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(54) **COMPACT TOOL CARRIER AND MAINFRAMES FOR A SELF-PROPELLED MACHINE**

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B66F 9/06 (2006.01)
B60P 1/48 (2006.01)
(Continued)

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(58) **Field of Classification Search**
CPC B62D 21/16; B62D 21/186; B62D 51/007; B62D 51/02; B62D 51/04; B66F 9/065;
(Continued)

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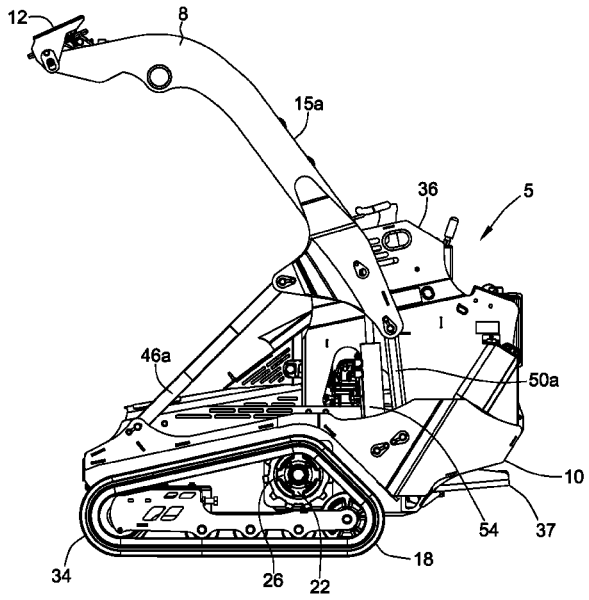
(57) **ABSTRACT**

Mainframes for a self-propelled machine are disclosed. The mainframe includes first and second pockets that extend from the front end to the rear end of the mainframe. A hydraulic reservoir housing extends from the first side to the second side of the mainframe. The hydraulic reservoir housing is disposed between the front end of the mainframe and first and second drive openings.

14 Claims, 7 Drawing Sheets



Related U.S. Application Data

continuation of application No. 16/270,070, filed on Feb. 7, 2019, now abandoned, which is a continuation of application No. 15/704,685, filed on Sep. 14, 2017, now Pat. No. 10,202,266, which is a continuation of application No. 15/062,801, filed on Mar. 7, 2016, now Pat. No. 9,975,750, which is a continuation of application No. 14/691,649, filed on Apr. 21, 2015, now Pat. No. 9,321,386.

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CPC .. B66F 9/075; B66F 9/07513; B66F 9/07518; B66F 9/07527; B66F 9/07572; B66F 9/07577; B60P 1/483; E02F 9/08; E02F 9/0816; E02F 9/0825

See application file for complete search history.

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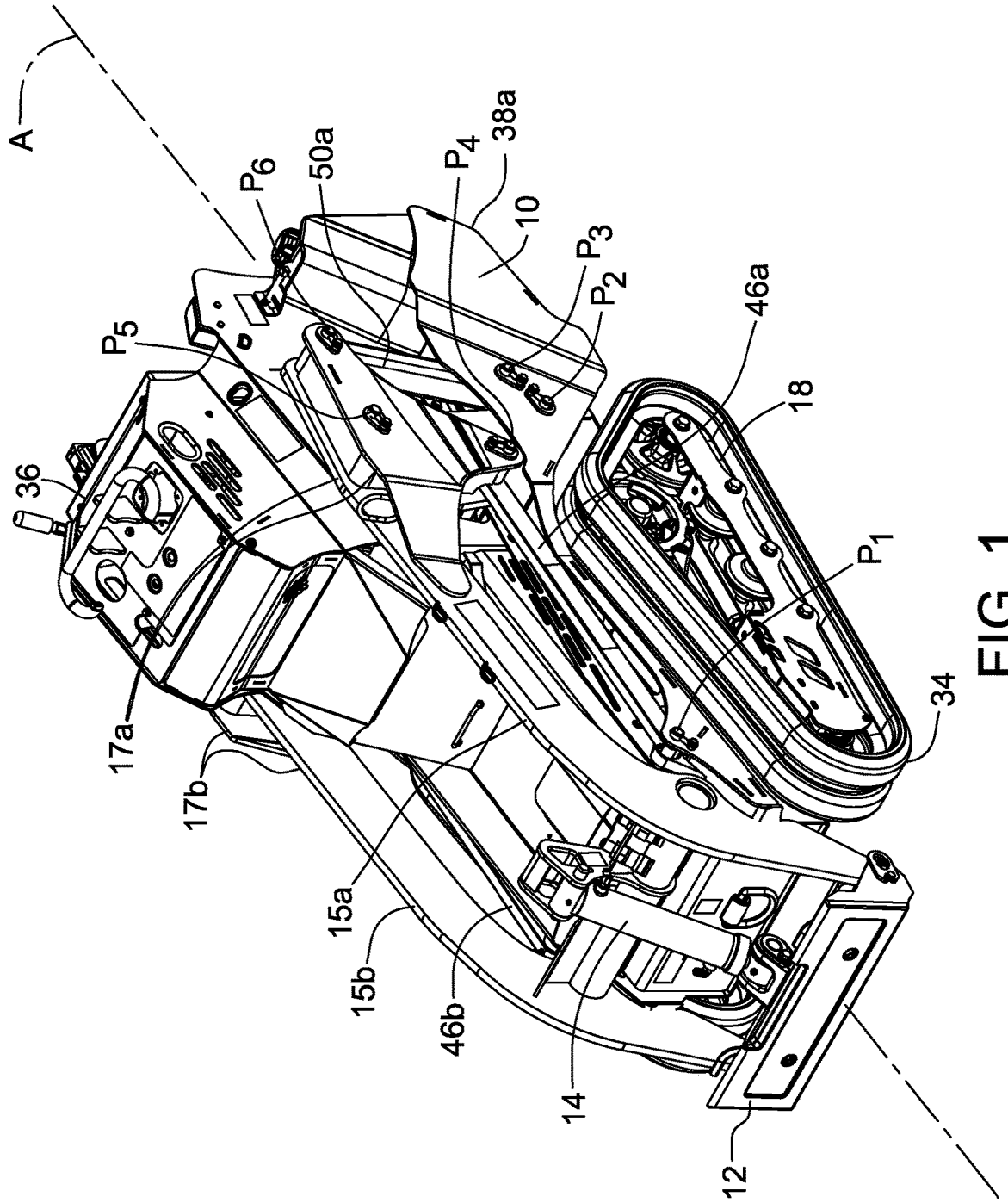

FIG. 1

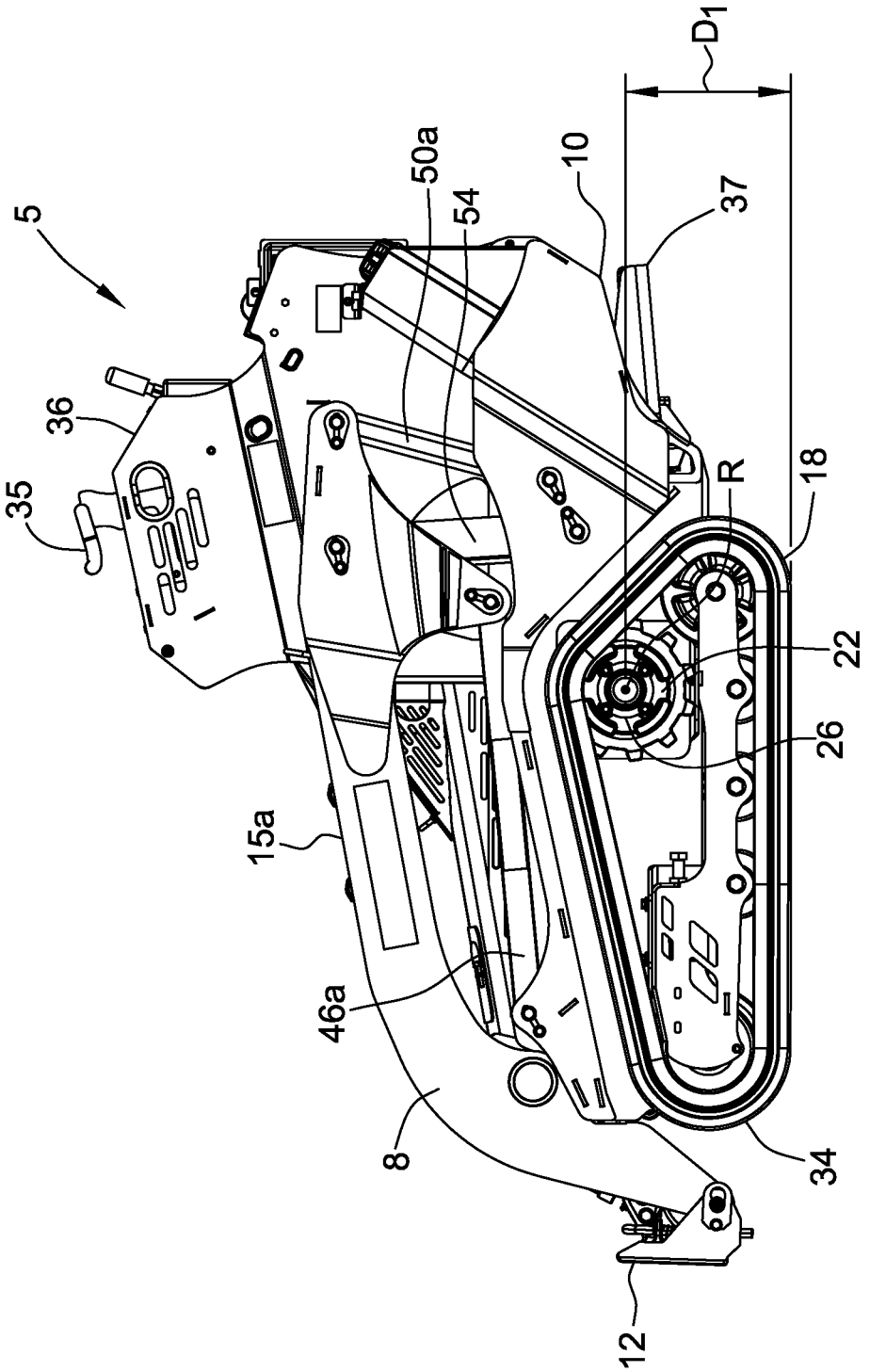

FIG. 2

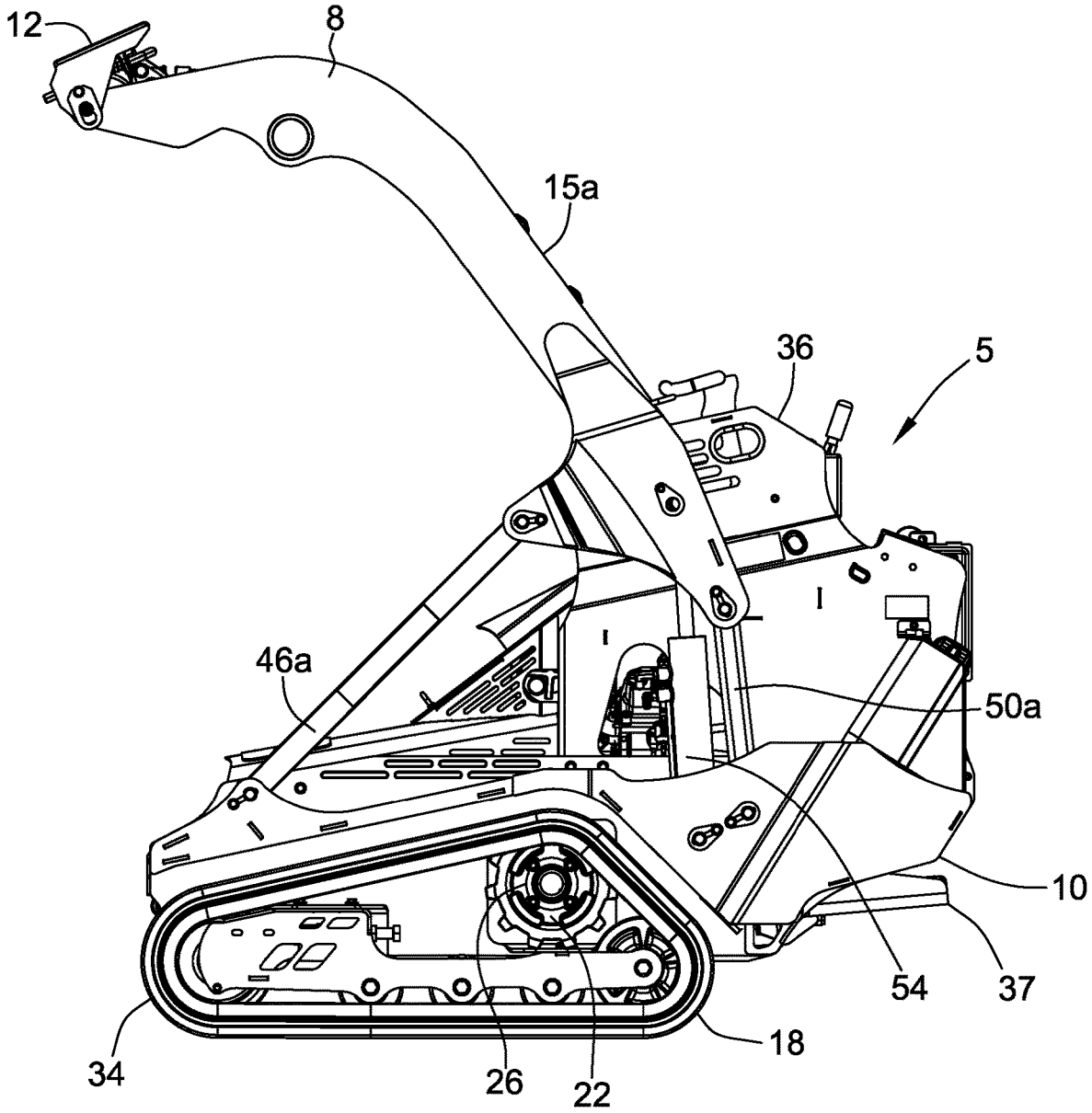

FIG. 3

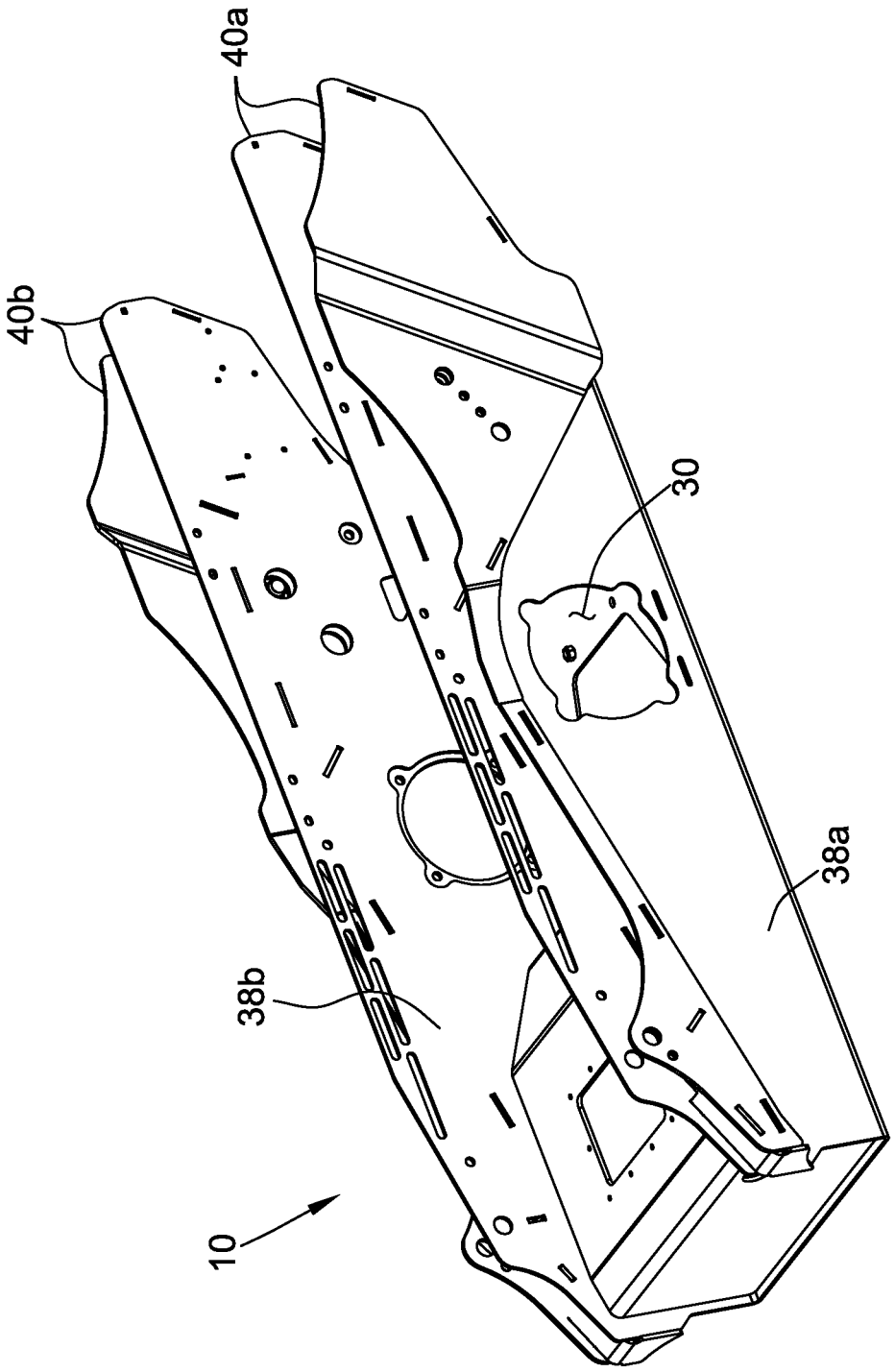

FIG. 4

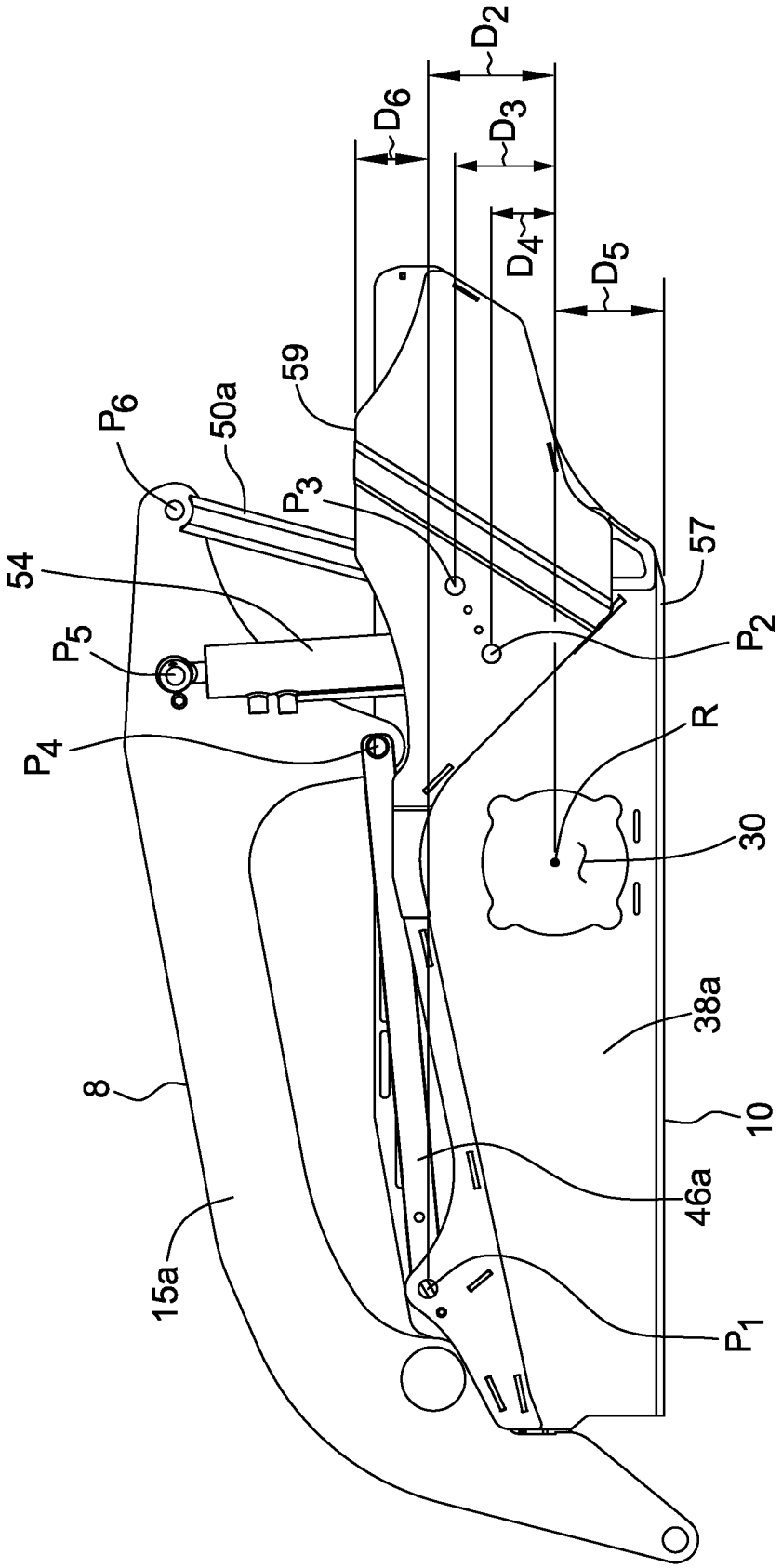

FIG. 5

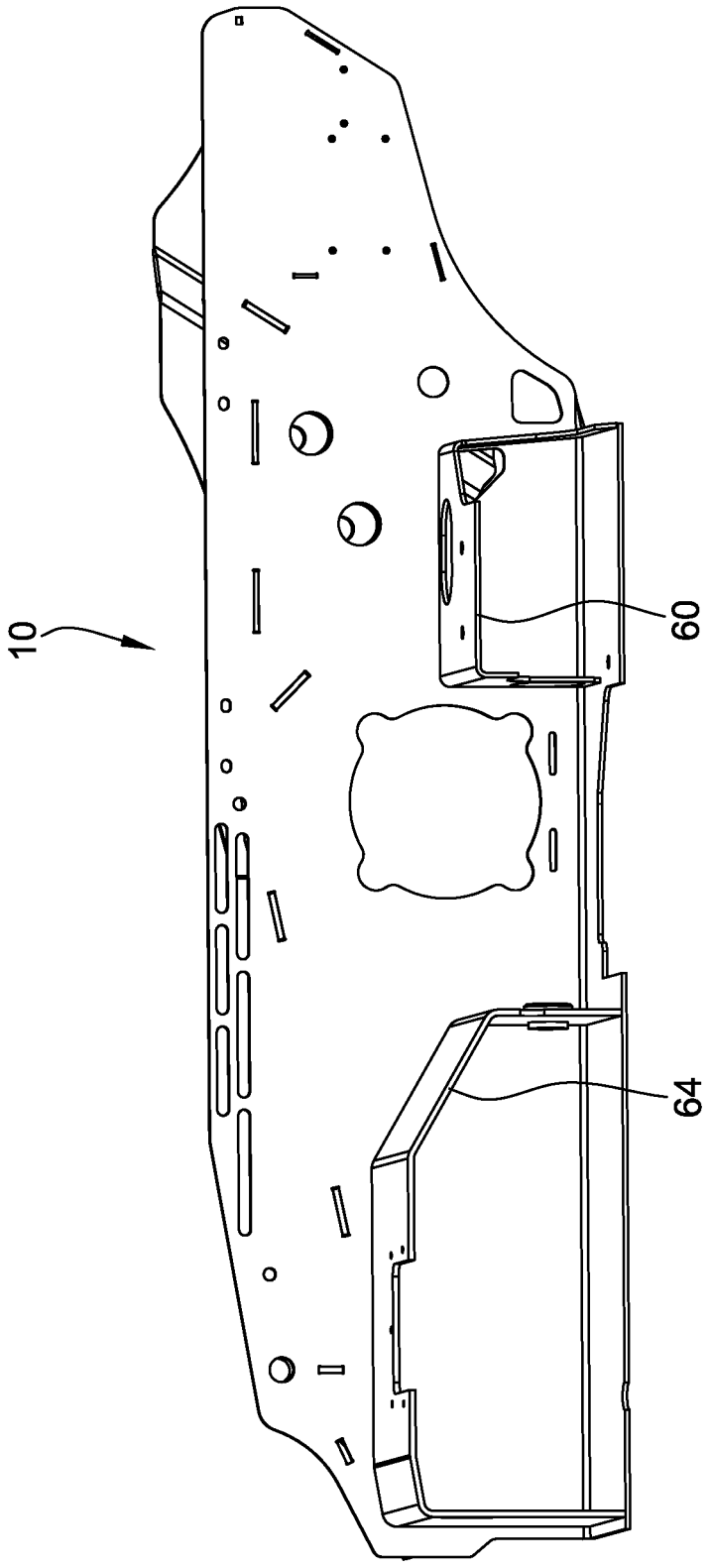

FIG. 6

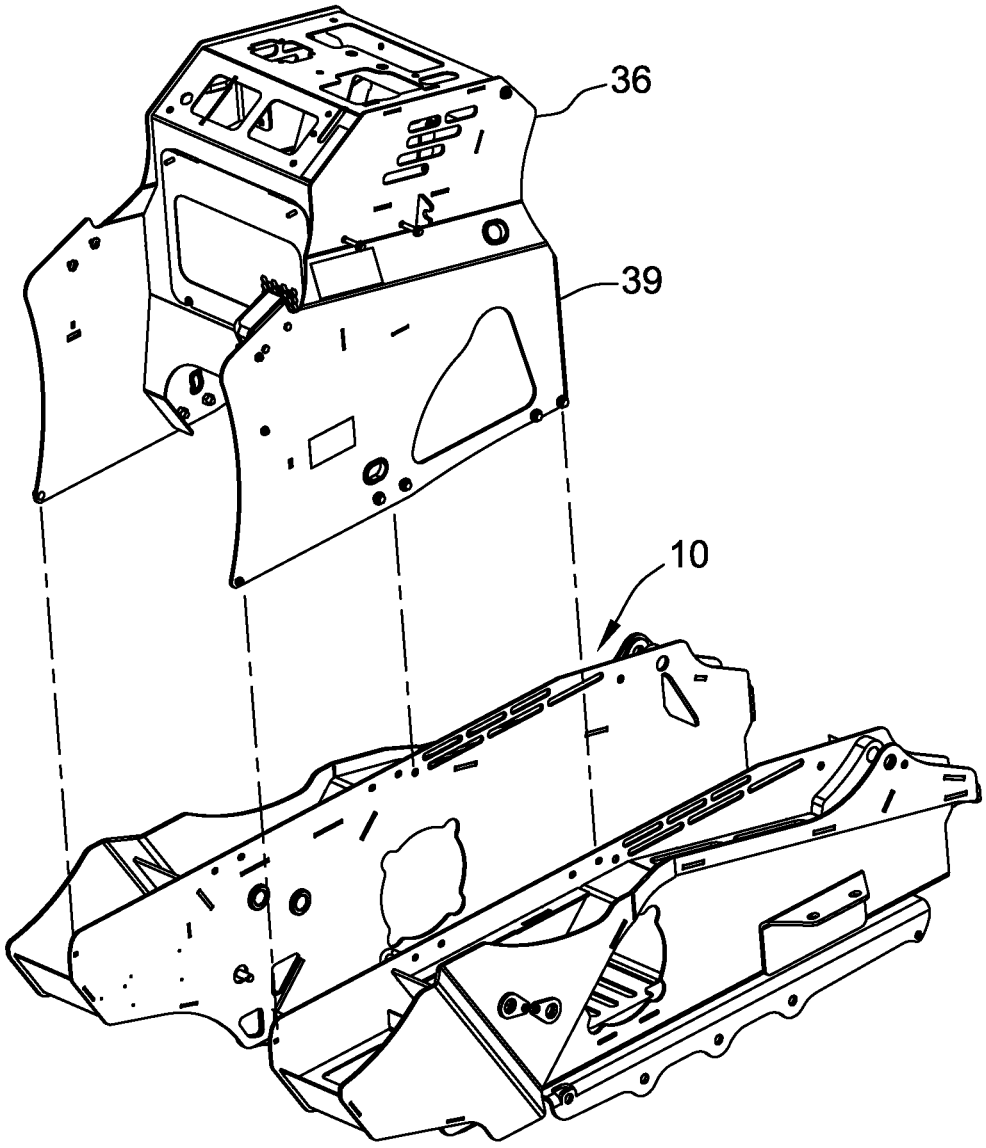

FIG. 7

COMPACT TOOL CARRIER AND MAINFRAMES FOR A SELF-PROPELLED MACHINE

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a continuation of Ser. No. 17/397,200, filed Aug. 9, 2021, which issued Oct. 11, 2022 as U.S. Pat. No. 11,465,891, which is a continuation of Ser. No. 16/270,070, filed Feb. 7, 2019, which is a continuation of U.S. patent application Ser. No. 15/704,685, filed Sep. 14, 2017, which issued Feb. 12, 2019 as U.S. Pat. No. 10,202,266, which is a continuation of U.S. patent application Ser. No. 15/062,801, filed Mar. 7, 2016, which issued May 22, 2018 as U.S. Pat. No. 9,975,750, which is a continuation of U.S. patent application Ser. No. 14/691,649, filed Apr. 21, 2015, which issued Apr. 26, 2016 as U.S. Pat. No. 9,321,386, which claims the benefit of U.S. Provisional Patent Application No. 62/118,860, filed Feb. 20, 2015, each of which is incorporated herein by reference in its entirety.

FIELD OF THE DISCLOSURE

The field of the disclosure relates mainframes for a self-propelled machine.

BACKGROUND

Compact tool carriers are tool-mounted machines that are capable of working in tight spaces for utility or do-it-yourself home projects. Compact tool carriers are walk-behind units or include a platform on which the operator may stand during use. Compact tool carriers are generally defined (e.g., ISO 6165 (2012) and SAE J2752) as "a self-propelled crawler or wheeled machine having an operating mass of less than 1500 kg with a rigid frame, having either a pedestrian operating position or a standing operator platform at the rear of the machine and either front-mounted interchangeable equipment or lift arms with an attachment bracket capable of coupling to interchangeable, front-mounted attachments." The tool carriers may be attached to a variety of interchangeable tools such as buckets, augers, forks, stump grinders, tillers, rollers and the like.

Compact tool carriers may be distinguished from much larger conventional skid steers in which an operator is seated in the operating position. Compact tool carriers pose difficulty in design relative to full-size skid steers due to variation in weight, complexity and size.

A continuing need exists for compact tool carriers with a relatively low-profile, compact design and/or that are characterized by a more effective loader lifting profile.

This section is intended to introduce the reader to various aspects of art that may be related to various aspects of the disclosure, which are described and/or claimed below. This discussion is believed to be helpful in providing the reader with background information to facilitate a better understanding of the various aspects of the present disclosure. Accordingly, it should be understood that these statements are to be read in this light, and not as admissions of prior art.

SUMMARY

One aspect of the present disclosure is directed to a compact tool carrier configured for standing or walk-behind operator control. The carrier has a mass of less than about 1500 kg and includes a loader having an arm and a linkage pivotally attached to the loader arm. An actuator is pivotally attached to the loader arm. The carrier includes a control station having operator controls for propelling the compact tool carrier forward and for raising and lowering the loader. The control station is configured for remote operation or is mounted toward the rear of the compact tool carrier and is adapted to allow for standing or walk-behind operation.

Another aspect of the present disclosure is directed to a compact tool carrier. The carrier comprises a loader and a mainframe for supporting the loader. The mainframe has a first side and a second side with each side having a top and a bottom. The first side of the mainframe has at least two pivot points relative to the loader. The carrier includes a drive mechanism comprising tracks or wheels for propelling the apparatus over a supporting surface. The drive mechanism is attached to the mainframe about a rotational axis. The compact tool carrier has a bottom at which the drive mechanism contacts the supporting surface. The rotational axis and bottom of the compact tool carrier are separated by a vertical distance D1. The rotational axis and each pivot point are separated by a vertical distance. Each vertical distance between the rotational axis and a pivot point is less than 1.5 times D1.

Various refinements exist of the features noted in relation to the above-mentioned aspects of the present disclosure. Further features may also be incorporated in the above-mentioned aspects of the present disclosure as well. These refinements and additional features may exist individually or in any combination. For instance, various features discussed below in relation to any of the illustrated embodiments of the present disclosure may be incorporated into any of the above-described aspects of the present disclosure, alone or in any combination.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a compact tool carrier with the loader in a down position;

FIG. **2** is a side view of the compact tool carrier with the loader in a down position;

FIG. **3** is a side view of the compact tool carrier with the loader in a raised position;

FIG. **4** is a perspective view of a mainframe of the compact tool carrier;

FIG. **5** is a side view of the mainframe and loader of the compact tool carrier;

FIG. **6** is a cross-section side view of the mainframe; and

FIG. **7** is an exploded perspective view of the mainframe and an upper frame of the compact tool carrier.

Corresponding reference characters indicate corresponding parts throughout the drawings.

DETAILED DESCRIPTION

An embodiment of a compact tool carrier is generally referred as "5" in FIG. **1**. The compact tool carrier **5** includes a loader **8** supported by a mainframe **10**. The loader **8** includes an attachment plate **12** for interchangeably attaching any one of a number of tools (not shown). In this regard, such interchangeable tools do not form part of the compact tool carrier **5** unless stated otherwise. The attachment plate **12** is connected to an actuator **14** for tilting of tools connected to the attachment plate **12**. The loader **8** has a first arm **15***a* and a second arm **15***b* generally opposite the first arm **15***a*. Each arm **15***a*, **15***b* may be a single weldment or may include various components attached by fasteners (e.g.,

nuts and bolts). The first and second arms **15***a*, **15***b* each include a bracket portion **17***a*, **17***b* (FIG. **1**) for fastening various linkages.

As used herein, "compact tool carrier" refers to machines that are self-propelled and are capable of carrying interchangeable equipment and that generally have a mass (not including the interchangeable tool) of less than about 1500 kg (about 3307 lb). Use of the term "compact tool carrier" herein is intended to exclude full size skid steers (e.g., seat-operated units) due to a large variation in weight, complexity and size. In some embodiments, the compact tool carrier **5** meets the definition of a compact tool carrier provided in ISO 6165 (2012) and SAE J2752 set forth above, both standards being incorporated herein by reference for all relevant and consistent purposes.

The compact tool carrier **5** includes a longitudinal axis A that is parallel to the direction of travel of the carrier (i.e., parallel to its length). The compact tool carrier **5** is generally longitudinally symmetrical (i.e., relative to the longitudinal axis A) in that several components have a corresponding component with the same function opposite the component (i.e., across the axis A). Corresponding components of the pair may be indicated herein by use of a reference number followed by "A" and "B" and may be referred to as a "first" component and a "second" component, respectively. While the compact tool carrier **5** may be described herein with reference to the components of one side of the compact tool carrier **5**, any component designated by "A" or "B" herein or shown in FIGS. **1-7** includes a corresponding component with the same function opposite the component.

The compact tool carrier **5** includes a drive mechanism **18** attached to the mainframe **10**. In the illustrated embodiment, the drive mechanism **18** is directly mounted (i.e., connected without intermediary parts) to the mainframe **10** by way of drive sprocket **22** connected to a hub **26** (FIG. **2**). The hub **26** is attached to a shaft (not shown) that extends through a drive opening **30** (FIG. **4**) of the mainframe **10**. The sprocket **22**, hub **26** and shaft (not shown) rotate about a rotational axis R (FIG. **5**). As shown, the drive mechanism **18** includes tracks **34**. In other embodiments, the drive mechanism **18** includes wheels.

The compact tool carrier **5** includes a control station **36** (FIG. **1**) which may include controls (not all controls being shown) for propelling the compact tool carrier **5** forward and/or for raising and lowering the loader **8**. The control station **36** may be mounted toward the rear of the compact tool carrier **5** (i.e., opposite the attachment plate **12**) and is generally adapted to allow for standing or walk-behind operation. As used herein, "standing operation" generally refers to operation in which the operator stands on a platform attached to the compact tool carrier while "walk-behind operation" generally refers to operation in which the operator stands on the surface supporting the compact tool carrier **5**. In the illustrated embodiment, the compact tool carrier **5** includes an operator platform **37** (FIG. **2**).

In embodiments in which the compact tool carrier **5** includes an operator platform **37** for standing operation, the difference between the height of the control station **36** (e.g., as measured from the highest control for operating the loader or propelling the apparatus forward) and the platform **37** may be at least about 90 cm (e.g., from about 90 cm to about 130 cm). In embodiments in which the operator walks behind the compact tool carrier **5**, the control station **36** may be at least about 90 cm (e.g., from about 90 cm to about 130 cm) from the surface supporting the compact tool carrier. Such a range generally complies with the zones of comfort and reach for controls in earth-moving equipment set forth in ISO 6682 (2008) as determined from the physical dimensions of operators and minimum operator space envelope as set forth in ISO 3411 (2007), both of which are incorporated herein by reference for all relevant and consistent purposes.

In the illustrated embodiment, the control station **36** is attached to an upper frame **39** (FIG. **7**) that is attached and supported by the mainframe **10**. In other embodiments, rather than being integrated as one unit in the compact tool carrier **5**, the control station **36** is separate from the body (e.g., mainframe) of the carrier and is operated remotely. In such embodiments, the control station **36** may be wired or may operate wirelessly to propel the carrier **5** and/or raise and lower the loader **8**.

The mainframe **10** includes a first side **38***a* and a second side **38***b* generally opposite the first side **38***a*. As used herein, the term "mainframe" generally refers to a single weldment to which the loader **8** is attached, optionally through one or more pivotal linkages. The mainframe **10** includes bracket portions **40***a*, **40***b* (FIG. **4**) through which various pivot linkages are attached. In the illustrated embodiment, the engine (not shown) and the drive mechanism **18** comprising tracks or wheels are directly connected to the mainframe **10**.

The first loader arm **15***a* is pivotally connected to the first side **38***a* of the mainframe **10**, and the second loader arm **15***b* is pivotally connected to the second side **38***b* of the mainframe **10**. The loader arms **15***a*, **15***b* and sides **38***a*, **38***b* of the mainframe **10** each include three pivot points for pivoting the loader **8** relative to the mainframe **10**. The first side **38***a* of the mainframe **10** includes a forward pivot point P_1 (FIG. **5**) a rear pivot point P_3 and a central pivot point P_2 between the forward pivot point P_1 and the rear pivot point P_3. Similarly, the first arm **15***a* includes a forward pivot point P_4, a rear pivot point P_6 and a central pivot point P_5 between the forward pivot point P_4 and the rear pivot point P_6. The compact tool carrier **5** includes a first forward linkage **46***a* attached to the first side **38***a* of the mainframe **10** at its forward pivot point P_1 and attached to the first arm **15***a* at its forward pivot point P_4. A first rear linkage **50***a* is attached to the first side **38***a* of the mainframe **10** at its rear pivot point P_3 and is attached to the first arm **15***a* of the loader **8** at its rear pivot point P_6. While the carrier **5** is shown with two loader linkages **46***a*, **50***a* on each side of the carrier **5**, in other embodiments the carrier **5** includes a single linkage.

An actuator **54**, shown as a hydraulic cylinder, is attached to the first side **38***a* of the mainframe **10** at its center pivot point P_2 and is attached to the loader arm **15***a* at its center pivot point P5 to raise the loader **8**. The compact tool carrier **5** may include a single actuator **54**, or, as in other embodiments, a second actuator (not shown) is connected to the second side **38***b* (FIG. **4**) of the mainframe **10** and the second arm **15***b* (FIG. **1**). The actuator **54** is powered to raise the loader **8** and, in some embodiments, is also powered to lower the loader **8** (as opposed to a one-way actuator lowered by gravity alone).

The second side **38***b* (FIG. **4**) of the mainframe **10** may include a forward pivot point and a rear pivot point to which a second forward linkage **46***b* (FIG. **1**) and second rear linkage (not shown) are respectively attached. The second arm **15***b* may also include a forward pivot point and rear pivot point to which the second forward linkage **46***b* and second rear linkage are attached. In embodiments in which the compact tool carrier **5** includes a second actuator (not shown), the second side **38***b* of the mainframe **10** includes a central pivot point between its forward pivot point and its rear pivot point, and the second arm **15***b* also includes a central pivot point between its forward pivot point and its rear pivot point. The second cylinder may be attached to the

central pivot point of the second side **38***b* of the mainframe **10** and the central pivot point of the second arm **15***b*.

In some embodiments, the first and second ends **38***a*, **38***b* of the mainframe **10** and the first and second loader arms **15***a*, **15***b* do not include more than three pivot points at which the mainframe **10** and loader **8** pivot relative to each other. While the actuator **54** is shown as being attached between the other two linkages **46***a*, **50***a*, in other embodiments the actuator **54** is forward to both linkages **46***a*, **50***a* or rearward to both linkages **46***a*, **50***a*. Further, each side of the carrier **5** having an actuator **54** may include a single linkage rather than two linkages.

In some embodiments, the mainframe **10** is characterized by a relatively low profile (i.e., the pivot points are positioned relatively low on the mainframe allowing its height to be reduced). The rotational axis R (FIG. **5**) and the bottom of the compact tool carrier **5** (FIG. **2**) are separated by a distance D**1**. Generally, the bottom of the compact tool carrier **5** corresponds to the point at which the drive mechanism **18** contacts the surface supporting the compact tool carrier **5**. The rotational axis R and the forward pivot point P_1 of the first side **38***a* of the mainframe **10** are separated by a vertical distance D**2**. The rotational axis R and the rear pivot point P_3 are separated by a vertical distance D**3**. The rotational axis R and the central pivot point P_2 are separated by a vertical distance D**4**. Each of D**2**, D**3** and D**4** is less than about 1.5 times D**1** (1.5×D**1**). In some embodiments, each of D**2**, D**3** and D**4** is less than D**1** or even less than about 0.75 times D**1** (0.75×D**1**).

The mainframe **10** profile may also be expressed relative to the distance D**5** between the rotational axis R (FIG. **5**) and the bottom **57** of the mainframe **10**. Each of D**2**, D**3** and D**4** is less than about twice D**5** (2×D**5**). In some embodiments, each of D**2**, D**3** and D**4** is less than about 1.75 times D**5** (1.75×D**5**) or less than about 1.5 times D**5** (1.5λD**5**). P2 and P3 may be relatively lower than P1 and their distances D**3**, D**4** from the rotational axis R may be even less than about 1.25 times D**5** (1.25×D**5**). The distance D**6** between the top 59 of the first side **38***a* of the mainframe **10** and the highest pivot point (P_1 in the illustrated embodiment), is less than about 1.5 times D**5**, less than about D**5** or less than about 0.75 times D**5**.

The second side **38***b* (FIG. **1**) of the mainframe **10** may have a similar pivot point arrangement. The rotational axis R and the forward pivot point of the second side **38***b* are separated by a vertical distance D**2'** (not shown). The rotational axis R and the rear pivot point of the second side are separated by a vertical distance D**3'** (not shown). The rotational axis R and the central pivot point (if any) of the second side **38***b* of mainframe **10** are separated by a vertical distance D**4'** (not shown). Each of D**2'**, D**3'** and D**4'** is less than about 1.5 times D**1** (1.5×D**1**) or less than D**1** or even less than about 0.75 times D**1** (0.75×D**1**). The rotational axis R and the bottom of the second side **38***b* of the mainframe **10** are separated by a vertical distance D**5'** (not shown). Each of D**2'**, D**3'** and D**4'** is less than twice D**5'** (2×D**5'**) or less than about 1.75 times D**5'** (1.75×D**5'**) or less than about 1.5 times D**5'** (1.5λD**5'**). D**3'** and D**4'** may be even less than about 1.25 times D**5'** (1.25×D**5'**). The distance D**6'** between the top of the second side **38***b* of the mainframe **10** and the highest pivot point is less than about 1.5 times D**5'**, less than about D**5'** or less than about 0.75 times D**5'**.

The compact tool carrier **5** includes an engine (not shown) for propelling the drive mechanism **18**. As shown in FIG. **6**, the engine may be mounted to an engine bracket **60** that forms part of the mainframe **10**. The engine may drive a hydraulic pump that powers hydraulic motors (not shown) which drive the drive mechanism **18** (FIG. **1**) and which provide hydraulic power to actuator **54**. The mainframe **10** includes a reservoir **64** for storing and cycling of hydraulic fluid.

Compared to conventional compact tool carriers, embodiments of the compact tool carrier **5** described above have several advantages. By positioning the pivot points relatively low on the mainframe **10**, the mass of the mainframe **10** and the resulting cost of the carrier **5** may be reduced. Further, such a low-profile mainframe **10** improves visibility for the operator and allows the center of gravity of the carrier **5** to be lowered which improves its stability. In embodiments in which the carrier **5** includes an actuator **54** (FIG. **5**) for lifting the loader **8** that is disposed between forward linkage **46***a* and a rear linkage **50***a* on at least one side **38***a*, **38***b* of the mainframe **10**, the loader **8** is characterized by an travel path in which the loader travels vertically rather than over a radial path. The vertical travel path of the loader **8** is more effective relative to conventional travel paths for compact tool carriers **5** as the carrier **5** may operate closer to other structures.

As used herein, the terms "about," "substantially," "essentially" and "approximately" when used in conjunction with ranges of dimensions, concentrations, temperatures or other physical or chemical properties or characteristics is meant to cover variations that may exist in the upper and/or lower limits of the ranges of the properties or characteristics, including, for example, variations resulting from rounding, measurement methodology or other statistical variation.

When introducing elements of the present disclosure or the embodiment(s) thereof, the articles "a", "an", "the" and "said" are intended to mean that there are one or more of the elements. The terms "comprising," "including," "containing" and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements. The use of terms indicating a particular orientation (e.g., "top", "bottom", "side", etc.) is for convenience of description and does not require any particular orientation of the item described.

As various changes could be made in the above constructions and methods without departing from the scope of the disclosure, it is intended that all matter contained in the above description and shown in the accompanying drawing [s] shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A mainframe for a self-propelled machine, the mainframe having a front end, a rear end and a longitudinal axis and comprising:

a first side comprising:

a first bracket portion for supporting a load, the first bracket portion forming an upward-facing first pocket that extends from the front end to the rear end of the mainframe, the first side defining a first drive opening for receiving a first hub of a drive mechanism; and

a plurality of first pivot points for attachment of a loader including a first front pivot point proximate the front end, a first rear pivot point proximate the rear end, and a first central pivot point located between the first front pivot point and the first rear pivot point along the longitudinal axis;

a second side comprising:

a second bracket portion for supporting a load, the second bracket portion forming an upward-facing second pocket that extends from the front end to the

rear end of the mainframe, the second side defining a second drive opening for receiving a second hub of a drive mechanism; and

a plurality of second pivot points for attachment of a loader including a second front pivot point proximate the front end, a second rear pivot point proximate the rear end, and a second central pivot point located between the second front pivot point and the second rear pivot point along the longitudinal axis; and

a hydraulic reservoir housing configured to store hydraulic fluid, the hydraulic reservoir housing being connected to the first side of the mainframe and connected to the second side of the mainframe, the hydraulic reservoir housing being disposed between the front end of the mainframe and the first and second drive openings.

2. The mainframe as set forth in claim **1** further comprising an engine bracket that extends from the first side toward the second side for mounting an engine to the mainframe, the engine bracket being disposed between the rear end and the first and second drive openings.

3. The mainframe as set forth in claim **1** wherein the mainframe is a single weldment.

4. A compact tool carrier having a longitudinal axis and comprising:

a loader having a loader arm, the loader being adapted to carry a tool;

a mainframe for supporting the loader, the mainframe having a first side and a second side, and having a front end and a rear end relative to the longitudinal axis;

a first linkage pivotally attached to the first side of the mainframe and directly pivotally attached to the loader arm;

a second linkage pivotally attached to the first side of the mainframe and directly pivotally attached to the loader arm;

an actuator pivotally attached to the first side of the mainframe and directly pivotally attached to the loader arm; and

a control station having operator controls for propelling the compact tool carrier forward and for raising and lowering the loader, the control station being mounted toward the rear end of the compact tool carrier.

5. The compact tool carrier as set forth in claim **4**, wherein the mainframe comprises an engine bracket that extends from the first side toward the second side for mounting an engine to the mainframe, the engine bracket being spaced from the rear end of the mainframe.

6. The compact tool carrier as set forth in claim **5** comprising an engine to propel a drive mechanism, the engine being attached to the engine bracket.

7. The compact tool carrier as set for in claim **4**, wherein the mainframe incorporates a single weldment.

8. The compact tool carrier as set forth in claim **4**, wherein the loader arm is a first loader arm, the loader comprising a second loader arm and the compact tool carrier comprising a third linkage pivotally attached to the second side of the mainframe and pivotally attached to the second loader arm and a fourth linkage pivotally attached to the second side of the mainframe and pivotally attached to the second loader arm.

9. The compact tool carrier as set forth in claim **8**, wherein the actuator is a first actuator, the compact tool carrier comprising a second actuator, the second actuator being pivotally attached to the second side of the mainframe and pivotally attached to the second loader arm.

10. The compact tool carrier as set forth in claim **4** comprising a drive mechanism comprising tracks or wheels, the drive mechanism being attached to the mainframe.

11. The compact tool carrier as set forth in claim **4**, wherein the actuator is a hydraulic cylinder.

12. The compact tool carrier as set forth in claim **4**, wherein the loader arm incorporates a single weldment.

13. The compact tool carrier as set forth in claim **4**, wherein the mainframe defines a pocket toward a rear of the mainframe to partially surround an operator.

14. The compact tool carrier as set forth in claim **13** further comprising an operator platform at least partially within the pocket.

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