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— *of inventorship (Rule 4.17(iv))*

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(54) **Title**: 3-WHEELED STAND-UP PERSONAL MOBILITY VEHICLE AND COMPONENTS THEREIN

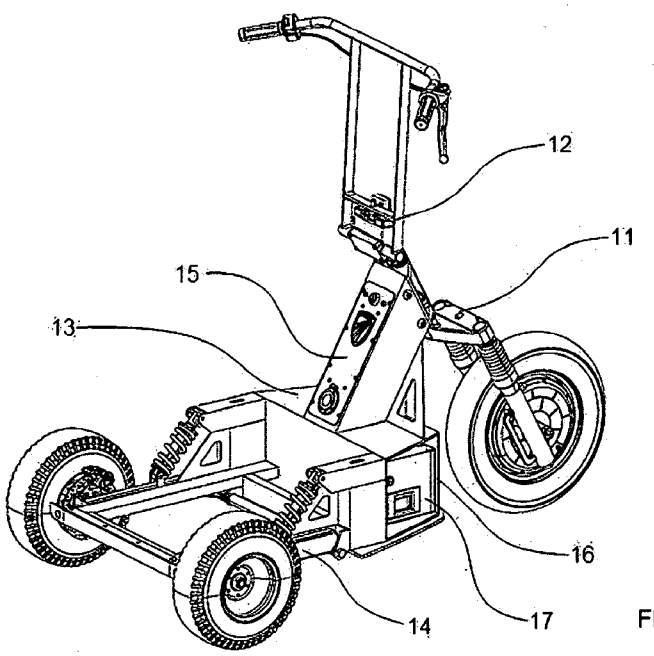



FIG. 1

(57) **Abstract**: An electric vehicle with a modular frame that includes a main chassis with a rider platform (standing position), front/fork/wheel assembly, handlebar assembly, and rear trailing arm assembly with left and right rear wheels. The front fork assembly bolts to the main chassis. The handlebar assembly fastens to the pivoting steer tube of the front fork assembly. The trailing arm assembly bolts to the main chassis and pivots to provide suspension for the vehicle. The trailing arm includes a stabilizet bar connecting the right and left trailing arms. Electronic enclosures are integral to the main chassis and are structural members of the vehicle. The battery pack can be installed or removed from the min chassis with a hand-activated latch. The electronics plate contains traction system electronics and is removable from the main chassis. The handle bar assembly includes a folding mechanism.

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# 3-WHEELED STAND-UP PERSONAL MOBILITY VEHICLE AND COMPONENTS THEREIN

## RELATED APPLICATION AND CLAIM OF PRIORITY

This PCT application claims priority to earlier filed United States application Serial No. 12/082,443, filed April 10, 2008.

## FIELD OF THE INVENTION

The present invention relates generally to an electric vehicle and more particularly to an electric vehicle with a standing rider.

## BACKGROUND OF THE INVENTION

In the field of electric vehicles and more particularly two and three-wheeled electric scooters, previous inventors have created many designs for chassis, suspension, and electric powertrains. These designs have often resulted in problems such as vehicle instability, rider fatigue, steep learning curves, electronics that are vulnerable to inclement weather, time-consuming assembly, complex maintenance procedures, and awkward or costly shipping.

In light of this, the inventors, based on the experiences of designing and developing related products for many years, aimed at the above problems, and after detailed design and cautious evaluation, ultimately obtained an invention of real practicability.

## BRIEF SUMMARY OF THE INVENTION

The facts of improving functionality and effectiveness by this invention follow.

Mainly through such improved design, the vehicle is more stable and less likely to tip over when the rider turns the vehicle, the rider experiences less fatigue, routine maintenance

and repair are made easier, shipping costs are reduced, electronics are less vulnerable to water damage or severe impact and manufacturing costs are reduced.

The trailing arm assembly is made up of two trailing arms and a stabilizer tube affixed between them. The trailing arms mount to the main chassis and hold the left and right rear wheels. The trailing arms provide suspension for the rear of the vehicle. The advantage of the stabilizer bar is a reduction in the lateral sway normally associated with three-wheeled vehicles having one wheel in the front and two wheels in the back. Reduced sway also reduces the risk of vehicle roll-over accidents.

The trailing arm assembly and the front fork assembly have suspension on all three wheels. On the fork assembly, two fork tubes contain springs which absorb the impact of obstacles and uneven surfaces. The trailing arm assembly has two springs mounted on either trailing arm. These springs absorb shocks caused by either of the rear wheels hitting obstacles and uneven surfaces. The advantage of this suspension is a reduction in rider fatigue. Also, the rider is less likely to lose control of the vehicle when the vehicle strikes a large obstacle in its path.

The handle bar assembly includes the handle bars and a hinge that allows the handle bars to be folded down for storage and shipping. The hinge mounts to the steer tube in the fork assembly and also mounts to an automotive grade latch. This latch captures a pin that is bolted to the handle bars. When the latch is released, the handlebars fold down. When the latch and pin are engaged, the handlebars will remain upright. The advantage is that the vehicle can be loaded into the back of a standard SUV or can be shipped in a smaller container thereby reducing shipping costs.

The powertrain electronics and battery pack are enclosed in the main chassis. The vertical member of the main chassis is used to house the powertrain electronics. The horizontal member of the main chassis houses the battery pack. The advantage of using the

main chassis to house electronics is increased protection against inclement weather as well as routine washing of the vehicle to clean its interior and exterior.

The battery pack and powertrain electronics plate are separate components and are integrally designed as part of the main chassis. The battery pack is removable without tools by depressing a hand latch and removing the battery pack from the primary horizontal member of the main chassis. The powertrain electronics plate contains the powertrain electronic components for the vehicle and is fastened to the vertical member of the main chassis using standard screws. It is removable with common hand tools. The advantage of this easily removable battery pack and powertrain electronics plate is that routine maintenance and repair can be done by the end-user thereby reducing costly visits by and to professional electric vehicle service persons and locations.

There are four sub-assemblies for the vehicle. They are the front fork assembly, handlebar assembly, trailing arm assembly, and main chassis. These four sub-assemblies are fastened together using widely available hardware and common hand tools. Unlike prior designs, these sub assemblies do not require complex fabrication techniques such as welding in order to complete final assembly. The advantage is reduced labor costs for final assembly during the manufacturing process.

The above describes the technical characteristics of this invention based on the preferred embodiment as described in this patent. However, experts familiar with this technique are allowed to change and modify this invention as long as they do not depart from the spirit and principle of this invention. Any change and modification may still be confined to the following scope defined by the present patent.

## BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE DRAWINGS

FIGURE 1 is a perspective view of the invention.

FIGURE 2 is an exploded perspective view of the invention.

FIGURE 3 is a perspective view of the trailing arm assembly.

FIGURE 4 is a perspective view of the trailing arm assembly attached to the main chassis.

FIGURE 5 is a perspective view of the main chassis.

FIGURE 6 is a perspective view of the front fork assembly.

FIGURE 7 is a partial magnified view of the head tube portion of the front fork assembly.

FIGURE 8 is a side view of the handlebar assembly in the upright position

FIGURE 9 is a side view of the handlebar assembly in the folded down position

FIGURE 10 is a partial magnified view of the hinge at the base of the handlebar assembly (upright position).

FIGURE 11 is a partial magnified view of the hinge at the base of the handlebar assembly (folded down position).

FIGURE 12 is a perspective view of the powertrain electronics plate.

FIGURE 13 is an exploded perspective view of the powertrain electronics plate separated from its location in the main chassis.

FIGURE 14 is a perspective view of the powertrain electronics plate installed in the main chassis.

FIGURE 15 is an exploded perspective view of the battery pack separated from its location in the main chassis.

FIGURE 16 is a perspective view of the battery pack in its enclosure in the main chassis.

## DETAILED DESCRIPTION OF THE INVENTION

The features and the advantages of the present invention will be more readily understood upon a thoughtful deliberation of the following detailed description of a preferred embodiment of the present invention with reference to the accompanying drawings.

As shown in FIGS. 1-2, an electric vehicle with modular chassis embodied in the present invention comprises a front fork assembly **15,** and **11,** a handlebar assembly **12**, a main chassis **13**, a trailing arm assembly **14**, an electronics plate a battery pack **17**. Among these, the front fork assembly **11** is bolted to the main chassis **13**. The handlebar assembly **12** is fastened to the steer tube **19** which protrudes from the top of the head tube **20**. The trailing arm assembly **14** bolts to the main chassis **13** and pivots to provide suspension for the rear of the vehicle. The powertrain electronics plate **15** fastens into the primary vertical chassis member **28**. The battery pack **17** slides into the primary horizontal chassis member **29.** By placing the battery pack **17** inside the primary horizontal chassis member **29,** the battery pack **17** is protected against impact and water damage. By placing the electronics plate **15** inside the primary vertical chassis member **28**, the components on the electronics plate **15** are also protected against impact and water damage.

As shown in FIGS. 3-4, a trailing arm assembly **14** comprises two trailing arms **23** that support rear wheel axles **21**. Right and left rear wheels are mounted to the rear wheel axles **21** on the trailing arms *23.* A lower shock mount **22** is welded to each of the trailing arms **23**. The trailing arms **23** are connected with a stabilizer tube **24**. The trailing arm assembly **14** is mounted to the main chassis **13** at the trailing arm assembly pivot point **25.** Main chassis mount for trailing arm assembly **26** secures the trailing arm assembly **14** to the main chassis **13** and allows it to pivot about the center of the stabilizer tube **24** axis. Rear shock absorbers **27** are bolted to the lower shock mount **22** and the upper shock mount **30** to

allow the trailing arm assembly **14** to provide suspension for the rear of the vehicle. The stabilizer tube **24** connects the trailing arms **23** and causes both to pivot synchronously.

As shown in FIG. 5, the main chassis **13** is constructed using several standard aluminum extrusions. Two relatively large extrusions make up the core structure of the main chassis **13.** The primary horizontal chassis member **29** and the primary vertical chassis member **28** serve dual purposes. They firstly provide structural support to the entire vehicle and secondly house the battery pack **17** and the electronics plate **15.** Upper shock mounts **30** are welded to the primary horizontal chassis member **29** and the platform gusset **31.** This welded structure supports the rider platform **32** where the rider of the vehicle will sit or stand. Neck gussets **35** are welded to the primary vertical chassis member **28** and the primary horizontal chassis member **29** to strengthen the chassis. A skid plate **34** is welded to the bottom of the primary horizontal chassis member **29** to protect the vehicle from severe impact with pathway hazards. A rear bumper **33** is bolted to the rear of the main chassis **13.** Head tube bolts **36** fasten and seal the head tube **20** to the primary vertical chassis member **28.** The trailing arm assembly **14** is bolted to the main chassis **13** using the main chassis mounts for the trailing arm assembly **26.** This mount uses bushings to allow the trailing arm **23** to pivot about the trailing arm pivot point **25.**

As shown in FIG. 6, the front fork assembly **11** comprises a steer tube **19,** a head tube **20,** a fork crown **37,** two front shock absorbers **38,** a front wheel axle **39,** a traction motor **40,** and a front tire **41.** The steer tube **19** pivots to allow the rider to steer the vehicle by turning the front wheel. The head tube **20** retains the steer tube **19** using standard bearings and collars. The steer tube **19** is press fit into the fork crown **37** and then welded in place. The front shock absorbers **38** are tightly clasped by the fork crown **37** using automotive grade bolts. The front wheel axle **39** is affixed to both front shock absorbers **38** using automotive grade bolts and is an integral part of the traction motor **40.** The traction motor **40** is designed

to be used as a wheel and is outfitted with a standard tire rim for direct mounting of the front tire **41** to the traction motor **40**.

As shown in FIG. 7, the head tube **20** mounts to the primary vertical chassis member **28** using head tube bolts **36**. This assembly mates the front fork assembly **11** to the main chassis **13.**

As shown in FIGS. 8-11, the handlebar assembly **12** comprises the handlebars **42,** handlebar latch stop **43**, handlebar latch **44**, handlebar hinge **45**, and handlebar retaining plate **46**. The handlebar assembly **12** is attached tightly to the front fork assembly **11** to enable the rider to use the handlebars **42** to steer the vehicle. The handlebar hinge **45** is slipped over the steer tube **19** and grips the steer tube **19** by tightening three bolts along its collar. The handlebars **42** swivel from an upright position to a folded down position. The handlebar latch **44** contains a lever that is manually activated by the rider. Upon activation, the handlebar latch **44** releases the handlebar latch bolt **47** and the handlebars will pivot about the axis of the handlebar pivot tube **49**. The handlebar latch bolt **47** is held to the handlebars by the handlebar bolt cross bar **48**. The handlebar bolt cross bar **48** is welded to the handlebar vertical tube **50.**

As shown in FIGS. 12-14, the electronics plate **15** comprises the electronics charge port **51**, on/off LED **52**, key switch **53**, charge indicator LED **54**, battery charger **56**, motor controller **57**, and electronics fuse block **58**. These electronics components are held to the electronics plate **15** using mounting brackets and or industrial adhesives. The electronics plate **15** is installed into the primary vertical chassis member **28** turning the electronic plate bolts **55** into the electronics plate bolt holes **59.** Ergo the primary vertical chassis member **28** also serves as the electronics enclosure **18**.

As shown in FIGS. 15-16, the battery pack **17** comprises battery guides **60**, battery pack latch **61**, battery pack lock **62**, battery pack handle **63**, battery pack cover **64,** battery pack connector **65**, battery pack fuse block **66** and 4 standard **12** volt lead acid batteries.

Using the battery pack guides **60**, the battery pack **17** slides into the primary horizontal chassis member **29** which also serves as the battery enclosure **16**. As it slides into the primary horizontal chassis member **29**, the battery pack latch **61** deploys into a slot in the bottom surface thereby fixing the position of the battery pack **17**. The rider may choose to lock the battery pack **17** into the primary horizontal chassis member **29** by using the battery pack lock **62**. The rider may remove the battery pack **17** by unlocking the battery pack lock **62** and actuating the battery pack latch **61** by hand and pulling the battery pack **17** out using the battery pack handles **63**.

## CLAIMS

We claim:

1. A vehicle comprising:

an electric propulsion system having an energy storage system, a power conversion system, and one or more electric traction motors;

a plurality of wheels;

suspension systems on one or more of the wheels;

a steering apparatus;

a braking system comprising mechanical brakes, electromagnetic regenerative brakes or both;

a platform for one or more riders to sit or stand;

a throttle that controls the electric propulsion system; and

structural members of its chassis made from standard metal extrusions that serve as primary structural chassis members for the entire vehicle and also serve as enclosures for the electronic systems of the vehicle.

2. The system in Claim 1, wherein the power conversion systems, housed in the primary structural chassis members, are fastened to a mounting plate and are removable as a single unit from their chassis enclosure using hand held tools.

3. The system in Claim 1, wherein the energy storage system, housed in the primary structural chassis members, is removable as a single unit from its chassis enclosure.

4. The system in Claim 1, wherein the energy storage system, housed in the primary structural chassis members, is removable as a single unit from its chassis enclosure using hand-operated levers and without the assistance of any tools.

5. The system of Claim 1, wherein a handlebar assembly comprises a mechanical device that allows the rider to fold down the handlebar assembly using hand-operated levers and without the assistance of any tools.

6. The system in Claim 1, wherein the head tube is removable from the main chassis using standard bolts.

7. A system in Claim 1, wherein the front of the vehicle has suspension components that are bolted to the front wheel(s) and also to a fork crown

8. A system in Claim 1, wherein the rear of the vehicle has suspension components that are bolted to the trailing arms and also to the main chassis

9. A system in Claim 1, wherein the vehicle is comprised of four modular sub-assemblies defined as a front fork assembly, a handlebar assembly, a main chassis, and a trailing arm assembly, all of which are bolted together using standard bolts and commonly available hand tools.

10. The system of Claim 1, wherein a trailing arm design is used for the rear suspension of the vehicle

11. The system of Claim 10, wherein a stabilizer tube connects the two trailing arms that make up the rear suspension of the vehicle.

12. A folding handlebar assembly comprising:

handlebars with two vertical tubes, one horizontal tube used for pivoting and one horizontal bar used to hold a latch bolt;

handlebar hinge comprising a semi-cylindrical recess for positioning the horizontal pivot tube, mounting holes for a handlebar retaining plate, mounting holes for fastening a latch mechanism, and a collar for gripping a steer tube;

handlebar hinge plate that bolts to the handlebar hinge;

a latching mechanism;

a hand release lever on the latching mechanism;

a latch bolt; and

a latch stop that mounts to the top of the latching mechanism.

13. A vehicle comprising:

an electric propulsion system having an energy storage system, a power conversion system, and one or more electric traction motors;

a plurality of wheels;

suspension systems on one or more of the wheels;

a steering apparatus;

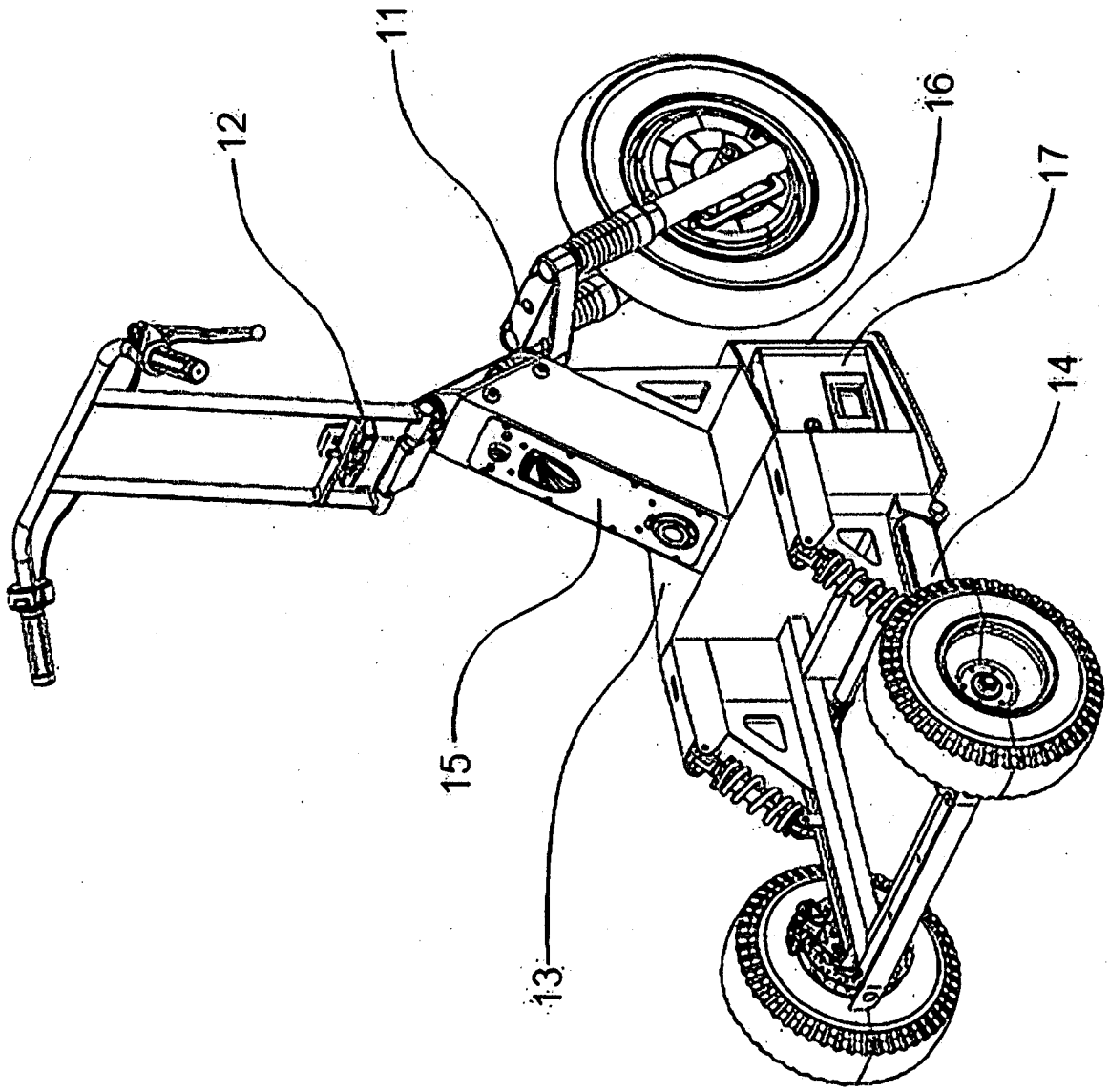
a braking system comprising mechanical brakes, electromagnetic regenerative brakes or both;

a platform for one or more riders to sit or stand;

a throttle that controls the electric propulsion system; and

a trailing arm suspension comprising two trailing arms and a perpendicular tube connecting the two trailing arms that strengthens the lateral stability of the vehicle.

FIG. 1



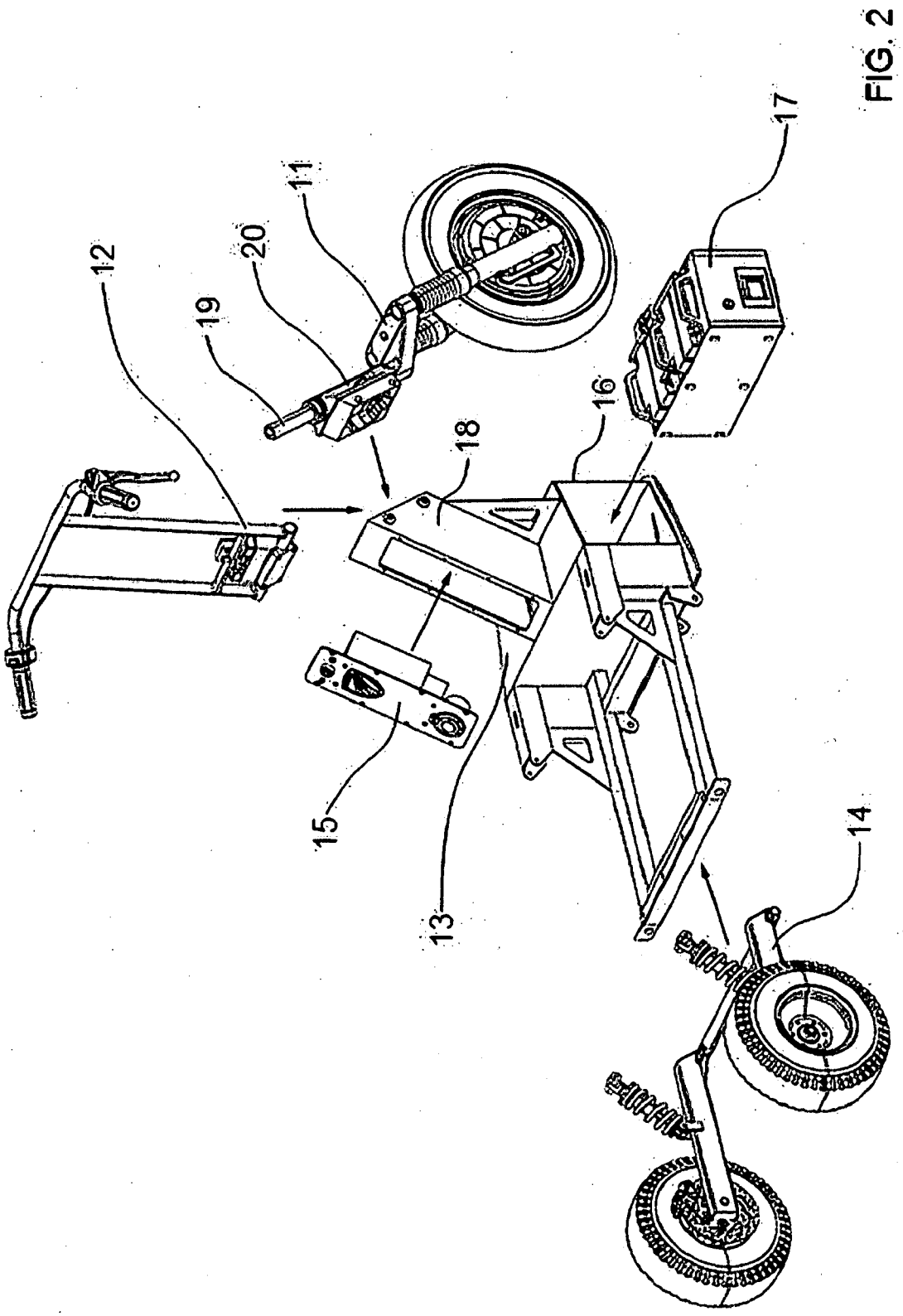



FIG. 2

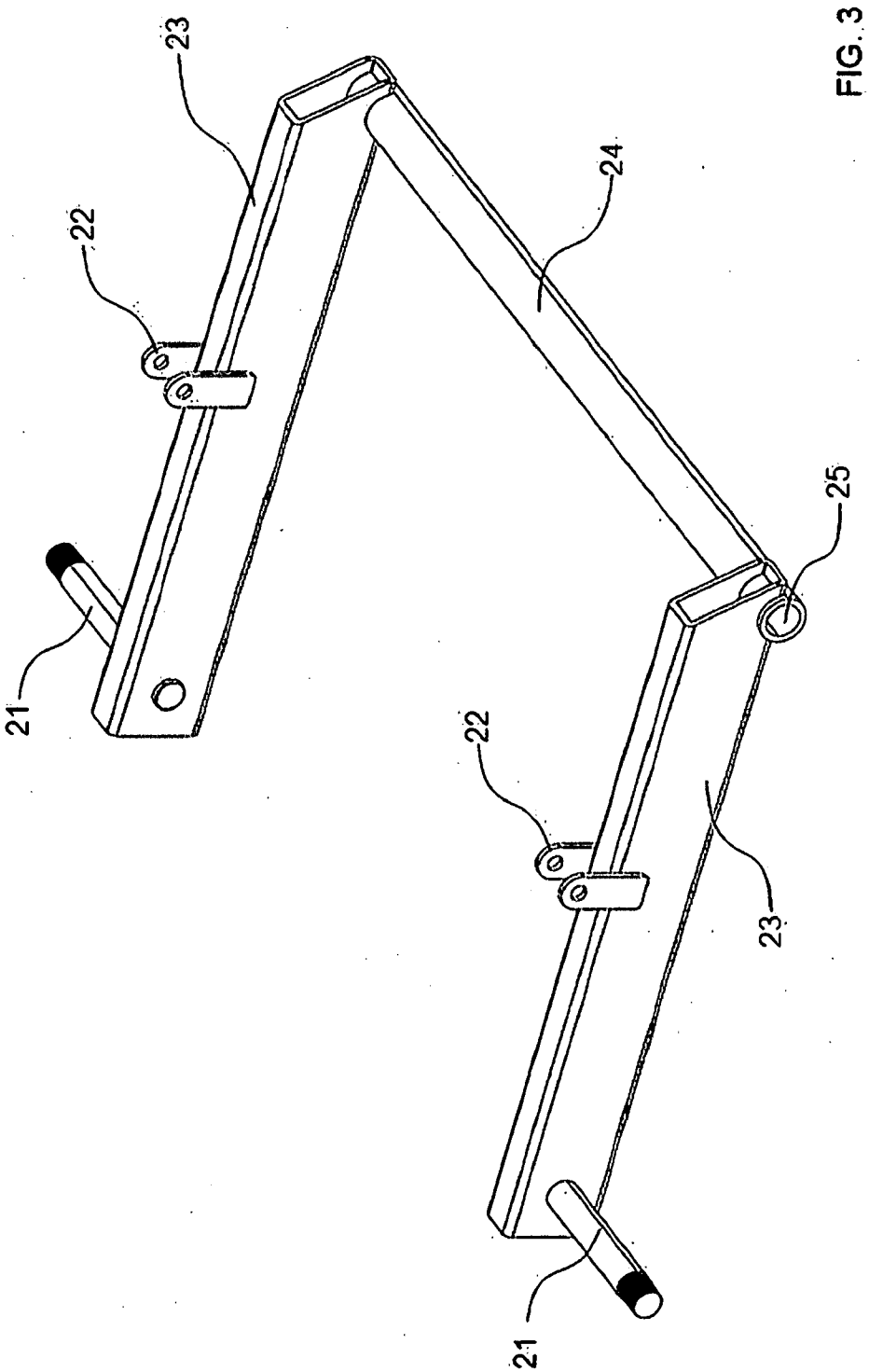
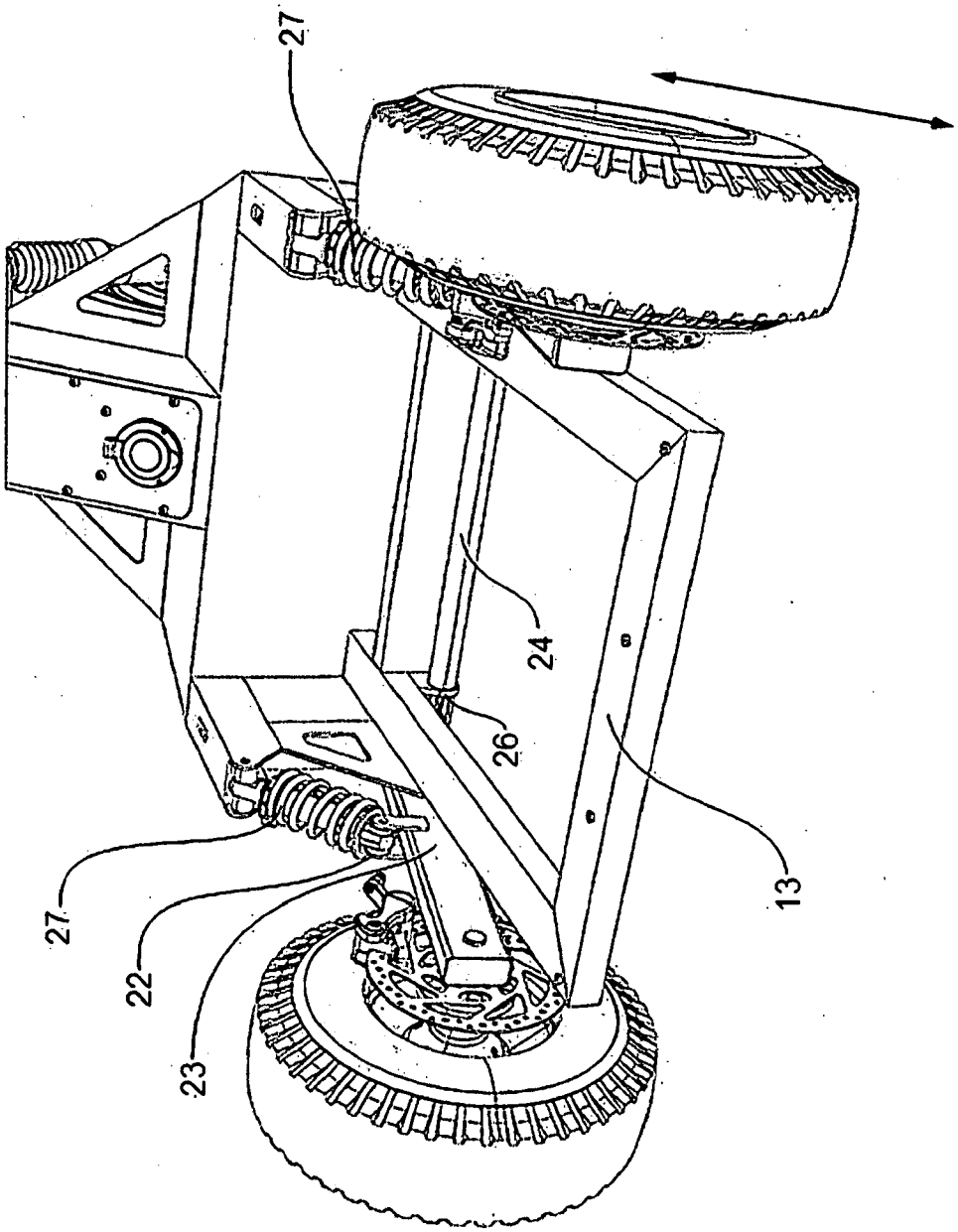



FIG. 3

FIG. 4



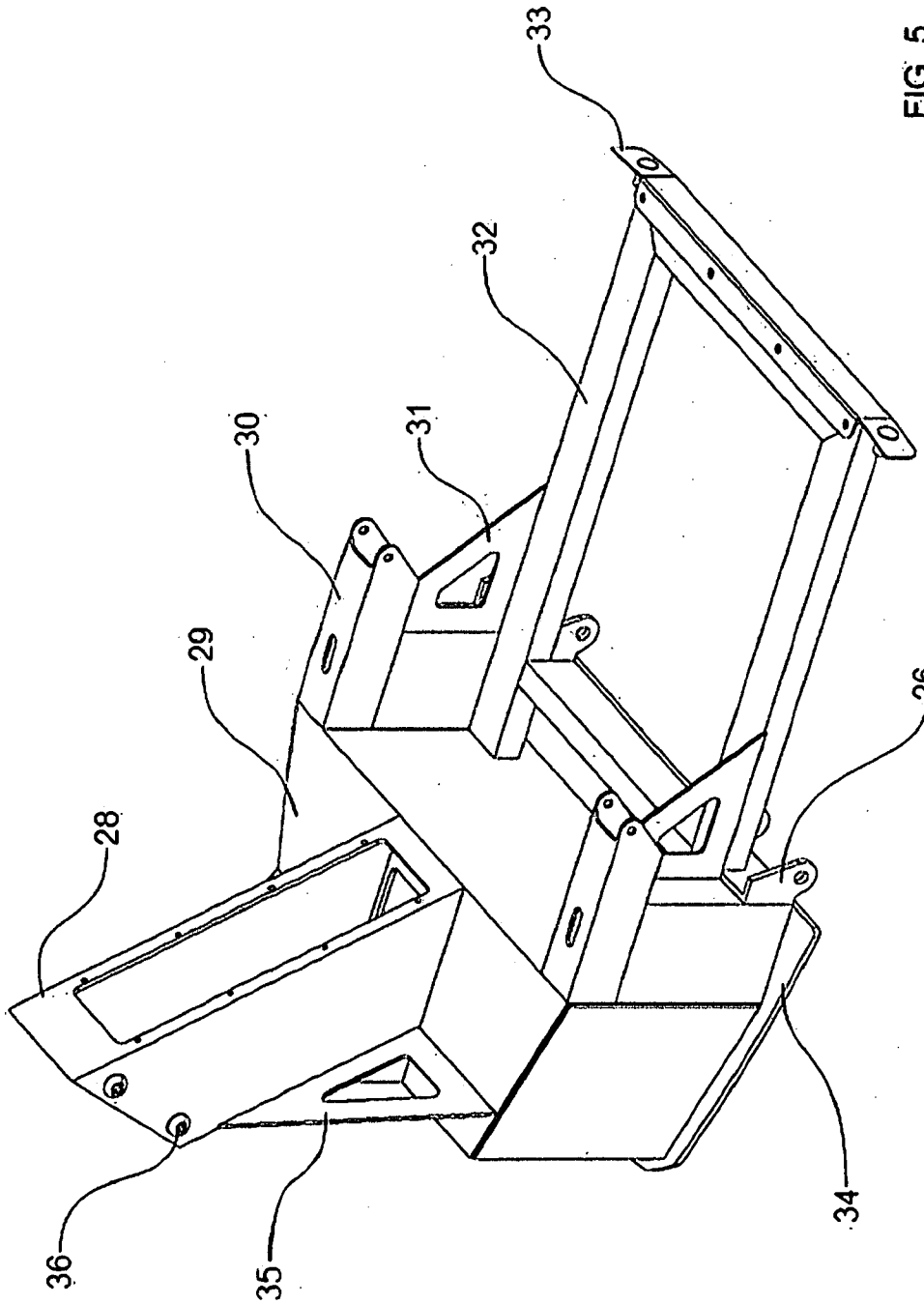



FIG. 5

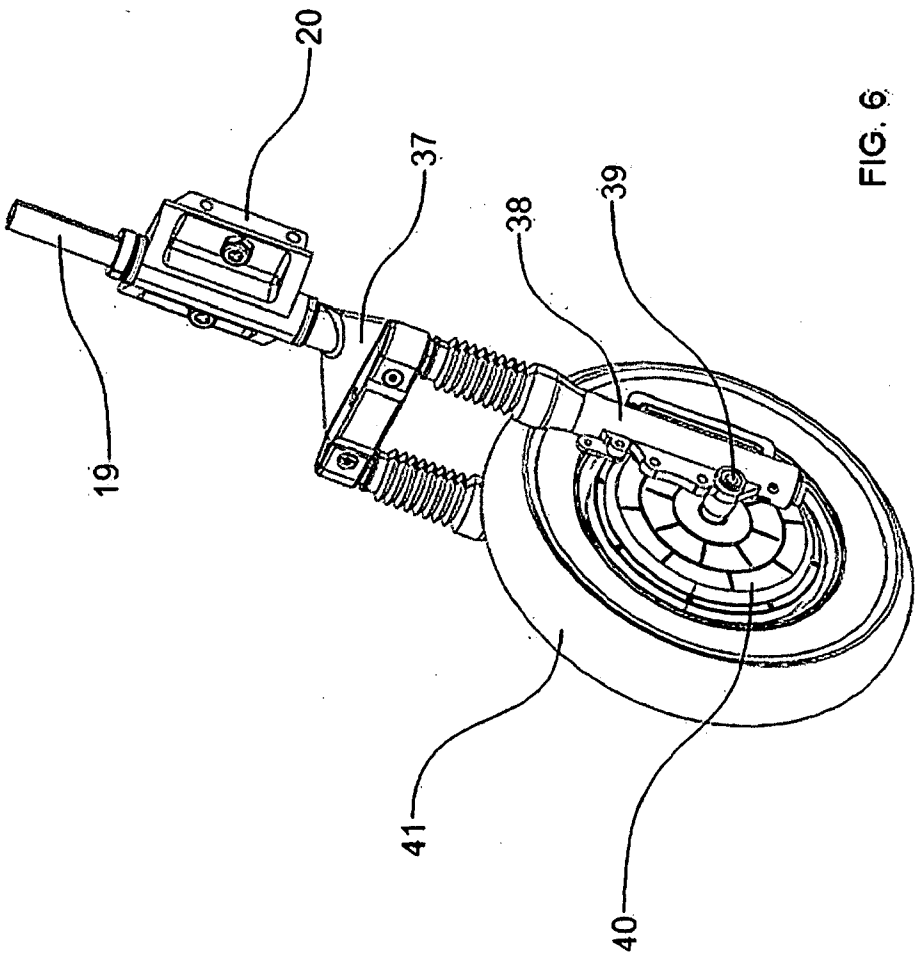



FIG. 6

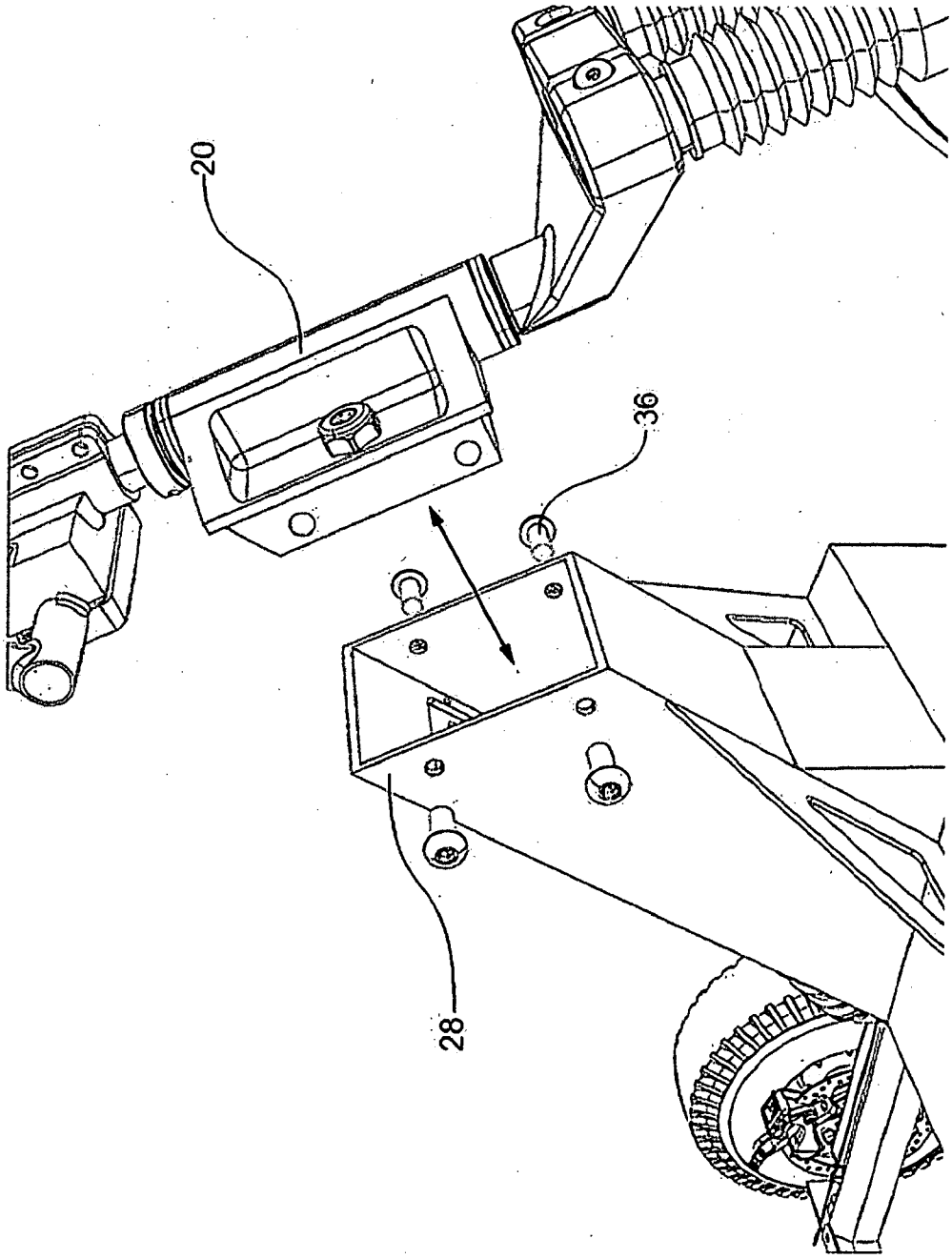



FIG. 7

FIG. 8

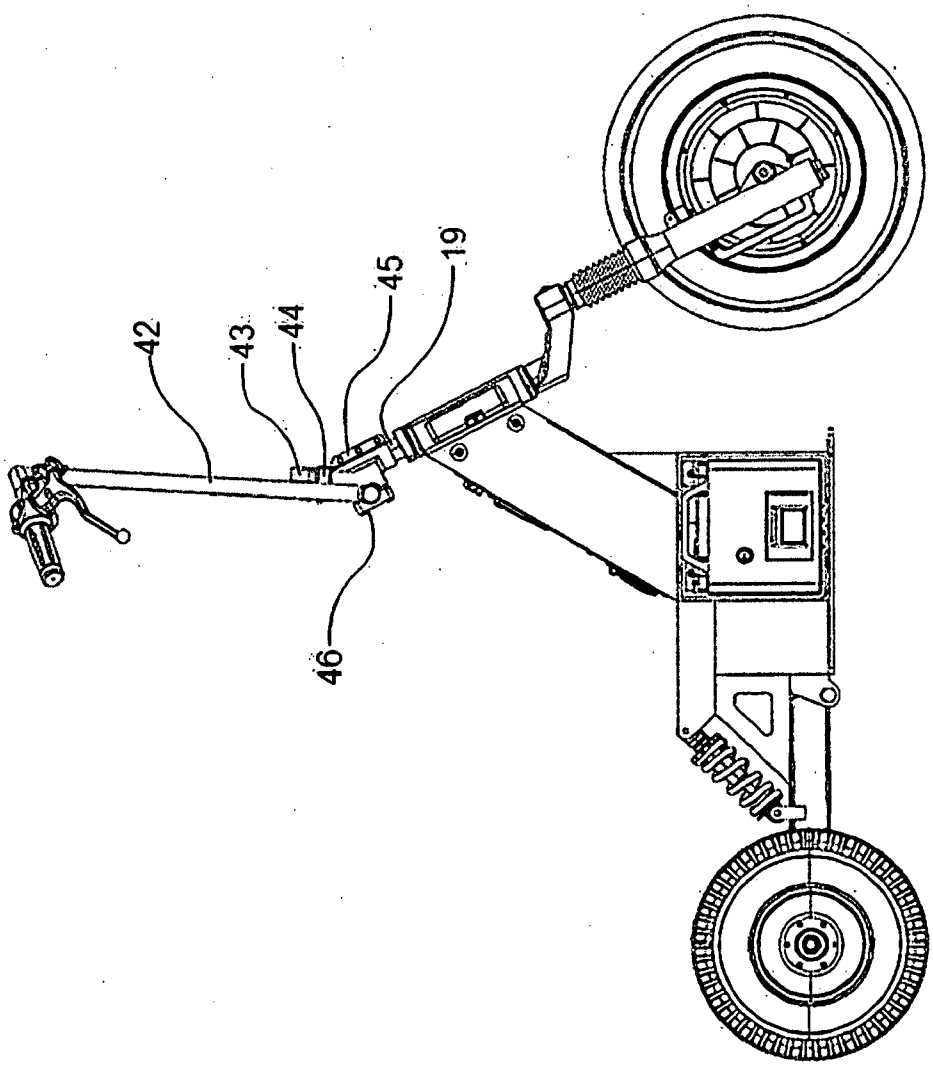
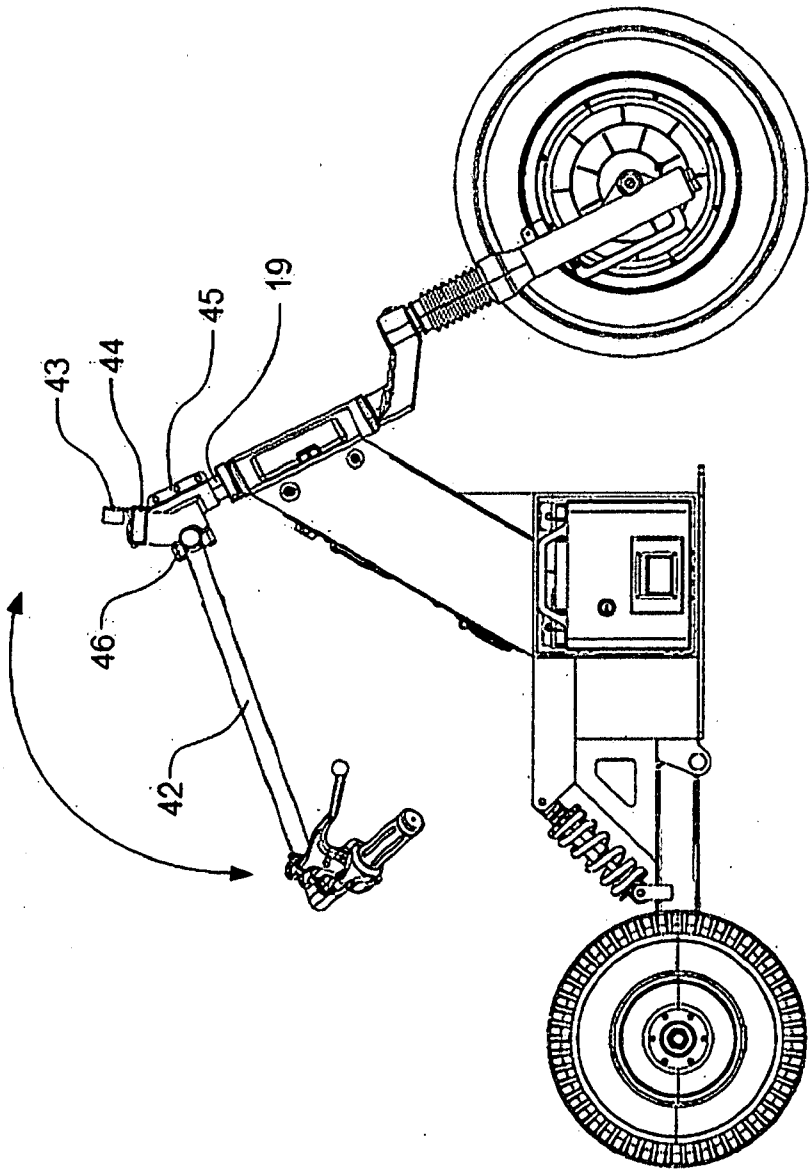


FIG. 9



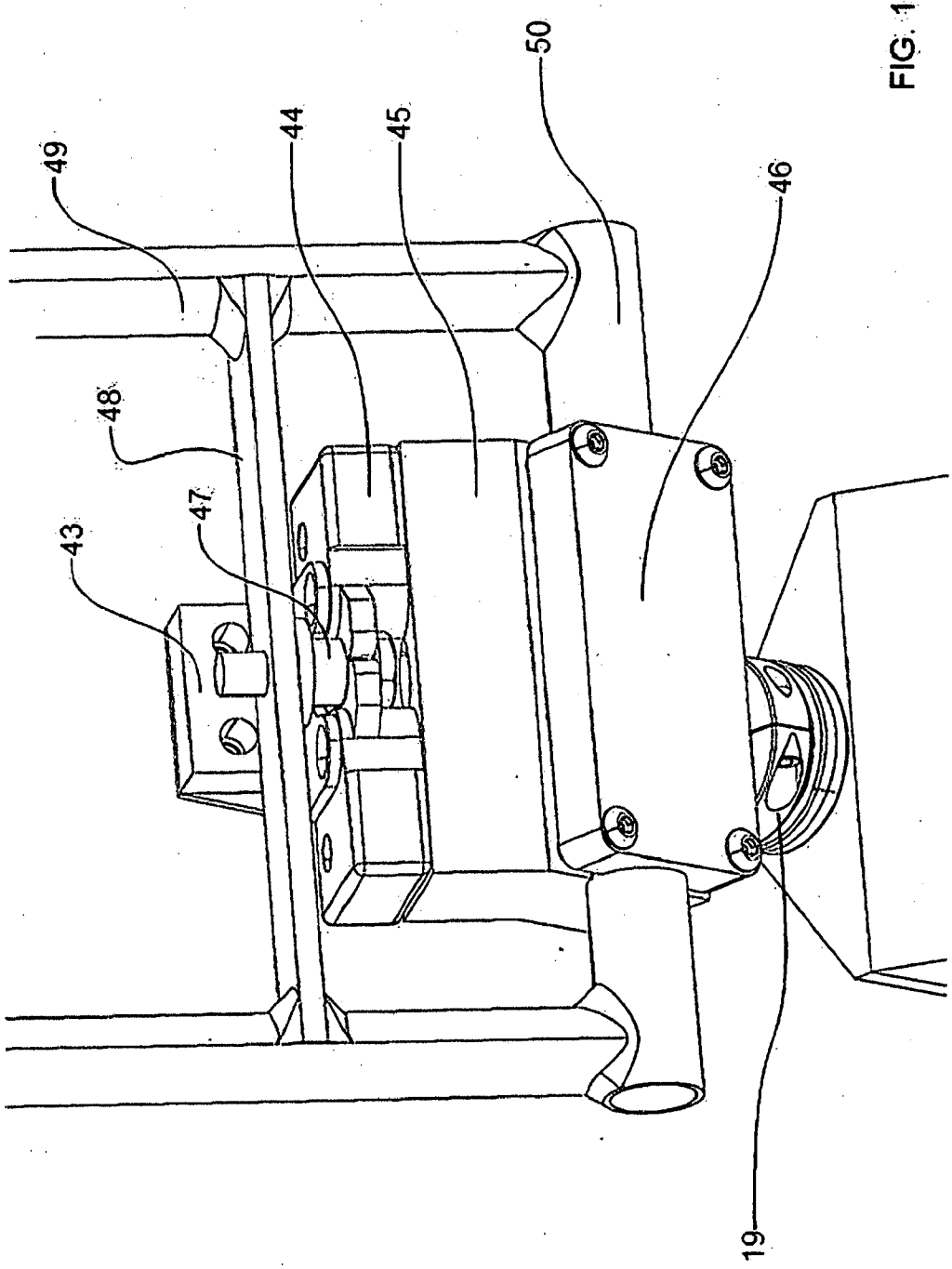



FIG. 10

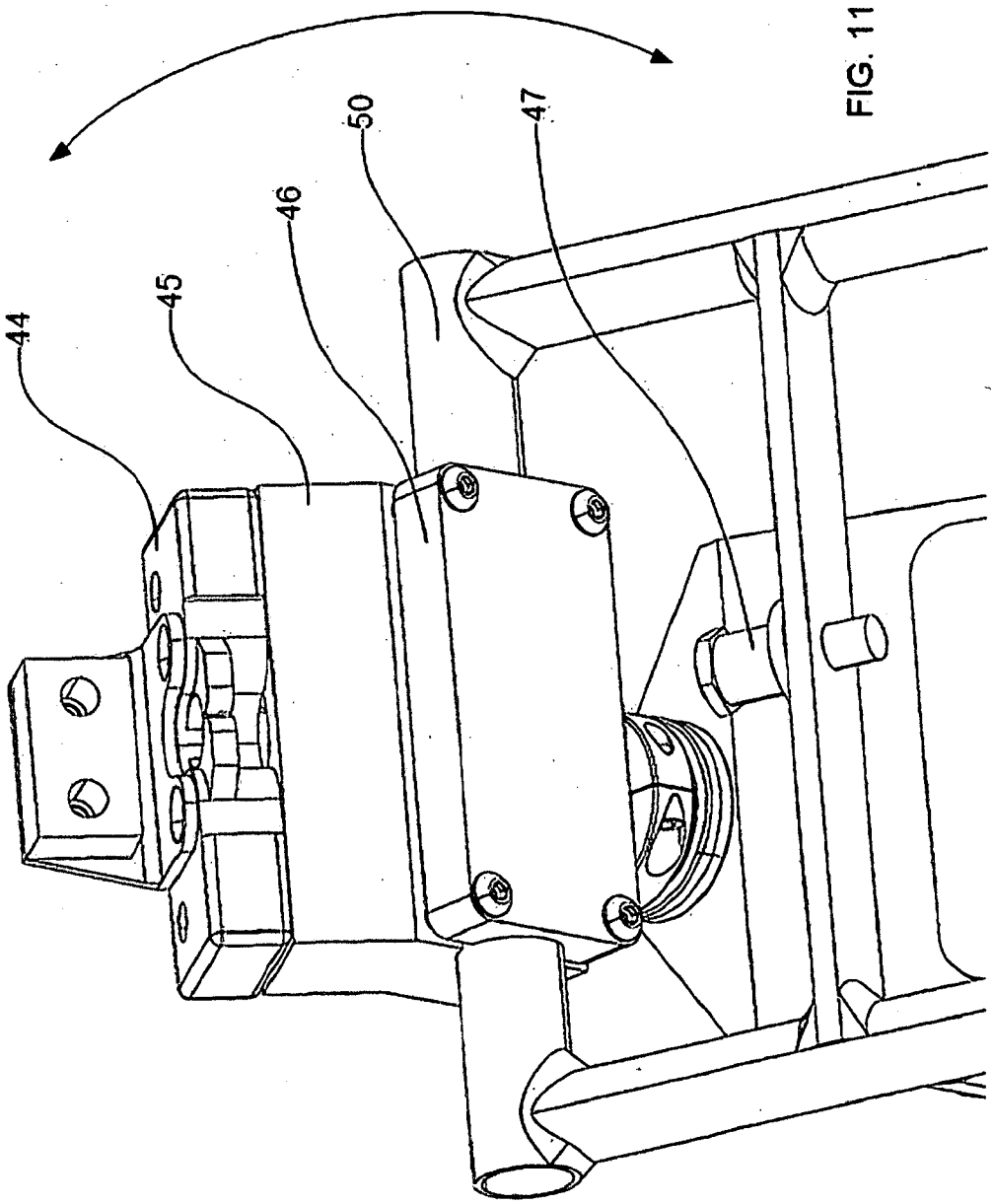



FIG. 11

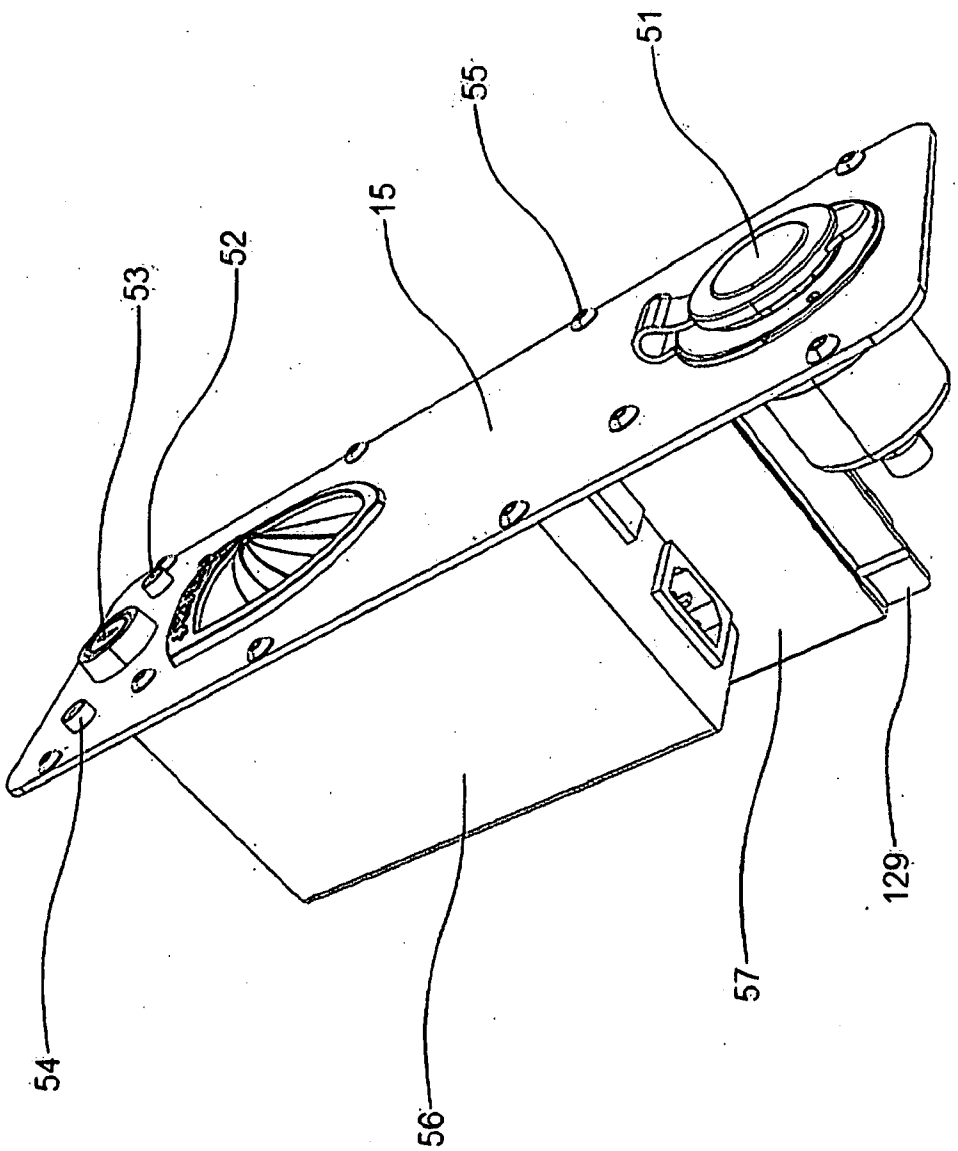
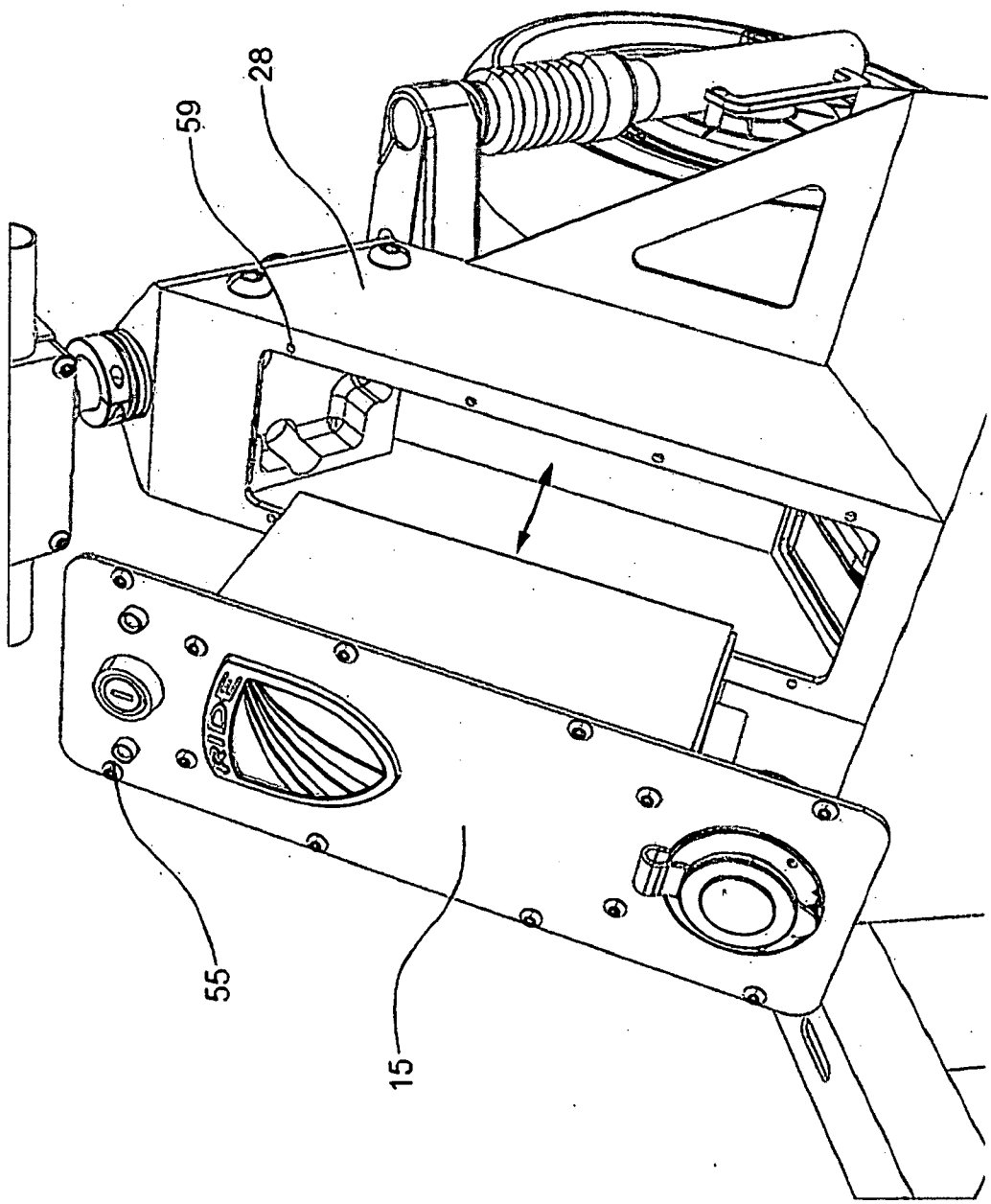



FIG. 12

FIG. 13



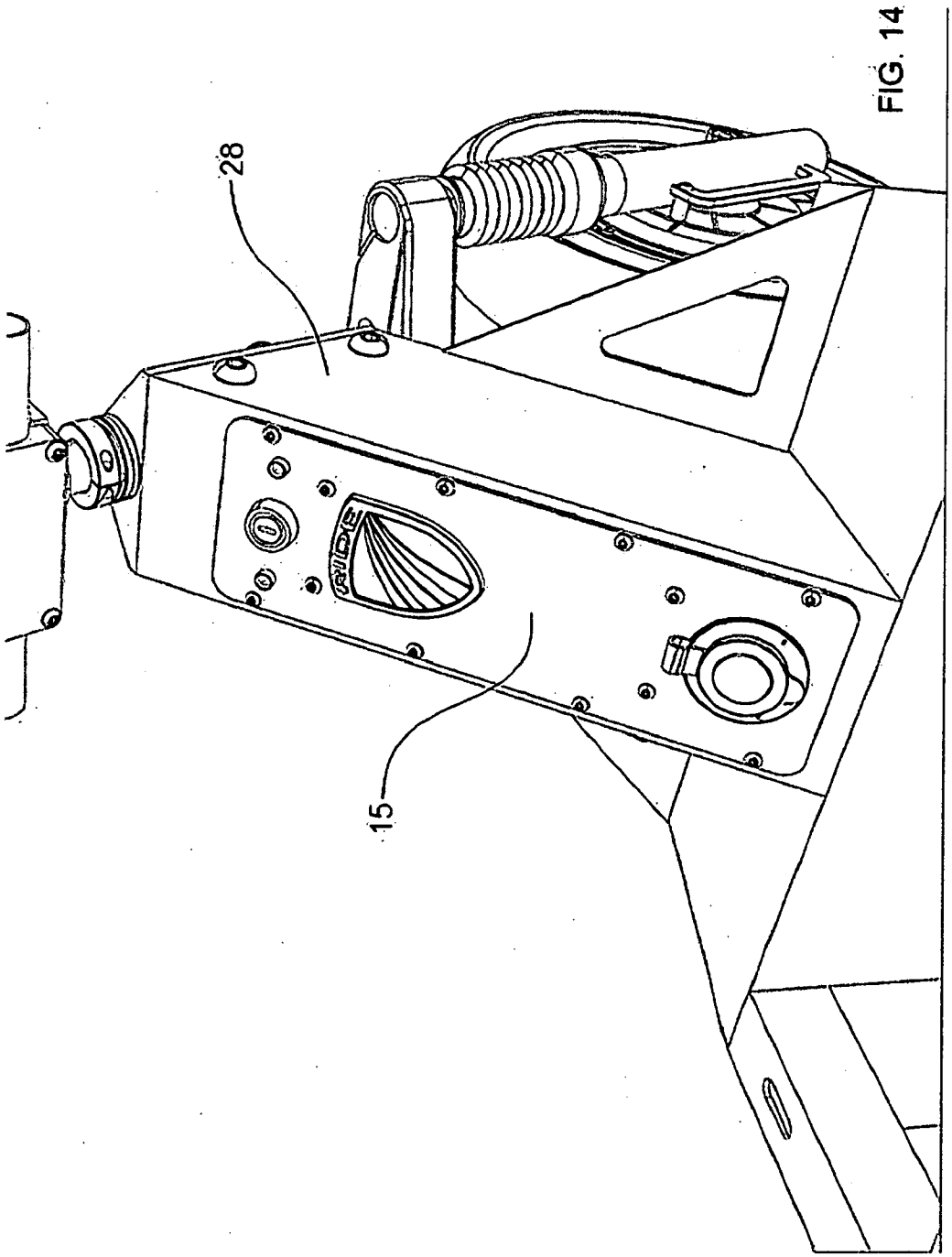



FIG. 14

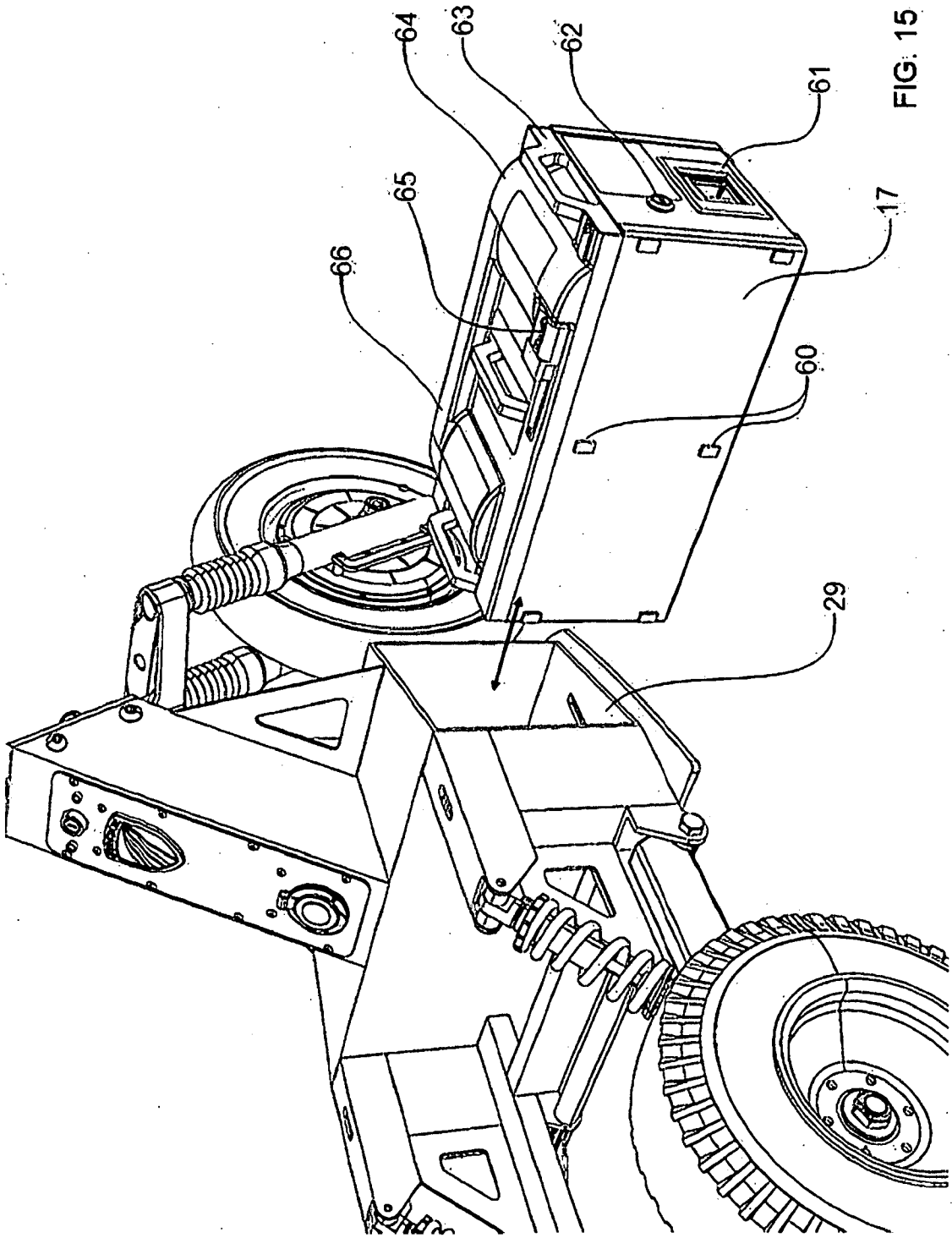



FIG. 15

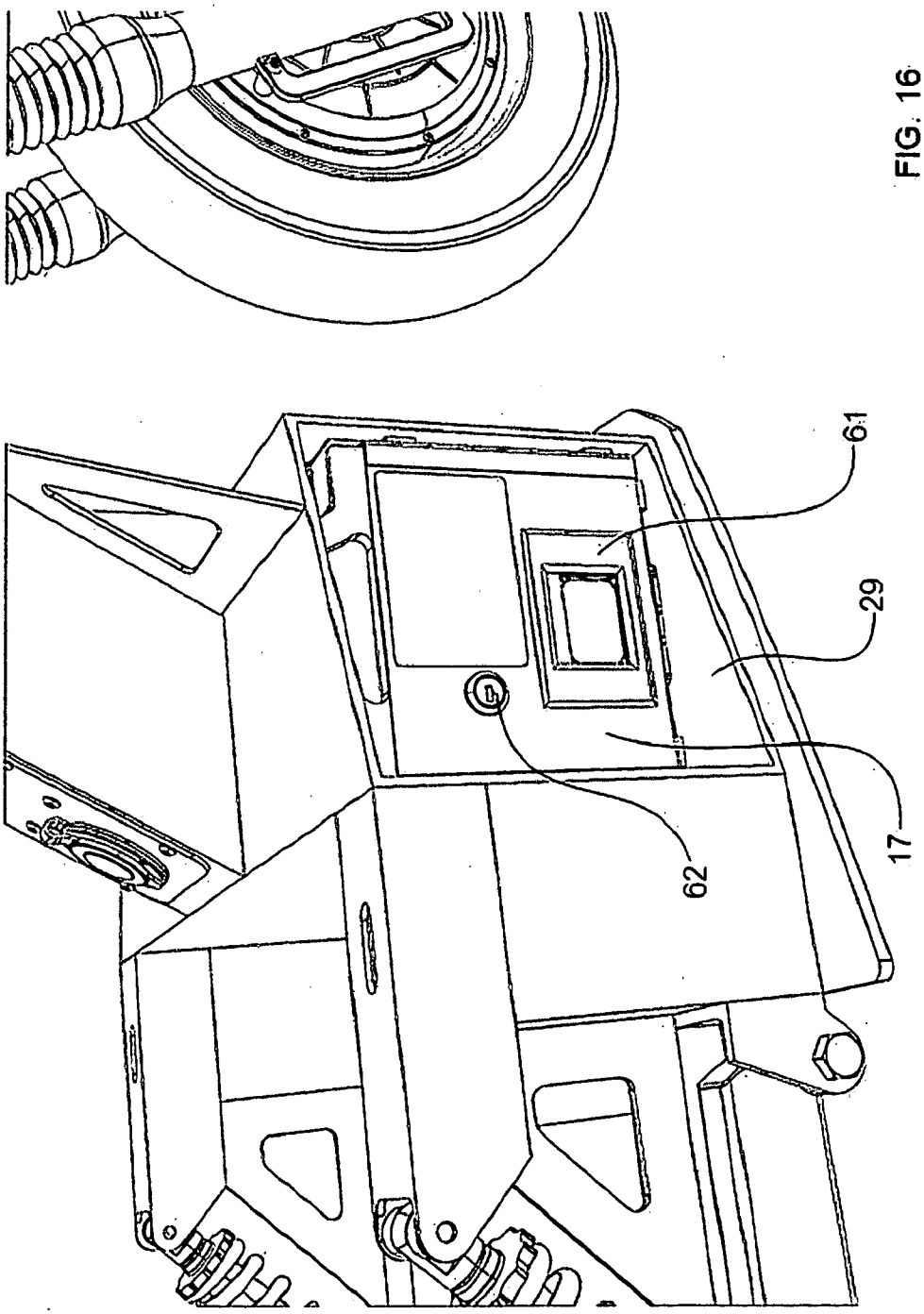



FIG. 16

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 09/02267

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B60K 1/00 (2009.01)
USPC - 180/65.1
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - B60K 1/00 (2009.01)
USPC - 180/65.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC 280/3, 29, 62, 63; 180/252 (text search - see terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST(USPT,PGPB,EPAB,JPAB); Google Scholar; Google Patents
Search Terms: vehicle, scooter, stand-up, electric, motor, platform, chassis, frame, suspension, trailing, arm, handlebar, energy, store, front, fork, brake, removable, conversion, transfer, 3-wheeled, personal, mobility, rider, extruded, metal, crown

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | US 7,017,694 B2 (Shirazawa) 28 March 2006 (28.03.2006), Fig 1, col 3, ln 41-44 and ln 54-58, col 4, ln 8-15 | 1-11 and 13 |
| Y | US 2006/0032683 A1 (Kejha) 16 February 2006 (16.02.2006), para [0084] | 1-11 |
| Y | US 6,056,077 A (Kobayashi) 02 May 2000 (02.05.2000), Fig 2 | 11 and 13 |
| Y | US 5,788,207 A (Bunker) 04 August 1998 (04.08.1998), col 4, ln 34-36 | 2 |
| Y | US 3,934,669 A (Adams) 27 January 1976 (27.01.1976), Fig 4, col 5, ln 48-62 | 4-5 and 7 |

☐ Further documents are listed in the continuation of Box C. ☐

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
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| 13 July 2009 (13.07.2009) | 24 JUL 2009 |
| Name and mailing address of the ISA/US<br>Mail Stop PCT, Attn: ISA/US, Commissioner for Patents<br>P.O. Box 1450, Alexandria, Virginia 22313-1450<br>Facsimile No. 571-273-3201 | Authorized officer:<br>Lee W. Young<br>PCT Helpdesk: 571-272-4300<br>PCT OSP: 571-272-7774 |

Form PCT/ISA/210 (second sheet) (April 2007)

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 09/02267

**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:
Group I: claims 1-11 and 13: directed to a vehicle powered by a electric propulsion system.

Group II: claims 12: directed to a folding handlebar assembly.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Group I does not include the inventive concept of a handlebar assembly including with two vertical tubes, one horizontal tube used for pivoting and one horizontal bar used to hold a latch bolt; a hinge; a hinge plate; and a latch mechanism, as required by Group II.

Group II does not include the inventive concept of a vehicle including a electric propulsion system including a energy storage system, a power conversion system, and a electric traction motor; and a plurality of wheels, as required by Group I.

Groups I and II therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
Group I: claims 1-11 and 13: directed to a vehicle powered by a electric propulsion system.

**Remark on Protest**

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.