

(12) **United States Patent**
Chen et al.

(10) **Patent No.:** **US 10,214,048 B2**
(45) **Date of Patent:** **Feb. 26, 2019**

(54) **BICYCLE WHEEL**

(71) Applicant: **GIANT MANUFACTURING CO., LTD.**, Taichung (TW)
(72) Inventors: **I-Teh Chen**, Taichung (TW); **Che-Wei Hsu**, New Taipei (TW); **Hui-Yuan Su**, Kaohsiung (TW)

(73) Assignee: **GIANT MANUFACTURING CO., LTD.**, Taichung (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/819,442**

(22) Filed: **Aug. 6, 2015**

(65) **Prior Publication Data**
US 2016/0039245 A1 Feb. 11, 2016

(30) **Foreign Application Priority Data**
Aug. 8, 2014 (TW) 103127281 A

(51) **Int. Cl.**
B60B 1/02 (2006.01)
B60B 1/00 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **B60B 1/0215** (2013.01); **B60B 1/003** (2013.01); **B60B 1/0223** (2013.01); **B60B 1/041** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC .. B60B 1/00; B60B 1/003; B60B 1/02; B60B 1/0215; B60B 1/04; B60B 1/041; B60B 1/042
(Continued)

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,702,725 A * 2/1955 Lyman B60B 1/003 301/59
3,907,372 A 9/1975 Goldberg
(Continued)

FOREIGN PATENT DOCUMENTS

EP 0786360 A2 7/1997
EP 0962338 A1 12/1999
(Continued)

OTHER PUBLICATIONS

A bike forum about bicycle wheel spokes found by the link <http://www.bikeforums.net/bicycle-mechanics/209570-spoke-choice-though-sheldon.html> published at Bike Forums Website: www.bikeforums.net on Jul. 9, 2006.

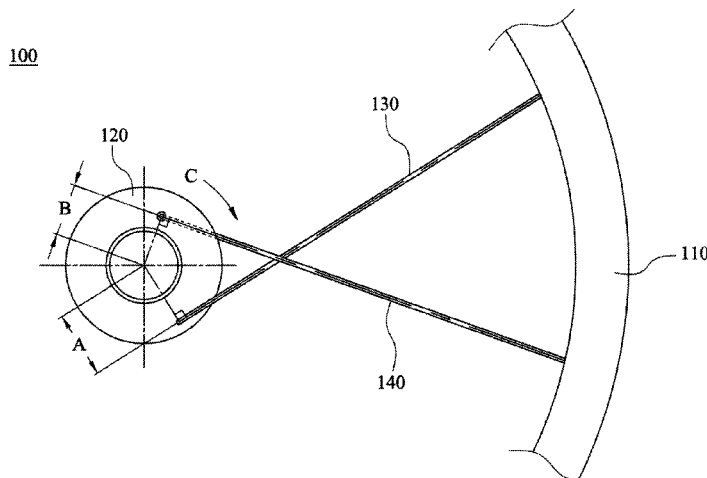
(Continued)

Primary Examiner — Jason R Bellinger
(74) *Attorney, Agent, or Firm* — CKC & Partners Co., Ltd.

(57) **ABSTRACT**

The bicycle wheel includes a rim, a hub, a driving device, a plurality of first side pulling spokes, a plurality of first side pushing spokes, and a plurality of second side spokes. The rim has a first side and a second side. The hub is located in a center of the rim. The driving device is connected to the hub which is located on the first side of the rim. Each of the first side pulling spokes and the first side pushing spokes is connected to the rim and the hub, and located on the first side of the rim, respectively. Each of the second side spokes is connected to the rim and the hub, and located on the second side of the rim.

16 Claims, 14 Drawing Sheets



(51)	Int. Cl. B60B 1/04 B60B 27/02 B60B 27/00	(2006.01) (2006.01) (2006.01)	6,024,414 A * 2/2000 Dietrich B60B 1/0215 301/110.5 6,145,938 A 11/2000 Dietrich 2002/0074853 A1 6/2002 Krampera 2006/0255654 A1 11/2006 Meggiolan 2007/0063574 A1 3/2007 Mercat et al.
------	---	-------------------------------------	--

(52) **U.S. Cl.**
CPC **B60B 1/042** (2013.01); **B60B 27/023**
(2013.01); **B60B 27/0015** (2013.01); **B60B**
2900/111 (2013.01); **B60Y 2200/13** (2013.01);
Y02T 10/86 (2013.01)

FOREIGN PATENT DOCUMENTS

(58) **Field of Classification Search**
USPC 301/55, 58-59
See application file for complete search history.

EP	1134096 A2	9/2001
JP	09202107 A	8/1997
TW	533144 B	5/2003

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,246,275 A	9/1993	Arredondo	
5,494,337 A	2/1996	Behnke	
5,882,088 A *	3/1999	Yahata	B60B 1/041 301/110.5

OTHER PUBLICATIONS

A website about bicycle wheel found by the link <http://www.bontrager.com/model/12509> published at Bontrager Website: <http://www.bontrager.com>.

* cited by examiner

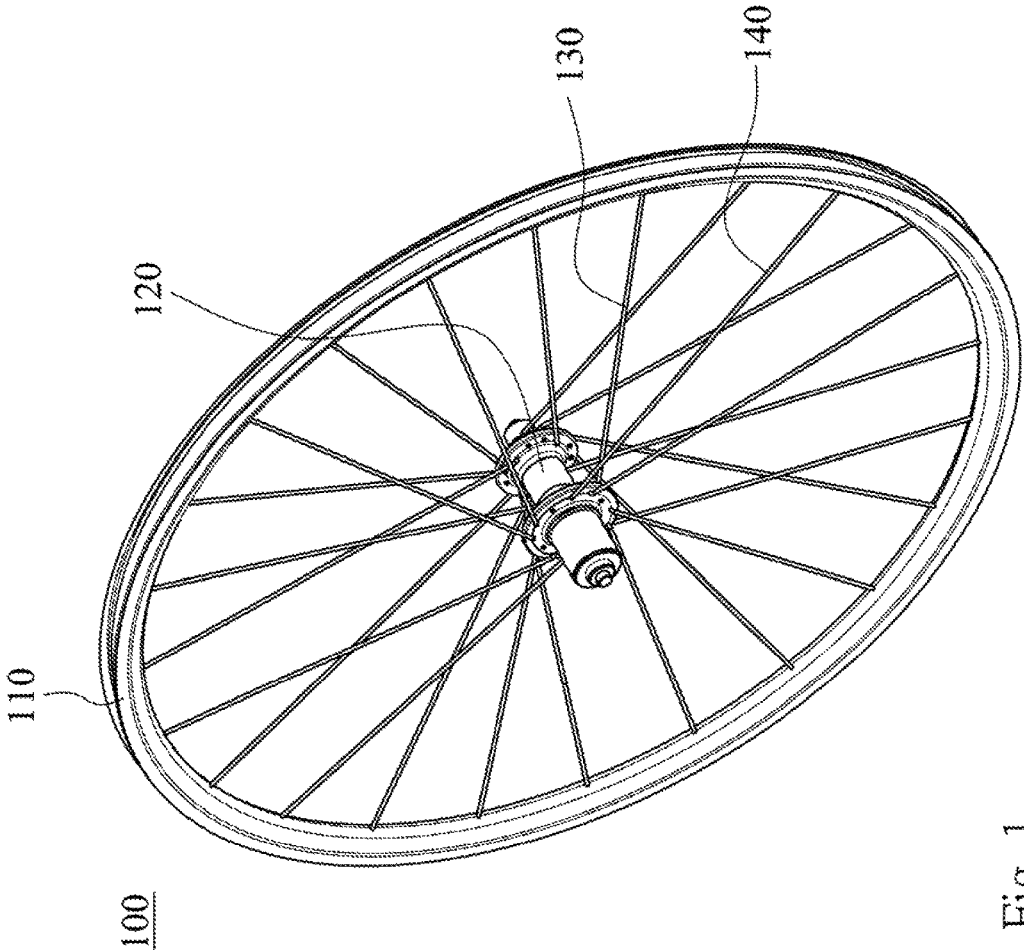


Fig. 1

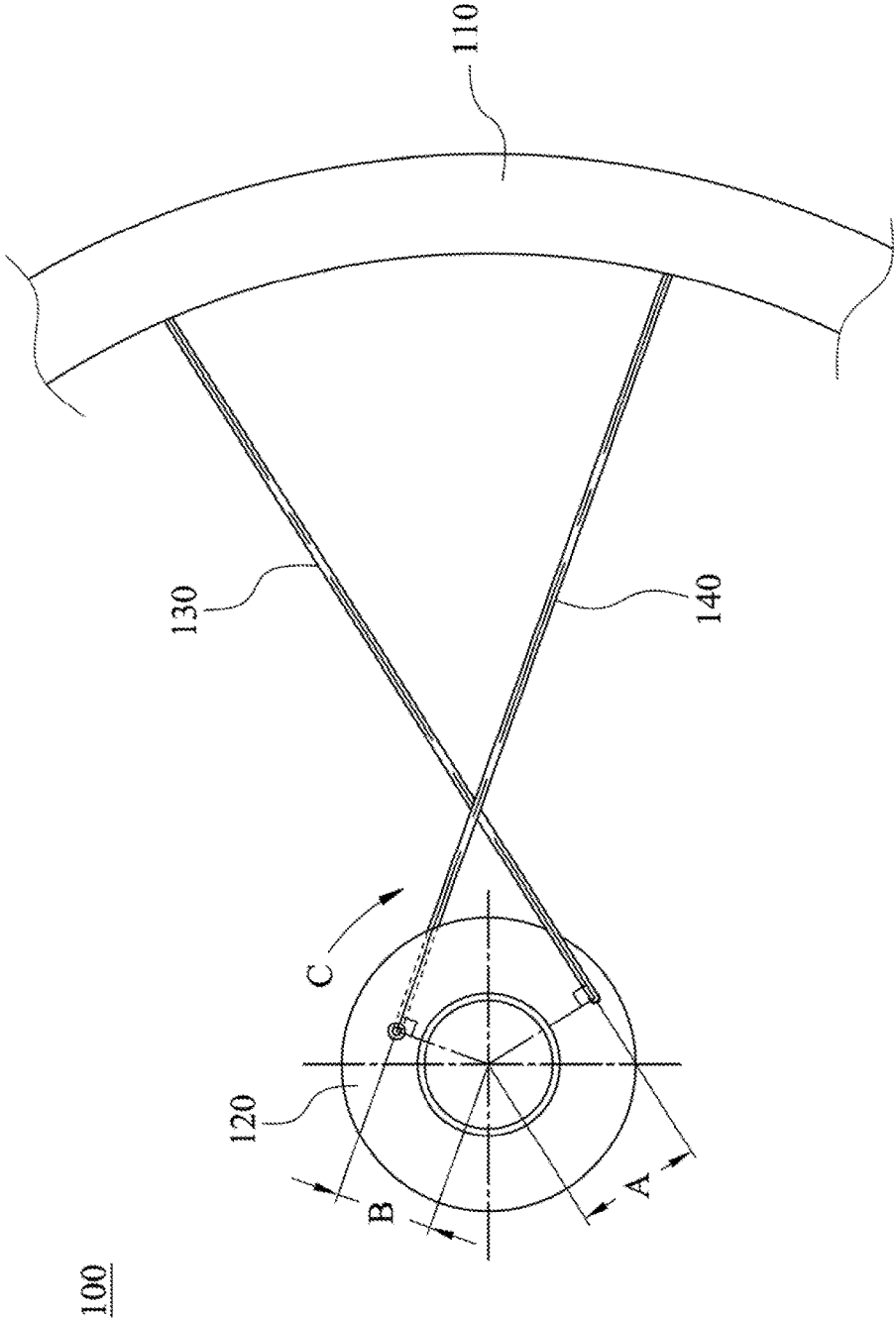


Fig. 2

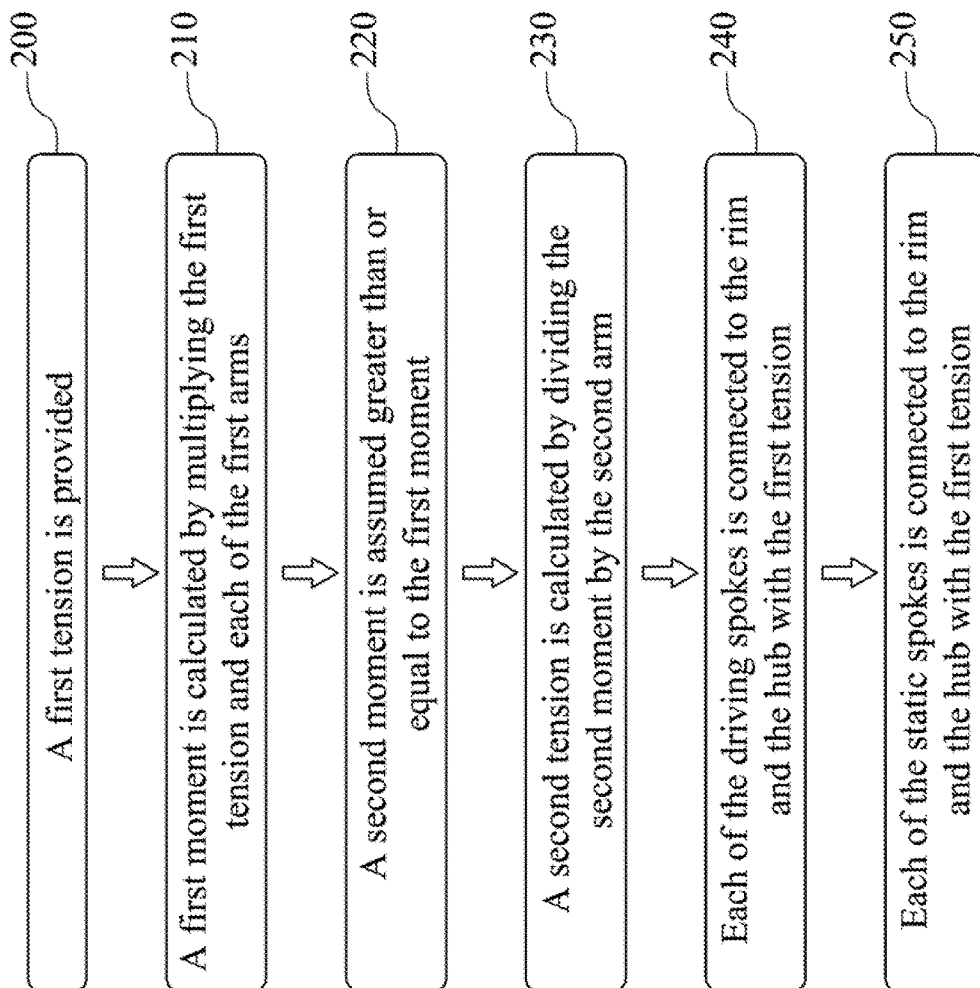


Fig. 3

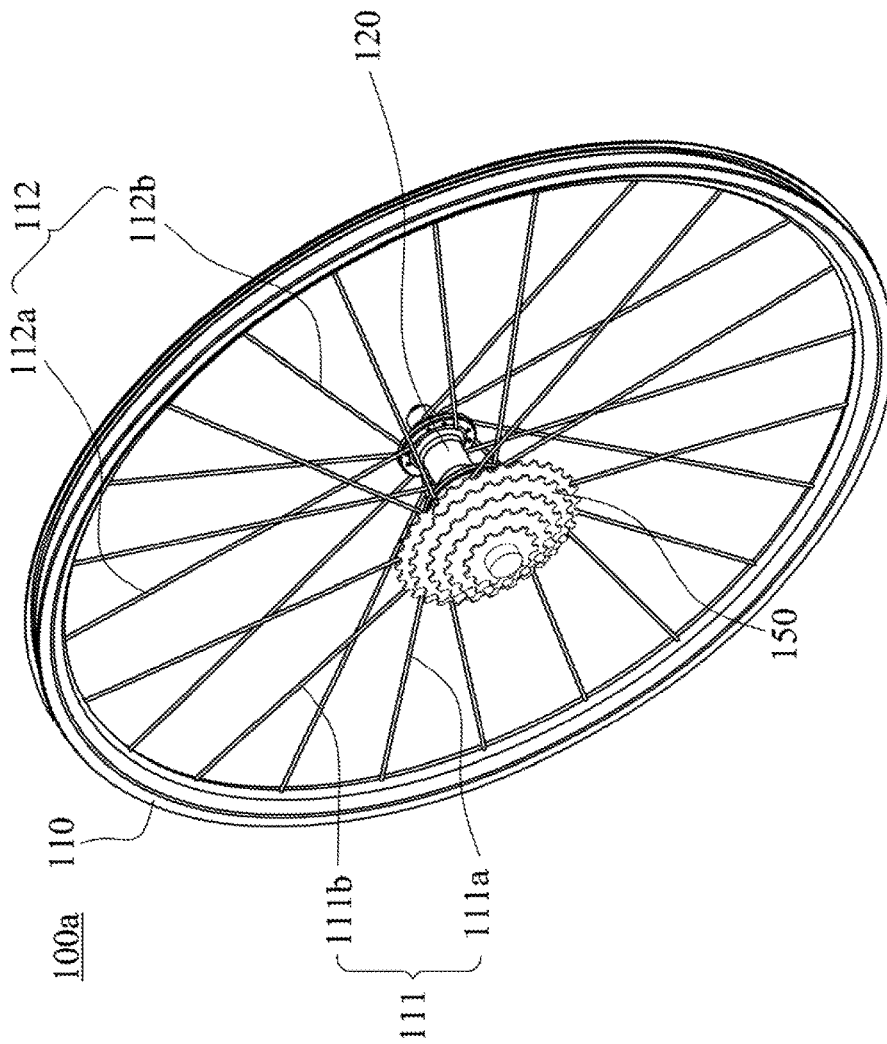


Fig. 4

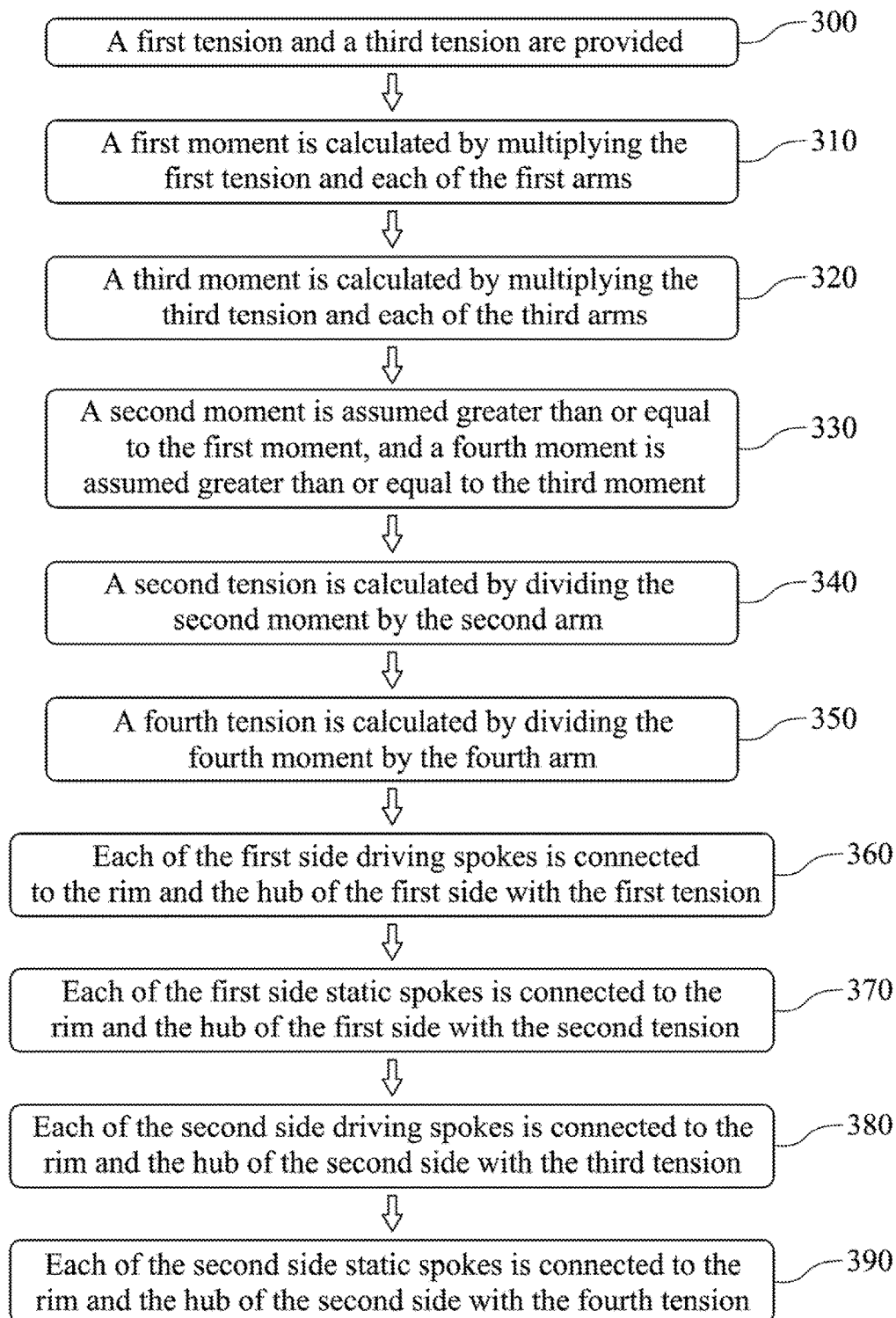


Fig. 5

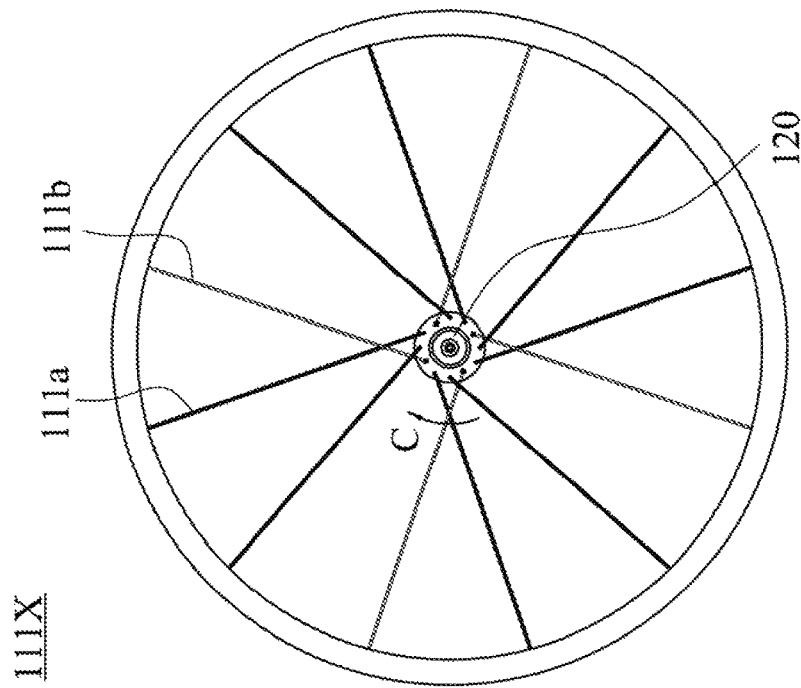


Fig. 6A

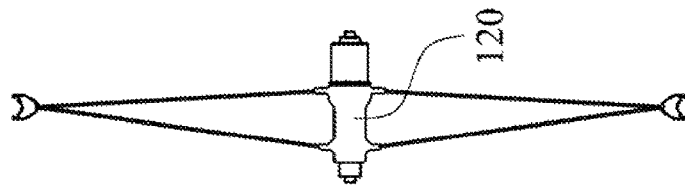


Fig. 6B

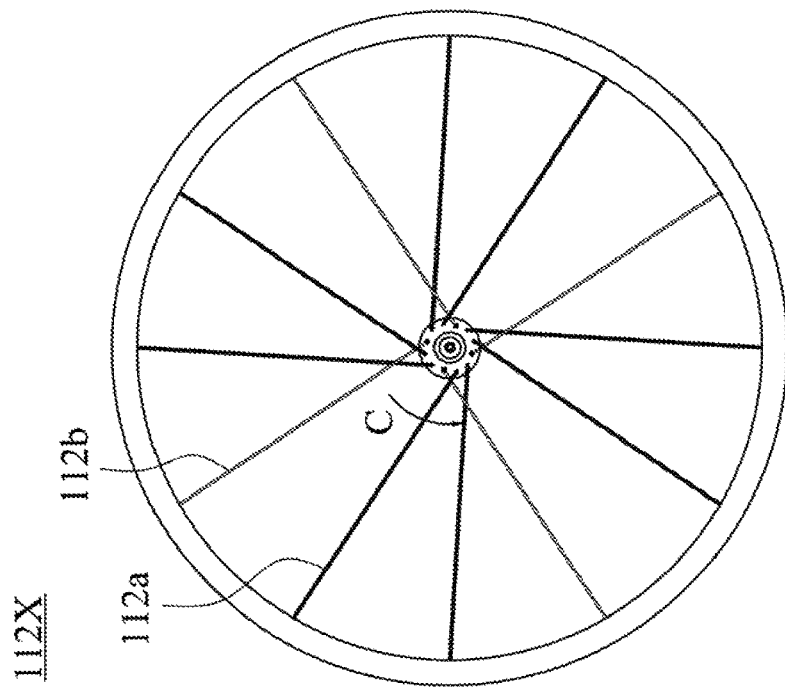


Fig. 6C

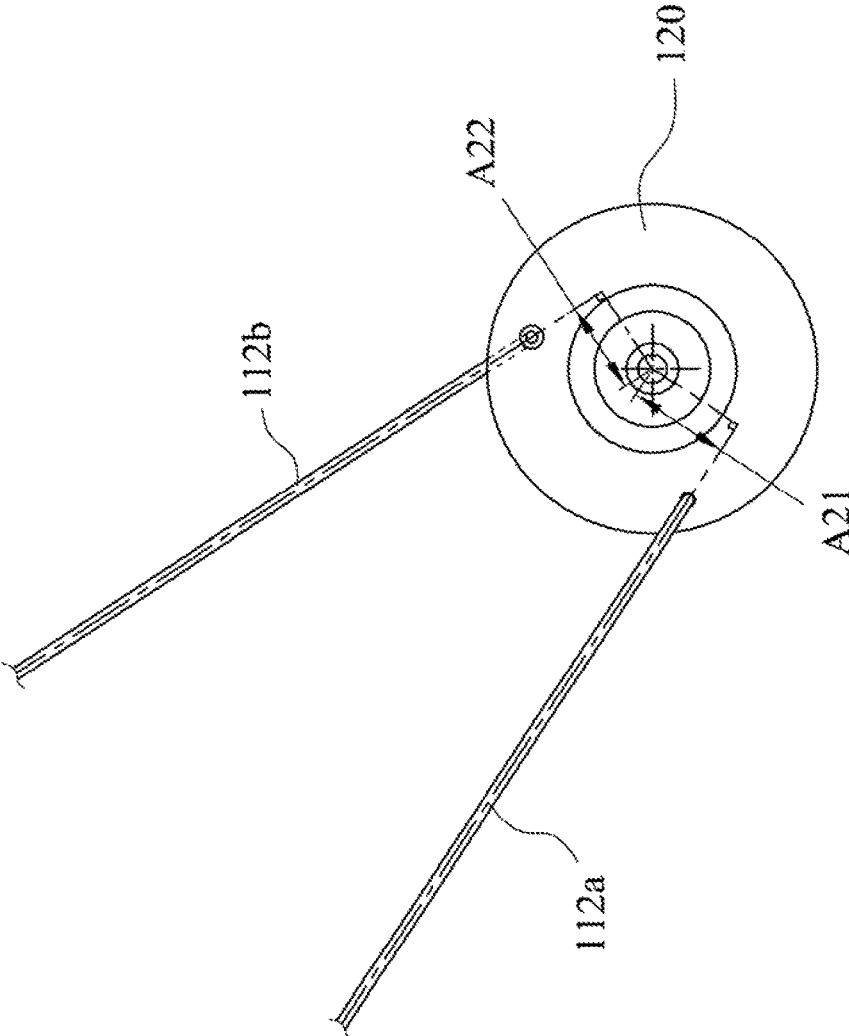


Fig. 6D

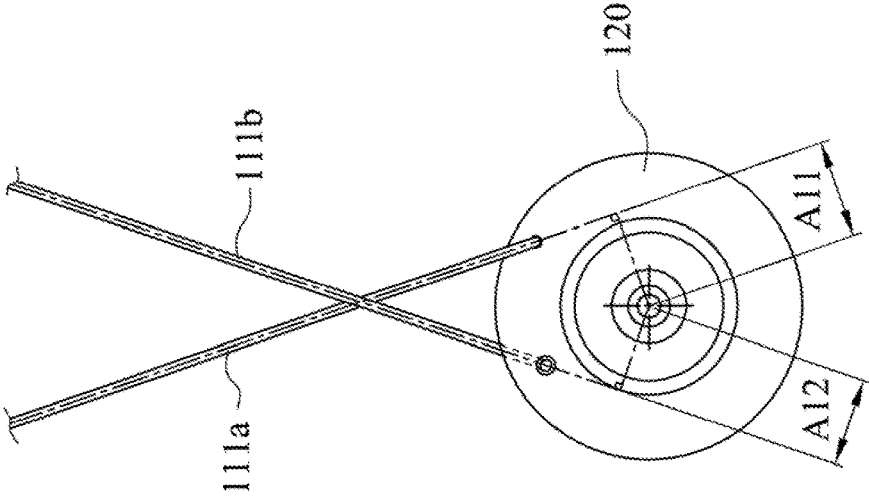


Fig. 6E

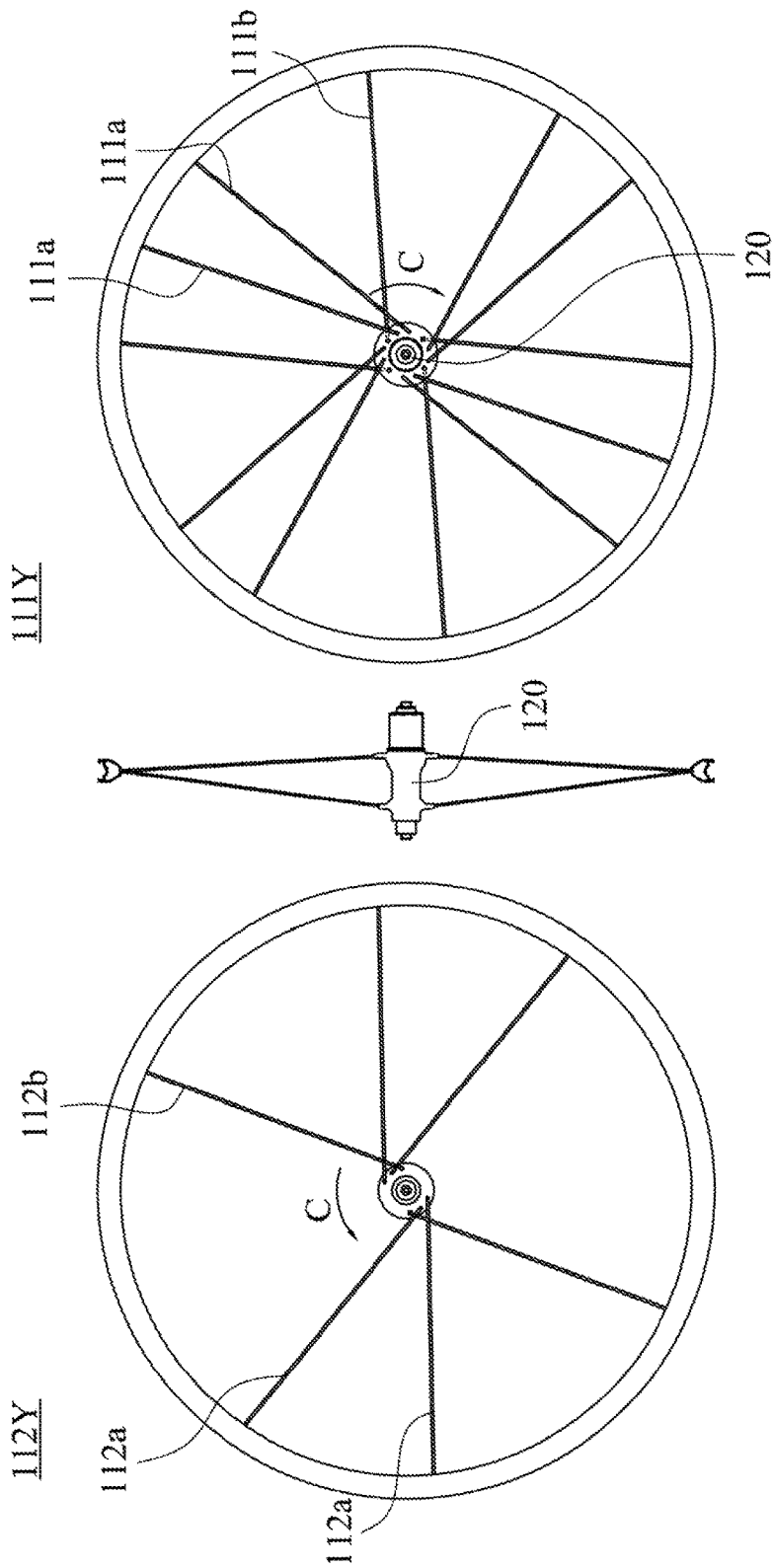


Fig. 7C

Fig. 7B

Fig. 7A

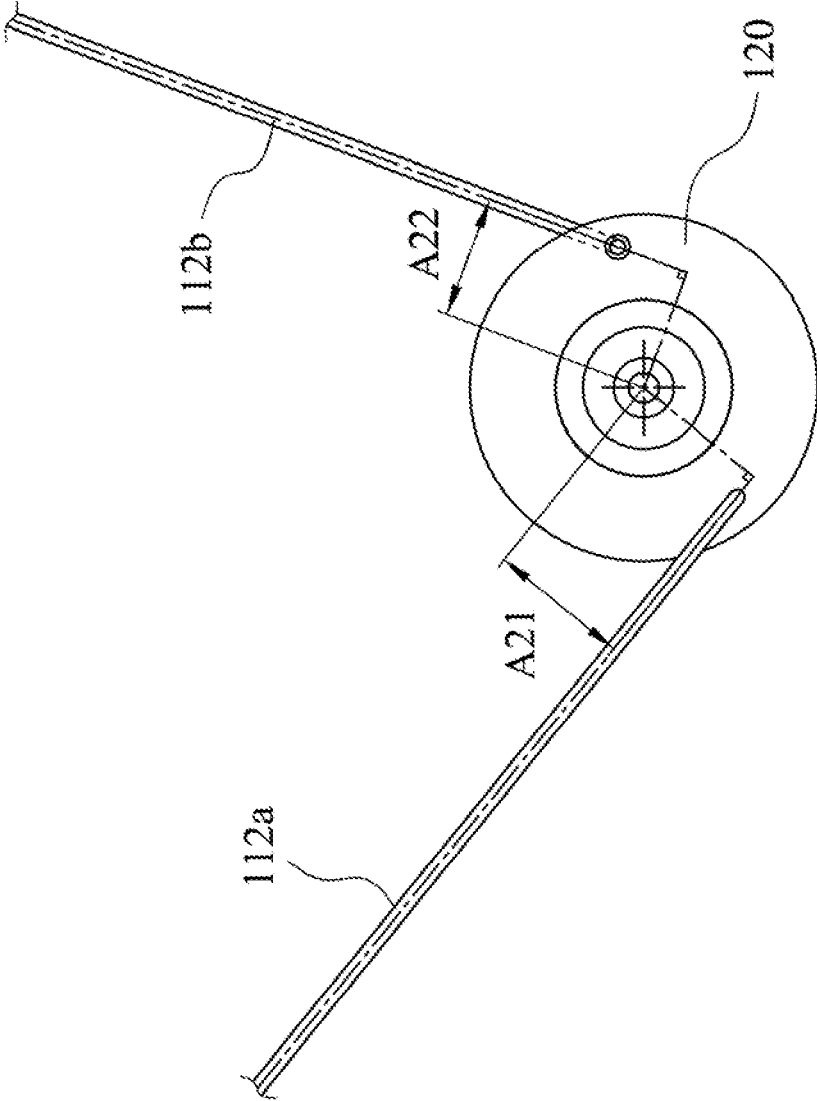


Fig. 7D

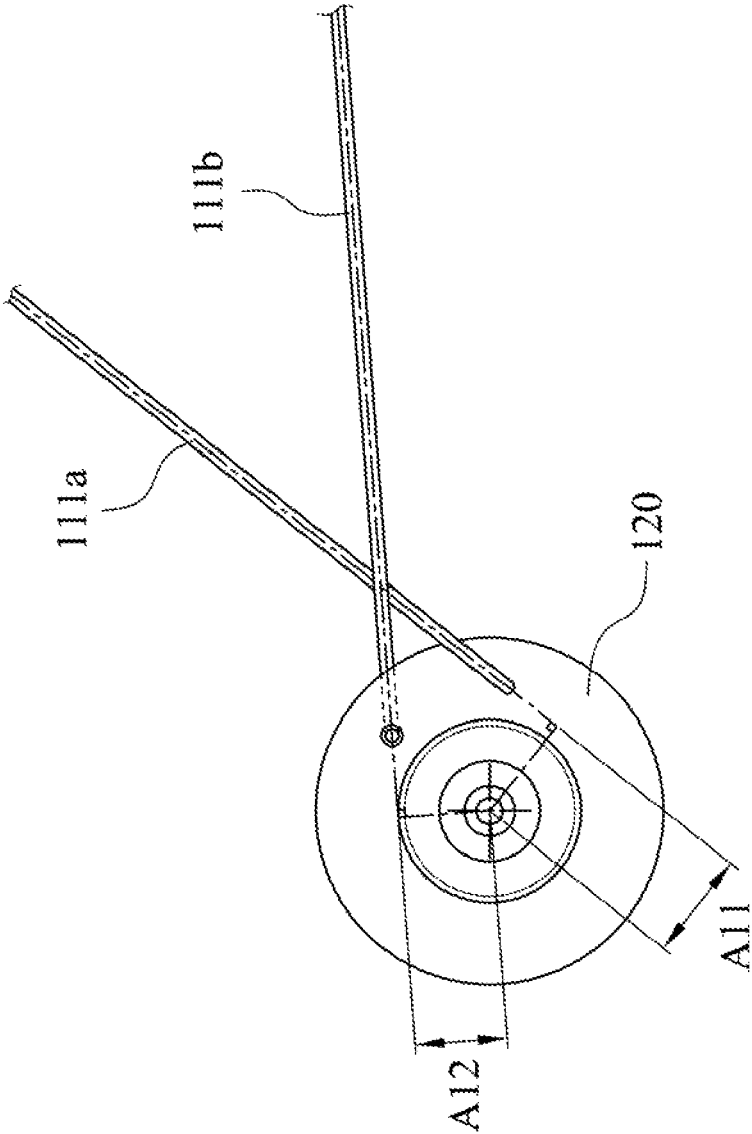


Fig. 7E

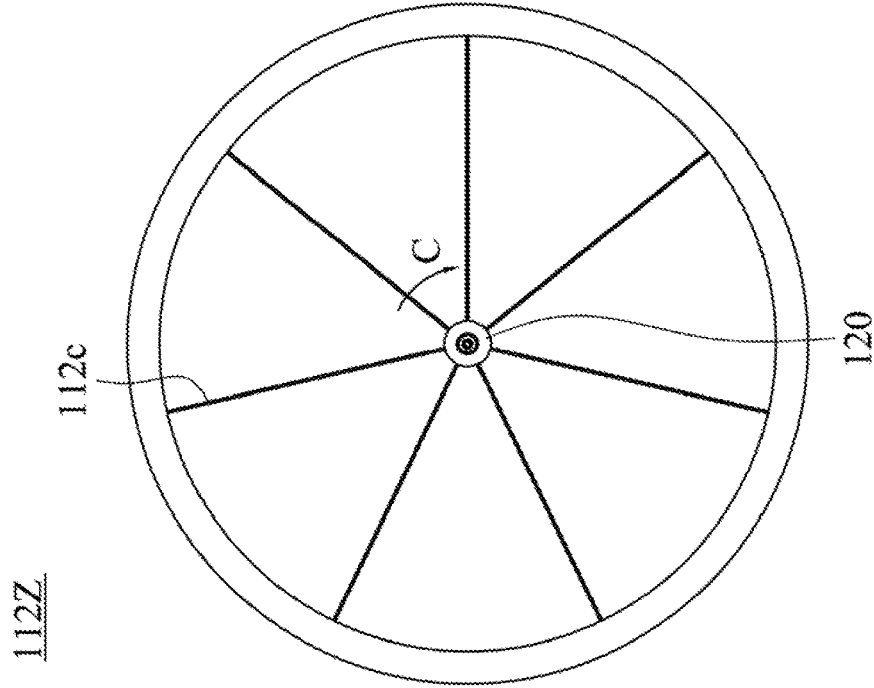
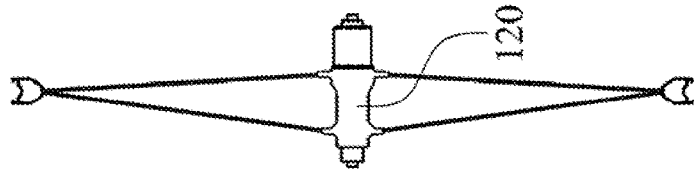
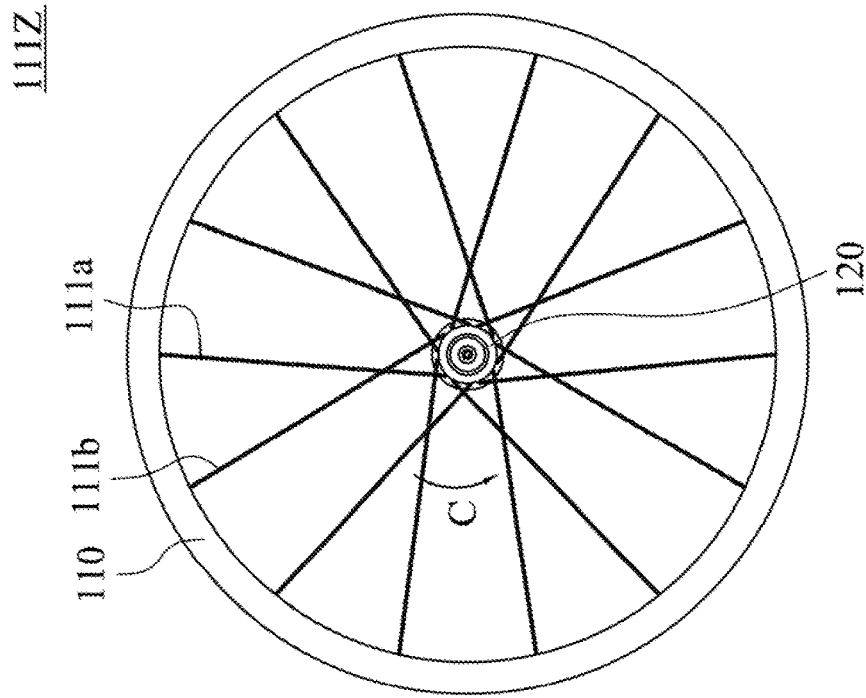


Fig. 8C

Fig. 8B

Fig. 8A

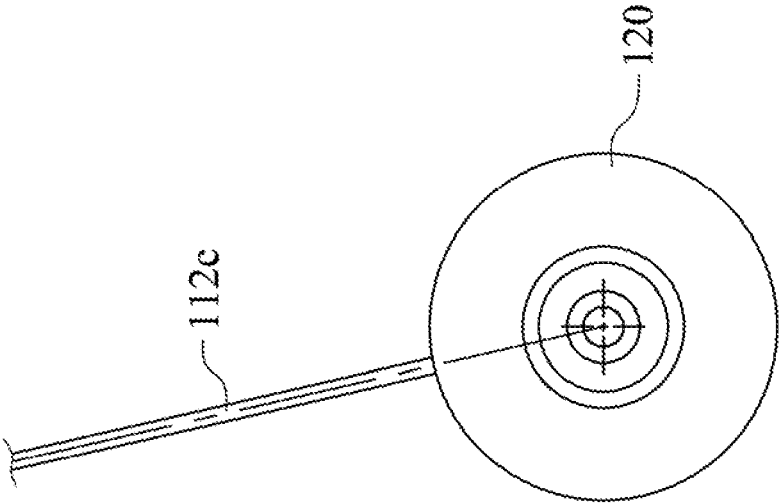


Fig. 8D

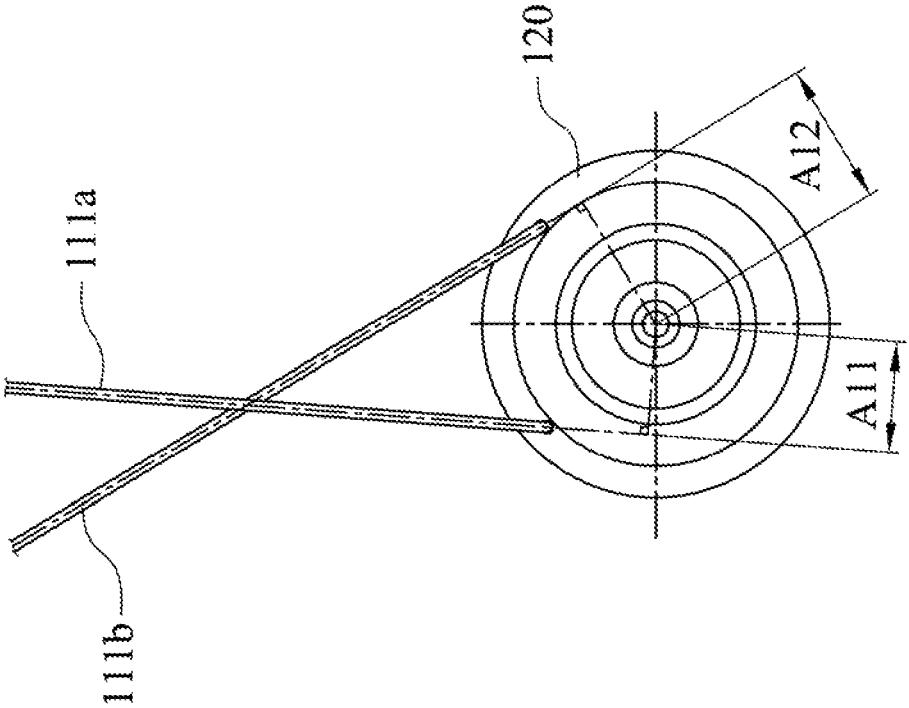


Fig. 8E

1

BICYCLE WHEEL

RELATED APPLICATIONS

This application claims priority to Taiwan Application Serial Number 103127281, filed Aug. 8, 2014, which is herein incorporated by reference.

BACKGROUND

Technical Field

The present disclosure relates to a wheel. More particularly, the present disclosure relates to a bicycle wheel.

Description of Related Art

Bicycle wheel can not only use to support the weight from user and the bicycle frame, but also bear the up-down-left-right impact stresses from various roads during cycling. Recently, the lightweight trend of bicycle leads to development of the lightweight design of bicycle wheel, especially the lightweight design of bicycle wheel with safety.

In general, conventional method for assembling bicycle wheel spokes structure is crossover weave method and radiation weave method. The spokes structure assembled by the radiation weave method provides worse power transmission. The spokes structure assembled by the cross weave method causes the increasing of the tension of pulling spokes and the decreasing of the tension of pushing spokes due to the power transmission. The aforementioned method for assembling bicycle wheel spokes structure will lead the pulling spoke broken easily when the tension of the pulling spoke is increased. Also, the pushing spokes will loosen easily when the tension thereof is decreased, so that the distribution of the stress of the bicycle wheel would be non-uniform and broken easily, and others spokes would be broken easily under the increasing tension.

SUMMARY

According to one aspect of the present disclosure, a bicycle wheel is provided. The bicycle wheel includes a rim, a hub, a driving device, a plurality of first side pulling spokes, a plurality of first side pushing spokes and a plurality of second side spokes. The rim has a first side and a second side. The hub is located in a center of the rim. The driving device is connected to the hub which is located on the first side of the rim. Each of the first side pulling spokes is connected to the rim and the hub, and located on the first side of the rim, wherein a vertical distance between an extending axis of each of the first side pulling spokes and a center of the hub is defined as a first arm A11. Each of the first side pushing spokes is connected to the rim and the hub, and located on the first side of the rim, wherein a vertical distance between an extending axis of each of the first side pushing spokes and the center of the hub is defined as a second arm A12. Each of the second side spokes is connected to the rim and the hub, and located on the second side of the rim. Wherein, $0 < A11/A12$.

BRIEF DESCRIPTION OF THE DRAWINGS

The present disclosure can be more fully understood by reading the following detailed description of the embodiment, with reference made to the accompanying drawings as follows:

2

FIG. 1 is a three dimensional view of a bicycle wheel according to one embodiment of the present disclosure;

FIG. 2 is a partially enlarged view of the bicycle wheel according to the embodiment of FIG. 1;

FIG. 3 is a flowchart of a method for assembling the bicycle wheel of FIG. 1;

FIG. 4 is a three dimensional view of a bicycle wheel according to another embodiment of the present disclosure;

FIG. 5 is a flowchart of a method for assembling the bicycle wheel of FIG. 4;

FIG. 6A is a left-side schematic view of a bicycle wheel according to further another embodiment of the present disclosure;

FIG. 6B is a front-side schematic view of the bicycle wheel of FIG. 6A;

FIG. 6C is a right-side schematic view of the bicycle wheel of FIG. 6A;

FIG. 6D is a partially enlarged view of the second side of the bicycle wheel of FIG. 6A;

FIG. 6E is a partially enlarged view of the first side 111 of the bicycle wheel of FIG. 6C;

FIG. 7A is a left-side schematic view of a bicycle wheel according to still another embodiment of the present disclosure;

FIG. 7B is a front-side schematic view of the bicycle wheel of FIG. 7A;

FIG. 7C is a right-side schematic view of the bicycle wheel of FIG. 7A;

FIG. 7D is a partially enlarged view of the second side of the bicycle wheel of FIG. 7A;

FIG. 7E is a partially enlarged view of the first side of the bicycle wheel of FIG. 7C;

FIG. 8A is a left-side schematic view of a bicycle wheel according to still another embodiment of the present disclosure;

FIG. 8B is a front-side schematic view of the bicycle wheel of FIG. 8A;

FIG. 8C is a right-side schematic view of the bicycle wheel of FIG. 8A;

FIG. 8D is a partially enlarged view of the second side of the bicycle wheel of FIG. 8A; and

FIG. 8E is a partially enlarged view of the first side of the bicycle wheel of FIG. 8C.

DETAILED DESCRIPTION

FIG. 1 is a three dimensional view of a bicycle wheel 100 according to one embodiment of the present disclosure. In FIG. 1, the bicycle wheel 100 includes a rim 110, a hub 120, a plurality of pulling spokes 130, and a plurality of pushing spokes 140. The hub 120 is located in a center of the rim 110.

The pulling spokes 130 of the present disclosure are defined as the spokes having a vector with a direction along an extending axis thereof from the hub 120 to the rim 110, and a direction of the moment on the center of the bicycle wheel generated from the vector is different from a rotation direction of the rim 110. The pushing spokes 140 of the present disclosure are defined as the spokes having a vector with a direction along an extending axis thereof from the hub 120 to the rim 110, and a direction of the moment on the center of the bicycle wheel generated from the vector is the same as the rotation direction of the rim 110.

FIG. 2 is a partially enlarged view of the bicycle wheel 100 of FIG. 1. Each of the pulling spokes 130 is connected to the rim 110 and the hub 120, wherein a vertical distance between an extending axis of each of the pulling spokes 130 and a center of the hub 120 is defined as a first arm A. Each

of the pushing spokes **140** is connected to the rim **110** and the hub **120**, wherein a vertical distance between an extending axis of each of the pushing spokes **140** and the center of the hub **120** is defined as a second arm B. Each of the second arms B is smaller than each of the first arm A. C presents as a rotation direction of the rim **110**.

Further, a number of the pulling spokes **130** can be greater than or equal to a number of the pushing spokes **140**.

FIG. 3 is a flowchart of a method for assembling the bicycle wheel **100** of FIG. 1, and the method for assembling the bicycle wheel **100** includes the following steps. Step **200**, a first tension is provided. Step **210**, a first moment is calculated by multiplying the first tension and each of the first arms A. Step **220**, a second moment is assumed greater than or equal to the first moment. Step **230**, a second tension is calculated by dividing the second moment by one of the second arms B. Step **240**, each of the pulling spokes **130** is connected to the rim **110** and the hub **120** with the first tension. Step **250**, each of the pushing spokes **140** is connected to the rim **110** and the hub **120** with the second tension.

In the embodiment of FIGS. 1-3, each of the second arms B is smaller than each of the first arms A, and the second moment is smaller than the first moment for calculating the first tension and the second tension. Using the first tension to connect the pulling spokes **130** to the rim **110** and the hub **120** can avoid the excessive tension during cycling, and using the second tension to connect the pushing spokes **140** to the rim **110** and the hub **120** can avoid the insufficient tension during cycling. Therefore, the bicycle wheel of the present disclosure not only can avoid a problem of non-uniform tension distribution, but also can increase durability.

FIG. 4 is a three dimensional view of a bicycle wheel **100a** according to another embodiment of the present disclosure. In FIG. 4, the bicycle wheel **100a** is a bicycle rear wheel, and includes a rim **110**, a hub **120**, a driving device **150**, a plurality of first side pulling spokes **111a**, a plurality of first side pushing spokes **111b**, and a plurality of second side spokes (not labeled) including a plurality of second side pulling spokes **112a** and a plurality of second side pushing spokes **112b**. The rim **110** has a first side **111** and a second side **112**. The hub **120** is located in a center of the rim **110**. The driving device **150** is connected to the hub **120** which is located on the first side **111** of the rim **110**. Each of the first side pulling spokes **111a** is connected to the rim **110** and the hub **120**, and located on the first side **111** of the rim **110**, wherein a vertical distance between an extending axis of each of the first side pulling spokes **111a** and the center of the hub **120** is defined as a first arm A11 (shown in FIG. 6E). Each of the first side pushing spokes **111b** is connected to the rim **110** and the hub **120**, and located on the first side **111** of the rim **110**, wherein a vertical distance between an extending axis of each of the first side pushing spokes **111b** and the center of the hub **120** is defined as a second arm A12 (shown in FIG. 6E). Each of the second side pulling spokes **112a** is connected to the rim **110** and the hub **120**, and located on the second side **112** of the rim **110**, wherein a vertical distance between an extending axis of each of the second side pulling spokes **112a** and the center of the hub **120** is defined as a third arm A21 (shown in FIG. 6D). Each of the second side pushing spokes **112b** is connected to the rim **110** and the hub **120**, and located on the second side **112** of the rim **110**, wherein a vertical distance between an extending axis of each of the second side pushing spokes **112b** and the center of the hub **120** is defined as a fourth arm A22 (shown in FIG. 6D), and each fourth arm is smaller than each third arm. The first side pulling spokes **111a**, the first side pushing spokes

111b, the second side pulling spokes **112a** and the second side pushing spokes **112b** are connected to the hub **120** and the rim **110** in a straight-pulled method.

In detail, the first arm A11 and the second arm A12 satisfy the following relationship: $0 < A11/A12$. Therefore, durability of the bicycle wheel **100a** can be increased. Moreover, the first arm A11 and the second arm A12 can satisfy the following relationship: $1 < A11/A12 \leq 3$, $1 \leq A11/A12 \leq 1.4$, $1.15 \leq A11/A12 \leq 2$, $1.15 \leq A11/A12 \leq 1.4$ or $1.24 \leq A11/A12 \leq 1.35$.

The third arm A21 and the fourth arm A22 satisfy the following relationship: $A21/A22 \geq 1$.

A sum of each first arm A11 between each first side pulling spoke **111a** and the center of the hub **120** is defined as $\Sigma A11$, and a sum of each first arm A12 between each first side pushing spoke **111b** and the center of the hub **120** is defined as $\Sigma A12$, wherein $\Sigma A11 - \Sigma A12 > 10$ mm. Further, $\Sigma A11$ and $\Sigma A12$ can be satisfied as $\Sigma A11 - \Sigma A12 > 30$ mm. Moreover, a sum of each third arm A21 between each second side pulling spoke **112a** and the center of the hub **120** is defined as $\Sigma A21$, a sum of each fourth arm A22 between each second side pushing spoke **112b** and the center of the hub **120** is defined as $\Sigma A22$, wherein $(\Sigma A11 + \Sigma A21) - (\Sigma A12 + \Sigma A22) > 10$ mm. Further, $\Sigma A11$, $\Sigma A12$, $\Sigma A21$ and $\Sigma A22$ can be satisfied as $(\Sigma A11 + \Sigma A21) - (\Sigma A12 + \Sigma A22) > 30$ mm.

The first side pulling spokes can include one or more values of the first arms A11, that is, the first arms A11 of the first side pulling spokes are not limited to one value. Further, the second arms A12, the third arms A21 and the fourth arms A22 are also not limited to one value, respectively.

FIG. 5 is a flowchart of a method for assembling the bicycle wheel **100a** of FIG. 4, and the method includes the following steps. Step **300**, a first tension and a third tension are provided. Step **310**, a first moment is calculated by multiplying the first tension and each of the first arms A11. Step **320**, a third moment is calculated by multiplying the third tension and each of the third arms A21. Step **330**, a second moment is assumed greater than or equal to the first moment, and a fourth moment is assumed greater than or equal to the third moment. Step **340**, a second tension is calculated by dividing the second moment by the second arm A12. Step **350**, a fourth tension is calculated by dividing the fourth moment by the fourth arm A22. Step **360**, each of the first side pulling spokes **111a** is connected to the rim **110** and the hub **120** of the first side **111** with the first tension. Step **370**, each of the first side pushing spokes **111b** is connected to the rim **110** and the hub **120** of the first side **111** with the second tension. Step **380**, each of the second side pulling spokes **112a** is connected to the rim **110** and the hub **120** of the second side **112** with the third tension. Step **390**, each of the second side pushing spokes **112b** is connected to the rim **110** and the hub **120** of the second side **112** with the fourth tension.

In the embodiment of FIGS. 4 and 5, each of the second arms A12 is smaller than each of the first arms A11, each of the fourth arms A22 is smaller than each of the third arms A21, thus the sum of the second moment and the fourth moment is smaller than the sum of the first moment and the third moment, and the first tension, the second tension, the third tension and the fourth tension can be calculated. the first side pulling spokes **111a** can be connected to the rim **110** and the hub **120** of the first side **111** by the first tension, the second side pulling spokes **112a** can be connected to the rim **110** and the hub **120** of the second side **112** by the third tension, the first side pushing spokes **111b** can be connected to the rim **110** and the hub **120** of the first side **111** by the

5

second tension, and the second side pushing spokes **112b** can be connected to the rim **110** and the hub **120** of the second side **112** by the fourth tension, so that the excessive tension between the rim **110** and the hub can be avoided during cycling. Hence, the bicycle wheel and the method for assembling thereof in the present disclosure not only can avoid a problem of non-uniform tension distribution, but also can increase durability during using.

Each of the first side pulling spokes **111a** has a first tension, and the first tension multiplied by the first arm **A11** equals to a first moment, each of the first side pushing spokes **111b** has a second tension, and the second tension multiplied by the second arm **A12** equals to a second moment, each of the second side pulling spokes **112a** has a third tension, and the third tension multiplied by the third arm **A21** equals to a third moment, and each of the second side pushing spokes has a fourth tension, and the fourth tension multiplied by the fourth arm **A22** equals to a fourth moment. For satisfying the conditions that the second moment is smaller than the first moment and the fourth moment is smaller than the third moment, a number of the first side pulling spokes **111a** can be greater than or equal to a number of the first side pushing spokes **111b** and a number of the second side pulling spokes **112a** can be greater than a number of the second side pushing spokes **112b**, or a sum of the first side pulling spokes **111a** and the first side pushing spokes **111b** can be greater than or equal to a sum of the second side pulling spokes **112a** and the second side pushing spokes **112b**. The detail number of the first side pulling spokes **111a**, the first side pushing spokes **111b**, the second side pulling spokes **112a**, and the second side pushing spokes **112b** are shown in Table 1

TABLE 1

Ratio of the	First side		Second side		
spoke number of the first side and the spoke number of the second side	Number of pulling spokes	Number of pushing spokes	Number of pulling spokes	Number of pushing spokes	Number of total spokes
1:1	4	2	4	2	12
	4	2	2	4	12
	4	2	3	3	12
	5	4	5	4	18
	6	3	6	3	18
	6	4	5	5	20
	6	5	6	5	22
	7	4	7	4	22
	7	5	7	5	24
	7	5	6	6	24
2:1	8	4	6	6	24
	8	4	8	4	24
	7	6	7	6	26
	8	5	8	5	26
	8	6	8	6	28
	8	6	7	7	28
	8	7	8	7	30
	10	5	10	5	30
	9	6	9	6	30
	10	6	10	6	32
3:2	10	6	8	8	32
	10	7	10	7	34
	12	6	9	9	36
	12	6	12	6	36
	6	6	3	3	18
	6	6	4	2	18
	8	4	3	3	18
	8	4	4	2	18
	12	6	6	3	27
	16	8	8	4	36
3:2	6	3	3	3	15
	8	4	4	4	20
	6	6	4	4	20

6

TABLE 1-continued

Ratio of the	First side		Second side		
spoke number of the first side and the spoke number of the second side	Number of pulling spokes	Number of pushing spokes	Number of pulling spokes	Number of pushing spokes	Number of total spokes
4:3	10	5	5	5	25
	10	5	6	4	25
	9	9	6	6	30
	9	9	8	4	30
	10	8	6	6	30
	10	8	8	4	30
	12	6	6	6	30
	12	6	8	4	30
	14	7	8	6	35
	14	7	7	7	35
5:3	18	9	12	6	45
	8	8	6	6	28
	8	8	8	4	28
	10	6	6	6	28
	10	6	8	4	28
	16	8	10	6	40
	16	8	8	8	40
	6	6	5	5	22
	6	6	6	4	22
	8	4	5	5	22
5:3	8	4	6	4	22
	5	5	3	3	16
	5	5	4	2	16
	6	4	3	3	16
	6	4	4	2	16
	9	6	6	3	24
	6	9	6	3	24
	12	8	6	6	32
	12	8	8	4	32
	15	10	9	6	40
5:4	6	4	4	4	18
	5	5	4	4	18
	9	6	6	6	27
	9	6	8	4	27
	12	8	10	6	36
	12	8	8	8	36
	7	7	3	3	20
	7	7	4	2	20
	8	6	4	2	20
	8	6	3	3	20
7:4	14	7	6	3	30
	7	7	4	4	22
	8	6	4	4	22
	12	9	8	4	33
	12	9	6	6	33
	7	7	5	5	24
	7	7	6	4	24
	8	6	5	5	24
	8	6	6	4	24
	7	7	6	6	26
7:6	8	6	6	6	26
	8	6	8	4	26
	8	8	6	4	26
	8	8	5	5	26
	10	6	5	5	26
	10	6	6	4	26
	4	4	4	3	15
	10	6	7	7	30
	8	8	7	7	30
	8	8	8	6	30

FIG. 6A is a left-side schematic view of a bicycle wheel according to further another embodiment of the present disclosure, FIG. 6B is a front-side schematic view of the bicycle wheel of FIG. 6A, and FIG. 6C is a right-side schematic view of the bicycle wheel of FIG. 6A.

In the embodiment of FIG. 6C, the right side is a first side **111X** of a rim **110**. A driving device **150** being a chain wheel is located on the first side **111X**. A number of the first side pulling spokes **111a** is 8, a number of the first side pushing spokes **111b** is 4, and a sum of the first side pulling spokes

111a and the first side pushing spokes **111b** is 12. C presents a rotation direction of the rim **110**. FIG. 6A shows a second side **112X** of a rim **110** as the left side. A number of the second side pulling spokes **112a** is 8, a number of the second side pushing spokes **112b** is 4, and a sum of the second side pulling spokes **112a** and the second side pushing spokes **112b** is 12. C presents a rotation direction of the rim **110**. A ratio of the sum of the first side pulling spokes **111a** and the first side pushing spokes **111b** and the sum of the second side pulling spokes **112a** and the second side pushing spokes **112b** (that is, the ratio of the spoke number of the first side **111X** and the spoke number of the second side **112X**) is 1:1. A sum of the first side pulling spokes **111a**, the first side pushing spokes **111b**, the second side pulling spokes **112a**, and the second side pushing spokes **112b** is 24.

FIG. 6D is a partially enlarged view of the second side **112X** of the bicycle wheel of FIG. 6A. FIG. 6E is a partially enlarged view of the first side **111X** of the bicycle wheel of FIG. 6C. In FIGS. 6D and 6E, the vertical distance between the extending axis of each of the first side pulling spokes **111a** and the center of the hub **120** is the first arm **A11**, the vertical distance between the extending axis of each of the first side pushing spokes and the center of the hub **120** is the second arm **A12**, the vertical distance between the extending axis of each of the second side pulling spokes **112a** and the center of the hub **120** is the third arm **A21**, the vertical distance between the extending axis of each of the second side pushing spokes **112b** and the center of the hub **120** is the fourth arm **A22**. According to the embodiment of FIG. 6E, the values of the first arms **A11** of the first side pulling spokes **111a** are the same, that is, the first side pulling spokes **111a** include only one value of the first arms **A11**. In detail, each of the first arms **A11** is 21.18 mm, each of the second arms **A12** is 21.18 mm, each of the third arm **A21** is 17.58 mm, each of the fourth arm **A22** is 17.58 mm, wherein $A11/A12=1$, $A21/A22=1$, $\Sigma A11-\Sigma A12=84.72$ mm, and $(\Sigma A11+\Sigma A21)-(\Sigma A12+\Sigma A22)=155.04$ mm.

FIG. 7A is a left-side schematic view of a bicycle wheel according to still another embodiment of the present disclosure, FIG. 7B is a front-side schematic view of the bicycle wheel of FIG. 7A, and FIG. 7C is a right-side schematic view of the bicycle wheel of FIG. 7A.

According to the embodiment of FIG. 7C, the right side is a first side **111Y** of a rim **110**. A driving device **150** being a chain wheel is located on the first side **111Y**. A number of the first side pulling spokes **111a** is 8, a number of the first side pushing spokes **111b** is 4, and a sum of the first side pulling spokes **111a** and the first side pushing spokes **111b** is 12. C presents a rotation direction of the rim **110**. FIG. 7A shows a second side **112Y** of a rim **110** as the left side. A number of the second side pulling spokes **112a** is 4, a number of the second side pushing spokes **112b** is 2, and a sum of the second side pulling spokes **112a** and the second side pushing spokes **112b** is 6. C presents a rotation direction of the rim **110**. A ratio of the sum of the first side pulling spokes **111a** and the first side pushing spokes **111b** and the sum of the second side pulling spokes **112a** and the second side pushing spokes **112b** (that is, the ratio of the spoke number of the first side **111Y** and the spoke number of the second side **112Y**) is 2:1. A sum of the first side pulling spokes **111a**, the first side pushing spokes **111b**, the second side pulling spokes **112a**, and the second side pushing spokes **112b** is 18.

FIG. 7D is a partially enlarged view of the second side **112Y** of the bicycle wheel of FIG. 7A. FIG. 7E is a partially enlarged view of the first side **111Y** of the bicycle wheel of FIG. 7C. In FIGS. 7D and 7E, the vertical distance between the extending axis of each of the first side pulling spokes

111a and the center of the hub **120** is the first arm **A11**, the vertical distance between the extending axis of each of the first side pushing spokes and the center of the hub **120** is the second arm **A12**, the vertical distance between the extending axis of each of the second side pulling spokes **112a** and the center of the hub **120** is the third arm **A21**, the vertical distance between the extending axis of each of the second side pushing spokes **112b** and the center of the hub **120** is the fourth arm **A22**. According to the embodiment of FIGS. 7D and 7E, the first arms **A11** of the first side pulling spokes **111a** include two different values, each two of the first side pulling spokes **111a** which are adjacent to each other have different values of the first arms **A11**. The third arms **A21** of the second side pulling spokes **112a** include two different values, each two of the second side pulling spokes **112a** which are adjacent to each other have different values of the third arms **A21**. In detail, each two of the first arms **A11** which are adjacent to each other are 20.13 mm, 17.58 mm, respectively, each of the second arms **A12** is 17.58 mm, each two of the third arms **A21** which are adjacent to each other are 23.11 mm, 21.98 mm, respectively, each of the fourth arm **A22** is 20.13 mm. When $A11=20.13$ mm, $A11/A12=1.15$; when $A11=17.58$ mm, $A11/A12=1$. When $A21=23.11$ mm, $A21/A22=1.15$; when $A21=21.98$ mm, $A21/A22=1.09$. $\Sigma A11-\Sigma A12=80.52$ mm, and $(\Sigma A11+\Sigma A21)-(\Sigma A12+\Sigma A22)=44.74$ mm.

FIG. 8A is a left-side schematic view of a bicycle wheel according to still another embodiment of the present disclosure, FIG. 8B is a front-side schematic view of the bicycle wheel of FIG. 8A, and FIG. 8C is a right-side schematic view of the bicycle wheel of FIG. 8A.

In FIGS. 8A to 8C, the bicycle wheel is a rear bicycle wheel. In general, the rear bicycle wheel provides braking function, so that C presents a rotation direction of the rim **110** which is in the braked situation. The right side is a first side **111Z** of a rim **110**. A driving device **150** being a chain wheel is located on the first side **111Z**, that is, the first side **111Z** is a driving side. A number of the first side pulling spokes **111a** is 7, a number of the first side pushing spokes **111b** is 7, and a sum of the first side pulling spokes **111a** and the first side pushing spokes **111b** is 14. A number of the second side spokes **112c** is 7.

FIG. 8D is a partially enlarged view of the second side **112Z** of the bicycle wheel of FIG. 8A. FIG. 8E is a partially enlarged view of the first side **111Z** of the bicycle wheel of FIG. 8C. In FIGS. 8D and 8E, the first arm **A11** which represents a vertical distance between an extending axis of each of the first side pulling spokes **111a** and the center of the hub **120** is 21 mm, the second arm **A12** which represents a vertical distance between an extending axis of each of the first side pushing spokes **111b** and the center of the hub **120** is 27 mm. That is, $0 < A11/A12 < 1$. Moreover, the arm which represents a vertical distance between an extending axis of each of the second side spokes **112c** and the center of the hub **120** is 0.

Therefore, the bicycle wheel and the method for assembling thereof of the present disclosure provide the following advantages.

1. Each of the first arms is greater than each of the second arms, and each of the third arms is greater than each of the fourth arms. Hence, the tension of the pulling spokes (including the first side pulling spokes and the second side pulling spokes) is smaller than the tension of the conventional pulling spokes under the condition without forcing; and the tension of the pushing spokes (including the first side pushing spokes and the second side pushing spokes) is greater than the tension of the conventional pulling spokes

under the condition without forcing. By such arrangement, break of the pulling spokes and the pushing spokes can be avoided.

2. The number of the first side pulling spokes is greater than the number of the first side pushing spokes, and the number of the second side pulling spokes is greater than the number of the second side pushing spokes, and the tension of the pulling spokes (including the first side pulling spokes and the second side pulling spokes) is smaller than the tension of the conventional pulling spokes under the condition without forcing; and the tension of the pushing spokes (including the first side pushing spokes and the second side pushing spokes) is greater than the tension of the conventional pulling spokes under the condition without forcing. Hence, the forcing tension of the pulling spokes is smaller than the conventional pulling spokes, and the forcing tension of the pushing spokes is greater than the conventional pulling spokes. By such arrangement, break of the pulling spokes and the pushing spokes can be avoided.

3. The bicycle wheel of the present disclosure can be applied to a bicycle as the bicycle front wheel or the bicycle rear, and when the arm of each said spokes satisfy the relationship, the bicycle wheel has better rigidity, so that the ruggedness and the safety of the bicycle wheel can be provided.

It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present disclosure without departing from the scope or spirit of the disclosure. In view of the foregoing, it is intended that the present disclosure cover modifications and variations of this disclosure provided they fall within the scope of the following claims.

What is claimed is:

1. A bicycle wheel, comprising:
 a rim, having a first side and a second side;
 a hub located in a center of the rim;
 a driving device connected to the hub which is located on the first side of the rim;
 a plurality of first side pulling spokes, each of the first side pulling spokes connected to the rim and the hub, and located on the first side of the rim, wherein a vertical distance between an extending axis of each of the first side pulling spokes and a center of the hub is defined as a first arm (A11);
 a plurality of first side pushing spokes, each of the first side pushing spokes connected to the rim and the hub, and located on the first side of the rim, wherein a vertical distance between an extending axis of each of the first side pushing spokes and the center of the hub is defined as a second arm (A12); and
 a plurality of second side spokes, each of the second side spokes connected to the rim and the hub, and located on the second side of the rim;
 wherein, $0 < (A11/A12)$;
 wherein a sum of each first arm between each first side pulling spoke and the center of the hub is defined as $(\Sigma A11)$, and a sum of each first arm between each first side pushing spoke and the center of the hub is defined as $(\Sigma A12)$;
 wherein, $(\Sigma A11 - \Sigma A12) > 30$ mm;
 wherein a number of the first side pulling spokes is greater than a number of the first side pushing spokes.

2. The bicycle wheel of claim 1, wherein the first side pulling spokes are defined as the spokes having a pulling vector with a direction along an extending axis thereof from the hub to the rim, a direction of the moment on the center of the bicycle wheel generated from the pulling vector is

different from a rotation direction of the rim, the first side pushing spokes are defined as the spokes having a pushing vector with a direction along an extending axis thereof from the hub to the rim, and a direction of the moment on the center of the bicycle wheel generated from the pushing vector is the same as the rotation direction of the rim.

3. The bicycle wheel of claim 1, wherein the bicycle wheel is a bicycle rear wheel.

4. The bicycle wheel of claim 3, wherein, $1 < (A11/A12) \leq 3$.

5. The bicycle wheel of claim 4, wherein, $1.15 \leq (A11/A12) \leq 1.4$.

6. The bicycle wheel of claim 4, wherein the second side spokes comprise:

a plurality of second side pulling spokes, each of the second side pulling spokes connected to the rim and the hub, and located on the second side of the rim, wherein a vertical distance between an extending axis of each of the second side pulling spokes and the center of the hub is defined as a third arm (A21); and

a plurality of second side pushing spokes, each of the second side pushing spokes connected to the rim and the hub, and located on the second side of the rim, wherein a vertical distance between an extending axis of each of the second side pushing spokes and the center of the hub is defined as a fourth arm (A22);

wherein, a sum of each third arm (A21) between each second side pulling spoke and the center of the hub is defined as $(\Sigma A21)$, and a sum of each fourth arm (A22) between each second side pushing spoke and the center of the hub is defined as $(\Sigma A22)$;

wherein, $(\Sigma A11 + \Sigma A21) - (\Sigma A12 + \Sigma A22) > 30$ mm.

7. The bicycle wheel of claim 5, wherein, $1.15 \leq (A11/A12) \leq 2$.

8. The bicycle wheel of claim 7, wherein the second side spokes comprises:

a plurality of second side pulling spokes, each of the second side pulling spokes connected to the rim and the hub, and located on the second side of the rim; and

a plurality of second side pushing spokes, each of the second side pushing spokes connected to the rim and the hub, and located on the second side of the rim.

9. The bicycle wheel of claim 8, wherein a vertical distance between an extending axis of each of the second side pulling spokes and the center of the hub is defined as a third arm (A21), and a vertical distance between an extending axis of each of the second side pushing spokes and the center of the hub is defined as a fourth arm (A22);

wherein, $(A21/A22) > 1$.

10. The bicycle wheel of claim 8, wherein,
 a vertical distance between an extending axis of each of the second side pulling spokes and the center of the hub is defined as a third arm (A21), and a sum of each third arm (A21) between each second side pulling spoke and the center of the hub is defined as $(\Sigma A21)$; and

a vertical distance between an extending axis of each of the second side pushing spokes and the center of the hub is defined as a fourth arm (A22), a sum of each fourth arm (A22) between each second side pushing spoke and the center of the hub is defined as $(\Sigma A22)$;
 wherein, $(\Sigma A11 + \Sigma A21) - (\Sigma A12 + \Sigma A22) > 30$ mm.

11. The bicycle wheel of claim 5, wherein, $1.24 \leq (A11/A12) \leq 1.35$.

12. The bicycle wheel of claim 11, wherein the second side spokes comprises:

a plurality of second side pulling spokes, each of the second side pulling spokes connected to the rim and the

hub, and located on the second side of the rim, wherein
a vertical distance between an extending axis of each of
the second side pulling spokes and the center of the hub
is defined as a third arm (A21); and
a plurality of second side pushing spokes, each of the 5
second side pushing spokes connected to the rim and
the hub, and located on the second side of the rim,
wherein a vertical distance between an extending axis
of each of the second side pushing spokes and the
center of the hub is defined as a fourth arm (A22); 10
wherein, a sum of each first arm (A11) between each first
side pulling spoke and the center of the hub is defined
as ($\Sigma A11$), a sum of each first arm (A12) between each
first side pushing spoke and the center of the hub is
defined as ($\Sigma A12$), a sum of each third arm (A21) 15
between each second side pulling spoke and the center
of the hub is defined as ($\Sigma A21$), and a sum of each
fourth arm (A22) between each second side pushing
spoke and the center of the hub is defined as ($\Sigma A22$);
wherein, ($\Sigma A11 + \Sigma A21$) - ($\Sigma A12 + \Sigma A22$) > 10 mm. 20

13. The bicycle wheel of claim 11, wherein the first side
pulling spokes, the first side pushing spokes and the second
side spokes are connected to the hub and the rim in a
straight-pulled method.

14. The bicycle wheel of claim 3, wherein, $1 \leq (A11/A12)$ 25
 ≤ 1.4 .

15. The bicycle wheel of claim 2, wherein the bicycle
wheel is a bicycle front wheel.

16. The bicycle wheel of claim 15, wherein, $0 < (A11/A12)$
 < 1 . 30

* * * * *