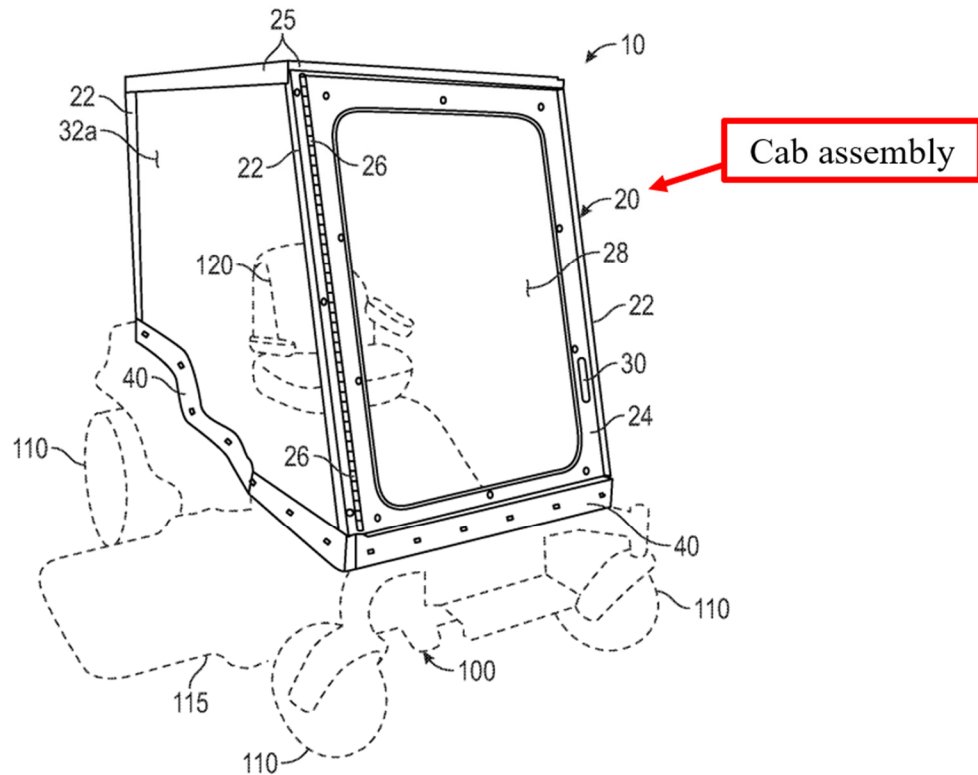


Ex. CI-1005 at Cover.



Ex. CI-1006 at 27 (annotations added).

57. Notably, the cabs shown above resemble one embodiment of the “cab assembly 20” of the ’815 patent:

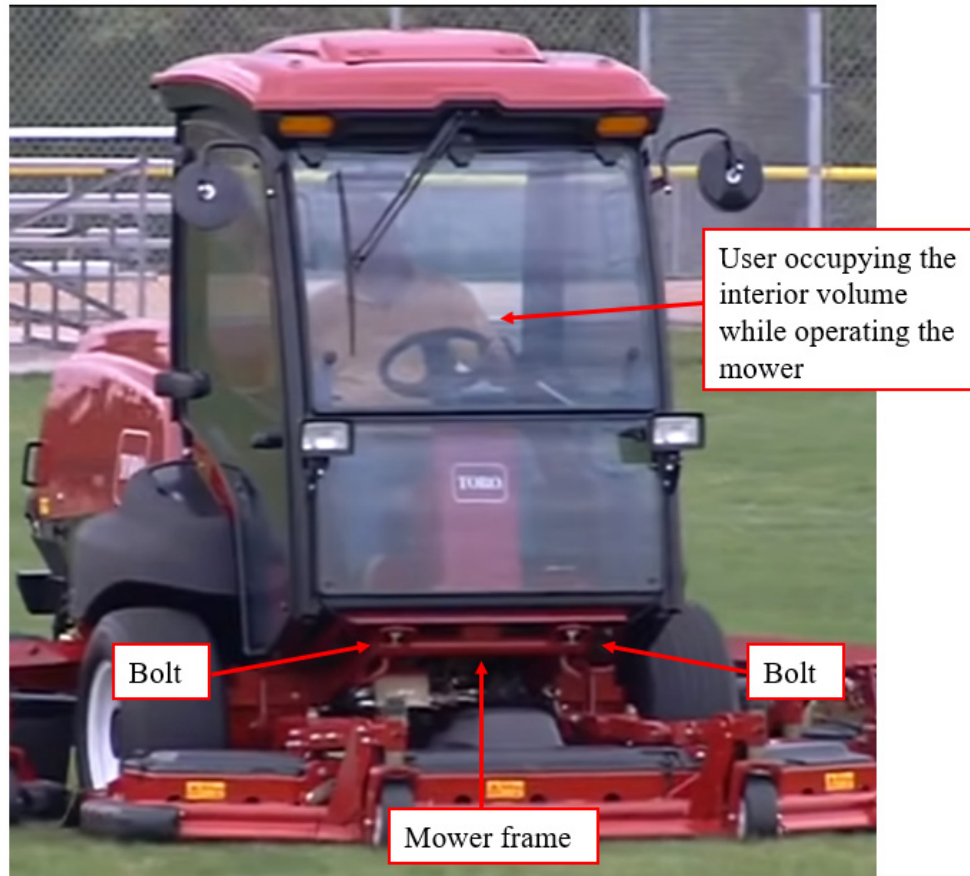


Ex. CI-1001 at Fig. 1 (annotations added), 4:41-46.

58. This resemblance confirms my conclusion that the Toro references and Judice disclose *a cab assembly having a front wall, a first sidewall, a second sidewall, and a ceiling that collectively define an interior volume.*

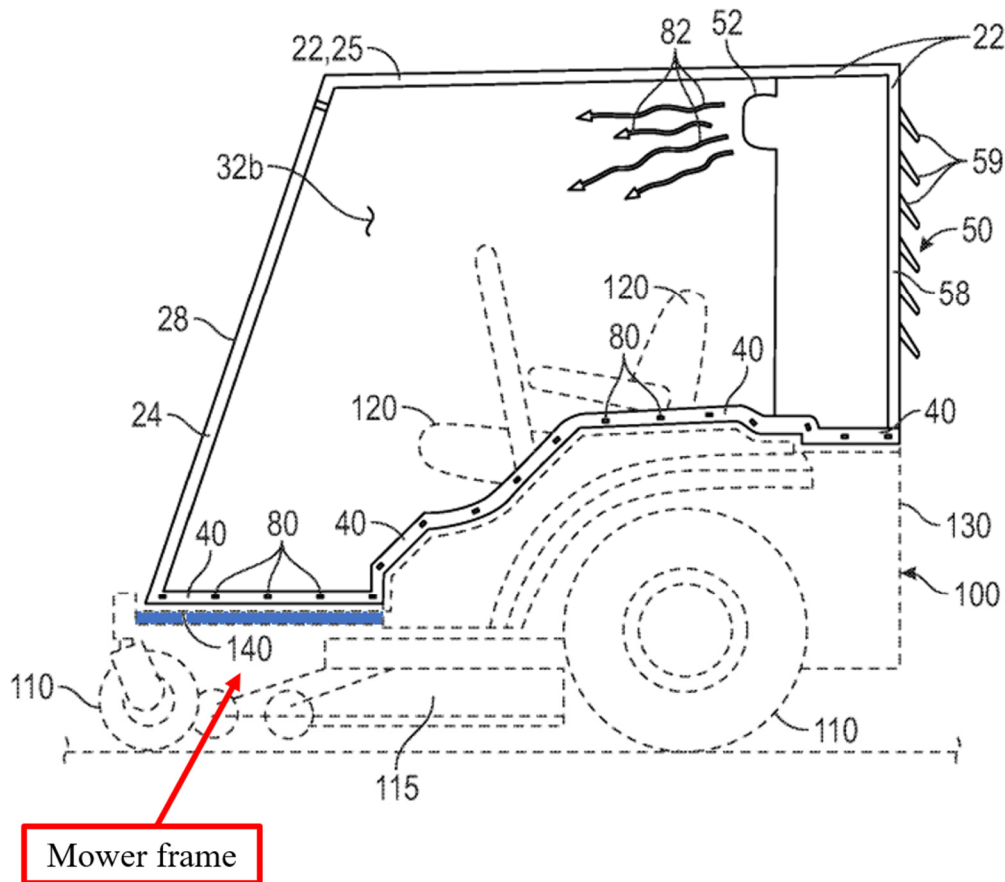
[1.2] wherein the cab assembly is adapted to secure to a mower frame of the lawn mower such that a user may occupy the interior volume while operating the lawn mower; and

59. The Toro-Judice combination discloses this limitation. For example, the Toro cab assembly is secured to a mower frame of the lawn mower (via bolts), and a user may occupy the interior volume while operating the lawn mower:



Ex. CI-1004 at 1:18 (annotations added). Moreover, the Toro cab assembly is adapted to receive bolts securing the cab assembly to the mower frame, as depicted above.

60. Notably, the '815 patent teaches the same method of securing the cab assembly to the mower frame. Ex. CI-1001 at 5:1-4 (“The cab assembly 20 can be attached to side frames 140 of the mower 100 . . . using a plurality of fasteners 80 such as bolts, screws, or the like.”). It also identifies the same part of the lawn mower as the “mower frame”:



Id. at Fig. 2A (annotation and color added), 5:4-6 (referring to “mower frame 140”).

61. Patent Owner’s infringement contentions in the parallel litigation confirm that the part of the Toro lawn mower identified above corresponds to the claimed “*mower frame*.” As shown below, Patent Owner contends in the litigation that the mower frame “includes the preexisting geometry of the mower body,” and it points to the same part of the lawn mower as I do above:



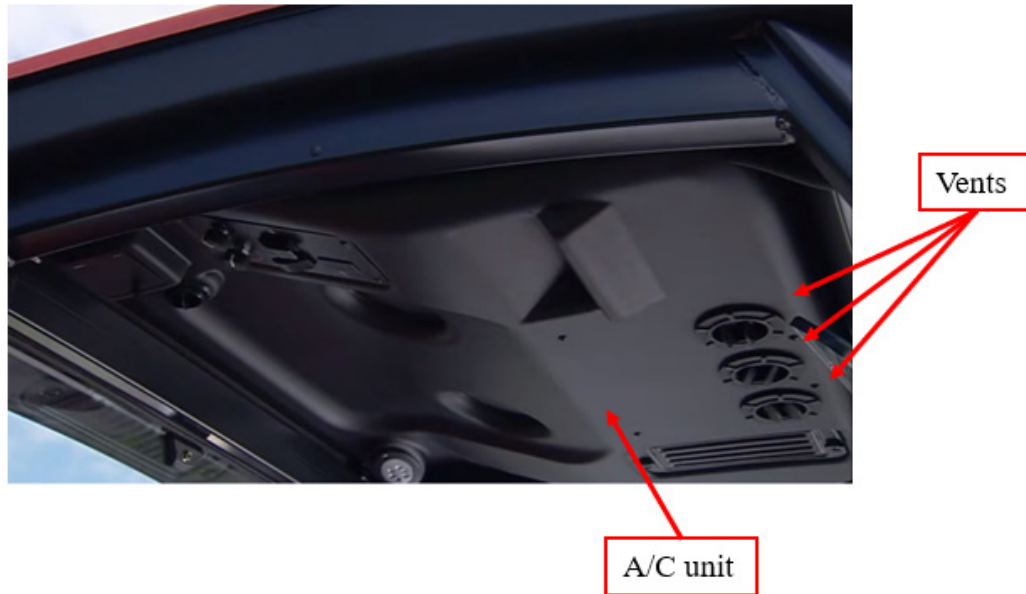
Ex. CI-1015 at 4 (annotations by Patent Owner).

62. Even if it were not clear that Toro Video discloses securing the cab assembly to the mower frame as shown above, it would have been obvious to do so in the Toro-Judice combination. A skilled artisan would have recognized the design need (and common-sense need) to affix the cab assembly to the lawn mower in one way or another to prevent the cab assembly from jostling around or falling off during operation, especially because lawn mowers frequently accelerate, decelerate, turn, and are often used on uneven terrain. A skilled artisan also would have known there were only a finite number of identified, predictable solutions for affixing the cab

assembly to the lawn mower: either secure the cab assembly to the mower frame (using fasteners, for example) or secure it to some other part of the lawn mower. A skilled artisan would have seen the former option as superior (or at least suitable) because the mower frame is more rigid and structurally sound than other parts of the lawn mower. And securing the cab assembly to the mower frame would have been within a skilled artisan's technical grasp because, as the '815 patent acknowledges, it would have required nothing more than well-known fastening methods, "such as bolts, screws, or the like," and adapting the cab assembly for use with the fastening methods. Ex. CI-1001 at 5:1-4. (Of course, a skilled artisan would have also recognized that the cab assembly could be secured to the mower frame in other ways as well, such as by welding.) Thus, even if it were not clear that Toro Video discloses this limitation, a skilled artisan would have been motivated to adapt the Toro cab assembly to secure it to the mower frame and had a reasonable expectation of success in doing so.

[1.3] an air conditioning unit configured to produce conditioned air,

63. The Toro-Judice combination satisfies this limitation. The Toro mower has a "low-profile air conditioning and heating unit" (*air conditioning unit configured to produce conditioned air*) built into the roof. Ex. CI-1004 at 0:35-40.



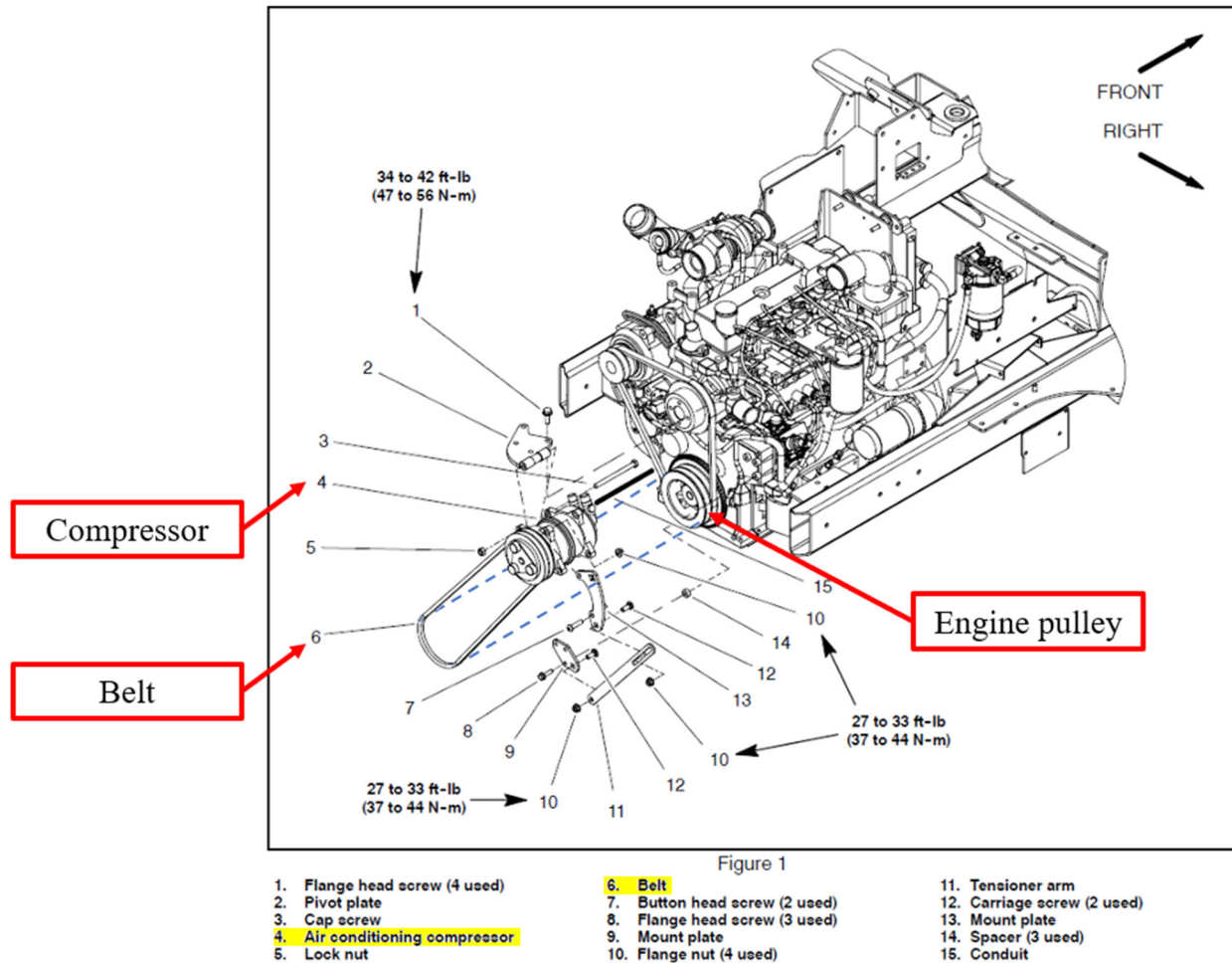
Ex. CI-1004 at 0:38 (annotations added).

64. Judice also independently discloses this limitation. Ex. CI-1006 at 27.

Indeed, Judice's title is "He Mows Grass In Air-Conditioned Comfort." *Id.*

[1.4] wherein the air conditioning unit is adapted to be powered in part by rotary motion transmitted from an engine of the lawn mower,

65. The Toro-Judice combination discloses this limitation. The Toro A/C unit includes a "compressor mounted on the engine and driven by a v-belt." Ex. CI-1005 at 9-2. As shown below, the v-belt connects the compressor to the engine pulley:



Id. at 9-4 (annotations added); *see also id.* at 9-5 (showing the compressor in more detail); *id.* at 3-30 (identifying the engine pulley as the “crankshaft pulley,” which is another name for the engine pulley as the pulley is mounted to the crankshaft).

66. When the engine is running, the engine pulley rotates. When the engine pulley rotates, the belt transmits the engine pulley’s rotary motion to the compressor, thus driving the compressor. Notably, the ’815 patent contemplates the same technique of driving the compressor:

The compressor 68 includes a pulley-driven unit . . . that is powered by the engine 135 of the lawn mower 100 and is in mechanical

communication therewith via an interconnecting *drive belt 92*. . . . The compressor 68 can be in mechanical communication with the *engine pulley 94* via a *drive belt 92*. . . . The compressor 68 receives rotating mechanical power from the engine 135 of the riding mower 100 (FIG. 1) via drive components including a *drive belt 92* and corresponding tensioning pulleys 93a.

Ex. CI-1001 at 6:38-43, 7:32-38, 7:50-54 (emphasis added).

67. Because its compressor is belt driven by the engine pulley, the A/C unit of the Toro-Judice combination is “*adapted to be powered in part by rotary motion transmitted from an engine of the lawn mower.*”

68. If the claim term “powered *in part*” requires there to be a second power source (such that only part of the A/C unit is powered by rotary motion), the Toro-Judice combination would still disclose this limitation because the Toro A/C unit also receives electrical power from the electrical system of the mower. Ex. CI-1005 at 5-53 (“A relay is used to control the air conditioning electrical power circuit on the Groundsmaster 5910 [and] provides current for air conditioning components.”), 10-16 (depicting electrical connections for the blower fan and condenser fan).

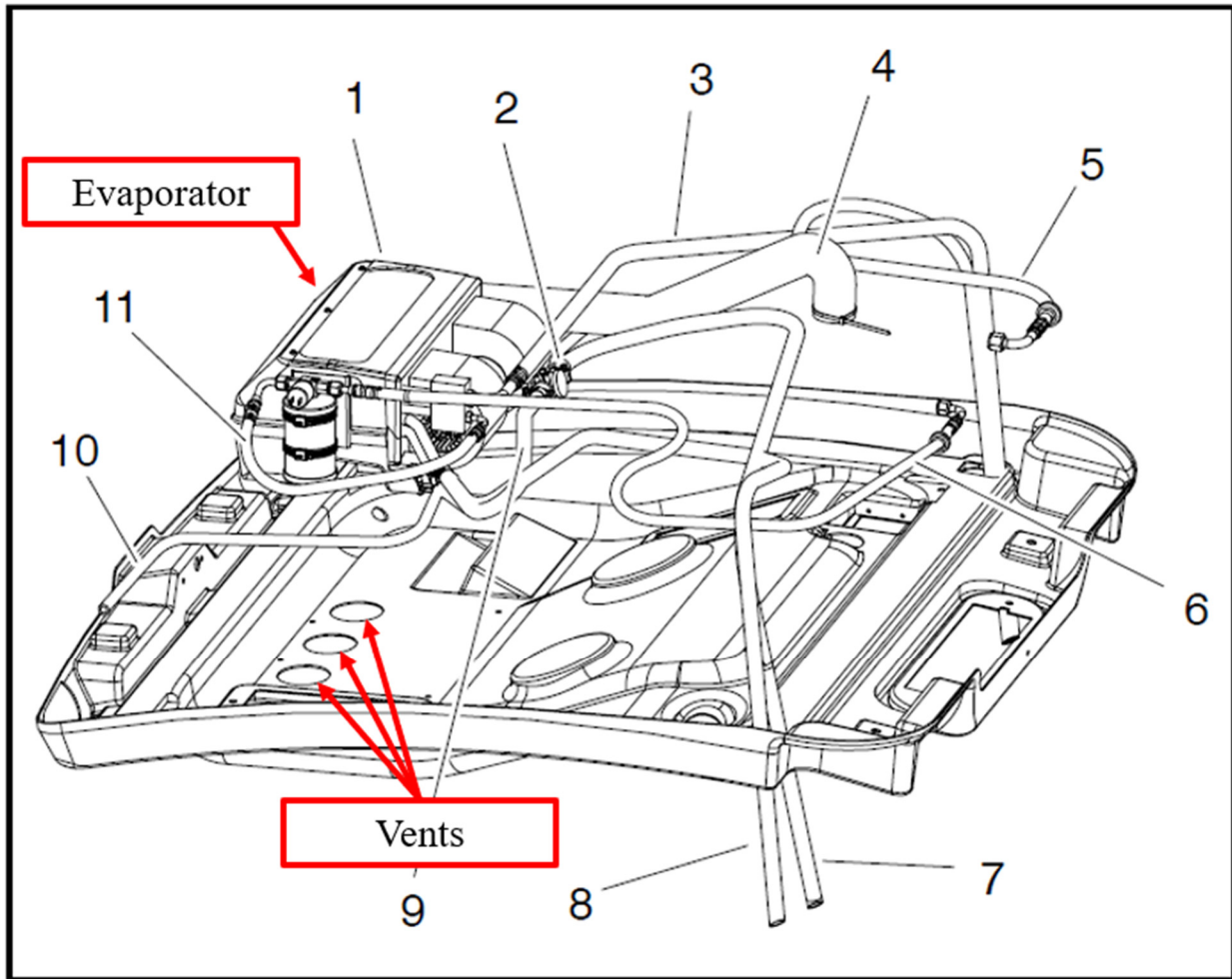
[1.5] the air conditioning unit being secured in relation to the cab assembly such that conditioned air produced by the air conditioning unit is emitted directly into the interior volume,

69. The Toro-Judice combination discloses this limitation. As shown below, the Toro A/C unit is built into the roof of the cab, and three of its vents are located on the underside of the evaporator. A skilled artisan would have recognized that these vents are for emitting conditioned air produced by the A/C unit into the interior

volume. Moreover, as shown below, there are no ducts between the evaporator and the vents, which means the Toro A/C unit emits conditioned air *directly* into the interior volume. Accordingly, the Toro A/C unit is “*secured in relation to the cab assembly such that conditioned air produced by the air conditioning unit is emitted directly into the interior volume.*”



Ex. CI-1004 at 0:38 (annotations added).



Ex. CI-1005 at 9-9 (annotations added).

70. If the A/C unit must be affixed to the mower roll bar, it would have been obvious to do so. As discussed in Section VII.E, rollovers were a known hazard by the earliest possible effective filing date. Because of that known hazard, a skilled artisan would have been motivated to affix the A/C unit to one of the Toro cab assembly's rollover protection posts (see figure below) to further minimize the risk of damage to the A/C unit and to reduce the risk of the A/C unit being dislodged and becoming a projectile.



Ex. CI-1004 at 0:21.

[1.6] wherein one or more components of the air conditioning unit define a rear wall disposed opposite the front wall,

71. The Toro-Judice combination discloses this limitation. I previously explained in Section VII.E why a skilled artisan would have been motivated to relocate the Toro A/C unit to the rear wall, as Judice teaches. In making that modification, a skilled artisan would have wanted to keep the Toro A/C unit's shape roughly the same to minimize design changes (and thus minimize costs associated with the modification). And because the Toro A/C unit is wide and flat (like a wall), relocating it to the rear wall would cause the A/C unit to “*define*” the rear wall.



Ex. CI-1004 at 0:40 (annotations added).

72. Even if a skilled artisan would have instead changed the shape of the Toro A/C unit such that it would make up only part of the rear wall, rather than “define” the rear wall, it would not matter under Patent Owner’s interpretation of this limitation. In the parallel litigation, Patent Owner contends that this limitation encompasses A/C units that make up only part of a rear wall. *See, e.g.*, Ex. CI-1015 at 17. Although I disagree with that interpretation, I apply it here because I am informed that claims must be construed the same for purposes of infringement and validity. Under Patent Owner’s interpretation, the Toro-Judice combination would still satisfy this limitation even if one were to change the shape of the Toro A/C unit such that it composes only part of the rear wall. In any event, as I explained above, a skilled artisan would have been motivated not to change the Toro A/C unit’s shape.

[1.7] wherein the cab assembly includes a lower frame adapted to be secured to the mower frame such that when the lower frame is secured to the mower frame the front wall is disposed in front of an operator seat of the lawn mower and the rear wall is disposed behind the operator seat; and

73. The Toro-Judice combination discloses this limitation.

74. **First**, the Toro cab assembly includes “a lower frame adapted to be secured to the mower frame” under Patent Owner’s interpretation of that term. In the parallel litigation, Patent Owner contends this term encompasses the lower parts of the cab frame:



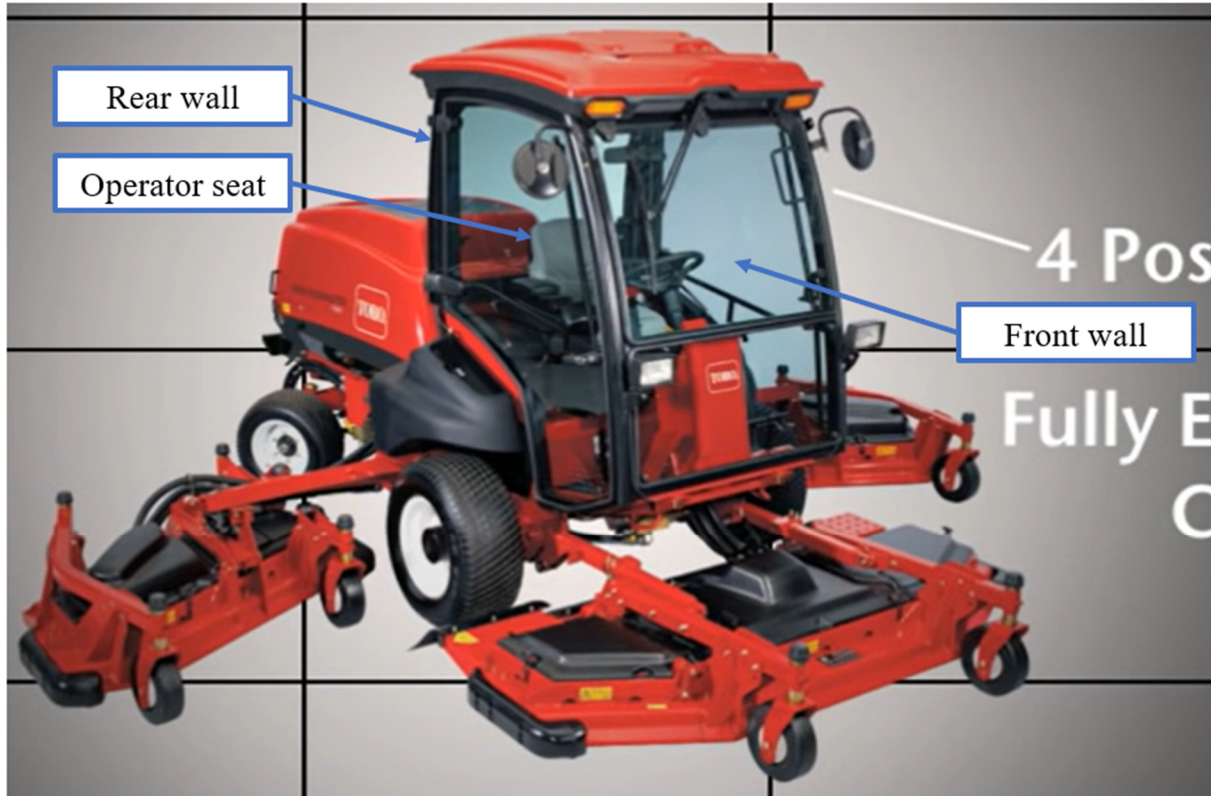
Ex. CI-1015 at 20 (annotations by Patent Owner).

75. Although I disagree with that interpretation, I apply it here because I am informed that claims must be construed the same for purposes of infringement and validity. Under Patent Owner’s interpretation, the Toro cab assembly has “a lower frame adapted to be secured to the mower frame”:



Ex. CI-1004 at 0:22 (annotations added).

76. ***Second***, when the lower frame of the Toro cab assembly is secured to the mower frame, “*the front wall is disposed in front of an operator seat of the lawn mower and the rear wall is disposed behind the operator seat*”:



Ex. CI-1004 at 0:22 (annotations added).

77. Accordingly, the cab assembly of the Toro-Judice combination “includes a lower frame adapted to be secured to the mower frame such that when the lower frame is secured to the mower frame the front wall is disposed in front of an operator seat of the lawn mower and the rear wall is disposed behind the operator seat.”

[1.8] wherein the cab assembly has a height that increases as the cab assembly extends from the rear wall to the front wall.

78. In the parallel district court litigation, Patent Owner contends that the “height” in this limitation refers to the distance from the cab floor to the cab ceiling:



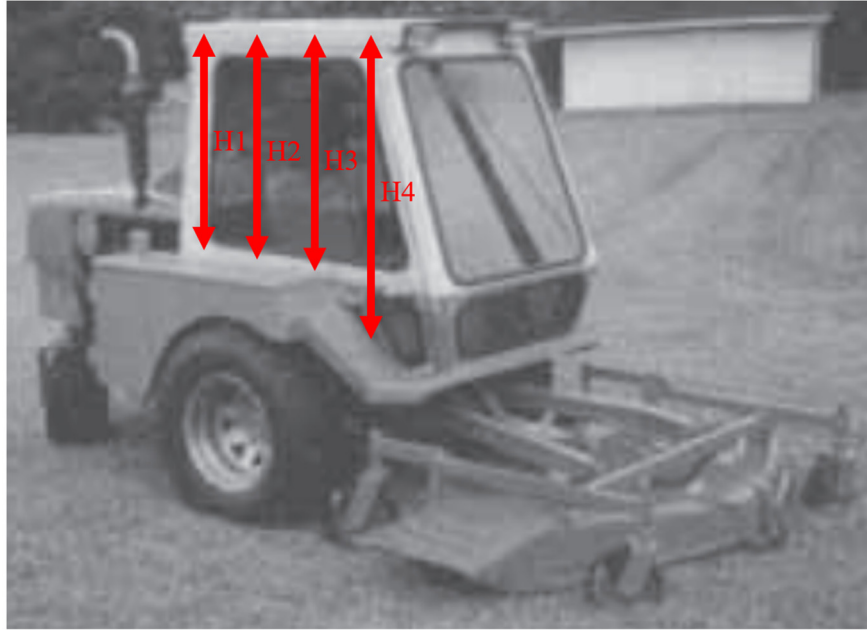
Ex. CI-1015 at 8 (annotations by Patent Owner).

79. Although I disagree with that interpretation, I apply it here because I am informed that claims must be construed the same for purposes of infringement and validity. Under Patent Owner's interpretation, the Toro-Judice combination discloses this limitation. For example, the Toro cab assembly has a height that increases as the cab assembly extends from the rear wall to the front wall:



Ex. CI-1003 at 1:09 (annotations added).

80. Likewise, under Patent Owner's interpretation of this limitation, the Judice cab assembly also has a height that increases as the cab assembly extends from the rear wall to the front wall:

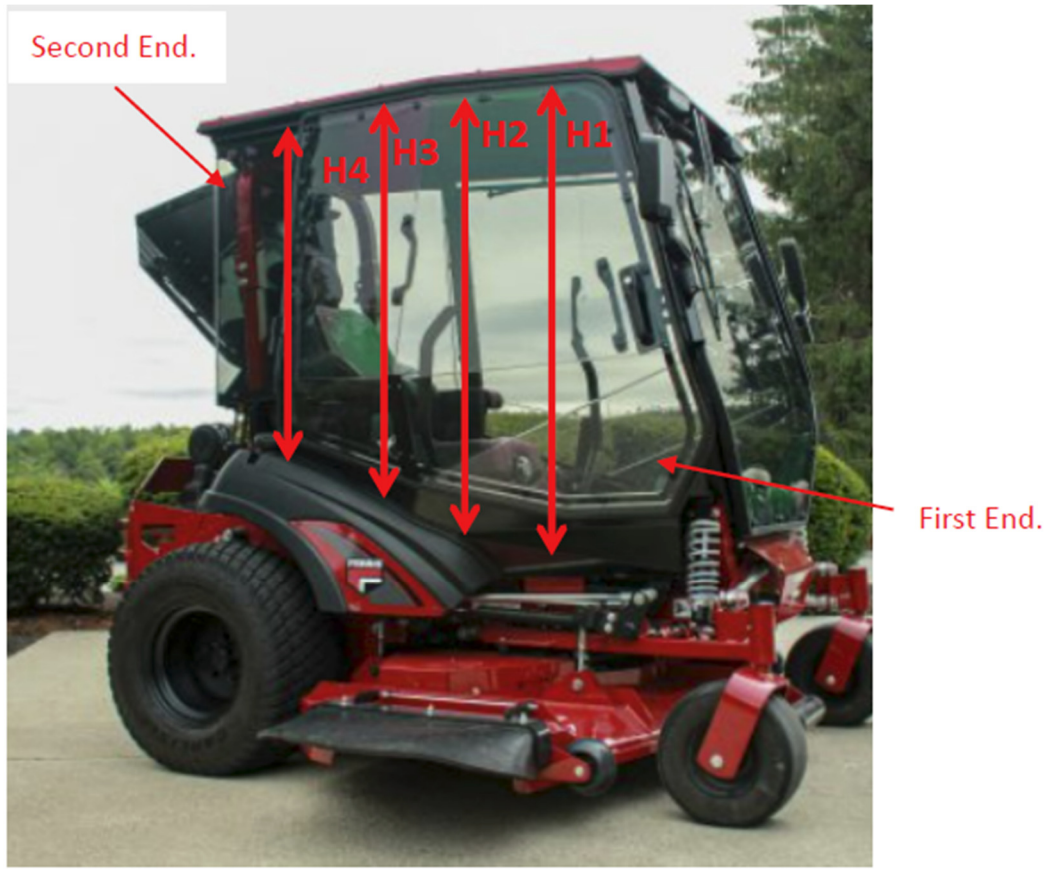


Ex. CI-1006 at 27 (annotations added).

2. Claim 3

3. The system of claim 1, wherein the first sidewall and the second sidewall each have a first end proximal to the front wall and a second end opposite the first end, wherein a height of the first sidewall and the second sidewall decreases as each sidewall extends from the first end to the second end.

81. In the parallel litigation, Patent Owner contends that this limitation refers to the distance between the bottom and the top of the sidewall:



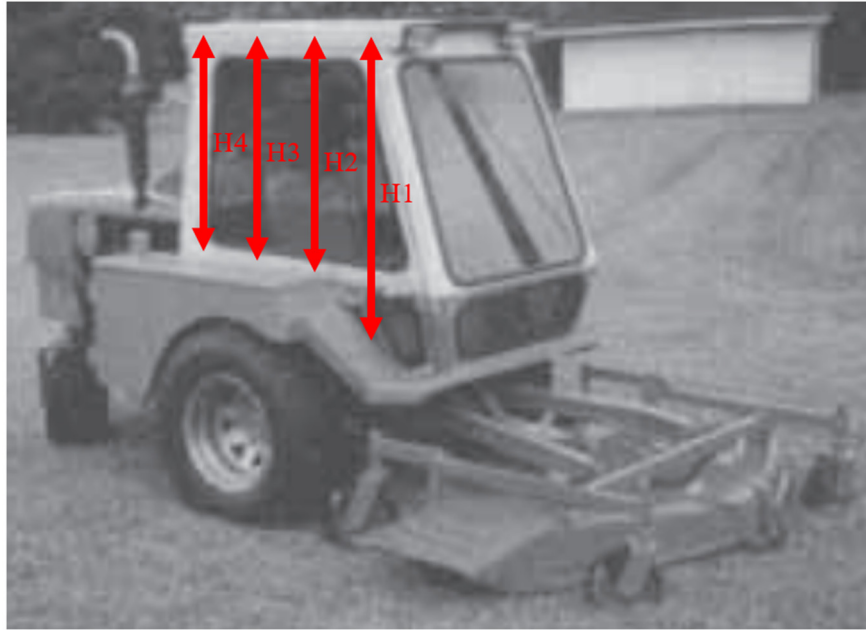
Ex. CI-1015 at 10 (annotations by Patent Owner).

82. Although I disagree with that interpretation, I apply it here because I am informed that claims must be construed the same for purposes of infringement and validity. Under that interpretation, the Toro-Judice combination discloses this limitation. For example, each sidewall of the Toro cab assembly has a height that decreases as each sidewall extends from the front end (*first end*) to the rear end (*second end*):



Ex. CI-1004 at 1:09 (annotations added).

83. Likewise, under Patent Owner's interpretation of this limitation, each sidewall of the Judice cab assembly also has a height that decreases as each sidewall extends from the front end (*first end*) to the rear end (*second end*):



Ex. CI-1006 at 27 (annotations added).

3. Claim 4

4. The system of claim 1, wherein at least one of the first sidewall, the second sidewall, and the front wall is semi-transparent

84. The Toro-Judice combination discloses this limitation. For example, the sidewalls and front wall of the Toro cab assembly comprise tinted windows and are thus *semi-transparent*:



Ex. CI-1004 at 0:21; *see also id.* at 0:28-32 (stating that the windows are made of “tempered safety glass,” which a skilled artisan would have recognized is semi-transparent).

VIII. Ground 2: Toro Video, Toro Manual, and Uchida

A. Overview of Toro Video (Ex. CI-1004)

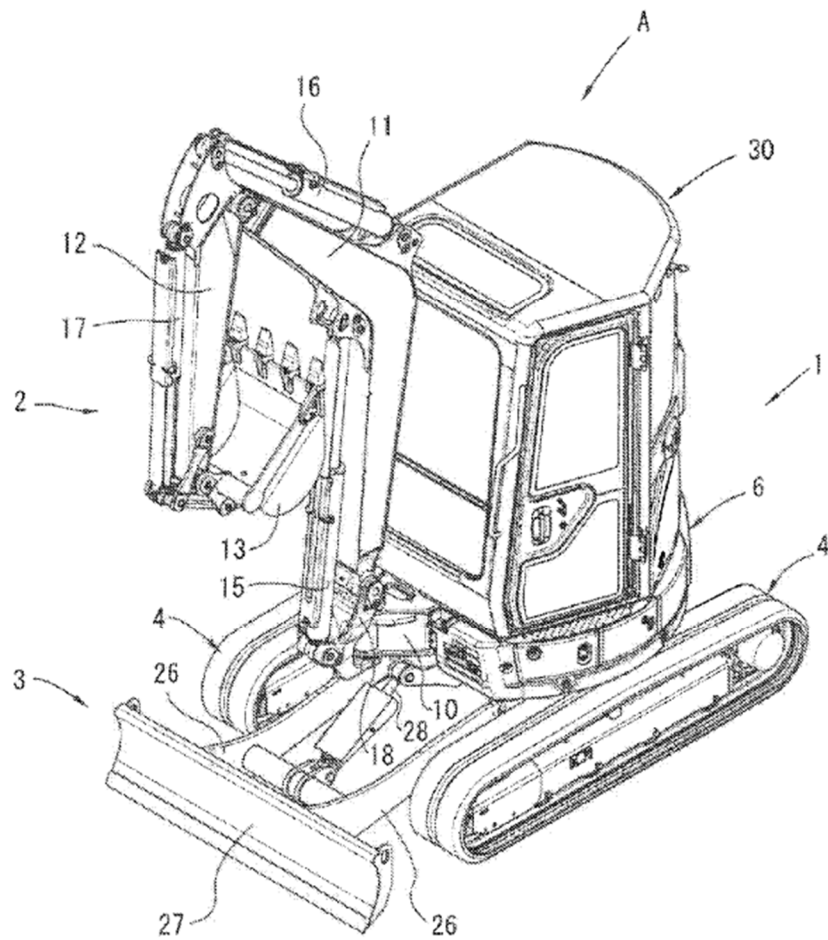
85. *See* § VII.A above.

B. Overview of Toro Manual (Ex. CI-1005)

86. *See* § VII.B above.

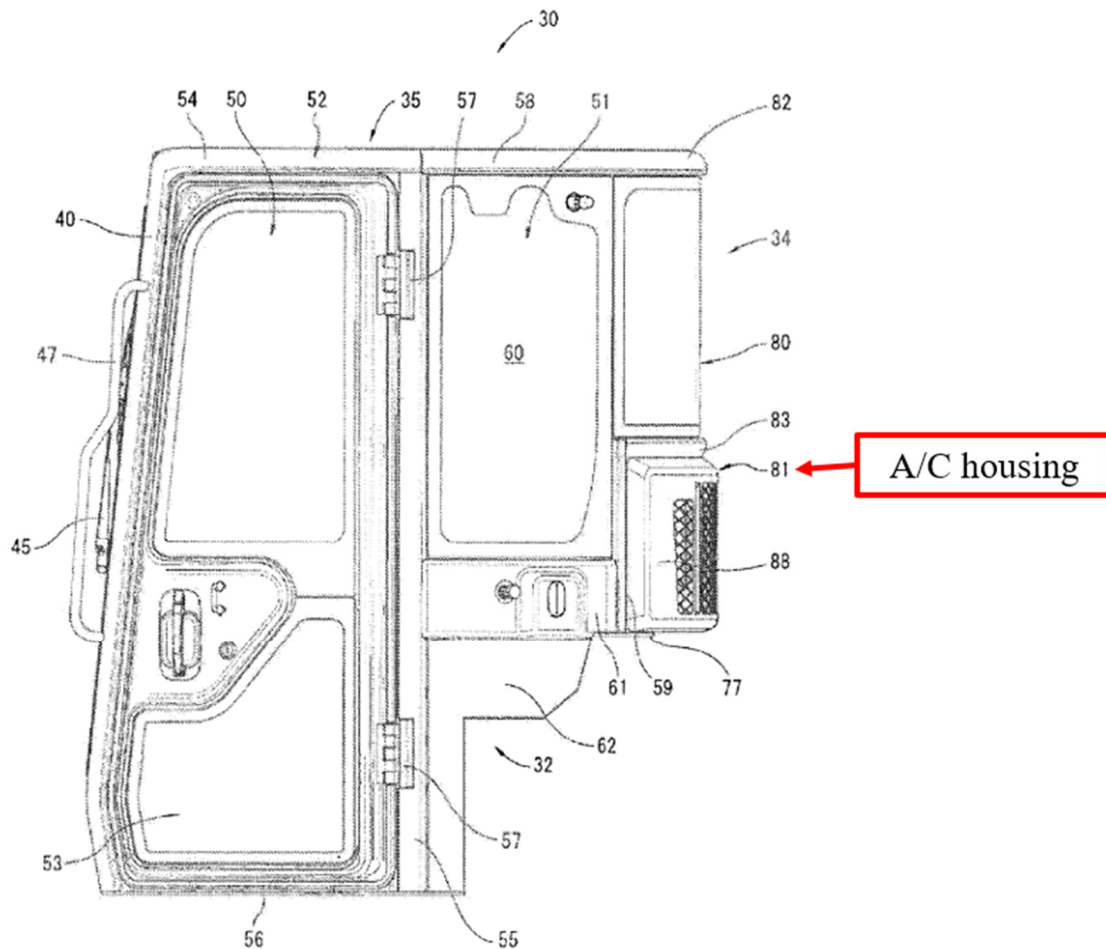
C. Overview of Uchida (Ex. CI-1007)

87. Uchida discloses an air-conditioned cab for a “turning working vehicle” (e.g., excavator). Ex. CI-1007 at Abstract.



Id. at Fig. 1.

88. Parts of Uchida’s air conditioner (e.g., “a condenser . . . and the like”) are housed in a housing 81 “mounted on a lower portion of the rear wall of the cabin”:



Id. at Abstract, [0049], Fig. 9 (annotations added).

89. Uchida's cab "is defined by a front wall portion, a left side wall portion, a ride side wall portion, a rear wall portion, and a ceiling portion." *Id.* at [0044].

D. A Skilled Artisan Would Have Combined the Toro References

90. *See* § VII.D above.

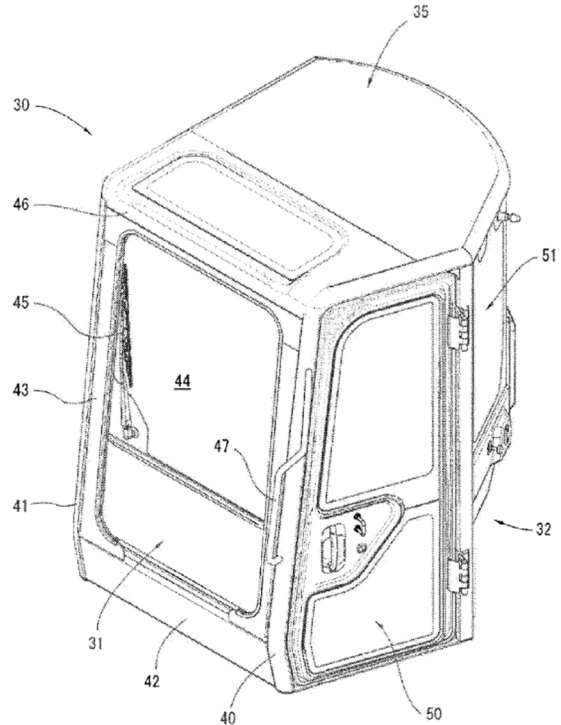
E. A Skilled Artisan Would Have Modified the Toro Combination in View of Uchida

91. A skilled artisan would have been motivated to modify the lawn mower of the Toro references in view of Uchida by repositioning the A/C unit from the roof to the rear wall.

92. A skilled artisan would have looked to the Toro references and Uchida together because they are in the same technical field (air-conditioned working vehicles) and address the same problem (operator comfort). For example, while the Toro references disclose a riding lawn mower with a “climate-controlled operator space” for a “comfortable operator,” Ex. CI-1004 at 0:00-15, Uchida discloses a turning working vehicle with an air-conditioner, Ex. CI-1007 at Abstract. Although Uchida describes a different type of vehicle than the Toro references, the examiner of the ’815 patent recognized that “[s]imply because one teaching relates to a different type of vehicle does not preclude a proper 103 rejection.” Ex. CI-1002 at 44. Moreover, the cab assemblies of Toro and Uchida resemble each other:



Ex. CI-1004 at 1:08



Ex. CI-1007 at Fig. 8

Both disclosures also operate similarly. For example, both Toro Manual and Uchida disclose using the vehicle engine to drive the compressor of the A/C unit via a belt. Ex. CI-1005 at 9-2 through 9-5; Ex. CI-1007 at [0070] (“a compressor 193 . . . is interlockingly connected to the engine E”) and Fig. 19. Thus, a skilled artisan would have considered the Toro references and Uchida together.

93. Furthermore, a skilled artisan would have recognized that positioning the A/C unit on the rear wall, as disclosed in Uchida, would yield several advantages compared to positioning the A/C unit on the roof, as disclosed in the Toro references:

94. **First**, this modification would reduce the overall height of the cab, which a skilled artisan would have wanted to do because lawn mowers are often

operated under trees and stored in small storage areas, such as sheds. Indeed, Toro Video suggests that “increased clearance under trees and storage areas” was desirable. Ex. CI-1004. at 0:35-43.

95. ***Second***, a skilled artisan would have also recognized that positioning the A/C unit on the rear wall would protect it from branch strikes and other damage from overhead obstacles, which were a known problem. For example, a 2010 lawn mower manual warns of low hanging branches. Ex. CI-1020 at 9.

96. ***Third***, a skilled artisan would have known that moving the A/C unit from the roof to the rear wall would shorten the coolant lines to and from the compressor located in the engine compartment, which decreases both cost and the probability of coolant leaks. *See* Ex. CI-1005 at 9-2 and 9-9 (showing the compressor of the Toro A/C unit is in the engine compartment and has coolant lines (“A/C hose”) to the condenser and from the evaporator). It was commonly known before the earliest possible effective filing date that leaks were a common issue in A/C units. *See, e.g.*, Ex. CI-1021 at 4-2, 4-3. A skilled artisan at the earliest possible effective filing date also would have known that the likelihood of a leak in a fluid line increases as length increases because each additional length creates additional potential for leakage. Thus, decreasing the length of the coolant lines would decrease the probability of leaks and decrease the cost of maintenance of the lawn mower to the customer while also decreasing the cost of the coolant lines as well.

97. ***Fourth***, a skilled artisan would have recognized that moving the A/C unit from the roof to the rear wall would lower the mower's center of gravity and therefore decrease the risk of rollover, which was a well-known concern. For example, Toro Video acknowledges this concern by touting its rollover protection system. Ex. CI-1004 at 0:18-24. As another example, it was known that rollover injuries were a common source of injuries from riding mowers, second only to falling off the mower. Ex. CI-1022 at 374. One way to decrease rollover risk is to lower the center of gravity. Anyone who's taken high-school physics would have known this fact. For instance, to reduce the likelihood of a rollover, NIOSH developed an "AutoROPS" with a lower center of gravity than then-conventional ROPS. Ex. CI-1023. Thus, a skilled artisan would have been motivated to move the Toro A/C unit from the roof to the rear wall, as Uchida teaches, to decrease the risk of rollover.

98. ***Fifth***, a skilled artisan would have recognized that in the event of a rollover, having the A/C unit on the rear wall would minimize the likelihood of it being crushed. Indeed, rollovers were a known concern by the earliest effective filing date. Because rollovers were a known issue, a skilled artisan would have thought not only to minimize the risk of rollover, but also to minimize the extent of the damage that would result from a rollover. A skilled artisan also would have known that an A/C unit on the roof would likely be crushed or severely damaged following a

rollover, and that moving the A/C unit to the rear wall would reduce the probability of such damage.

99. Relocating the Toro A/C unit from the roof to the rear wall also would have been obvious to try. I understand that a modification would have been obvious to try if there was a design need or market pressure to solve a problem and only a finite number of identified, predictable solutions within a skilled artisan's technical grasp. Here, the Toro references and Judice show (1) there was a design need or market pressure to equip lawn mower cabs with A/C units, and (2) there were only a finite number of identified, predictable solutions: position the A/C unit on either the roof or the rear wall. *See generally* Ex. CI-1004; Ex. CI-1005; Ex. CI-1007. A skilled artisan would not have considered locating the A/C unit on the front or side walls a feasible solution because it would have obstructed the driver's view and thus increased the risk of accident. A skilled artisan would also have recognized that zero-turn mowers, such as the Toro mower, have less need of rear visibility than most vehicles, since zero-turn mowers can easily turn around instead of backing up.

100. A skilled artisan would have reasonably expected a successful outcome from moving the Toro A/C unit to the rear wall as Uchida teaches. Air-conditioned working vehicles were known at the time of the '815 patent and had been successfully demonstrated in the real world by then, as evidenced by at least the Toro references and Uchida. Moreover, this modification would have been a routine

design change because it merely relocates the existing A/C unit of Toro to a different part of the cab, without changing its function or operating principles. Having seen these disclosures implemented in the real world, a skilled artisan would have had confidence that their principles were sound and could be combined in the manner I've proposed in this Declaration. Thus, the result of the Toro-Uchida combination would have been predictable to a skilled artisan, and a skilled artisan would have expected it to work.

F. Obviousness Analysis

1. Claim 1

[1.pre] An enclosure system for a lawn mower, the system comprising:

101. I incorporate and refer to my analysis of this limitation in Section VII.F, excluding any references to Judice.

[1.1] a cab assembly having a front wall, a first sidewall, a second sidewall, and a ceiling that collectively define an interior volume,

102. I incorporate and refer to my analysis of this limitation in Section VII.F, excluding any references to Judice.

[1.2] wherein the cab assembly is adapted to secure to a mower frame of the lawn mower such that a user may occupy the interior volume while operating the lawn mower; and

103. I incorporate and refer to my analysis of this limitation in Section VII.F, excluding any references to Judice.

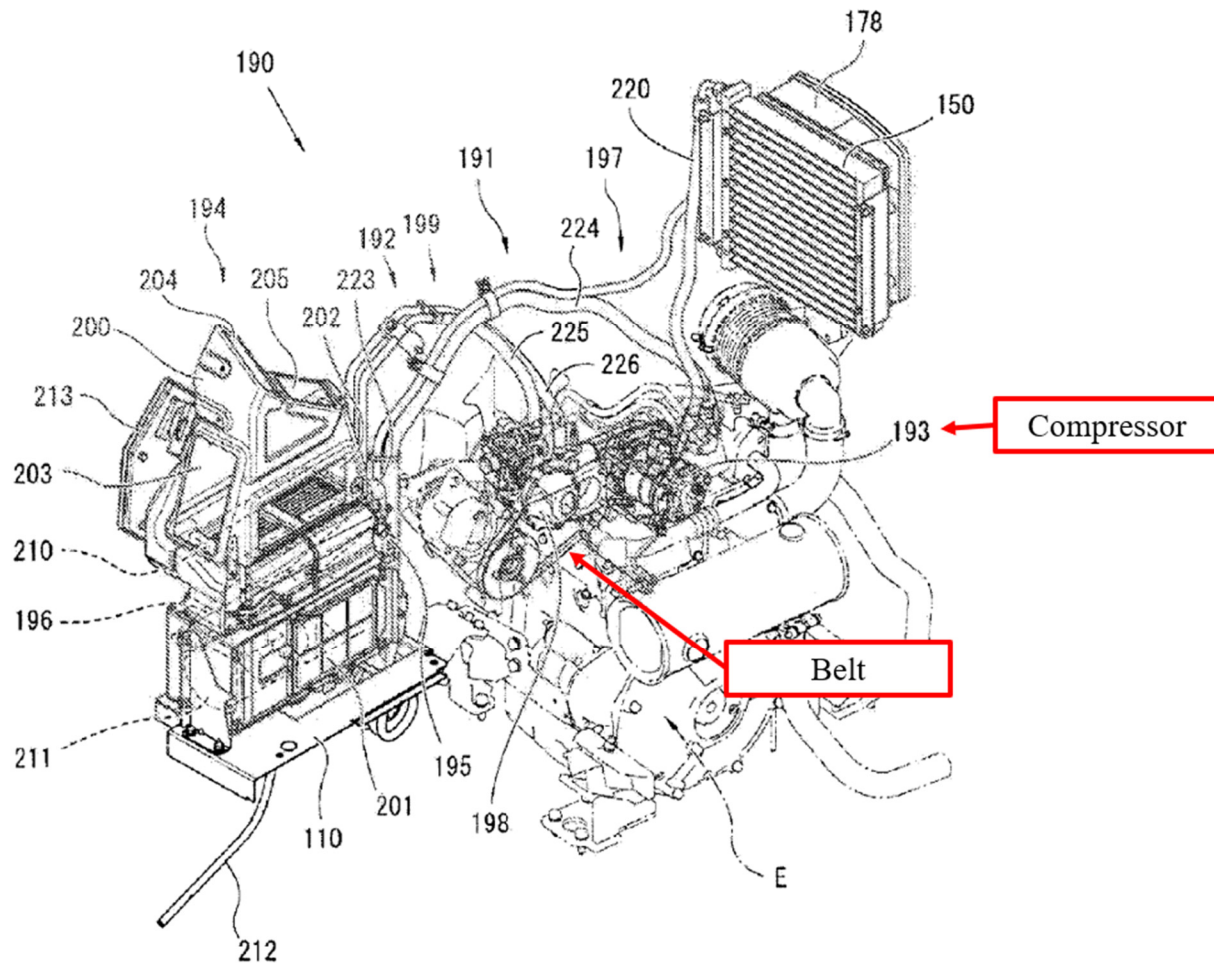
[1.3] an air conditioning unit configured to produce conditioned air,

104. I incorporate and refer to my analysis of this limitation in Section VII.F, excluding any references to Judice.

[1.4] wherein the air conditioning unit is adapted to be powered in part by rotary motion transmitted from an engine of the lawn mower,

105. I incorporate and refer to my analysis in Section VII.F[1.4], excluding any references to Judice.

106. Additionally, Uchida also discloses this limitation. Uchida discloses a compressor that is interlockingly connected to the engine. Ex. CI-1007 at [0070]. Like Toro Manual, Uchida also discloses a belt that connects the compressor and the engine pulley, so the rotation of the engine pulley drives the compressor:



Id. at Fig. 19 (annotations added).

[1.5] the air conditioning unit being secured in relation to the cab assembly such that conditioned air produced by the air conditioning unit is emitted directly into the interior volume,

107. I incorporate and refer to my analysis of this limitation in Section VII.F, excluding any references to Judice.

[1.6] wherein one or more components of the air conditioning unit define a rear wall disposed opposite the front wall,

108. The Toro-Uchida combination discloses this limitation. I previously explained in Section VIII.E why a skilled artisan would have been motivated to

relocate the Toro A/C unit to the rear wall, as Uchida teaches. In making that modification, a skilled artisan would have wanted to keep the Toro A/C unit's shape roughly the same to minimize design changes (and thus minimize costs associated with the modification). And because the Toro A/C unit is wide and flat (like a wall), relocating it to the rear wall would cause the A/C unit to “*define*” the rear wall.



Ex. CI-1004 at 0:40 (annotations added).

109. Even if a skilled artisan would have instead changed the shape of the Toro A/C unit such that it would make up only part of the rear wall, rather than “*define*” the rear wall, it would not matter under Patent Owner’s interpretation of this limitation. In the parallel litigation, Patent Owner contends that this limitation encompasses A/C units that make up only part of a rear wall. *See, e.g.*, Ex. CI-1015 at 17. Although I disagree with that interpretation, I apply it here because I am informed that claims must be construed the same for purposes of infringement and validity. Under Patent Owner’s interpretation, the Toro-Uchida combination would still satisfy this limitation even if one were to change the shape of the Toro A/C unit

such that it composes only part of the rear wall. In any event, as I explained above, a skilled artisan would have been motivated not to change the Toro A/C unit's shape.

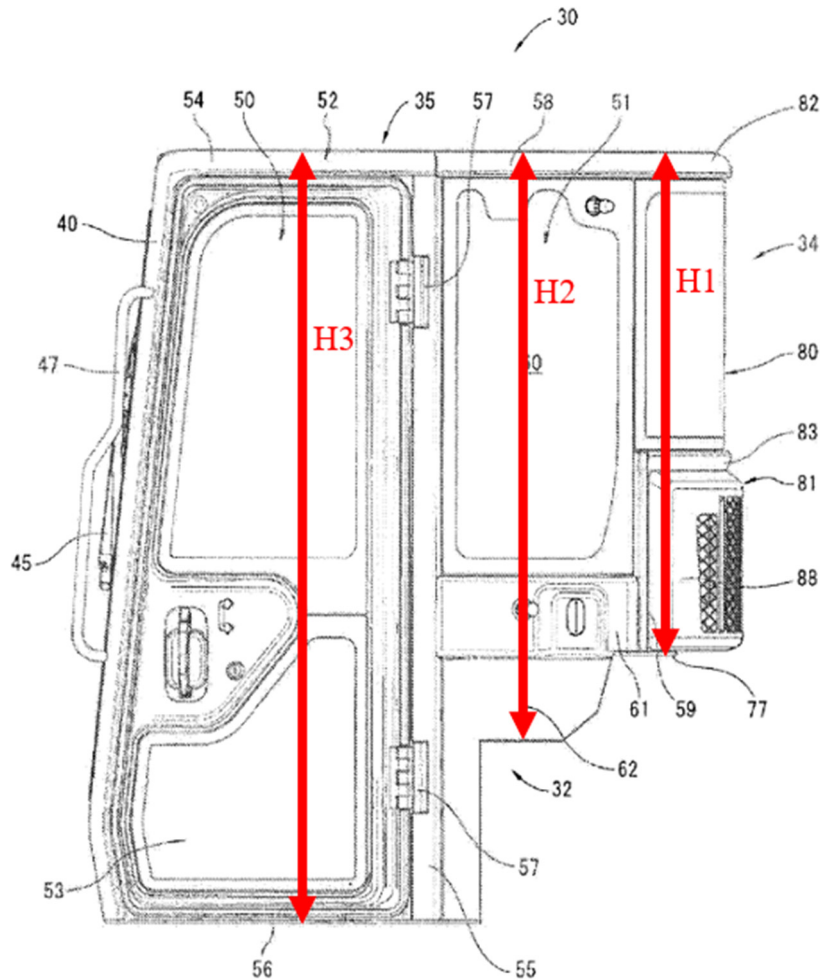
[1.7] wherein the cab assembly includes a lower frame adapted to be secured to the mower frame such that when the lower frame is secured to the mower frame the front wall is disposed in front of an operator seat of the lawn mower and the rear wall is disposed behind the operator seat; and

110. I incorporate and refer to my analysis of this limitation in Section VII.F, excluding any references to Judice.

[1.8] wherein the cab assembly has a height that increases as the cab assembly extends from the rear wall to the front wall.

111. I incorporate and refer to my analysis of this limitation in Section VII.F, excluding any references to Judice.

112. Additionally, under Patent Owner's interpretation ("height" refers to the distance from the cab floor to the cab ceiling), Uchida also discloses this limitation:

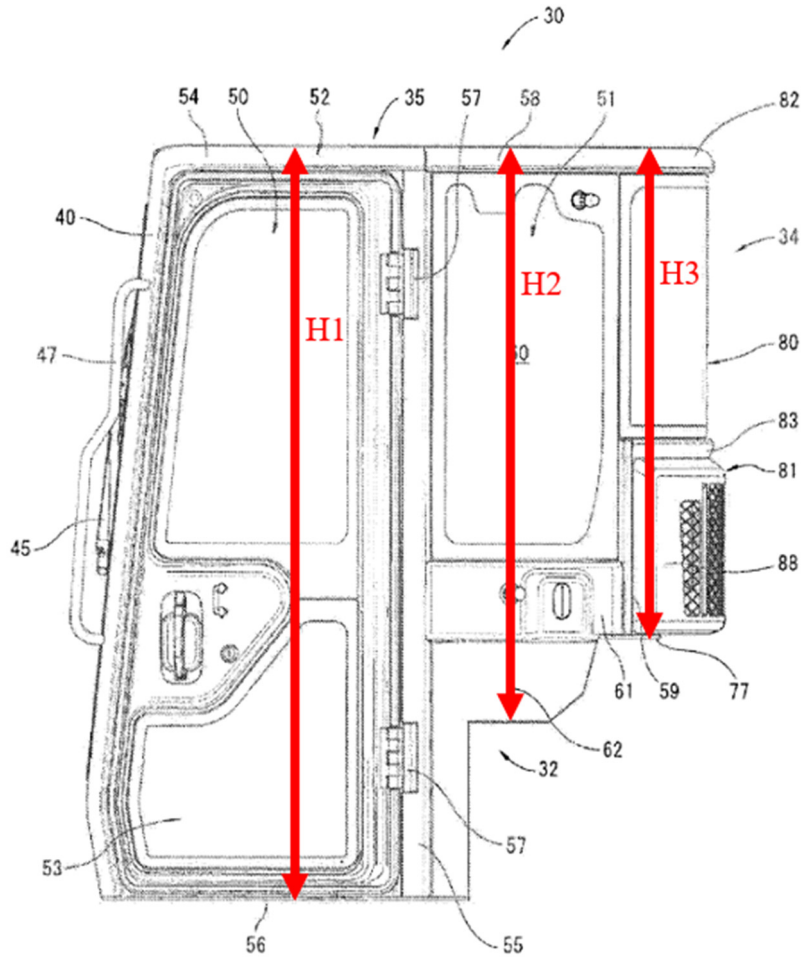


Ex. CI-1007 at Fig. 9 (annotations added).

2. Claim 3

3. The system of claim 1, wherein the first sidewall and the second sidewall each have a first end proximal to the front wall and a second end opposite the first end, wherein a height of the first sidewall and the second sidewall decreases as each sidewall extends from the first end to the second end.

113. I incorporate and refer to my analysis of this claim in Section VII.F, excluding any references to Judice. Additionally, under Patent Owner's interpretation of this limitation ("height" refers to the distance between the bottom and the top of the sidewall), Uchida also discloses this limitation:



Id. (annotations added).

3. Claim 4

4. The system of claim 1, wherein at least one of the first sidewall, the second sidewall, and the front wall is semi-transparent

114. I incorporate and refer to my analysis of this claim in Section VII.F, excluding any references to Judice.

IX. ADDITIONAL REMARKS

115. I currently hold the opinions expressed in this Declaration. But my analysis may continue, and I may acquire additional information and/or attain additional insights that may result in added observations.

116. I declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare 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 the Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patents issued thereon.

Dated: 7/1/79

By: Roel H. de Vries
Roel H. de Vries

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Assistant Professor University of Pittsburgh at Johnstown 9/08 to present
Department Chair, Mechanical Engineering 9/23 to present

- Teaching or taught the following courses:

Machine Design	Advanced Machine Design	Engineering Design	Engineering Drawing
Strengths of Materials	Strengths of Materials Lab	Fluid Mechanics Lab	Senior Projects
Introduction to Engineering Analysis		Computer Aided Design and Drafting	
Introduction to Mechanical Engineering Design		Vehicle Dynamics	Fluid Power

- Significant curriculum development for Advanced Machine Design, Vehicle Dynamics, Engineering Drawing, and Introduction to Engineering Analysis, and Fluid Power.
- Faculty Advisor, SAE Baja Team.
- College Research Council (Chair one year.)
- Faculty Senate Education Policies Committee.

Principal deVries Engineering 1/09 to present

- Contract design and analysis for Pillar Innovations:
 - Testing and certification of Refuge Chambers for coal mines.
 - Design of screen and rake for water inlet to power generation station.
 - Design of structure and drive for 100 cubic yard oil drill waste handling system.
 - Design and analysis of components for high-temperature pressurized ash handling.
 - Design of transfers and drives for over-land conveyor system.
- Projects for other clients include:
 - Design of accessories for medical exam table and procedure chair.
 - Patent 11,090,214 for Leg Support Assembly, 8/17/21
 - Drafting and design of manure spreaders and forage wagons.
- Forensic Engineering and analysis
 - 52 cases, 14 reports, 7 depositions, 1 trial testimony
- Consulting on patent issues.

Associate Lapina Associates 3/09 to 12/16

- Forensic Engineering and analysis
- 40 cases, 20 reports, 3 depositions, 3 trial testimonies

Engineering Manager and Chief Engineer J&J Truck Bodies and Trailers 9/04 to 9/08

- Managed department of 10 – 15 employees, including :

Research and Development	Engineering	Programming
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- Department responsibilities included:
 - Development of new products for truck bodies, trailers, and specials.
 - Design and drafting using AutoCAD 2D and 3D solid modeling software.

- Design analysis using ANSYS Finite Element Analysis software.
- Personal responsibilities included:
 - Managing department activities, projects, and schedules.
 - Training, hiring, firing, and performance evaluations.
 - Design and analysis.
 - Design control, including product validation and checking drawings.
- Significant projects included:

New light-weight steel dump body	New smooth side extrusion for dump bodies and trailers
Mine refuge chamber housings	Double drop-deck trailer with raising frame
Roll-off Hoists	Sand storage and delivery systems for gas well stimulation
Conveyor tube galleries	Dump body heat system for engines with DPF
- Patent activity – applications for:

Smooth side panel extrusion	Trailer with raising frame	Controls for heated dump bodies
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Engineering Manager, Project Engineer Tekfor USA 1/03 to 9/04

- Managed department of 3 – 6 employees, including:

Tool Design	Project Engineers	Student Interns
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- Department responsibilities included:
 - Design and drafting of tooling for Hatebur and Eumuco closed-die forges.
 - Management of pre-production phase of new products, including Quality Planning.
 - Customer liaison – automotive Tier II businesses
- Personally responsible for new product launch comprising \$9.5 million of new business.
- Trained forklift operator.

Engineering Manager Steiner Turf Equipment, Inc. 9/94 to 1/03

- Managed department of 14 employees, including:

CAD engineers and designers	Prototype shop technicians
Publication technicians	Engineering clerk
- Department responsibilities included:
 - Development of new products for Steiner and Brouwer product lines.
 - Design and drafting, Bills of Materials, Routings, and shop work instructions.
 - Prototype build and testing.
 - Compliance with ANSI and CE standards.
 - Owner / Operator manuals.
 - Manufacturing Engineering, including tooling, CNC programming, trouble-shooting.
 - Investigating and resolving field service concerns.
- Personal responsibilities included:
 - Same as listed for Somerset Welding and Steel
 - Product liability coordinator (two cases to trial with defense verdict)
- Significant design projects included:
 - Big Roll Sod Harvesting system, including the first one-operator sod harvester.
 - Sod layers – two self-propelled and three tractor-mounted.
 - New cutting head for sod harvesters.
 - New Steiner tractors – four-wheel drive, front-wheel drive, and zero-turn.

New Steiner attachments – Trencher, Core Aerator, V-Blade Plow, Vertical Auger, Power Box Rake
Pallet Mover, Passive Sweeper, Turbine Blower, Generator, Flip-up Mower Decks, etc.
Cushman fairway sweeper, Jacobsen PTO Blower

- Patent activity:
 - U.S. 5,775,436 – Large roll harvester, issued 7/7/98.
 - U.S. 6,056,064 – Slab rolling method, issued 5/2/00.
 - U.S. 6,223,830 – Perforated slabs, issued 5/1/01.
 - U.S. 6,347,502 – ZTM deck height, issued 2/19/02.
 - U.S. 6,571,883 – New pivoting cutting head, issued 6/3/03.
 - U.S. 7,195,077 - New pivoting cutting head, issued 3/27/07.
 - Successful defense of infringement case.
- Company accomplishments during this time:
 - Sales growth from \$18 million to \$35 million per year.
 - ISO 9001 quality certification December 1999.

Design Engineer	<u>Ford New Holland</u>	2/88 to 9/94
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- Lead Engineer for design and launch of “D Series” Industrial Tractor Loaders.
 - Project management – controlling timing, budgets, and piece cost.
 - Directing design work of Danish cab supplier.
 - Layout and design of non-cab parts.
 - Coordination of prototyping, testing, drafting, release, and launch.
 - Project was on time (19 months) and within budget (\$640,000).
 - New features included two cab models, improved three-point hitch and cooling.
- Lead Engineer for design and launch of 250C, 260C Industrial Tractors.
 - Similar responsibilities as “D Series” above.
 - Project included new operator platforms, reconfigured sheet metal, and re-sourcing the tractor to England and the loader to Canada.
- Product Improvement for Industrial tractor models.
 - Trouble-shooting warranty concerns involving performance and reliability.
 - Designing and implementing changes and cost reductions.
 - Liaison with Marketing, Service, Manufacturing, and suppliers.
- Cost reduction task force CAD/CAM task force.

M.S. Agricultural Engineering	<u>Cornell University</u>	8/85 to 12/87
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- Concentration – Power and Machinery Minor – Mechanical Engineering
 - GPA 3.99 overall, 3.97 in major
- Outstanding Teaching Assistant Award, 1987.
 - T.A. for courses in Ag Machine Design, and Tractors.
- Thesis research in non-chemical pest control, investigating a Colorado Potato Beetle’s grip characteristics and experimenting with a beetle blower.
- Other research – Computer simulation of potato late blight spray management practices using C and Fortran languages.

Design Engineer Campbell Soup Company 5/82 to 8/85

- Developed patented process and machinery for automatic cookie sandwiching
U.S. Patent 4,622,891, issued 11/18/86.
- Other projects involving frozen dinner assembly – design, drafting, testing, installation.
- Toastmasters Club – charter president.

Manufacturing Engineer Sperry New Holland 6/81 – 4/82

- Process Engineer, Tool Design Engineer for sheet metal fabrication in hay tools.

B.S. Mechanical Engineering Lafayette College 8/77 – 5/81

- Graduated cum laude – GPA 3.57 overall, 3.56 in major

Professional Engineering Certification

PE072147	Pennsylvania
0037140	Maryland
022348	West Virginia

Other Skills and Training

SAE seminar training in Patents, Copyrights, and Trademarks
SAE seminar training in Product Liability and Expert Witnessing.
3D CAD –AutoDesk Inventor, Creo, ComputerVision, Calma
FEA software – ANSYS Design Space
Programming languages – Basic and FORTRAN
In-house training in Design for Assembly, Statistical Process Control, Quality Circle Facilitator, Industrial Engineering, CMM operation.

Other activities and organizations, past and current

American Society of Mechanical Engineers
Society of Automotive Engineers
Tau Beta Pi
Pi Tau Sigma
Phi Kappa Phi
Mu Upsilon Sigma
Coach for Science Olympiad, Bible quizzing, soccer
Sunday School teacher
Church board
Village Council – Village of Dalton, Ohio

Publications and presentations

Presented “Leadership Approach to Building an Inclusive Campus Community” to the 2019 Industry, Engineering, and Management Systems Conference, March 17-19, 2019

Presented poster on “Building a Healthy Learning Community in Engineering” at Pitt Johnstown’s Healthy U Medical Humanities Conference, 4/5/18.

Participated in University of Pittsburgh’s Assessment and Teaching Conference, 1/25/19, and presented a poster on “Building a Healthy Learning Community in Engineering.”

“End Fixture Design to Enhance Column Buckling Lesson” (secondary author) was presented / published at ASEE Conference, June 2016 in New Orleans.

“Quick-Response Drill for Training in the Identification of Stress Conditions” (primary author) and *“Enhancing Spatial Visualization Skills in Engineering Drawing Course”* (secondary author), both presented / published at ASEE Conference, June 2015 in Seattle.

“Reconfiguring an Engineering Drawing Course – Mapping Goals and Methods to Leverage CADD Functionality” was presented at ASEE International Conference in Vancouver, BC July 26, 2011, and published by ASEE.