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(54) CLOTH SWING APPARATUS OF CLOTH DYEING MACHINE

(57) The plaiting device for dyeing machines introduced in this invention comprises a connecting tube, a plaiter, a motor and a cylinder, characterized in that said device further includes a support ring; said support ring has a pair of sleeve and a transmission shaft, the ring connecting to the plaiter, is also driven by a piston. The shaft also connects to a four bar linkage system and the motor. The piston connects to the plunger of an air cylinder. The pneumatic control and motor is manipulated by the automation system on a dyeing machine. The outer shape at the end of connecting tube is spherical while the top of plaiter is circular covering said end of tube concentrically with matched diameter such that said plaiter moves seamlessly around the end of connecting tube. There could be multiple sets of four bar linkage systems where each connects to a plaiter. This invention is applicable in fabric dyeing industry.

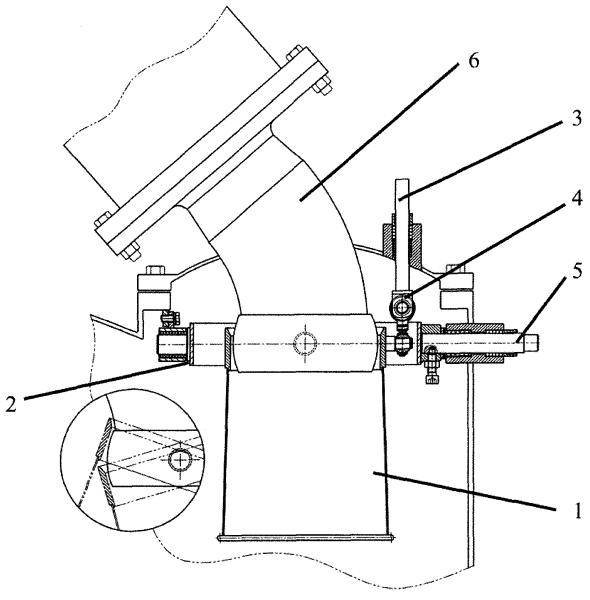

Fig. 1

EP 2 987 900 A1

Description

Scope of invention

[0001] This invention relates to dyeing equipment, particularly a new plaiting device for fabric dyeing machines.

Background information

[0002] Common dyeing machines comprise a nozzle and a storage chamber, which allow fabrics moving in circular rope form in the machine. Fabrics will fall into the storage chamber after passing the nozzle, while the storage chamber is wider than the outlet of nozzle. To prevent the fabrics from messing in the storage chamber, the common method is to use single directional plaiting, which is connected with a sleeve at the end of nozzle, guiding the fabrics to stack in the storage chamber.

[0003] However, fabric stacking up in a single plane is not favorable in the storage chamber, as squeezing and tangling will occur. The defects are more significant when the nozzle is exerting high pressure or dealing with heavy fabrics. There exists double-axis plaiting to address the foresaid defects, but the existing design has many potential threats, for instance, the plaiter is not completely fitted to the nozzle outlet. A big shell at the nozzle outlet is used to cover the plaiting range in order to prevent them from collision, yet it occupies a rather large space in operation. This gap reduces the pressure and causes uneven blow. In addition, the outlet of nozzle is curved to match the plaiter, which also reduces the efficiency of wind blow. As a result it fails to disperse the fabric where twisting and tangling happen next. Furthermore, two motors are needed to drive both axis for a double-axis plaiting device operating in long hours, which causes massive consumption of electricity and hence production cost. Therefore, the utilization of plaiting device is limited by the above matters.

[0004] The purpose of this invention is to provide a solution for an air flow fabric dyeing machine given the above barriers.

Description of Invention

[0005] To overcome the flaws on existing plating devices, the present invention introduces a double-axis plating device applicable on dyeing machines. The technical solution is described as follow:

> The plaiting device for dyeing machines introduced in this invention comprising a connecting tube (6), a plaiter (1), a motor (7) and a cylinder (13), is characterized in that said device further includes a support ring (2), said support ring has a pair of sleeve (17A&17B) and a transmission shaft (5), the ring (2) is inserted into those sleeves by two rods (16A & 16B) connecting to the plaiter (1), wherein said plaiter has a ball (15B) and said ball connects to another ball (15A) with a socketed arm (4), driven by a piston (3); said balls (15A & 15B) and socketed arm (4) form a ball-and-socket joint.

[0006] The plaiting device for dyeing machines introduced in this invention is characterized in that the transmission shaft (5) being connected to a rocker (10), said rocker forms a motorized four-bar linkage system with two cranks (8), a linkage rod (9) and a motor (7).

[0007] The plaiting device for dyeing machines introduced in this invention is characterized in that the piston (3) being connected to a plunger (14) of an air cylinder (13), wherein said plunger and piston reciprocate pneumatically.

[0008] The plaiting device for dyeing machines introduced in this invention is characterized in that the pneumatic control and motor (7) are monitored by an electrical control system.

[0009] The plaiting device for dyeing machines introduced in this invention is characterized in that the outer shape at the end of connecting tube being spherical while the top of plaiter is circular covering said end of tube concentrically with matched diameter such that said plaiter moves seamlessly around the end of connecting tube.

[0010] The plaiting device for dyeing machines introduced in this invention is characterized in that there are seals at the openings of dyeing vessel for said transmission shaft (5) and piston (3).

[0011] The plaiting device for dyeing machines introduced in this invention is characterized in that there could be multiple sets of four bar linkage systems where each connects to a plaiter.

[0012] The support ring in the present invention acts as a mechanical linkage between the plaiter and the dyeing machine. An axis of rotation is formed between the plaiter and the machine, wherein the plaiter is driven by a motor outside the machine. A four bar linkage system, more specifically a crank-rocker system, converts the rotational movement provided by the motor to a reciprocation movement.

[0013] The pneumatic piston is powered by the compressed air source on the dyeing machine, using a ball and socket joint to convert a linear movement to a reciprocation movement between the plaiter and the support ring.

[0014] One of the advantages using a pneumatic device is that its adjustment can be made easily. Traditional linkage designs have limited reciprocating range as the length is fixed, even a slider is used it could not improve much. On the other hand, despite the fixed travel length in a piston, the reciprocating range and speed can be manipulated by choosing a double-action cylinder with longer travel distance, together with the control of air pressure, switching frequency executed by the automated system on a dyeing machine, which is more flexible and convenient than mechanical adjustments.

[0015] As mentioned above, being the major part for guiding fabrics the plaiter forms another axis with the

support ring, in addition to the axis between the plaiter and the machine which makes double axes in total. The top of plaiter surrounds the end of connecting tube such that it matches in any angle.

[0016] In the present invention, the fixed connecting tube is jointed with the plaiter by a ball and socket joint. The design in this invention allows close attachment between these two parts in designated range of movement such that there would not be any pressure loss in between.

[0017] The plaiting device in this invention fully utilizes the space inside the storage chamber and the air blow to spread out the fabric, maintaining an air flow dyeing machine's advantage. Since the fabric is propelled by wind blow and driven by a double-axis plaiter, fabrics could be aligned in sparser pattern in the storage chamber to prevent knotting. Hence, the weakness of existing designs is overcame.

Description of figures

[0018]

Figure 1 is the structure at the nozzle end in this invention.
Figure 2 is a 3D diagram of the double-axis motion of the plaiter.
Figure 3 illustrates the action of piston pushing downward.
Figure 4 is another 3D view of the plaiter.
Figure 5 is the lateral view of plaiter.
Figure 6 is the back view of plaiter.
Figure 7 is the exploded view of ball-and-joint connection.
Figure 8 is the exploded view of the joint between the plaiter and support ring.
Figure 9 shows a four bar linkage connecting a motor and a support ring.
Figure 10 shows a working diagram of double acting cylinder.
Figure 11 is a parallel system of multiple four bar linkages connecting to one single motor.

[0019] Wherein the numbers in the above figures refer to:

1. Plaiter
2. Support Ring
3. Piston
4. Socketed arm
5. Transmission shaft
6. Connecting tube
7. Motor
8. Crank
9. Linkage Rod
10. Rocker
11. Ports (A&B)
12. Chamber (A&B)
13. Air Cylinder
14. Plunger
15. Ball (A&B)
16. Rod (A&B)
17. Sleeve (A&B)

Description of the preferred embodiments

[0020] This invention is described with follow embodiments:

In the embodiment shown in Fig. 1, the structure of nozzle end in a dyeing machine is shown. The end of Connecting tube (6) is circular, in which the top of plaiter covers and rotates around it. The detailed view at bottom left corner of Fig.1 shows one of the axes that supports the plaiter to reciprocate around the nozzle end. The plaiter is connected with Support Ring (2) and the socketed arm (4). Said Support Ring (2) is connected to a bracket and form a swinging axis relative to the machine. The Support Ring is connected to a transmission shaft (5). Said transmission shaft pierces through the dyeing vessel to connect with its driving source, like a motor or other actuator. The piercing for said transmission shaft through the vessel wall is sealed mechanically to prevent liquor leakage under high temperature and high pressure conditions. As one-way motors are widely used in the industry, its one-way rotation can be transformed to pendulum by using a four bar linkage. A transmission shaft from the linkage is connected to the support ring, such that said support ring is able to reciprocate. Since the plaiter is mounted on the support ring, it will also swing in pendulum along the same axis.

[0021] The second pendulum axis of plaiter is performed by a pneumatic piston. A Socketed arm (4) connects the top of plaiter and Piston (3). The other side of said piston is connected to a double-acting cylinder. Similarly, the opening for said piston piercing the dyeing vessel is also sealed with specific component to prevent leakage.

[0022] Fig. 2 further shows a design of double-axis plaiting device in a 3D view. The aforesaid axes are represented by Z axis and X axis, wherein the Z axis is contributed by the support ring and the dyeing machine. The X axis is formed by the linkage between the plaiter and the support ring, so the plaiter can reciprocate relative to the ring. Moreover, the support ring can perform pendulum in said Z axis by the actuation from the pneumatics system. As X axis is perpendicular to the Z axis, therefore, the double-axis pendulum of plaiter can be achieved relative to the dyeing machine. The pendulum of X axis is driven by linear motion of piston. Since the socketed arm is located at a distance away from the X axis, the back-and-forth motion of piston would let the plaiter swinging with respect to the X axis.

[0023] Fig. 3 shows the movement of Piston (3) in one direction. When said piston is plunged downward (as shown as the arrow near said piston); a socketed arm is moved as well as the plaiter. Since the plaiter is supported at X axis, which will be rotated in clockwise base on the lever principle, it is shown as the arrow at X axis in figure. In the contrast, when piston is moved upward, plaiter is dragged and rotated in anti-clockwise. Thus, the plaiter is swung in certain range when the piston is going back and forth.

[0024] Fig. 4 shows the plaiter in another position. The rotation of Z axis will cause the socketed arm in plaiter moving away from the axis of piston's motion. Without destructing the continuity of linkage, on both ends of the socketed arm lie one socket, so that the dislocation of plaiter caused by Z axis rotation can be compensated by the adjustment of the ball-and-socket hinge.

[0025] Fig. 5 shows the lateral view of plaiter. The Z axis is rotated in certain degree of angle relative to the horizontal level, and piston (3) is moved to a higher position. When the Socketed arm (4) in connection with said piston is dragged; the other end of plaiter is also dragged to a position that is higher than Z axis. Since the motion of plaiter is limited by the X axis of support ring, and the sphere of Socketed arm (4) on the plaiter is fixed, the sphere is offset from the Z axis when plaiter is rotated along X axis. The advantage of using a socketed arm is that the two components with different degree of freedoms are able to link up, and convert the motion of single degree to planar or three dimensional motion, vice versa.

[0026] Fig. 6 shows the back view of plaiter in same position illustrated in Fig. 5. When the plaiter is swung at a certain horizontal angle from Z axis, the X axis is also tilted at an altitude. Moreover, it is rotated at certain angle by piston (3), so the sphere on the plaiter is derailed from both axes. Besides, Fig. 5 shows the sphere located on said plaiter is ahead of the sphere located on piston. Thus, two spheres are located on different planes in any planar view in space. In this embodiment, a socketed arm is the best option for connecting two ends of components.

[0027] Fig. 7 is an exploded view of the structure of socketed arm. The shadowed parts in the figure are the spheres fixed on said plaiter and piston, covered by sockets on the socketed arm. The socket is able to wrap and rotate around the sphere. The structure of socketed arm is formed by the linkage among two said connections.

[0028] Fig. 8 shows the exploded view between the support ring and plaiter. The dotted lines show the axes on the support ring. There are two holes (17A) and (17B) on both sides of the support ring concentric to the X axis. Two extrusions (16A) and (16B) on the plaiter are fitted respectively to said holes such that the plaiter is able to swing with respect to the support ring. A transmission shaft (5) is used to plug into another hole tightly which lies perpendicularly with the holes on X-axis, such that when it rotates, so does the support ring.

[0029] Fig. 9 shows a four bar linkage structure for converting continuous rotational motion to a pendulum. The four bar linkage structure comprises fixed rod, crank, rocker and connecting rod. The fixed rod is static, which is defined as a linkage between rotational axis of motor (7) and axis of support ring (2) in Fig.8. Since both the positions of motor and support ring are fixed on the machine, the fixed rod is considered present. The crank (8), defined to perform a rotational motion, and rocker (10), defined to move in pendulum, are connected by the linkage rod (9). According to Grashof Condition, if there is a short rod on a side which is able to rotate, then the rod on the other side can only be swung back and forth. To apply the principle into this invention, the rod next to the motor is designed to be shortest, in order to achieve full rotation of motor, while the other rod moves in pendulum. With the rocker and support ring connected in phase, the rotational motion from motor can be converted into a pendulum by the four bar linkage mechanism.

[0030] Fig. 10 is an illustration of the working mechanism of a double-acting air cylinder, which provides a linear back and forth driving force for piston. The Piston (3) is connected to a Plunger (14), said plunger is extended to the chamber of air cylinder and separates the chamber into space (12A) and (12B). The separated chambers have two ports (11A) and (11 B) respectively, wherein said ports are connected to compressed air supply. When compressed air is injected into specific chamber through one of the ports, the pressure in that chamber will rise and exert force on the plunger. Since the separated chamber is airtight, the plunger moves from end to end. The embodiment of double act air cylinder can be further explained in Fig. 3. For instance, the compressed air is injected into chamber (12A) through port (11A), the pressure in said chamber will be increased, pushing the plunger (14) towards the opposite chamber (12B), vice versa.

[0031] Fig. 11 further shows the design for one motor controlling multiple plaiters. It is obvious that each tube in a dyeing machine has a plaiter. The pendulum motion of a rocker in four bar linkage can be transferred to neighboring plaiters with same structure and size. In Grashof Condition, if the length of linkage rod and fixed rod are the same, the rods on both sides can have synchronized pendulum. To transfer the pendulum from left to right in this figure, the length of linkage rod is designed to be same as the distance among the lateral distance of plaiters.

[0032] Since the pendulum on the right support ring is same as the one in the left, said motion can be extended by the aforesaid design on a multi-tube dyeing machine, and all plaiters will have synchronized pendulum with only one motor driving.

[0033] In the setup of dyeing machine, an air cylinder (13) is perpendicularly installed on the top of Piston (3). The pushing action of plunger leads to the relative movement of Piston (3). The said motion is shown in Fig. 3. When compressed air is injected from Port (11 B) into

chamber (12B), the plunger (14) is compressed and then is pulled towards air cylinder. Thus, the plunger and piston can perform back and forth linear motion by injecting compressed air into chamber (12A) and chamber (12B) alternatively. Combining the mechanical design shown in Fig. 3, the linear motion of piston can be converted to pendulum. This is the implementation of pneumatics control on one of the axis in plaiting device.

[0034] For further consideration, an electric control can be introduced to manipulate the air cylinder, such that the speed and amplitude of pendulum can be monitored by controlling the injection pressure, time and frequency between two ports.

Claims

1. A plaiting device for a dyeing machine, comprising a connecting tube (6), a plaiter (1), a motor (7) and a cylinder (13), is **characterized in that** said device further includes a support ring (2), said support ring has a pair of sleeve (17A&17B) and a transmission shaft (5), the ring (2) is inserted into those sleeves by two rods (16A & 16B) connecting to the plaiter (1), wherein said plaiter has a ball (15B) and said ball connects to another ball (15A) with a socketed arm (4), driven by a piston (3); said balls (15A & 15B) and socketed arm (4) form a ball-and-socket joint.

2. A plaiting device for a dyeing machine according to claim 1, **characterized in that** said transmission shaft (5) is connected to a rocker (10), said rocker forms a motorized four-bar linkage system with two cranks (8), a linkage rod (9) and a motor (7).

3. A plaiting device for a dyeing machine according to claim 1, **characterized in that** said socketed arm acts as a joint between piston (3) and plaiter (1), the piston connects to a plunger (14) in a double-acting air cylinder (13).

4. A plaiting device for a dyeing machine according to claim 1, **characterized in that** the pneumatic control and motor (7) are monitored by an electrical control system.

5. A plaiting device for a dyeing machine according to claim 1, **characterized in that** the outer shape at the end of connecting tube (6) is spherical and the top of plaiter is circular covering said end of tube concentrically.

6. A plaiting device for a dyeing machine according to claim 1, **characterized in that** there are seals at the openings of dyeing vessel for said transmission shaft (5) and piston (3).

7. A plaiting device for a dyeing machine according to claim 1, 2, 3, 5 or 6, **characterized in that** there are more than one plaiter containing on a dyeing machine with a four bar linkage connected its adjacent plaiter.

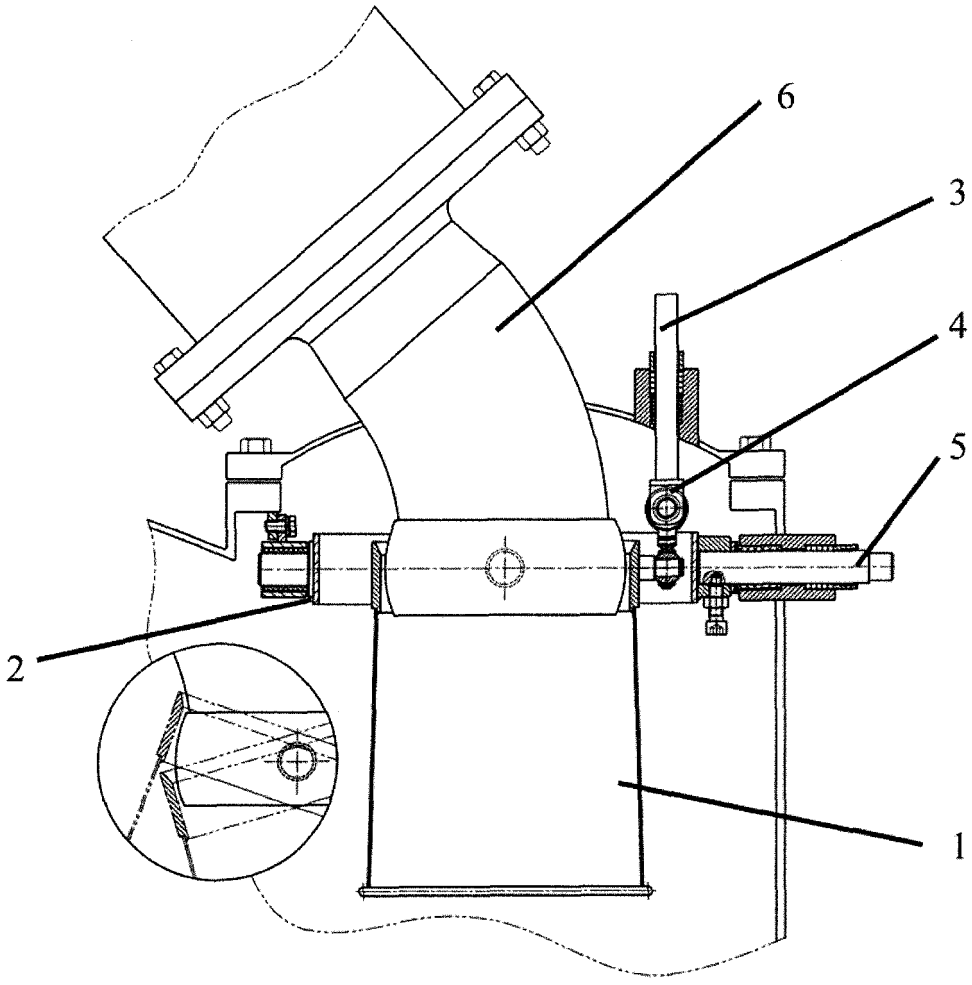

Fig. 1

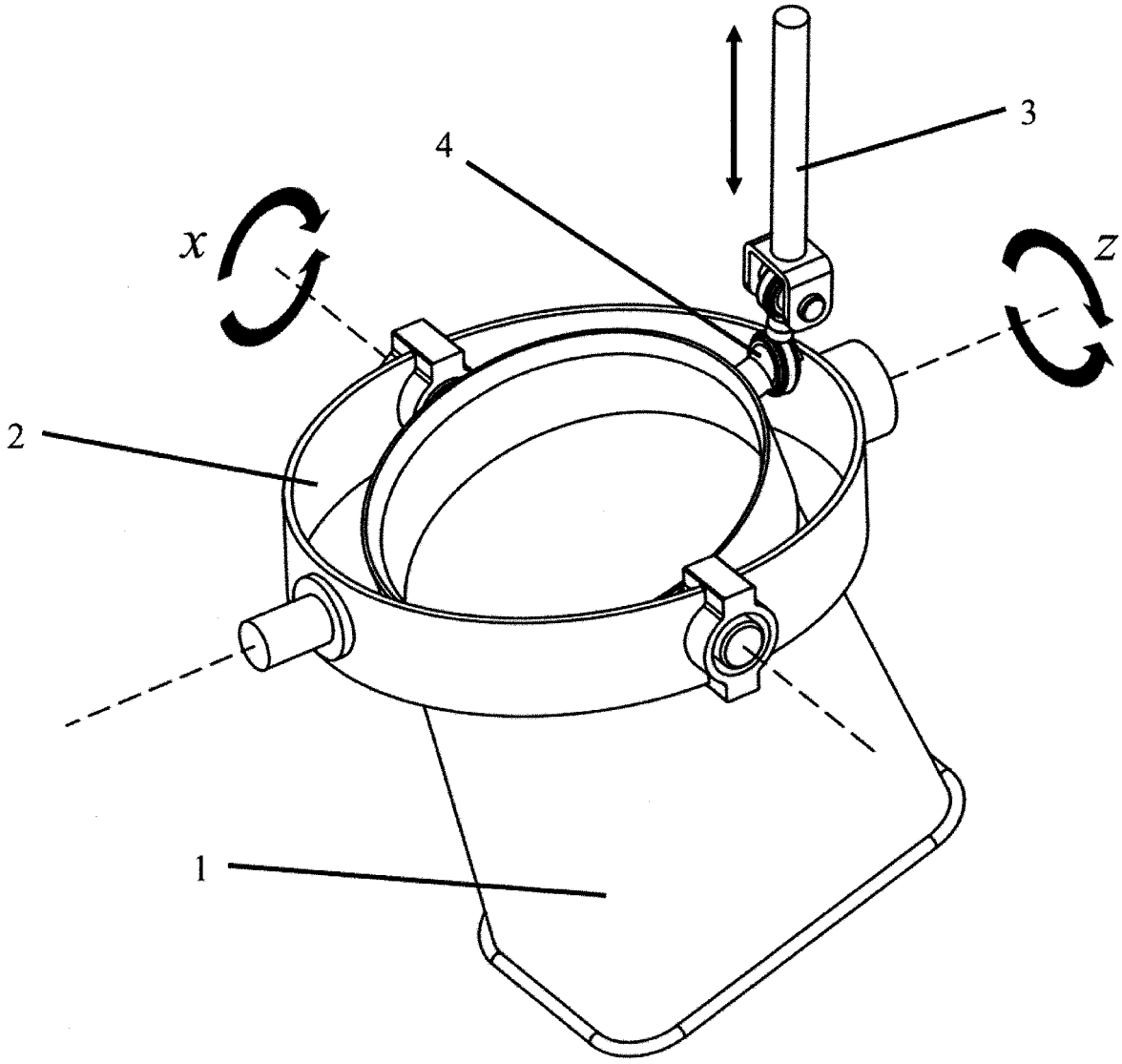

Fig. 2

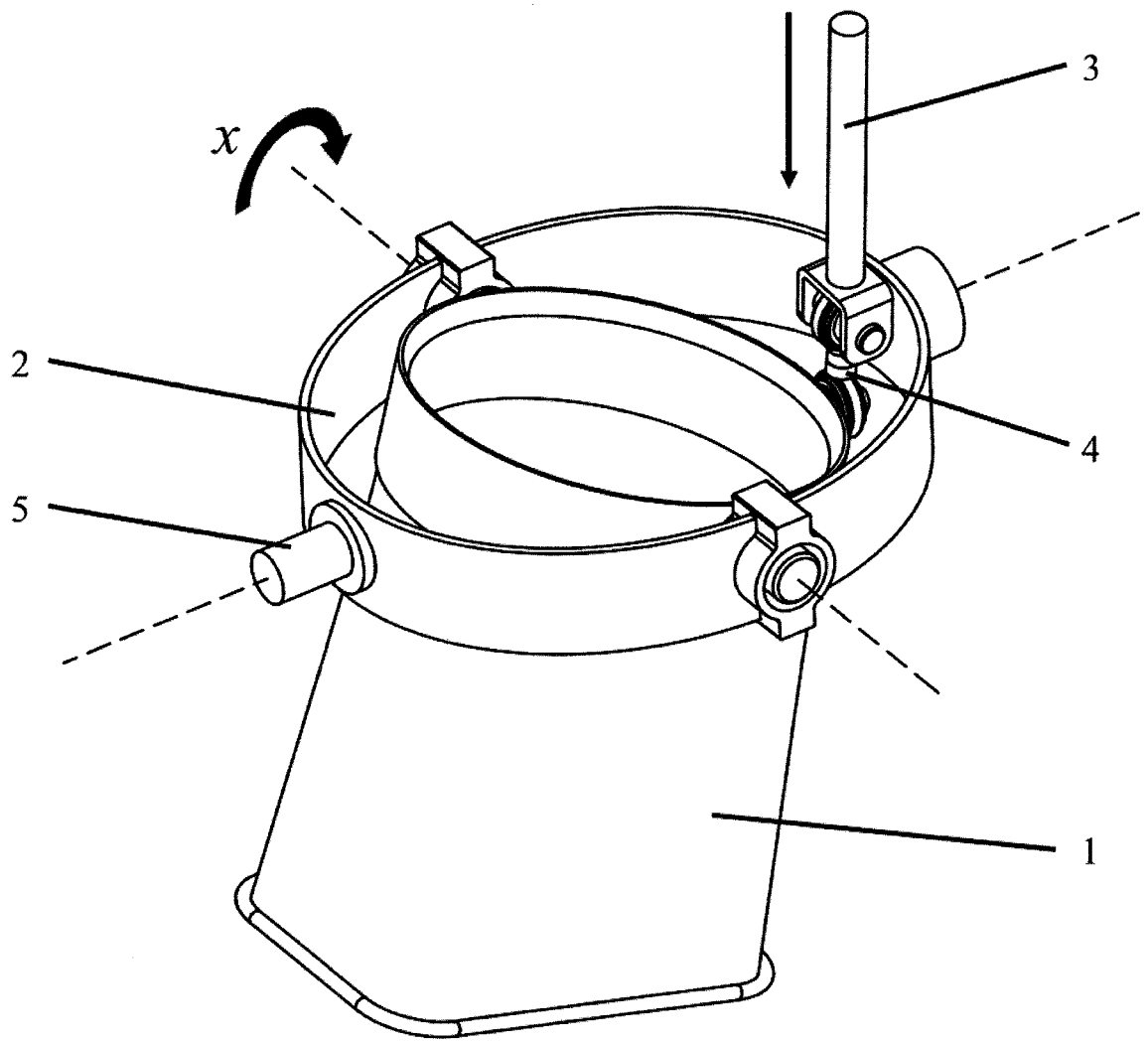

Fig. 3

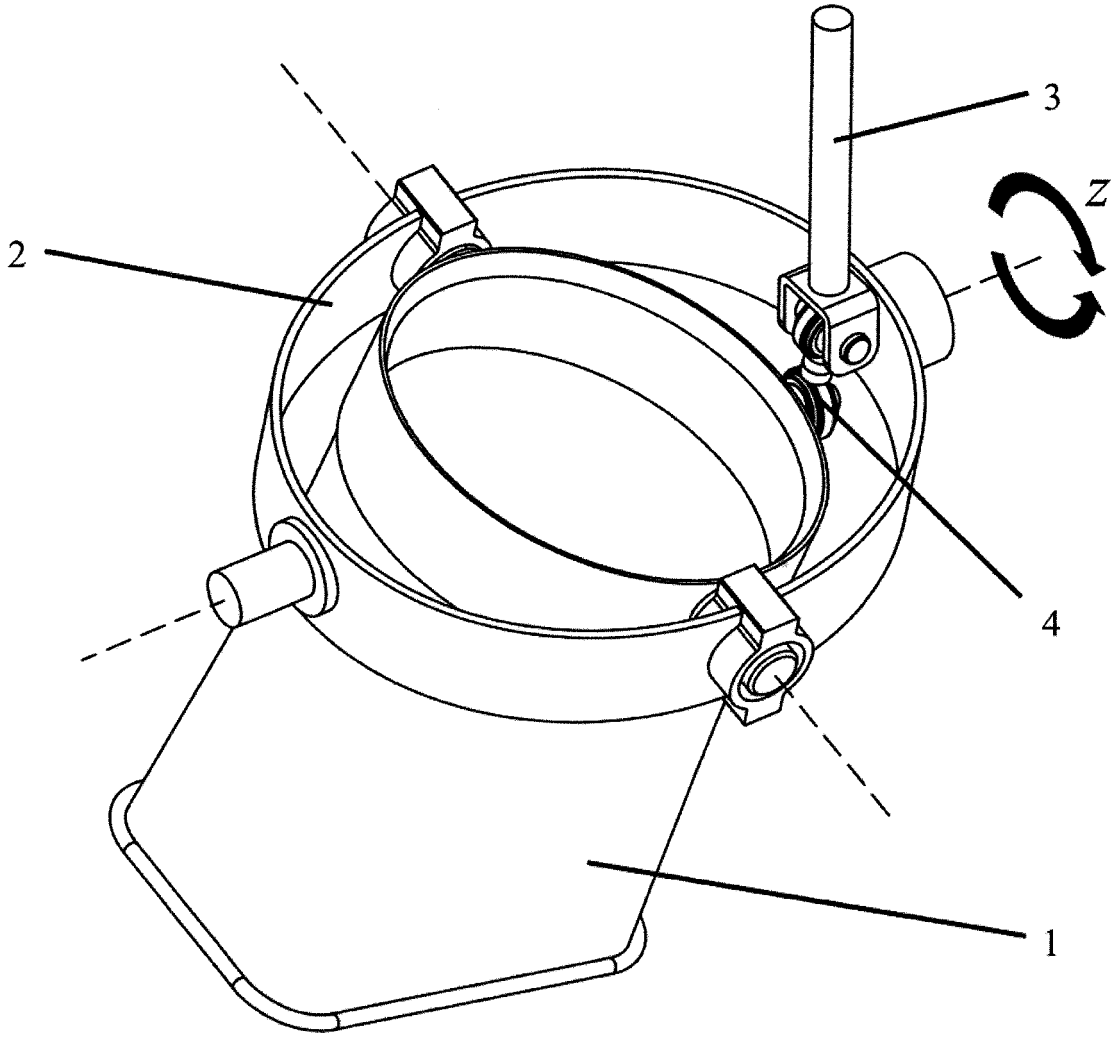

Fig. 4

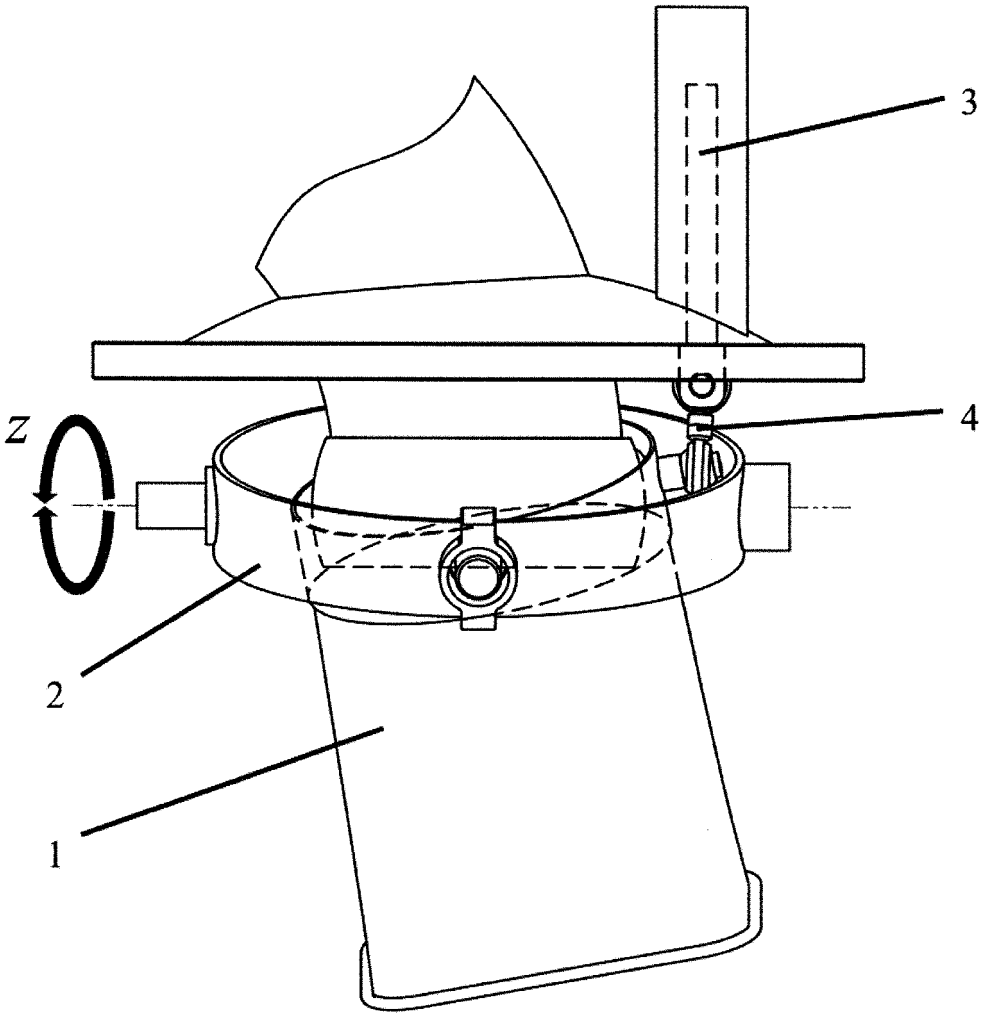

Fig. 5

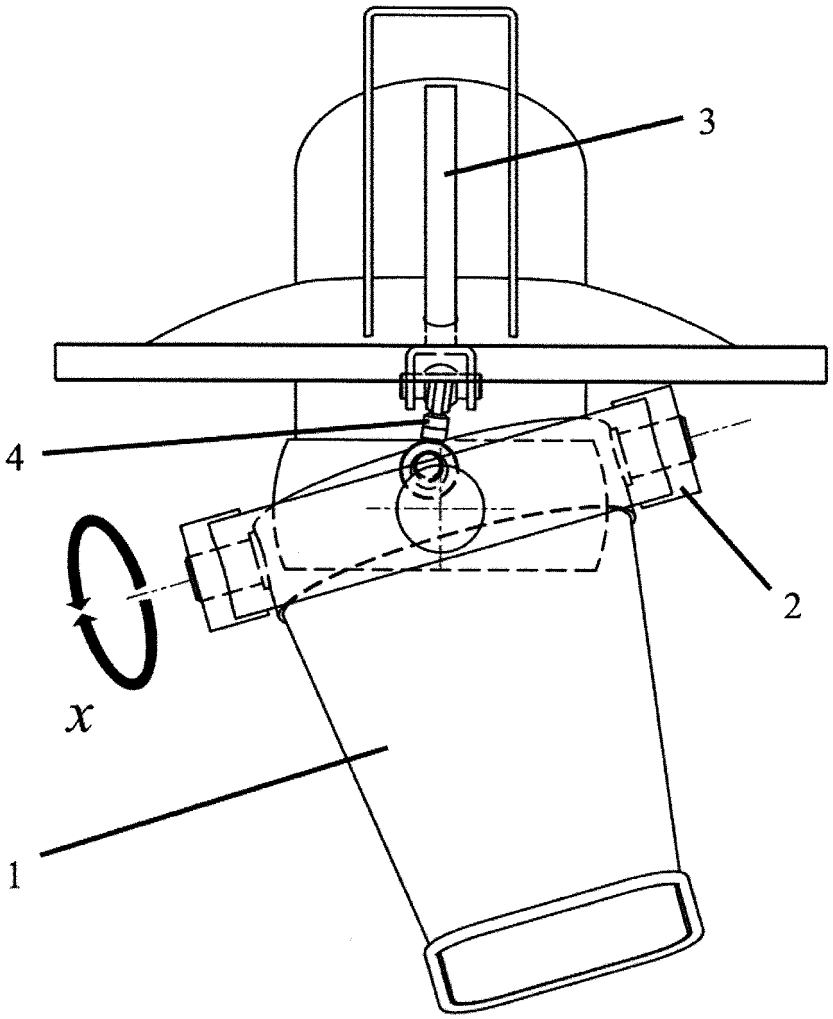

Fig. 6

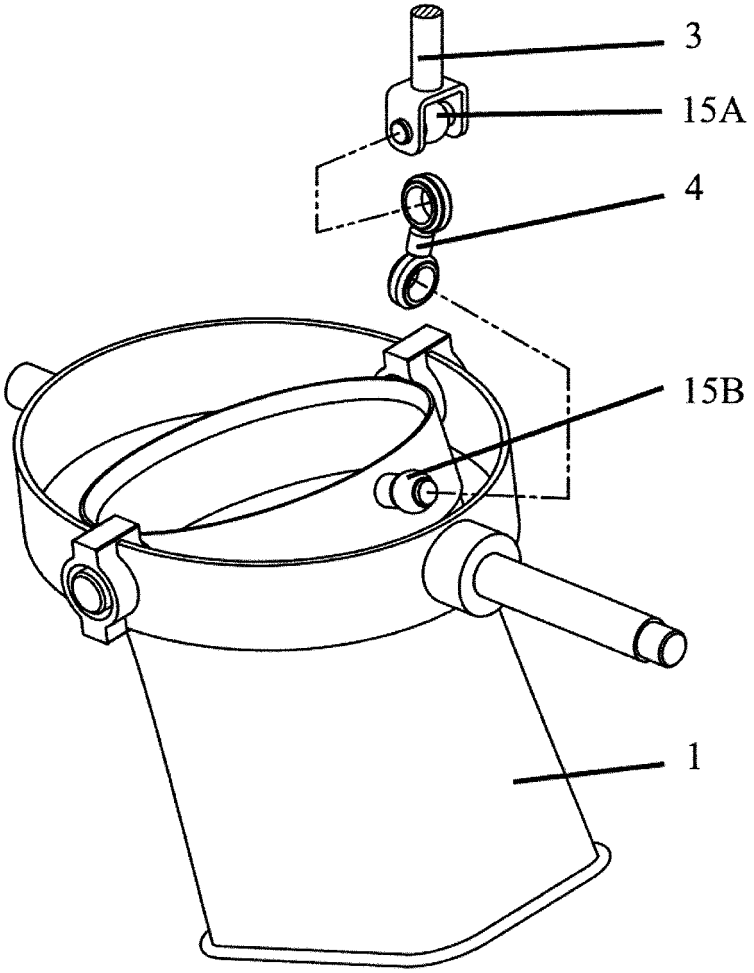

Fig. 7

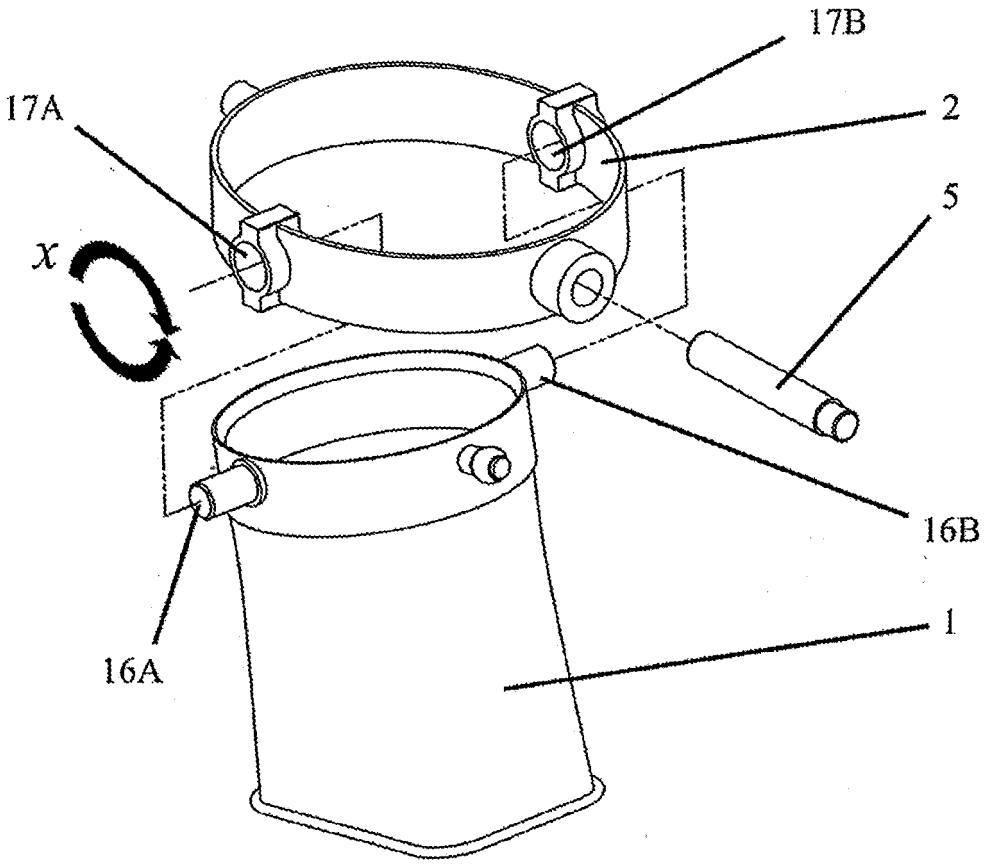

Fig. 8

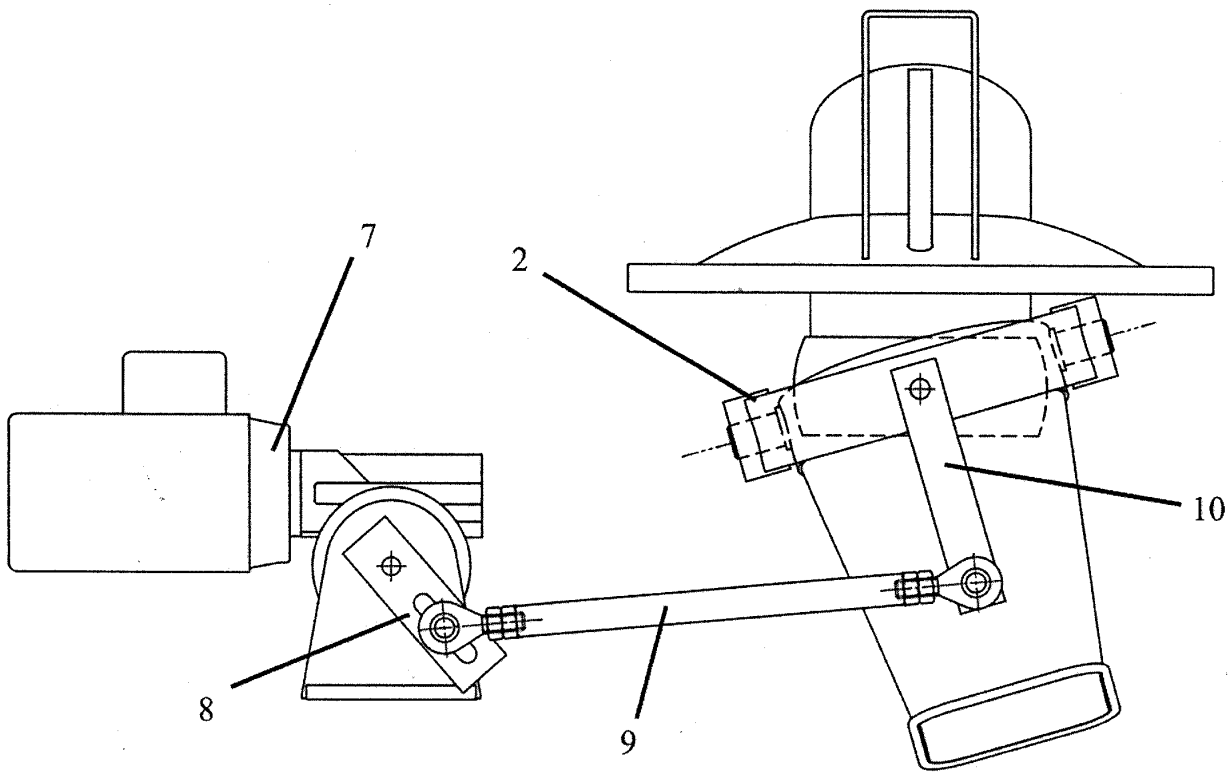

Fig. 9

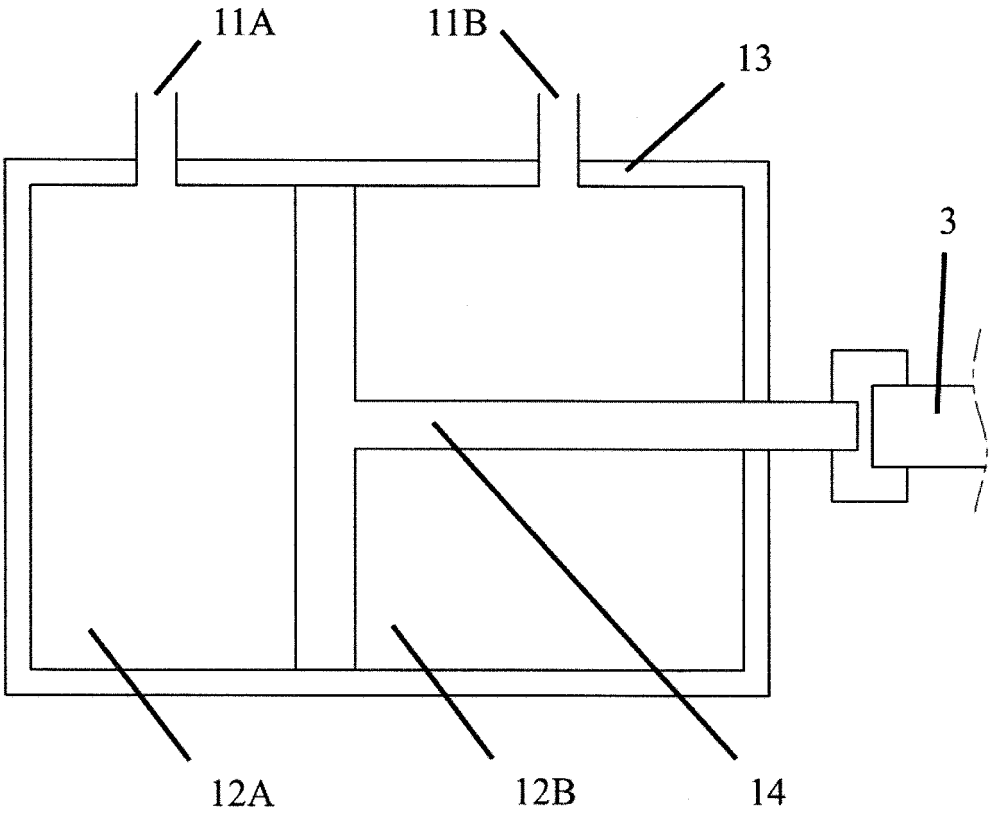

Fig. 10

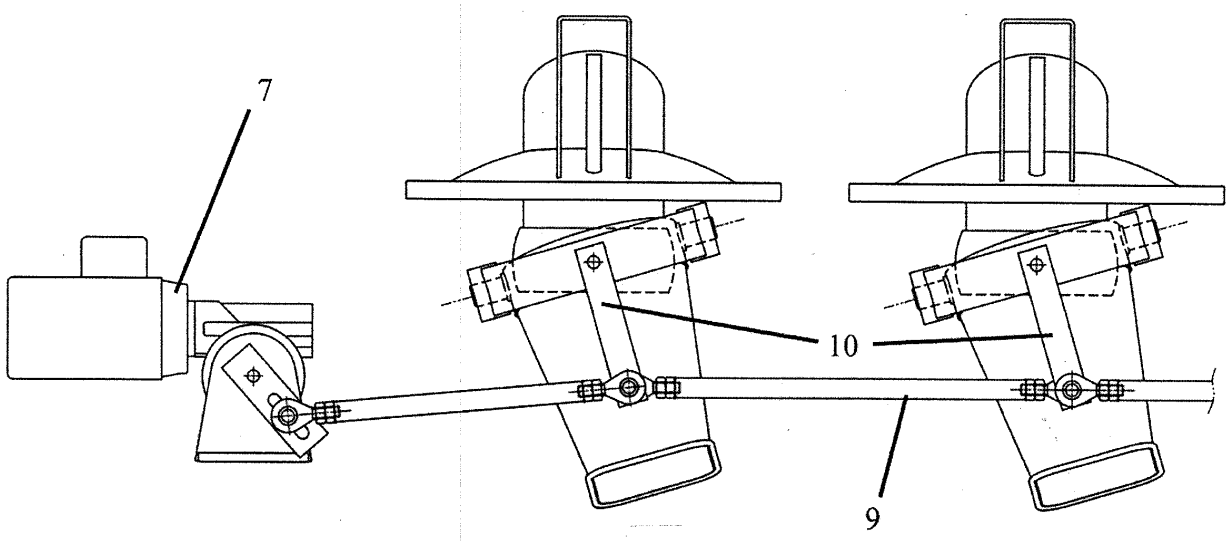

Fig. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/074379

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: D06B; B65H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI; EPODOC; CNKI; CNPAT: cloth swing, cloth inspecting, opening, spreading, cloth discharge, piston, biax; swing???, swung, plait, plaiter, fold???, stack???, pucker???, pile, superimposed, guide, propellent???, collaps???, heap???, motor, electromotor, drive, cylinder?, cylindre, hydraulic??, pneumatic??, actuator?, dye, cloth, fabric, textile, jet?, injet?, inject?, spray?, nozzle?, frame?, framework?, hold???, carrier?, support???, bear???

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 101613921 A (WUXI DONGBAO MACHINERY CO., LTD.), 30 December 2009 (30.12.2009), description, page 1, lines 10-16, and figures 1-3	1-7
A	CN 102851907 A (WUXI XINDA GYEING AND FINISHING CO., LTD.), 02 January 2013 (02.01.2013), the whole document	1-7
A	CN 2656460 Y (CAI, Zhongnan et al.), 17 November 2004 (17.11.2004), the whole document	1-7
A	CN 102127846 A (WUXI HUIZE GENERAL MACHINERY CO., LTD.), 20 July 2011 (20.07.2011), the whole document	1-7
A	JPS 60102290 U (OSHIMA MACHINE CO., LTD.), 12 July 1985 (12.07.1985), the whole document	1-7
A	JPH 05139585 A (SANDO IRON WORKS KK), 08 June 1993 (08.06.1993), the whole document	1-7

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 January 2014 (16.01.2014)	**23 January 2014 (23.01.2014)**
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer **LI, Xia** Telephone No.: (86-10) **62085496**

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/074379

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	TWM 428195 U (LIN, Weiting), 01 May 2012 (01.05.2012), the whole document	1-7
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A	US 5129242 A (GASTON COUNTY DYEING MACH), 14 July 1992 (14.07.1992), the whole document	1-7
A	US 971778 A (PALMER, I.E.), 04 October 1910 (04.10.1910), the whole document	1-7

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2013/074379

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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Form PCT/ISA/210 (patent family annex) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/074379

A. CLASSIFICATION OF SUBJECT MATTER

D06B 23/04 (2006.01) i

D06B 3/28 (2006.01) i

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