

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

J&M MANUFACTURING CO., INC.,
Petitioner

v.

UNVERFERTH MANUFACTURING CO., INC.,
Patent Owner

U.S. Patent No. 6,176,504

**DECLARATION OF ALBERT KARVELIS Ph.D., P.E.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 6,176,504**

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

I, Albert Karvelis Ph.D., P.E., hereby declare as follows:

INTRODUCTION – SCOPE

1. I have been asked by counsel for Petitioner J&M Manufacturing Co., Inc. (“J&M” or “Petitioner”) to review U.S. Patent No. 6,176,504¹ (“‘504 patent”) titled “Short Steer Wagon,” issued to Van Mill *et al.*, and assigned to Patent Owner Unverferth Manufacturing Co., Inc. (“Unverferth” or “Patent Owner”). I have also been asked to review the relevant prior art and to independently determine whether claims 1, 2, and 5 of the ‘504 patent would have been anticipated and/or obvious to a person of ordinary skill in the art at the time of the claimed invention.

QUALIFICATIONS

2. I am a licensed professional engineer with over forty years of experience in industrial machinery and mechanisms. This experience includes R&D, design, manufacturing, and testing of machinery and mechanisms for a wide variety of industries including transportation technology and material handling equipment technology for the agricultural industry.

¹ I have been informed that this document will be submitted as Exhibit 1001 and have been asked to cite it as such.

3. I am a Principal Engineer currently employed by Exponent Inc., an engineering and science consulting organization with over 800 engineers, scientists, physicians, and technical support staff located in six countries with 22 offices. I have also worked at Packer Engineering for 19 years, where I consulted on tractor trailers, agricultural equipment, suspensions, steering issues, and general mechanical design.
4. While at Borg Warner Corporation, as Manager of Mechanical Engineering, I provided technical design support for Rockford Powertrain, a division of Borg Warner that served the agricultural equipment industry. My work included technical design and test support for couplings and universal/CV joints. I also worked on joint projects with John Deere (Deere & Company) on tractor related new product development. Additionally, I worked with General Motors Truck and Bus (GMC) and Ford Motor Co. on light truck suspension and drivetrain problems. My duties at Borg Warner Corporation further included developing mechanical design technology to be used in the transportation industry.
5. While at Packer Engineering and Exponent Inc., I consulted for a Midwest manufacturer of specialized truck and trailers on steering and suspension issues. I have also assisted in the design of grain handling equipment, irrigation equipment, seed planting equipment, as well as performing

studies of material handling equipment for grain. I have performed studies of steering stability for tractor trailers pulling two containers (doubles).

6. I have served on the Industrial Advisory/Liaison Boards and as guest lecturer at MIT, Purdue University, Northwestern University, the University of Iowa, and Northern Illinois University, and have served as Adjunct Professor of Mechanical Engineering. I have served in numerous leadership positions in the Design Engineering Division of the American Society of Mechanical Engineers International (“ASME”) including Chair, ASME Power Transmission and Gearing Committee and session Chair and International Conference Chair for power transmission.
7. I was first trained in patent matters while on active duty with the Office of Naval Research in approximately 1971. While employed at the Borg Warner Corporation, I represented the mechanical engineering arts on the Patent Committee.
8. In recognition of my substantial contributions to the field of engineering, in 2008 the American Society of Mechanical Engineering International named me an ASME Fellow.
9. An expanded summary of my professional experience is contained in the Curriculum Vitae attached as Appendix 1.

BACKGROUND OF THE RELEVANT TECHNOLOGY AND PRIOR ART

Basic Wagon Design

10. In the layperson's parlance, most are familiar with wagons pulled by children or those used in yard work, and these have many features in common with wagons and trailers used in the agricultural industry. A wagon typically has an underlying frame with longitudinal frame members to which one or more axles are attached. For example, one axle is positioned near the front end, and one axle is positioned near the rear end, each axle typically having at least a pair of wheels. The front wheels are typically steerable. Because a wagon is generally pulled by a tow vehicle, the wagon includes an attachment structure such as a tongue, for example, which can be connected to and disconnected from the tow vehicle. The tongue is typically coupled to the front wheels so that the tongue's side to side motion also moves the front wheels from side to side and thereby facilitates steering the wagon. Wagons are used to transport loads of materials via a bed, box, tank, etc. that is mounted to the upper side of the frame.
11. As explained in the "Background of the Invention" section ("Background") of the '504 patent: "Wagons are a traditionally and widely used form of transportation. Wagons are used to carry a wide variety of goods, including

grains, livestock, dry goods, persons, liquids, machinery, etc.” (Ex. 1001 at col. 1, ll. 16-19). The Background of the ‘504 patent further explains:

Wagons in their most basic form include a tongue, a frame, at least one pair of wheels, and a bed, box, or tank for hauling cargo. The tongue of the wagon may be connected to a vehicle, such as, for example, a tractor, truck, pickup harvester, or other self-propelled machine. A variety of wheels may be used, depending on the intended use.

A common variation is the four-wheeled wagon, having pairs of wheels at either end of the wagon. The extra pair of wheels contribute [sic] to stability of the wagon and may also increase the load-carrying capacity. In a four-wheeled wagon, generally one pair of steerable wheels is capable of being pivoted in unison so that the wagon may be turned. The turning action is controlled by the tongue, which pivots the steerable wheels (i.e., the front wheels) by means of a steering rod or rods which connect the tongue to each steerable wheel. As the tongue is displaced to either side of a center position, both steerable wheels are therefore pivoted.

In a conventional wagon construction, a frame is employed upon which the pairs of wheels are mounted. The tongue is pivotally attached to the front of the frame and connected to the steerable wheels through a steering linkage. The wheels and corresponding axles extend beyond the frame, but are positioned relatively near to the frame. This is because if the wheels extended far beyond the frame, excessive bending

loads would be imposed on the axles, with possible breakage occurring as a result of heavy loads or due to traveling over rough roads or rough ground. Conventional wagon designs therefore have a frame positioned generally within about one-half of the wheel diameter from the wheel.

(Ex. 1001 at col. 1, ll. 20-50).

12. I will refer to these well-known and conventional wagons described in the Background of the '504 patent as "Admitted Prior Art Wagons." Fig. 1 of the '504 patent depicts the undercarriage of one such Admitted Prior Art Wagon. (Ex. 1001 at col. 2, ll. 21-22, 34).
13. Certain examples of conventional wagons that were on sale before the priority date of the '504 patent are shown in their respective trade publications. I have been informed that these trade publications will be submitted as Exhibits 1007-1012, and I have been asked to cite them as these Exhibits.
14. First, "The Brent Grain Train" brochure was published in 1995 by Unverferth. (Ex. 1007; "Unverferth Grain Train Brochure"). The Unverferth Grain Train Brochure shows Brent model number 440, 540, 640, and 740 wagons. (*See* Ex. 1007 at pg. 1). As an example, Figure A below shows a photograph of the models 440 and 540, adopted from this brochure. The Brent wagons shown in the Unverferth Grain Train

Brochure are representative of the Admitted Prior Art Wagons described in the Background of the '504 patent outlined above in paragraph 11 and below in paragraph 63.



Figure A. Adopted from Unverferth Grain Train Brochure (Ex. 1007 at pg. 1).

15. Second, the Parker “Gravity Wagons” brochure was published in 1996. (Ex. 1008; “Parker Brochure”). The Parker Brochure shows Parker model number 5250, 6250, and 7250 wagons. (See Ex. 1008 at pg. 1). As an example, Figure B below shows a photograph of the model 5250, adopted from this brochure. The Parker wagons shown in the Parker Brochure are representative of the Admitted Prior Art Wagons described in the

Background of the '504 patent outlined above in paragraph 11 and below in paragraph 63.



Figure B. Adopted from Parker Brochure (Ex. 1008 at pg. 2).

16. Third, the Unverferth “High-Value Grain Deserves A High-Quality Ride” brochure was published in 1996. (Ex. 1009; “Unverferth 430/530/630 Brochure”). The Unverferth 430/530/630 Brochure shows Unverferth model number 430, 530, and 630 wagons. (*See* Ex. 1009 at pgs. 1 and 2). As an example, Figure C below shows a photograph of the model 630, adopted from this brochure. The Unverferth wagons shown in the Unverferth 430/530/630 Brochure are representative of the Admitted Prior Art Wagons described in the Background of the '504 patent outlined above in paragraph 11 and below in paragraph 63.



Figure C. Adopted from Unverferth 430/530/630 Brochure (Ex. 1009 at pgs. 1 and 3).

17. Fourth, the Killbros “Model 555, Model 655: Grain Transport” brochure was published in 1997. (Ex. 1010; “Killbros 555/655 Brochure”). As an example, Figure D below shows a photograph of the model 555, adopted from this brochure. The Killbros models shown in the Killbros 555/655 Brochure are representative of the Admitted Prior Art Wagons described in the Background of the ‘504 patent outlined above in paragraph 11 and below in paragraph 63.



Figure D. Adopted from Killbros 555/655 Brochure (Ex. 1010 at pg. 1).

18. Fifth, the Killbros “Model 390: Partitioned Gravity Grain Box” brochure was published in 1997. (Ex. 1011; “Killbros 390 Brochure”). The Killbros model number 390 grain box, shown in Figure E below, is representative of the Admitted Prior Art Wagons described in the Background of the ‘504 patent outlined above in paragraph 11 and below in paragraph 63.



Figure E. Adopted from Killbros 390 Brochure (Ex. 1011 at pg. 1).

19. Sixth, the “Unverferth GB-335: The Bulk Material Handling Specialist” brochure was published in 1997. (Ex. 1012; “Unverferth GB-335 Brochure”). The Unverferth model number GB-335 gravity box, shown in Figure F below, is representative of the Admitted Prior Art Wagons described in the Background of the ‘504 patent outline above in paragraph 11 and below in paragraph 63.



Figure F. Adopted from Unverferth GB-335 Brochure (Ex. 1012 at pg. 1).

Indentations in Longitudinal Frame Members

20. The prior art at the time the '504 patent was filed also included several disclosures of vehicles, including towed vehicles, having longitudinal frame members with indentations that allowed for improved turning ability of the corresponding steerable wheels.
21. As a first example, U.S. Patent No. 1,741,873 to Nordine² ("Nordine") issued December 31, 1929. (Ex. 1002). Nordine is directed to "a frame for trailers or the like which is provided with indentations in the sides thereof into which the front wheels may extend when turning on a short radius."

² I have been informed that this document will be submitted as Exhibit 1002 and have been asked to cite it as such.

(Ex. 1002 at pg. 1, ll. 1-5; *see also* pg. 1, ll. 17-19). Nordine further explains:

[Side] members 2 and 3 are bent inward to the points 8 and 9 between the points 10 and 11. It is understood that these points may be positioned so that the frame will clear a wheel of any suitable design or size and the depth of the indentations may be greater or lesser as may be desired.

(Ex. 1002 at pg. 1, ll. 74-80; *see also* pg. 2, ll. 64-66 (“the said side members provided with indentations to clear the wheels when making a turn.”)). The frame members with inwardly oriented indentations of Nordine are shown in Fig. 1, an annotated version of which is reproduced below.

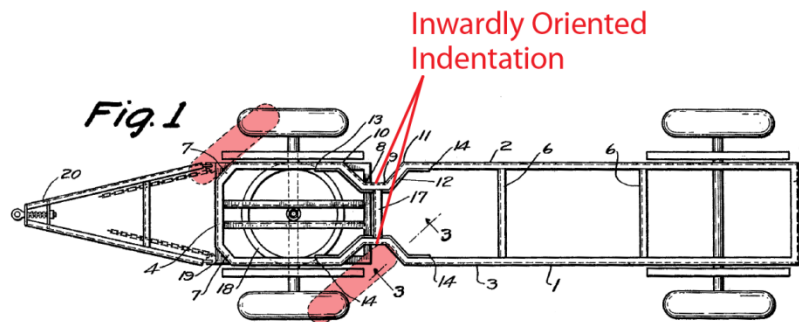


Figure G. Adopted from Nordine (Ex. 1002 at Fig. 1) and annotated.

22. Second, U.S. Patent No. 2,373,398 to Hoobler³ (“Hoobler”) issued April 10, 1945. (Ex. 1003). Hoobler is directed, in part, to a trailer vehicle for highway transport. (Ex. 1003 at pg. 1, left col., ll. 1-2). Hoobler discloses that “the channel frame 24 comprising the frame [20] is preferably curved or bent inwardly at both sides between the pivot pins 32 and 43, as indicated at 54, to allow sufficient room for turning of the dual wheels 47 carrying the dolly frame 21.” (Ex. 1003 at pg. 3, left col., ll. 8-13). The frame 20 with inwardly oriented indentations of Hoobler are shown in Fig. 8, an annotated version of which is reproduced below.

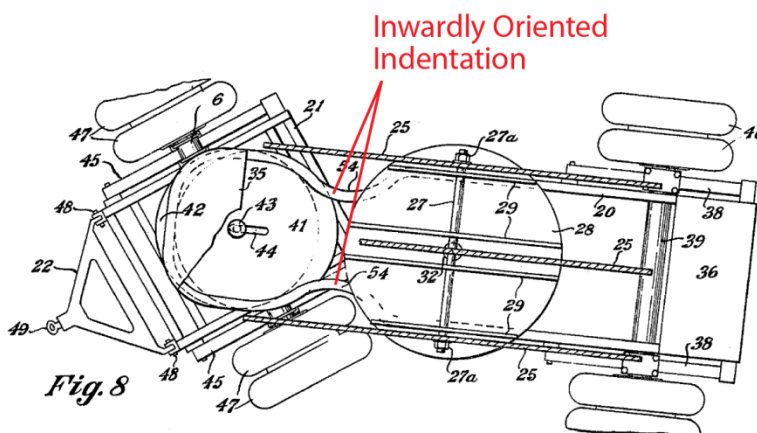


Figure H. Adopted from Hoobler (Ex. 1003 at Fig. 8) and annotated.

³ I have been informed that this document will be submitted as Exhibit 1003 and have been asked to cite it as such.

23. Third, U.S. Patent No. 1,731,557 to Wright⁴ (“Wright”) issued January 23, 1926. (Ex. 1004). Wright is directed to a highway vehicle. (Ex. 1004 at Title). Wright discloses: “The frame of the truck is bent inwardly as at 26 and at 27 to accommodate the wheels 14 and 15 when the truck is turning relative to the frame 11.” (Ex. 1004 at pg. 1, ll. 90-93; *see also* claim 2). The frame members with inwardly oriented indentations of Wright are shown in Fig. 3, an annotated version of which is reproduced below.

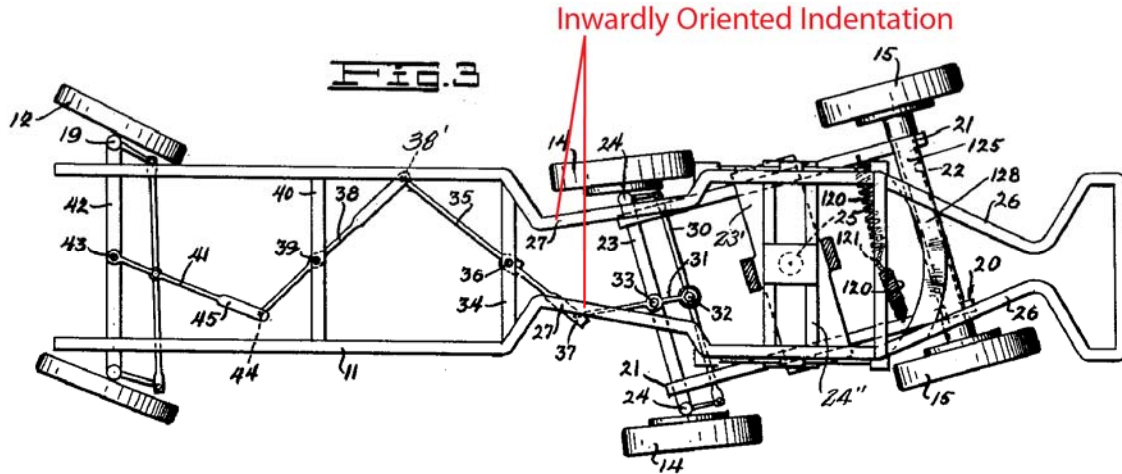


Figure I. Adopted from Wright (Ex. 1004 at Fig. 3) and annotated. *See also* Ex. 1004 at Fig. 2.

⁴ I have been informed that this document will be submitted as Exhibit 1004 and have been asked to cite it as such.

24. Fourth, German Patent Application Publication No. 3046054 to Gobel⁵ (“Gobel”) was published on June 9, 1982. (Ex. 1005). Gobel is directed to an agricultural vehicle. (Ex. 1005 at pg. 2, ¶¶ 1, 2). Gobel discloses that “longitudinal carriers 2 are bent toward the vehicle center 13,” such that “the wheel on the inside of the curve engages into the bent the [sic] area of the carrier frame 15.” (Ex. 1005 at pg. 3, ¶ 2). Gobel explicitly refers to the bent areas of the longitudinal carriers as “frame indent[s]” and explains that the frame indents “create[] additional space for the locked front wheels” (Ex. 1005 at pg. 2, ¶ 6), such that “a small turning radius can be achieved.” (Ex. 1005 at pg. 2, ¶ 4). The frame with inwardly oriented indentations of Gobel is shown in Fig. 2, an annotated version of which is reproduced below.

⁵ I have been informed that this document will be submitted as Exhibit 1005 and have been asked to cite it as such.

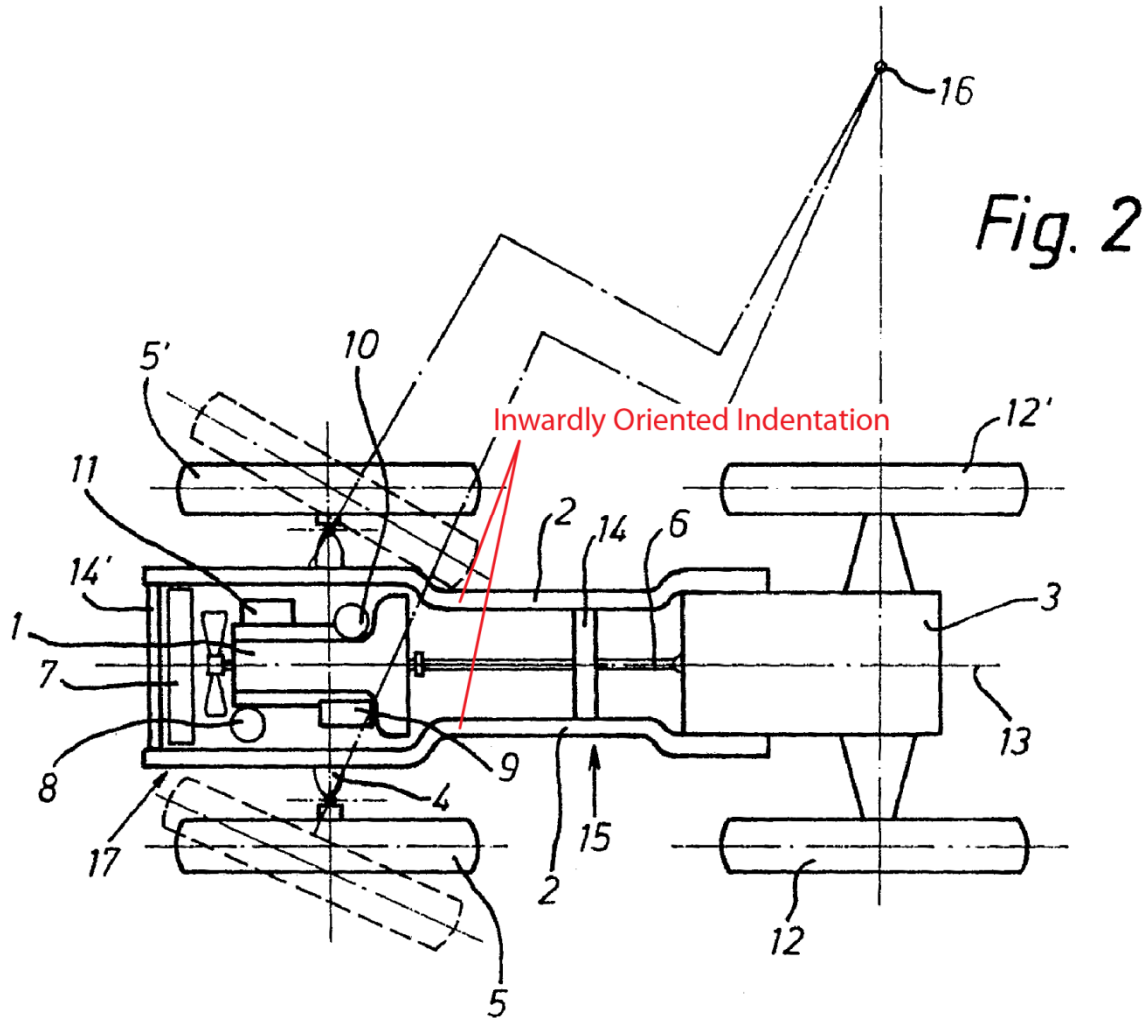


Figure J. Adopted from Gobel (Ex. 1005 at Fig. 2) and annotated.

25. Fifth, Japanese Patent Application Publication No. S60-104468 to Kataue⁶ *et al.* (“Kataue”) was published June 8, 1985. (Ex. 1006). Kataue is directed to a body frame for a tractor. (Ex. 1006 at Title). Kataue discloses that a portion of the left and right frames (1) are “formed with a sufficiently

⁶ I have been informed that this document will be submitted as Exhibit 1006 and have been asked to cite it as such.

narrow disposed spacing” therebetween so that “a steering turning angle of the front wheels (8)(8) that steer and turn near the narrow formed section can be sufficiently sharp.” (Ex. 1006 at pg. 2, ¶ 3; *see also* pg. 2, ¶ 1 (“[T]he left and right frames preferably have a small cross section . . . in order to reduce the turning radius, a disposed spacing between the left and right frames is preferably as narrow as possible, and it is particularly preferred to be narrower in the area where a front wheel turns.”)). The narrowing of the left and frames results in inwardly oriented indentations in the frames, as shown in Fig. 2, an annotated version of which is reproduced below.

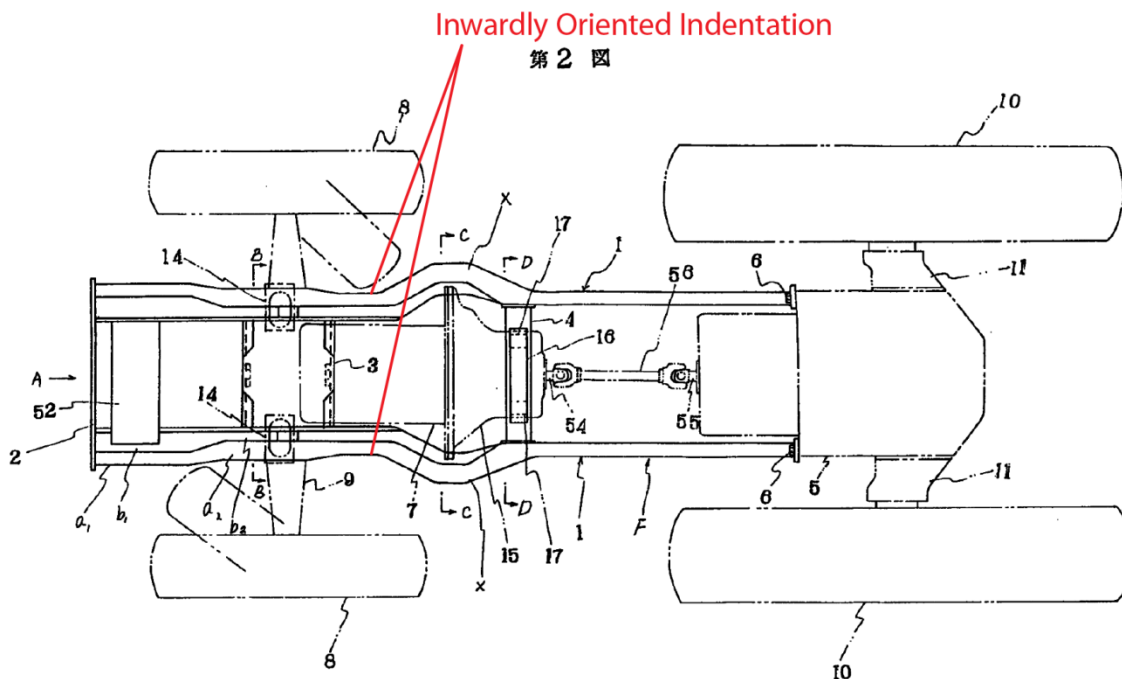


Figure K. Adopted from Kataue (Ex. 1006 at Fig. 2) and annotated.

SUMMARY OF THE ‘504 PATENT

26. The ‘504 patent describes a short steer wagon having an improved turning capability. While the title of the ‘504 patent states that it is directed to a “wagon,” the disclosure of the ‘504 patent is actually limited to wagon undercarriages. For example, the claims and detailed description of the preferred embodiments do not discuss any container portion to be used on the claimed “wagons.” (*See generally* Ex. 1001). Moreover, the figures show only the undercarriage. (Ex. 1001 at Figs. 1-4.)
27. The ‘504 patent teaches the basic structure and function of known, conventional wagons. (Ex. 1001 at col. 1, ll. 16-55; col. 2, ll. 34-38; Fig. 1). As noted above, I will refer to these conventional wagons described in the Background of the ‘504 patent as “Admitted Prior Art Wagons.” In the Admitted Prior Art Wagons disclosed in the ‘504 patent, the turning radius is limited by contact between the steerable wheels and the longitudinal frame members. (Ex. 1001 at col. 1, ll. 52-54) (“The proximity of the frame limits the ability of the steerable wheels to pivot, and thereby limits the turning radius of the wagon.”). This interference point geometrically limits the maximum steering angle. Based on the prior art mentioned above, it was known for at least 70 years before the priority date of the ‘504 patent that improved turning capability could be achieved by indenting the

longitudinal frame members so that the original interference point is displaced inwardly, thus permitting a greater turning angle and consequently a comparatively smaller minimum turning radius.

28. It is clear that the indentations in the longitudinal frame members shown in Fig. 2 of the '504 patent are the sole inventive concept of the '504 patent. See the below comparison of Fig. 1 of the '504 patent, which shows an Admitted Prior Art Wagon (Ex. 1001 at col. 2, ll. 20-21, 34-37), and Fig. 2 of the '504 patent, which shows an embodiment of the claimed invention (Ex. 1001 at col. 2, ll. 22-25).

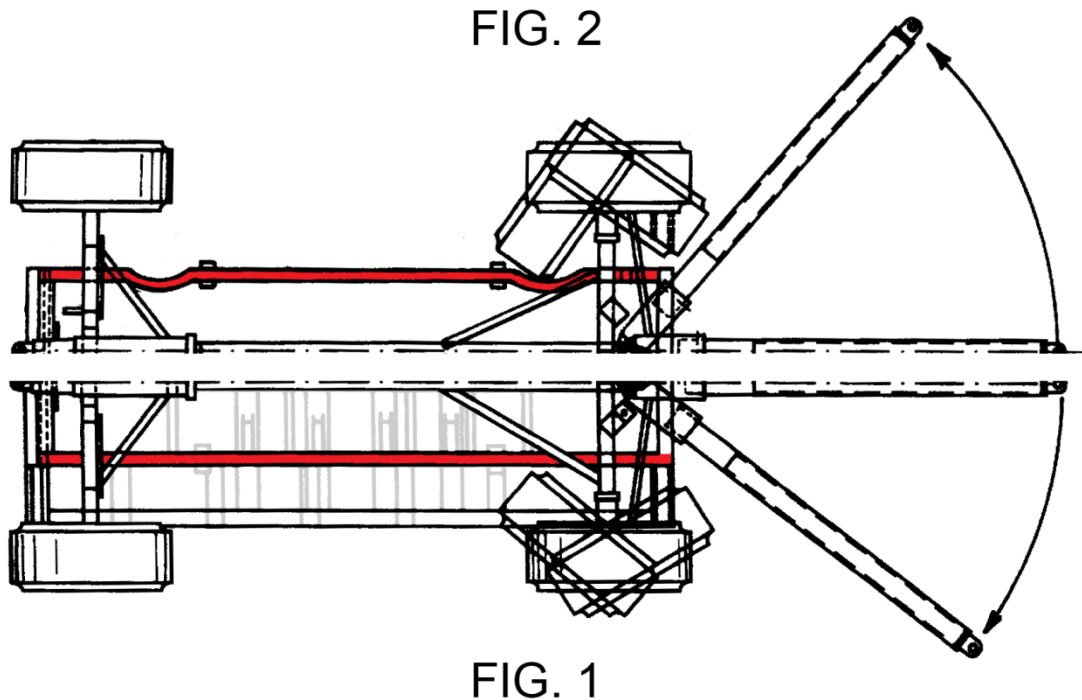


Figure L. Adopted from the '504 patent (Ex. 1001 at Figs. 1 and 2) and annotated.⁷

29. Claims 1, 2, and 5 of the '504 patent are set forth below:⁸

Claim 1. A wagon having two opposed ends and two opposed sides extending between the opposed ends, the wagon further comprising:

- a. a pair of wheels at each of said opposed ends;
- b. a frame having at least one longitudinal frame member
- c. a tongue having a rear portion connected to a frame of said wagon and having a front portion adapted for connection to a vehicle;
- d. at least one said pair of wheels being steerable to right and left sides and connected to a rear portion of said tongue for steering with said tongue, with a wheel having a leading edge facing toward an end of said wagon and a trailing edge facing toward a central portion of said wagon;
- e. said wagon having a longitudinal frame member on each side, each longitudinal frame member having an outer

⁷ Figs. 1 and 2 were edited for this comparison. Fig. 1 was flipped to the same orientation as Fig. 2. All reference numerals and leader lines were removed from both figures. A portion of the bed framing in Fig. 1 was grayed out.

⁸ Letters have been added for ease of future reference to the claim elements.

edge portion on an intermediate portion of said longitudinal frame member;

- f. said steerable wheels being completely outside said longitudinal frame members when said steerable wheels are oriented in a straight running direction; and
- g. each longitudinal frame member including an inwardly oriented indentation adjacent said trailing edge of each corresponding steerable wheel, each said indentation allowing said corresponding steerable wheel to be turned so that said trailing edge of said corresponding steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member.

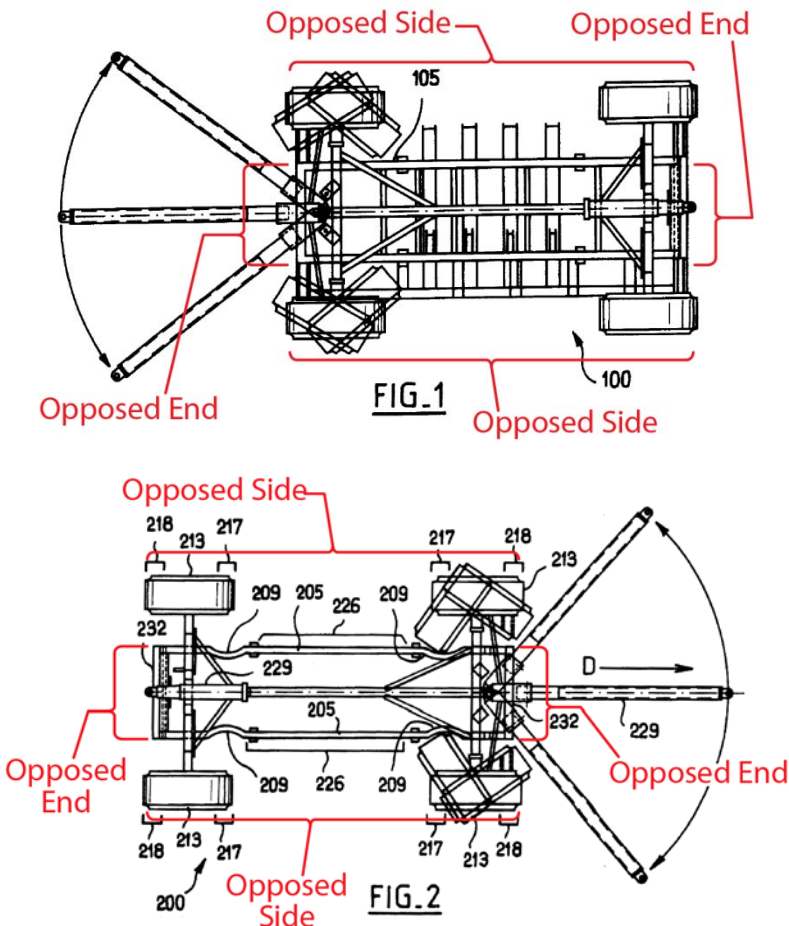
Claim 2. The wagon of claim 1, wherein a lateral frame member extends across each end of said wagon, with said lateral frame member being positioned adjacent to said leading edge of said steerable wheel wherein said steerable wheel can be turned so that said leading edge of said steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member.

Claim 5. The wagon of claim 1, wherein said indentations permit a greater turning angle for said pair of wheels than would be obtainable without said indentations.

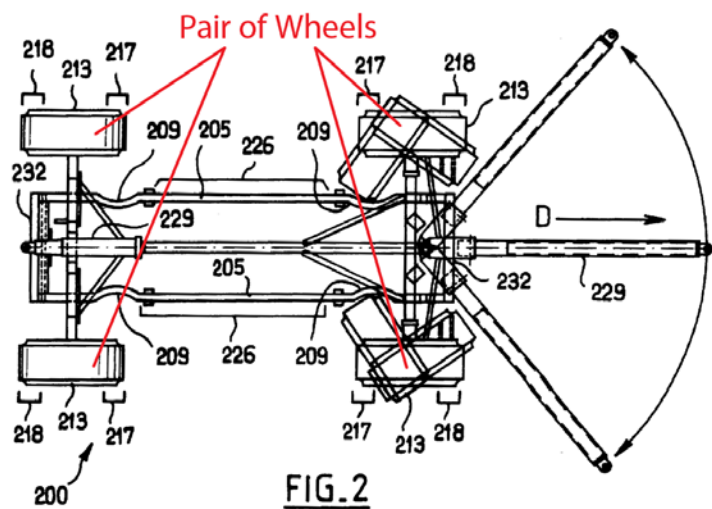
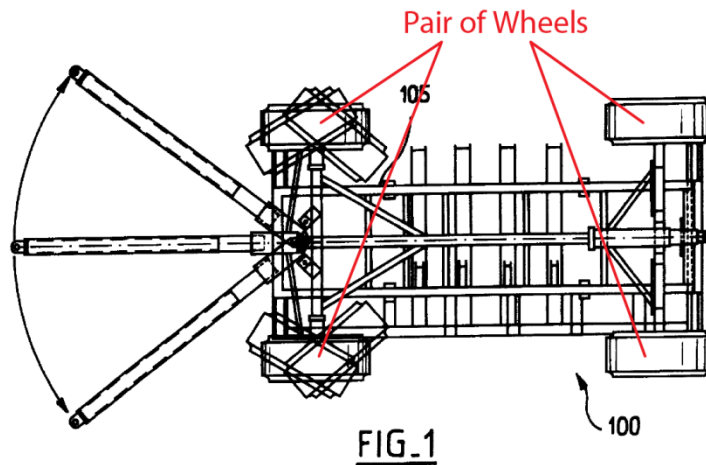
(Ex. 1001 at col. 3, l. 29 – col. 4, l. 34).

30. The Admitted Prior Art Wagon in Fig. 1 and the embodiment of the claimed wagon depicted in Fig. 2 both have elements (a)-(f) of claim 1 as shown in the table below. The only structural difference between the Admitted Prior Art Wagon shown in Fig. 1 and the embodiment of the claimed wagon depicted in Fig. 2 is the “indentations” in the longitudinal frame members, which is element (g) of claim 1.

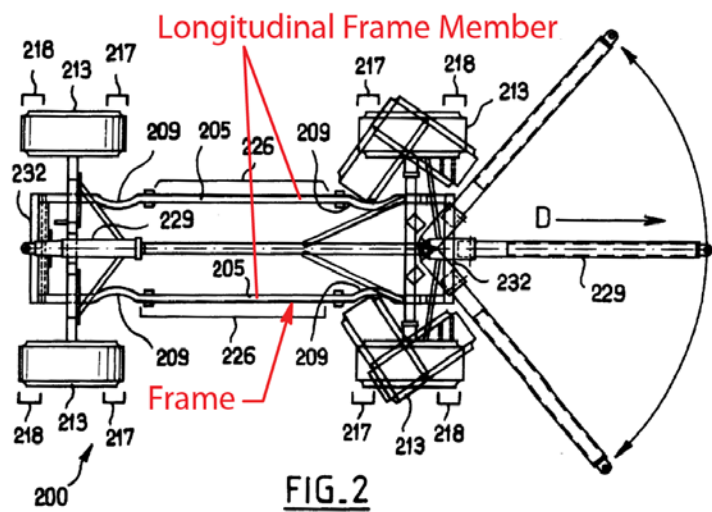
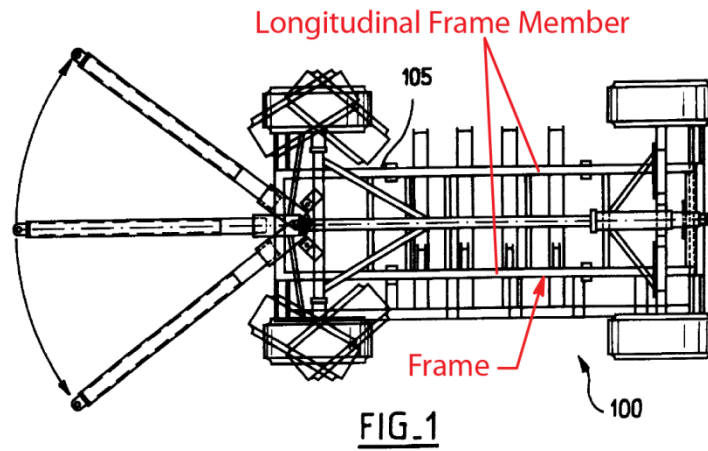
Table 1.

<p>A wagon having two opposed ends and two opposed sides extending between the opposed ends, the wagon further comprising:</p>	
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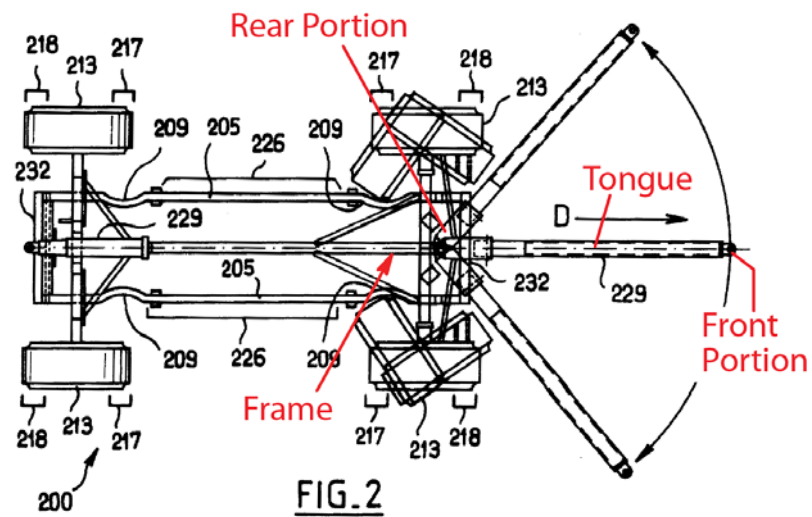
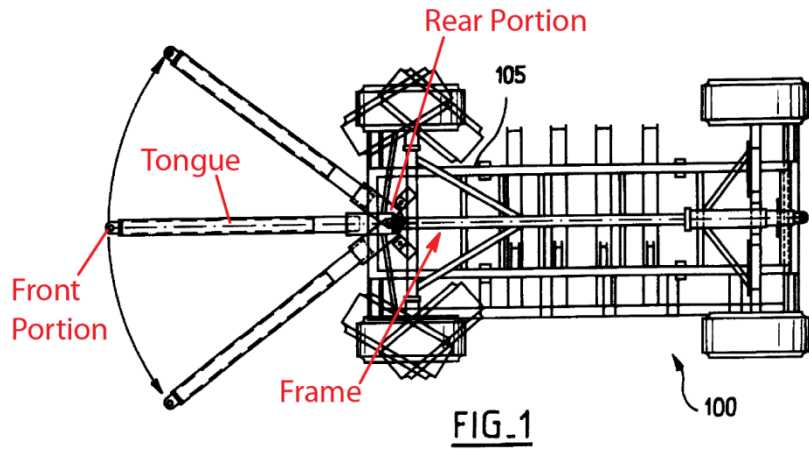
(a) a pair of wheels at each of said opposed ends;



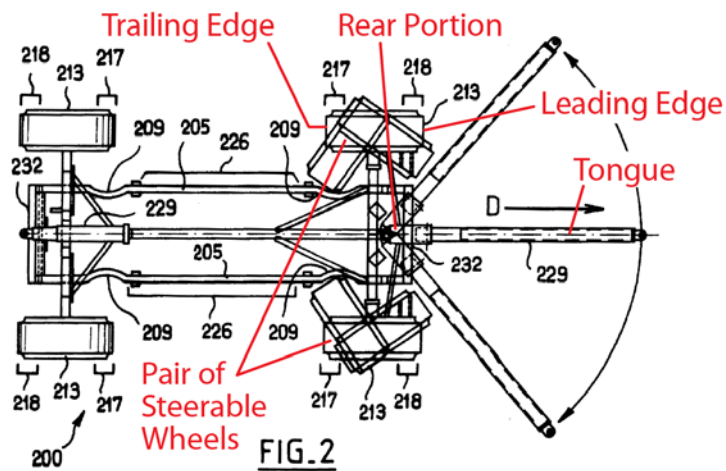
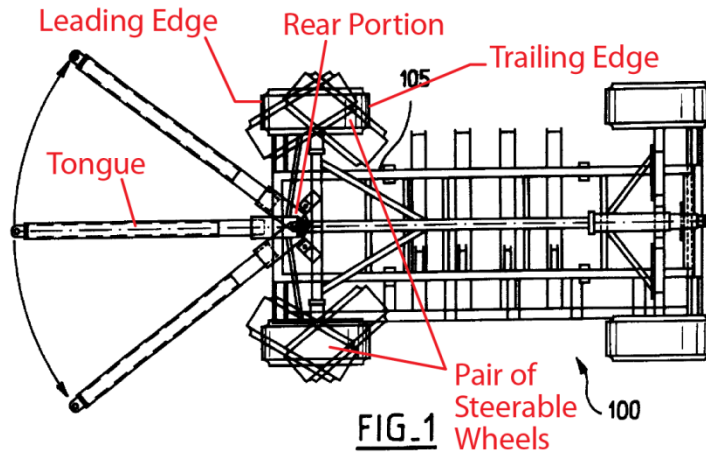
(b) a frame having at least one longitudinal frame member



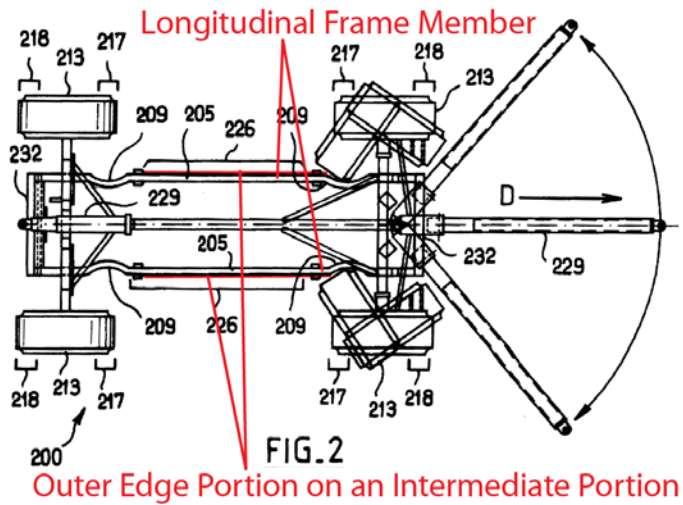
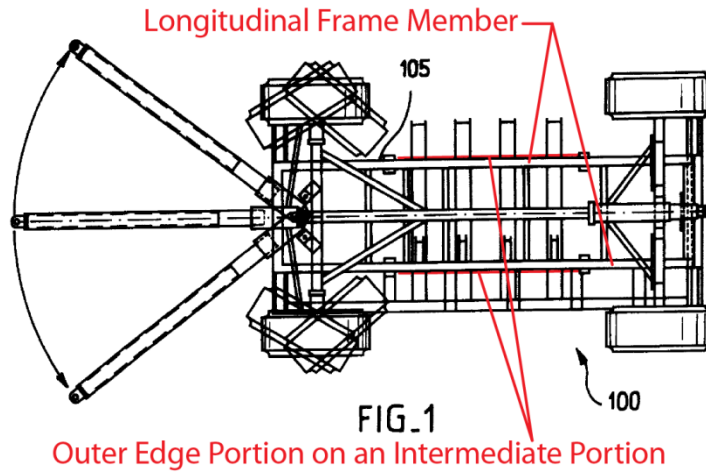
(c) a tongue having a rear portion connected to a frame of said wagon and having a front portion adapted for connection to a vehicle;



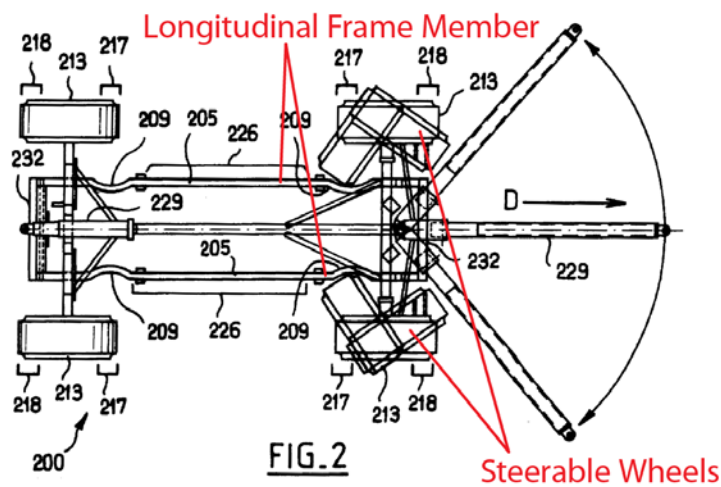
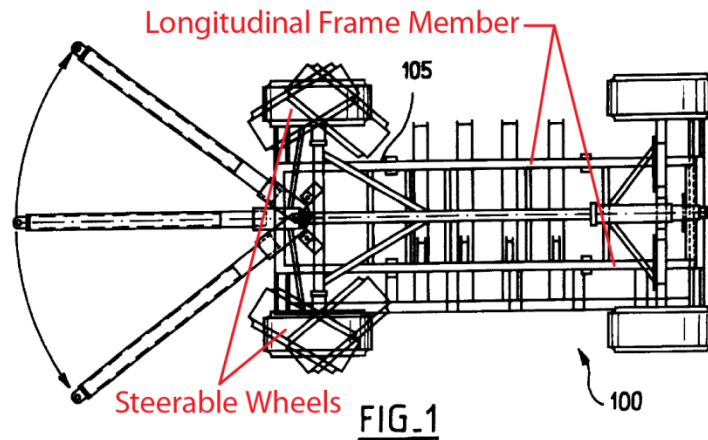
(d) at least one said pair of wheels being steerable to right and left sides and connected to a rear portion of said tongue for steering with said tongue, with a wheel having a leading edge facing toward an end of said wagon and a trailing edge facing toward a central portion of said wagon;



(e) said wagon having a longitudinal frame member on each side, each longitudinal frame member having an outer edge portion on an intermediate portion of said longitudinal frame member; [and]



(f) said steerable wheels being completely outside said longitudinal frame members when said steerable wheels are oriented in a straight running direction[.]



PROSECUTION HISTORY

31. Application Serial No. 09/399,099 (“the ‘099 application”), which issued as the ‘504 patent, was filed on September 20, 1999, claiming priority to Provisional Application No. 60/101,950, which was filed on September 25, 1998. (*See* Ex. 1001).
32. I have reviewed the prosecution history of the ‘099 application. The Examiner allowed the ‘099 application without issuing an Office Action. (*See* Ex. 1012). A telephonic Examiner Interview was conducted on

September 19, 2000, during which the Examiner and a representative for Applicant Unverferth discussed prior art reference GB 2,300,839 to Wheeler (“Wheeler”) and suggested claim amendments that were then reflected in an Examiner Amendment. (Ex. 1012 at 30). The Examiner Amendment to claim 1 consisted of the addition of the phrase “a frame having at least one longitudinal frame member,” amending “connected to a rear portion of a corresponding tongue for steering” to “connected to a rear portion of said tongue for steering with said tongue,” and amending “an intermediate portion of said longitudinal member” to “an intermediate portion of said longitudinal frame member.” (Ex. 1012 at 32; *see also* Ex. 1012 at 18). Following the Examiner Interview, the Examiner issued a Notice of Allowability. (*See* Ex. 1012 at 31). As his Statement of Reasons for Allowance, the Examiner stated: “The limitation of a [sic] <<wheels...connected to a ...tongue for steering with said tongue >> of lines 7 – 9, together with the remaining limitations in claim 1; has not been found in the art.” (Ex. 1012 at 32). The ‘504 patent issued on January 23, 2001. (*See* Ex. 1001).

33. None of the prior art discussed in my declaration was of record during prosecution of the ‘504 patent. It is my opinion that all of the references

cited herein are more relevant and are stronger than the Wheeler reference that was discussed during the Examiner Interview.

LEGAL PRINCIPLES

34. I have been informed that a claim is anticipated when each and every element of the claim is found in a single prior art reference.
35. I have been informed that, even if every element of a claim is not found explicitly or inherently in a single prior art reference, the claim may still be unpatentable if the differences between the claimed elements and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person of ordinary skill in the art. That is, the invention may be obvious to a person of ordinary skill in the art when seen in light of one or more references.
36. I have been informed that a person of ordinary skill in the art can be assumed to have before him/her all of the relevant prior art.
37. I have been informed that a claim is obvious when it is only a combination of old and known elements, with no change in their respective functions, and that these familiar elements are combined according to known methods to obtain predictable results.
38. I have further been informed that some examples of rationales that may support a conclusion of obviousness include:

- Combining prior art elements according to known methods to yield predictable results;
- Simple substitution of one known element for another to obtain predictable results;
- Use of known techniques to improve similar devices (or products) in the same way (*e.g.*, obvious design choices);
- Applying a known technique to a known device (or product) ready for improvement to yield predictable results;
- Choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success—*i.e.*, “obvious to try”;
- Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to the person of ordinary skill in the art; and
- Some teaching, suggestion, or motivation in the prior art that would have led the person of ordinary skill in the art to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

39. I have also been informed that the rationale to combine prior art references can come from a variety of sources, not just the prior art itself or the

specific problem the patentee was trying to solve. And I understand that the references themselves need not provide a specific hint or suggestion of the alteration needed to arrive at the claimed invention; the analysis may include recourse to logic, judgment, and common sense available to the person of ordinary skill that does not necessarily require explanation in any reference.

40. I have been informed that the following four factors are considered when determining whether a patent claim is obvious: (1) the scope and content of the prior art; (2) the differences between the prior art and the claim; (3) the level of ordinary skill in the art; and (4) secondary considerations tending to prove obviousness or nonobviousness.
41. I have also been informed that the courts have established a collection of secondary factors of nonobviousness, which include: unexpected, surprising, or unusual results; prior art that teaches away from the alleged invention; substantially superior results; synergistic results; long-standing need; commercial success; and copying by others. I have further been informed that there must be a connection, or nexus, between these secondary factors and the scope of the claim language.

42. I understand that an invalidity analysis requires first that the claims be construed. After the claims are construed, they are compared to the prior art.
43. I have been advised by counsel that, absent any explicit teaching by the inventor, the ordinary and customary meanings of the terms in the patent are to be applied. Further, I have been informed that the application of the claim term should use the “broadest reasonable interpretation.”

PERSON OF ORDINARY SKILL IN THE ART

44. The ‘504 patent describes a straightforward modification of the longitudinal frame members of the Admitted Prior Art Wagons, consisting of adding indentations to longitudinal frame members to allow improved turning ability, such as decreased turning radius.
45. In my opinion, at the time of the invention, a person of ordinary skill in the art would, therefore, have had a bachelor’s degree in mechanical engineering or a similar technical field and a couple of years experience designing mechanical equipment, or 5-10 years of experience designing wagons.
46. I am an individual of more than ordinary skill in the art. Nevertheless, I have endeavored to perform my analysis as I believe a person of ordinary skill in the art would have done.

INVALIDITY ANALYSIS

Claim Construction

47. In the context of the ‘504 patent, under the standard of the broadest reasonable interpretation, it is my opinion that the person of ordinary skill in the art would understand the term “inwardly oriented indentation” in claim 1 to mean “an inward displacement.”

Ground 1 – Anticipation Based on Nordine

48. Nordine, which was not before the Examiner during prosecution of the application that issued as the ‘504 patent, teaches that indentations in longitudinal frame members are beneficial because they provide a frame for trailers and the like with increased turning ability.⁹ (Ex. 1002 at pg. 1, ll. 1-31). Nordine states:

The invention is a frame for trailers or the like which is provided with indentations in the sides thereof into which the front wheels may extend when turning on a short radius.

The object of the invention is to provide a frame for trailers or the like which is so constructed that the trailer may be turned on a comparatively short radius.

. . .

⁹ Wagons and trailers are comparable products having similar uses and are within the same field of endeavor.

A further object of the invention is to provide a means for reenforcing [sic] a frame for trailers or the like so that indentations may be provided in the sides to permit a short turning radius.

...

With these ends in view the invention embodies a trailer frame having indentations in the sides thereof to clear the wheels when turning on a short radius . . .

(Ex. 1002 at pg. 1, ll. 1-9, 15-19, 25-28).

49. Fig. 1 of Nordine, an annotated version of which is reproduced below, shows the indentations (highlighted) in the longitudinal frame members.

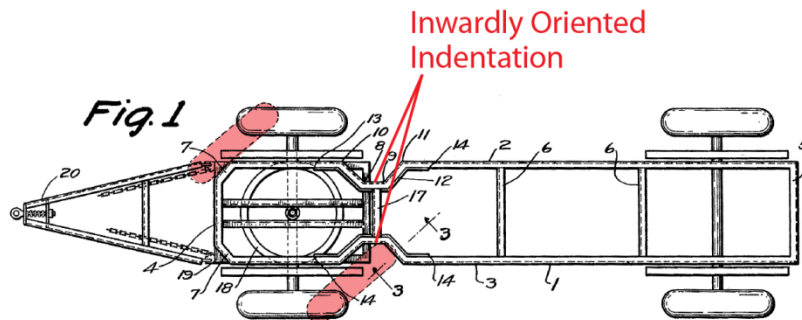


Figure M. Adopted from Nordine (Ex. 1002 at Fig. 1) and annotated.

50. In describing the indentations in the longitudinal frame members, as illustrated in Fig. 1, Nordine states:

The members 2 and 3 are bent inward to the points 8 and 9 between the points 10 and 11. It is understood that these points may be positioned so that the frame will clear a wheel of any suitable design or size and the depth of the indentations may be greater or lesser as may be desired.

(Ex. 1002 at pg. 1, ll. 74-80).

51. In summary, Nordine teaches a frame for trailers and the like having indentations in the longitudinal frame members so that the interference point is displaced inwardly. As such, a trailer or wagon with this frame will have an improved turning capability. The indentations permit a greater turning angle and produce a comparatively smaller minimum turning radius.

52. Nordine teaches all of the elements of claim 1. Nordine teaches:

A wagon (“trailer or the like”) having two opposed ends and two opposed sides extending between the opposed ends (Ex. 1002 at Fig. 1; pg. 1, ll. 1-2, 58-60), including:

- a. a pair of wheels at each of said opposed ends (Ex. 1002 at Fig. 1; pg. 1, ll. 36-37);
- b. a frame having at least one longitudinal frame member (Ex. 1002 at Fig. 1; pg. 1, ll. 55-59);
- c. a tongue having a rear portion connected to a frame of said wagon and having a front portion adapted for connection to a vehicle (Ex. 1002 at Figs. 1 and 2; pg. 2, ll. 21-23);
- d. at least one said pair of wheels being steerable to right and left sides and connected to a rear portion of said tongue for steering with said tongue, with a wheel having a leading edge facing toward an end of said wagon and a trailing edge facing toward a central

portion of said wagon (Ex. 1002 at Fig. 1; pg. 1, ll. 1-5; pg. 2, ll. 25-30);

- e. said wagon having a longitudinal frame member on each side, each longitudinal frame member having an outer edge portion on an intermediate portion of said longitudinal frame member (Ex. 1002 at Figs. 1 and 2; pg. 1, ll. 55-59);
- f. said steerable wheels being completely outside said longitudinal frame members when said steerable wheels are oriented in a straight running direction (Ex. 1002 at Fig. 1); and
- g. each longitudinal frame member including an inwardly oriented indentation adjacent said trailing edge of each corresponding steerable wheel, each said indentation allowing said corresponding steerable wheel to be turned so that said trailing edge of said corresponding steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member. (Ex. 1002 at Fig. 1; pg. 1, ll. 74-80; pg. 2, ll. 44-46).

See also claim chart in Appendix 2.

53. With respect to dependent claim 2, Nordine teaches:

[A] lateral frame member extends across each end of said wagon, with said lateral frame member being positioned adjacent to said leading edge of said steerable wheel wherein said steerable wheel can be turned so that said leading edge of

said steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member.

(Ex. 1002 at Fig. 1; pg. 1, ll. 58-70). *See also* claim chart in Appendix 2.

54. With respect to dependent claim 5, Nordine teaches:

[S]aid indentations in the longitudinal frame members permit a greater turning angle for said pair of wheels than would be obtainable without said indentation.

(Ex. 1002 at Fig. 1; pg. 1, ll. 6-9, 74-80; pg. 2, ll. 44-46). *See also* claim chart in Appendix 2.

55. Because Nordine teaches each and every element of claims 1, 2, and 5 of the ‘504 patent, it is my opinion that Nordine anticipates each of those claims.

Ground 2 – Anticipation Based on Hoobler

56. Hoobler, which was also not before the Examiner during prosecution of the application that issued as the ‘504 patent, is directed to tractor and trailer vehicles.¹⁰ (Ex. 1003 at pg. 1, ll. 1-2). Hoobler identifies steering problems with traditional trailers, especially those with tandem axles. (Ex. 1003 at

¹⁰ As explained above with respect to Nordine, wagons and trailers are comparable products having similar uses and are within the same field of endeavor.

pg. 1, left col., ll. 38-51). Hoobler achieves steering improvements through a self-aligning mechanism that “provides for making turns on a much smaller radius.” (Ex. 1003 at pg. 3, left col., ll. 70-72). The self-aligning mechanism uses a frame that it is “preferably curved or bent inwardly at both sides between the pivot pins 32 and 43, as indicated at 54, to allow sufficient room for turning of the dual wheels.” (Ex. 1003 at pg. 3, left col., ll. 8-13; Figs. 7 and 8). The invention’s frame indentations are clearly visible in Hoobler’s Figs. 7 and 8, annotated versions of which are reproduced below.

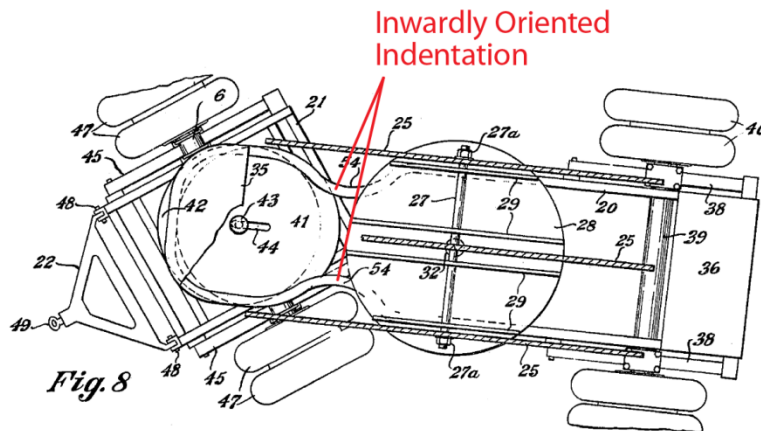
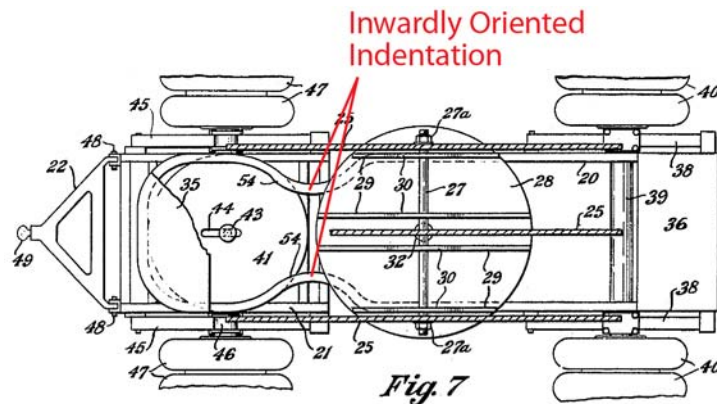


Figure N. Adopted from Hoobler (Ex. 1003 Figs. 7 and 8) and annotated.

57. Hoobler teaches all of the elements of claim 1. Hoobler teaches:

A wagon (trailer) having two opposed ends and two opposed sides extending between the opposed ends (Ex. 1003 at Fig. 7), including:

- a. a pair of wheels at each of said opposed ends (Ex. 1003 at Fig. 7; pg. 2, right col., ll. 34-37, 51-53);
- b. a frame having at least one longitudinal frame member (Ex. 1003 at Fig. 7; pg. 2, left col., ll. 49-50);
- c. a tongue having a rear portion connected to a frame of said wagon and having a front portion adapted for connection to a vehicle (Ex. 1003 at Figs. 4 and 7; pg. 2, left col., ll. 51-55; pg. 2 right col., ll. 60-63);
- d. at least one said pair of wheels being steerable to right and left sides and connected to a rear portion of said tongue for steering with said tongue, with a wheel having a leading edge facing toward an end of said wagon and a trailing edge facing toward a central portion of said wagon (Ex. 1003 at Fig. 8; pg. 3, left col., ll. 62-69; pg. 4, right col., ll. 11-14);
- e. said wagon having a longitudinal frame member on each side, each longitudinal frame member having an outer edge portion on an intermediate portion of said longitudinal frame member (Ex. 1003 at Figs. 4 and 7; pg. 2, left col., ll. 49-50);

- f. said steerable wheels being completely outside said longitudinal frame members when said steerable wheels are oriented in a straight running direction (Ex. 1003 at Fig. 7); and
- g. each longitudinal frame member including an inwardly oriented indentation adjacent said trailing edge of each corresponding steerable wheel, each said indentation allowing said corresponding steerable wheel to be turned so that said trailing edge of said corresponding steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member. (Ex. 1003 at Figs. 7 and 8; pg. 3, left col., ll. 8-13).

See also claim chart in Appendix 2.

58. With respect to dependent claim 2, Hoobler teaches:

[A] lateral frame member extends across each end of said wagon, with said lateral frame member being positioned adjacent to said leading edge of said steerable wheel wherein said steerable wheel can be turned so that said leading edge of said steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member.

(Ex. 1003 at Figs. 4 and 8; pg. 2, right col., ll. 27-29). *See also* claim chart in Appendix 2.

59. With respect to dependent claim 5, Hoobler teaches:

[S]aid indentations in the longitudinal frame members permit a greater turning angle for said pair of wheels than would be obtainable without said indentation.

(Ex. 1003 at Fig. 8; pg. 3, left col., ll. 8-13). *See also* claim chart in Appendix 2.

60. Because Hoobler discloses each and every element of claims 1, 2, and 5 of the '504 patent, it is my opinion that Hoobler anticipates each of those claims.

Ground 3 – Obvious Based on Admitted Prior Art Wagons in View of Nordine

Admitted Prior Art Wagons

61. The '504 patent teaches the basic structure and function of the Admitted Prior Art Wagons. (Ex. 1001 at col. 1, ll. 16-55; col. 2, ll. 34-38; Fig. 1). The Admitted Prior Art Wagons have four wheels, which increases the load capacity and stability of the vehicle. (Ex. 1001 at col. 1, ll. 26-29). The Admitted Prior Art Wagons generally have one pair of wheels that is steerable in unison through the pivoting action of a tongue. (Ex. 1001 at col. 1, ll. 29-37).
62. The Admitted Prior Art Wagons include a frame to which the wheels are mounted. (Ex. 1001 at col. 1, ll. 38-39). The tongue is connected to the steerable wheels through a linkage. (Ex. 1001 at col. 39-41). The Admitted

Prior Art Wagons have the wheels positioned relatively close to the frame because if they are spaced too far from the frame, there will be “excessive” bending loads on the axles. (Ex. 1001 at col. 1, ll. 42-45). With the wheels close to the frame, however, tight turning ability is limited by interference between the frame and the steerable wheels. (Ex. 1001 at col. 1, ll. 51-55). The ‘504 patent identifies a turning problem with conventional wagons as one that cannot be solved by maintaining the width of the frame and increasing the wheel track (*i.e.*, the distance between the wheel and the frame measured from the wheel hub along the axle when in a straight-running direction). (Ex. 1001 at col. 1, ll. 42-45).

63. The Admitted Prior Art Wagons include elements (a)-(f) of claim 1. As set forth in the ‘504 patent, the Admitted Prior Art Wagons have two opposed ends and two opposed sides extending between the opposed ends (Ex. 1001 at Fig. 1; col. 2, l. 34), including:

- a. a pair of wheels at each of said opposed ends (Ex. 1001 at Fig. 1; col. 1, ll. 26-27);
- b. a frame having at least one longitudinal frame member (Ex. 1001 at Fig. 1; col. 1, ll. 38-39; col. 2, ll. 34-36);
- c. a tongue having a rear portion connected to a frame of said wagon and having a front portion adapted for connection to a vehicle (Ex. 1001 at Fig. 1; col. 1, ll. 20-24, 39-40);

- d. at least one said pair of wheels being steerable to right and left sides and connected to a rear portion of said tongue for steering with said tongue, with a wheel having a leading edge facing toward an end of said wagon and a trailing edge facing toward a central portion of said wagon (Ex. 1001 at Fig. 1; col. 1, ll. 39-41);
- e. said wagon having a longitudinal frame member on each side, each longitudinal frame member having an outer edge portion on an intermediate portion of said longitudinal frame member (Ex. 1001 at Fig. 1); [and]
- f. said steerable wheels being completely outside said longitudinal frame members when said steerable wheels are oriented in a straight running direction (Ex. 1001 at Fig. 1; col. 1, ll. 42-43)[.]

See also claim chart at Appendix 2.

64. In summary, the Admitted Prior Art Wagons includes each and every element ((a)-(f)) of claim 1, except for the indentations in the longitudinal frame members (element (g)).

Admitted Prior Art Wagons + Nordine

65. As discussed above, Nordine expressly teaches element (g) of claim 1. (Ex. 1002 at Fig. 1; pg. 1, ll. 74-80; pg. 2, ll. 44-46). In view of the teachings of Nordine, it would have been obvious to the person of ordinary skill in the

art to combine Nordine with the Admitted Prior Art Wagons to achieve a wagon having each of the elements of claims 1, 2, and 5.

66. Nordine expressly teaches: "...a frame for trailers or the like which is provided with indentations in the sides thereof into which the front wheels may extend when turning on a short radius." (Ex. 1002 at pg. 1, ll. 1-5).
67. With respect to claim 1, as explained above, Nordine teaches:
- g. each longitudinal frame member including an inwardly oriented indentation adjacent said trailing edge of each corresponding steerable wheel, each said indentation allowing said corresponding steerable wheel to be turned so that said trailing edge of said corresponding steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member. (Ex. 1002 at Fig. 1; pg. 1, ll. 74-80; pg. 2, ll. 44-46).

See also claim chart in Appendix 2.

68. With respect to dependent claim 2, as explained above, Nordine teaches:
- [A] lateral frame member [that] extends across each end of said wagon, with said lateral frame member being positioned adjacent to said leading edge of said steerable wheel wherein said steerable wheel can be turned so that said leading edge of said steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member.

(Ex. 1002 at Fig. 1; pg. 1, ll. 58-70). *See also* claim chart in Appendix 2.

69. With respect to dependent claim 5, as explained above, Nordine teaches:

[S]aid indentations in the longitudinal frame members permit a greater turning angle for said pair of wheels than would be obtainable without said indentation.

(Ex. 1002 at Fig. 1; pg. 1, ll. 6-9, 74-80; pg. 2, ll. 44-46). *See also* claim chart in Appendix 2.

70. There are at least several reasons why it would have been obvious to the person of ordinary skill in the art to combine Nordine's teaching of indented longitudinal frame members with the Admitted Prior Art Wagons.

71. Inspired by the desire for tighter turning radius expressly disclosed in Nordine and the other prior art described above disclosing indented longitudinal frame members, the person of ordinary skill in the art would have understood how to implement the teaching of Nordine to provide indented longitudinal frame members in the Admitted Prior Art Wagons.

72. First, Nordine provides explicit teachings to increase turning ability of wagons and trailers through indentations in longitudinal frame members:

The invention is a frame for trailers or the like which is provided with indentations in the sides thereof into which the front wheels may extend when turning on a short radius.

The object of the invention is to provide a frame for trailers or the like which is so constructed that the trailer may be turned on a comparatively short radius.

. . .

A further object of the invention is to provide a means for reenforcing [sic] a frame for trailers or the like so that indentations may be provided in the sides to permit a short turning radius.

. . .

With these ends in view the invention embodies a trailer frame having indentations in the sides thereof to clear the wheels when turning on a short radius. . .

(Ex. 1002 at pg. 1, ll. 1-9, 15-19, 25-28).

The members 2 and 3 are bent inward to the points 8 and 9 between the points 10 and 11. It is understood that these points may be positioned so that the frame will clear a wheel of any suitable design or size and the depth of the indentations may be greater or lesser as may be desired.

(Ex. 1002 at pg. 1, ll. 74-80).

73. The Nordine teachings would have led the person of ordinary skill to combine prior art reference teachings of the Admitted Prior Art Wagons and Nordine to arrive at the invention claimed in claims 1, 2, and 5 of the '504 patent.
74. Second, the known indentations in the longitudinal frame members of Nordine could have been applied to the Admitted Prior Art Wagons in the

same way as found in Nordine to achieve the identical, explicit turning goals of Nordine.

75. Third, the person of ordinary skill in the art would have combined the indentations in the longitudinal frame members of Nordine with the Admitted Prior Art Wagons because there were a limited number of predictable solutions to the limitation of turning angle created by interference of the wheel and a longitudinal frame member. There were (and are) two potential solutions to this problem: (1) moving the interfering wheel outwardly, or (2) indenting the interfering frame member inwardly.
76. The person of ordinary skill in the art would have recognized the first potential solution to be unattractive. Moving the interfering wheel outwardly necessarily incurs penalties in manufacturing cost and complexity. In fact, the '504 patent acknowledges the disadvantages of the first potential solution:

The wheels and corresponding axles extend beyond the frame, but are positioned relatively near to the frame. This is because if the wheels extend far beyond the frame excessive bending loads would be imposed on the axles, with possible breakage occurring as a result of heavy loads or due to traveling over rough roads or rough ground.

(Ex. 1001 at col. 1, ll. 43-47).

77. As to the second potential solution, moving a portion of the interfering longitudinal frame member inwardly does not require changes to the steering linkage, axle, or other existing turning mechanism(s) and avoids the expressed disadvantage of the first potential solution.
78. Therefore, the person of ordinary skill in the art would have recognized a finite number of identified, predictable solutions and a reasonable expectation of success with respect to the second potential solution .
79. With the person of ordinary skill in the art's knowledge of the field, it would have been obvious to try combining the indentations in the longitudinal frame members of Nordine with the Admitted Prior Art Wagons to locally reduce interference between the wheels and longitudinal frame members, without increasing the wheel tracks of the Admitted Prior Art Wagons.
80. Fourth, it would have been a simple substitution of the known longitudinal frame members with indentations of Nordine for the straight longitudinal frame members of the Admitted Prior Art Wagons to obtain the predictable result of increased turning ability. It would have been a straightforward substitution to swap the indented geometry of the frame members of Nordine with the straight geometry of the frame members in the Admitted Prior Art Wagons. The simplicity of this substitution resides in the fact that

only the local area adjacent the trailing edge of the wheel needs to be inwardly indented or displaced. Furthermore, the results of the substitution were foreseeable and predictably result in increased wheel clearance and turning ability as a result of the change in frame geometry. There is nothing unpredictable in the result of this particular substitution.

81. Fifth, it would have been an obvious design choice to improve the Admitted Prior Art Wagons by including the known indentations in the longitudinal frame members of Nordine. Nordine implements longitudinal frame members with indentations on a vehicle that is pulled by another vehicle. (Ex. 1002 at pg. 2, ll. 18-23). Nordine expressly describes the frame for a “trailer or the like.” (Ex. 1002 at pg. 1, ll. 1-2). Therefore, Nordine discloses vehicles that are similar to the Admitted Prior Art Wagons. For example, both are pulled by another vehicle, both have two sets of wheels, and both serve as the base for transporting materials over land. (Ex. 1002 at pg. 2, ll. 18-23, 30-35; Fig. 1; Ex. 1001 at col. 1, ll. 16-25). The known technique of Nordine explicitly addresses improved turning radius through indentations in longitudinal frame members. (Ex. 1002 at pg. 1, ll. 1-9, 15-19, 25-28; pg. 1, ll. 74-80). As such, Nordine provides an obvious design choice to improve the turning ability of the Admitted Prior Art Wagons.

82. In addition, Gobel, Kataue, and Wright (discussed above) each teach that indented longitudinal frame members can be used to achieve an increase in turning ability. These sources were all available to the person of ordinary skill in the art during the relevant time period and would have provided additional motivation to combine the indented longitudinal frame members of Nordine with the Admitted Prior Art Wagons in order to increase turning ability.
83. For these reasons, it is my opinion that each of claims 1, 2, and 5 of the '504 patent would have been obvious to the person of ordinary skill in the art over the Admitted Prior Art Wagons in view of Nordine.

Ground 4 – Obvious Based on Admitted Prior Art Wagons in View of Hoobler

Admitted Prior Art Wagons + Hoobler

84. As discussed above, the Admitted Prior Art Wagons include all elements of claim 1, except for the indentations in the longitudinal frame members. In view of the teachings of Hoobler, it would have been obvious to the person of ordinary skill in the art to combine Hoobler with the Admitted Prior Art Wagons to achieve a wagon having each of the elements of claims 1, 2, and 5.

85. Hoobler expressly teaches “...frame [20] is preferably curved or bent inwardly at both sides...to allow sufficient room for turning of the dual wheels...” (Ex. 1003 at pg. 3, left col., ll. 8-13; Figs. 7 and 8).

86. With respect to claim 1, as explained above, Hoobler teaches:

- g. each longitudinal frame member including an inwardly oriented indentation adjacent said trailing edge of each corresponding steerable wheel, each said indentation allowing said corresponding steerable wheel to be turned so that said trailing edge of said corresponding steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member.

(Ex. 1003 at Figs. 7 and 8; pg. 3, left col., ll. 8-13). *See also* claim chart in Appendix 2.

87. With respect to dependent claim 2, as explained above, Hoobler teaches:

- [A] lateral frame member [that] extends across each end of said wagon, with said lateral frame member being positioned adjacent to said leading edge of said steerable wheel wherein said steerable wheel can be turned so that said leading edge of said steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member.

(Ex. 1003 at Figs. 4 and 8; pg. 2, right col., ll. 27-29). *See also* claim chart in Appendix 2.

88. With respect to dependent claim 5, as explained above, Hoobler teaches:

[S]aid indentations in the longitudinal frame members permit a greater turning angle for said pair of wheels than would be obtainable without said indentation.

(Ex. 1003 at Fig. 8; pg. 3, left col., ll. 8-13). *See also* claim chart in Appendix 2.

89. There are several reasons why it would have been obvious to the person of ordinary skill in the art to combine Hoobler's teaching of indentations in the longitudinal frame members with the Admitted Prior Art Wagons.

90. Inspired by the desire for tighter turning radius expressly disclosed in Hoobler and the other prior art described above disclosing indentations in longitudinal frame members, the person of ordinary skill in the art would have understood how to implement the teaching of Hoobler to provide indentations in the longitudinal frame members in the Admitted Prior Art Wagons.

91. First, Hoobler provides explicit teachings to increase turning ability of towed trailers through indentations in longitudinal frame members. (Ex. 1003 at pg. 3, left col., ll. 8-13; Figs. 7 and 8). These teachings would have led the person of ordinary skill to combine prior the Admitted Prior Art Wagons and Hoobler to arrive at the invention claimed in claims 1, 2, and 5 of the '504 patent.

92. Second, the known indentations in the longitudinal frame members of Hoobler could have been applied to the Admitted Prior Art Wagons in the same way as found in Hoobler to achieve the identical, explicit turning goals of Hoobler.
93. Third, the person of ordinary skill in the art would have combined the indentations in the longitudinal frame members of Hoobler with the Admitted Prior Art Wagons because there were a limited number of predictable solutions to the limitation of turning angle created by interference of the wheel and a longitudinal frame member. There were (and are) two potential solutions to this problem: (1) moving the interfering wheel outwardly, or (2) indenting the interfering frame member inwardly.
94. The person of ordinary skill in the art would have recognized the first potential solution to be unattractive. Moving the interfering wheel outwardly necessarily incurs penalties in manufacturing cost and complexity. In fact, the '504 patent acknowledges the disadvantages of the first potential solution:

The wheels and corresponding axles extend beyond the frame, but are positioned relatively near to the frame. This is because if the wheels extend far beyond the frame excessive bending loads would be imposed on the axles, with possible breakage

occurring as a result of heavy loads or due to traveling over rough roads or rough ground.

(Ex. 1001 at col. 1, ll. 43-47).

95. As to the second potential solution, moving a portion of the interfering longitudinal frame member inwardly does not require changes to the steering linkage, axle, or other existing turning mechanism(s) and avoids the expressed disadvantage of the first potential solution.
96. Therefore, the person of ordinary skill in the art would have recognized a finite number of identified, predictable solutions and a reasonable expectation of success with respect to the second potential solution.
97. With the person of ordinary skill in the art's knowledge of the field, it would have been obvious to try combining the indentations in the longitudinal frame members of Hoobler with the Admitted Prior Art Wagons to locally reduce interference between the wheels and longitudinal frame members without increasing the wheel tracks of the Admitted Prior Art Wagons.
98. Fourth, it would have been a simple substitution of the known longitudinal frame members with indentations of Hoobler for the straight longitudinal frame members of the Admitted Prior Art Wagons to obtain the predictable result of increased turning ability. It would have been a straightforward substitution to swap the indented geometry of the frame members of

Hoobler with the straight geometry of the frame members in the Admitted Prior Art Wagons. The simplicity of this substitution resides in the fact that only the local area adjacent the trailing edge of the wheel needs to be inwardly indented or displaced. Furthermore, the results of the substitution were foreseeable and predictably resulted in increased wheel clearance and turning ability as a result of the change in frame geometry. There is nothing unpredictable in the result of this particular substitution.

99. Fifth, it would have been an obvious design choice to improve the Admitted Prior Art Wagons by including the known longitudinal frame members with indentations of Hoobler. Hoobler implements indentations of longitudinal frame members on a vehicle that is pulled by another vehicle. (Ex. 1003 at pg. 1, left col., ll. 1-2; pg. 2, left col., ll. 49-57; Figs. 3 and 8). Therefore, Hoobler discloses vehicles that are similar to the Admitted Prior Art Wagons. For example, both are pulled by another vehicle, both have two sets of wheels, and both serve as the base for transporting materials over land. (Ex. 1003 at pg. 1, left col., ll. 1-2; pg. 2, left col., ll. 49-57; Figs. 3 and 8; Ex. 1001 at col. 1, ll. 16-25). The known technique of Hoobler explicitly addresses improved turning radius through indentations in longitudinal frame members. (Ex. 1003 at pg. 3, left col., ll. 8-13; Figs. 7

and 8). As such, Hoobler provides an obvious design choice to improve the turning ability of the Admitted Prior Art Wagons.

100. In addition, Gobel, Kataue, and Wright each teach that indented longitudinal frame members can be used to achieve an increase in turning ability. These sources were all available to the person of ordinary skill in the art during the relevant time period and would have provided additional motivation to combine the indented longitudinal frame members of Nordine with the Admitted Prior Art Wagons in order to increase turning ability.
101. For these reasons, it is my opinion that each of claims 1, 2, and 5 of the ‘504 patent would have been obvious to the person of ordinary skill in the art over the Admitted Prior Art Wagons in view of Hoobler.

CONCLUSION

102. For the reasons explained above, it is my opinion that Nordine and Hoobler disclose each and every element of claims 1, 2, and 5 of the ‘504 patent, and therefore anticipate those claims.
103. For the reasons explained above, it is my opinion the Admitted Prior Art Wagons in combination with either Nordine or Hoobler, render claims 1, 2, and 5 of the ‘504 patent obvious.
104. I reserve the right to supplement or revise this declaration based on any additional information that may become available to me in this matter.

105. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information or 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.

Date: October 22, 2015

A handwritten signature in black ink, appearing to read "Albert Karvelis", written over a horizontal line.

Albert Karvelis Ph.D., P.E.

APPENDIX 1



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Professional Profile

Dr. Albert V. Karvelis is a Principal Engineer in Exponent's Mechanical Engineering practice. His practice area for 40 years has been machinery and manufacturing. This includes all aspects of machinery, from R&D and intellectual property through design, manufacturing, safety/risk assessment, test, failure analysis, and performance assessment. His practice areas include mechanical power transmission, machine design, vibration and acoustics; failure analysis of machinery; fluid dynamics and fluid machinery.

Dr. Karvelis has been employed as an Engineer, Engineering Manager and Vice President, and Consultant in a wide variety of industries, including HVAC (Trane Company), nuclear and fossil power (Babcock & Wilcox), aerospace (US Navy), automotive components, petrochemicals, and materials processing (Borg Warner). He has participated or led design teams in the design/test/analysis of products such as valves, pumps (Byron Jackson & Centralift), fans/compressors (TLT Babcock, Emerson), power transmission systems and components (Borg Warner Corporation, Borg Warner Chemicals, Morse Chain, Wells Fargo & York International), automated assembly/fabrication machinery, medical devices, sensors, and consumer products. While at Packer Engineering, he served as head of the Machinery and Manufacturing consulting division and led the Intellectual Property practice area.

For over 20 years, Dr. Karvelis has been active in and held leadership positions within the American Society of Mechanical Engineers, in the Design Engineering Division and the Codes & Standards Division. In 1996, he was Chair of the ASME 7th International Power Transmission and Gearing Conference and co-editor of the Proceedings. He has also been appointed to serve on the ANSI Standards committees for: ANSI B11.0 (2010) Safety of Machinery –General Requirements and Risk Assessment; ANSI B11.19 (2010) Performance Criteria for Safeguarding

As Adjunct Professor of Mechanical Engineering, he has taught graduate courses in fatigue, fracture mechanics, and vibration, and has lectured on ethics and safety in design for over 15 years. Dr. Karvelis also co-authored a chapter on ergonomics and workplace in the recently published McGraw-Hill Manufacturing Engineering Handbook.

Dr. Karvelis was elected to the rank of ASME Fellow in 2008. The American Society of Mechanical Engineers Fellow Grade is recognition of significant engineering achievements and contributions to the engineering profession.

Dr. Karvelis has testified in State and Federal Courts as a mechanical engineering expert in matters involving intellectual property and machine design and performance issues, and has served as a court-appointed neutral party in binding arbitration of complex machinery performance.

09/13

Academic Credentials and Professional Honors

Ph.D., Engineering Acoustics, Pennsylvania State University, 1975
M.S.E., Aerospace Engineering, University of Michigan, 1967
B.S.E., Aerospace Engineering, University of Michigan, 1966

Fellow, American Society of Mechanical Engineers, Elected 2008
NASA Fellow, Penn State University, Mechanical Engineering Department, 1970–1973
Elected to Honorary Sigma Xi Research Society 1973

Licenses and Certifications

Licensed Professional Engineer, Connecticut, #24271
Licensed Professional Engineer, Florida, #62164
Licensed Professional Engineer, Illinois, #062-050540
Licensed Professional Engineer, Michigan, #6201051092
Licensed Professional Engineer, Wisconsin, #36728-006

Languages

Lithuanian

Text Book

Curry DG, Karvelis AV. Ergonomics. Chapter 58, pp. 58.1–58.40. In: Manufacturing Engineering Handbook. Geng H (ed), New York: McGraw-Hill, June 2004.

Publications and Recent Presentations

Karvelis A. Designing around a patent—What every engineer should know. American Society of Mechanical Engineers International Short Course, January 7, 2011.

Karvelis A (ed). Proceedings, 7th International Power Transmission and Gearing Conference, 1996.

Karvelis A. A contextual analysis of the effectiveness of backup alarms. Proceedings, 14th International System Safety, August 12–17, 1996.

Karvelis A. Self-locking worm gears: Fact or fiction? Power Transmission Design, March 1996.

Karvelis A. Computer aided 3-D surface reconstruction during high speed crush events. SAE Special Publication SP-851, Technical Paper No. 910320, February 1991.

Karvelis A, Liubinskas A, Anderson C. 3-D coordinate reconstruction of high speed mechanically dynamic experiments. Presented at Image Acquisition & 10 Image Processing of Optical Engineering Midwest Conference, September 27–28, 1990.

Karvelis A (ed). Advanced topics in vibration. In: ASME Publication DE-Vol. 8, 1988.

Karvelis A. A systems approach to reducing gear rattle. SAE Technical Paper 870396, presented at SAE Congress, February 1987.

Karvelis A, Lapple W. Fluid dynamic forces in an atmospheric fluidized bed combustor. Proceedings, Fluid Mechanics of Combustion Systems, ASME, June 1981.

Karvelis A, Minoofar D. Practical considerations in noise testing of quiet valves. Proceedings, INTERNOISE-80 December 1980.

Karvelis A, Reethof G. A cross-correlation technique for investigating internal flow noise. Proceedings, ASME Noise & Fluids Engineering, November 1977.

Karvelis A, Reethof G. Valve Noise research using internal wall pressure fluctuations. Proceedings, INTERNOISE-74, 1974.

Karvelis A, Reethof G. Internal wall pressure field studies downstream from orificial-type valves. Instrument Society of America, Paper 74-827, 1974.

Reports

Karvelis A, Campbell K. Pressure delivery device for Meniere's disease. Report to Public Health Service, National Institute of Health, National Institute of Deafness and Other Communication Disorders, November 9, 1993.

Karvelis A, Raj D, *et al.* Acoustic monitoring of nuclear safety and relief valves. EPRI Final Report No. 3332, December 1983.

Olszewski JS, Anthony JM. Development of sensors and instrumentation for the TMI-2 OTSG Tube Vibration Measurements program. NP-1875 EPRI Research Project S140-1, June 1981.

Prior Experience

Senior Vice President, Packer Engineering, 2001–2008

Vice President, Packer Engineering, 1989–2001

Manager, Engineering Mechanics, Borg Warner Corporation, 1982–1988 (Responsible for Fluid-Thermal Group, Stress Analysis Group, Machinery Design Technology Group, Transmission Group)

Senior Research Engineer, Group Supervisor, Babcock & Wilcox Research Center, Mechanical Engineering Laboratory, 1977–1982

Research Engineer, The Trane Company, 1975–1977

Albert V. Karvelis, Ph.D., P.E.

Page 3
09/13

The logo consists of the letters 'EX' in a stylized, bold, serif font. The 'E' and 'X' are connected, with the 'X' having a small trademark symbol (TM) to its upper right.

Executive Officer-USNR-R, Intellectual Property Auditor, Department of the Navy, Office of Naval Research Reserve Unit 4-4, 1970–1975
Various Positions, U.S. Navy, Naval Air Systems Command, including tour as Senior Project Officer at Headquarters, Propulsion Division, 1967–1970 and student naval aviator

Project Experience

(Sample Projects as Principal Investigator/Manager)

Design, test, and installation of electromechanical mechanisms and sensors in: Mach 8 wind tunnel, nuclear reactor steam generator. Directed development of laser Doppler enabled *in-situ* fluid flow measurement technology in automotive torque converters. Led the design and development of a commercial high-speed die-cut and foil-transfer machine for paper-converting application.

Directed or participated in independent mechanical design reviews and/or safety reviews of: cookware, control and pressure relief valves, power boilers, hospital lifts, home elevators, aluminum ingot portable plant (casting and machining), steel fabrication equipment, Mars Lander deployer mechanism, automated remote maintenance systems, electric motor bearings, road milling machines, infant walkers, crop converter, and others.

Performed failure analysis of a pharmaceutical production system equipment, ranging from initial formulation through packaging, transport, re-processing, re-packaging and inspection. Failure analysis also performed on Medium Density Fiberboard production line equipment failures.

Design of test facilities and execution of valve testing ranging from 1 cc/min gas flow simulation in silicon chip manufacturing to 1 million lbs /hour steam blowdown testing for nuclear PRV valves for post-Three Mile Island evaluations. Other testing has included accelerated life testing for high temperature liquid control valves.

Principal Investigator on a National Institutes of Health SBIR development of a portable pressure devices for alleviating the symptoms of Menier's Disease. Also performed independent mechanical and electrical design review for open MRI production version prior to commercial release. Developed reduction-to-practice process for infant heart-lung equipment and key design improvements for a miniaturized portable oxygen concentrator for patients.

Numerous failure and product recall investigations of industrial products such as valves, milling machines, hydraulic mobile cranes, windmill gearboxes, truck components, air compressors, and HVAC fire/smoke dampers crankshafts. Studies for product recall include consumer products such as infant toys and furniture, and boat transmissions, , and kitchen appliances.

Patent/trade secret projects: design-around patented technology for rail car components; reduction to practice for medical devices, infringement analysis; validity analysis for paper converting machinery, valves, and gas delivery systems, including trial testimony. Trained by

the Office of Naval Research in 1970, later served on the Corporate Patent Committee at Borg Warner Corporation.

Led the design/NRC qualification /build and install of vibration sensors for nuclear steam generator monitoring at Duke Power and GPU (Three Mile Island II). At Oconee Unit II, the team installed the sensors during a fuel outage in a radioactive environment requiring special safety procedures and equipment.

Directed the development of finite difference based fluid flow modeling for internal flows for US Navy Nuclear Fuels Program. Validation of code through closed form solutions of potential flow and experiments data on backward facing steps.

Appointed by the Wisconsin court to serve as the neutral member in a three person panel of experts in a mandatory arbitration involving an automated welding assembly line machine for car/truck frames. The dispute dealt not only with contract performance issues but also design and manufacturing practices.

Responsible for directing multi-disciplinary teams of OEM (GM, Ford, Chrysler, Subaru) in solving driveline problems associated with clutches and transmissions interacting with vehicle suspension. The transmission component design group, while under his supervision, was responsible for over 51 patent disclosure submittals filed with the USPTO. Improvements to manual transmissions, continuously variable and automatic transmissions as torque converter design were the focus of many of the patents.

In recognition for his contributions and expertise in machinery design and also in machine safety, Dr. Karvelis was appointed/elected by ASME to serve on both the ANSI/ASME B15.1 Safety Standard – Power Transmission committee and the ASME Design Engineering Division Technical Committee on Power Transmission and Gearing, as well as the ASME Design Engineering Division Design Education Committee. The Association for Manufacturing Technology has also recognized his contributions and expertise and appointed him Chair of the ANSI/AMT Safety Standard- B11.10 Metal Saws.

Academic Appointments

- Staff Faculty Member, Department of Mechanical Engineering, Pennsylvania State University, 1974–1975
- Adjunct Professor of Mechanical Engineering, Northern Illinois, 1986–1989
- Lecturer, Northern Illinois University, Department of Mechanical Engineering, 1990–2004 – Senior Mechanical Engineering Design Course
- Lecturer on “Safety and Ethics in Design & Philosophical Underpinnings of Engineering Ethics,” Northwestern University, 2005; Purdue University Mechanical Engineering Department Seminar on Design, 1984

Advisory Appointments

- US National Renewable Energy Laboratory (NREL) – US Department of Energy (DOE) Advanced Drivetrain Workshop Panel for Wind Turbine Technology, NREL, Denver, CO, June 2010
- Industrial Advisory Board, Northern Illinois University, Department of Mechanical Engineering, 2002–present
- Western Society of Engineers, Board of Directors/Trustee, 2003–2007
- Ohio State Gear Dynamics Laboratory, 1983–1989
- Purdue University, Herrick Labs Industrial Advisory Board, 1983–1987
- University of Iowa, Department of Mechanical Engineering, 1984–1987
- American Institute of Physics, Advisory Board Reviewer, 1972–1975

Peer Reviewer

- *ASME Journal of Mechanical Design*

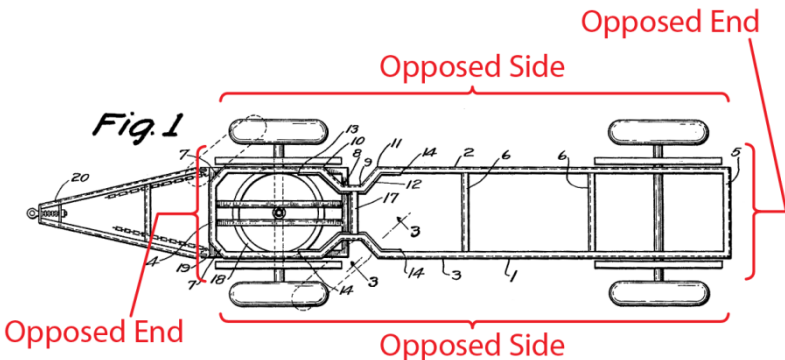
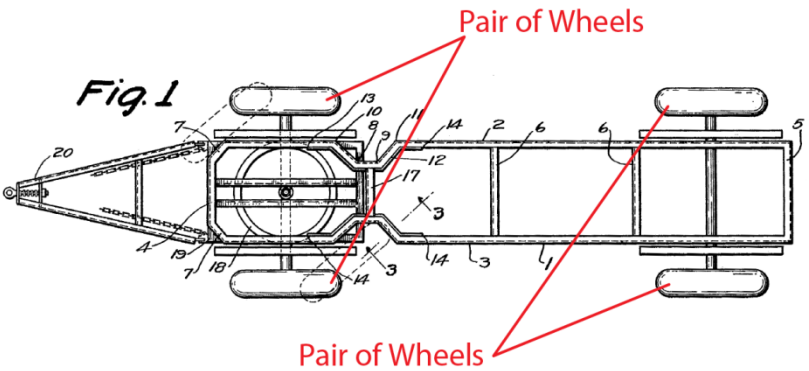
Professional Affiliations

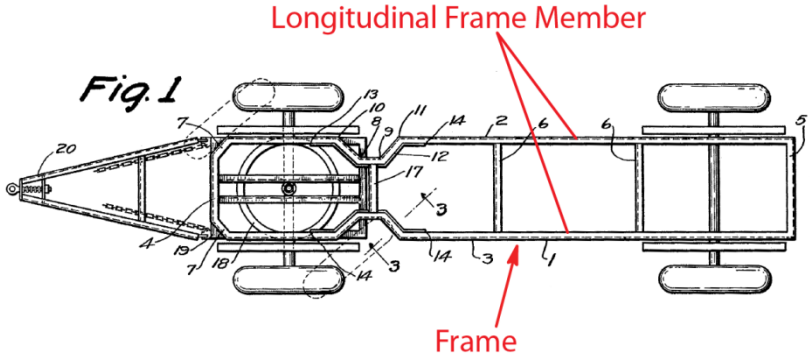
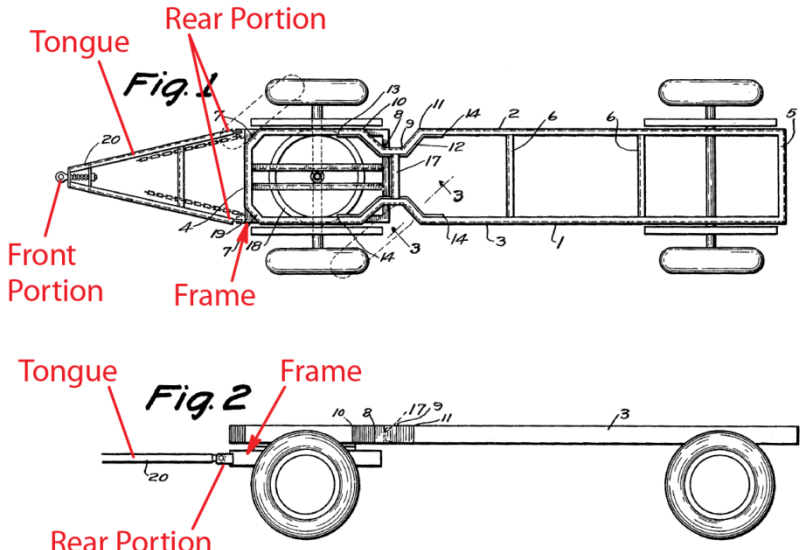
- Session Organizer & Technical Papers Reviewer ASME 2013 Power Transmission and Gearing Conference (PTG) – International Design Engineering Technical Conferences
- International Standards Organization (ISO) – US/ANSI Registered Representative ISO/TC 39/SC 10/WG 6 – Machinery Safety American National Standard ANSI B11.10 “Safety of Machinery-General Requirements and Risk Assessment,” Issued December 2, 2010, Standard Developer/Committee Member
- ASME Design Engineering Division – Design Engineering Education Committee – Treasurer, Peer Review Journal Articles, 2008
- Session Organizer – Papers Reviewer: ASME 7th Symposium on International Design and Design Education- Best Practices in Design and Design Education – Montreal Canada
- Association for Manufacturing Technology- Subcommittee Machinery Safety Standard B11.19 Revision 2010
- ASME International Design Engineering Technical Conference/ IDETC/CIE 2009 – Technical Papers Review Coordinator, Paper Reviewer
- ASME Power Transmission & Gearing Technical Committee, Member 1985–present; Chairman 1992–1996
- Association for Manufacturing Technology (AMT) – ANSI B11.10 Safety Metal Saws Subcommittee Chair
- ASME International Design Engineering Technical Conferences, Session Organizer, Paper Reviewer, Las Vegas, NV, 2007
- HFES 51st Annual Meeting, Papers Reviewer, Assigned Co-Chair Warning Session, Baltimore, MD, 2007
- ASME International Design Engineering Technical Conferences, Session Organizer, Paper Reviewer, Long Beach, CA, 2005
- Western Society of Engineers (WSE) Board of Directors, Trustee, 2004–2008

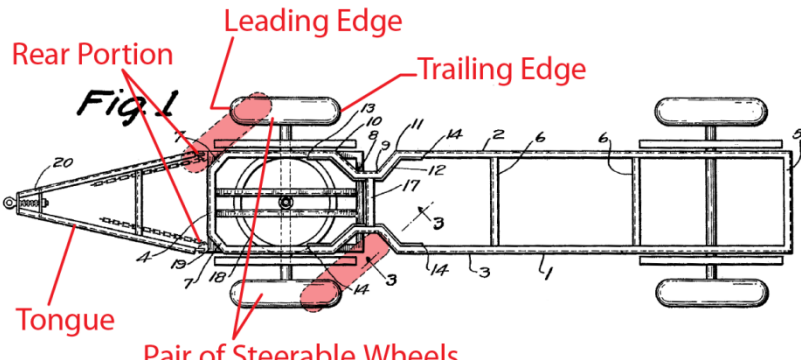
- ASME Design Engineering Technical Conference, Paper Reviewer, Session Chair, Chicago, IL, 2003
- ASME Design Engineering Technical Conference, Paper Reviewer, Session Chair, Montreal, Quebec, 2002
- ASME Design Engineering Technical Conference 2000 Session Organizer, Technical Session Chair, Baltimore, MD, 2000
- Human Factors Society Technical Programs Committee Annual Conference, 1998
- Chair, ASME 7th International Power Transmission and Gearing Conference, San Diego, CA, 1996
- American Society of Mechanical Engineers – 6th International Power Transmission and Gearing Conference, Session Chairman, “Transmissions,” 1992
- SAE International Congress & Exposition, Session Chairperson, “Side Impact Occupant Protection Technologies,” 1991
- U.S. Small Business Administration – Small Business Innovation Research Program, Invited Speaker, “Small Business R & D – The Not So Obvious Benefits”
- Society of Automotive Engineers Personal Watercraft Safety Committee, 1990–1991
- American Society of Mechanical Engineers 5th International Power Transmission and Gearing Conference, Session Organizer and Session Chair, San Diego CA, 1989
- Industrial Research Exposition/Conference, Session Chairman, “Recent Trends in Mechanical Design,” September 1989, Chicago, IL
- Industrial Research Exposition/Conference, Organizer/Session Chair, “Recent Trends in Mechanical Design – Coordinating Design with Manufacturing,” September 1989, Chicago, IL, 1989
- American Society of Mechanical Engineers Design Technology Conference, Session Organizer, “Micro-Computer Applications in Vibrations,” Proceedings Editor, 1987
- Department of Mechanical Engineering, Purdue University; Pennsylvania State University, Invited Speaker, “Industrial Engineering Practice,” 1986
- Mechanical Failures Prevention Group (sponsored by Office of Naval Research & National Bureau of Standards), Reliability and Maintainability Conference, Naval Air Test Center, Session Chairman, “Wear Monitoring,” 1986
- American Society of Mechanical Engineers Design Division, Technical Committee on Sound and Vibration, 1980–1984; Vice Chairman, 1982–1984
- NBS/U.S. Navy, Mechanical Failures Prevention Group, Committee Member, 1984–1987
- American Society of Mechanical Engineers 4th International Conference on Power Transmission, Session Chairman, 1984
- Mechanical Failures Prevention Group Conference, Session Chairman, “Artificial Intelligence, Diagnostics,” Gaithersburg, MD
- Acoustical Society of America, S-4 Standards Committee Member, 1982–1984
- American Society of Mechanical Engineers Design Engineering Conference, Session Organizer and Chairman of Session 3.1, “Integrating Dynamic Testing into the Design and Development Cycle” Boston MA, 1981
- American Society of Mechanical Engineers Design Engineering Conference, Organizer and Chairman, “Signal Processing” Session, 1980

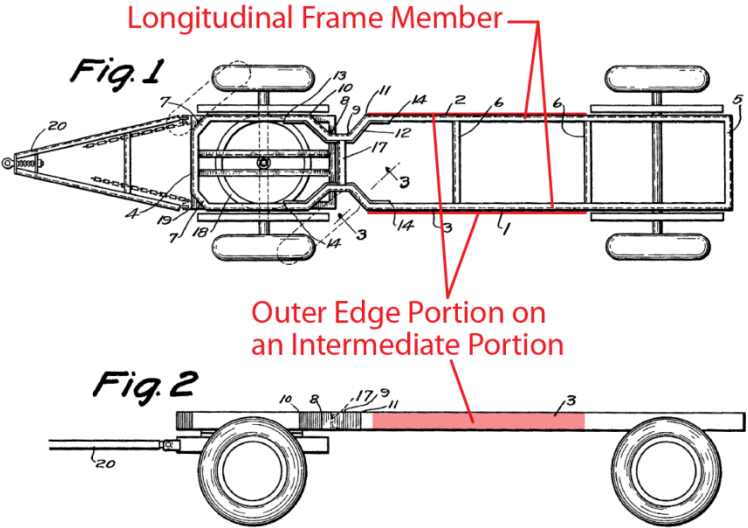
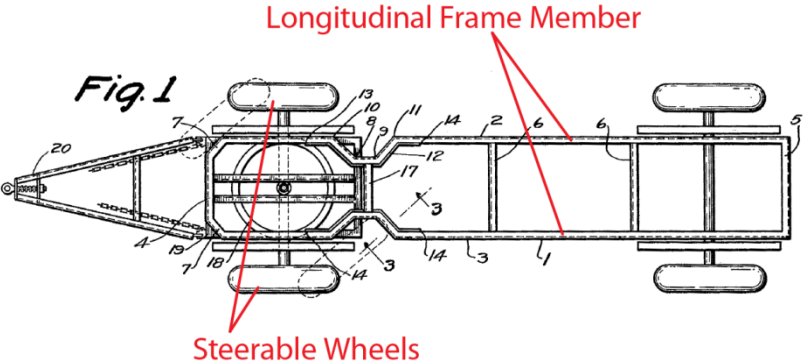
- OAI Digital Time Series Analysis Short Course, Lecturer, “Quality Assurance and Computer Software,” Santa Clara, CA
- Instrument Society of America, Standards and Practices Committee: SP-79, Control Valve Noise Measurement and Prediction, 1972–1976
- American Institute of Physics Advisory Panel on Publishing, 1972–1975
- Executive Officer, Office of Naval Research Reserve Unit 4-4, State College, PA, 1970–1975
- Summer Active Duty 1972–1973: Chicago ONR Office Technical Audit of ONR-sponsored research at Mid-West Universities
- Pentagon, Office of the Chief of Naval Operations, responsible for drafting OPNAVINST 3605 – Environmental Policy Manual for Military Airports, summer 1974

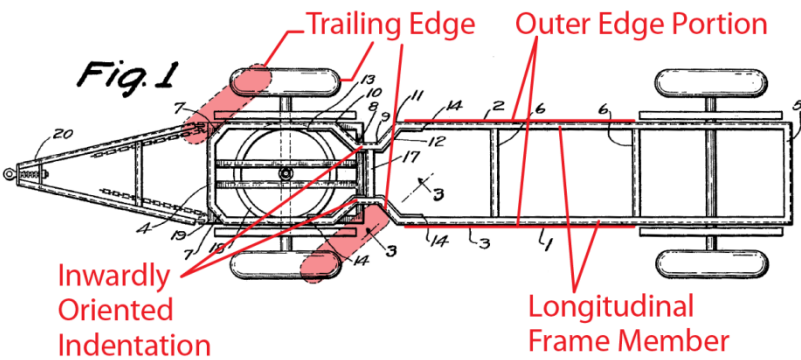
APPENDIX 2

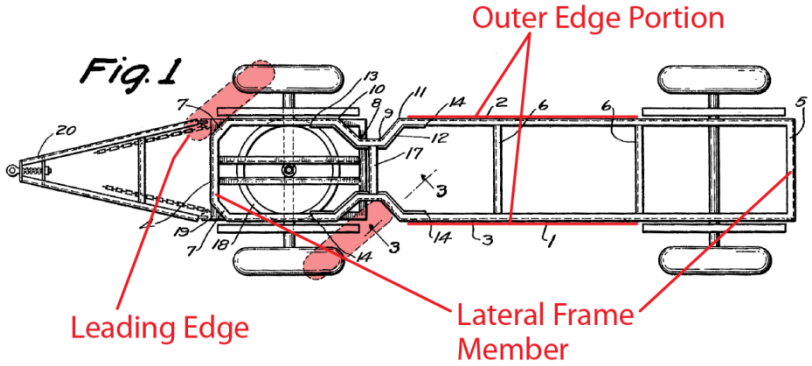
U.S. Patent No. 6,176,504	Anticipated by U.S. Patent No. 1,741,873 (Nordine)
<p>1. A wagon having two opposed ends and two opposed sides extending between the opposed ends, the wagon further comprising:</p>	<p>Ex. 1002 at Fig. 1; pg. 1, ll. 1-2, 58-60 (“In the design shown ... side beams, 2 and 3, tied together at the ends by means 4 and 5 ...”).</p>  <p>The diagram, labeled 'Fig. 1', shows a plan view of a trailer frame. It features a central rectangular body with a triangular front end (20) and a rectangular rear end (5). The frame is composed of side beams (2 and 3) and cross members (4 and 5). Red annotations highlight specific features: 'Opposed End' at the front and rear, and 'Opposed Side' for the left and right sides. The frame is supported by four wheels, with two pairs of wheels at each end.</p>
<p>a pair of wheels at each of said opposed ends;</p>	<p>Ex. 1002 at Fig. 1; pg. 1, ll. 36-37 (“Figure 1 is a plan view of a trailer frame of the four wheel type.”).</p>  <p>The diagram, labeled 'Fig. 1', shows a plan view of a trailer frame, identical to the one in the previous row. Red annotations highlight the 'Pair of Wheels' at each of the two opposed ends of the frame.</p>

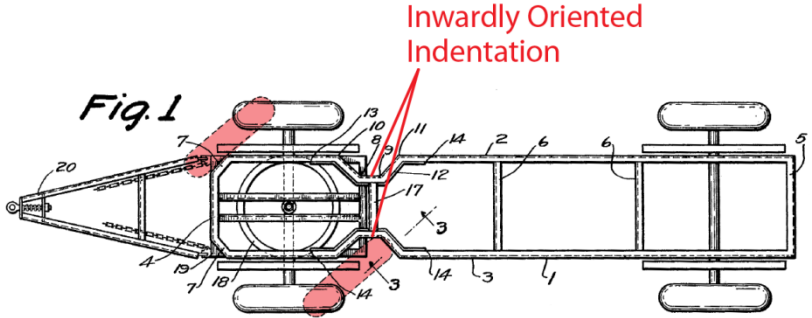
U.S. Patent No. 6,176,504	Anticipated by U.S. Patent No. 1,741,873 (Nordine)
<p>a frame having at least one longitudinal frame member</p>	<p>Ex. 1002 at Fig. 1; pg. 1, ll. 55-59 (“ . . . numeral 1 indicates a trailer frame which may be of any suitable type or design and constructed in any suitable manner. In the design shown it is made of channels with side beams, 2 and 3 . . .”).</p> 
<p>a tongue having a rear portion connected to a frame of said wagon and having a front portion adapted for connection to a vehicle;</p>	<p>Ex. 1002 at Figs. 1 and 2; pg. 2, ll. 21-23 (“ . . . the truck 19 may be attached to the rear of a motor truck or to another trailer by a frame 20 . . .”).</p> 

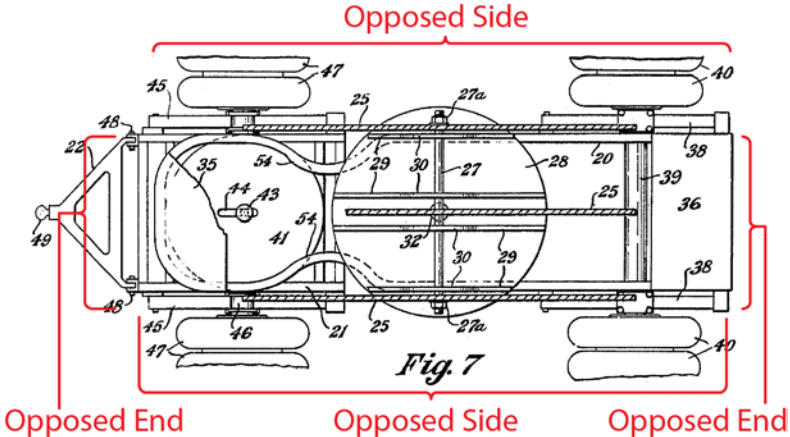
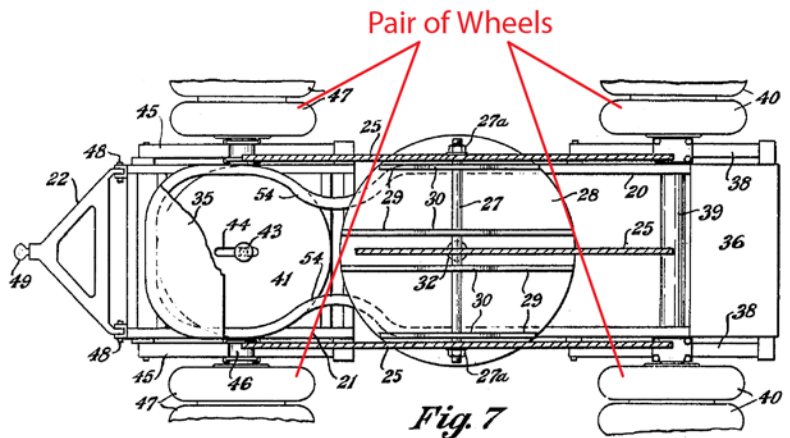
U.S. Patent No. 6,176,504	Anticipated by U.S. Patent No. 1,741,873 (Nordine)
<p>at least one said pair of wheels being steerable to right and left sides and connected to a rear portion of said tongue for steering with said tongue, with a wheel having a leading edge facing toward an end of said wagon and a trailing edge facing toward a central portion of said wagon;</p>	<p>Ex. 1002 at Fig. 1; pg. 1, ll. 1-5 (“The invention is a frame for trailers or the like which is provided with indentations in the sides thereof into which the front wheels may extend when turning on a short radius.”); pg. 2, ll. 25-30.</p> 

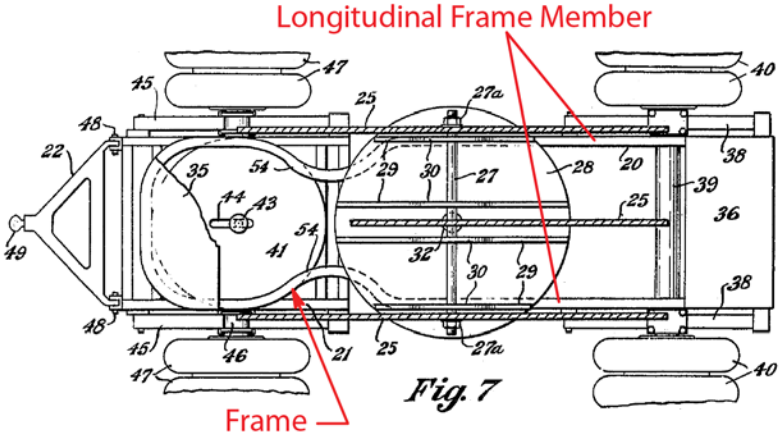
U.S. Patent No. 6,176,504	Anticipated by U.S. Patent No. 1,741,873 (Nordine)
<p>said wagon having a longitudinal frame member on each side, each longitudinal frame member having an outer edge portion on an intermediate portion of said longitudinal frame member;</p>	<p>Ex. 1002 at Figs. 1 and 2; pg. 1, ll. 55-59 (“ . . . numeral 1 indicates a trailer frame which may be of any suitable type or design and constructed in any suitable manner. In the design shown it is made of channels with side beams, 2 and 3 . . .”).</p> 
<p>said steerable wheels being completely outside said longitudinal frame members when said steerable wheels are oriented in a straight running direction; and</p>	<p>Ex. 1002 at Fig. 1. The steerable wheels of Nordine are completely outside the longitudinal frame members when the steerable wheels are oriented in a straight running direction.</p> 

U.S. Patent No. 6,176,504	Anticipated by U.S. Patent No. 1,741,873 (Nordine)
<p>each longitudinal frame member including an inwardly oriented indentation adjacent said trailing edge of each corresponding steerable wheel, each said indentation allowing said corresponding steerable wheel to be turned so that said trailing edge of said corresponding steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member.</p>	<p>Ex. 1002 at Fig. 1; pg. 1, ll. 74-80 (“The members 2 and 3 are bent inward to the points 8 and 9 between the points 10 and 11. It is understood that these points may be positioned so that the frame will clear a wheel of any suitable design or size and the depth of the indentations may be greater or lesser as may be desired.”); pg. 2, ll. 44-46 (“... the said side members provided with indentations to clear the wheels when making a turn at the rear . . .”).</p> 

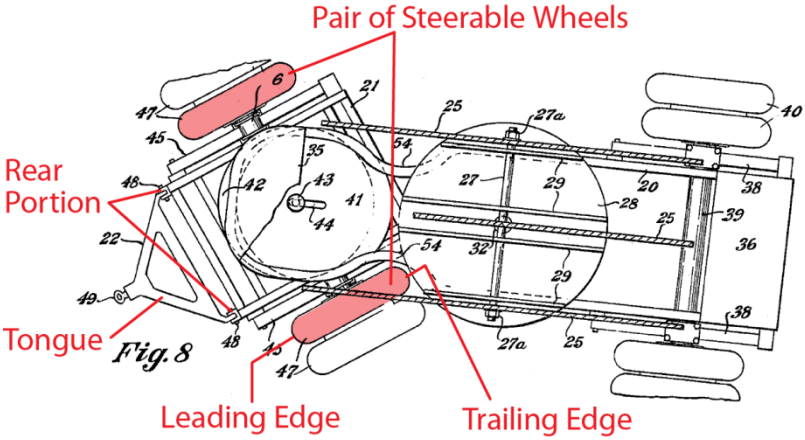
U.S. Patent No. 6,176,504	Anticipated by U.S. Patent No. 1,741,873 (Nordine)
<p>2. The wagon of claim 1, wherein a lateral frame member extends across each end of said wagon, with said lateral frame member being positioned adjacent to said leading edge of said steerable wheel wherein said steerable wheel can be turned so that said leading edge of said steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member.</p>	<p>Ex. 1002 at Fig. 1; pg. 1, ll. 58-70 (“In the design shown it is made of channels with side beams, 2 and 3, tied together at the ends by means 4 and 5 . . . The side members 2 and 3 are connected to the cross beam 4 at the front by diagonal sections 7 . . . These sections are of sufficient size to clear the side of a wheel as shown in dotted lines in Figure 1.”).</p> <p>With reference to Fig. 1 of Nordine, the forward lateral frame member is positioned adjacent to the leading edge of the right steerable wheel wherein the right steerable wheel is turned so that the leading edge of the right steerable wheel is positioned inwardly with respect to the outer edge portion of the right longitudinal frame member.</p> 

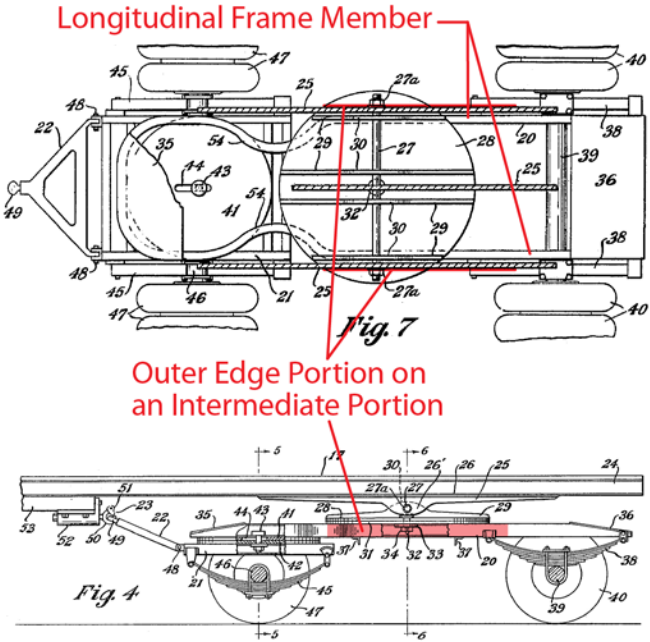
U.S. Patent No. 6,176,504	Anticipated by U.S. Patent No. 1,741,873 (Nordine)
<p>5. The wagon of claim 1, wherein said indentations permit a greater turning angle for said pair of wheels than would be obtainable without said indentation.</p>	<p>Ex. 1002 at Fig. 1; pg. 1, ll. 6-9 (“The object of the invention is to provide a frame for trailers or the like which is so constructed that the trailer may be turned on a comparatively short radius.”); pg. 1, ll. 74-80 (“The members 2 and 3 are bent inward to the points 8 and 9 between the points 10 and 11. It is understood that these points may be positioned so that the frame will clear a wheel of any suitable design or size and the depth of the indentations may be greater or lesser as may be desired.”); pg. 2, ll. 44-46 (“... the said side members provided with indentations to clear the wheels when making a turn at the rear . . .”).</p> 

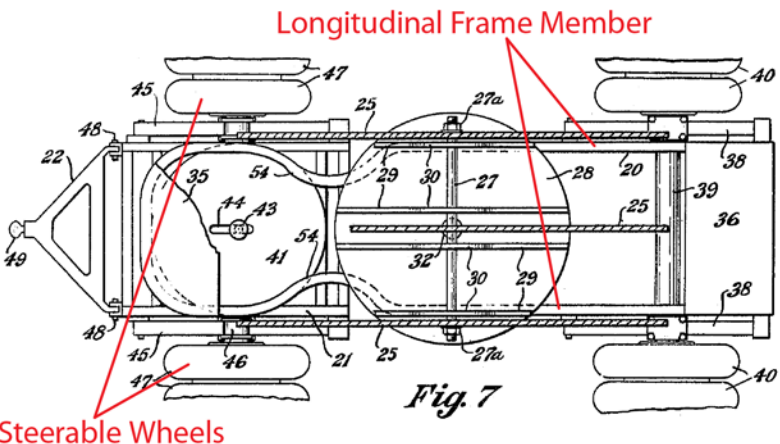
U.S. Patent No. 6,176,504	Anticipated by U.S. Patent No. 2,373,398 (Hoobler)
<p>1. A wagon having two opposed ends and two opposed sides extending between the opposed ends, the wagon further comprising:</p>	<p>Ex. 1003 at Fig. 7.</p> 
<p>a pair of wheels at each of said opposed ends;</p>	<p>Ex. 1003 at Fig. 7; pg. 2, right col., ll. 34-37; 51-53 (“As shown the rear end of the subframe is . . . on top of an axle 39 mounting dual wheels 40 in a usual fashion.”) (“As shown the dolly frame is supported by leaf springs 45 on an axle 46 carrying dual wheels 47 in a usual fashion, . . .”).</p> 

U.S. Patent No. 6,176,504	Anticipated by U.S. Patent No. 2,373,398 (Hoobler)
<p>a frame having at least one longitudinal frame member</p>	<p>Ex. 1003 at Fig. 7; pg. 2, left col., ll. 49-50 (“The rear end portion of the semi-trailer platform is supported on a subframe indicated at 20 . . .”).</p>  <p style="text-align: center;"><i>Fig. 7</i></p>

U.S. Patent No. 6,176,504	Anticipated by U.S. Patent No. 2,373,398 (Hoobler)
<p>a tongue having a rear portion connected to a frame of said wagon and having a front portion adapted for connection to a vehicle;</p>	<p>Ex. 1003 at Figs. 4 and 7; pg. 2, left col., ll. 51-55 (“... the front end of the subframe is supported on a dolly frame 21 to the front end of which is pivotally connected a tongue 22 having a towing connection at 23 with the forward portion of the trailer . . .”); pg. 2, right col., ll. 60-63 (“The ring 49 of the tongue is preferably universally connected to the forward portion of the trailer by means of the usual towing connection indicated generally at 23 . . .”).</p> <div data-bbox="667 756 1421 1402"> <p>The image contains two technical drawings of a trailer assembly. Fig. 7 is a side cross-sectional view. It shows a main frame (21) with wheels (40) at the rear. A tongue (22) is pivoted to the front of the frame at a pivot point (23). The tongue has a front portion (49) and a rear portion (48). A rear portion (45) is also shown, connected to the frame. Various other components are labeled with numbers like 25, 27, 28, 29, 30, 32, 36, 38, 39, 40, 41, 43, 44, 46, 47, 54. Fig. 4 is a top-down plan view. It shows the frame (21) with wheels (40) and a tongue (22) pivoted to it. The tongue has a front portion (49) and a rear portion (48). A rear portion (45) is also shown. Various other components are labeled with numbers like 5, 6, 17, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54.</p> </div>

U.S. Patent No. 6,176,504	Anticipated by U.S. Patent No. 2,373,398 (Hoobler)
<p>at least one said pair of wheels being steerable to right and left sides and connected to a rear portion of said tongue for steering with said tongue, with a wheel having a leading edge facing toward an end of said wagon and a trailing edge facing toward a central portion of said wagon;</p>	<p>Ex. 1003 at Fig. 8; pg. 3, left col., ll. 62-69 (“ . . . as shown in Figs. 3 and 8, the dolly frame swings about pivot 23, and the pin 43 slides in slot 44, and trailer swings about pivot 32 while the wheels 47 and 40 move into suitable alignment for substantially tracking wheels 13 of the tractor around a curve.”); pg. 4, right col., ll. 11-14 (“ . . . rearward of the dolly connecting the sub-frame and frame for towing the sub-frame from the frame, means supporting the front of the subframe on the dolly forward of the said fifth wheel . . .”).</p> 

U.S. Patent No. 6,176,504	Anticipated by U.S. Patent No. 2,373,398 (Hoobler)
<p>said wagon having a longitudinal frame member on each side, each longitudinal frame member having an outer edge portion on an intermediate portion of said longitudinal frame member;</p>	<p>Ex. 1003 at Figs. 4 and 7; pg. 2, left col., ll. 49-50 (“The rear end portion of the semi-trailer platform is supported on a subframe indicated at 20 . . .”).</p> 

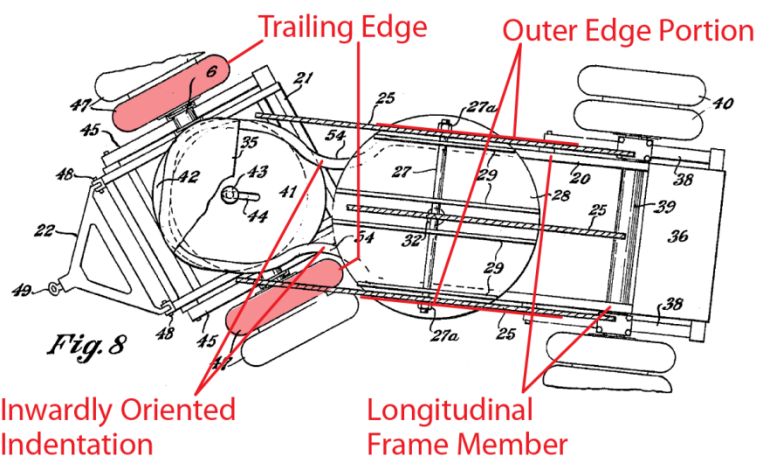
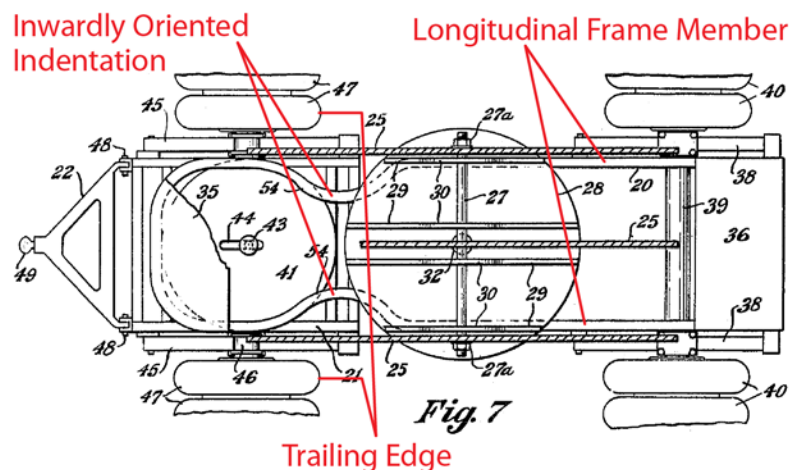
U.S. Patent No. 6,176,504	Anticipated by U.S. Patent No. 2,373,398 (Hoobler)
<p>said steerable wheels being completely outside said longitudinal frame members when said steerable wheels are oriented in a straight running direction; and</p>	<p>Ex. 1003 at Fig. 7.</p>  <p>Longitudinal Frame Member</p> <p>Steerable Wheels</p> <p><i>Fig. 7</i></p>

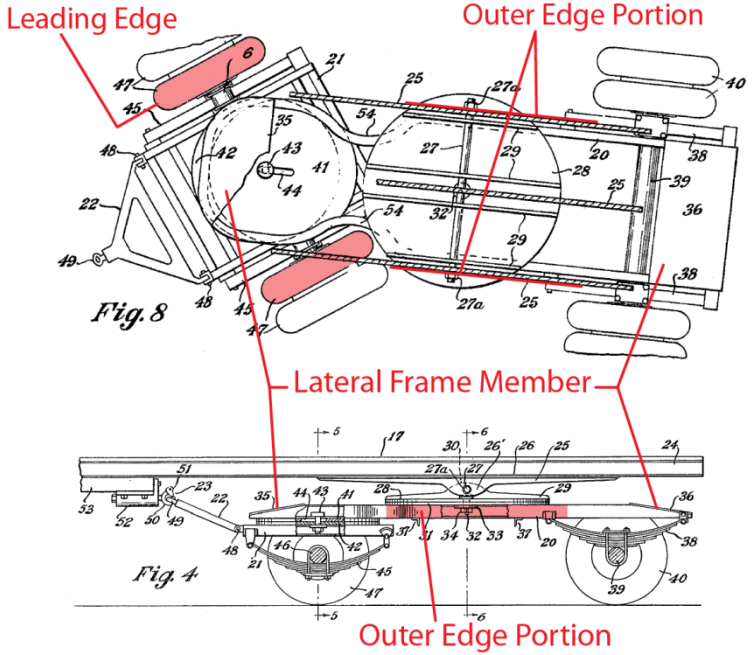
U.S. Patent No. 6,176,504

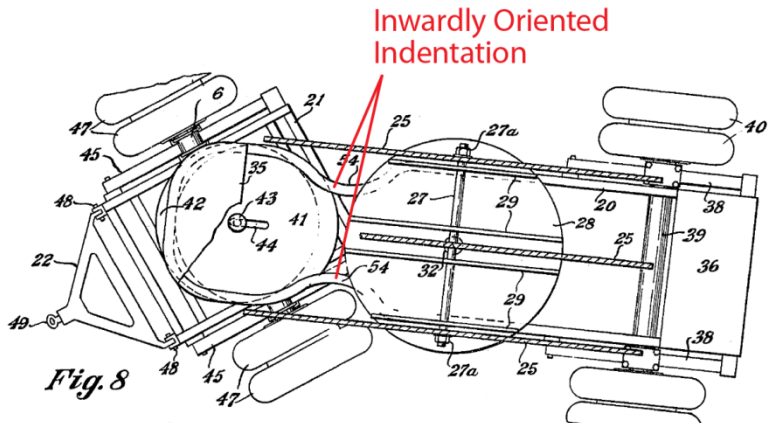
each longitudinal frame member including an inwardly oriented indentation adjacent said trailing edge of each corresponding steerable wheel, each said indentation allowing said corresponding steerable wheel to be turned so that said trailing edge of said corresponding steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member.

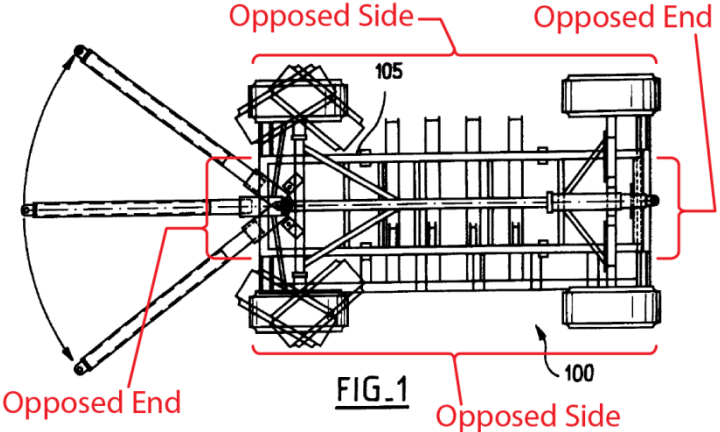
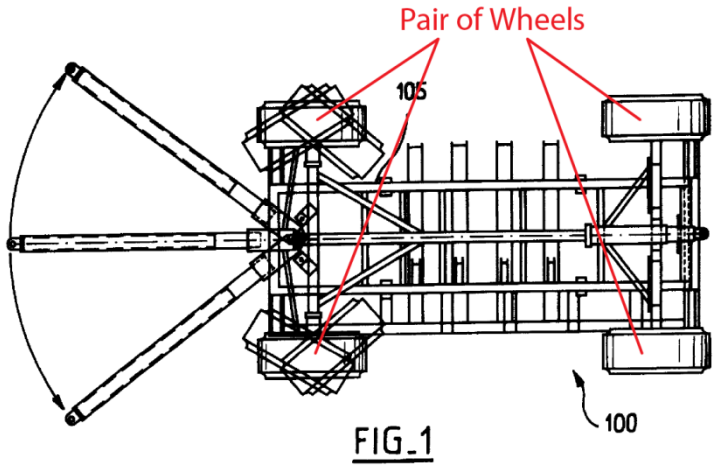
Anticipated by U.S. Patent No. 2,373,398 (Hoobler)

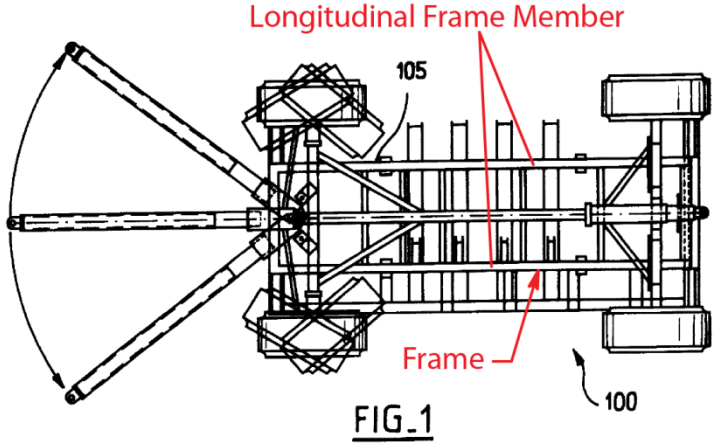
Ex. 1003 at Figs. 7 and 8; pg. 3, left col., ll. 8-13 (“... the frame [20] is preferably curved or bent inwardly at both sides between the pivot pins 32 and 43, as indicated at 54, to allow sufficient room for turning of the dual wheels 47 . . .”)

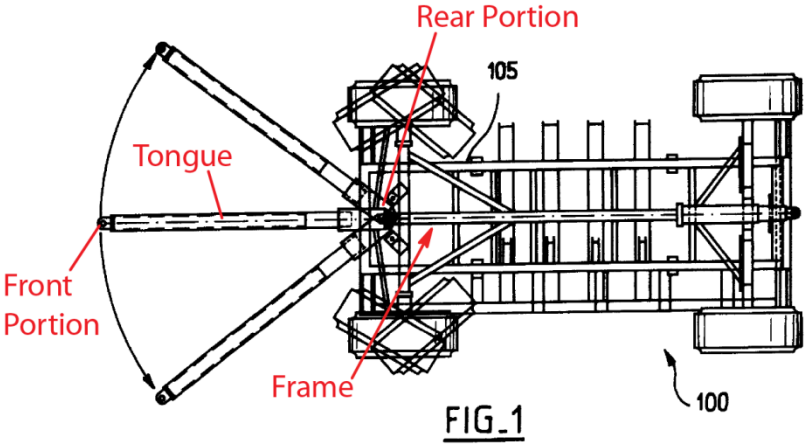


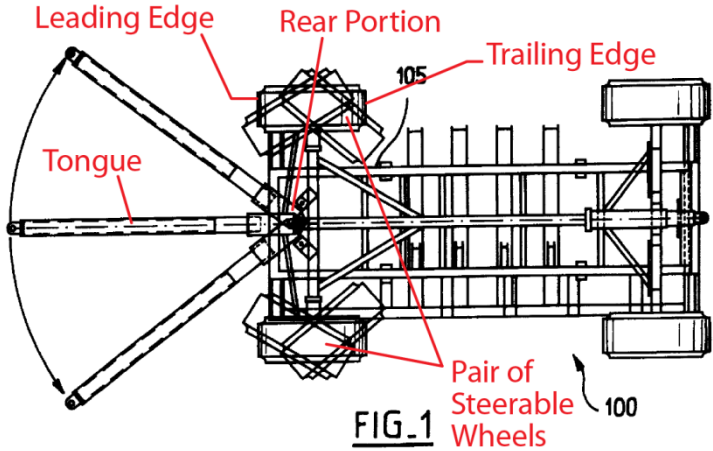
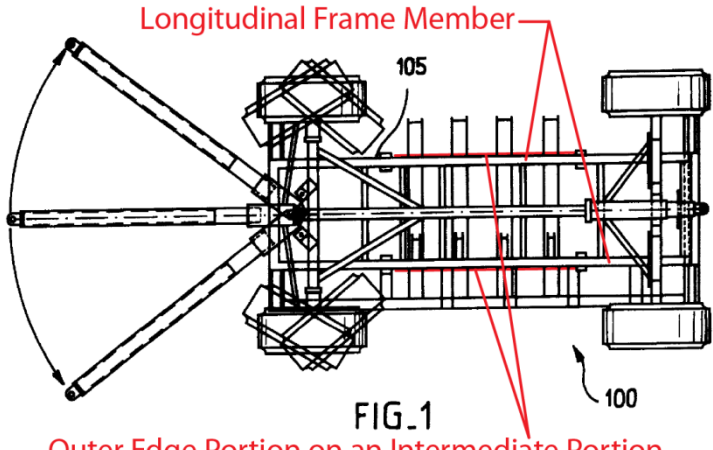
U.S. Patent No. 6,176,504	Anticipated by U.S. Patent No. 2,373,398 (Hoobler)
<p>2. The wagon of claim 1, wherein a lateral frame member extends across each end of said wagon, with said lateral frame member being positioned adjacent to said leading edge of said steerable wheel wherein said steerable wheel can be turned so that said leading edge of said steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member.</p>	<p>Ex. 1003 at Figs. 4 and 8; pg. 2, right col., ll. 27-29 (“The subframe 20 may conveniently be constructed of channels as shown, with transverse plates 35 and 36 . . .”)</p> <p>With reference to Figs. 4, 7, and 8 of Hoobler, the forward lateral frame member is positioned adjacent to the leading edge of the right steerable wheel wherein the right steerable wheel is turned so that the leading edge of the right steerable wheel is positioned inwardly with respect to the outer edge portion of the right longitudinal frame member.</p> 

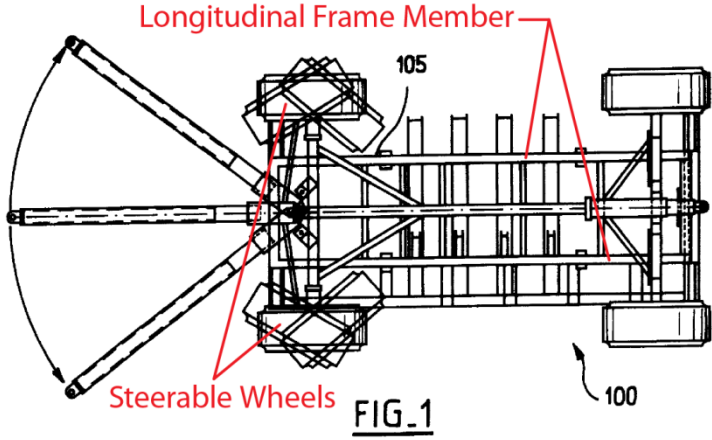
U.S. Patent No. 6,176,504	Anticipated by U.S. Patent No. 2,373,398 (Hoobler)
<p>5. The wagon of claim 1, wherein said indentations permit a greater turning angle for said pair of wheels than would be obtainable without said indentation.</p>	<p>Ex. 1003 at Fig. 8; pg. 3, left col., ll. 8-13 (“... the frame [20] is preferably curved or bent inwardly at both sides between the pivot pins 32 and 43, as indicated at 54, to allow sufficient room for turning of the dual wheels 47 ...”).</p> 

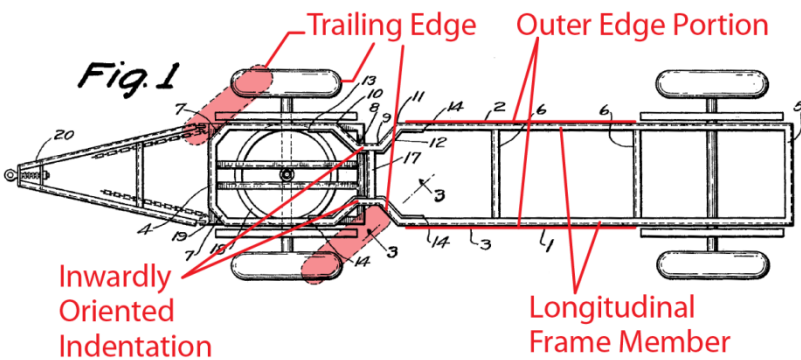
U.S. Patent No. 6,176,504	Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 1,741,873 (Nordine)
<p>1. A wagon having two opposed ends and two opposed sides extending between the opposed ends, the wagon further comprising:</p>	<p>Ex. 1001 at Fig. 1; col. 2, l. 34 (“FIG. 1 shows a wagon 100 configuration of the related art . . .”).</p>  <p>FIG. 1</p>
<p>a pair of wheels at each of said opposed ends;</p>	<p>Ex. 1001 at Fig. 1; col. 1, ll. 26-27 (“A common variation is the four-wheeled wagon, having pairs of wheels at either end of the wagon.”).</p>  <p>FIG. 1</p>

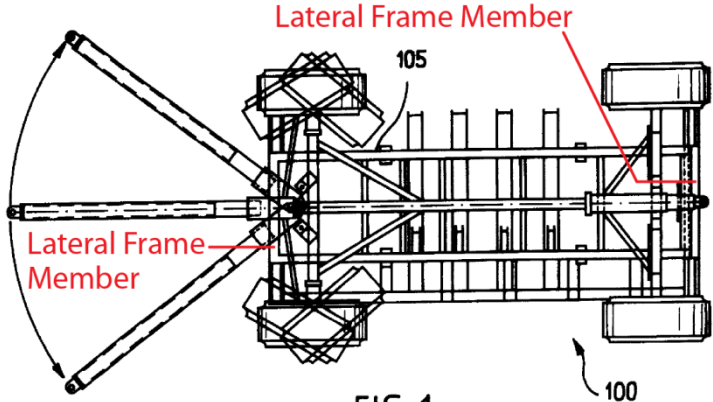
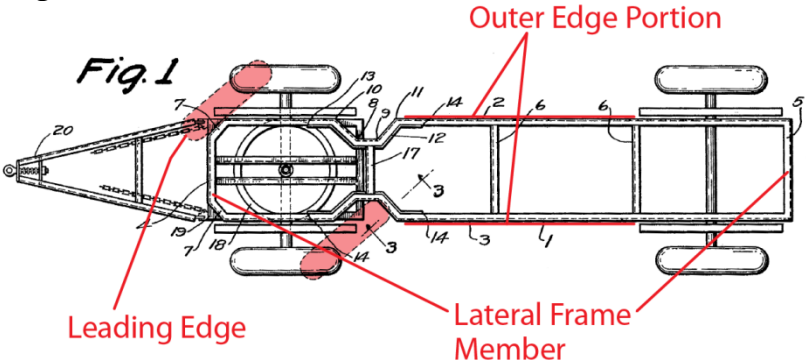
U.S. Patent No. 6,176,504	Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 1,741,873 (Nordine)
a frame having at least one longitudinal frame member	<p>Ex. 1001 at Fig. 1; col. 1, ll. 38-39 (“In a conventional wagon construction, a frame is employed upon which the pairs of wheels are mounted.”); col. 2, ll. 34-36 (“FIG. 1 shows a wagon 100 configuration of the related art, illustrating the turning limitation imposed on the related art wagon 100 by the frame member 105.”).</p> 

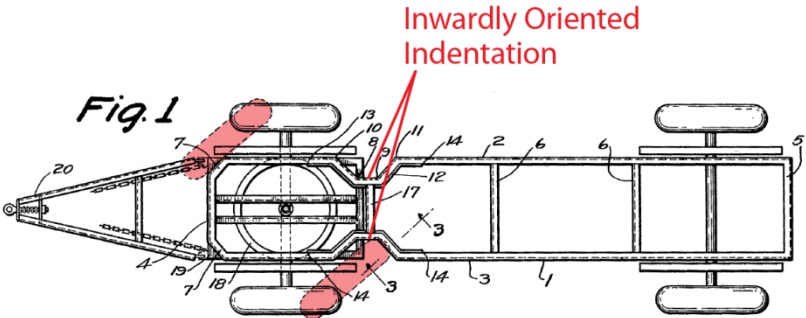
U.S. Patent No. 6,176,504	Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 1,741,873 (Nordine)
<p>a tongue having a rear portion connected to a frame of said wagon and having a front portion adapted for connection to a vehicle;</p>	<p>Ex. 1001 at Fig. 1; col. 1, ll. 20-24 (“Wagons in their most basic form include a tongue, . . . The tongue of the wagon may be connected to a vehicle, such as, for example, a tractor, truck, pickup harvester, or other self-propelled machine.”); col. 1, ll. 39-40 (“The tongue is pivotally attached to the front of the frame . . .”).</p> 

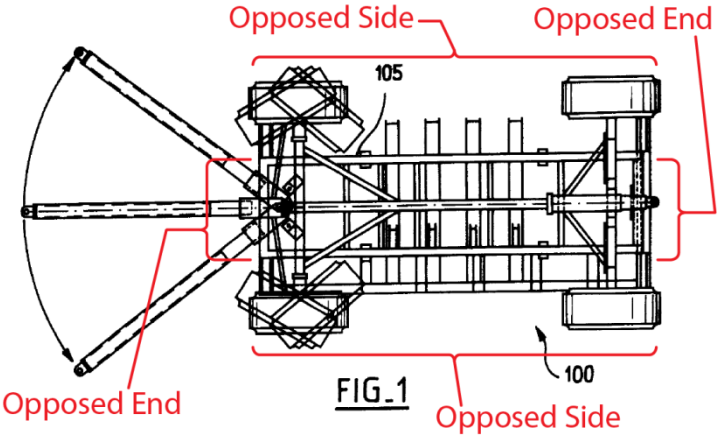
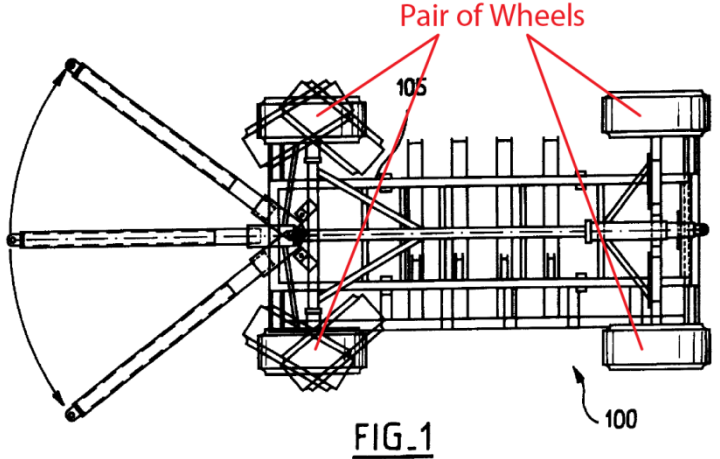
U.S. Patent No. 6,176,504	Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 1,741,873 (Nordine)
<p>at least one said pair of wheels being steerable to right and left sides and connected to a rear portion of said tongue for steering with said tongue, with a wheel having a leading edge facing toward an end of said wagon and a trailing edge facing toward a central portion of said wagon;</p>	<p>Ex. 1001 at Fig. 1; col. 1, ll. 39-41 (“The tongue is pivotally attached to the front of the frame and connected to the steerable wheels . . .”).</p>  <p>FIG. 1</p>
<p>said wagon having a longitudinal frame member on each side, each longitudinal frame member having an outer edge portion on an intermediate portion of said longitudinal frame member;</p>	<p>Ex. 1001 at Fig. 1.</p>  <p>FIG. 1</p>

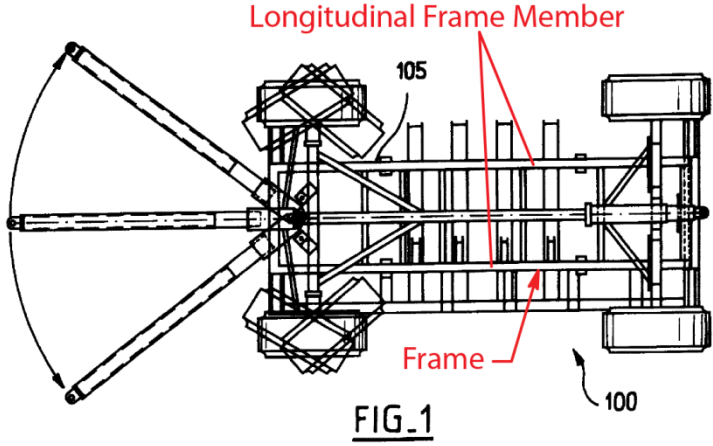
U.S. Patent No. 6,176,504	Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 1,741,873 (Nordine)
<p>said steerable wheels being completely outside said longitudinal frame members when said steerable wheels are oriented in a straight running direction; and</p>	<p>Ex. 1001 at Fig. 1; col. 1, ll. 42-43 (“The wheels and corresponding axles extend beyond the frame . . .”)</p> <p>The steerable wheels of the Admitted Prior Art Wagons are completely outside the longitudinal frame members when the steerable wheels are oriented in a straight running direction.</p> 

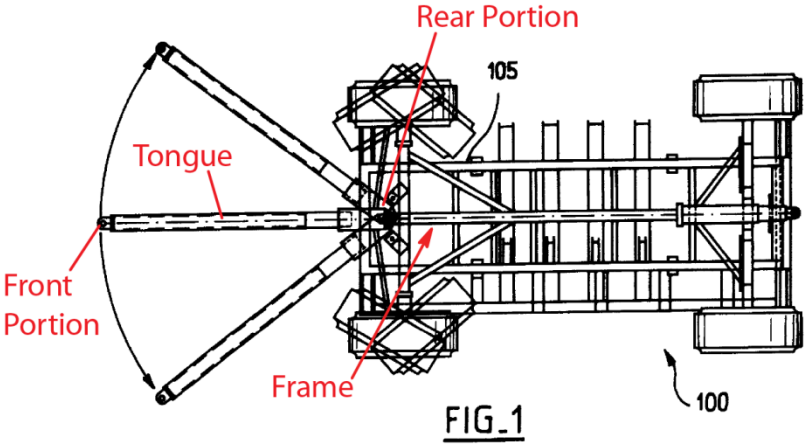
U.S. Patent No. 6,176,504	Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 1,741,873 (Nordine)
<p>each longitudinal frame member including an inwardly oriented indentation adjacent said trailing edge of each corresponding steerable wheel, each said indentation allowing said corresponding steerable wheel to be turned so that said trailing edge of said corresponding steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member.</p>	<p>Ex. 1002 at Fig. 1; pg. 1, ll. 74-80 (“The members 2 and 3 are bent inward to the points 8 and 9 between the points 10 and 11. It is understood that these points may be positioned so that the frame will clear a wheel of any suitable design or size and the depth of the indentations may be greater or lesser as may be desired.”); pg. 2, ll. 44-46 (“... the said side members provided with indentations to clear the wheels when making a turn at the rear ...”).</p> 

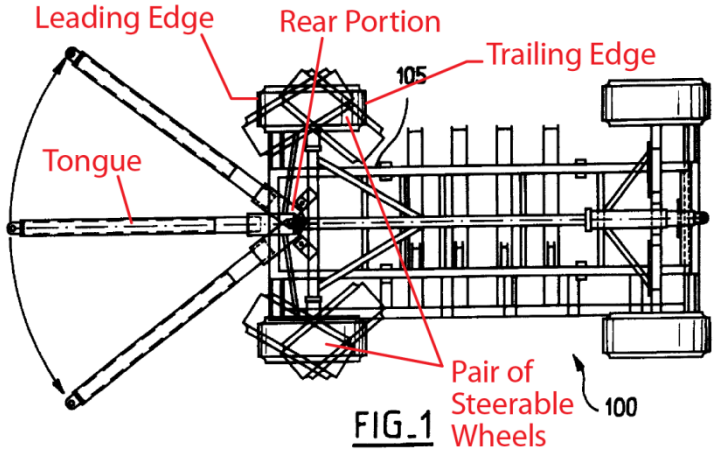
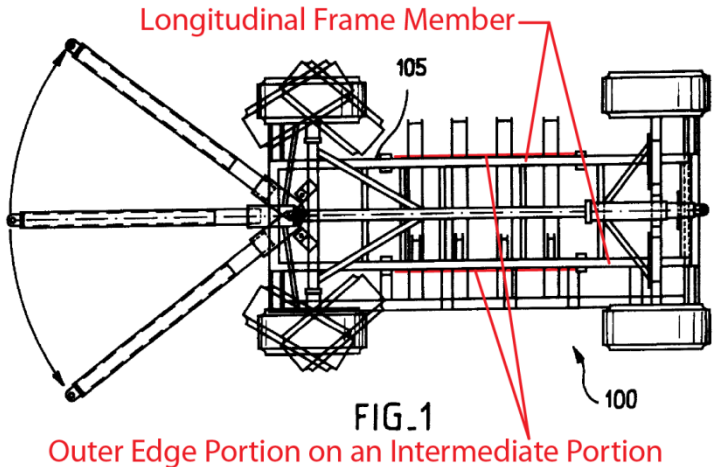
U.S. Patent No. 6,176,504	Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 1,741,873 (Nordine)
<p>2. The wagon of claim 1, wherein a lateral frame member extends across each end of said wagon, with said lateral frame member being positioned adjacent to said leading edge of said steerable wheel wherein said steerable wheel can be turned so that said leading edge of said steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member.</p>	<p>Ex. 1001 at Fig. 1. The Admitted Prior Art Wagons have a lateral frame member extending across each end of the wagon.</p>  <p>FIG. 1</p> <p>Ex. 1002 at Fig. 1; pg. 1, ll. 58-70 (“In the design shown it is made of channels with side beams, 2 and 3, tied together at the ends by means 4 and 5 . . . These sections are of sufficient size to clear the side of a wheel as shown in dotted lines in Figure 1.”).</p> <p>With reference to Fig. 1 of Nordine, the forward lateral frame member is positioned adjacent to the leading edge of the right steerable wheel wherein the right steerable wheel is turned so that the leading edge of the right steerable wheel is positioned inwardly with respect to the outer edge portion of the right longitudinal frame member.</p> 

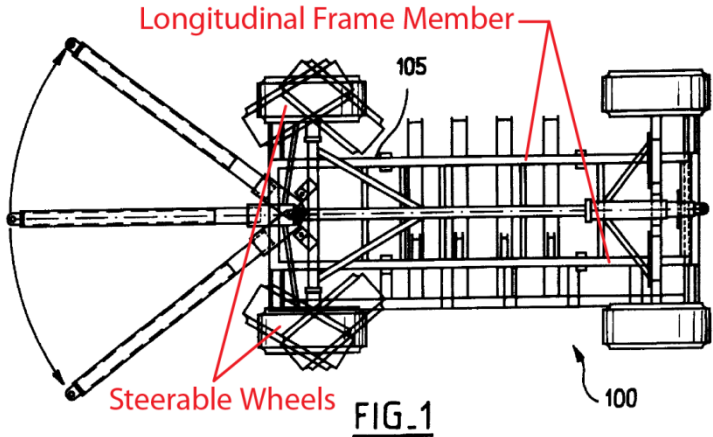
U.S. Patent No. 6,176,504	Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 1,741,873 (Nordine)
<p>5. The wagon of claim 1, wherein said indentations permit a greater turning angle for said pair of wheels than would be obtainable without said indentation.</p>	<p>Ex. 1002 at Fig. 1; pg. 1, ll. 6-9 (“The object of the invention is to provide a frame for trailers or the like which is so constructed that the trailer may be turned on a comparatively short radius.”); pg. 1, ll. 74-80 (“The members 2 and 3 are bent inward to the points 8 and 9 between the points 10 and 11. It is understood that these points may be positioned so that the frame will clear a wheel of any suitable design or size and the depth of the indentations may be greater or lesser as may be desired.”); pg. 2, ll. 44-46 (“... the said side members provided with indentations to clear the wheels when making a turn at the rear . . .”).</p> 

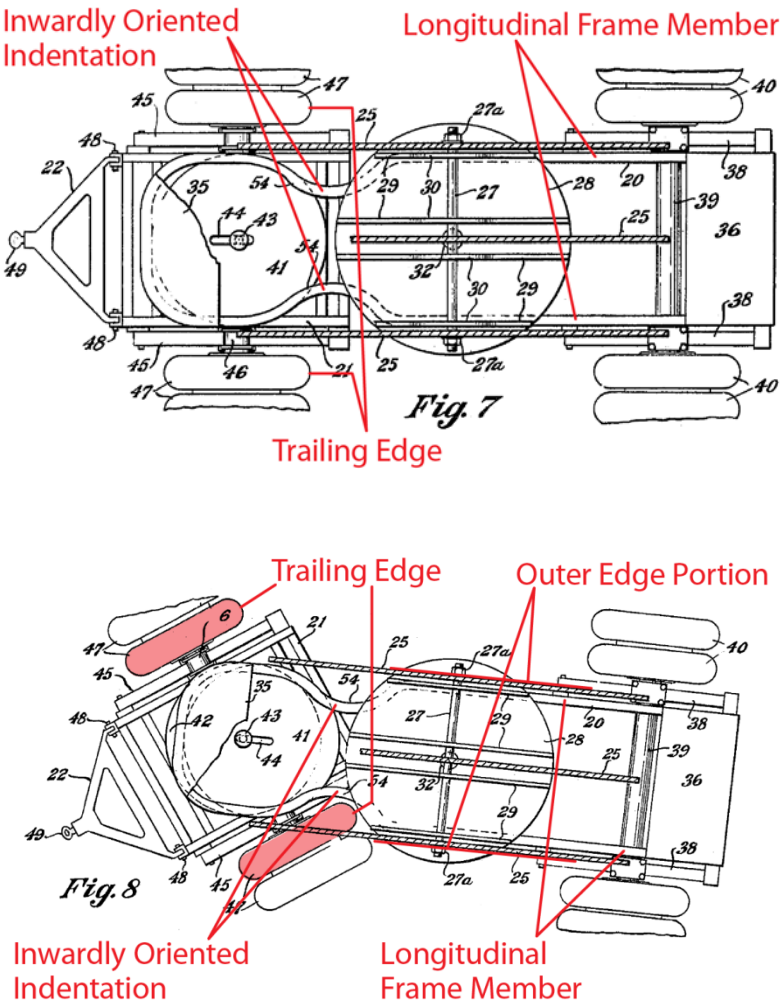
U.S. Patent No. 6,176,504	Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 2,373,398 (Hoobler)
<p>1. A wagon having two opposed ends and two opposed sides extending between the opposed ends, the wagon further comprising:</p>	<p>Ex. 1001 at Fig. 1; col. 2, ll. 34 (“FIG. 1 shows a wagon 100 configuration of the related art . . .”).</p>  <p>FIG. 1</p>
<p>a pair of wheels at each of said opposed ends;</p>	<p>Ex. 1001 at Fig. 1; col. 1, ll. 26-27 (“A common variation is the four-wheeled wagon, having pairs of wheels at either end of the wagon.”).</p>  <p>FIG. 1</p>

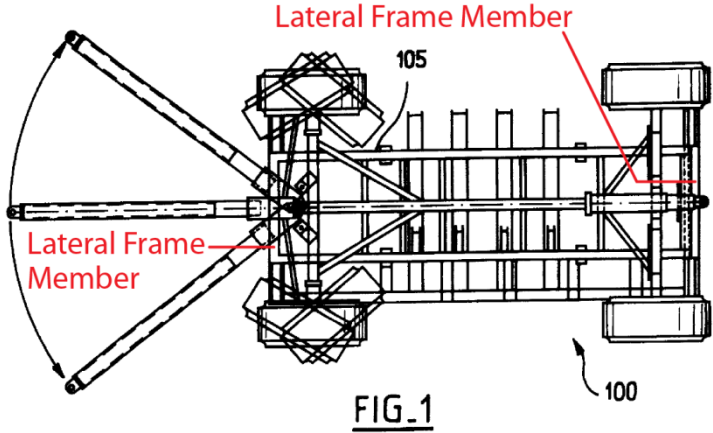
U.S. Patent No. 6,176,504	Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 2,373,398 (Hoobler)
a frame having at least one longitudinal frame member	<p>Ex. 1001 at Fig. 1; col. 1, ll. 38-39 (“In a conventional wagon construction, a frame is employed upon which the pairs of wheels are mounted.”); col. 2, ll. 34-36 (“FIG. 1 shows a wagon 100 configuration of the related art, illustrating the turning limitation imposed on the related art wagon 100 by the frame member 105.”).</p>  <p style="text-align: center;">FIG_1</p>

U.S. Patent No. 6,176,504	Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 2,373,398 (Hoobler)
<p>a tongue having a rear portion connected to a frame of said wagon and having a front portion adapted for connection to a vehicle;</p>	<p>Ex. 1001 at Fig. 1; col. 1, ll. 20-24 (“Wagons in their most basic form include a tongue, . . . The tongue of the wagon may be connected to a vehicle, such as, for example, a tractor, truck, pickup harvester, or other self-propelled machine.”); col. 1, ll. 39-40 (“The tongue is pivotally attached to the front of the frame. . .”).</p> 

U.S. Patent No. 6,176,504	Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 2,373,398 (Hoobler)
<p>at least one said pair of wheels being steerable to right and left sides and connected to a rear portion of said tongue for steering with said tongue, with a wheel having a leading edge facing toward an end of said wagon and a trailing edge facing toward a central portion of said wagon;</p>	<p>Ex. 1001 at Fig. 1; col. 1, ll. 39-40 (“The tongue is pivotally attached to the front of the frame and connected to the steerable wheels . . .”).</p>  <p>FIG. 1</p>
<p>said wagon having a longitudinal frame member on each side, each longitudinal frame member having an outer edge portion on an intermediate portion of said longitudinal frame member;</p>	<p>Ex. 1001 at Fig. 1.</p>  <p>FIG. 1</p>

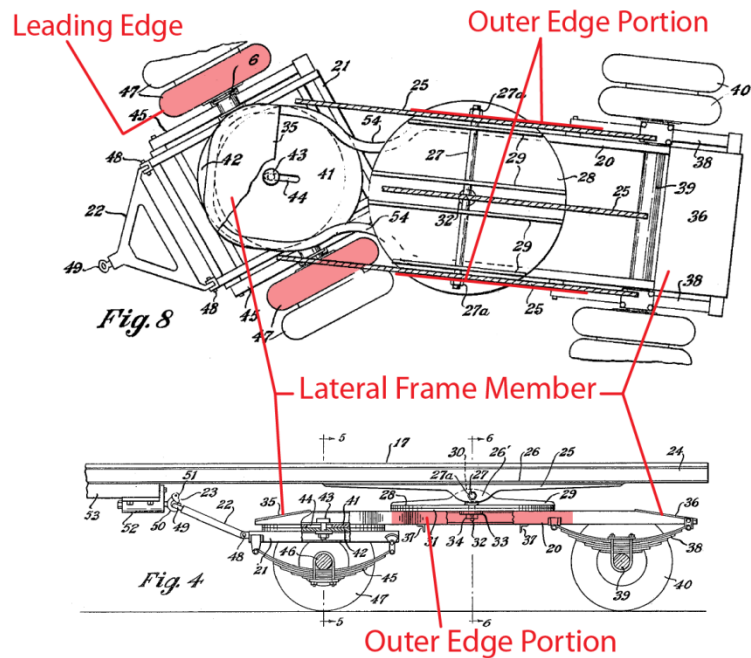
U.S. Patent No. 6,176,504	Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 2,373,398 (Hoobler)
<p>said steerable wheels being completely outside said longitudinal frame members when said steerable wheels are oriented in a straight running direction; and</p>	<p>Ex. 1001 at Fig. 1. The steerable wheels of the Admitted Prior Art Wagons are completely outside the longitudinal frame members when the steerable wheels are oriented in a straight running direction.</p>  <p style="text-align: center;">FIG. 1</p>

U.S. Patent No. 6,176,504	Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 2,373,398 (Hoobler)
<p>each longitudinal frame member including an inwardly oriented indentation adjacent said trailing edge of each corresponding steerable wheel, each said indentation allowing said corresponding steerable wheel to be turned so that said trailing edge of said corresponding steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member.</p>	<p>Ex. 1003 at Figs. 7 and 8; pg. 3, left col., ll. 8-13 (“As best shown in Figs. 7 and 8, the channel frame 24 comprising the frame [20] is preferably curved or bent inwardly at both sides between the pivot pins 32 and 43, as indicated at 54, to allow sufficient room for turning of the dual wheels 47 carrying the dolly frame 21.”).</p> 

U.S. Patent No. 6,176,504	Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 2,373,398 (Hoobler)
<p>2. The wagon of claim 1, wherein a lateral frame member extends across each end of said wagon, with said lateral frame member being positioned adjacent to said leading edge of said steerable wheel wherein said steerable wheel can be turned so that said leading edge of said steerable wheel is positioned inwardly with respect to said outer edge portion of a corresponding longitudinal frame member.</p>	<p>Ex. 1001 at Fig. 1. The Admitted Prior Art Wagons have a lateral frame member extending across each end of the wagon.</p>  <p>Ex. 1003 at Figs. 4 and 8; pg. 2, right col., ll. 27-29 (“The subframe 20 may conveniently be constructed of channels as shown, with transverse plates 35 and 36 . . .”).</p> <p>With reference to Figs. 4, 7, and 8 of Hoobler, the forward lateral frame member is positioned adjacent to the leading edge of the right steerable wheel wherein the right steerable wheel is turned so that the leading edge of the right steerable wheel is positioned inwardly with respect to the outer edge portion of the right longitudinal frame member.</p>

U.S. Patent No. 6,176,504

Obvious over Admitted Prior Art Wagons in view of U.S. Patent No. 2,373,398 (Hoobler)



5. The wagon of claim 1, wherein said indentations permit a greater turning angle for said pair of wheels than would be obtainable without said indentation.

Ex. 1003 at Fig. 8; pg. 3, left col., ll. 8-13 (“... the frame [20] is preferably curved or bent inwardly at both sides between the pivot pins 32 and 43, as indicated at 54, to allow sufficient room for turning of the dual wheels ...”).

