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(54) **EXTRUDED MONOLITHIC ALUMINUM TRAILER LANDING GEAR FOOT AND METHOD OF MAKING SAME**

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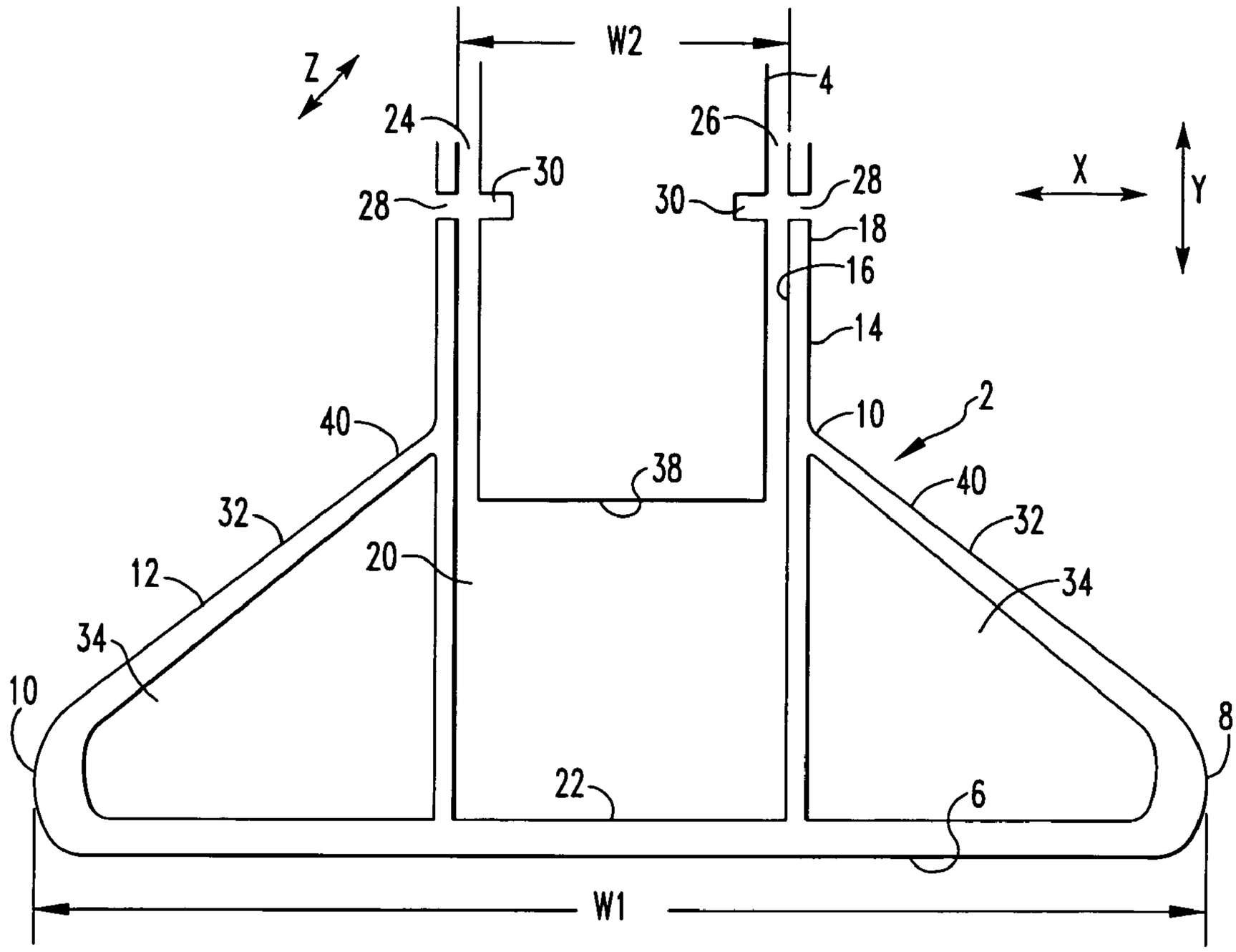
(52) **U.S. Cl.** **248/188.8**

(57) **ABSTRACT**

This invention discloses a monolithic aluminum foot for use with a tractor trailer landing gear. The monolithic foot has a pocket that is adapted to receive the landing gear and one or more support members extending radially outward from the walls of the pocket. The support members are integrally extruded with the walls of the pocket during the extrusion of the foot. The foot and the landing gear have one or more aligned apertures that are adapted to receive one or more locking members, which lock the foot to the landing gear. This invention also discloses an extrusion method of fabricating monolithic foot in tractor trailer gear.



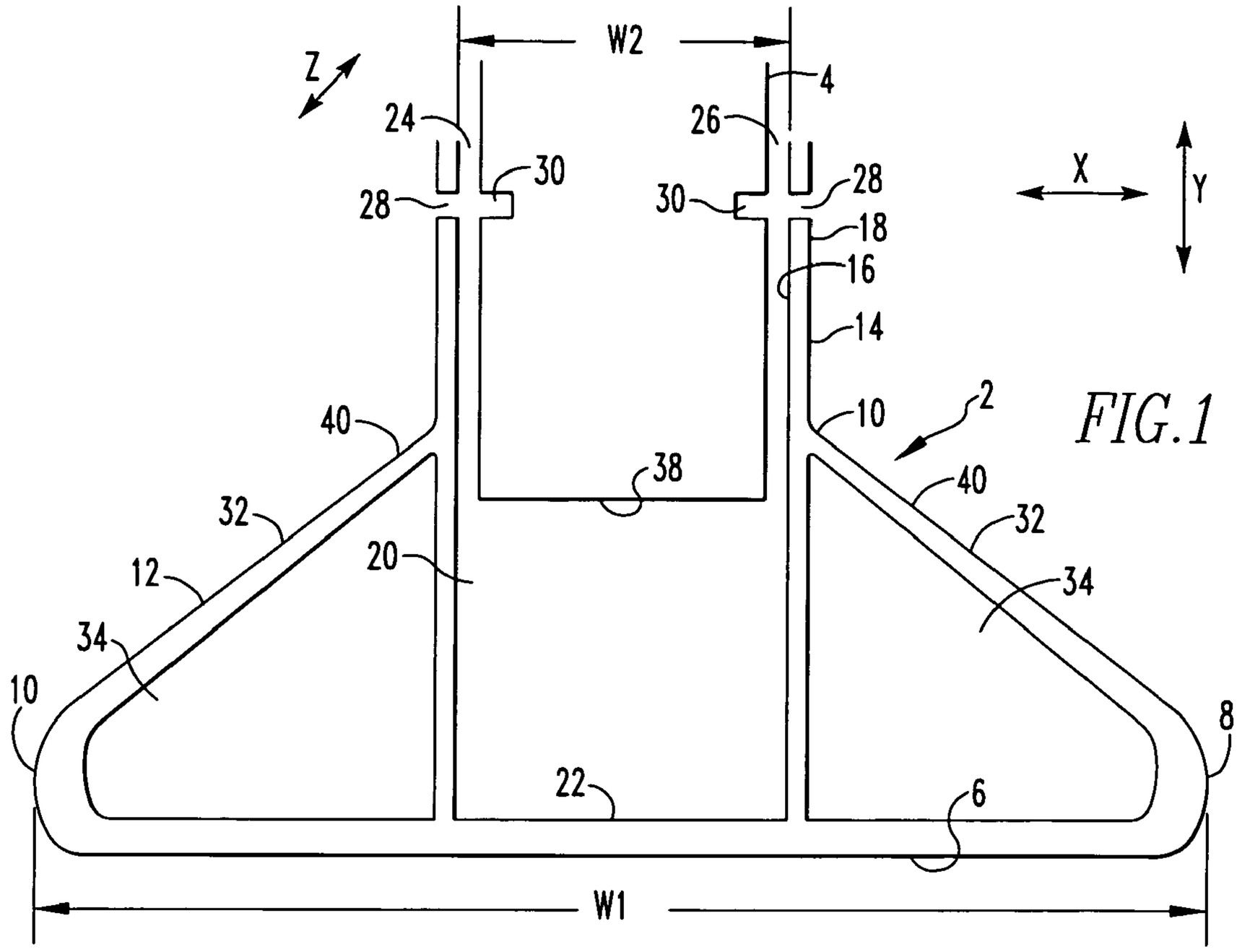

W2
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FIG. 1

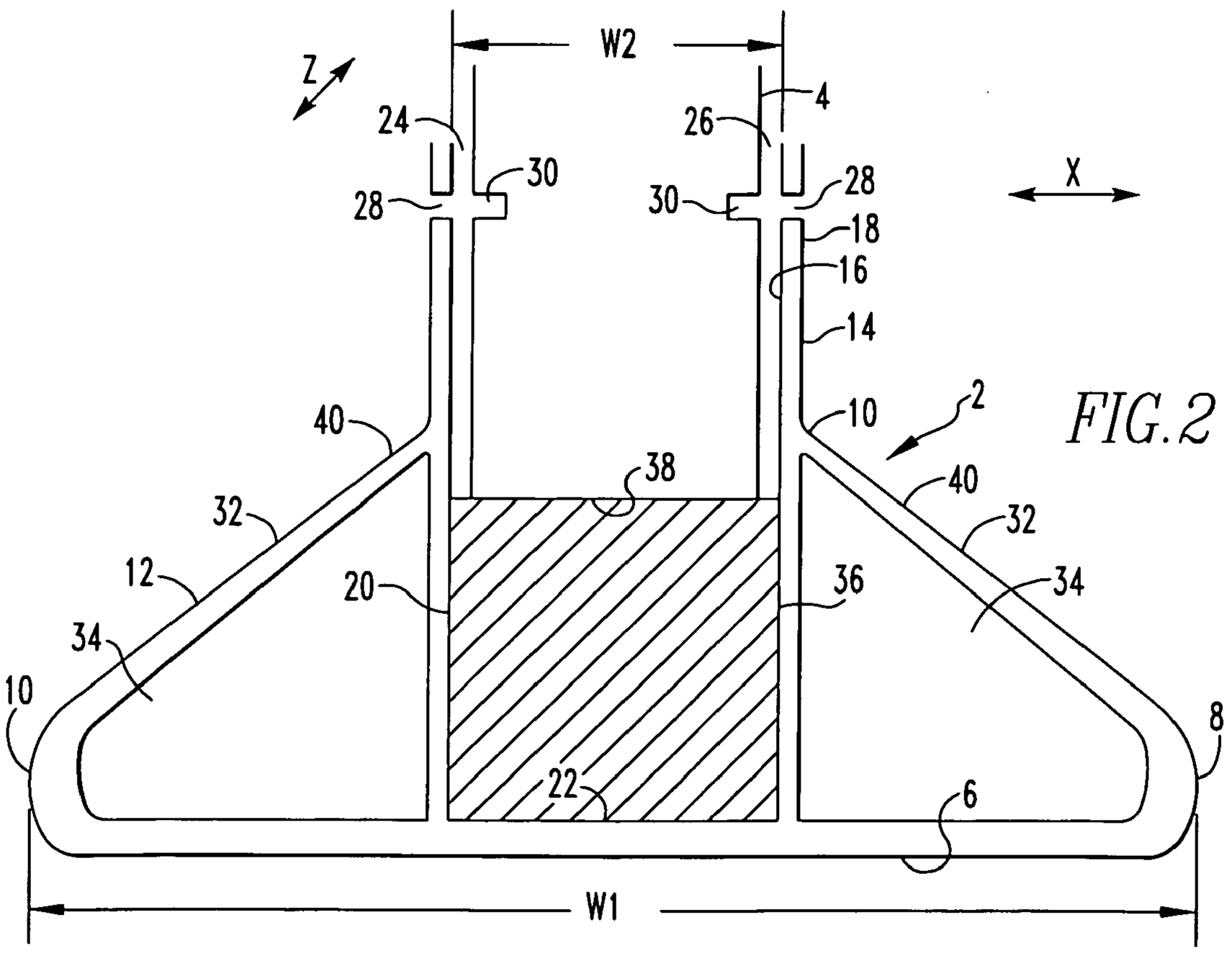
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FIG. 2

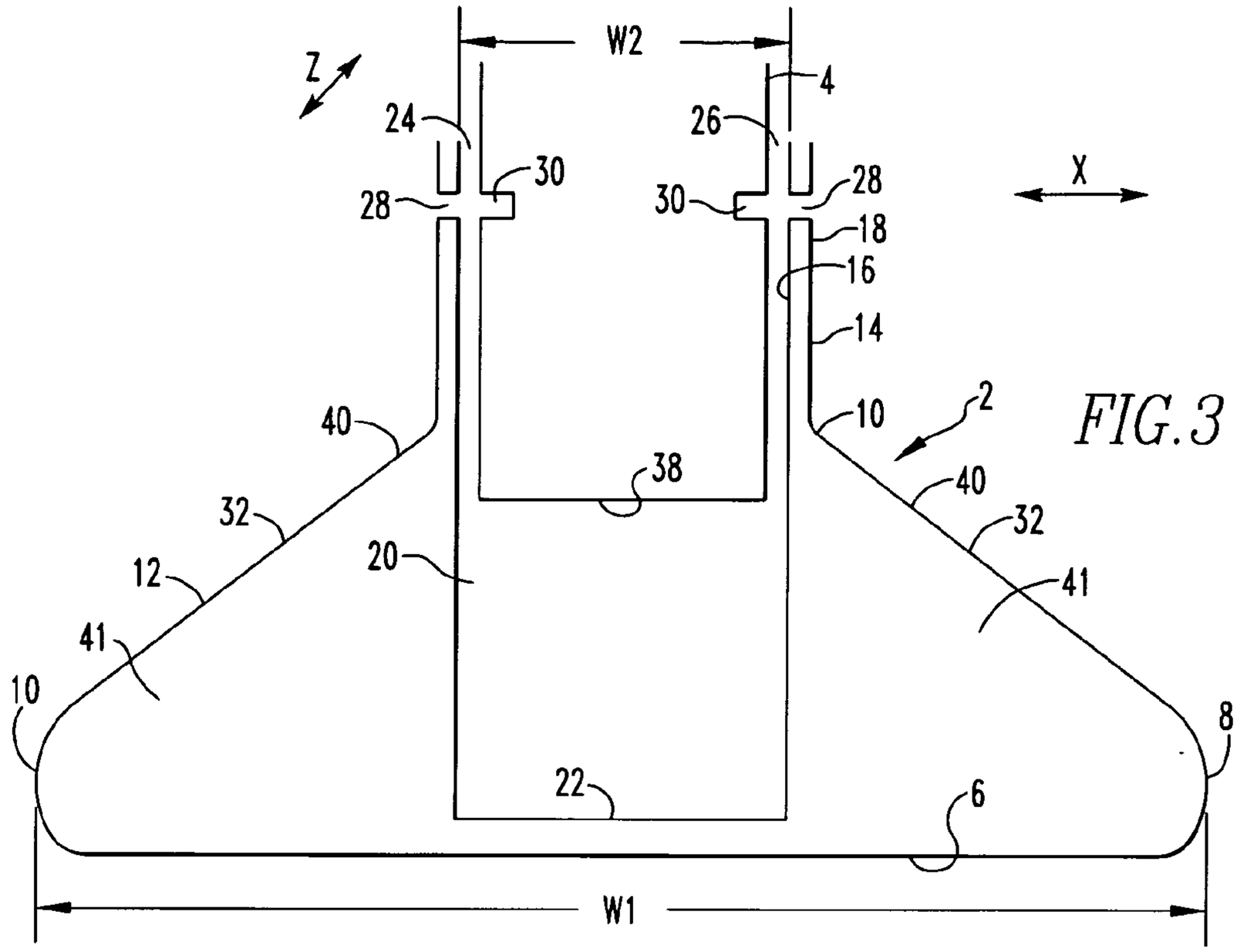
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FIG. 3

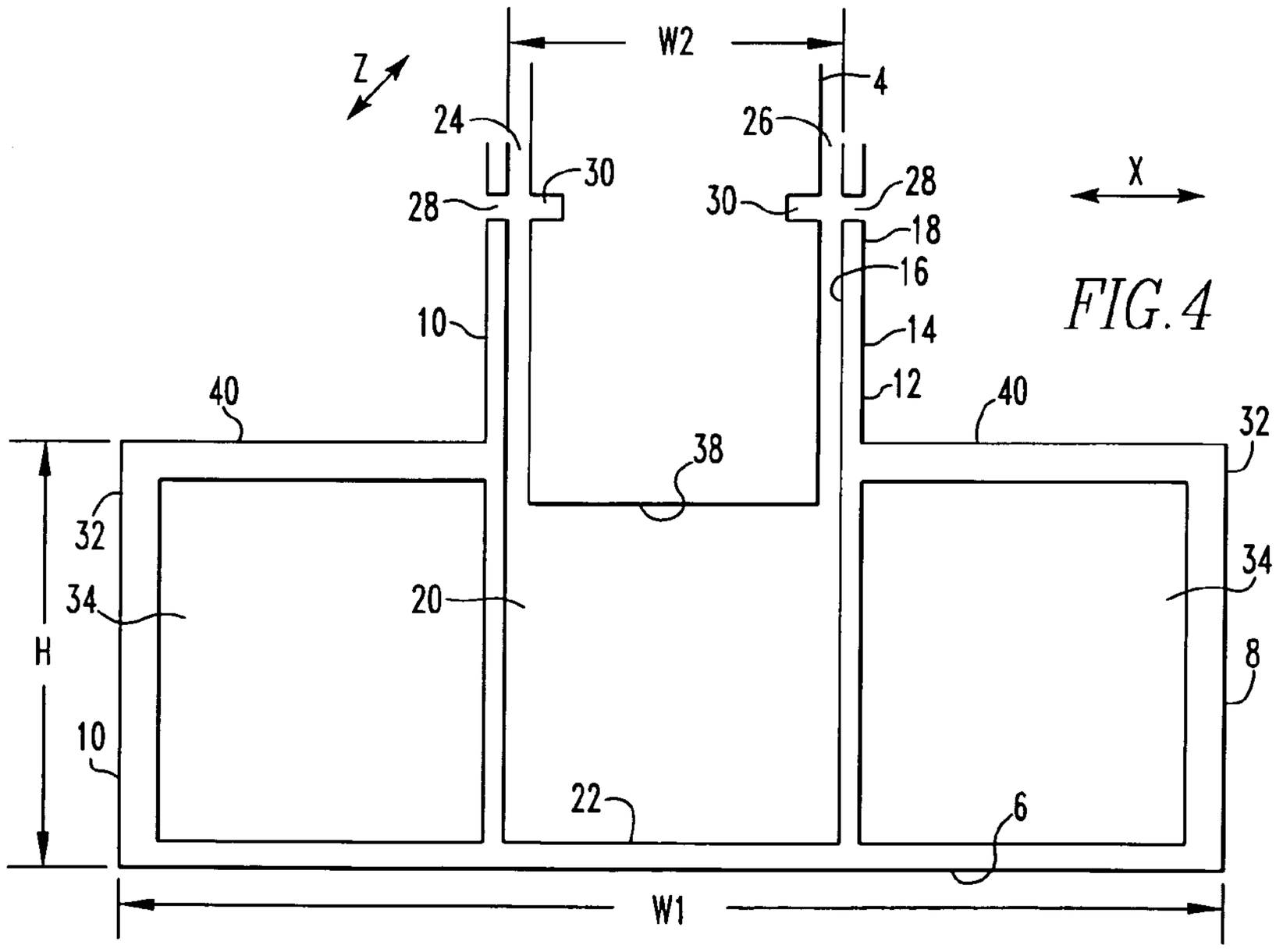
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FIG. 4

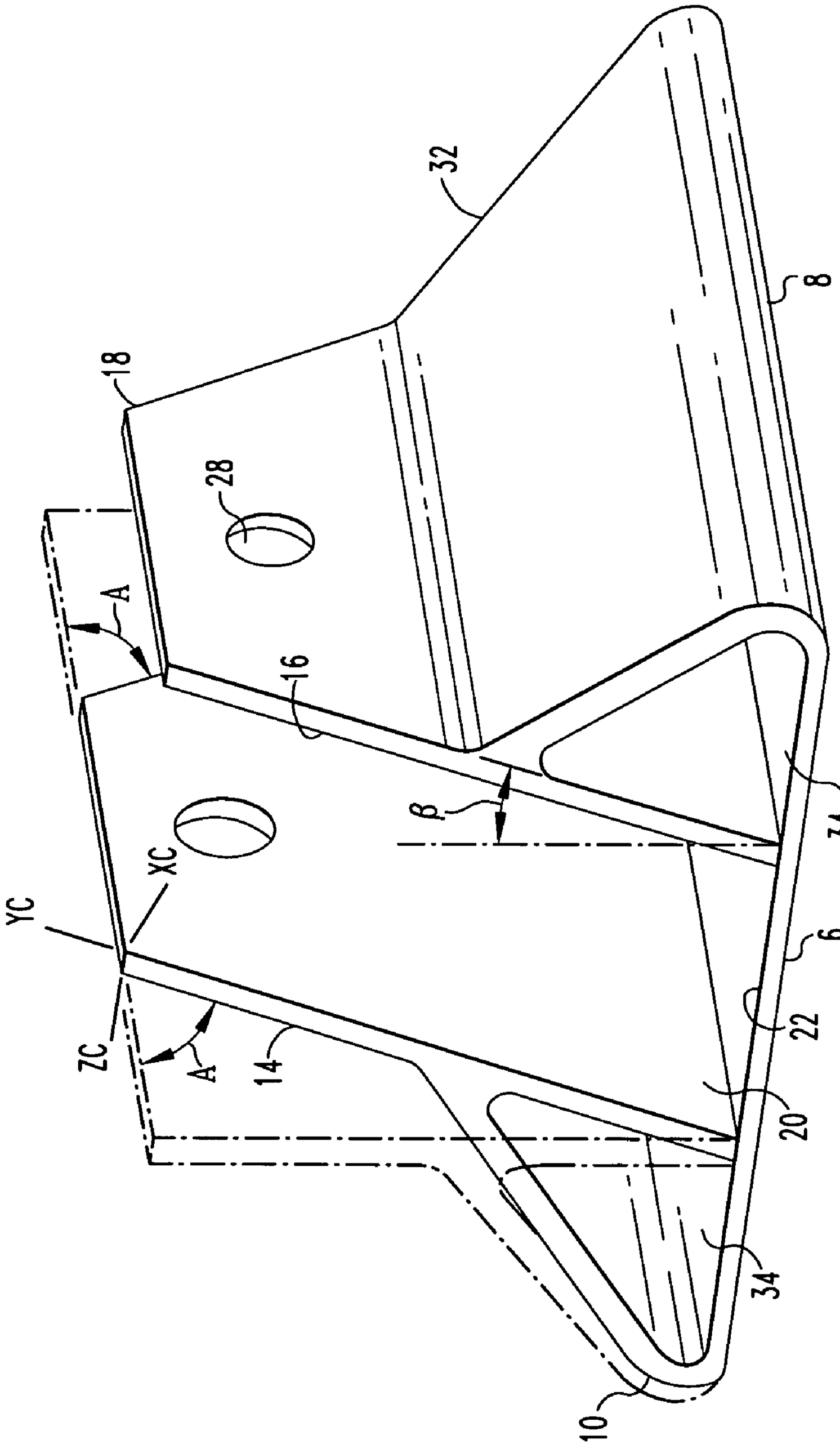

FIG.5

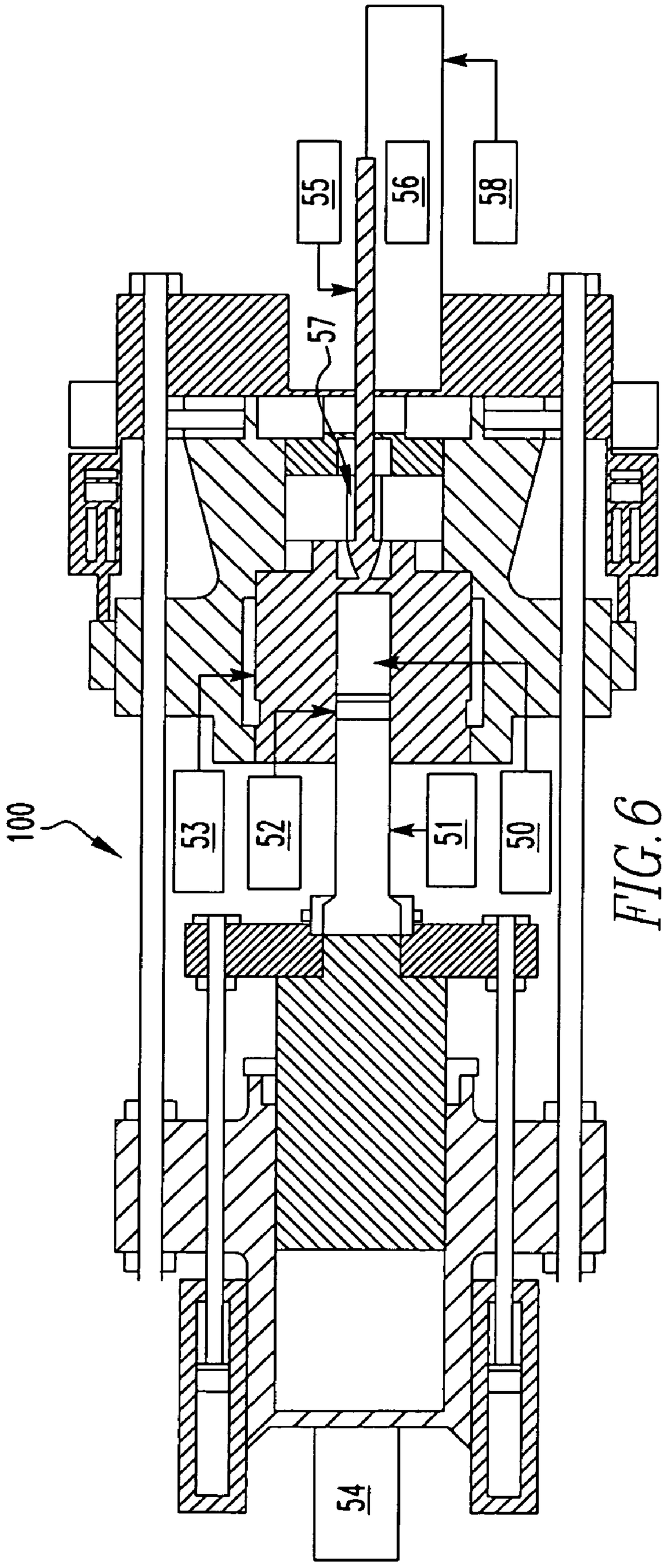

FIG. 6

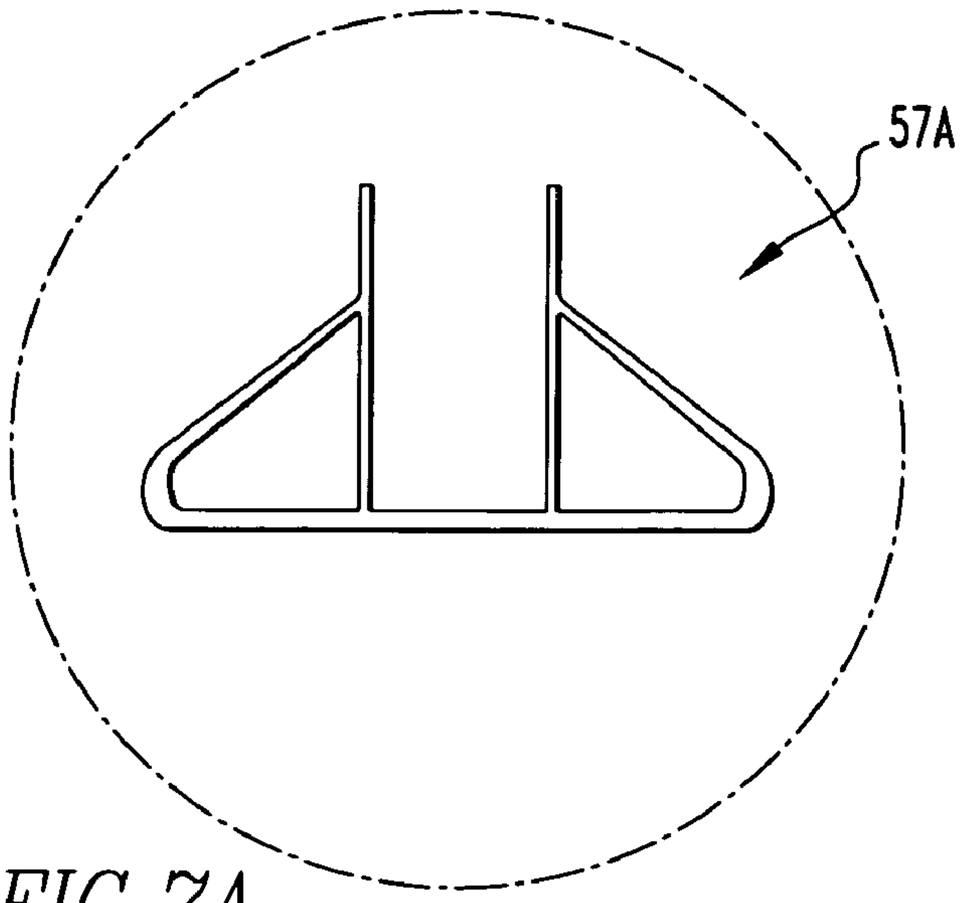

FIG. 7A

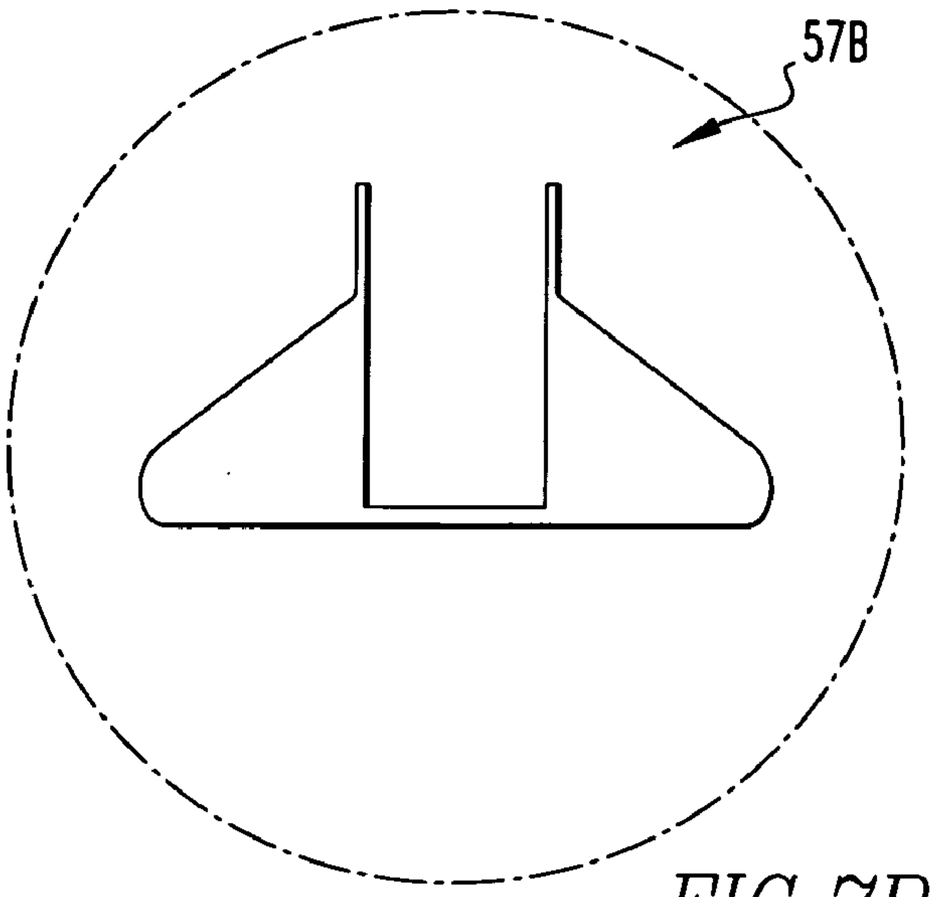

FIG. 7B

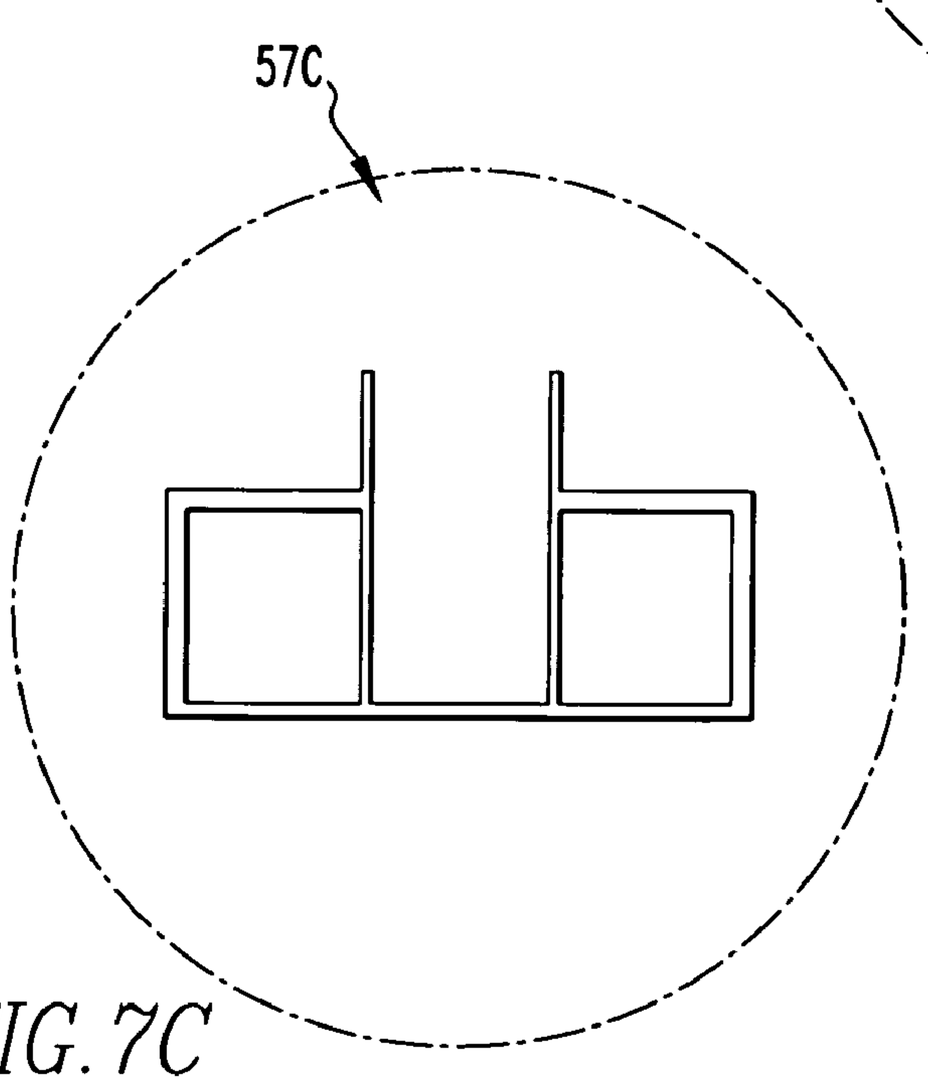

FIG. 7C

EXTRUDED MONOLITHIC ALUMINUM TRAILER LANDING GEAR FOOT AND METHOD OF MAKING SAME

CROSS REFERENCE TO RELATED APPLICATION

[0001] The present invention claims the benefit of U.S. provisional patent application 60/650,421 filed Feb. 4, 2005 the whole contents and disclosure of which is incorporated by reference as is fully set forth herein.

FIELD OF THE INVENTION

[0002] This invention relates generally to landing gear for tractor trailers. Specifically, this invention discloses a monolithic aluminum trailer landing gear foot.

BACKGROUND OF THE INVENTION

[0003] Class 8 tractor-trailers have trailer landing gear, which are extendible legs that support the weight of the trailer when the trailer is disengaged from the tractor (i.e. motor vehicle, commercial truck, or military truck). At the end of the landing gear is a foot that provides a stable and level platform onto which the trailer's weight may be supported. Durability requirements as well as the anticipated foundation on which the foot will rest upon (e.g. on-road or off-road). are a few factors that are considered by the landing gear manufacturer when selecting an appropriate foot for the tractor trailer's landing gear.

[0004] Traditional tractor trailer landing feet have been manufactured by welding several steel components together. For instance, a typical foot would be comprised of two main components: (1) a housing and (2) a pan. The housing is a structure that is adapted to receive one end of a tractor trailer landing gear through an open end. The typical dimensions of the housing structure is about 10.16 cm×10.16 cm (4 in.×4 in.). The housing structure also has one or more apertures that aligned to one or more apertures located on the landing gear. These apertures are adapted to receive an axle (e.g. pin or bolt) which locks the housing to the landing gear. The pan is typically a 30.48 cm×30.48 cm (12 in.×12 in.) piece of flat steel having one or more stiffening ribs and/or flanges that prevent the pan from bending under a force (e.g. weight of the trailer or side loading force). To fabricate the foot, the pan is welded to the housing structure.

[0005] There are several disadvantages with current steel landing gear feet. First, steel landing gear feet add to the total gross weight of the trailer thereby reducing the fuel efficiency of the tractor, as well as the total amount of material that may be loaded into the trailer. Another disadvantage of the steel foot is the amount of process steps required for manufacture, including welding and painting. Yet another disadvantage of steel landing gear feet is that the feet will eventually corrode from abrasion and exposure to salt. Finally, mechanical failure of a steel foot is possible, since the foot is comprised of two or more welded components.

[0006] Therefore, there exists a need for a landing gear foot that is lightweight, durable, and easily fabricated.

SUMMARY OF THE INVENTION

[0007] This invention discloses a monolithic foot for use with tractor trailer landing gear. The monolithic foot has a top surface, a bottom surface, a first end, a second end. At least two fins extend substantially vertically upward from the bottom surface of the monolithic foot. The fins have an interior wall and an exterior wall. The fins are positioned so that a pocket is formed between the interior surfaces of each fin. The pocket has at least one interior wall, a bottom wall, and an open upper end with an opening. The opening is located opposite the bottom wall of the pocket. The pocket is adapted to receive the landing gear through the opening of the open upper end. The foot has one or more support members extending radially outward from the exterior wall of the fins. The support members are integrally extruded into the exterior walls of the fins during the fabrication of the foot. The foot and the landing gear have one or more aligned apertures that are adapted to receive one or more locking members, which lock the foot to the landing gear.

[0008] In one embodiment, the support members are angular gussets. In other embodiments, the support members have a substantially rectangular, square, or U-shape. The support members may be solid or have a hollow interior. In one embodiment, the foot pivots relative to the landing gear.

[0009] In another aspect of the present invention, a method is provided for producing the above described monolithic foot. Broadly, the method includes the steps of providing a metal billet; and pressing the metal billet through a die to provide a profile of a foot engageable to the landing gear of a trailer. Pressing the metal through a die may include an extrusion process. The method may further include the steps of sectioning the profile into at least two feet; and heat treating each of the feet.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] **FIG. 1** (side cross-sectional view) is a schematic showing one preferred embodiment of the invention depicting the foot and landing gear.

[0011] **FIG. 2** (side cross-sectional view) is a schematic showing one preferred embodiment of the invention depicting a resilient cushion or pad positioned within the cavity of the foot.

[0012] **FIG. 3** (side cross-sectional view) is a schematic showing one preferred embodiment of the invention depicting the support members as having a solid interior.

[0013] **FIG. 4** (side cross-sectional view) is a schematic showing one preferred embodiment of the invention depicting the support members as having a rectangular shape.

[0014] **FIG. 5** (prospective view) is a three dimensional view of a preferred embodiment of the invention.

[0015] **FIG. 6** (schematic view) depicts one embodiment of an extruder.

[0016] FIGS. **7**(*a*)-(*c*) (front view) depict embodiments of extrusion dies to provide monolithic landing gear feet in accordance with the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0017] The accompanying figures and the description that follows set forth this invention in its preferred embodiments. However, it is contemplated that persons generally familiar with tractor trailer landing gears will be able to apply the

novel characteristics of the structures and methods illustrated and described herein in other contexts by modification of certain details. Accordingly, the figures and description are not to be taken as restrictive on the scope of this invention, but are to be understood as broad and general teachings. When referring to any numerical range of values, such ranges are understood to include each and every number and/or fraction between the stated range minimum and maximum. Finally, for purposes of the description hereinafter, the terms "upper", "lower", "right", "left", "vertical", "horizontal", "top", "bottom", and derivatives thereof shall relate to the invention, as it is oriented in the drawing figures.

[0018] This invention discloses a monolithic aluminum landing gear foot that is able to withstand lateral loads greater than 13,000 pounds (lbs.) per Association of American Railroads (AAR) M-931-99 5.6.1 specifications and that is approximately half the weight of current steel landing gear foots. The term "monolithic", as used throughout this paper, denotes a unitary structure, wherein the unitary structure is not provided by a welded or mechanical fusion of multiple structures. The inventive monolithic aluminum landing gear foot, by eliminating the need of having to weld multiple components together to fabricate a foot, reduces the total cost associated with the manufacture of a landing gear foot.

[0019] The foot disclosed in this invention can be formed from the Aluminum Association 6XXX or 7XXX series of aluminum alloys. 6XXX series alloys typically include magnesium and silicon as the principal alloying elements. 7XXX series alloys typically include zinc as the principal alloying element. Specifically, the foot can be fabricated from a 6061-T6 or a 7005-T6 aluminum alloy. AA 6061 typically includes 0.40-0.80 wt. % Si, less than 0.7 wt. % Fe, 0.15-0.40 wt. % Cu, less than 0.15 wt. % Mn, 0.8-1.2 wt. % Mg, 0.04-0.035 wt. % Cr, less than 0.25% Zn, and less than 0.15 wt. % Ti. AA 7005 typically includes less than 0.35 wt. % Si, less than 0.40 wt. % Fe, less than 0.10 wt. % Cu, 0.20-0.70 wt. % Mn, 1.0-1.8 wt. % Mg, 0.06-0.20 wt. % Cr, 4.0-5.0 wt. % Zn, and 0.01-0.06 wt. % Ti.

[0020] As can be seen in **FIG. 1**, this invention discloses an extruded monolithic aluminum foot **2** for use with an extendable and retractable tractor trailer landing gear **4** (e.g. telescopic leg), which supports a tractor trailer (not shown) when extended and suspended from the tractor trailer when retracted. The foot **2**, which can be extruded using extrusion processes that are commonly known in the art, has a bottom surface **6**, a first end **8**, a second end **10**, and a top surface **12**. One or more fins **14** extend substantially vertically upward from the bottom surface **6** of the foot **2**. The fins **14** have an interior wall **16** and an exterior wall **18**. The fins **14** are positioned so that a pocket **20** is formed between the interior walls **16** of the fins **14**.

[0021] The pocket **20** includes at least one interior wall **16**, a bottom wall **22**, and open upper end **24**. The open upper end **24** has an opening **26** that is located opposite the bottom wall **22** of the pocket **20**. The pocket **20** is adapted to receive the landing gear **4** through the opening **26** of the open upper end **24**. The bottom surface **6** of the foot **2** is the surface of the foot **2** that comes into contact with the ground.

[0022] In an alternative embodiment, a resilient cushion or pad (not shown) may be attached to the bottom surface **6** in order to provide a shock absorber between the bottom surface **6** of the foot **2** and the ground. It is noted that one skilled in the art would recognize that the edges of the bottom surface **6** of the foot **2** may be curled upward toward the top surface **12** thereby allowing the foot **2** to easily slide if dragged in the direction of Z, wherein the Z direction is defined along an axis perpendicular to both the x-axis and y-axis, as depicted in **FIG. 1**.

[0023] The foot **2** and the landing gear **4** are connected by one or more locking members (not shown) that extend through aligned aperture **28** of the foot **2** and aperture **30** of the landing gear **4** thereby locking foot **2** to landing gear **4**. The locking member can be an axle, a bolt, or a pin. If desired the axles, bolts, or pins allow the foot **2** to pivot relative to the landing gear **4**.

[0024] One or more support members **32** extend outward from the exterior wall **18** of the fins **14**. In other words, the support members **32** extend away from an axis of the pocket **20**. The support members **32** are integrally extruded with the fins **14** and the bottom surface **6** during the extrusion of the foot **2**. In the embodiment shown in **FIG. 1**, the support members **32** are angular gussets. The support members **32** may prevent the foot **2** from bending when a side loading force X is applied to the foot **2**. As can be seen in **FIG. 1**, the angular gusset support members **32** have a substantially triangular shape with a substantially triangular hollow interior **34**. The hollow interior **34** of the support members **32** aide in reducing the total weight of the foot **2**.

[0025] W**1** is the distance between a first end **8** of the foot **2** and a second end **10** of the foot **2** (i.e. width of the foot **2**). The width W**1** of the foot **2** can range from about 22.86 cm to about 30.48 cm (9 in. to 12 in.). The width W**1** of the foot can vary depending on the surface onto which the foot **2** would rest. For example, if the foot **2** is going to rest on a soft surface (e.g. sand), then W**1** will be longer since the area of the foot **2** must be larger in order to support the weight of the trailer on a soft surface. In contrast, if the foot **2** is going to rest on a hard surface (e.g. asphalt), then W**1** can be shorter since the area of the foot **2** does not have to be large since the surface will provide additional support to the trailer.

[0026] W**2** is the distance between the interior walls **16** of the pocket **20**. W**2** can range from about 7.62 cm to about 12.70 cm (3 in.-5 in.). It is noted that the above described dimensions are provided for illustrative purposes only and are not deemed to limit the invention, since the dimensions of W**1** and W**2** may be selected to provide structural integrity to the foot that is required for any application and service.

[0027] **FIG. 2** depicts another preferred embodiment of the invention. In this embodiment, a resilient cushion or pad **36** is placed between the bottom **38** of the landing gear **4** and the bottom wall **22** of the pocket **20**. The function of the resilient cushion/pad **36** is to act as a shock absorber so that shocks are absorbed by the cushion **36** when the landing gear **4** is extended to support the trailer. In one embodiment, the resilient cushion/pad **36** is formed from a material that may include a styrene-butadiene copolymer. The resilient cushion/pad **36** may be other resilient elastic materials, preferably being rubber.

[0028] **FIG. 3** depicts another embodiment of this invention. As can be seen in **FIG. 3**, the foot **2** has two support

members **32** extending from the exterior walls **18** of the fins **14**. However, in this embodiment the support members **32** do not have a hollow interior **34**. Rather, the interior **41** of the support members **32** in this embodiment are solid metal. A support member **32** with a solid interior **41** would be able to withstand greater side loading force X than a support member **32** having a hollow interior **34**. However, the solid interior **41** of the support members **32** would also increase the total weight of the foot **2**.

[**0029**] **FIG. 4** depicts yet another embodiment of this invention. In this embodiment, the support members **32** have a substantially rectangular or square shape. As can be appreciated by one skilled in the art, the height H of the support members **32** may be varied depending upon the manufacturer's specifications. It is noted that the support members **32** in **FIG. 4** could also have rounded edges at the first and second ends **8** and **10** thereby creating a support member **32** with a substantially U-shape. As in the embodiments described above, the support members **32** in this embodiment could have either a hollow or solid interior **34**. Additional stiffening ribs and or flanges may (not shown) may be placed adjacent the top surface **40** of the support members **32** thereby providing additional support to the support members **32**.

[**0030**] As can be seen in **FIG. 5**, the fins **14** and the support members **32** maybe saw cut at an angle A to reduce the weight of the foot **2**. It is noted that one skilled in the art would appreciate that the angle A on one side of the foot **2** can either be the same angle or a different angle from the angle A on the opposite side of the foot. Angle β as formed between the front or rear face of the foot **2** and the foot's base **6** (also referred to as bottom surface) is preferably less than 90 degree's.

[**0031**] Another aspect of the present invention is a method of forming the above monolithic aluminum landing gear foot, in which the monolithic aluminum landing gear foot is provided by an extrusion processes. Extrusion is defined as the process of shaping material, such as aluminum, by forcing it to flow through a shaped opening in a die.

[**0032**] Referring to **FIG. 6**, in one embodiment of an extrusion process, in a first process step, billets **50**, preferably being aluminum are heated to a temperature on the order of about 800° F. (approximately 420° C.) to about 950° F. (approximately 500° C.). The billet **50** may be cut to predetermined dimensions and fed into the extrusion press. The extrusion press **100** may include main cylinder **54** having a chamber and cylinder into which hydraulic fluid is pumped to generate the desired movement. Once the billet **50** reaches the appropriate temperature, the billet **50** is transferred to a loader where a thin film of smut or lubricant may be added to the billet **50** and a ram **51** of the extrusion press **100**. The smut or lubricant acts as a parting agent to ensure that the billet **50** and the ram. **51** do not stick together. The ram **51** may be a steel rod attached to the main cylinder **54** and having a dummy block **52** at the end of the ram **51** that applies pressure to the billet **50**.

[**0033**] The billet **50** is then transferred to a cradle, wherein the ram **51** applies pressure to a dummy block **52**, which in turn pushes the billet **50** until within the container **53**. The dummy block **52** is a tight fitting steel block attached to the ram **51** stem, which seals the billet **50** in the container **53** and prevents the metal from leaking backward. The container **53** is a chamber in the extrusion press **100** that holds the billet **50** as it is pushed through a die at one end of the chamber, which is under pressure from the dummy block **52** and ram **51** entering at the opposing end of the chamber.

[**0034**] In a next process step, the billet **50** being under pressure is crushed against the die, wherein the billet **50** becomes shorter and wider until it is in full contact with the container walls **53**. In a preferred embodiment, as aluminum is flowing through the die, a cooling means, such as liquid nitrogen, is directed around or flows through at least some portions of the die. In some embodiments, nitrogen gas is utilized instead of liquid nitrogen, wherein nitrogen gas provides an inert atmosphere that may increase the life of the die.

[**0035**] The pressure provided to the billet **50** causes the soft but solid metal to squeeze through the die opening. Referring to **FIG. 7**(*a*), the die **57***a* may have a profile that is selected to provide a monolithic landing gear foot having angled gussets **34**, as depicted in **FIGS. 1 and 2**. Referring to **FIG. 7**(*b*), the die **57***b* may have a profile that is selected to provide a monolithic landing gear foot having solid angled gusset support members **41**, as depicted in **FIG. 3**. Referring to **FIG. 7**(*c*), the die **57***c* may have a profile that is selected to provide a monolithic landing gear foot having rectangular support members, as depicted in **FIG. 4**. As illustrated in FIGS. **7**(*a*)-**7**(*c*), the profile of the die determines the monolithic landing gear foot's **2** cross-sectional profile, wherein the monolithic landing gear foot's bottom surface **6**, first end **8**, second end **10** and top surface **12** are provided in a unitary structure. It is noted that the term unitary denotes that the entire structure of the monolithic landing gear's foot is simultaneously formed, as opposed to being separately formed and then mechanically fastened or welded together.

[**0036**] Referring back to **FIG. 6**, the extrusion is pushed through the die to the leadout table and puller, which guide the metal down the run out table **58** during extrusion. In some embodiments, the extrusion may be cooled by forced air (fans) or by water quench. When an extrusion reaches a desired length, the extrusion is cut with a profile saw or shear. After the extrusion has cooled, the extrusion may be stretched, wherein stretching straightens the extrusion and performs work hardening.

[**0037**] In a next process step, the extrusion is transferred to a sawing table and cut to a specific length. During this process step, the length of the monolithic landing gear foot is determined. The extrusion may be cut along a direction perpendicular to the direction in which the extrusion is formed, wherein the front and rear faces of the monolithic foot are at a 90 degree angle to the monolithic foot's base. In another embodiment, the extrusion may be cut in an angled orientation, as depicted in **FIG. 5**. The aligned aperatures **28** may also be machined into the fins **14**, **16** of each monolithic landing gear foot during this stage of the process.

[**0038**] After the extrusion is cut into a plurality of monolithic lander gear feet, each of the monolithic landing gear feet may then be treated using heat treatments or aging processes. In one example, heat treating or aging hardens the metal by speeding the aging process in a controlled temperature environment for a set amount of time. T5 temper denotes that the monolithic landing gear is artificially aged

after extrusion, to improve mechanical properties or dimensional stability, or both. T6 temper denotes a solution heat-treatment and then artificially aging to peak strength.

[0039] It is noted that the above description of extrusion is for illustrative purposes only and the present invention is not limited to the above described process steps, as other intermediate process steps and conditions are also contemplated and within the scope of the present invention.

[0040] The present invention provides a lightweight trailer landing gear foot.

[0041] Another aspect of this invention is to reduce the cost of manufacturing a trailer landing gear foot by eliminating the need for having to weld multiple components to manufacture the foot.

[0042] Having described the presently preferred embodiments, it is to be understood that the invention may be otherwise embodied within the scope of the appended claims.

What is claimed is:

1. A trailer landing gear structure comprising:

a monolithic foot formed from a metal and engageable to a landing gear of a trailer.

2. The trailer landing gear according to claim 1 wherein said metal is an aluminum alloy.

3. The trailer landing gear structure according to claim 1 wherein said aluminum alloy is selected from a 6XXX or 7XXX series of aluminum alloys.

4. The trailer landing gear structure according to claim 1 wherein:

said monolithic foot comprises at least two fins extending substantially vertically upward from a bottom surface, each of said at least two fins having an interior wall and an exterior wall positioned so that a pocket is formed between said interior walls of each of said at least two fins, said pocket having a bottom wall and an open upper end configured to receive said landing gear;

said monolithic foot having one or more support members extending outward from said exterior wall of each of said at least two fins; and

one or more apertures in each of said at least two fins that are configured to receive one or more locking members, wherein said locking members lock said monolithic foot to said landing gear.

5. The trailer landing gear structure according to claim 4 wherein said one or more support members are angular gussets.

6. The trailer landing gear structure according to claim 4 wherein said one or more support members have a substantially rectangular, square, or U-shape.

7. The trailer landing gear structure according to claim 4 further comprising a resilient pad positioned within said pocket between a bottom surface of said landing gear and a bottom wall of said pocket.

8. The trailer landing gear structure according to claim 4 wherein said locking members comprises an axle, bolt, or pin.

9. The trailer landing gear structure according to claim 4 wherein said support members have a hollow or solid interior.

10. The trailer landing gear structure according to claim 4 wherein said at least two fins and said support members are at an angle of less than 90 degrees relative to said bottom surfice of said monolithic foot base.

11. A method of making a trailer landing gear structure comprising: providing a metal billet; and pressing said metal billet through a die to provide a profile of a foot engageable to a landing gear of a trailer.

12. The method of claim 11, wherein said metal billet comprises aluminum.

13. The method of claim 12, wherein said pressing said metal billet through a die comprises an extrusion process.

14. The method of claim 12, further comprising sectioning said profile into at least two feet; and heat treating said at least two feet.

15. The method of claim 14 wherein said profile of said each of said feet comprise at least two fins extending substantially vertically upward from a bottom surface, each of said at least two fins having an interior wall and an exterior wall positioned so that a pocket is formed between said interior walls of each of said at least two fins, said pocket having a bottom wall and an open upper end configured to receive a landing gear; and

said each of said feet having one or more support members extending outward from said exterior wall of each of said at least two fins.

16. The method of claim 15 wherein said one or more support members are angular gussets.

17. The method of claim 15 wherein said one or more support members have a substantially rectangular, square, or U-shape.

18. The method of claim 15 wherein said support members have a hollow or solid interior.

19. The method of claim 15 further comprising forming one or more apertures in said fins that are adapted to receive one or more locking members, wherein said locking members lock said foot to said landing gear.

20. The method of claim 15 wherein said fins and said support members are saw cut at an angle of less than 90 degrees relative to a base of said foot.

* * * * *