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Clonch et al.

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(54) **MAGNETIC DENDROMETER**

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(**) Term: **15 Years**

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(52) **U.S. Cl.**
USPC **D10/96**

(58) **Field of Classification Search**
USPC D10/46, 61, 72, 96
CPC G01B 5/0035
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

466,986	A	*	1/1892	Van Roden	G01B 3/166 33/801
D30,194	S	*	2/1899	Bristol	D10/102
911,729	A	*	2/1909	Jones	G01B 3/166 33/679.1
1,385,139	A	*	7/1921	MacDougal	G01B 5/0035 33/561.2
1,978,682	A	*	10/1934	Marvin	G01B 5/08 33/555.4
2,191,808	A	*	2/1940	Schramm	G09F 3/14 248/230.8
2,236,443	A	*	3/1941	Oboler	G01B 5/08 33/555.3
2,416,664	A	*	2/1947	Ruge	G01B 7/16 33/DIG. 13
D158,239	S	*	4/1950	Wills	D10/49
2,815,424	A	*	12/1957	Painter	G01L 5/102 73/781

(Continued)

OTHER PUBLICATIONS

High precision zero-friction magnetic dendrometer; Cameron Clonch, et al.; sciencedirect.com; Jun. 2, 2021; Accessed Jun. 23, 2023; URL:<https://www.sciencedirect.com/science/article/pii/S246806722100078X> (Year: 2021).*

(Continued)

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(57) **CLAIM**

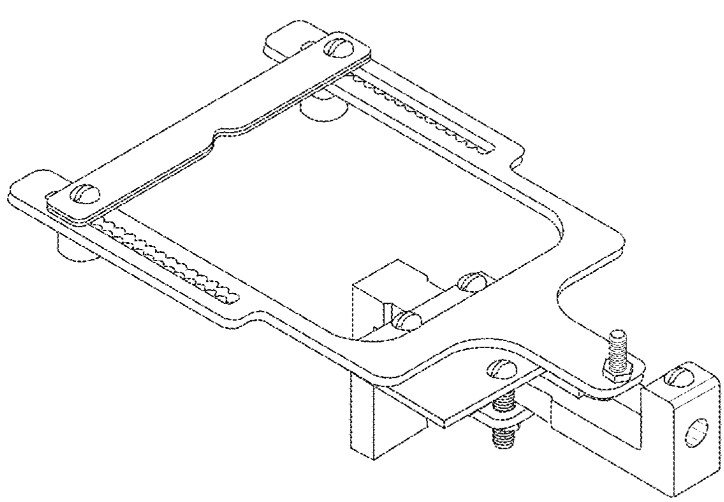
The ornamental design for a magnetic dendrometer, as shown and described.

DESCRIPTION

This application is supported by the USDA National Institute of Food and Agriculture, Hatch project NI18HFPXXXXXG055 and the National. Science Foundation award #1832170. The Government may have some interest in this application.

FIG. **1** illustrates a top isometric view of a magnetic dendrometer, showing a 3D view of the design.
FIG. **2** illustrates a top orthogonal view thereof.
FIG. **3** illustrates a bottom orthogonal view thereof.
FIG. **4** illustrates a back orthogonal view thereof.
FIG. **5** illustrates a side orthogonal view thereof; and,
FIG. **6** illustrates a front orthogonal view thereof.
The described article is a dendrometer for measuring and quantifying water stress in agricultural, horticultural and wild plants. The described dendrometer employs a movable magnet and a stationary magnetic sensor for determining plant stem expansion and contraction.

1 Claim, 6 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2,924,019	A *	2/1960	Verner	A01G 7/00 33/783
3,303,572	A *	2/1967	Vreeland, Jr.	G01B 7/12 33/544.5
3,937,212	A *	2/1976	Fletcher	A61B 5/4519 600/595
4,290,311	A *	9/1981	Brewer	G01L 9/0002 73/730
4,549,355	A *	10/1985	Sauer	G01B 7/16 33/794
5,067,246	A *	11/1991	Hesske	G01B 3/1084 33/555.4
5,774,999	A *	7/1998	Smith	G01B 5/0035 33/759
5,809,660	A *	9/1998	Bitterlich	G01B 5/0035 33/555.4
6,009,631	A *	1/2000	Gensler	G01B 5/0035 33/555.4
7,398,602	B2 *	7/2008	Cohen Amar	G01B 7/18 33/555.1
9,149,009	B2 *	10/2015	Edgington	A01G 17/12
9,377,288	B2	6/2016	DeLucia et al.	
2006/0123647	A1 *	6/2006	Amar	G01B 7/18 324/692
2014/0360037	A1 *	12/2014	DeLucia	G01N 33/0098 33/555.4
2015/0116092	A1 *	4/2015	Yang	G01B 5/0035 33/555.4
2023/0175830	A1 *	6/2023	Clonch	G01B 5/025 33/555.1

OTHER PUBLICATIONS

"Dendrometers." Edaphic Scientific. https://www.edaphic.com.au/products/Dendrometers/ (accessed Jun. 21, 2020).

"Dex Fruit Dendrometers" ICT International. https://ictinternational.com/products/dex-fruit-dendrometers/dex-fruit-dendrometers/ (accessed Nov. 2021).

"Home of the Point Dendrometers" Natkon. https://natkon.ch/ (accessed Jun. 20, 2020).

AS5311 High Resolution Magnetic Linear Encoder, 13th ed., AMS, Premstaetten, Austria. Available: https://www.mouser.com/datasheet/2/588/AS5311_DS000200_2-00-263458.pdf (33 pages).

"Coefficients of Linear Thermal Expansion." Engineering Toolbox. https://www.engineeringtoolbox.com/linear-expansion-coefficients-d_95.html (accessed Dec. 12, 2020).

Conesa, M. et al., "Maximum daily trunk shrinkage and daily stem water potential reference equations for irrigation scheduling in table grapes," in Agricultural Water Management vol. 172(1), pp. 51-61, Jul. 2016. Available: http://dx.doi.org/10.1016/j.agwat.2016.04.011.

Dong, C. et al., "Evaluation of thermal expansion coefficient of carbon fiber reinforced composites using electronic speckle interferometry," Optics Express, vol. 25(1), pp. 531-543 (2018). Available: https://doi.org/10.1364/OE.26.000531.

Fernandez, J. et al., "Irrigation scheduling from stem diameter variations: A review," in Agricultural and Forest Meteorology (Elsevier), vol. 150, Issue 2, Feb. 15, 2010, pp. 135-151. Nov. 2009. [Online]. Available: http://dx.doi.org/10.1016/j.agrformet.2009.11.006.

Gambetta et al., "The physiology of drought stress in grapevine: towards an integrative definition of drought tolerance," Journal of Experimental Botany, vol. 71, Issue 16, Aug. 6, 2020, pp. 4658-4676, https://doi.org/10.1093/jxb/eraa245.

Global Tree Growth Project, "Dendrometer observations of short-term tree growth" Smithsonian Environmental Research Center. https://serc.si.edu/research/projects/global-tree-growth-project (accessed Feb. 19, 2021).

ICT International, Large Stem Point Dendrometer. Available: https://www.ictinternational.com/products/large-stem-point-dendrometer/large-stem-point-dendrometer/ Accessed Nov. 12, 2021, 4 pages.

Intrigliolo, D. et al., "Evaluation of grapevine water status from trunk diameter variations" in Irrigation Science, vol. 26, Issue 1, pp. 49-59, Sep. 2007. [Online]. Available: http://dx.doi.org/10.1007/s00271-007-0071-2.

Levin, A., "Re-evaluating pressure chamber methods of water status determination in field-grown grapevine (*Vitis* spp.)" in Agricultural Water Management vol. 221 pp. 422-429, Jul. 20, 2019. Available: doi: 10.1016/j.agwat.2019.03.026.

Matthews, M. et al., "Dependence of Wine Sensory Attributes on Vine Water Status". 2019. Journal of the Science of Food and Agriculture, vol. Issue 3, pp. 321-335. Available: https://doi.org/10.1002/jsfa.2740510305.

McCutchan, H., et al. "Stem-water Potential as a Sensitive Indicator of Water Stress in Prune Trees (*Prunus domestica* L. cv. French)" in Journal of the American Society for Horticultural Science. vol. 117)4), pp. 607-611 (5 pages). 1992. Available: https://doi.org/10.21273/JASHS.117.4.607v.

Pearsall, K. et al., "Evaluating the potential of a novel dual heat-pulse sensor to measure volumetric water use in grapevines under a range of flow conditions". 2014. Functional Plant Biology, vol. 41(8), pp. 874-883. Available: doi: 10.1071/FP13156.

Santesteban, L. et al., "Discrimination ability of leaf and stem water potential at different times of the day through a meta-analysis in grapevine (*Vitis vinifera* L.)" in Agricultural Water Management vol. 221, pp. 202-210, Jul. 20, 2019. Available: doi: 10.1016/j.agwat.2019.04.020.

Temnani, A. et al., "Irrigation Protocols in Different Water Availability Scenarios for 'Crimson Seedless' Table Grapes under Mediterranean Semi-Arid Conditions," Water 2021, vol. 13, Issue 1, p. 22. Available: https://dx.doi.org/10.3390/w13010022.

Wang, J. et al., "New Inexpensive Dendrometers for Monitoring Crop Tree Growth" Irrigation Toolbox. Nov. 2008, 24 pages. Available: http://irrigationtoolbox.com/ReferenceDocuments/TechnicalPapers/IA/2008/2124translated.pdf.

Williams, L. et al., "Relationship among Ambient Temperature and Vapor Pressure Deficit and Leaf and Stem Water Potentials of Fully Irrigated, Field-Grown Grapevines" in American Journal of Enology and Viticulture, vol. 58(2), 10 pages. Jun. 2007.

WSL, (28) Point dendrometer. Available: https://www.wsl.ch/en/about-wsl/instrumented-field-sites-and-laboratories/lwf-demonstration-site/20-vegetation-and-biodiversity/28-point-dendrometer.html. Accessed Nov. 12, 2021. 2 pages.

* cited by examiner

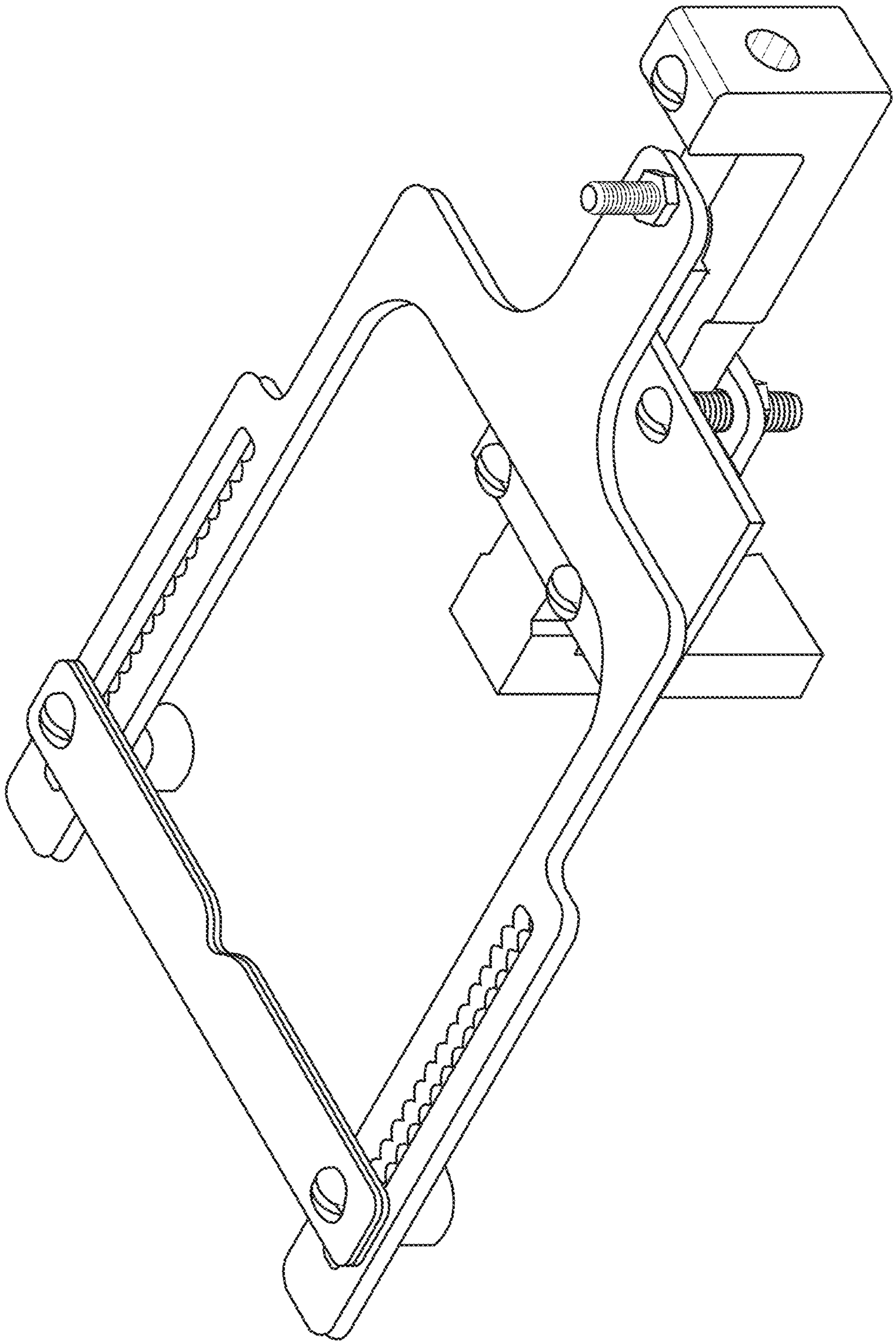


FIG. 1

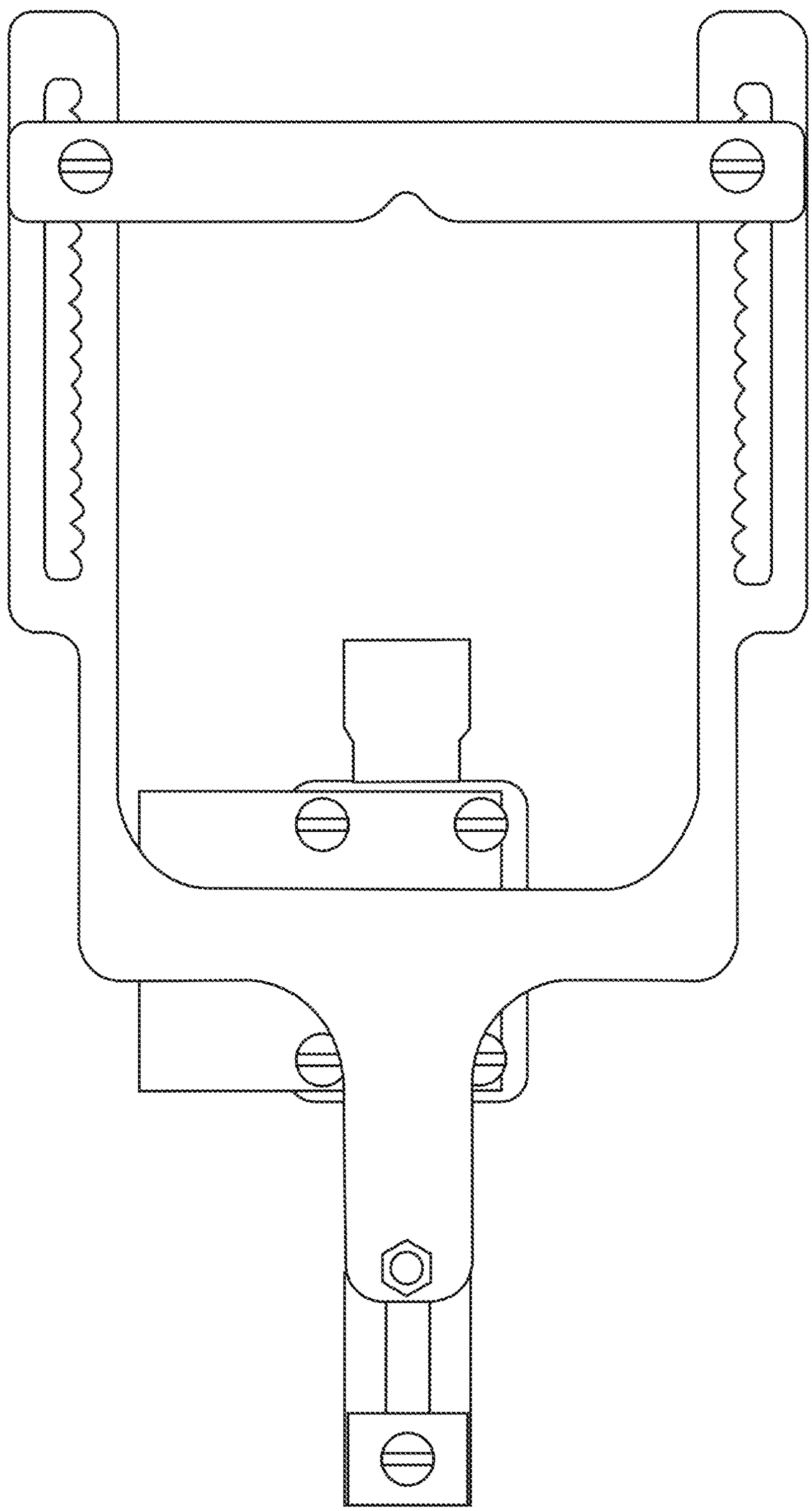


FIG. 2

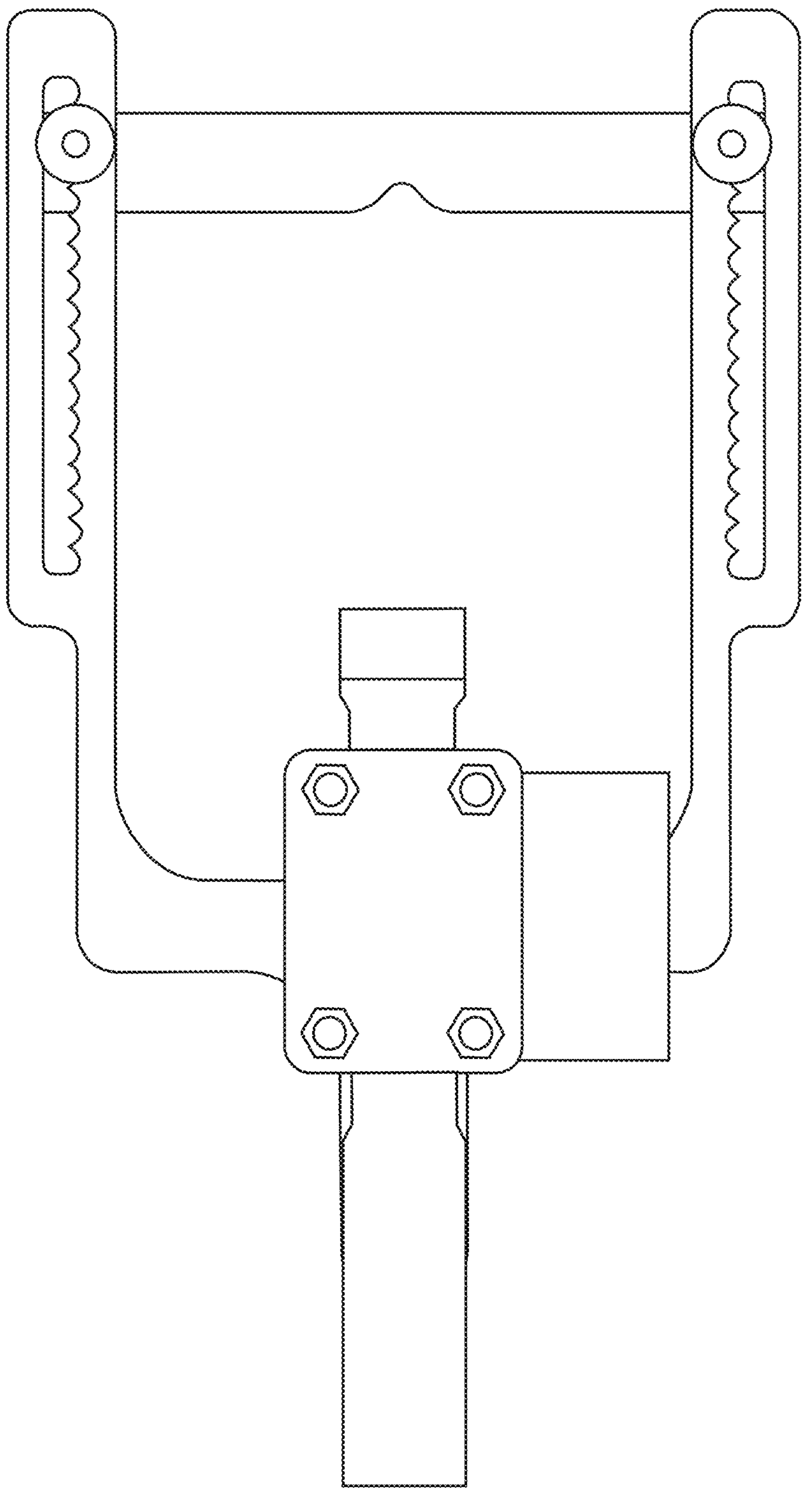


FIG. 3

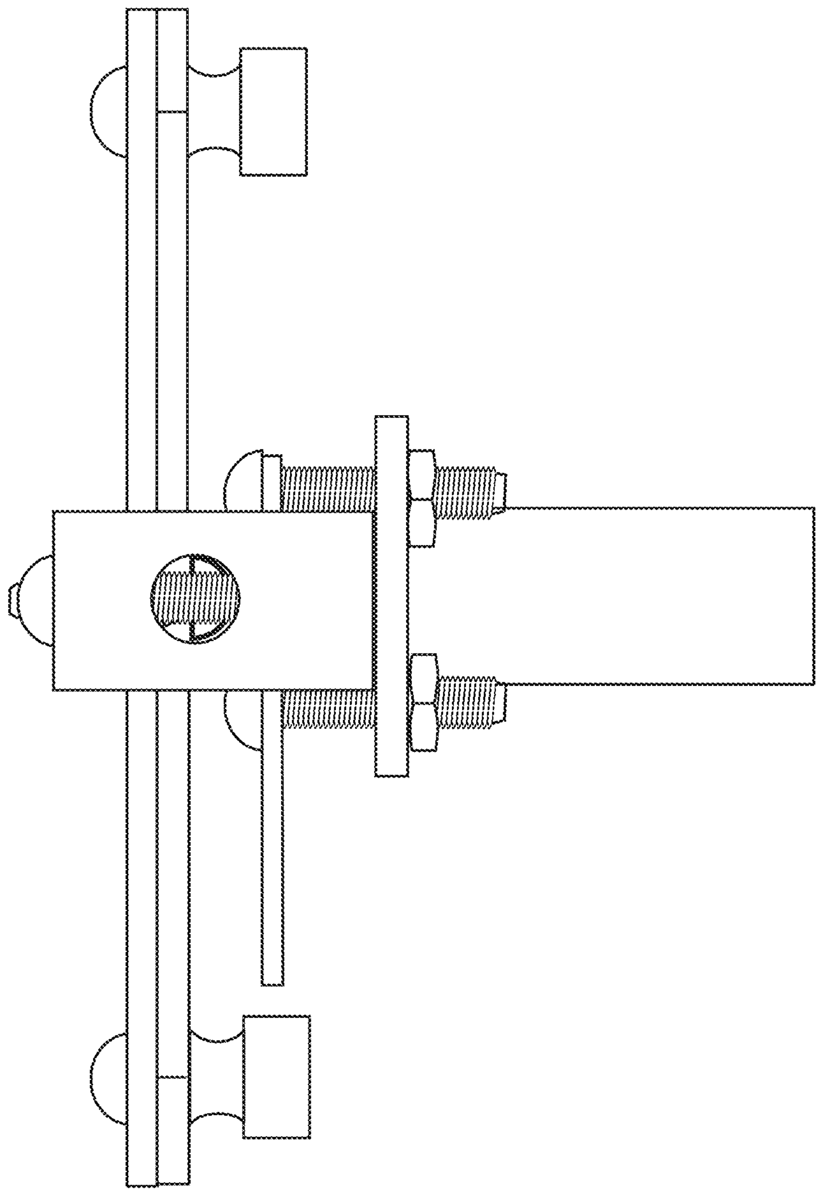


FIG. 4

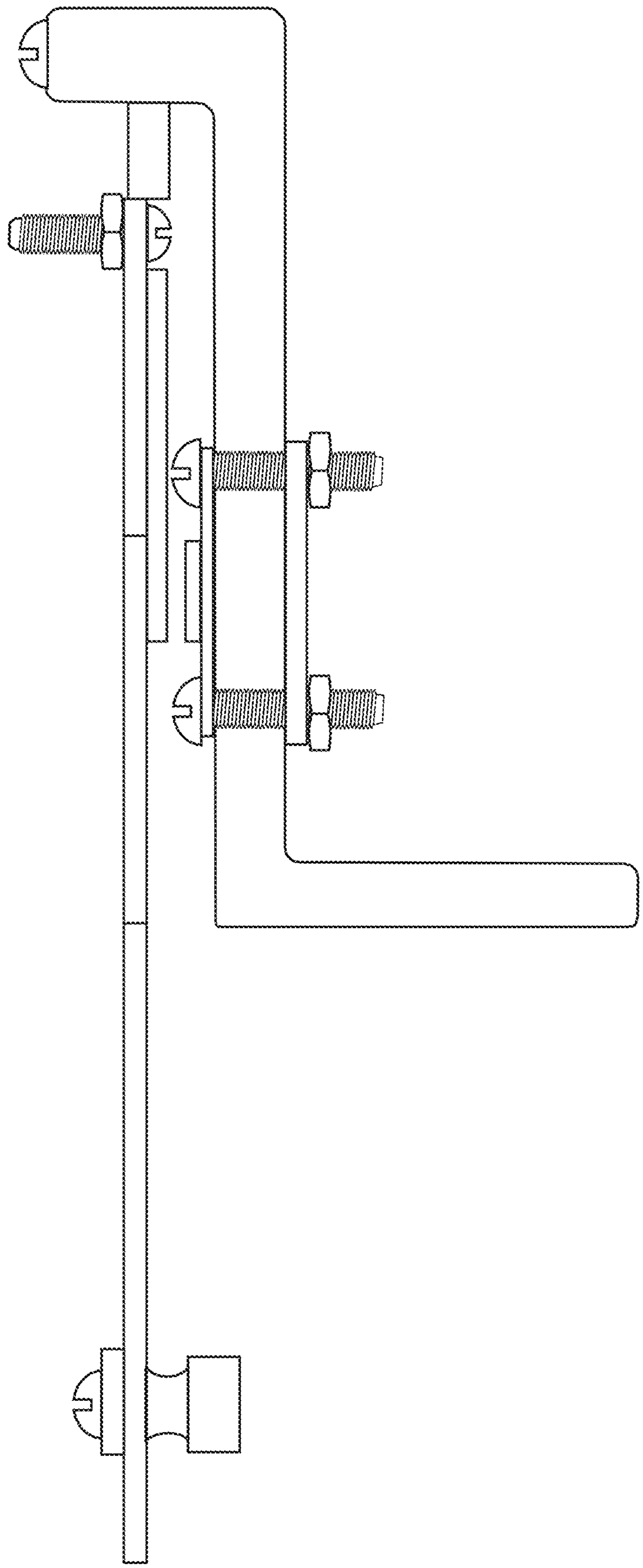


FIG. 5

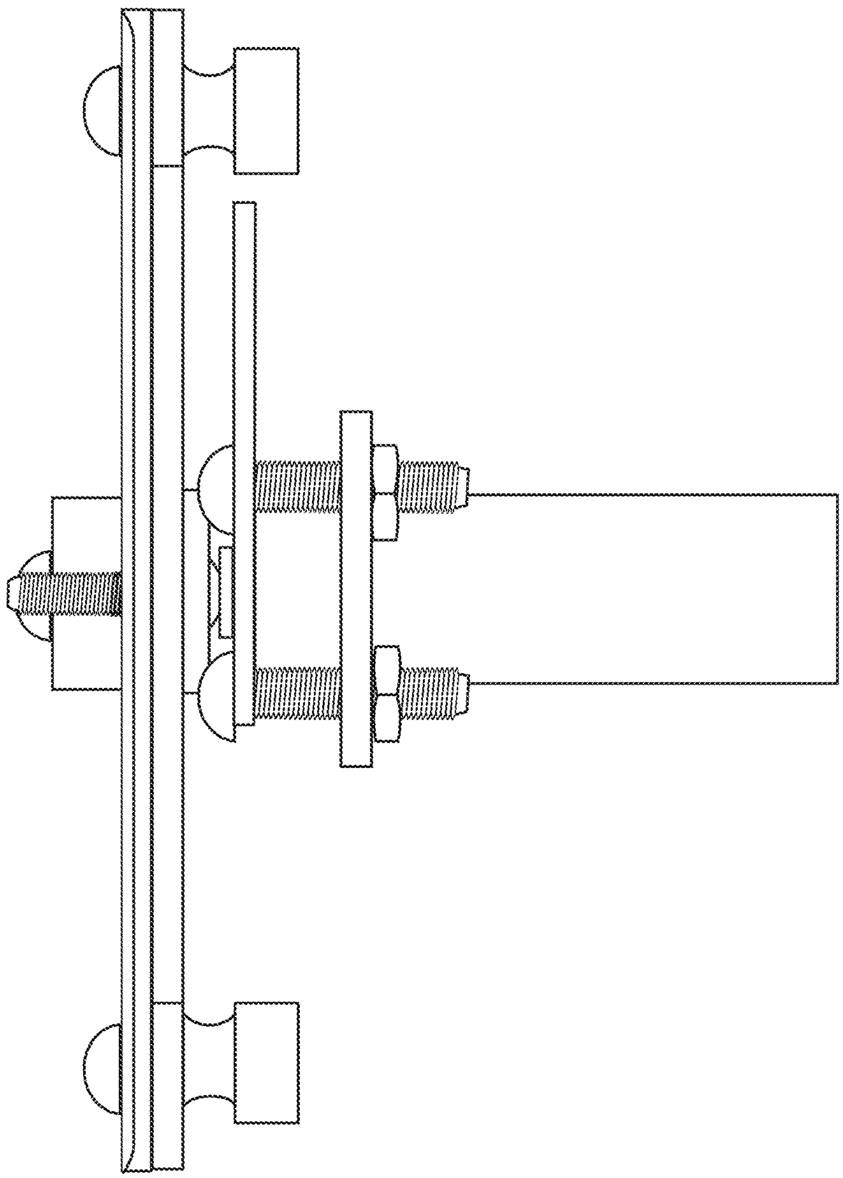


FIG. 6