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Clause

(10) **Patent No.: US 9,823,686 B1**
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(54) **THREE-AXIS MOTION JOYSTICK**

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(51) **Int. Cl.**

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G05G 1/04	(2006.01)
G05G 5/03	(2008.04)
B62D 1/12	(2006.01)
B60K 26/02	(2006.01)

(52) **U.S. Cl.**
CPC ***G05G 9/047*** (2013.01); ***B60K 26/02*** (2013.01); ***B62D 1/12*** (2013.01); ***G05G 1/04*** (2013.01); ***G05G 5/03*** (2013.01); *B60K 2026/029* (2013.01); *G05G 2009/04766* (2013.01); *G05G 2009/04774* (2013.01)

(58) **Field of Classification Search**
CPC .. B60K 26/00; B60K 2026/029; B60K 26/02; B62D 1/12; G05G 9/04; G05G 9/047; G05G 2009/04714; G05G 9/04737; G05G 2009/04781; G05G 9/04792; G05G 5/03; G05G 1/04; G05G 2009/04766; G05G 2009/04774; B25J 13/02; Y10T 74/20213
USPC ..... 180/333, 315; 74/471 R, 471 X Y
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,011,739 A * 12/1961 Boyce B64C 13/04 244/237
3,028,126 A * 4/1962 Holleman B64C 13/04 244/236
3,196,709 A * 7/1965 Bickford B62D 1/14 74/557
3,299,731 A * 1/1967 Russell, Jr. ..... B64C 13/04 200/6 A
3,312,123 A * 4/1967 Rumpf B62D 1/04 280/775
3,350,956 A * 11/1967 Monge B64C 13/04 244/234
3,388,609 A * 6/1968 Miller G05G 9/047 137/636.2
3,831,633 A * 8/1974 Corner B62D 11/183 137/636.2

(Continued)

OTHER PUBLICATIONS

Bionic Laboratories, www.bioniklabs.com/ website, Inmotionwrist interactive therapy system, accessed on Jul. 7, 2016.

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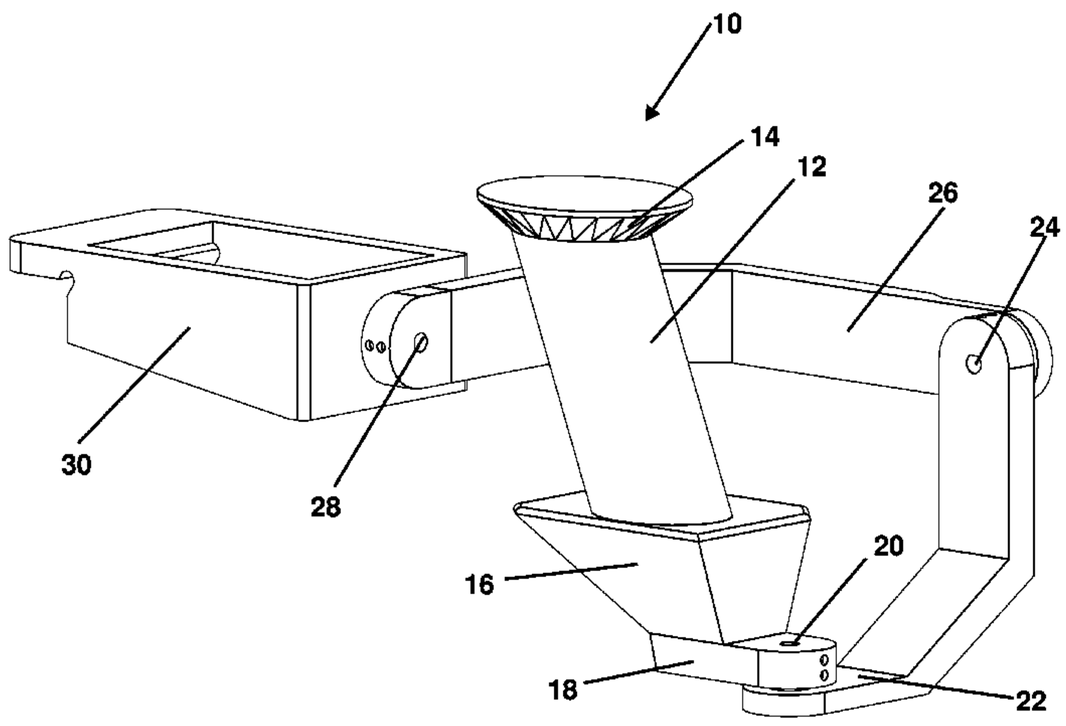
(57) **ABSTRACT**

A controller having a joystick which can be moved in three dimensions is disclosed. The joystick is connected by a Y (yaw) link which is, in turn, connected to a P (pitch) link, which is, in turn connected to an R (roll) link. The R link is rotatable about a fixed-position mounting base. In this manner, one can rotate a joystick around any of three axes. When used to control a vehicle, rotation around the yaw and roll axes can steer (with yaw being more fine-tuned steering), and rotation around the pitch axis can control acceleration and deceleration. A starting or center position for each link can be defined, and the further a link is rotated and/or force increases on tires being steered from this central position, the more resistance is applied, in embodiments of the disclosed technology.

14 Claims, 18 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

3,897,805	A *	8/1975	Casey	E02F 3/76	137/636.2
4,027,547	A *	6/1977	Rahman	G05G 9/047	137/636.2
4,069,720	A *	1/1978	Thor	B64C 13/04	244/225
4,422,345	A *	12/1983	Green	G05G 9/047	74/471 XY
4,531,080	A	7/1985	Nordstrom et al.		
4,555,960	A	12/1985	King		
4,641,849	A *	2/1987	De Cortanze	B62D 1/12	180/219
4,667,909	A *	5/1987	Curci	B64C 13/12	244/234
4,726,248	A *	2/1988	Kawai	B25J 13/02	74/471 XY
4,895,039	A *	1/1990	Hegg	B64C 13/04	180/333
4,920,820	A *	5/1990	Ingham	B62D 1/12	74/471 XY
4,976,582	A *	12/1990	Clavel	B25J 9/1065	108/138
5,007,300	A *	4/1991	Siva	B25J 13/02	414/5
5,019,761	A *	5/1991	Kraft	G05B 19/427	318/568.1
5,050,449	A *	9/1991	Falcou	G05G 7/04	338/128
5,107,080	A *	4/1992	Rosen	B64C 13/04	200/6 A
5,125,602	A	6/1992	Vauvelle		
5,142,931	A	9/1992	Menahem		
5,182,961	A *	2/1993	Menahem	B64C 13/04	244/234
5,379,663	A *	1/1995	Hara	B25J 13/02	345/161
5,456,428	A *	10/1995	Hegg	B64C 13/12	244/229
5,497,847	A *	3/1996	Ota	B60K 20/02	180/333
5,503,040	A *	4/1996	Wright	B64C 13/04	244/236
5,587,937	A *	12/1996	Massie	B25J 9/1689	700/264
5,655,411	A *	8/1997	Avitan	G05G 9/047	74/471 XY
5,724,068	A *	3/1998	Sanchez	G05G 9/047	345/161
5,755,645	A *	5/1998	Miller	A61H 1/0285	482/115
5,769,363	A *	6/1998	Griswold	B64C 13/04	244/234
5,805,140	A *	9/1998	Rosenberg	G01B 5/008	345/156
5,859,372	A *	1/1999	Neltoft	G01L 5/166	250/221
5,979,264	A *	11/1999	Rosheim	B25J 17/0266	74/490.03
5,995,893	A *	11/1999	Lee	G05G 9/047	414/680
6,059,660	A *	5/2000	Takada	G05G 9/047	273/148 B
6,222,179	B1 *	4/2001	Mikan	G05G 9/047	250/221
6,267,673	B1 *	7/2001	Miyamoto	A63F 13/06	463/23
6,293,160	B1 *	9/2001	Shigemoto	G01L 1/2231	73/862.632
6,437,771	B1 *	8/2002	Rosenberg	A63F 13/06	345/156
6,573,885	B1 *	6/2003	McVicar	F16D 3/382	345/156
6,642,685	B2 *	11/2003	Onodera	G05G 9/047	318/568.16
6,670,945	B1	12/2003	Nakamura		
6,681,880	B2 *	1/2004	Bernhardt	G05G 9/047	172/442
6,722,224	B2 *	4/2004	Nordstrom	G05G 9/047	74/471 XY
6,727,889	B2	4/2004	Shaw		
6,805,021	B2 *	10/2004	Kato	F16H 59/105	74/473.12
6,837,124	B2 *	1/2005	Tsai	G05G 9/047	188/333
6,880,855	B2 *	4/2005	Chernoff	B60N 2/4693	180/315
6,966,397	B2 *	11/2005	Yanaka	B62D 1/12	180/315
7,236,157	B2 *	6/2007	Schena	A63F 13/06	345/161
7,320,263	B2 *	1/2008	Gustafsson	G05G 5/28	74/471 XY
7,466,303	B2 *	12/2008	Yi	A61B 5/055	345/156
7,623,945	B2 *	11/2009	Kraft	B25J 13/02	414/2
7,675,258	B2 *	3/2010	Dattilo	G05G 1/04	318/560
7,701,161	B2 *	4/2010	Hanlon	B64C 13/04	318/561
7,726,692	B2 *	6/2010	Ozaki	B62D 1/04	280/778
7,783,384	B2 *	8/2010	Kraft	B25J 13/02	414/2
7,843,426	B2 *	11/2010	Larson	G05G 9/047	345/156
8,087,619	B2 *	1/2012	Hanlon	B64C 13/04	244/223
8,096,206	B2 *	1/2012	Konig	G05G 9/047	74/471 XY
8,100,029	B2 *	1/2012	Peterson	G05G 9/047	244/234
8,230,755	B2 *	7/2012	Ishikawa	G05G 9/047	74/470
8,235,330	B2 *	8/2012	Rozovski	B64C 13/04	244/220
8,371,187	B2 *	2/2013	Payandeh	B25J 13/02	74/469
8,667,860	B2 *	3/2014	Helmer	B25J 13/02	74/490.01
8,770,055	B2 *	7/2014	Peterson	B64C 13/04	74/471 XY
8,881,616	B2 *	11/2014	Dize	G05G 9/047	345/161
9,051,836	B2 *	6/2015	Yates	F01D 7/00	
9,134,187	B1 *	9/2015	Organ	G01L 5/223	
9,575,504	B2 *	2/2017	Dize	G05G 9/047	
2002/0175467	A1 *	11/2002	Dicus	B60G 17/033	273/148 B
2002/0190948	A1 *	12/2002	Coutant	G05G 23/02	345/161
2003/0152452	A1 *	8/2003	Hodgson	B60N 2/4693	414/694
2004/0099081	A1 *	5/2004	Riwan	B25J 3/04	74/490.01
2006/0090588	A1 *	5/2006	Zumbusch	B62D 1/12	74/543
2006/0156848	A1 *	7/2006	Gosselin	B25J 13/02	74/471 XY
2006/0254377	A1 *	11/2006	Henle	B64C 13/04	74/471 XY
2008/0193260	A1 *	8/2008	Yokokohji	B25J 13/02	414/1
2009/0266948	A1 *	10/2009	Hanlon	G05G 9/047	248/201
2012/0017714	A1 *	1/2012	Rinaldi	G05G 9/047	74/471 R

(56) **References Cited**

U.S. PATENT DOCUMENTS

2014/0160015	A1*	6/2014	Ogawa	B25J 13/02 345/156
2015/0060185	A1*	3/2015	Feguri	B60T 7/10 180/333
2017/0050721	A1*	2/2017	Voiles	G05G 9/047

* cited by examiner

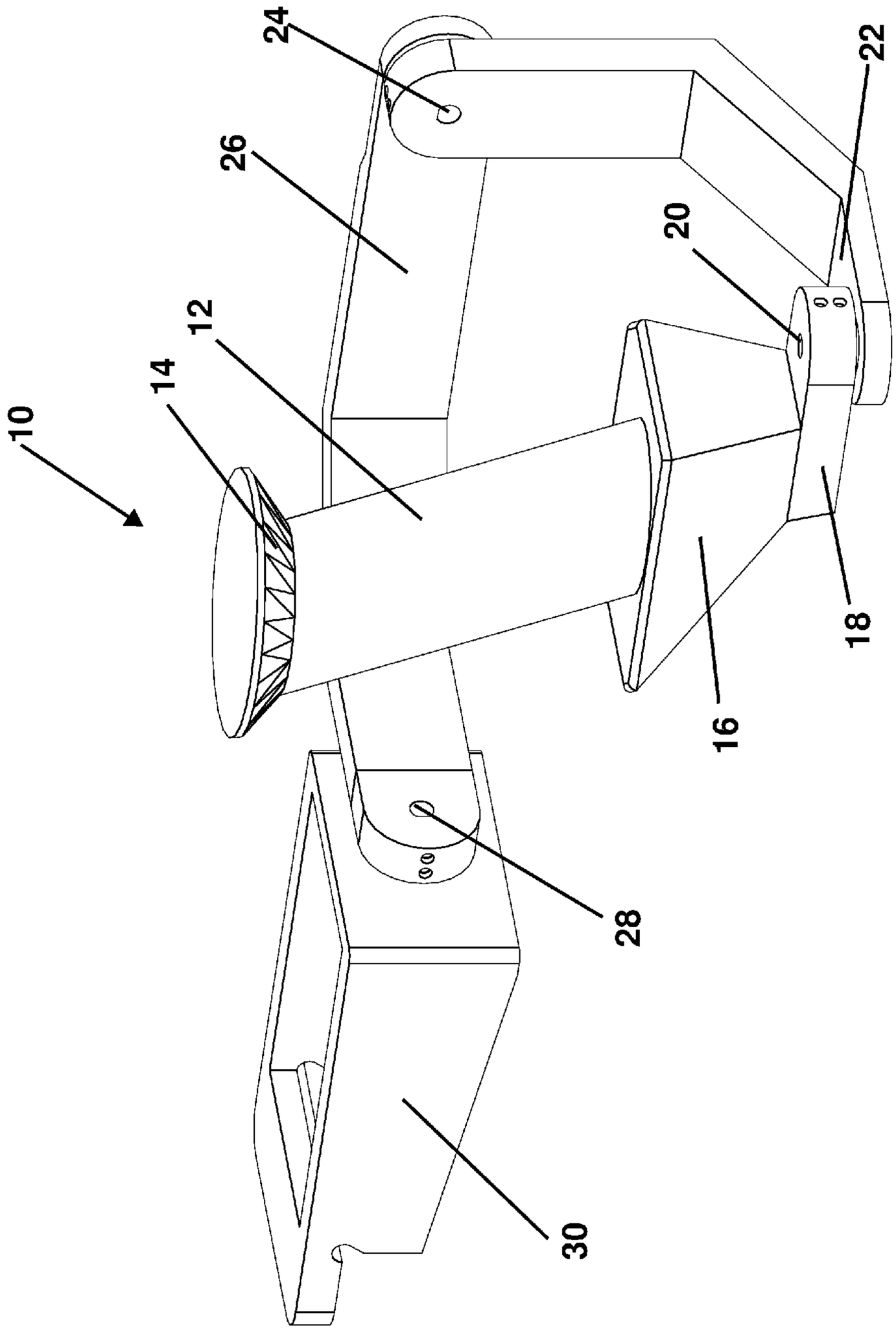
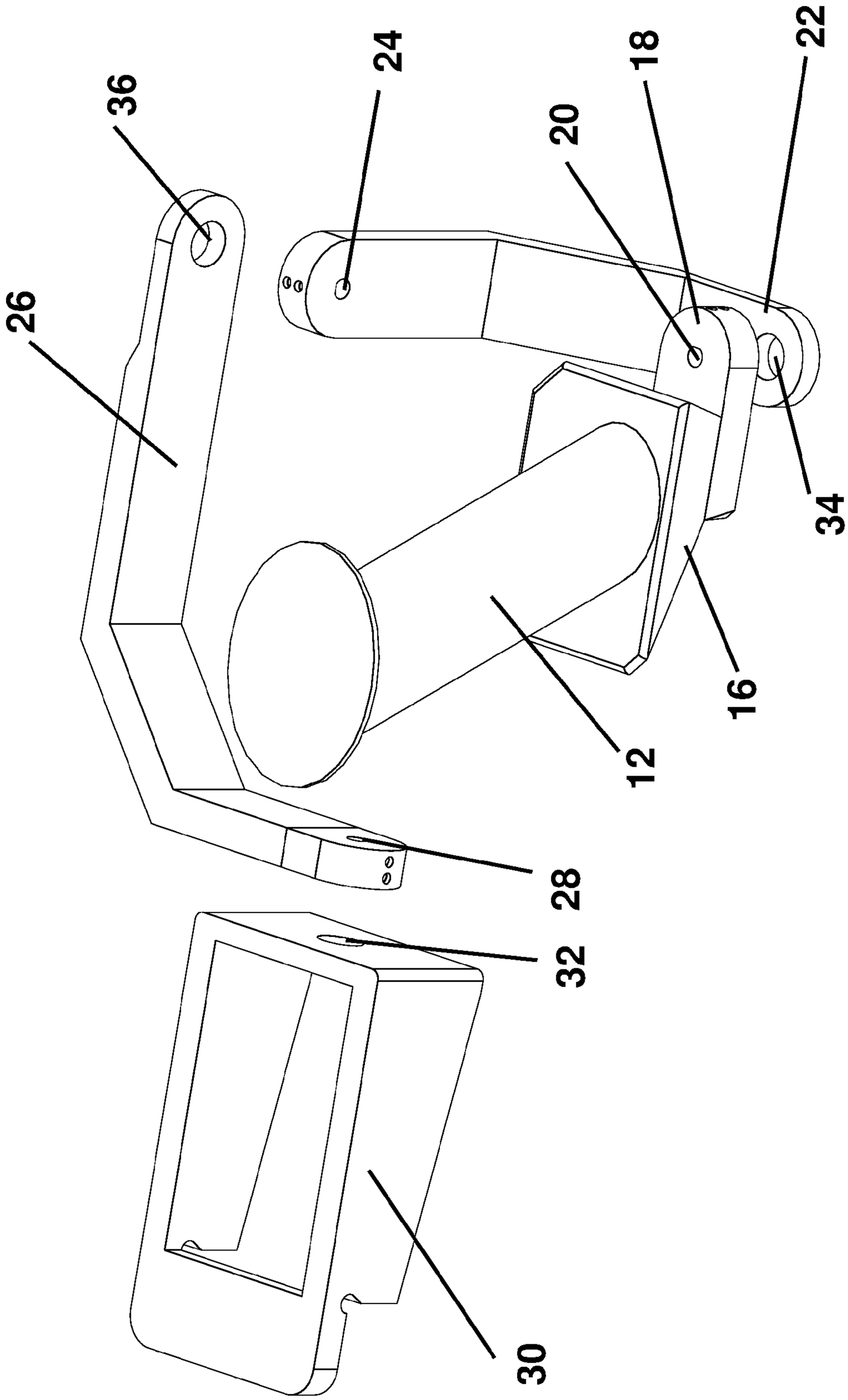


FIG. 1



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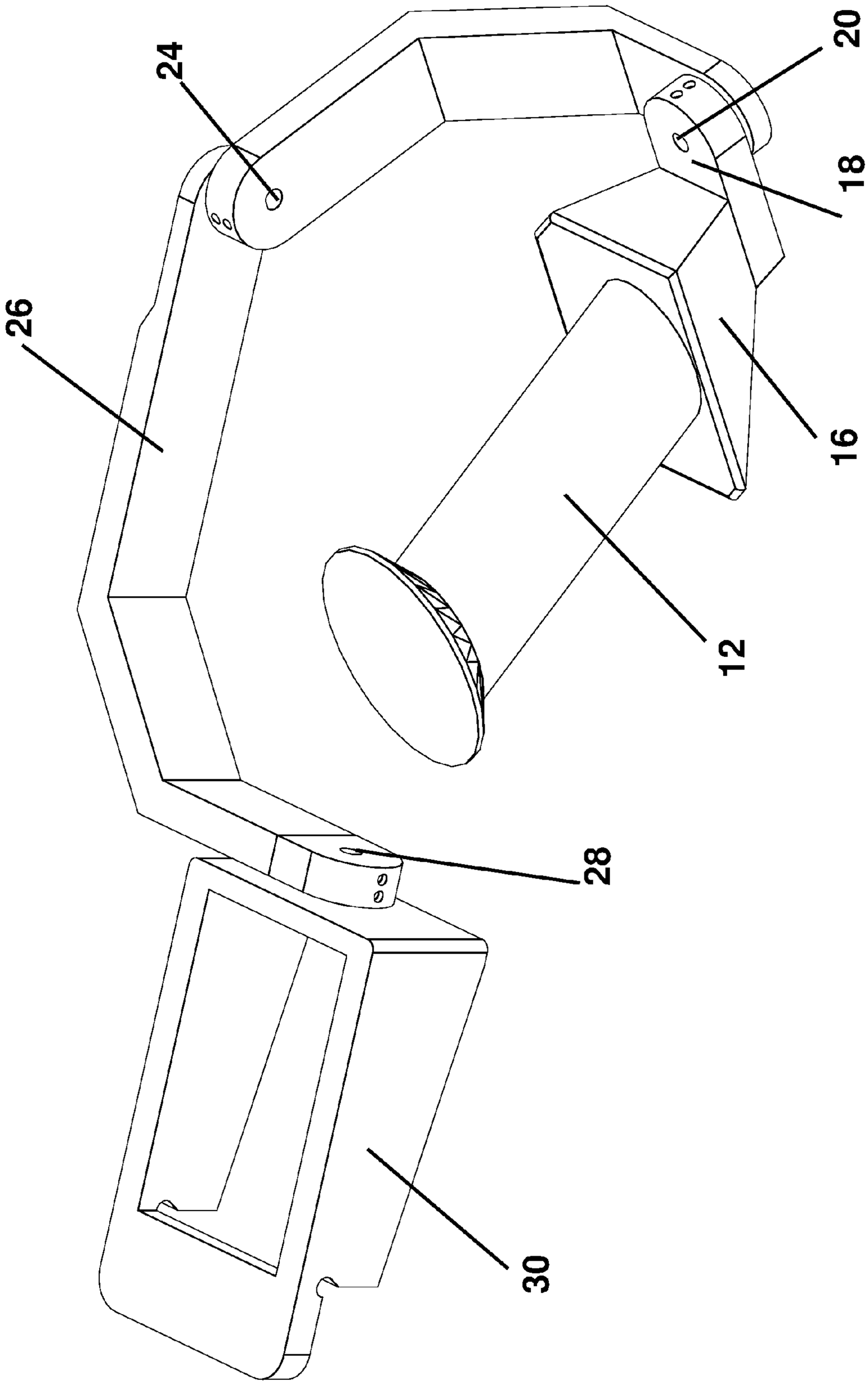

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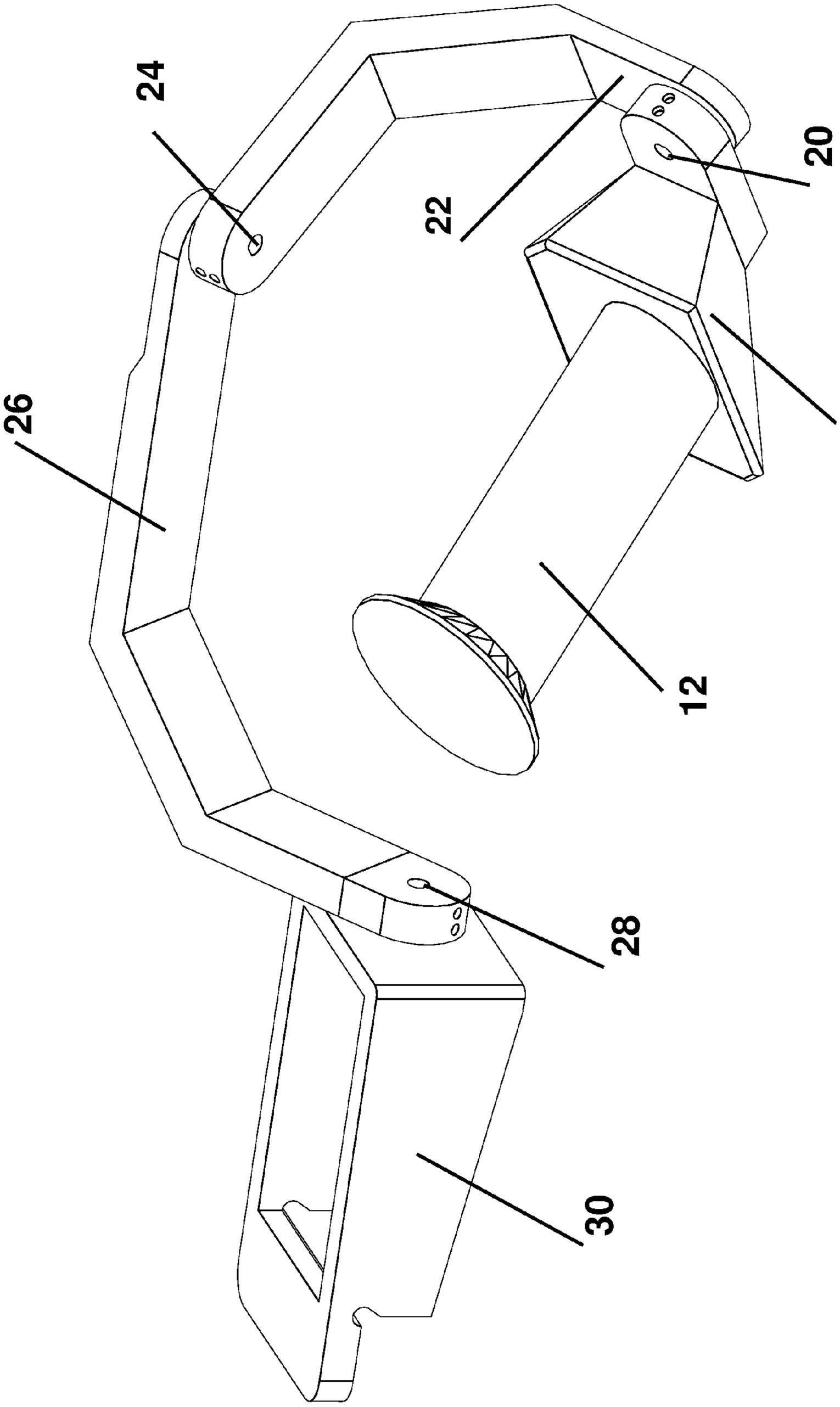

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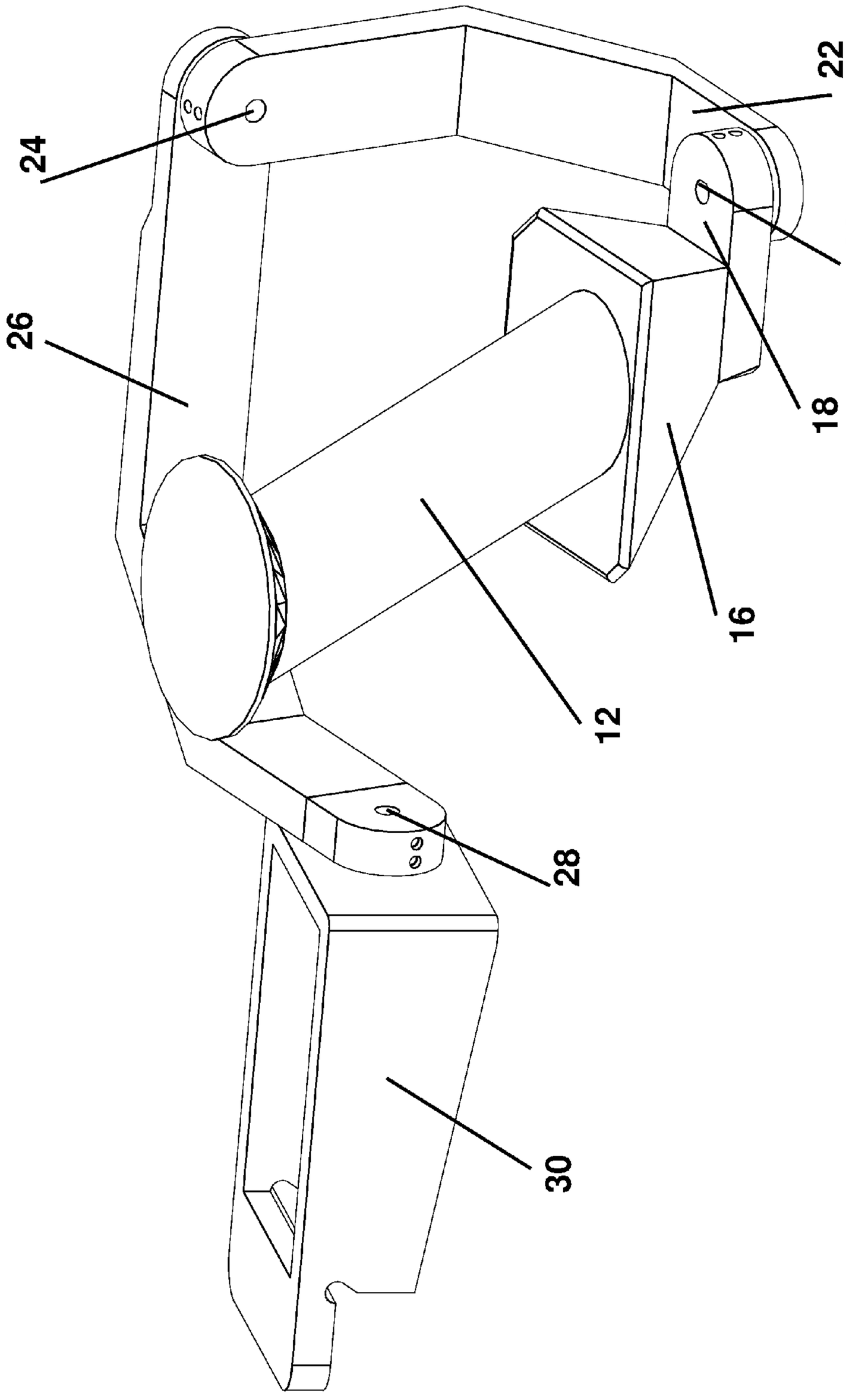

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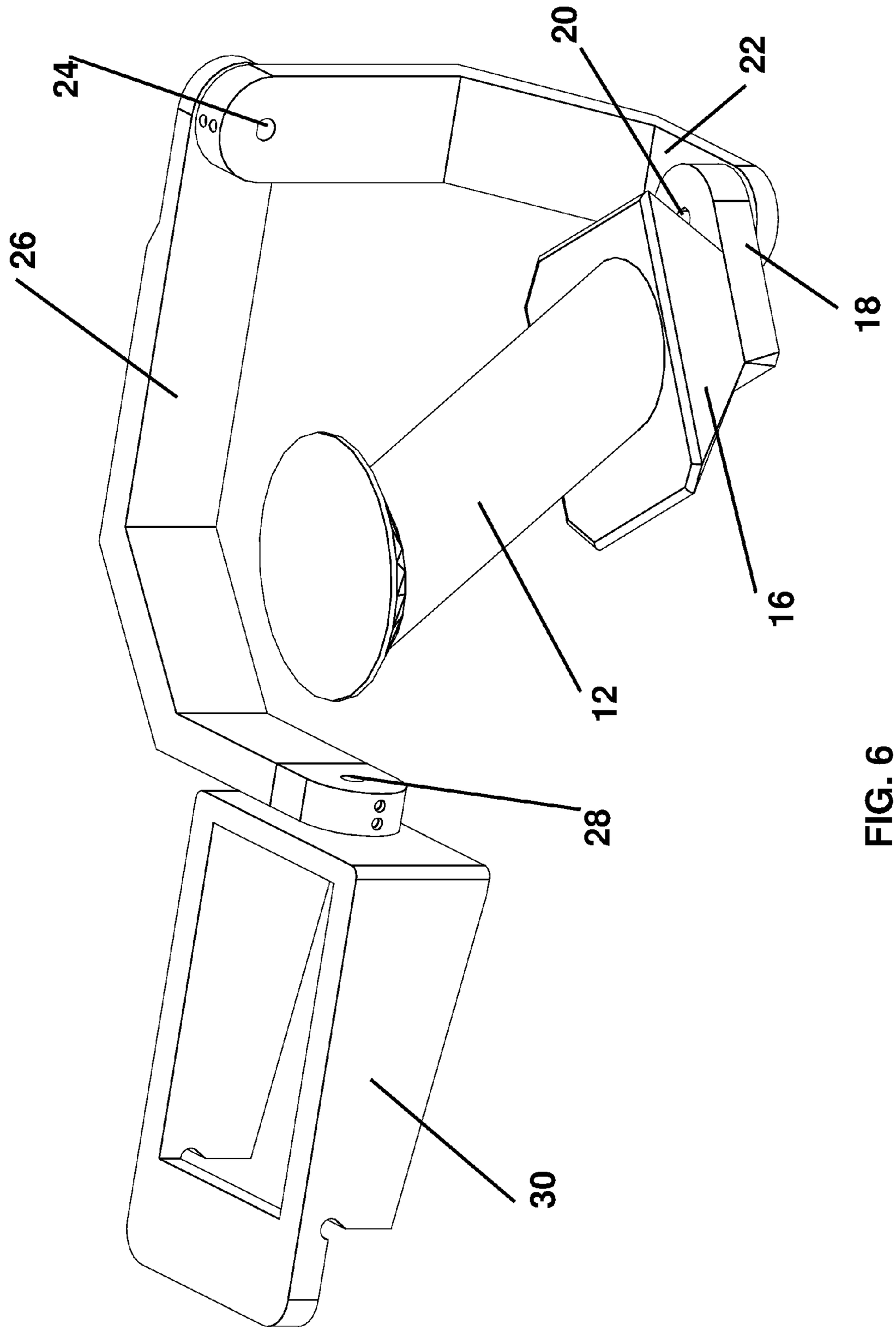

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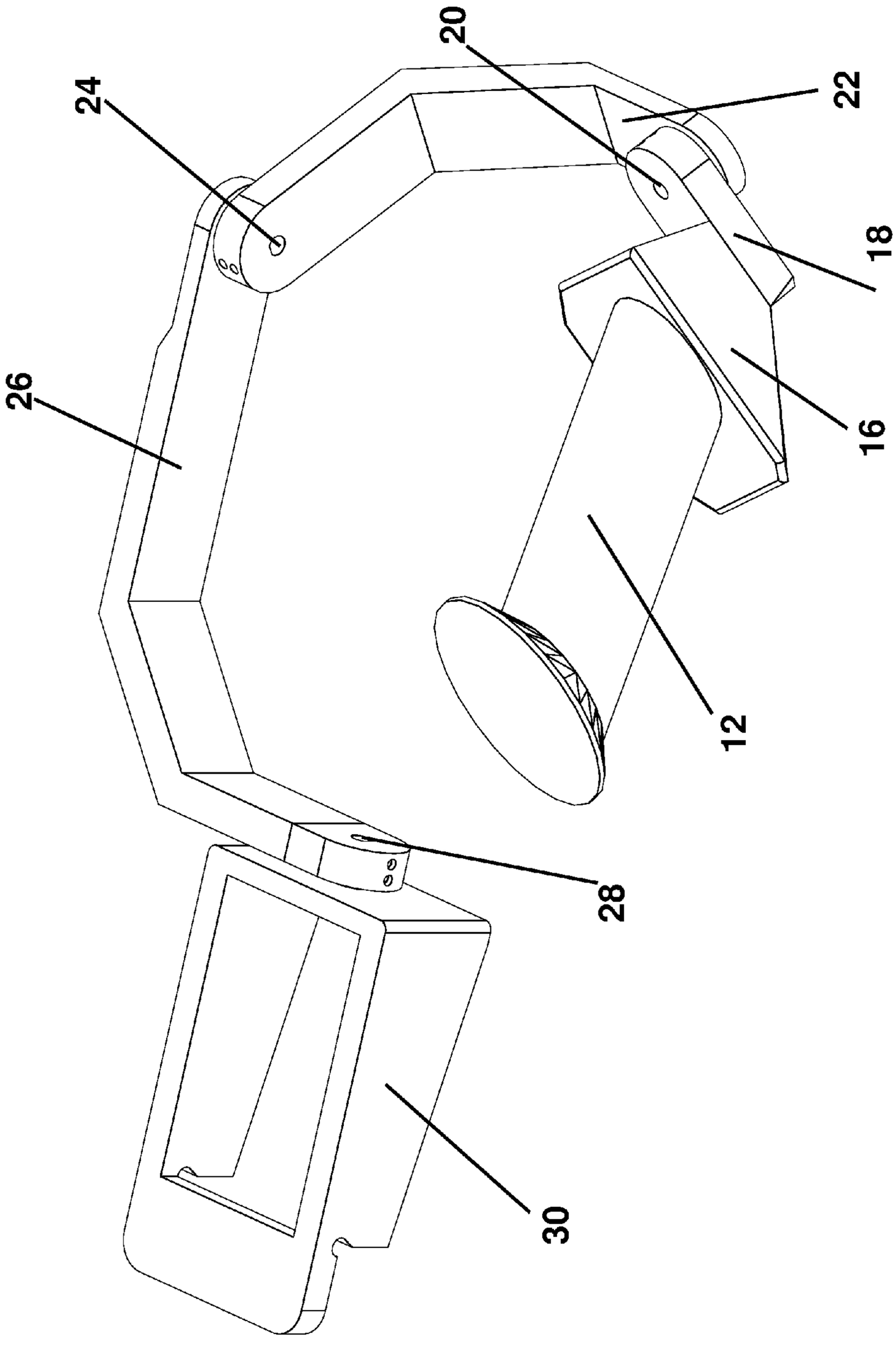

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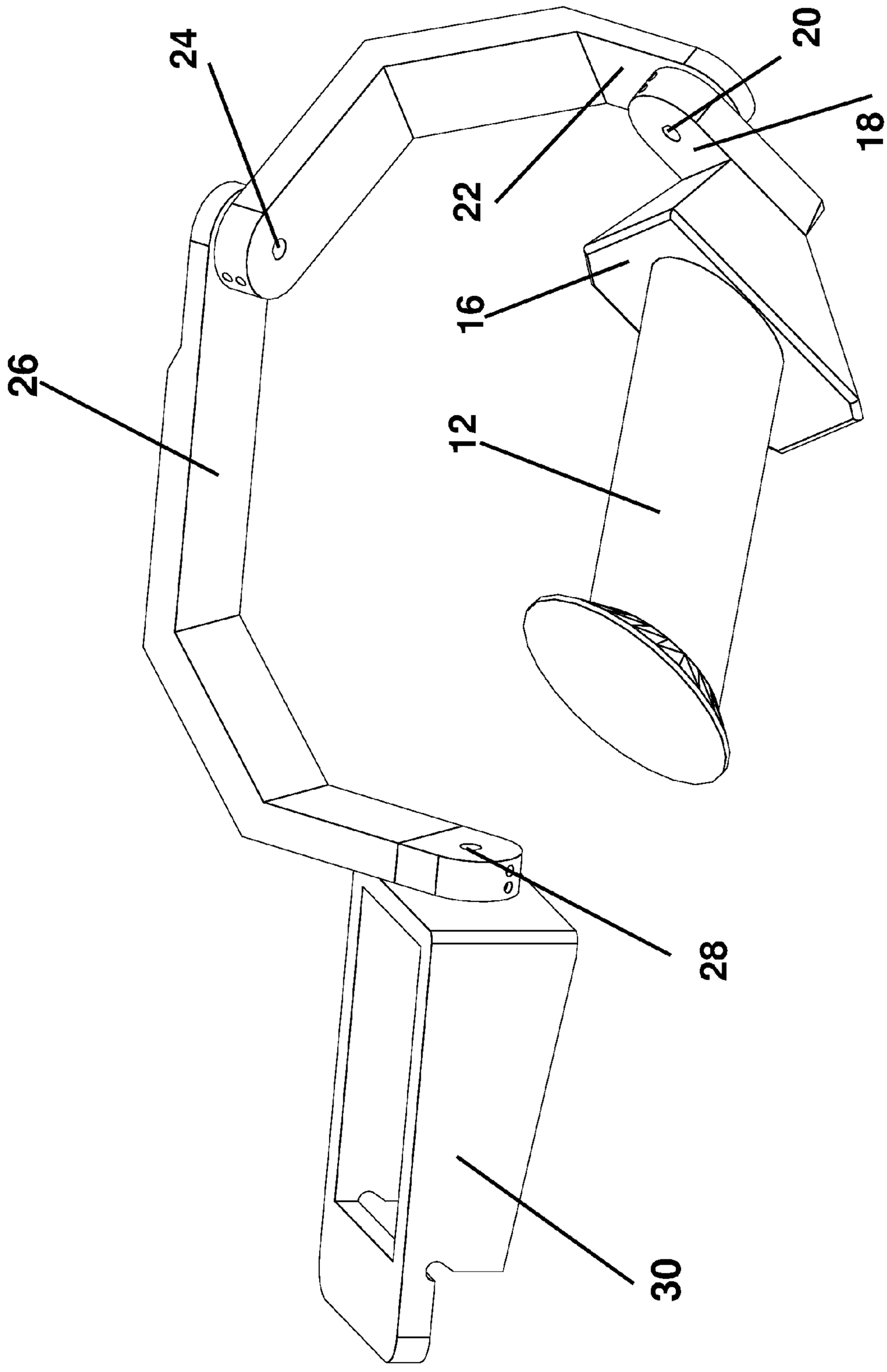

FIG. 8

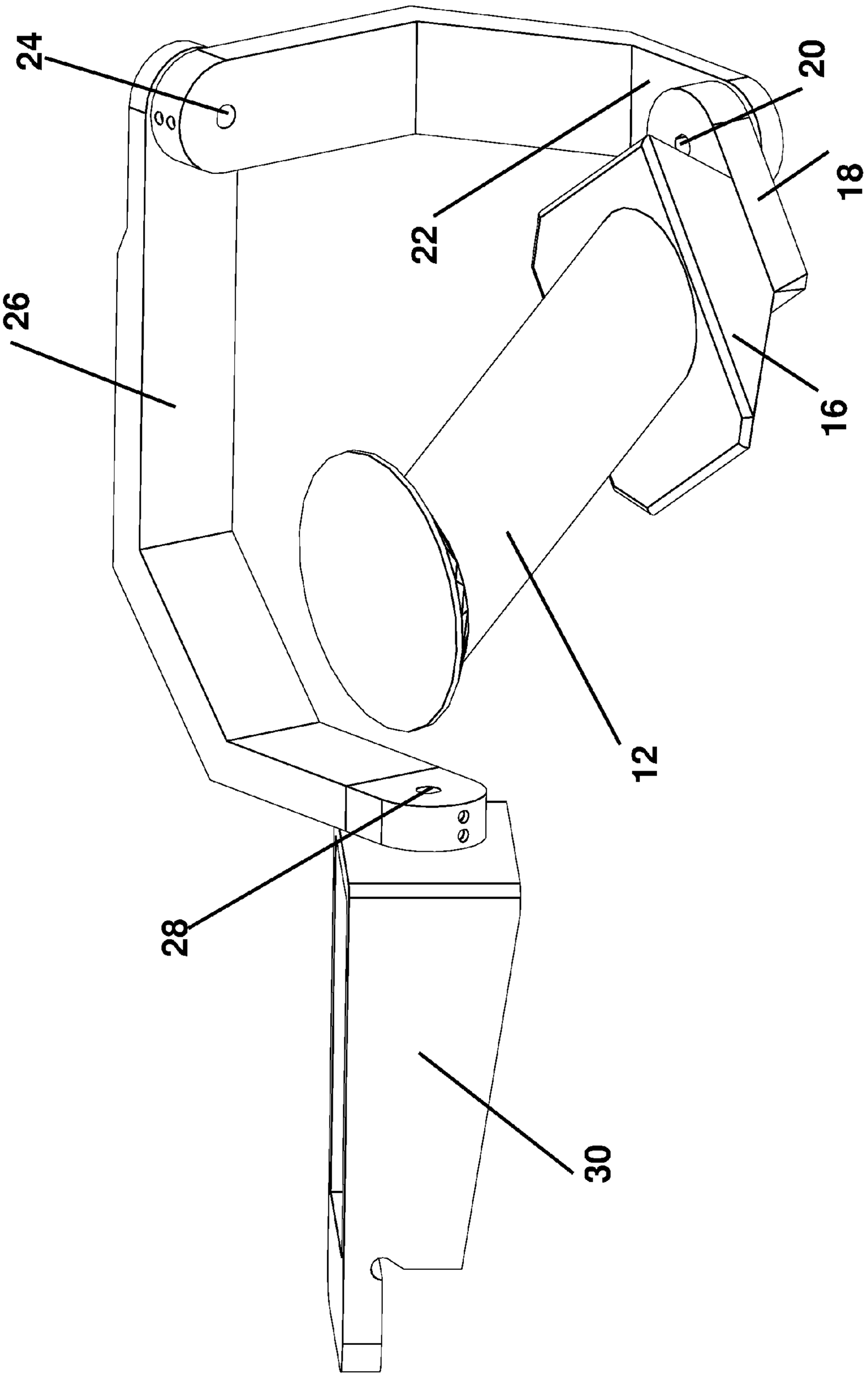

FIG. 9

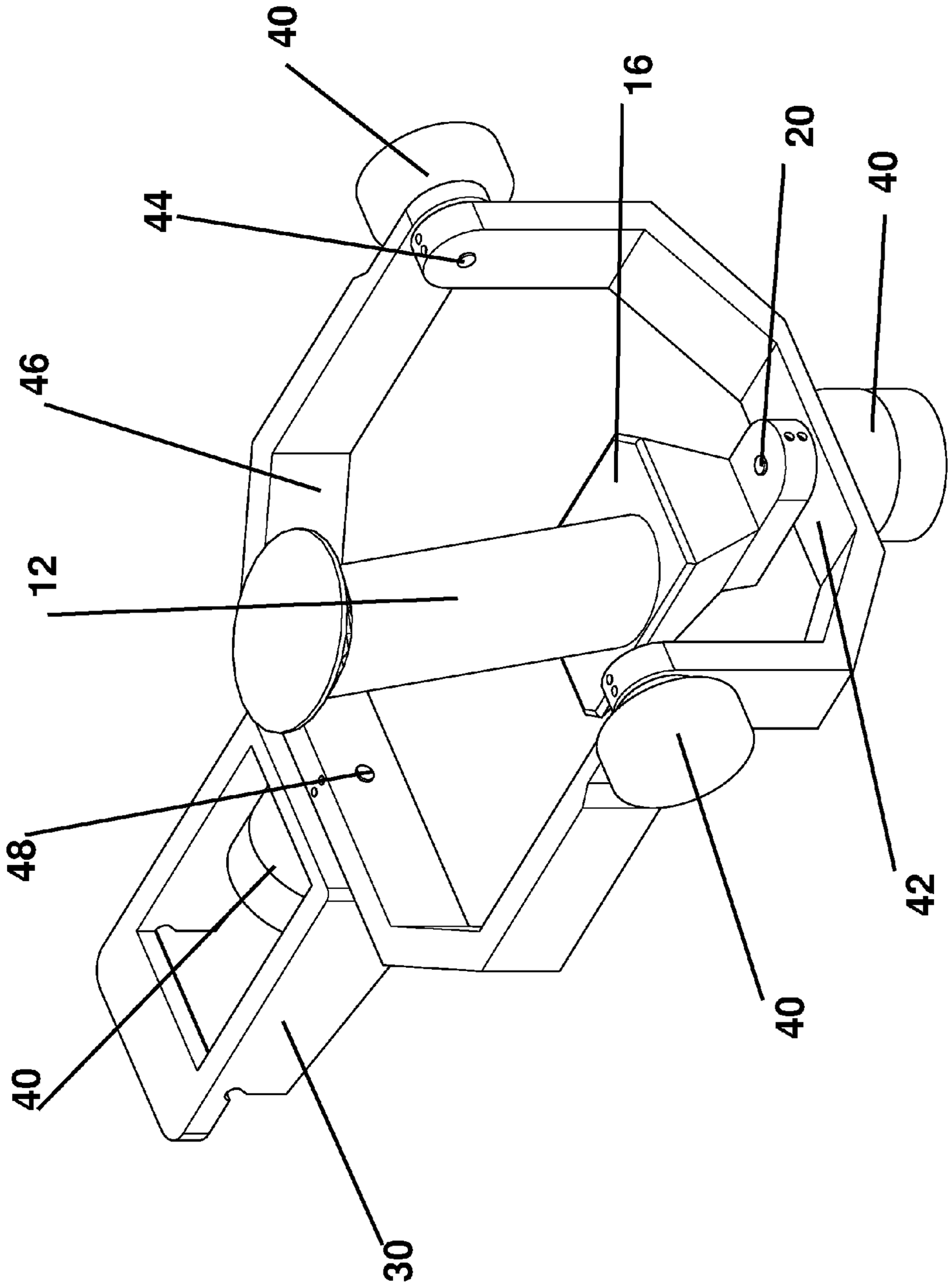

FIG. 10

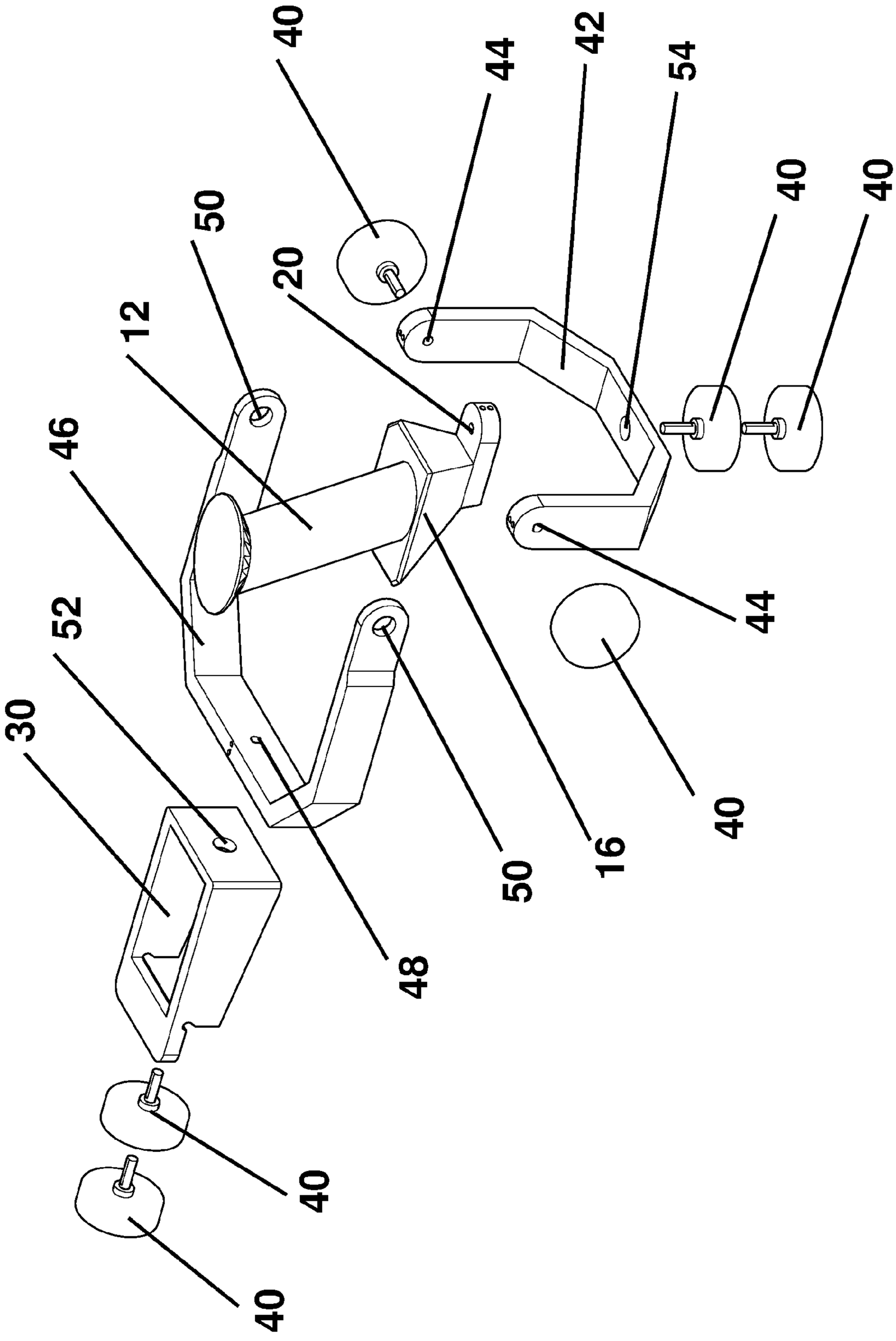

FIG. 11

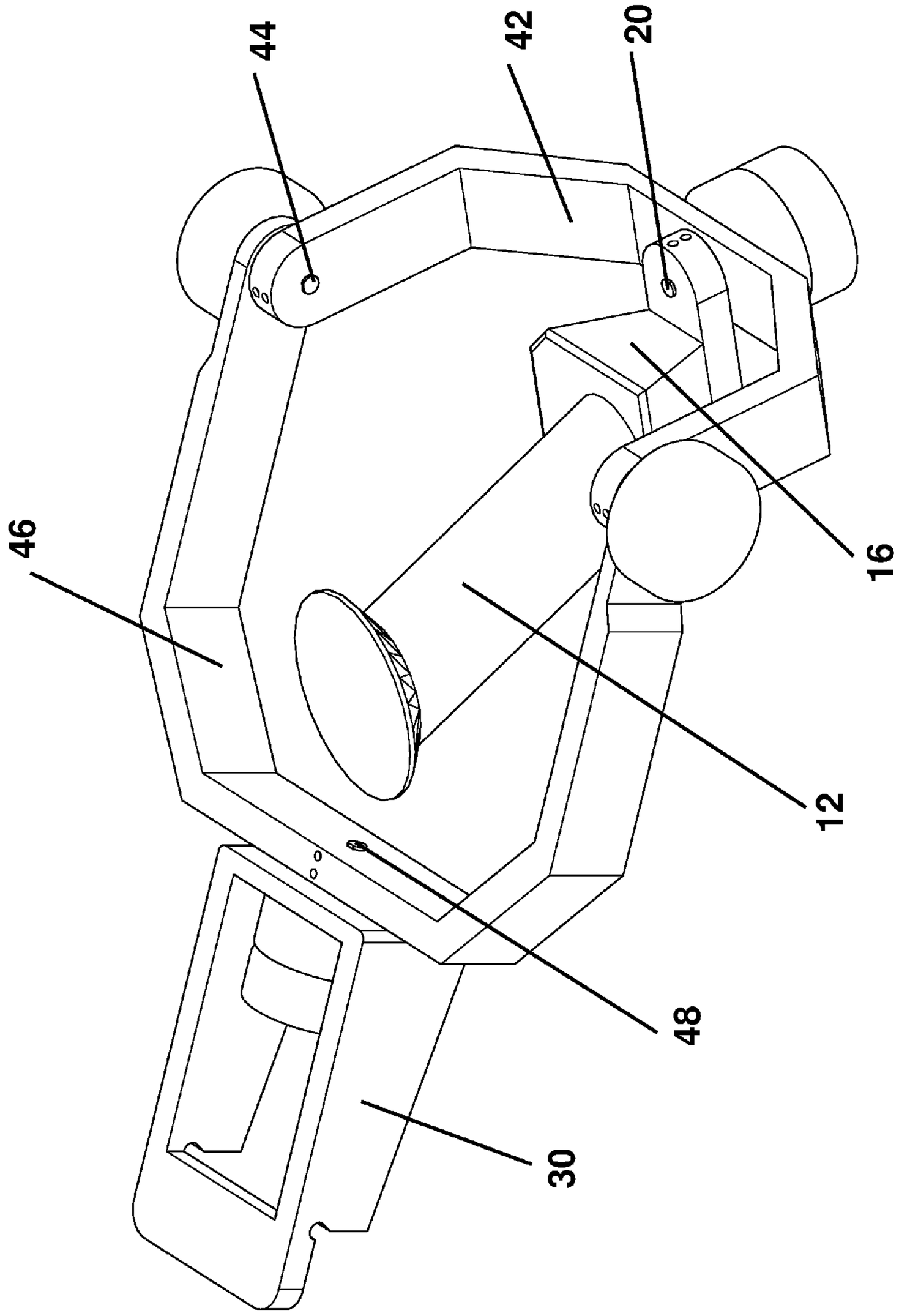

FIG. 12

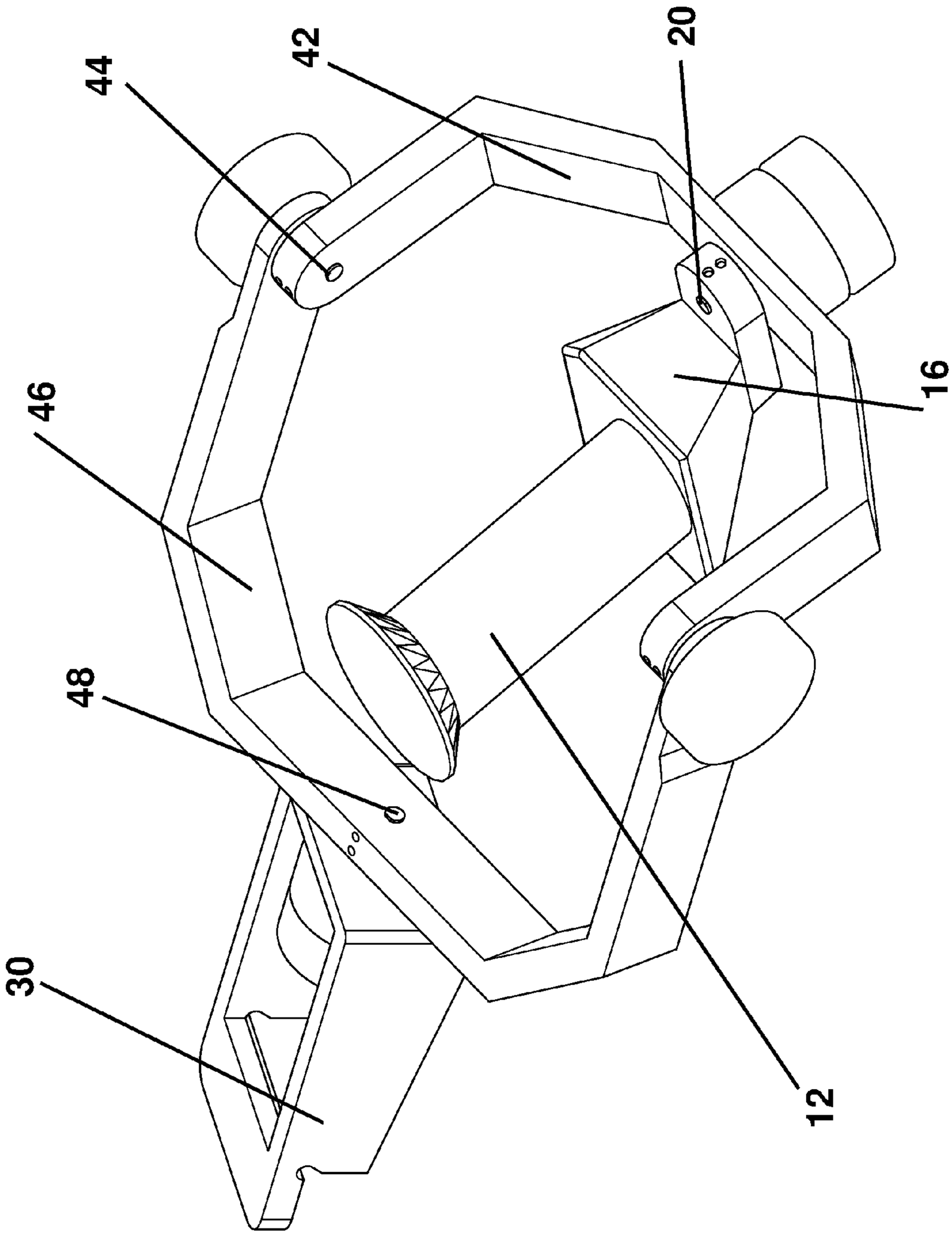

FIG. 13

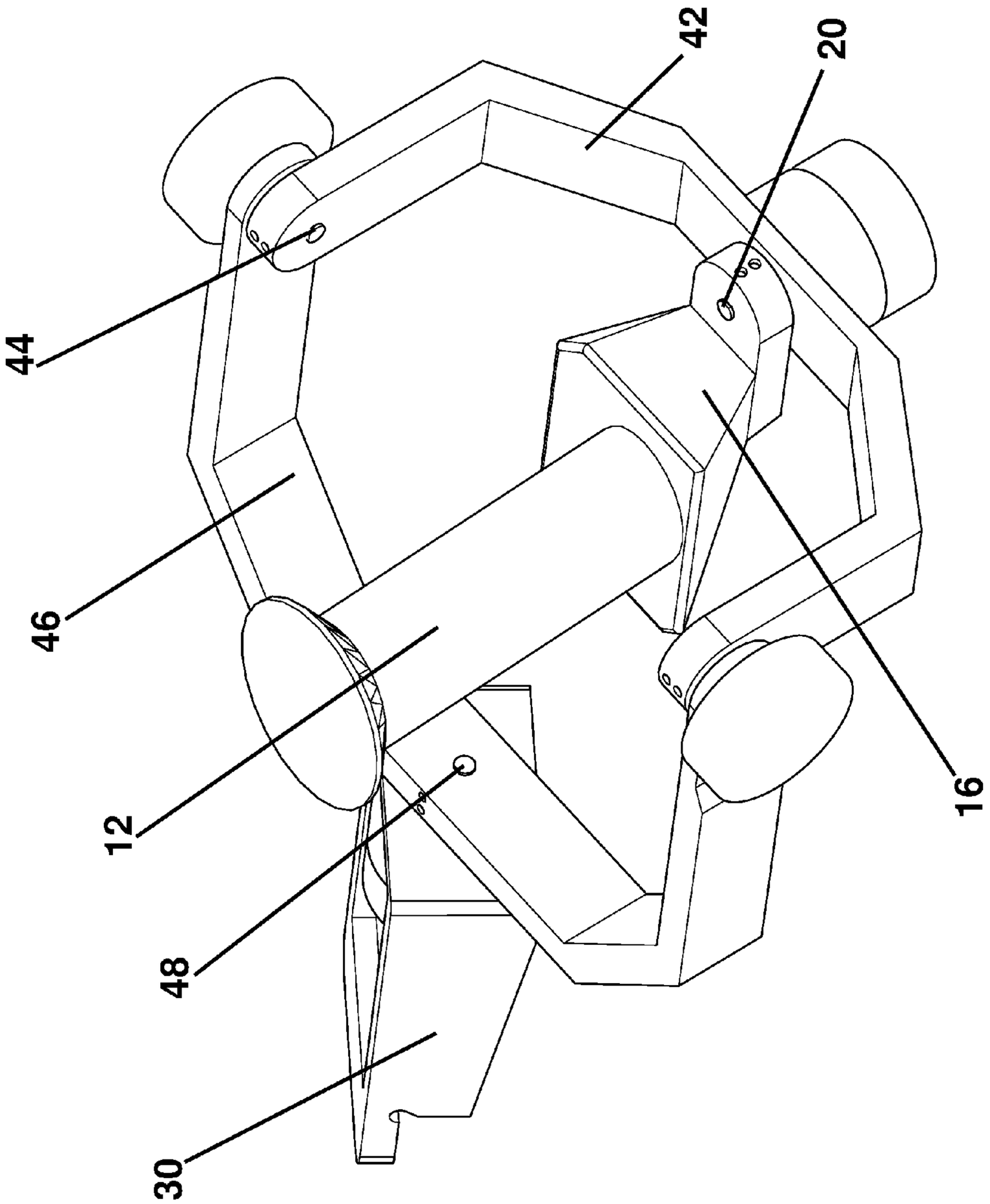

FIG. 14

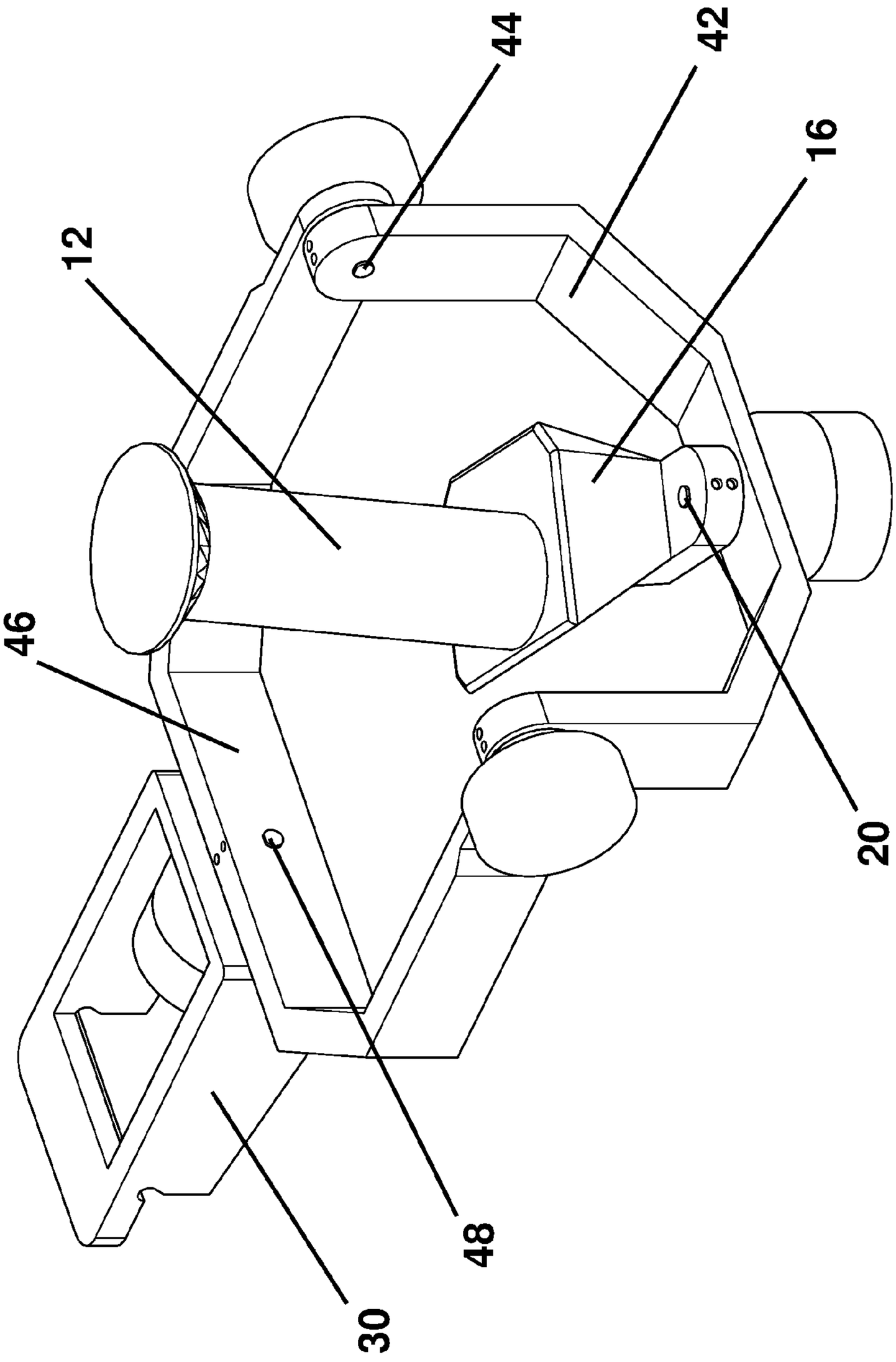

FIG. 15

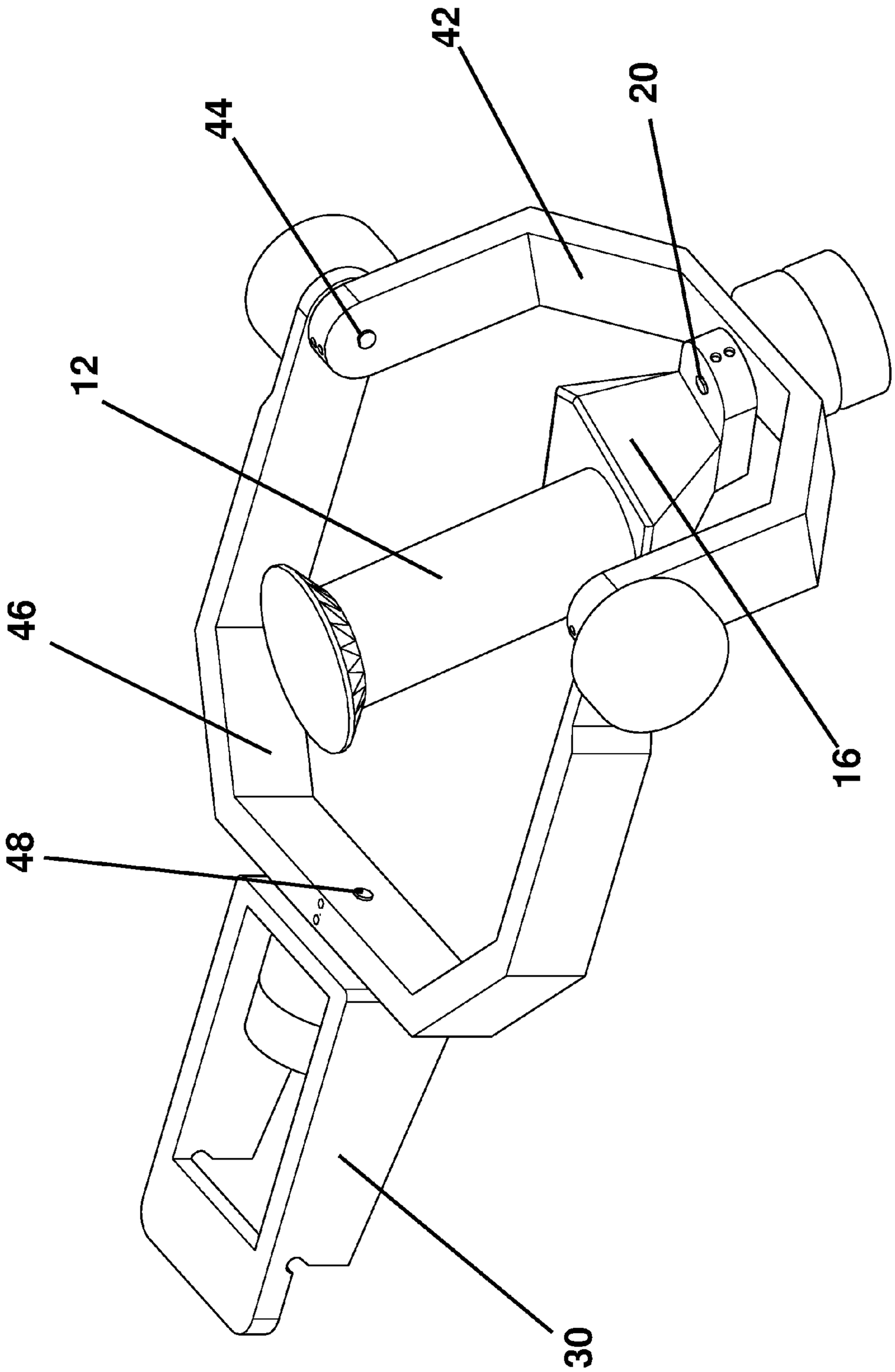

FIG. 16

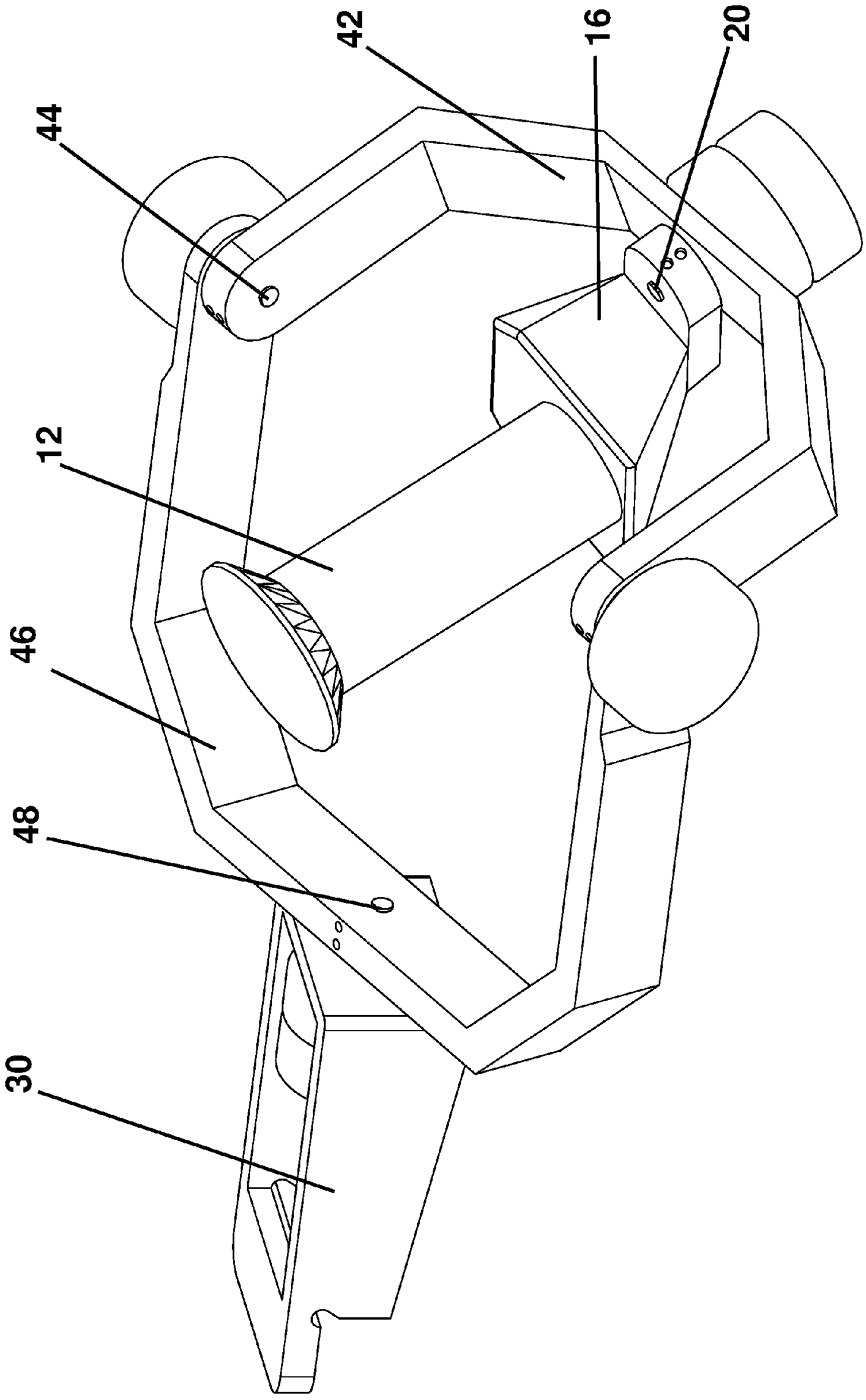

FIG. 17

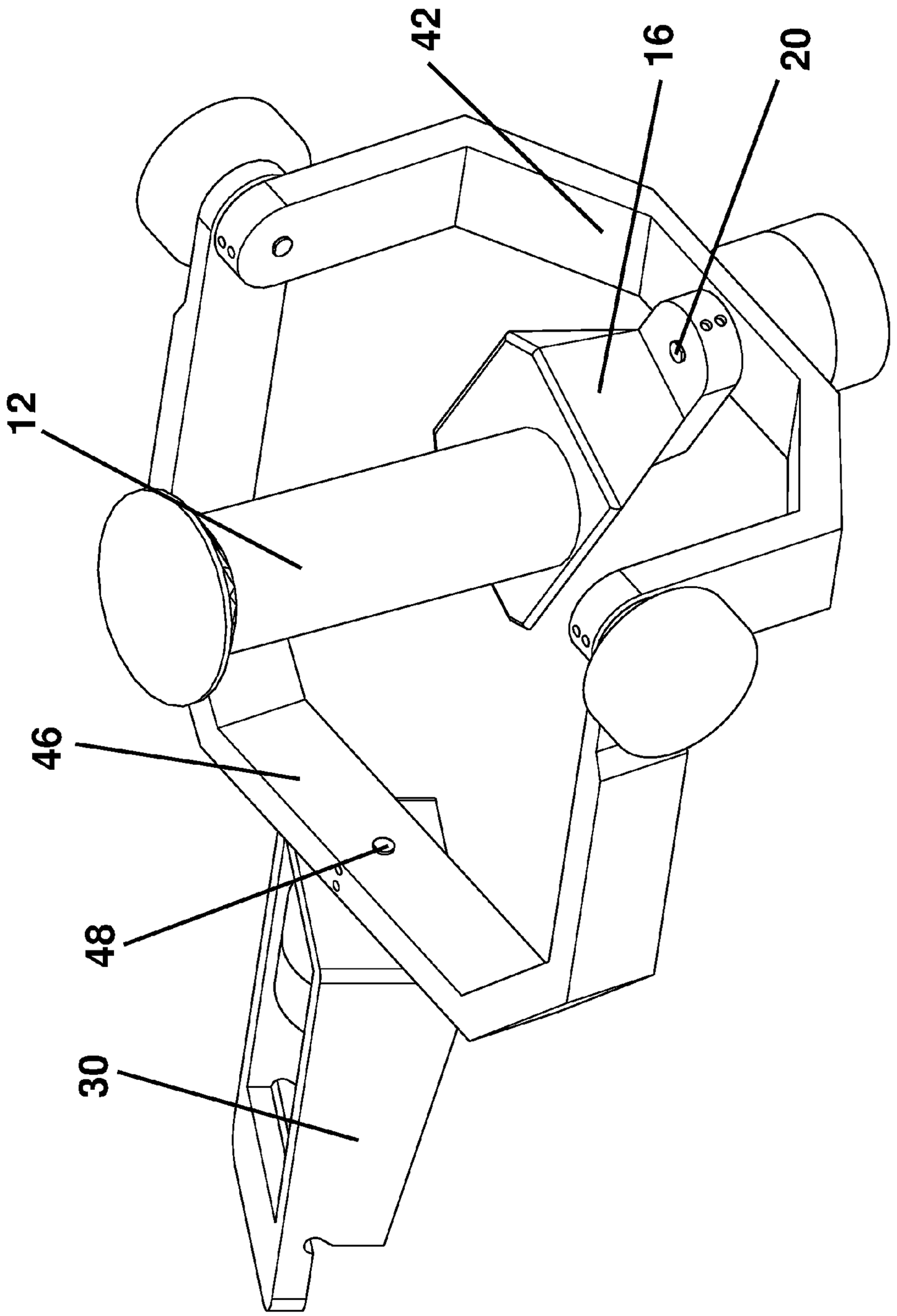

FIG. 18

THREE-AXIS MOTION JOYSTICK

FIELD OF THE DISCLOSED TECHNOLOGY

The disclosed technology relates generally to hand-held controllers and, more specifically, to joysticks which move around three wrist axes.

BACKGROUND OF THE DISCLOSED TECHNOLOGY

Conventional automobiles have three primarily hydromechanical actuators: hydraulic steering assist, hydraulic transmission, and hydraulic brakes. This hydraulic machinery is operated by arms moving a steering wheel and legs moving foot pedals. Arms, legs, steering wheel, and foot pedals all have significant inertia, and therefore relatively slow operating times. However, their slow operation is a good speed match for the slow response times of hydraulic steering, transmission, and brakes.

The typical electric vehicle (EV) has three primarily electromechanical actuators: electric power steering, electric motor propulsion, and electric regenerative braking (plus hydraulic brakes as backup). This electric machinery is also operated by arms moving a steering wheel and legs moving foot pedals. However, the slow operation of arms, legs, steering wheel, and foot pedals is a poor speed match for the fast response times of electric steering, propulsion, and braking.

Arms and legs moving a steering wheel and pedals are too cumbersome and slow to fully exploit the responsiveness of an EV's electric machinery. Automobile manufacturers have tried several alternatives, mainly the 2 degrees of freedom (DoF) tilt joystick. A 2 DoF tilt joystick is more nimble and faster to operate than a steering wheel and pedals, but it is not used in EVs because it is still not fast enough, and it has low steering precision.

A 2 DoF tilt joystick can be operated more nimbly than a steering wheel. However, like the steering wheel, it requires significant movement of the driver's entire arm. This is due to its pivot point being located below the driver's wrist. This pivot location simplifies the design and construction of the tilt joystick and makes it a very compact controller, but the required arm movement means it is not much faster than a steering wheel.

A typical steering wheel has a rotational range up to 900 degrees lock to lock—all the way left to all the way right. Using a steering wheel, a driver can turn an automobile through its entire range of steering and still make precise steering adjustments at any steering angle. A 2 DoF tilt joystick's maximum practical tilt range around its pivot point is about 90 degrees in any direction, or one tenth that of a steering wheel. This limited tilt range makes precise steering adjustments with a 2 DoF joystick very difficult to achieve over the entire range of steering. Because of its minimal speed advantage and low precision steering, the 2 DoF tilt joystick is not compelling enough to replace the mature technology of the steering wheel.

While some three degree of freedom joysticks do exist, there is a need in the art for devices which are simple to manufacture, reliable, and accurately transcribe motion in three directions.

SUMMARY OF THE DISCLOSED TECHNOLOGY

A controller of embodiments of the disclosed technology has a fixed position mounting base and a first flange having

a first end and second end at right angles to each other, the first end of the first flange being rotatably connected to the fixed position mounting base. A second flange has a first end and second end at right angles to each other, the first end of the second flange rotatably connected to the second end of the first flange. A joystick (defined as an elongated flange which is gripped during usage by the controller) is rotatably connected to the second end of the second flange. A roll sensor (defined as a device which measures a degree, amount, or angle rotation of the joystick) measures rotation of the first flange with respect to the fixed position mounting base. A pitch sensor measures rotation of the second flange with respect to the first flange, and a yaw sensor measures rotation of the joystick with respect to the second flange. The pitch and yaw sensors are defined as identical to the roll sensor, except that they measure pitch and yaw, respectively, instead of roll.

In embodiments of the disclosed technology, a most elongated axis of the joystick is substantially perpendicular to a linkage which rotatably attaches the fixed position mounting base to the first flange. That is, the linkage is perpendicular to the joystick and is "in front" of the joystick when the joystick is centered in a resting position. As such, the second end of the first flange and the first end of the second flange are at right angles to each other as well, in such a configuration.

Rotation of the first flange with respect to the fixed position mounting base causes a vehicle to turn left or right. Rotation of the second flange with respect to the first flange causes the vehicle to accelerate or decelerate. Rotation of the joystick (e.g., yaw) with respect to the second flange causes the vehicle to turn left or right to a lesser degree (e.g., vehicle turning) per degree of rotation than said rotation of said first flange (e.g., roll) with respect to the fixed position mounting base.

A second version of the controller is like the first, except that the flanges are extended around on either side, forming a U-shaped connector. Thus, in this variation, a fixed position mounting base has a substantially U-shaped first flange having a mid-region and first and second ends, a middle of said mid-region rotatably connected to the fixed position mounting base. A substantially U-shaped second flange has a mid-region and first and second ends, the first ends of the first and second flanges being rotatably connected, and the second ends of the first and second flanges being rotatably connected. The joystick, in this embodiment, is rotatably connected to a middle of the mid-region of the second flange.

At least one torque motor engaged with a linkage between the first flange and the second flange provides counteractive force to movement of the second flange with respect to the first flange. The counteractive force, in embodiments of the disclosed technology, is zero when the second flange is at a right angle to the first flange and increases as said second flange moves away from the first/prior right angle to the first flange.

A most elongated axis of the joystick, in this second version/embodiment of the disclosed technology, is substantially perpendicular to each of: a) the mid-region of the first flange and second flange, b) the first ends of the first flange and second flange, and c) the second ends of the first flange and second flange. Further elements of the first version are equally applicable to the second version of this technology.

"Substantially" and "substantially shown," for purposes of this specification, are defined as "at least 90%," or as otherwise indicated. "Identical" and "exactly," for purposes of this specification, are defined as "within an acceptable

tolerance level known in the art." Any device may "comprise," or "consist of," the devices mentioned here-in, as limited by the claims. Any element described may be one of "exactly" or "substantially," as described.

It should be understood that the use of "and/or" is defined inclusively, such that the term "a and/or b" should be read to include the sets: "a and b," "a or b," "a," or "b."

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a first controller with three axes of movement in a first resting position, in an embodiment of the disclosed technology.

FIG. **2** shows a blown-apart version of the controller of FIG. **1**.

FIG. **3** shows the controller of FIG. **1** rotated around the pitch axis.

FIG. **4** shows the controller of FIG. **1** rotated around the pitch and roll axes.

FIG. **5** shows the controller of FIG. **1** rotated around the roll axis.

FIG. **6** shows the controller of FIG. **1** rotated around the yaw axis.

FIG. **7** shows the controller of FIG. **1** rotated around the yaw and pitch axes.

FIG. **8** shows the controller of FIG. **1** rotated around the yaw, pitch, and roll axes.

FIG. **9** shows the controller of FIG. **1** rotated around the yaw and roll axes.

FIG. **10** shows a second controller with three axes of movement in a first resting position, in an embodiment of the disclosed technology.

FIG. **11** shows a blown-apart version of the controller of FIG. **10**.

FIG. **12** shows the controller of FIG. **10** rotated around the pitch axis.

FIG. **13** shows the controller of FIG. **10** rotated around the pitch and roll axes.

FIG. **14** shows the controller of FIG. **10** rotated around the roll axis.

FIG. **15** shows the controller of FIG. **10** rotated around the yaw axis.

FIG. **16** shows the controller of FIG. **10** rotated around the yaw and pitch axes.

FIG. **17** shows the controller of FIG. **10** rotated around the yaw, pitch, and roll axes.

FIG. **18** shows the controller of FIG. **10** rotated around the yaw and roll axes.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE DISCLOSED TECHNOLOGY

A controller having a joystick which can be moved in three dimensions is disclosed. The joystick is connected by a Y link (sometimes referred to as a "flange") (yaw) which is, in turn, connected to a P link (pitch), which is, in turn connected to an R link (roll). The R link is rotatable about a fixed-position mounting base. In this manner, one can rotate a joystick in any of three directions. When used to control a vehicle, rotation around the yaw and roll axes can steer (with yaw being more fine-tuned steering), and rotation around the pitch axis can control acceleration and deceleration. A starting or center position for each link can be defined, and the further a link is rotated from this central position, the more resistance is applied, in embodiments of the disclosed technology.

Embodiments of the disclosed technology will become clearer in view of the forthcoming description of the figures.

FIG. **1** shows a first controller with three axes of movement in a first resting position, in an embodiment of the disclosed technology. Here, a mounting base **30** is fixedly mounted, such as to an interior of a car, a table top, or the like. It can be mounted within a dashboard of a vehicle or fixed to a top surface either temporarily or permanently. For example, when the controller is used for video games, one might clamp the mounting base **30** to a top of a table surface, whereas when used in an electric vehicle, it might be within a dashboard and fixedly connected, such that it stays stationary with respect to a car chassis. Using a linkage **28**, a first flange **26** rotates around the linkage and, as such, the first flange **26** is rotatably connected to the mounting base **30**. The linkages described herein rotatably connect two elements together such that many rotations back and forth can take place while the rotatable connection between the two elements linked, remain rotably connected. The linkages allow for 360 degrees of rotation around a single axis.

A second flange **22** connects to the first flange **26** by way of a second linkage **24**. The first and second flanges rotate at right angles to one another. Each has a turn of ninety degrees between a first connecting end and a second connecting end, a "connecting end" being a portion there-of through which a linkage passes there-through. In some embodiments, there are three sections of each flange, as shown in FIG. **1** where a first end portion with linkage passing there-through/portal for a linkage is at a 45 degree angle to a mid-region of the flange, which is, in turn, at a 45 degree angle to a second end portion. Thus, an "end" of a flange is a portion which connects to another item and is defined by a furthest end of the flange until a bend in the flange, the bend occurring after a portal/linkage passing there-through, such that the linkage is between the furthest end and bend.

Still referring to FIG. **1**, a joystick **12** is rotatably connected to a second end of the second flange **22**. The joystick can have a wider base **16**, a wider top region **14**, and a linking section **18**. The linking section has, in some embodiments, a portal through which a linkage **20** passes there-through to connect the joystick and base **12/16** to the second end of the second flange **22**. The joystick can rotate about the linkage **20**. As such, the elongated length of the joystick **12** (the most elongated length or length desired to be perpendicular to a forearm of a person holding the joystick/passes through a clasped hand there-around) is perpendicular to the linkage **28** between the mounting base **30** and first flange **26**, as well as perpendicular to the linkage **24** connecting the first **26** and second **22** flanges together.

Note that linkages **28**, **24**, and **20** are, in at least one configuration, perpendicular to one another. The joystick **12** is in front of the mounting piece **30** when every flange is centered, meaning that, in embodiments, one reaches to hold the joystick such that the joystick **12** is situated between the person holding the joystick and mounting base **30**. Then, the joystick **12** is in a position to be moved around any of three axes, causing the corresponding flange joystick to rotate with respect to one to which it is rotatably connected. This will be shown/discussed with reference to FIGS. **3-9** below.

FIG. **2** shows a blown apart version of the controller of FIG. **1**. Here, one can see the mounting base **30** with a portal **32** passing there-through for a linkage **28**. The linkage can be any sort of elongated fastening mechanism such as a dowel, screw, or motor axle. Note that, in this embodiment, the first flange **26** is defined by three sections. A first end has the linkage **28** pass there-through, and a second end has a portal **36** with a linkage **24** pass there-through. A middle

section is between the first and second ends, and the first end, middle section, and second end are distinct from one another based on the position of the bend between each and a generally flat, elongated region within each. This same configuration applies to the second flange **22**, except that the first end has a linkage **24**, and a second end has a portal **34**.

The first flange **26** is also referred to herein as an "R link", the second flange **22** as a "P link," and the linking section **18** as a "Y link." Each link can rotate with respect to each link to which it is connected. In embodiments, each link can only rotate with respect to a link to which it is connected. Thus, the R link **26** can rotate with respect to the mounting base **30** in a manner which constitutes "roll." The P link **22** can rotate with respect to the R link in a manner which constitutes "pitch," and the Y link **18** can rotate with respect to the R link in a manner which constitutes "yaw." Any combinations of changes of roll, pitch, and yaw are possible, though typically limited by the rotation of the forearm and/or wrist of the user of the controller.

FIG. **3** shows the controller of FIG. **1** with rotations around the pitch axis. Here, the P link is pulled back, where "front" is defined as towards or at the mounting base **30**, and "back" is away there-from. The rotation of the P-link with respect to the R-link causes a change in pitch which can be recorded by a sensor, such as measuring rotation within/at the inner edges of the portal **36** (see FIG. **2**).

FIG. **4** shows the controller of FIG. **1** with rotations around the pitch and roll axes. In addition to the rotation described with reference to FIG. **3** around the pitch axis, rotation of the first flange **26** (R-link) with respect to the mounting base **30** takes place around the linkage **28**. This rotation can also be measured with sensors, such as within the mounting base **30** measuring rotational displacement of the linkage **28**. Such sensors can be hidden with the mounting base and/or flange and cannot necessarily be seen from the outside, such as in FIG. **4**.

FIG. **5** shows the controller of FIG. **1** with rotation around the roll axis. To accomplish this, only the first flange **26** is rotated, while the position of the second flange **22** with respect to the first flange stays the same.

FIG. **6** shows the controller of FIG. **1** with a rotation around the yaw axis. This rotation is accomplished by rotating the joystick **12** with respect to the second flange **22**. Measurement of this angle of change (yaw) can be made within, or at, the linkage **20**.

FIG. **7** shows the controller of FIG. **1** with rotations around the yaw and pitch axes. Here, the combination of rotating the joystick **12** with respect to the second flange **22**, and rotation of the second flange **22** with respect the first flange **26** (rotation of the Y link and P link), causes a change in yaw and pitch simultaneously.

FIG. **8** shows the controller of FIG. **1** with rotations around the yaw, pitch, and roll axes. Here, each element which can be rotated with respect to another, in an embodiment of the disclosed technology, is so rotated. Rotation of the R link (flange **26** with respect to the mounting base **30**) can be used to steer a vehicle left or right. Rotation of the P link (flange **22** with respect to flange **26**) can be used for acceleration and deceleration of a vehicle. Rotation of the Y link (flange **18** with respect to flange **22**) can be used for fine control of steering, such that, per degree of rotation, steering has less magnitude for rotation of the Y link compared to rotation of the R link.

FIG. **9** shows the controller of FIG. **1** with rotations around the yaw and roll axes. Here, the pitch remains constant, compared to FIG. **1** (flange **22** with respect to flange **26** remain at a 90 degree angle to each other), but the yaw is changed (the joystick **12** angle to the second flange **22** changes,) as well as the roll (the angle of the first flange **26** with respect to the mounting base **30**).

FIG. **10** shows a second controller with three axes of movement in a first resting position, in an embodiment of the disclosed technology. Elements of FIGS. **10-18**, which remain the same as those of FIGS. **1-9** above, are identically numbered, where possible. Here, there is a plurality of servos or motors **40** which introduce counter-force or torque when the first linkage **46**, second linkage **42**, or joystick **12** are rotated with respect to another element. In some embodiments, the greater the offset from a right angle, or 90 degrees, to an adjacent element, the greater the torque/resistive force. This prevents excess movement and can simulate torque one would feel when, for example, moving steering wheels left and right. Thus, for example, rotation of the first flange **46** with respect to the mounting base **30** can cause wheels of a vehicle to rotate. The more the wheels rotate, in a mechanical setting, the more resistance is felt on a steering wheel or device. A first motor **40** situated in the mounting base **30** adds counter force, pushing the first flange back to a central position to which the flange **46** will return if a person stops applying force there-on.

FIG. **11** shows a blown-apart version of the controller of FIG. **10**. Note that the elements **40** can be used to measure turning angle of the elongated member there-in, and thus, the angle of turn of two elements with respect to one another. The elements **40** can also comprise motors or other devices which generate torque as the elongated elements are turned with respect to other elements. These other elements include a mounting base **30** having a portal **52** through which a linkage **48** passes, and a first flange **46**, which is generally U-shaped and has portals **50**. A second flange **42** is also generally U-shaped and has portals **44** attached to the portals **50**, such that the second flange is rotatable with respect to the first, which is, in turn, rotatable with respect to the mounting base **30**. The first flange **46** and second flange **42** are analogous to the respective same-named flanges **26** and **22**, but, instead of having a 90 degree turn from a first end to a second end, have a 180 degree turn from a first end to a second end. They are connected to other elements at each end, as well as at the center of each middle region. Another way of describing this is that a substantially mirror image of each first flange **26** and **22** is attached, forming a U-shape with the same connection locations, except that an end (at linkage **48** and portal **54**) is now in a middle region, and a second end of each flange also connects to an adjacent flange. Thus, there are now two connection points **50** and two connection points **44**.

FIG. **12** shows the controller of FIG. **10** with rotation around the pitch axis. This is analogous to what is shown in FIG. **3** in the prior version thereof. All elements of FIG. **3** remain the same, except that the first and second flanges extend on both sides, forming a U-shape, and connect twice into each other instead of once into each other. Note that the first flange **46** is in the same rotational position as the starting position shown in FIG. **10**, but the second flange **44** is rotated with respect to the first flange.

FIG. **13** shows the controller of FIG. **10** with rotations around the pitch and roll axes. This is analogous to what is shown in FIG. **4**.

FIG. **14** shows the controller of FIG. **10** with rotation around the roll axis. This is analogous to what is shown in FIG. **5**.

FIG. **15** shows the controller of FIG. **10** with rotation around the yaw axis. This is analogous to what is shown in FIG. **6**.

FIG. **16** shows the controller of FIG. **10** with rotations around the yaw and pitch axes. This is analogous to what is shown in FIG. **7**.

FIG. **17** shows the controller of FIG. **10** with rotations around the yaw, pitch, and roll axes. This is analogous to what is shown in FIG. **8**.

FIG. **18** shows the controller of FIG. **10** with rotations around the yaw and roll axes. This is analogous to what is shown in FIG. **9**.

Referring now especially to FIGS. **10-18**, the dual connection points between the first and second flanges add rigidity as well as bump resistance. A "bump" is an unwanted movement of the flanges and/or joystick with respect to one another. Each flange and the fixed position mounting base has two torque motors **40** for redundancy and protection against electrical failure. In some embodiments, the rotation of the R link is used at lower speeds for coarse steering maneuvers, such as turning and parking, rotation of the Y link is used for fine steering adjustment for higher speed maneuvers, such as highway lane keeping or lane changes, or rotation of both can occur simultaneously.

While the disclosed technology has been taught with specific reference to the above embodiments, a person having ordinary skill in the art will recognize that changes can be made in form and detail without departing from the spirit and the scope of the disclosed technology. The described embodiments are to be considered in all respects only as illustrative and not restrictive. All changes that come within the meaning and range of equivalency of the claims are to be embraced within their scope. Combinations of any of the methods, systems, and devices described herein-above are also contemplated and within the scope of the disclosed technology.

I claim:

1. A controller, comprising:

a fixed position mounting base;

a first flange having a first end and second end at right angles to each other, said first end of said first flange rotatably connected to said fixed position mounting base;

a second flange having a first end and second end at right angles to each other, said first end of said second flange rotatably connected to said second end of said first flange;

a joystick rotatably connected to said second end of said second flange;

wherein rotation of said first flange with respect to said fixed position mounting base causes a vehicle to turn left or right and rotation of said second flange with respect to said first flange causes said vehicle to accelerate or decelerate.

2. The controller of claim **1**, wherein a roll sensor measures rotation of said first flange with respect to said fixed position mounting base.

3. The controller of claim **2**, wherein a pitch sensor measures rotation of said second flange with respect to said first flange.

4. The controller of claim **3**, wherein a yaw sensor measures rotation of said joystick with respect to said second flange.

5. The controller of claim **4**, wherein a most elongated axis of said joystick is substantially perpendicular to a linkage which rotatably attaches said fixed position mounting base to said first flange, and said second end of said first flange and said first end of said second flange are at right angles to each other.

6. The controller of claim **1**, wherein rotation of said joystick with respect to said second flange causes said vehicle to turn left or right to a lesser degree per degree of rotation than said rotation of said first flange with respect to said fixed position mounting base.

7. A controller, comprising:

a fixed position mounting base;

a substantially U-shaped first flange having a mid-region and first and second ends, a middle of said mid-region rotatably connected to said fixed position mounting base;

a substantially U-shaped second flange having a mid-region and first and second ends, said first ends of said first and second flanges being rotatably connected, and said second ends of said first and second flanges being rotatably connected;

a joystick rotatably connected to a middle of said mid-region of said second flange; wherein

rotation of said second flange with respect to said first flange causes said vehicle to accelerate or decelerate and rotation of said joystick with respect to said second flange causes said vehicle to turn left or right to a lesser degree per degree of rotation than said rotation of said first flange with respect to said fixed position mounting base.

8. The controller of claim **7**, further comprising at least one torque motor engaged with a linkage between said first flange and said second flange providing counteractive force to movement of said second flange with respect to said first flange.

9. The controller of claim **8**, wherein said counteractive force is zero when said second flange is at right angle to said first flange, and said counteractive force increases as said second flange moves away from said right angle to said first flange.

10. The controller of claim **7**, wherein a roll sensor measures rotation of said first flange with respect to said fixed position mounting base.

11. The controller of claim **10**, wherein a pitch sensor measures rotation of said second flange with respect to said first flange.

12. The controller of claim **11**, wherein a yaw sensor measures rotation of said joystick with respect to said second flange.

13. The controller of claim **7**, wherein a most elongated axis of said joystick is substantially perpendicular to each of:

said mid-region of said first flange;

said mid-region of said second flange;

said first ends of said first flange;

said first ends of said second flange;

said second ends of said first flange; and

said second ends of said second flange.

14. The controller of claim **7**, wherein rotation of said first flange with respect to said fixed position mounting base causes a vehicle to turn left or right.

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