(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 792 778 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
22.10.2014 Bulletin 2014/43

(21) Application number: **11877221.9**

(22) Date of filing: **14.12.2011**

(51) Int Cl.:
D06B 23/00 *(2006.01)* ***D06B 1/02*** *(2006.01)*
D06B 3/28 *(2006.01)*

(86) International application number:
PCT/CN2011/083995

(87) International publication number:
WO 2013/086709 (20.06.2013 Gazette 2013/25)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

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(54) AIRFLOW DYEING MACHINE CAPABLE OF INDEPENDENTLY SUPPLYING AIR BY MULTIPLE PIPES

(57) An airflow dyeing machine capable of independently supplying air by multiple pipes comprises a main cylinder (1), a lifting roller (2), a connection pipe, two or more fans (3), and a nozzle combination (5) connected to the fans. One end of each fan (3) is connected to an independent air draft pipe, and the other end is connected to the independent nozzle combination (5). The fans (3) are arranged at the top of the main cylinder (1). Outlets of the fans are docked with airflow inlets of the nozzle combination (5). Fans and dyeing pipes are controlled by each independent circuit control system. A first nozzle mouth (19) is formed by a gap of an upper nozzle barrel (12) and a lower nozzle barrel (13) in the nozzle combination (5). A second nozzle mouth (20) is formed by a gap between an interception ring (14) and the tail of the lower nozzle barrel (13). A U-shaped baffle (15) is arranged between the tail of the lower nozzle barrel (13) and the interception ring (14), so that the airflow is centrally jet from lower part of the nozzle mouth. By means of the dyeing machine, the efficiency and the dyeing quality are greatly improved, the power consumption is reduced, and the operation flexibility is increased.

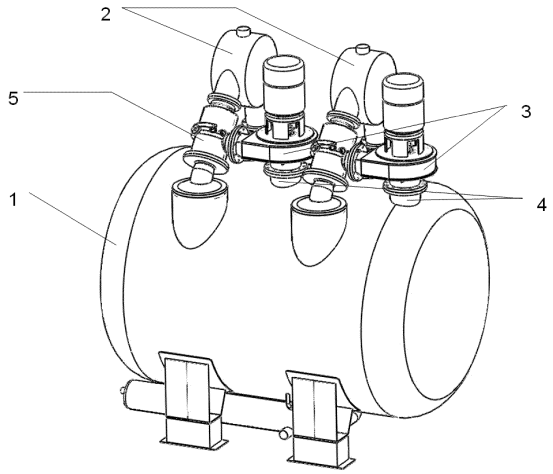

FIG. 1

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Description

[0001] The present invention relates to a dyeing machine, and more particularly to an air flow dyeing machine equipped with individual air blowers per dye chamber.

[0002] With the deepening and strengthening of environmental protection policies, traditional dyeing appliances and methods are facing a great challenge and need a further development. The air flow dyeing machine is developed under this background. It is renowned for small liquor ratio, high efficiency and remarkable dyeing performance.

[0003] In an air flow dyeing machine, fabric is driven by high air pressure from a closed-loop air blower. In the operational process of this type of equipment, there are two forms of techniques dyeing a fabric, liquor vaporization and pressurized penetration. In the process of liquor vaporization, dye liquor is forced through the spray nozzles by the pump and vaporised. Then the vapour is jetted onto the fabric with high pressure jet stream, penetrated the fabric and spread evenly (pressurized penetration). In the dyeing process, the fabric carries liquor instead of soaking in it. Excess liquor is gathered at the bottom of the kier, while the fabric piling up on Teflon tubes or a conveyer and moving forward gently.

[0004] Although the air flow dyeing machine can effectively lower the liquor ratio during dyeing, its high electrical consumption hesitates users. Some manufacturers simply choose less powerful blowers and claim that they would lower energy consumption. But in reality, the adaptability of the machine is reduced. The power of the blower is designed to satisfy the majority of dyeing processes. Therefore, reducing the capacity of the blower would inevitably affect the levelness and quality of dyeing, especially on high GSM (Gram per Square Meter) fabric.

[0005] Air flow dyeing machines nowadays generally adapt to a design of one blower supplying air pressure to multiple dye chambers. This results in uneven air pressure distribution and poor quality of dyeing. Long distribution duct also induces friction and loss to the air flow, which would lower the efficiency of the blower.

[0006] If there are different speeds requirements of fabric loop in a single batch, e.g. different fabric lengths. The current configuration cannot fulfil the requirements as only one single blower is arranged in the machine.

[0007] In single blower configuration, the maximum number of dyeing chambers on an air flow dyeing machine is six, as further increase would exceed the capability of blower.

[0008] In single blower configuration, even when the machine is operating with reduced loading, the power of the blower still cannot be reduced, as air is evenly distributed into dyeing chambers, no matter it is loaded or not.

[0009] In single blower configuration, if one chamber has to be stopped, the other chambers have to stop altogether. This would affect the dyeing results.

[0010] To conclude, the problems raised above have greatly limited the development and the efficiency of the current air flow dyeing machine. Moreover, it limits the flexibility of using.

[0011] The invention aims to solve the above problems and provides an energy-saving air flow dyeing machine which satisfies modern dyeing technologies.

[0012] The present invention provides an air flow dyeing machine, comprising a main kier, lifting reels, and connection pipes. The machine further comprises at least two blowers and nozzle assemblies connected thereto; one end of each blower connects to an individual suction pipe, and the other end connects to a corresponding nozzle assembly.

[0013] For the air flow dyeing machine, each blower is installed at the top of the main kier and comprises an air inlet facing downward, the air inlet connects to the main kier, and an air outlet of the blower connects to the nozzle assemblies.

[0014] For the air flow dyeing machine, the blowers are controllable by individual electrical control systems to start, stop, and output different pressures.

[0015] For the air flow dyeing machine, an air inlet of each blower is provided with an air filter.

[0016] For the air flow dyeing machine, each nozzle assembly is installed with a slope, an upward inlet of the nozzle assembly connects to the lifting reels, and a downward outlet of the nozzle assembly connects the main kier.

[0017] For the air flow dyeing machine, each nozzle assembly comprises a nozzle housing, an upper nozzle cone, a lower nozzle cone, a horseshoe block plate, a blockage ring, two or more groups of spraying nozzles, and two or more groups of connecting pipes.

[0018] For the air flow dyeing machine, an upper nozzle cone and a lower nozzle cone of each nozzle assembly are concentrically installed inside a nozzle housing, both being connected with a connection plate; a space between the upper nozzle cone and the lower nozzle cone forms a first nozzle gap, and the space is capable of adjustment by altering a distance between the nozzle cones.

[0019] For the air flow dyeing machine, a blockage ring is disposed at a rear of a nozzle housing, a space between the blockage ring and a lower nozzle cone forms a second nozzle gap, and a horseshoe block plate is disposed between the lower nozzle cone and the blockage ring to force air to blow out at the lower end of the nozzle.

[0020] For the air flow dyeing machine, each nozzle assembly comprises two or more groups of spraying nozzles with different flow volume, the spraying nozzles of each group are connected via the connection pipes, and the opening/closing of the connection pipes of each group is controlled by an individual valve.

[0021] For the air flow dyeing machine, the sprayer nozzle comprises an inlet, a first channel, a second channel, a third channel, and an outlet, the first channel is

connected to the third channel through the second channel, the third channel comprises a number of vaporising blocks fixed at the bottom, and the outlet is connected to the third channel.

[0022] In an existing air flow dyeing machine, the blower is located at the side of the machine, whereas the blowers in this invention are located in-between the chambers, next to the nozzle assembly, such that the blowers are connected to the nozzle assemblies with the shortest path. In contrast to the existing machines, the connecting path is shortened, such that the pressure loss due to resistances is minimised. Also the air source is drawn from the main kier, forming a closed loop of air circulation, prevent heat loss and improve efficiency. The installed power of the multiple blowers on the invention is much smaller than that of the existing machine, even the overall sum of power of all small blowers is lower than that of the one big blower of the existing machine, yet provides adequate power for driving the circulating fabric. Moreover, there are individual air filters on every blower in the present invention, such that the filtering effect is more efficient than the existing machine.

[0023] In an existing air flow dyeing machine, the blower is of high power; whereas in the present invention the power of the blower is much smaller, but it still can achieves desirable dyeing results. This saves the electricity and the energy. In an existing air flow dyeing machine, as all dye chambers are served by a single blower, in the case of reduced loading, i.e. having one or more empty dyeing chambers in a single batch, the power of blower still cannot be tuned down, which may causes inefficiency and wastes of energy. Whereas in the present invention each dye chamber is served by an individual blower, if any single chamber is not in service, its respective blower can be switched off to save precious energy.

[0024] In an existing air flow dyeing machine, in the case of tangling in one chamber, all other chambers have to be stopped as they are served by a single blower. It affects the normal dyeing procedure of all chambers and results in poor dyeing quality. In the present invention, each dye chamber is served by an individual blower, if any single chamber needs to be stopped, all other chambers can keep on operation without interruption.

[0025] In an existing air flow dyeing machine, as all dye chambers are served by a single blower, the maximum number of dyeing chambers on an air flow dyeing machine is six. In the present invention, each dyeing chamber is served by an individual blower, so there is no limitation of the number of chambers a machine can have. It provides more flexibility and possibility for air flow dyeing machine.

[0026] The present invention also includes a new spraying system, which consists of two sets of transmission pipes and spraying nozzles. The circulation paths of the two sets of spraying nozzles are roughly same. The two sets of spraying nozzles are in different flow volumes. Each set is controlled via a control valve, providing the machine with different spraying modes. Each spraying nozzle can be mounted independently on the nozzle housing and changes the set it belongs. It is easy for installation, where customization goes with. Each dye chamber of the present invention is served by an individual blower and each has two or more sets of spraying nozzles which the spraying volume can be adjusted according to dye recipe, this saves the energy and increases the operation flexibility, improves the dyeing quality and the efficiency.

[0027] The present invention also comprises a heat exchange system, a dosing system, and a dyeing circulation system, all of which form a normal air flow dyeing machine. It is a full-featured and fully functional air flow dyeing machine.

Figure 1 is a structure diagram of an air flow dyeing machine of the invention;
Figure 2 shows an external structure of a nozzle assembly of the invention;
Figure 3 is a cross-sectional view of a nozzle assembly of the invention;
Figure 4 is a cross-sectional view of a nozzle assembly and its surrounding configuration of the invention; and
Figures 5, 6 show cross-sectional views of a spraying nozzle of the invention.

[0028] In the drawing: 1. Main kier, 2. Lifting reel, 3. Blower, 4. Blower inlet, 5. Nozzle assembly, 6. First transmission pipe, 7. Second transmission pipe, 8. Spraying nozzle connection, 9. Spraying nozzle (L), 10. Spraying nozzle (S), 11. Nozzle housing, 12. Upper nozzle cone, 13. Lower nozzle cone, 14. Blockage ring, 15. Horseshoe block plate, 16. Air flow inlet, 17. Fabric inlet, 18. Fabric outlet, 19. First nozzle gap, 20. Second nozzle gap, 21 dye liquor channel, 22. Hole on spraying nozzles connection, 23. Seal, 24. Hole on transmission pipe, 25. Spraying nozzle main body, 26. Spraying nozzle inlet, 27. Spraying nozzle outlet, 28. First channel, 29. Second channel, 30. Third channel, 31. Vaporising block.

[0029] The following are the detailed description of the present invention:

[0030] As shown in figure 1, an air flow dyeing machine of the invention comprises a main kier 1, lifting reels 2, blower 3, and blower inlet 4, in which the blower 3 takes air from the main kier 1, and blows into a nozzle assembly 5 via connection pipe. There is also an air filter in the main kier 1 to prevent lint from being sucked into the blower.

[0031] Figure 2 shows an external structure of the nozzle assembly. It comprises the first transmission pipe 6, the second transmission pipe 7, spraying nozzle connection 8, and two types of spraying nozzles 9, 10. During operation, dyeing liquor is pumped to the transmission pipes from the circulation system the valve controls on the transmission pipes are either open or close, deciding whether dye liquor would enter the spraying nozzles from

the first transmission pipe 6 and the second transmission pipe 7. The first transmission pipe 6 and the second transmission pipe 7 will not cross after separation, and connect to two sets of different spraying nozzles 9, 10, respectively.

[0032] Figure 3 further shows a structure of the nozzle assembly, which consists of a nozzle housing 11, upper nozzle cone 12, lower nozzle cone 13, blockage ring 14, and a horseshoe block plate 15. On the housing there are two transmission pipes 6 and 7. The housing 11 further includes an air inlet 16, fabric inlet 17 and fabric outlet 18.

[0033] There are a first nozzle gap 19 and a second nozzle gap 20 inside the nozzle housing. Air flow enters the nozzle assembly via the air flow inlet 16 and mixes with the vaporized liquor, and then applies onto the fabric through the nozzle gaps. The said nozzle gaps are circular and share an equal gap distance. The upper nozzle cone 12 is concentrically installed with the lower nozzle cone 13 inside the nozzle housing 11. The space between the upper nozzle cone 12 and the lower nozzle cone 13 is defined as the first nozzle gap 19, where its dimension can be adjusted by setting the distance between the nozzle cones. In common practices, the lower nozzle cone 13 is fixed such that the upper nozzle cone 12 can move respectively. Nevertheless it is not considered as a constraint in design. The air flow inlet 16 lies on a side of nozzle housing 11 such that air could enter the housing. The nozzle housing is cylindrical shape. The fabric inlet and fabric outlet lie on the ends of the cylinder. Flanges are applied at both side of air inlet 16 for ease of connections. A blockage ring 14 is installed at the bottom of nozzle housing 11 to narrow the gap between the housing and lower nozzle cone 13, and the gap between the blockage ring 14 and lower nozzle cone 13 is defined as the second nozzle gap 20. Nevertheless the main function of the second nozzle is to lift the fabric, so a horseshoe block plate 15 is fixed on the gap, blocking a section of the said nozzle gap such that the flow concentrates and ejects at the bottom. As a result the fabric is lifted. The meaning behind this new design is very important and it greatly improves the capability of the machine.

[0034] There is a number of spraying nozzle connections 8 on the side of nozzle housing 11 in addition to the air inlet 16. Figure 4 shows the cross section view of a spraying nozzle and its surrounding configuration. The spraying nozzle connection 8 and spraying nozzles 9, 10 are all circular, although it is not limited to this configuration. In operation, each spraying nozzle 9, 10 is installed inside spraying nozzle connection 8. The spraying nozzle is screwed into the connection 8 until the hole at the spraying nozzle connection 22 aligns with that of the spraying nozzle 21. A number of seals 23 are located between the spraying nozzle connections and spraying nozzles, in order to prevent leakage. In this configuration, the transmission pipes 6, 7 surround the nozzle housing, each with holes at designated positions 24 to let dye liquor flow into the spraying nozzles 9, 10. The flow direction is indicated as arrow in the diagram. As the figure shows, different sets of spraying nozzles 9, 10 are connected to different set of transmission pipes 6, 7. Liquor in different transmission pipes 6, 7 would be directed to their corresponding sets of spraying nozzles 9, 10 where they would not cross each other. Users may connect identical spraying nozzles on one conducting pipe and choose their desired spraying rate by controlling the conducting pipe's valves (not shown) of different spraying nozzle sets. For example, two different types of spraying nozzles are adopted in this example, in which one of them has relatively higher spraying rate. Users may open the valve of the transmission pipe leading to high-flow spraying nozzles while shutting the other to get a high spraying rate, or vice versa. It is obvious that both valves can be opened simultaneously to attain maximum spraying rate.

[0035] Figures 5, 6 show the structures of two different spraying nozzles. The spraying rate can be controlled and varied through adjusting the dimension of the first channel 28, second channel 29, third channel 30, vaporising block 31 and spraying nozzle outlet 27. As shown in the figure, the inlet 26 direction relative to the outlet 27 is completely the opposite, in order to connect to their respective transmission pipes 7, 8. The dye reaches the outlet 27 through the channel in the spraying nozzle main body 25, in which its diameter defines the spraying rate.

[0036] Figure 1 shows a three-dimensional view of an air flow dyeing machine of the present invention. There is service door at the other side of the machine. During dyeing process, the fabric is put in via the service door, and driven by the air flow to run in circular motion inside the main kier, lifted up by the lifting reel, reached the nozzle assembly, liquor sprayed by the air flow on to the fabric. The process continues until the dyeing is completed.

Claims

1. An air flow dyeing machine, comprising a main kier, lifting reels, and connection pipes, **characterized in that** the machine further comprises at least two blowers and nozzle assemblies connected thereto; one end of each blower connects to an individual suction pipe, and the other end connects to a corresponding nozzle assembly.

2. The air flow dyeing machine of claim 1, **characterized in that** each blower is installed at the top of the main kier and comprises an air inlet facing downward, the air inlet connects to the main kier, and an air outlet of the blower connects to the nozzle assemblies.

3. The air flow dyeing machine of claim 1, **characterized in that** the blowers are controllable by individual electrical control systems to start, stop, and output

different pressures.

4. The air flow dyeing machine of claim 1, **characterized in that** an air inlet of each blower is provided with an air filter.

5. The air flow dyeing machine of claim 1, **characterized in that** each nozzle assembly is installed with a slope, an upward inlet of the nozzle assembly connects to the lifting reels, and a downward outlet of the nozzle assembly connects the main kier.

6. The air flow dyeing machine of claim 1, **characterized in that** each nozzle assembly comprises a nozzle housing, an upper nozzle cone, a lower nozzle cone, a horseshoe block plate, a blockage ring, two or more groups of spraying nozzles, and two or more groups of connecting pipes.

7. The air flow dyeing machine of claim 1 or 6, **characterized in that** an upper nozzle cone and a lower nozzle cone of each nozzle assembly are concentrically installed inside a nozzle housing, both being connected with a connection plate; a space between the upper nozzle cone and the lower nozzle cone forms a first nozzle gap, and the space is capable of adjustment by altering a distance between the nozzle cones.

8. The air flow dyeing machine of claim 1 or 6, **characterized in that** a blockage ring is disposed at a rear of a nozzle housing, a space between the blockage ring and a lower nozzle cone forms a second nozzle gap, and a horseshoe block plate is disposed between the lower nozzle cone and the blockage ring to force air to blow out at the lower end of the nozzle.

9. The air flow dyeing machine of claim 1 or 6, **characterized in that** each nozzle assembly comprises two or more groups of spraying nozzles with different flow volume, the spraying nozzles of each group are connected via the connection pipes, and the opening/closing of the connection pipes of each group is controlled by an individual valve.

10. The air flow dyeing machine of claim 1 or 6, **characterized in that** the sprayer nozzle comprises an inlet, a first channel, a second channel, a third channel, and an outlet, the first channel is connected to the third channel through the second channel, the third channel comprises a number of vaporising blocks fixed at the bottom, and the outlet is connected to the third channel.

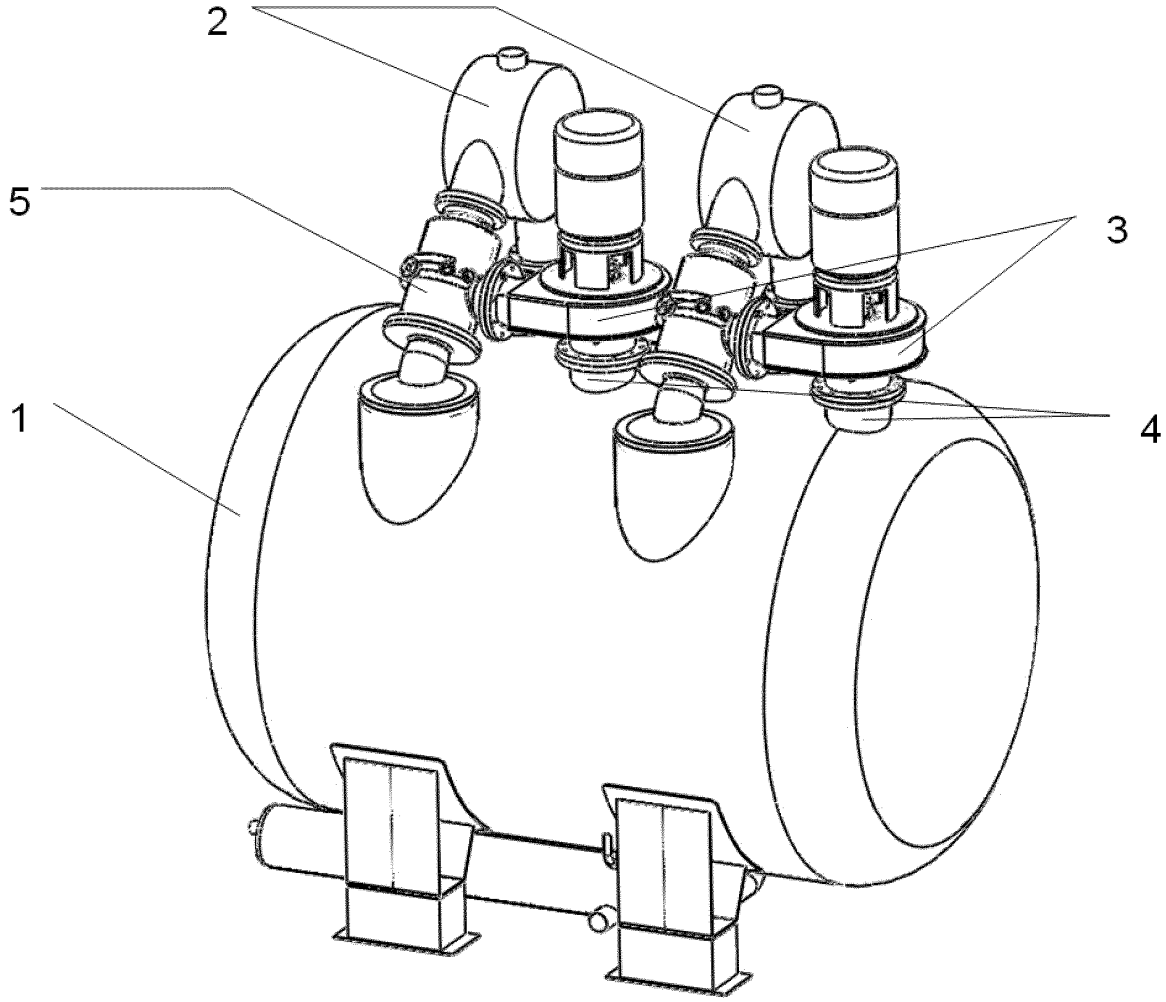

FIG. 1

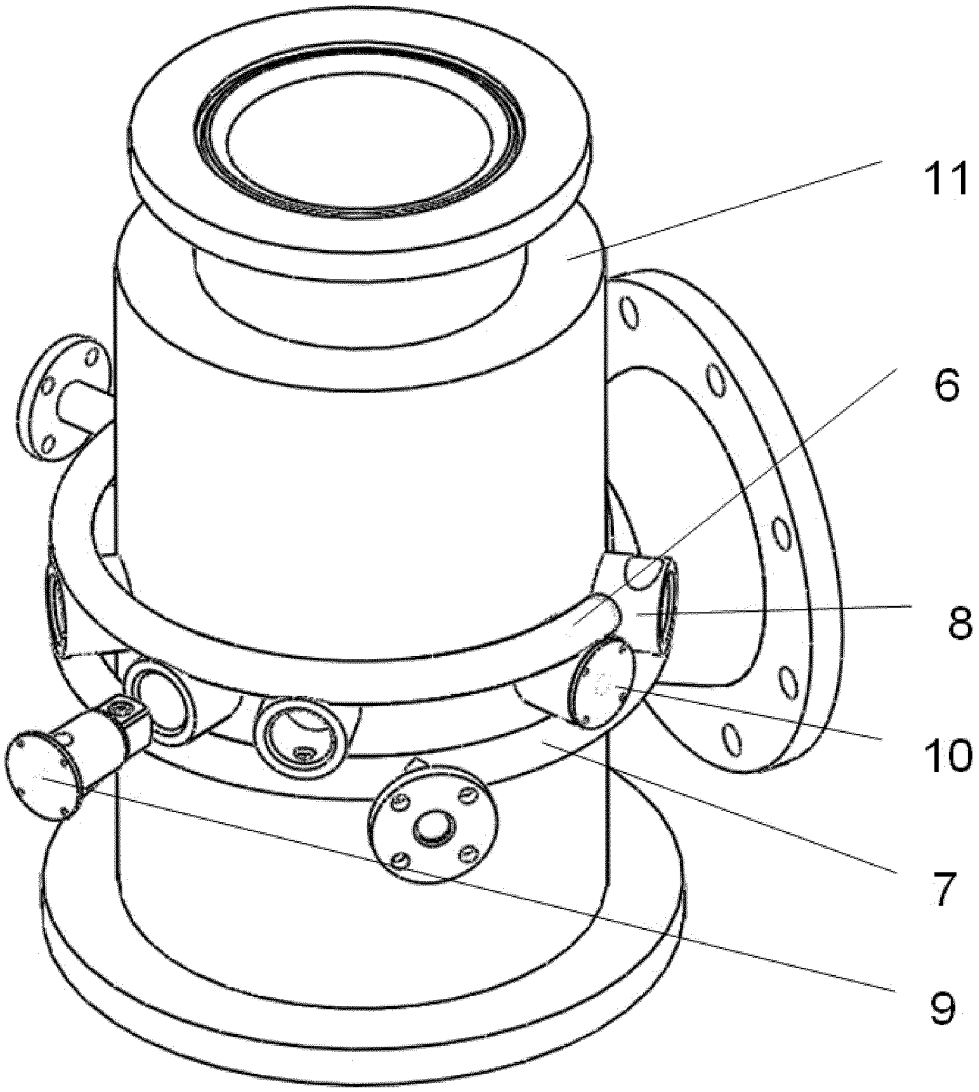

FIG. 2

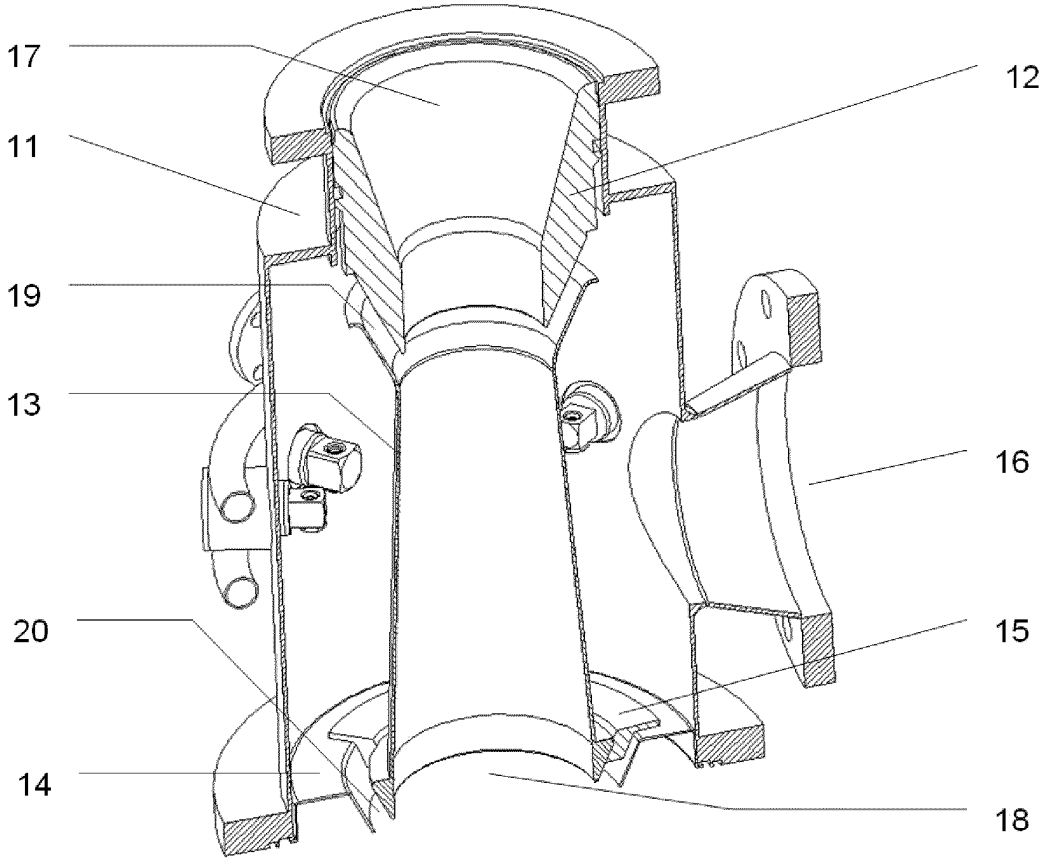

FIG. 3

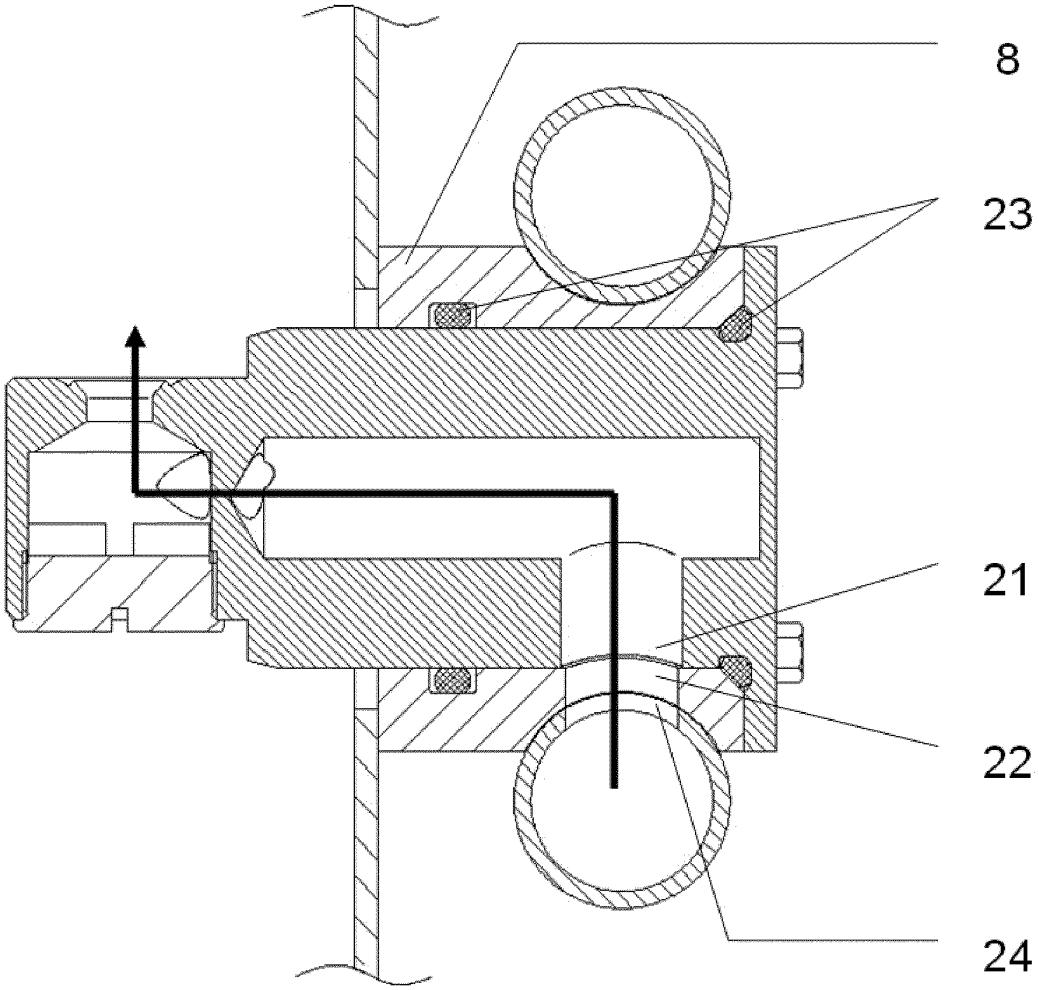

FIG. 4

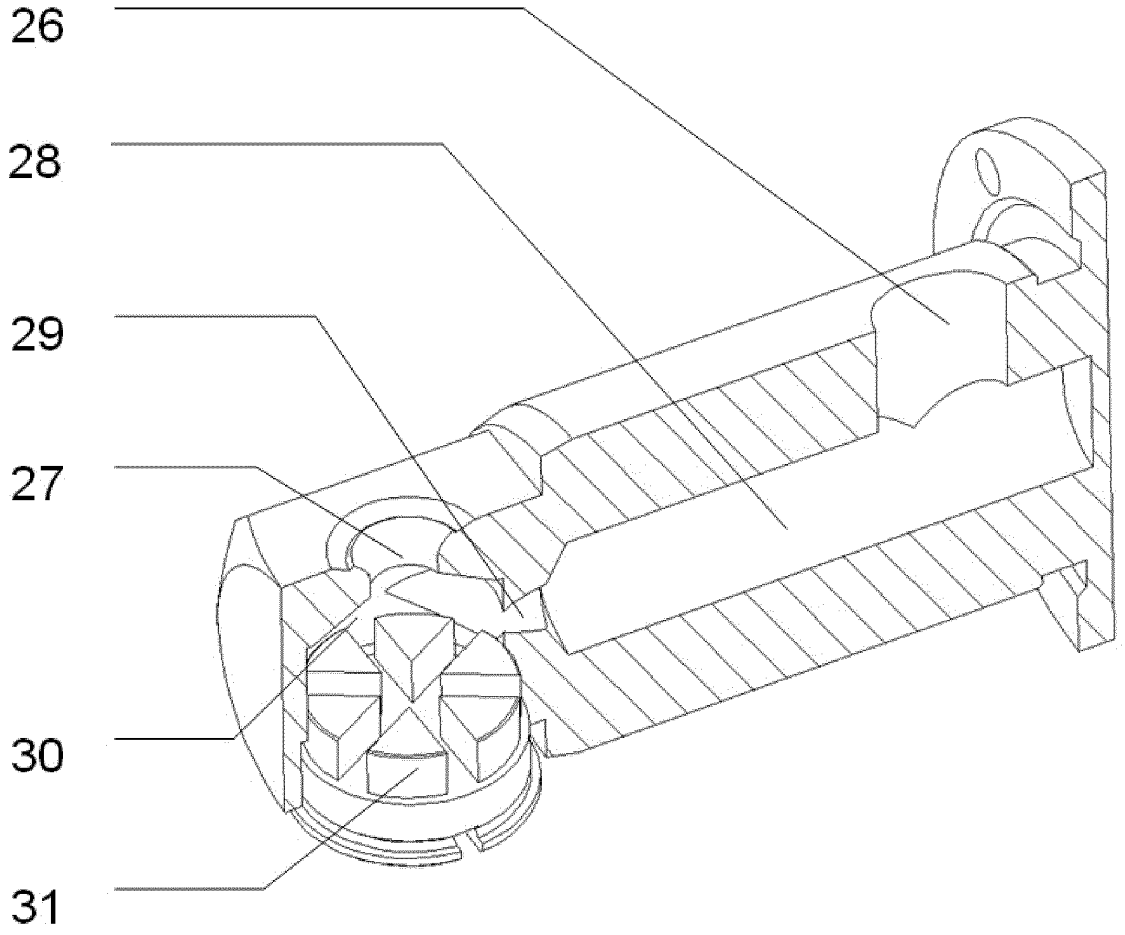

FIG. 5

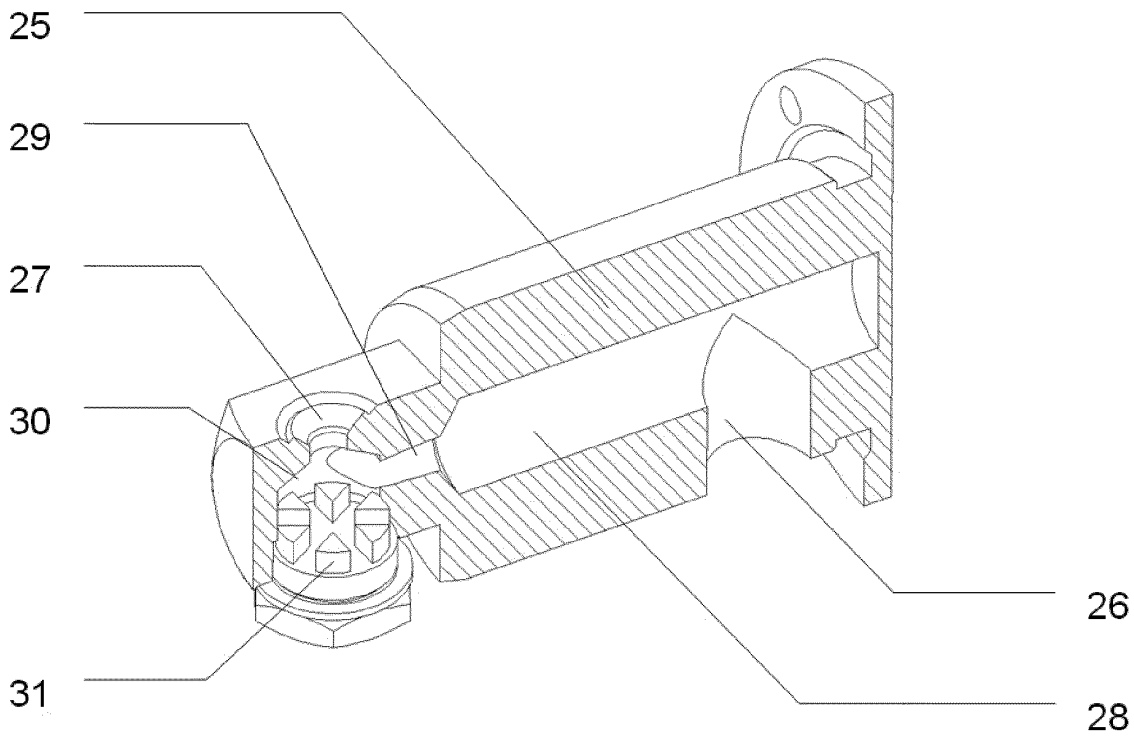

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/083995

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 23/00; D06B 1/02; D06B 3/28; D06B 1/08; D06B 1/00; D06B 3/10; D06B 23/20; D06B 3/00; D06B 15/00; D06B 15/09; D06C 7/00; F26B 13/02; F26B13/00

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)

CNPAT, CNKI, WPI, EPODOC, dyer, dying, dye, fan, blower, blast+, ventilat+, pump, nozzle, independent, individual, respective

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 101591845 A (ZHEJIANG ZHUOXIN MACHINERY CO., LTD.) 02 December 2009 (02.12.2009) description, the embodiment and figures 1-12	1-10
A	CN 101613919 A (WUXI DONGBAO MACHINERY CO., LTD.) 30 December 2009 (30.12.2009) the whole document	1-10
A	CN 102080318 A (GUANGZHOU PANYU GAOXUN DYEING EQUIP MER CO., LTD.) 01 June 2011 (01.06.2011) the whole document	1-10
A	CN 2359312 Y (YANG, Yongshuo) 19 January 2000 (19.01.2000) the whole document	1-10
A	DE 19548862 A1 (THEN MASCH & APP GMBH) 03 July 1997 (03.07.1997) the whole document	1-10

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

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"&"document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 August 2012 (29.08.2012)	**20 September 2012 (20.09.2012)**
Name and mailing address of the ISA 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 XIANG, Qixiong Telephone No. (86-10) **62413117**

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/083995

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2002-69832 A (INOUE KINZOKU KOGYO CO., LTD.) 08 March 2002 (08.03.2002) the whole document	1-10

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2011/083995

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CN 101591845 A	02.12.2009	None	
CN 101613919 A	30.12.2009	None	
CN 102080318 A	01.06.2011	CN 102080318 B	23.05.2012
CN 2359312 Y	19.01.2000	None	
DE 19548862 A1	03.07.1997	DE 19548862 C2	29.07.1999
JP 2002-69832 A	08.03.2002	JP 4511005 B2	28.07.2010

Form PCT/ISA /210 (patent family annex) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/083995

A. CLASSIFICATION OF SUBJECT MATTER

D06B 23/00 (2006.01) i

D06B 1/02 (2006.01) i

D06B 3/28 (2006.01) i

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