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Trailing arm for a vehicle

Abstract

An All-Terrain Vehicle with a frame, a rear axle and at least a rear trailing arm. The rear trailing arm may attach to the vehicle frame frontward of the rear axle and may enter a wheel hub space partially frontwards of the rear axle and attach to an inset wheel hub. The rear trailing arm may have multiple tubular portions including a frame tubular portion and a wheel tubular portion. The frame tubular portion and wheel tubular portion are attached together at approximately 90 degrees. The wheel tubular portion has at least a distal portion that is configurated to encompass at least a partial length of an ATV axle and a proximal portion that is frontwards of ATV axle. The trailing arm provides clearance when the wheel hub is moved vertically by an angle of 27 degrees.

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Background/Summary

(1) The present application incorporates entire contents by reference, U.S. Pat. No. 9,493,191 to Kariniemi filed Apr. 10, 2014, entitled “Arcuate Frame For A Vehicle” and U.S. Pat. No. 10,023,234 to Kariniemi, filed Dec. 20, 2016, entitled “An Arcuate Frame For A Vehicle” and U.S. Pat. No. 10,899,184 to Kariniemi, filed Dec. 22, 2018, entitled “Trailing Arms For a Vehicle”. The present application also incorporates and claims priority to U.S. provisional application No. 63/582,551 to Kariniemi filed Sep. 14, 2023.

FIELD OF THE INVENTION

(1) The present invention generally relates to wheeled vehicles, and more specifically to all-terrain vehicles and utility vehicles.

BACKGROUND OF THE INVENTION

(2) All-terrain vehicles (hereinafter “ATV”) typically have a shorter wheelbase which gives the ATV increased maneuverability over longer wheelbased ATVs such as sandrails, desert trucks, and dune buggies. The shorter wheelbase however can have shortcomings compared to a longer wheelbase, for example, a shorter wheel base can have a rougher ride due in at least part to having shocks with less travel. In some cases, it remains advantageous to lengthen an axle to allow for more movement or travel. For example, if an axle can move 27 degrees in an up and down motion, a longer axle allows for more travel. In some cases, keeping width of the ATV at a specific dimension is advantageous. So, in order to increase travel, a longer axle is utilized by moving axle

connection point (e.g. wheel hub), inset to a mating wheel, further to outside of the ATV. In order to provide proper clearance of trailing arms, it remains desirable to have improvements to the trailing arms. An example of an improvement to a trailing arm is a trailing arm made of tubular construction and having a cutaway portion and a remaining portion such that a trailing arm can be made that meets performance and cost objectives.

SUMMARY OF THE INVENTION

(3) It has been recognized that it would be advantageous to develop an ATV with increased maneuverability and increased travel. In one embodiment, an ATV has a frame (e.g., an arcuate frame according to U.S. Pat. No. 9,493,191 to Kariniemi or U.S. Pat. No. 10,023,234 to Kariniemi, with trailing arms as described herein attached to the frame. The trailing arms have a first portion that may be substantially straight and a second portion that is angled (or at an angle) from the first portion and attached to an inset wheel hub. The trailing arms enter wheel hub space frontward (in some examples the trailing arms may enter rearward of the rear axle as the rear axle enters the wheel hub space) of a rear axle, as the rear axle enters the wheel hub space, and some portion of at least some of the trailing arms cross the rear axle (with in the wheel hub space) to rearward side (in some examples cross to the frontward side) of rear axle near attachment point to the wheel hub (while ensuring clearance between axle and trailing arm when wheel is moved vertically up to 27 degrees from original axle location). Trailing arms made and used in accordance with this disclosure, enable use of trailing arms for inset wheel hubs that attach to a frame portion frontward (in some examples may be rearward) of the rear axle and provide clearance when the wheel is raised or lowered up to 27 degrees. One advantage of a trailing arm built and assembled to an ATV as shown and described is scrub can be minimized. In other embodiments, advantages of an improved trailing arm may be using 2 tubes. Manufacturing simplicity is advantageous and can improve production costs. In one embodiment, one tube may be used to establish a longitudinal portion of the trailing arm or a substantial portion of a length of the trailing arm. A second tube may be used to establish a lateral portion, or substantially lateral portion of the trailing arm, and an overall width of the trailing arm. In various embodiments, different trailing arm dimensions are needed and tube length can be tailored to fit many different configurations of an ATV. In one embodiment, the tube attaches to a plate located within the wheel, extends around periphery of wheel hub or wheel hub attachment, for example 360 degrees around and extends inward towards first tube or portion of tube that would extend from an ATV frame, for example, up to a point where an ATV axle would start to impede travel. At that point, or before that point, the tube would have a cutaway zone so axle can move freely. The tubes can be made of different tube wall thickness to accommodate greater strength or lighter trailing arms. The length of the tube can be a different thickness than the width tube. The diameter of the tubes can vary as needed. An ease of assembly is a benefit.

(4) A vehicle may comprise a frame; a first rear trailing arm; a rear wheel with a wheel hub space and a wheel hub, wherein the wheel hub is inset to the rear wheel inside of the wheel hub space, wherein the wheel hub has a wheel hub center axis; wherein the first rear trailing arm has a frame tube portion having a frame tube portion proximal end and a frame tube portion distal end wherein the frame tube portion distal end is configured to be attached to at least a portion of the frame frontward of the wheel hub center axis; wherein the first rear trailing arm has a wheel tube portion angled from the frame tube portion and the wheel tube portion having a wheel tube proximal portion and a wheel tube distal portion, wherein the wheel tube proximal portion is frontward of the wheel hub axis; and wherein the wheel tube distal portion is attached to the wheel hub and the wheel tube distal portion has a lumen that surrounds the wheel axis. The vehicle may have a wheel tube proximal portion as a remaining portion of the wheel tube distal portion that has been cutaway. The vehicle may have a frame tube proximal portion attached to the wheel tube proximal portion exterior surface. A trailing arm for a vehicle may comprise a frame tube portion and a wheel tube portion that is angled from frame tube portion; wherein the wheel tube portion has a wheel tube

proximal portion and a wheel tube distal portion; wherein the wheel tube proximal portion has a circumference less than the wheel tube distal portion circumference; and wherein the wheel tube distal portion has a wall thickness defining a lumen. The trailing arm may have a wheel tube portion having a maximum length extending between the wheel tube distal portion end and the wheel tube proximal portion end and the wheel tube proximal portion extends along a majority of the wheel tube maximum length. A method of manufacturing a trailing arm obtain a tubular wheel portion for a trailing arm; obtain a tubular frame portion for a trailing arm; remove a portion of tubular wheel portion to define a tubular wheel distal portion and a tubular wheel proximal portion wherein the tubular wheel proximal portion is a remaining amount from the removed portion; and attach the tubular wheel portion distal portion and tubular frame portion together. A method comprising cutting tubular wheel portion to length and tubular frame portion to length. Additional features and advantages of the invention will be apparent from the description which follows, taken in conjunction with accompanying drawings, which together illustrate, by way of example, features of the invention.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** shows a side view of a vehicle with trailing arm in accordance with an embodiment.

(2) FIG. **2** is a rear view of a vehicle frame with a trailing arm in accordance with an embodiment.

(3) FIG. **3** is a partial rear view of a frame with a trailing arm in accordance with an embodiment.

(4) FIG. **4** is a partial top view of a vehicle frame with a trailing arm in accordance with an embodiment.

(5) FIG. **5** is a view of a trailing arm in accordance with an embodiment.

(6) FIG. **6** is a view of a frame tube for a trailing arm in accordance with an embodiment.

(7) FIG. **7** is a view of a wheel tube for a trailing arm in accordance with an embodiment.

DETAILED DESCRIPTION

(8) Reference will now be made to some embodiments illustrated in the drawings, and specific language will be used herein to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended. Alterations and further modifications of the inventive features illustrated herein, and additional applications of the principles of the inventions as illustrated herein, which would occur to one skilled in the relevant art and having possession of this disclosure, are to be considered within the scope of the invention.

(9) A vehicle with trailing arms in accordance with various embodiments are disclosed herein and examples are illustrated in the Figures. The trailing arms may have a tubular (tubular is not to be read as only circular, for example, it could have a rectangular shape) construction and can be cut to length depending on a particular application. For example, the trailing arms may be constructed from a structural component or member, e.g., a tube made out of a tubular-shaped steel alloy. The trailing arms may be individual pieces, for example 2 individual pieces. In some embodiments, some of the individual pieces may be connected to each other by a welding. The structural component (e.g., tubular trailing arm) may have a tubular construction typically ranging from approximately 1 inch to 8 inches in diameter or whatever diameter is required for adequate strength. The trailing arms can be shaped to accommodate more wheel travel. For example in the wheel tube, a cutout may be made to accommodate an axle. The trailing arms may be attached at the frame, for example by a plate or a tubular bung tube to the frame on one end and attached to a wheel hub at opposing end. The trailing arms may have an arcuate shape or bend or change in direction to help accommodate more wheel travel.

(10) In an embodiment, as shown in FIG. **1**, an ATV **100** with a trailing arm **200** in accordance with an embodiment. FIG. **2** shows a rear view of a trailing arm **200** in accordance with an embodiment.

A wheel tube **202** is partially inset inside a wheel **206** and is attached to a frame tube **204** and the frame tube **204** is attached to the ATV **100**. FIG. **2** shows only one trailing arm **200**, yet it is to be understood that a second trailing arm is intended to be used on ATV **100**.

(11) In one embodiment, as shown in FIG. **3**, the wheel tube **202** of the trailing arm **200** is inset inside a wheel **206** approximately 8 inches. The wheel tube **202** can be inset any dimension desired to accommodate specific needs of the vehicle. The wheel tube **202** can be attached to a plate that is attached inside of the wheel **206**. The frame tube **204** is attached to the wheel tube **202**. The wheel tube **202** is angled from the frame tube, for example approximately 90 degrees, outward towards the wheel **206**.

(12) As shown in FIG. **4**, by example, a frame tube **204** is attached to a wheel tube **202** of trailing arm **200**. The frame tube **204** is attached to a mating mechanism **402**, e.g., a plate or bung tube. The mating mechanism **402** may be a bung tube and the bung tube **402** may be wider than the frame tube **204** diameter. The bung tube may be attached to a frame interface **406** in multiple locations, e.g., 4 locations along bung tube **402** length, and the frame interface **406** is attached to the frame **404**. The frame tube **204** is attached to the frame **404**, for example via the mating mechanism **402** and in some embodiments frame trailing arm interface **406** (e.g., bung, rod end, hyme joint, tabs etc.). The wheel tube **202** is at least partially inset inside of the wheel **206** in a wheel hub space **410** and the wheel tube **202** has a cutaway section **420** to clear axle **408**. The wheel tube **202** may have a first wheel tube tubular (e.g., circular) portion **416** and a wheel tube second portion **418** that is remaining from cutaway section **420** of the wheel tube **202**. In some embodiments the wheel tube first portion **416** and the wheel tube second portion **418** may be made individually and assembled (e.g., welded) together. In some embodiments the second (proximal) tubular portion **418** is in front of the wheel axis **414**. In some embodiments the proximal tubular portion **418** has less than 180 degrees (or alternatively has less than half the circumference (or perimeter) of the wheel tube distal portion **416**) of material left from wheel tube distal portion **416** when viewed axially. In some embodiments, wheel tube **202** has a proximal portion **418** circumference or perimeter that is less than wheel tube distal portion **416** circumference or perimeter (e.g., ⅛, ¼, ½ etc.) to provide clearance of axle **408**. In some embodiments the axle **408** may enter wheel hub space **410** at different angles, requiring a need to adjust proximal portion circumference to provide axle clearance. In some embodiments the wheel tube **202** has a first circular portion **416** attached to a wheel hub **412** and surrounds the wheel axle **408**. In some embodiments the wheel tube distal portion **416** has a wall thickness that defines an inner lumen **722** such that the wheel axle can be placed within the inner lumen of the wheel tube distal portion. In some embodiments the wheel tube proximal portion **418** extends along a majority of the wheel tube **202**.

(13) FIG. **5** shows, by way of example, a trailing arm **200** in accordance with an embodiment. The trailing arm **200** may have a wheel tube **202** with a wheel tube first portion (e.g., distal) **416** that may be circular and a wheel tube second portion (e.g. proximal) **418** that may be tubular and is a remaining portion from a cutaway section of wheel tube first portion **416**. Wheel tube **202** is attached, in some examples via welding, to a frame tube **204**. The frame tube **204** may have a strut mount **508**, and supporting brackets, **506**, **504**, **502**, and a mating mechanism **402**. The supporting brackets **502**, **506** can extend wider than frame tube **204**. The mating mechanism **402** may be a bung tube and the bung tube **402** may be wider than the frame tube **402** diameter. The bung tube may be attached to a frame interface **406** in multiple locations, e.g., 4 locations along bung tube **402** length, and the frame interface is attached to the frame **404**. Attaching to the frame in this way can minimize scrub. The wheel tube first portion **416** can be cut to length to accommodate particular ATVs. In some embodiments, a trailing arm **200** can have a wheel tube **202** and a frame tube **204** with extra lengths distal of mated section (e.g., welded) **510**. For example, wheel tube first portion **416** can have an axial length that is long enough to accommodate various ATVs and be cut to length. The frame tube **204** can have a distal end, i.e., away from welded section **510** that is cut to length. The extra lengths can provide a universal trailing arm build that can be easily customized

to lengths for various different ATVs. This minimizes part numbers and saves manufacturing time and cost.

(14) FIG. **6** shows, by way of example, a frame tube **204**. The frame tube **204** may have a frame tube distal end **602**. The frame tube distal end **602** can be attached to the frame **404** via a frame tube interface **406**. The frame tube **204** has a proximal end **604** that mates with wheel tube **202**. The frame tube proximal end **604** can be a cut section that has an arc or a radius to mate with wheel tube **202** (e.g., tubular) portion. The frame tube can have various dimensions, in one example, the frame tube **204** has a frame tube effective length **610** of approximately 26.5 inches from wheel tube center axis **606**. In one example frame proximal end **604** has a radius of 3.88 inches. Frame tube **204** can have a frame tube proximal end **604** with a radius of approximately 3 inches and a wall thickness of 0.25 inches. Various dimensions can be used to accommodate specific needs of trailing arm **200**. In some embodiments, frame tube **204** (e.g., tubular) has a frame tube distal end **602** that has a frame tapered portion **608**. The frame tapered portion can have a length of approximately 8 inches. In one embodiment, frame tube **204** has a frame tube distal end **602** that has a diameter of approximately 3 inches.

(15) FIG. **7** shows, by way of example, a wheel tube **202**. Wheel tube **202** has a wheel tube first proximal portion **704** that is an exterior surface (e.g., an exterior surface that faces frontward of ATV **100**) of wheel tube distal portion **418** and the wheel tube first proximal portion **704** can mate with frame tube proximal end **604**. Wheel tube **202** has a wheel tube distal portion **702** thatcan mate with wheel hub **412**. Wheel tube **202** has a second proximal portion **706** that may be tapered for approximately 5 inches. In some embodiments second proximal portion **706** may not be tapered and may be a proximal end of the wheel tube **202** and could be mated to an exterior surface of frame tube **204** or frame tube distal end **604**. Frame tube distal end **604** could be a square cut in some embodiments. Wheel tube **202** may have a wheel tube first (e.g., distal) portion **416** that is circular and has an axial length of approximately 4 inches. Wheel tube distal end **702** may have a diameter of approximately 8 inches. Wheel tube first portion **416** may have a wheel tube first portion proximal end **708** with a length of approximately 4.25 inches (or a length that extends past wheel tube centerline **710**, for example 0.25 inches). Wheel tube distal end **702** may have a diameter of approximately 8 inches. Wheel tube **202** may have a wheel tube wall **714** thickness of 0.25 inches, or 0.375 inches, or tailored to ATV needs. Wheel tube **202** may have an wheel tube maximum length **712**. In one example the wheel tube maximum length is approximately 15.8 inches, extending between wheel tube distal portion distal end **702** and wheel tube proximal portion proximal end **706**. Wheel tube first portion proximal end **708** may have a wheel tube first portion proximal end that is recessed **716**. Recessed portion **716** may extend a distance **718** approximately 2.5 inches from wheel tube distal end **702** and a distance **720** of 1.75 inches.

(16) The frame can be constructed in various ways, for example, U.S. Pat. Nos. 9,493,191 and 10,023,234 are incorporated by reference, and describe how an ATV frame can be made and useful with trailing arms described herein.

(17) It is to be understood that the above reference arrangement are only illustrative of the application for the principles of the present invention. Numerous modifications and alternative arrangements can be devised without departing from the spirit and scope of the present invention. While the present invention has been shown in the drawings and fully described above with particularity and detail in connection with what is presently deemed to be practical and useful embodiment(s) of the invention, it will be apparent to those of ordinary skill in the art that numerous modifications can be made without departing from the principles and concepts of the invention as set forth herein.

Claims

1. A vehicle comprising: a frame; a first rear trailing arm; a rear wheel with a wheel hub space and a wheel hub, wherein the wheel hub is inset to the rear wheel inside of the wheel hub space, wherein the wheel hub has a wheel hub center axis and a wheel axle; wherein the first rear trailing arm has a frame tube portion having a frame tube portion proximal end and a frame tube portion distal end wherein the frame tube portion distal end is configured to be attached to at least a portion of the frame frontward of the wheel hub center axis; wherein the first rear trailing arm has a wheel tube portion angled from the frame tube portion and the wheel tube portion having a wheel tube proximal portion and a wheel tube distal portion, wherein the wheel tube proximal portion is frontward of the wheel hub center axis and wherein the wheel tube proximal portion is a remaining portion of the wheel tube distal portion that has been cutaway; and wherein the wheel tube distal portion is attached to the wheel hub and the wheel tube distal portion has a lumen that surrounds the wheel axle.
2. The vehicle of claim 1 wherein the frame tube proximal portion is attached to the wheel tube proximal portion exterior surface.
3. A method of manufacturing a trailing arm comprising: obtaining a tubular wheel portion for the trailing arm; obtaining a tubular frame portion for the trailing arm; removing a portion of the tubular wheel portion to define a tubular wheel distal portion and a tubular wheel proximal portion wherein the tubular wheel proximal portion is a remaining amount from the removed portion; and attaching the tubular wheel distal portion and tubular frame portion together.
4. The method of claim 3 further comprising cutting the tubular wheel portion to length and the tubular frame portion to length.
5. A trailing arm comprising: a frame tube portion having a frame tube portion proximal end and a frame tube portion distal end wherein the frame tube portion distal end is configured to be attached to at least a portion of a vehicle frame frontward of a wheel hub center axis of a wheel hub; wherein the trailing arm has a wheel tube portion angled from the frame tube portion and the wheel tube portion having a wheel tube proximal portion and a wheel tube distal portion, wherein the wheel tube proximal portion is frontward of the wheel hub center axis and wherein the wheel tube proximal portion is a remaining portion of the wheel tube distal portion that has been cutaway; and wherein the wheel tube distal portion is attached to the wheel hub and the wheel tube distal portion has a lumen that surrounds a wheel axle.