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

(11) **EP 2 918 740 A1**

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

(43) Date of publication:
16.09.2015 Bulletin 2015/38

(21) Application number: **13853501.8**

(22) Date of filing: **04.03.2013**

(51) Int Cl.:
E03D 9/08 *(2006.01)*

(86) International application number:
PCT/JP2013/001289

(87) International publication number:
WO 2014/073124 (15.05.2014 Gazette 2014/20)

(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
Designated Extension States:
BA ME

(30) Priority: **06.11.2012 JP 2012244177**

(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd.**
Osaka-shi, Osaka 540-6207 (JP)

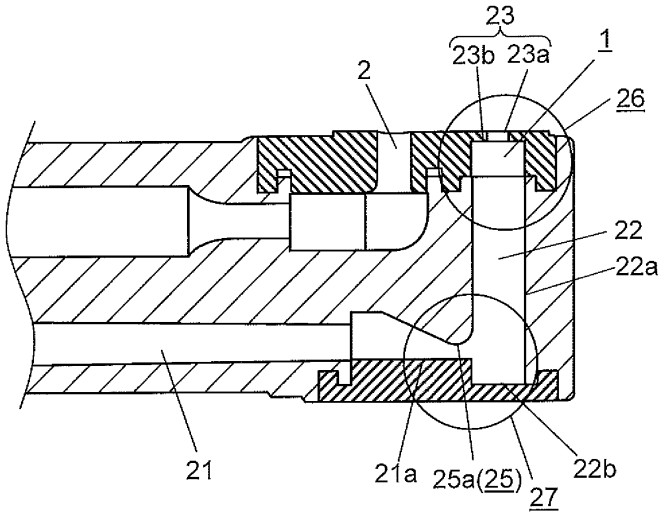
(72) Inventors:
- **KOGA, Ryoichi**
  Osaka-shi, Osaka 540-6207 (JP)
- **MATSUMURA, Mitsumasa**
  Osaka-shi, Osaka 540-6207 (JP)

(74) Representative: **Schwabe - Sandmair - Marx**
Patentanwälte
Stuntzstraße 16
81677 München (DE)

(54) HYGIENIC CLEANING DEVICE

(57) The present invention provides a sanitary cleaning device which discharges supplied cleaning water toward a body part from body part cleaning nozzle (1), wherein body part cleaning nozzle (1) includes: inflow passage (21); introducing passage (22); and nozzle spout portion (26) having discharge opening (23). Inflow passage (21) is connected to one end of introducing passage (22) via direction-changing portion (27) having throttling portion (25a), and nozzle spout portion (26) is connected to the other end of introducing passage (22), and includes a sharply-narrowed flow passage which is formed by introducing passage (22) and discharge opening (23) and where a cross section of a flow passage is sharply reduced. Due to such a constitution, it is possible to realize a sanitary cleaning device which has a cleaning effect and gives a clean feeling even when a flow rate of cleaning water is small.

FIG. 4



EP 2 918 740 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a sanitary cleaning device for cleaning a body part.

BACKGROUND ART

[0002] Conventionally, with respect to a sanitary cleaning device of a hot-water storing type, from a viewpoint of energy saving and ensuring a continuous use time, there has been a tendency where a flow rate of cleaning water for hot water cleaning is suppressed. As a result, a maximum flow rate of cleaning water at the time of hot water cleaning is lowered from a conventional flow rate of approximately 1.0 L/min to a flow rate of approximately 0.6 L/min.

[0003] Further, in a sanitary cleaning device of an instantaneous warming type, from a viewpoint of restriction imposed on imputing of electricity to a heater of a heat exchanger, the maximum flow rate of cleaning water is set to approximately 0.5 L/min. Accordingly, to ensure a cleaning effect and a clean feeling even with a small flow rate of cleaning water, a pulsation pump, a pneumatic pump or the like is used. In this case, the pulsation pump or the like is required to generate a high pressure and hence, there has been a demand for a special pump having a high pulsation effect.

[0004] Recently, a flow rate of cleaning water in a sanitary cleaning device of an instantaneous warming type and a flow rate of cleaning water in a sanitary cleaning device of a hot water storage type have become closer to each other. Accordingly, by introducing a pulsation pump or a pneumatic pump substantially equal to a pulsation pump or a pneumatic pump used in a sanitary cleaning device of an instantaneous warming type to a sanitary cleaning device of a hot water storage type, there is no problem with performance. However, due to a problem relating to a cost or the restriction imposed on space, in the sanitary cleaning device of a hot water storage type, it is necessary to effectively generate pulsations by a nozzle spout portion alone as a single unit.

[0005] Further, also with respect to a sanitary cleaning device of an instantaneous warming type, there has been a demand for the use of a pulsation pump at a lower cost by imparting a function of generating pulsation to a nozzle spout portion thus reducing a load of the pulsation pump.

[0006] Conventionally, as a method of generating pulsations in the nozzle spout portion, there has been disclosed a hot water cleaning toilet seat device which includes a jet flow portion where fluidic device is used when a maximum flow rate is 1.0 L/min (for example, see PTL 1). However, in the case of the hot water cleaning toilet seat device disclosed in PTL 1, when a flow rate of cleaning water is lowered to approximately 0.6 L/min, it is necessary to configure the jet flow portion such that a flow passage is extremely narrow. Accordingly, such a hot water cleaning toilet seat device has not been put into a practical use due to restrictions imposed on an operation, a response speed and the like of the fluidic device.

[0007] In view of the above, as a method of imparting pulsation to a jet flow which is effective in enhancing a cleaning effect and a clean feeling even when a flow rate of cleaning water is small, for example, there has been proposed a nozzle which uses a sharply-narrowed flow passage having a small spout opening diameter which is used in a fuel injection valve of an internal combustion engine (for example, see PTL 2).

[0008] The nozzle described in PTL 2 which uses a sharply-narrowed flow passage generates cavitation due to a negative pressure generated in a contracted flow portion. The generated cavitation spreads over the whole region of the hole in the nozzle spout opening, and generates super cavitation. Accordingly, a liquid and a gas are vigorously mixed with each other thus largely accelerating atomization of a fluid. That is, the nozzle described in PTL 2 which uses a sharply-narrowed flow passage is useful as a technique for strongly mixing a liquid and a gas in the nozzle spout opening.

[0009] However, the nozzle which uses the sharply-narrowed flow passage used in the fuel injection valve described in PTL 2 is provided on the premise that a fluid is atomized by being used in a state where a flow speed of a jet flow falls within a flow speed region of at least 10 m/sec or more such that the cavitation is surely generated. Accordingly, in the case of a sanitary cleaning device where a flow speed of cleaning water is approximately 10 m/sec at a maximum flow speed and a flow rate of cleaning water is small, only with an action of cavitation, a jet flow of cleaning water cannot be divided into water masses of a certain size. Accordingly, there has been a drawback that a high cleaning effect and an excellent clean feeling cannot be acquired when a flow rate of cleaning water is small.

Citation List

Patent Literatures

[0010]

PTL 1: Unexamined Japanese Patent Publication No. 2000-120141
PTL 2: Unexamined Japanese Patent Publication No. 2003-83205

SUMMARY OF THE INVENTION

[0011] To overcome the above-mentioned drawbacks, the present invention provides a sanitary cleaning device which discharges supplied cleaning water toward a body part from a body part cleaning nozzle, wherein the body part cleaning nozzle includes: an inflow passage; an introducing passage; a nozzle spout portion having a discharge opening. The inflow passage is connected to one

end of the introducing passage via a direction-changing portion having a throttling portion. The nozzle spout portion is formed of a sharply-narrowed flow passage which is connected to the other end of the introducing passage and whose flow passage cross-sectional area is sharply reduced by the introducing passage and the discharge opening.

[0012] Due to such a constitution, the throttling portion is disposed in the direction-changing portion which connects the inflow passage and the introducing passage of the body part cleaning nozzle to each other. Accordingly, a flow speed of cleaning water which is injected into the direction-changing portion from the inflow passage is increased at the throttling portion. In a state where the flow speed is high, cleaning water impinges on inner wall surface 22a of introducing passage 22 and, at the same time, the flow direction is diverted and hence, the turbulence of flow such as a vortex is generated in cleaning water. As a result, a high pulsation effect is imparted to a jet flow of cleaning water and hence, cleaning water can be spouted out from the discharge opening of the nozzle spout portion.

[0013] Further, due to the nozzle spout portion which forms the sharply-narrowed flow passage, cleaning water which flows into the nozzle spout portion spouts out from the discharge opening in a contracted flow state. At this point of time, in the nozzle spout portion, a space is formed between an outer periphery of a jet flow of cleaning water which forms a contracted flow and an inner peripheral wall of the discharge opening toward the discharge opening. Then, air flows into the space formed between the outer periphery of the jet flow of cleaning water and the inner peripheral wall of the discharge opening from the outside, a vortex is generated due to cleaning water outside the outer periphery of the jet flow in a contracted flow and air whereby cleaning water and air are mixed to each other. At this point of time, a mixing phenomenon of cleaning water and air is not uniform and hence, air and cleaning water flow out as masses. Accordingly, it is possible to impart pulsation to cleaning water spouted out from the discharge opening of the nozzle spout portion. As a result, it is possible to provide a sanitary cleaning device which has a high cleaning effect and an excellent clean feeling to a user even when a flow rate of cleaning water is small.

BRIEF DESCRIPTION OF DRAWINGS

[0014]

FIG.1 is a perspective view of a toilet device on which a sanitary cleaning device according to the first exemplary embodiment of the present invention is mounted.

FIG. 2 is a front view of a remote control unit of the sanitary cleaning device according to the first exemplary embodiment.

FIG. 3 is a schematic view showing the constitution of a body part of the sanitary cleaning device according to the first exemplary embodiment.

FIG. 4 is a cross-sectional view of an essential part of a body part cleaning nozzle of the sanitary cleaning device according to the first exemplary embodiment.

FIG. 5 is a cross-sectional view showing a nozzle spout portion of the body part cleaning nozzle shown in FIG. 4 in an enlarged manner.

FIG. 6 is a view for describing the manner of operation of the sanitary cleaning device according to the first exemplary embodiment when aspect ratio (L/D) between radius (D/2) and flow passage length L of a discharge opening of the nozzle spout portion is set to approximately 0.5.

FIG. 7 is a view for describing the manner of operation of the sanitary cleaning device according to the first exemplary embodiment when aspect ratio (L/D) of the discharge opening of the nozzle spout portion exceeds 1.

FIG. 8 is a view for describing the manner of operation of the sanitary cleaning device according to the first exemplary embodiment when aspect ratio (L/D) of the discharge opening of the nozzle spout portion is set to a value less than 0.25.

FIG. 9 is a graph showing the relationship between aspect ratio (L/D) and a load change width of a jet flow in the body part cleaning nozzle of the sanitary cleaning device according to the first exemplary embodiment.

FIG. 10 is a characteristic chart of aspect ratio (L/D) and a pressure loss of the body part cleaning nozzle of the sanitary cleaning device according to the first exemplary embodiment.

FIG. 11 is an enlarged cross-sectional view of the body part cleaning nozzle shown in FIG. 4 in a state where a corner of an inflow portion of the discharge opening of the nozzle spout portion is set at an acute angle.

FIG. 12 is a longitudinal cross-sectional view of a body part cleaning nozzle of a sanitary cleaning device according to the second exemplary embodiment of the present invention.

FIG. 13 is a graph showing a load change width of a jet flow in the body part cleaning nozzle shown in FIG. 12.

FIG. 14 is a longitudinal cross-sectional view of another example of the body part cleaning nozzle according to the second exemplary embodiment.

FIG. 15 is a cross-sectional view of a pulsation pump according to a third exemplary embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0015] Hereinafter, sanitary cleaning devices and toilet devices according to exemplary embodiments of the present invention are described with reference to draw-

ings. However, the present invention is not limited by the exemplary embodiments.

FIRST EXEMPLARY EMBODIMENT

[0016] Hereinafter, a sanitary cleaning device according to the first exemplary embodiment of the present invention and a toilet device provided with the sanitary cleaning device are described with reference to FIG. 1.

[0017] FIG.1 is a perspective view of the toilet device on which the sanitary cleaning device according to the first exemplary embodiment of the present invention is mounted.

[0018] As shown in FIG. 1, toilet device 1000 of this exemplary embodiment includes at least: sanitary cleaning device 100; toilet bowl 700; entrance detection sensor 600 and the like, and sanitary cleaning device 100 is mounted on toilet bowl 700.

[0019] Sanitary cleaning device 100 includes: body portion 200; remote control unit 300; toilet seat portion 400; lid portion 500 and the like. In body portion 200, sitting detection sensor 610 which is provided to an upper portion of a front surface, and a cleaning water supply mechanism (see FIG. 3) controlled by control part 4 are incorporated. Toilet seat portion 400 and lid portion 500 are mounted on body portion 200 in an openable and closeable manner. Sitting detection sensor 610 is formed of a reflective-type infrared sensor or the like, for example, and detects the presence or the non-presence of a user on toilet seat portion 400 by detecting an infrared ray reflected from a body part.

[0020] One end of the cleaning water supply mechanism incorporated into body portion 200 is connected to toilet bowl nozzle 40 mounted on a lower portion of a front surface of body portion 200, and the other end of the cleaning water supply mechanism is connected to a water supply pipe. In FIG. 1, toilet bowl nozzle 40 is shown in a state where toilet bowl nozzle 40 projects into the inside of toilet bowl 700. Due to such a constitution, the cleaning water supply mechanism supplies cleaning water supplied from the water supply pipe to toilet bowl nozzle 40. In the case of the preliminary cleaning of the toilet bowl, supplied cleaning water is spouted out to a wide area of an inner surface of toilet bowl 700 from toilet bowl nozzle 40. In the case of cleaning a rear portion of toilet bowl 700, cleaning water is spouted out to a back surface side of the inner surface of toilet bowl 700 from toilet bowl nozzle 40.

[0021] The cleaning water supply mechanism incorporated into body portion 200 is connected to nozzle portion 20 which is constituted of buttock nozzle 1 and bidet nozzle 2 which are body part cleaning nozzles and nozzle cleaning nozzle 3 (see FIG. 3). Due to such a constitution, the cleaning water supply mechanism supplies cleaning water supplied from the water supply pipe to nozzle portion 20. The supplied cleaning water is spouted out to a part of a user from nozzle portion 20 such as buttock nozzle 1 or bidet nozzle 2. Cleaning water supplied to nozzle cleaning nozzle 3 of nozzle portion 20 is spouted out to buttock nozzle 1, bidet nozzle 2 and the like of nozzle portion 20 for cleaning these elements.

[0022] Remote control unit 300 has a plurality of switches, and is mounted, for example, at a place where a user who is seated on toilet seat portion 400 can operate remote control unit 300.

[0023] Entrance detection sensor 600 is formed of a reflective-type infrared sensor or the like, for example, and is mounted at an entrance of a toilet room or the like. Entrance detection sensor 600 detects that a user has entered the inside of the toilet room when entrance detection sensor 600 detects an infrared ray reflected from a body part.

[0024] Control part 4 of body portion 200 (see FIG. 3) controls the operations of the respective parts of sanitary cleaning device 100 based on signals transmitted from remote control unit 300, entrance detection sensor 600 and sitting detection sensor 610.

[0025] Hereinafter, the constitution of remote control unit 300 of sanitary cleaning device 100 according to this exemplary embodiment is described with reference to FIG. 2.

[0026] FIG. 2 is a front view of the remote control unit of the sanitary cleaning device according to the exemplary embodiment.

[0027] As shown in FIG. 2, remote control unit 300 includes wide cleaning switch 305, rhythm cleaning switch 306, water power setting switches 307, 308, movement cleaning switch 309, cleaning position setting switches 310, 311 which are mounted on an upper portion of controller body portion 301, stop switch 302 for instructing cessation of a cleaning operation, buttock switch 303 and bidet switch 304 which are mounted on a lower portion of controller body portion 301.

[0028] As shown in FIG. 1, firstly, when a user operates the respective switches of remote control unit 300, predetermined signals corresponding to the respective switches are transmitted to body portion 200 from remote control unit 300 by wireless transmission, for example. In response to the received signals, control part 4 of body portion 200 (see FIG. 3) controls the operations of the respective constitutional parts of body portion 200 and toilet seat portion 400. For example, when a user operates by pushing buttock cleaning button 303 or bidet cleaning button 304, control part 4 moves nozzle portion 20 of body portion 200 such as buttock nozzle 1 or bidet nozzle 2, and makes nozzle portion 20 spout cleaning water thus cleaning a part of the user.

[0029] Hereinafter, the constitution and the manner of operation of a water supply system and a control system in body portion 200 of sanitary cleaning device 100 of this exemplary embodiment are described with reference to FIG. 3.

[0030] FIG. 3 is a schematic view showing the constitution of the body part of the sanitary cleaning device according to the exemplary embodiment.

[0031] As shown in FIG. 3, body portion 200 of sanitary

cleaning device 100 includes: control part 4, branch faucet 5; strainer 6; electromagnetic valve 7, atmosphere release portion 8; constant flow regulating valve 9; heat exchanger 12; temperature sensors 13a, 13b; water pump 14; buffer tank 15; changeover valve 16; nozzle portion 20; vacuum breaker 31; toilet bowl nozzle 40; toilet bowl nozzle motor 40m and the like. Nozzle portion 20 of body portion 200 includes, as described above, buttock nozzle 1, bidet nozzle 2 and nozzle cleaning nozzle 3. Changeover valve 16 includes changeover valve motor 16m.

[0032] As shown in FIG. 3, branch faucet 5 is interposed in water supply pipe 201 which constitutes a water supply source, and branch faucet 5 is connected to body part cleaning water flow passage 202 leading to buttock nozzle 1 and bidet nozzle 2 which are body part cleaning nozzles. In body part cleaning water flow passage 202, strainer 6, constant flow regulating valve 9, electromagnetic valve 7, atmosphere release portion 8 having tank 8a provided with vacuum breaker 31 and relief valve 51, temperature sensor 13a, heat exchanger 12, temperature sensor 13b, water pump 14, buffer tank 15, changeover valve 16 and branch faucet 5 are disposed in this order.

[0033] Toilet bowl nozzle 40 is connected to an end portion of toilet bowl cleaning water flow passage 205 branched from body part cleaning water flow passage 202 by changeover valve 16. Toilet bowl nozzle motor 40m is mounted on toilet bowl nozzle 40m.

[0034] Next, the flow of cleaning water in body portion 200 of sanitary cleaning device 100 and a control of the respective constitutional parts of body portion 200 by control part 4 is described with reference to FIG. 3.

[0035] Firstly, as shown in FIG. 3, tap water which flows in water supply pipe 201 is supplied to strainer 6 from branch faucet 5 as cleaning water. Dust, impurities and the like contained in cleaning water are removed by strainer 6.

[0036] Next, control part 4 controls electromagnetic valve 7 thus changing over a supply state of cleaning water. At this stage of operation, cleaning water passes through constant flow regulating valve 9 formed of a variable orifice made of rubber whose orifice diameter is changed corresponding to a working water pressure and hence, a pressure of cleaning water which flows in body part cleaning water flow passage 202 is reduced.

[0037] Then, cleaning water controlled by electromagnetic valve 7 is supplied to heat exchanger 12 through atmosphere releasing portion 8 described in detail hereinafter.

[0038] Then, heat exchanger 12 heats cleaning water supplied through the inside of body part cleaning water flow passage 202 to a predetermined temperature of 40°C or the like, for example. At this stage of operation, water pump 14 connected to heat exchanger 12 is subjected to a drive control by control part 4 and hence, a flow rate of cleaning water corresponding to an operation speed of water pump 14 is spouted out from buttock nozzle 1 or bidet nozzle 2 which is the body part cleaning nozzle. Accordingly, the heating operation of heat exchanger 12 is controlled by control part 4 based on measured temperature values which are measured by temperature sensors 13a, 13b and a controlled flow rate by water pump 14.

[0039] Next, cleaning water heated by heat exchanger 12 is supplied to changeover valve 16 by water pump 14 under pressure through buffer tank 15. Changeover valve 16 performs a changeover control by control part 4 such that the cleaning nozzle to be used is changed over to buttock nozzle 1 or bidet nozzle 2 which is the body part cleaning nozzle or nozzle cleaning nozzle 3. Further, changeover valve 16 performs a changeover control such that the cleaning nozzle is changed over to toilet bowl nozzle 40 which discharges cleaning water to a surface of the toilet bowl surface for preliminary cleaning of the toilet bowl, cleaning of a rear portion of the toilet bowl and the like.

[0040] At this stage of operation, buffer tank 15 functions as a temperature buffering portion for heated cleaning water. That is, buffer tank 15 suppresses the occurrence of temperature irregularity in cleaning water supplied under pressure to changeover valve 16. It is preferable that a total capacity of heat exchanger 12 and buffer tank 15 is 15 cc to 30 cc, and it is more preferable that the total capacity be 20 cc to 25 cc. For example, in the case of a sanitary cleaning device of an instantaneous warming type, in setting a flow rate of a jet flow to 500 cc/min., the capacity of heat exchanger 12 and the capacity of buffer tank 15 are factors which cause a delay in response. Accordingly, when the total capacity of heat exchanger 12 and buffer tank 15 is 25 cc, the influence of the capacity exerted on delay in response is approximately 5% (25/500). This influence is the influence of approximately 3 seconds in terms of time. However, with respect to a discharge time of cleaning water discharged from the nozzle, the nozzle is operated within 10 seconds usually and hence, provided that the time of delay in response brought about by the heat exchanger and the like falls within 3 seconds, the influence can be sufficiently absorbed and hence, there arises no problem when the capacity of heat exchanger 12 and buffer tank 15 falls within the above-mentioned range.

[0041] Next, control part 4 controls the operation of changeover valve motor 16m so as to change changeover valve 16 to any one of buttock nozzle 1, bidet nozzle 2 and nozzle cleaning nozzle 3 or toilet bowl nozzle 40, and supplies cleaning water supplied under pressure from water pump 14 through buffer tank 15. Accordingly, cleaning water is spouted out from any one of buttock nozzle 1, bidet nozzle 2 and nozzle cleaning nozzle 3, and toilet bowl nozzle 40.

[0042] Buttock nozzle 1 and bidet nozzle 2 are used for cleaning a part of a user. Nozzle cleaning nozzle 3 is used for cleaning a portion of buttock nozzle 1 and a portion of bidet nozzle 2 projecting into the inside of toilet bowl 700. Toilet bowl nozzle 40 is used for cleaning the

inside of the toilet bowl.

[0043] Hereinafter, the constitution and the manner of operation of the body part cleaning nozzle mounted on the sanitary cleaning device of this exemplary embodiment are described with reference to FIG. 4 and FIG. 5.

[0044] FIG. 4 is a cross-sectional view of an essential part of the body part cleaning nozzle of the sanitary cleaning device according to the exemplary embodiment. FIG. 5 is a cross-sectional view showing a nozzle spout portion of the body part cleaning nozzle shown in FIG. 4 in an enlarged manner.

[0045] As shown in FIG. 4, body part cleaning nozzle 1 of this exemplary embodiment is driven by the motor drive mechanism (not shown in the drawing) such that body part cleaning nozzle 1 projects to the inside of toilet bowl 700 from the inside of body portion 200 of sanitary cleaning device 100 at the time of cleaning, and is retracted and stored in the inside of body portion 200 after cleaning. In FIG. 4, the motor drive mechanism and the like are omitted, and only a distal end portion of body part cleaning nozzle 1 is shown.

[0046] Further, as shown in FIG. 4, buttock nozzle 1 and bidet nozzle 2 are provided in the inside of one body part cleaning nozzle 1.

[0047] Hereinafter, the constitution and the manner of operation of buttock nozzle 1 of the body part cleaning nozzle which is a key of this exemplary embodiment are described in detail.

[0048] As shown in FIG. 4, buttock nozzle 1 of this exemplary embodiment is constituted of nozzle spout portion 26 having at least: inflow passage 21; introducing passage 22; and discharge opening 23, and direction-changing portion 27 having throttling portion 25a.

[0049] Inflow passage 21 is provided for supplying cleaning water to direction-changing portion 27 from the cleaning water supply mechanism shown in FIG. 3.

[0050] Direction-changing portion 27 is configured to connect inflow passage 21 and one side of introducing passage 22 arranged in the direction at an approximately right angle (including a right angle) with respect to inflow passage 21, and diverts the flow direction of cleaning water. Throttling portion 25a of direction-changing portion 27 increases a flow speed of cleaning water supplied from inflow passage 21 by throttling (narrowing) a flow passage of cleaning water, and makes cleaning water impinge on inner wall surface 22a of introducing passage 22.

[0051] Introducing passage 22 introduces cleaning water whose flow speed is increased by throttling portion 25a of direction-changing portion 27 to nozzle spout portion 26. At this stage of operation, it is preferable that bottom portion 22b of introducing passage 22 is disposed lower than lowest portion 21a of inflow passage 21 of direction-changing portion 27. Due to such a constitution, it is possible to effectively generate turbulence in cleaning water which flows into introducing passage 22.

[0052] Nozzle spout portion 26 is constituted of inflow portion 23b connected to the other side of introducing passage 22, and discharge opening 23 having exit portion 23a. As shown in FIG. 5, a sharply-narrowed flow passage where a cross section of the flow passage is sharply reduced as described below is provided from introducing passage 22 having a diameter of 3 mm through inflow portion 23b of discharge opening 23 having a diameter of 1.3 mm, for example. In such a constitution, discharge opening 23 of nozzle spout portion 26 is formed such that aspect ratio (L/D) between flow passage length L of discharge opening 23 from inflow portion 23b side to exit portion 23a side of discharge opening 23 and diameter D of discharge opening 23 is set to a value which falls within a range from 0.25 to 0.75, and preferably within a range from 0.4 to 0.7.

[0053] Buttock nozzle 1 of this exemplary embodiment is constituted as described above, and cleaning water from the cleaning water supply mechanism is spouted out from exit portion 23a of discharge opening 23 of nozzle spout portion 26 through inflow passage 21, direction-changing portion 27 and introducing passage 22, and cleans a body part.

[0054] Next, in the nozzle spout portion of the body part cleaning nozzle of this exemplary embodiment, the manner of operation and advantageous effects acquired by setting aspect ratio (L/D) between flow passage length L of the discharge opening and diameter D of the discharge opening to a value which falls within a range from 0.25 to 0.75 and a reason for setting such aspect ratio (L/D) are described with reference to FIG. 6 to FIG. 8.

[0055] FIG. 6 is a view for describing the manner of operation and advantageous effects of the sanitary cleaning device according to the exemplary embodiment when aspect ratio (L/D) between radius (D/2) and flow passage length L of the discharge opening of the sanitary cleaning device is set to approximately 0.5. FIG. 7 is a view for describing the manner of operation and advantageous effects of the sanitary cleaning device according to the exemplary embodiment when aspect ratio (L/D) of the discharge opening of the nozzle spout portion exceeds 1. FIG. 8 is a view for describing the manner of operation and advantageous effects of the sanitary cleaning device according to the exemplary embodiment when aspect ratio (L/D) of the discharge opening of the nozzle spout portion is set to a value smaller than 0.25.

[0056] Firstly, as shown in FIG. 6, when aspect ratio (L/D) is set to a value which falls within a range from 0.25 to 0.75 with 0.5 at the center, minimum diameter portion 28a (maximum flow speed portion) of an outer periphery of a contracted jet flow of cleaning water generated with corner 23c of inflow portion 23b of discharge opening 23 indicated by contracted flow curve 28 shown in the drawing as an initiation point approximately agrees with (including "agrees with") the position of exit portion 23a of discharge opening 23, although the range of aspect ratio (L/D) changes to some extent due to Reynold's number. A flow rate of cleaning water becomes maximum at minimum diameter portion 28a of the outer periphery of the contracted jet flow of cleaning water. This is because a

cross section of the flow passage is sharply reduced at a portion reaching discharge opening 23 from introducing passage 22 thus forming a sharply-narrowed flow passage.

[0057] At this stage of operation, as shown in FIG. 6, space s is formed between the outer periphery of the jet flow of cleaning water of the contracted flow portion of cleaning water formed in a range from inflow portion 23b to exit portion 23a of discharge opening 23 and inner peripheral wall 23d of discharge opening 23. Then, at exit portion 23a of discharge opening 23 of nozzle spout portion 26, space s formed by the outer periphery of the jet flow of cleaning water and inner peripheral wall 23d of discharge opening 23 becomes maximum.

[0058] As shown in FIG. 6, it has been known that, from the lines of flow of the contracted flow portion, at a distance approximately half of diameter (D) of discharge opening 23 from starting of the contracted flow (corner 23c), the contracted flow is brought into a saturated state so that a flow speed of the contracted flow becomes maximum. That is, a flow speed of a contracted flow and an amount of negative pressure become maximum at the position approximately half of diameter (D) of discharge opening 23. Therefore, an opening area for air which flows into a negative pressure portion of cleaning water generated in the contracted flow portion of cleaning water in discharge opening 23 becomes maximum. Accordingly, a distance from exit portion 23a of discharge opening 23 to the center of vortex 29 generated between the contracted flow and inner peripheral wall 23d of discharge opening 23 becomes minimum. As a result, air easily flows into space s through an opening of exit portion 23a of discharge opening 23, and air which flows into space s is taken in a jet flow of cleaning water.

[0059] Air taken in a jet flow of cleaning water increases a volume of the jet flow. Accordingly, a diameter of the jet flow of cleaning water is increased due to taken air.

[0060] In this case, in this exemplary embodiment, nozzle spout portion 26 is formed with a predetermined aspect ratio such that space s formed between the outer periphery of the jet flow of cleaning water and inner peripheral wall 23d of discharge opening 23 becomes maximum at exit portion 23a of discharge opening 23 of nozzle spout portion 26. Therefore, the outer periphery of the jet flow of cleaning water can spread into space s and, at the same time, air can be taken in the jet flow. Accordingly, even when an amount of jet flow of cleaning water from body part cleaning nozzle is small, cleaning water is divided into water masses of a size which gives a strong clean feeling and, then, cleaning water can be spouted out from exit portion 23a of discharge opening 23 of nozzle spout portion 26. In this case, due to divided water masses, a load change width of a jet flow which impinges on a part to be washed by a pulsation jet flow of cleaning water is increased. As a result, even when a flow rate of cleaning water spouted out from the body part cleaning nozzle is small, it is possible to realize a sanitary cleaning device which acquires a high cleaning effect and gives an excellent clean feeling.

[0061] As shown in FIG 6, in space s formed between the outer periphery of a jet flow which is a contracted flow of cleaning water and inner peripheral wall 23d of discharge opening 23 of nozzle spout portion 26, vortex 29 is generated due to cleaning water separated from a contracted jet flow and air taken in space s from the outside. Then, air is further taken in a low pressure portion formed by generated vortex 29, and air is mixed with cleaning water. At this stage of operation, a mixing phenomenon of cleaning water and air does not take place uniformly and hence, masses formed by the mixture of air and water pulsate and are spouted out from exit portion 23a of discharge opening 23 of nozzle spout portion 26. Accordingly, cleaning water can be divided into water masses having a size with which a strong clean feeling can be acquired.

[0062] Particularly when a flow speed of cleaning water which flows into discharge opening 23 of nozzle spout portion 26 is sufficiently fast, that is, 13.5 m/sec, for example, cavitation or the like occurs at above-mentioned vortex 29 or corner 23c of inflow portion 23b of discharge opening 23 as an initiation point. Accordingly, it is possible to impart the larger pulsation to cleaning water which is spouted out from exit portion 23a of discharge opening 23 of nozzle spout portion 26. As a result, it is possible to realize a sanitary cleaning device which acquires a higher cleaning effect and give a more excellent clean feeling.

[0063] On the other hand, as shown in FIG. 7, when nozzle spout portion 26 is formed with aspect ratio (L/D) of discharge opening 23 of nozzle spout portion 26 set at 1 or more, the flow of cleaning water contracted by inflow portion 23b of discharge opening 23 becomes the flow which is adhered to inner peripheral wall 23d of discharge opening 23 again (re-adhesion) with aspect ratio (L/D) set at around 1. Further, even when aspect ratio (L/D) becomes larger than 1, a state where cleaning water is adhered to inner peripheral wall 23d of discharge opening 23 again (re-adhesion) is continued.

[0064] In such a state, when a flow speed of fuel is several 10 m/sec or more which is usually used in a fuel injection valve, for example, a large negative pressure is generated in discharge opening 23 of nozzle spout portion 26 and hence, cavitation occurs. Accordingly, in the inside of discharge opening 23 of nozzle spout portion 26, a fluid which is fuel and vapor of fuel generated due to a negative pressure are vigorously mixed with each other and hence, the fluid is dispersed into fine liquid droplets and these liquid droplets can be spouted out.

[0065] However, in the sanitary cleaning device of this exemplary embodiment, a flow speed of cleaning water is approximately 10 m/sec. Accordingly, the flow of cleaning water which is adhered to inner peripheral wall 23d of discharge opening 23 of nozzle spout portion 26 again becomes the stable flow where pulsation is suppressed. As a result, a pulsation effect of a jet flow of cleaning water is suppressed and hence, nozzle spout portion 26

where aspect ratio (L/D) exceeds 1 is not suitable as a body part cleaning nozzle of the sanitary cleaning device of this exemplary embodiment. Further, also in the case of nozzle spout portion 26 where aspect ratio (L/D) exceeds 0.75, an outer periphery of a jet flow of cleaning water becomes large and hence, a flow speed becomes small. Further, an opening area of space s becomes small and hence, an amount of air taken in space is also decreased. Accordingly, a pulsation pressure of cleaning water which is spouted out from exit portion 23a of discharge opening 23 of nozzle spout portion 26 is lowered and swinging property of cleaning water is lowered and hence, a cleaning effect and a clean feeling are lowered. As a result, aspect ratio (L/D) of discharge opening 23 of nozzle spout portion 26 is preferably set to 0.75, and more preferably to 0.7 or less.

[0066] As shown in FIG 8, in the case of nozzle spout portion 26 where aspect ratio (L/D) of discharge opening 23 of nozzle spout portion 26 is set to less than 0.25, the flow of cleaning water contracted by inflow portion 23b of discharge opening 23 spouts out from exit portion 23a of discharge opening 23 in a state where the flow of cleaning water is in the middle of contraction of flow. Accordingly, even after the flow of cleaning water is spouted out from exit portion 23a of discharge opening 23, a jet flow of cleaning water is converged to the center to a certain distance and hence, a jet flow forms a contracted flow such that a diameter of an outer periphery of the jet flow is decreased. Accordingly, cleaning water spouted out from exit portion 23a of discharge opening 23 of nozzle spout portion 26 exhibits stable behavior basically.

[0067] However, flow passage length L (distance) from the position where cleaning water starts the contraction of flow from inflow portion 23b of discharge opening 23 to the position where cleaning water is spouted out from exit portion 23a is short. Accordingly, vortex 29 generated in space s due to the flow of cleaning water peeled off by corner 23c of inflow portion 23b of discharge opening 23 becomes small. As a result, a pressure reduction amount due to the generation of a negative pressure in the contracted flow portion formed by discharge opening 23 becomes small and hence, cavitation also hardly occurs.

[0068] Further, a passage of air to exit portion 23a of discharge opening 23 of nozzle spout portion 26 is narrow because a distance from the position where cleaning water starts the contraction of flow is small. As a result, an amount of inflow of air taken in by space s is also decreased.

[0069] That is, when aspect ratio (L/D) of discharge opening 23 of nozzle spout portion 26 is less than 0.25, a state is brought about where jet flow of cleaning water hardly generates pulsation. Accordingly, a pulsation effect of the jet flow is low and hence, such aspect ratio is not suitable for the body part cleaning nozzle of a sanitary cleaning device of this exemplary embodiment.

[0070] Hereinafter, the description is made with respect to load change width of a jet flow of cleaning water which influences a cleaning effect and a clean feeling when above-mentioned aspect ratio (L/D) between flow passage length L of the discharge opening of the nozzle spout portion and diameter D of the discharge opening is changed, with reference to FIG 9.

[0071] FIG. 9 is a graph showing the relationship between aspect ratio (L/D) and a load change width of a jet flow in the body part cleaning nozzle of the sanitary cleaning device according to the exemplary embodiment. In the drawing, actually measured values (black square points) and an average value (solid line) of the actually measured values are shown.

[0072] As shown in FIG.9, it is understood that a load change width is maximum in the vicinity of aspect ratio (L/D) of 0.5 so that a pulsation effect can be acquired when aspect ratio (L/D) falls within a range from 0.25 to 0.75. It is also understood that high load change width of 4gw or more, for example, is acquired particularly when aspect ratio (L/D) falls within a range from 0.4 to 0.7. Also, a large load change width is acquired even when aspect ratio (L/D) is 0.75 or more; however, as described previously, an amount of contraction flow of cleaning water is small and a flow speed is lowered and hence, a cleaning effect and a clean feeling are lowered. Further, an outer periphery of a jet flow of cleaning water becomes large and hence, swing property of cleaning water spouted out from exit portion 23a of discharge opening 23 of nozzle spout portion 26 is lowered. Accordingly, the constitution of nozzle spout portion 26 where aspect ratio (L/D) is set to 0.75 or more is not preferable.

[0073] Next, a flow rate of cleaning water at which pulsation is generated with respect to above-mentioned aspect ratio (L/D) between flow passage length L of the discharge opening and diameter D of the discharge opening of the nozzle spout portion of this exemplary embodiment is described with reference to FIG. 10.

[0074] FIG. 10 is a view showing the relationship between a flow rate and a pressure loss of cleaning water with respect to predetermined aspect ratio (L/D) of the body part cleaning nozzle of the sanitary cleaning device according to the exemplary embodiment. FIG. 10 shows an example where aspect ratio (L/D) of the body part cleaning nozzle is set to 0.5. A solid line in the drawing indicates a result of study of flow rate and a pressure loss of cleaning water spouted out from the body part cleaning nozzle in the exemplary embodiment. On the other hand, a broken line in the drawing indicates the relationship between the flow rate and the pressure loss in the state where neither pulsation nor division occurs in cleaning water spouted out from the body part cleaning nozzle.

[0075] As shown in FIG. 10, it is understood that when a flow speed of cleaning water spouted out from the nozzle spout portion of the body part cleaning nozzle exceeds 5.2 m/sec, there is a tendency for a pressure loss to be slightly increased. To observe a jet flow of cleaning water spouted out from the body part cleaning nozzle in such a state, it is found that the jet flow becomes slightly whitish around the above-mentioned flow speed and the

entrapment of air into the jet flow of cleaning water starts.

[0076] Further, along with the increase of a flow speed of cleaning water, air is further taken in the jet flow so that the diameter of an outer periphery of the jet flow is increased. Then, when a flow speed of cleaning water exceeds 7 m/sec, water masses which take in air therein are jetted from exit portion 23a of discharge opening 23 in a divided manner. As a result, pulsation brought about by dividing of a jet flow is accelerated.

[0077] That is, it is found that, by setting aspect ratio (L/D) of the body part cleaning nozzle of the exemplary embodiment to a value which falls within a predetermined range from 0.25 to 0.75, for example, cleaning water is sufficiently divided even when a flow rate of cleaning water is 0.6 L/min so that cleaning water can be spouted out in a pulsation state.

[0078] As described above, it is preferable to set aspect ratio (L/D) of discharge opening 23 of nozzle spout portion 26 of the sanitary cleaning device according to the exemplary embodiment to a value which falls within a range of 0.25 to 0.75. Further, as described with reference to FIG 9, it is more preferable to particularly set aspect ratio (L/D) of discharge opening 23 of nozzle spout portion 26 to a value which falls within a range of 0.4 to 0.7. Accordingly, a load change width of pulsation of cleaning water can be increased even with a small flow rate and hence, the sanitary cleaning device of the exemplary embodiment can acquire a higher cleaning effect and a further excellent clean feeling.

[0079] Further, as described with reference to FIG. 6, corner 23c of inflow portion 23b of discharge opening 23 of nozzle spout portion 26 forms cleaning water which flows into nozzle spout portion 26 into a contracted flow and peels off the flow from inner peripheral wall 23d of discharge opening 23. Accordingly, corner 23c is important for pulsating a jet flow of cleaning water due to the formation of vortex 29 generated by a subsequent flow. In view of the above, in this exemplary embodiment, an angle θ of corner 23c is set at an approximately right angle (including a right angle) outwardly to inflow portion 23b from inner peripheral wall 23d of discharge opening 23. In this case, in general, a round shape is liable to be imparted to corner 23c by working or the like, and such a round shape influences peeling off of the flow of cleaning water. Accordingly, in this exemplary embodiment, when diameter D of discharge opening 23 is 1mm, for example, the round shape of corner 23c is formed such that a radius of curvature becomes 0.1 mm or less. Accordingly, the flow of cleaning water can be effectively separated from inner peripheral wall 23d of discharge opening 23 by corner 23c of inflow portion 23b of discharge opening 23 in nozzle spout portion 26. Then, air is mixed into a jet flow of cleaning water which flows along inner peripheral wall 23d of discharge opening 23 and hence, the jet flow of cleaning water can be divided easily. As a result, it is possible to effectively impart a pulsation effect to cleaning water which spouts out from the body part cleaning nozzle.

[0080] In this exemplary embodiment, the description is made with respect to the example where corner 23c of inflow portion 23b of discharge opening 23 in nozzle spout portion 26 is formed at an approximately right angle. However, the present invention is not limited to such an example. For example, as shown in FIG 11, an angle θ of corner 23c extending outwardly to inflow portion 23b from inner peripheral wall 23d of discharge opening 23 (that is, angle 0 of corner 23c made by inner peripheral wall 23d and inflow portion 23b) may be formed at an acute angle. Accordingly, even when discharge opening 23 is formed using a resin molded product, for example, the flow of cleaning water can be peeled off with more certainty from inner peripheral wall 23d of discharge opening 23 by corner 23c formed by inflow portion 23b and inner peripheral wall 23d of discharge opening 23. Further, an opening area (space s) for air which flows into a negative pressure portion generated by a contracted flow portion of cleaning water formed along inner peripheral wall 23d of discharge opening 23 can be increased to maximum thus allowing air to easily flow into space s. Accordingly, even when a flow rate of jet flow of cleaning water from the body part cleaning nozzle is small, the jet flow of cleaning water can be divided into water masses of a size by which a strong clean feeling can be acquired and hence, a pulsation effect can be increased. As a result, even when a flow rate of cleaning water is small, it is possible to produce a higher cleaning effect and to give a more excellent clean feeling.

[0081] In this exemplary embodiment, the description is made with respect to the example where corner 23c is formed on inflow portion 23b of discharge opening 23 of nozzle spout portion 26. However, the present invention is not limited to such an example. For example, a projecting portion formed of a burr may be formed toward introducing passage 22 from inflow portion 23b along inner peripheral wall 23d of discharge opening 23 of nozzle spout portion 26. In this case, the projecting portion such as a burr may be formed by forming discharge opening 23 of nozzle spout portion 26 by punching a sheet metal such as stainless steel or by resin molding, for example. Due to the burr formed on corner 23c of inflow potion 23b of discharge opening 23 in nozzle spout portion 26, a sharp edge having a more acute angle can be formed on inflow portion 23b into which a jet flow of cleaning water flows. Accordingly, the flow of cleaning water can be peeled off with more certainty from inner peripheral wall 23d of discharge opening 23 by an edge portion of the burr. Further, an opening area (space s) for air which flows into a negative pressure portion generated by a contracted flow portion of cleaning water formed along inner peripheral wall 23d of discharge opening 23 can be increased to maximum thus allowing air to more easily flow into space s. Accordingly, even when a flow rate of jet flow of cleaning water from the body part cleaning nozzle is small, the jet flow of cleaning water can be divided into water masses of a size by which a strong clean feeling can be acquired and hence, a pulsation effect can

be increased. As a result, even when a flow rate of cleaning water is small, it is possible to produce a higher cleaning effect and to give a more excellent clean feeling.

SECOND EXEMPLARY EMBODIMENT

[0082] Hereinafter, a body part cleaning nozzle of a sanitary cleaning device according to the second exemplary embodiment of the present invention is described with reference to FIG. 12.

[0083] FIG 12 is a longitudinal cross-sectional view of the body part cleaning nozzle of the sanitary cleaning device according to the second exemplary embodiment of the present invention,

[0084] As shown in FIG. 12, this exemplary embodiment differs from the body part cleaning nozzle of the sanitary cleaning device of the first exemplary embodiment in that turbulence generating portion 25 is formed on bottom portion 22b of introducing passage 22 which forms direction-changing portion 27 of the body part cleaning nozzle toward nozzle spout portion 26. It is preferable that turbulence generating portion 25 be provided in the vicinity of direction-changing portion 27 or on a direction-changing portion 27 side of introducing passage 22. Other constitutions and the manner of operation and advantageous effects of this exemplary embodiment are equal to those of the sanitary cleaning device of the first exemplary embodiment and hence, the detailed description of other constitutions and the manner of operation and advantageous effects of this exemplary embodiment is omitted.

[0085] That is, as shown in FIG. 12, turbulence generating portion 25 in this exemplary embodiment is formed of a projection having a prism shape, for example, and is formed on bottom portion 22b of introducing passage 22 in an erected manner toward nozzle spout portion 26. In such a constitution, as one example, in the case where a diameter of introducing passage 22 is 3 mm, projection 25c having a prism shape which constitutes turbulence generating portion 25 has a width of 2 mm (in the direction orthogonal to the direction that cleaning water flows into introducing passage 22) and a thickness of 1 mm (in the direction that cleaning water flows into introducing passage 22), for example. Further, the projection having a prism shape which constitutes turbulence generating portion 25 is formed in the direction toward nozzle spout portion 26 such that a height (in the direction toward nozzle spout portion 26) of the projection falls within a range twice as large as a distance between a lowest portion 21a of inflow passage 21 where upper surface 25c1 of projection 25c forms direction-changing portion 27 and a lowest portion of inflow passage 21 and throttling portion 25a.

[0086] Due to such a constitution, cleaning water whose flow speed is increased by throttling portion 25a which constitutes direction-changing portion 27 impinges on projection 25c which constitutes turbulence generating portion 25 and is disposed in the inside of introducing passage 22. Further, impinged cleaning water turns around projection 25c and reaches a back surface side of projection 25c so that cleaning water is further vigorously disturbed. The disturbed cleaning water is spouted out from nozzle spout portion 26 which forms a sharply-narrowed flow passage in a state where cleaning water is divided more effectively. As a result, a pulsation effect of a jet flow of cleaning water is further enhanced so that a higher cleaning effect and an excellent clean feeling can be acquired even when a flow rate of jet flow of cleaning water is small.

[0087] Hereinafter, the manner of operation and advantageous effects when above-mentioned turbulence generating portion 25 is formed is described with reference to FIG. 13.

[0088] FIG. 13 is a graph showing a load change width of a jet flow in the body part cleaning nozzle shown in Fig. 12. In FIG. 13, for a comparison purpose, a load change width of a jet flow in a body part cleaning nozzle which includes neither a throttling portion nor a turbulence generating portion and includes only nozzle spout portion 26 which forms a sharply-narrowed flow passage is also shown in FIG. 13.

[0089] As shown in FIG. 13, firstly, due to the provision of throttling portion 25a, when a flow rate of cleaning water is increased, a flow speed of cleaning water is increased. In such a state, when turbulence generating portion 25 is further provided, an amplitude of a load change width of a jet flow is increased along with the increase of a flow rate. Accordingly, a jet flow of cleaning water having a large flow rate and a high flow speed can enlarge a load change width and hence, it is possible to realize a desired jet flow of cleaning water.

[0090] That is, for example, even when a user sets a weak water flow condition, that is, a condition where a flow rate of cleaning water is minimum and a flow speed of cleaning water is small, firstly, the flow speed of cleaning water is made as fast as possible due to throttling portion 25a. Further, by making cleaning water whose flow speed is increased impinge on turbulence generating portion 25 thus generating turbulence such as a vortex flow, it is possible to generate a pulsation jet flow where an amplitude of a load change width of the jet flow is large.

[0091] On the other hand, as shown in FIG. 13, even when neither the throttling portion nor turbulence generating portion is provided and only the nozzle spout opening which constitutes a sharply-narrowed nozzle is provided, provided that a flow rate of cleaning water is large and a flow speed of cleaning water is fast, a jet flow having large pulsation can be generated by cavitation generated at the sharply-narrowed portion. That is, it is understood that when a flow rate shown in FIG. 13 exceeds 0.7 L/min, a load change width of a jet flow can be enlarged. Accordingly, it is understood that even only with the constitution of the nozzle spout opening which constitutes the sharply-narrowed nozzle, it is possible to acquire a jet flow of cleaning water having a large load change width

by increasing a flow rate of cleaning water.

[0092] However, it is difficult to realize a jet flow of cleaning water having a large load change width when a flow rate of cleaning water is small, that is, the flow rate is 0.6 L/min or less.

[0093] As described above, according to this exemplary embodiment, in the case where the turbulence generating portion (projection 25c shown in FIG. 13) is provided to direction-changing portion 27, a load change width of a jet flow can be enlarged along with the increase of a flow rate of cleaning water compared to a case where neither throttling portion nor the turbulence generating portion is provided. Further, it is understood that even when a flow rate of cleaning water is 0.6 L/min or less, a high load change width can be acquired. Accordingly, even when a flow rate of cleaning water is small, a pulsation effect of a jet flow of cleaning water can be enhanced so that a higher cleaning effect and a more excellent clean feeling can be acquired.

[0094] In this exemplary embodiment, the description has been made by taking the case where the upper surface of projection 25c which constitutes turbulence generating portion 25 has the same height. However, the present invention is not limited to such a constitution. For example, upper surface 25c1 of projection 25c may be formed in an inclined manner toward a lower side (a bottom portion 22b side of introducing passage 22) as the upper surface 25c1 is away from a throttling portion 25a side. Due to such a constitution, cleaning water which impinges on projection 25c can be effectively disturbed.

[0095] Further, in this exemplary embodiment, the description has been made with respect to the case where projection 25c which constitutes turbulence generating portion 25 is provided to introducing passage 22 which constitutes direction-changing portion 27. However, the present invention is not limited to such a case. For example, as shown in FIG. 14, projection 25b may be disposed upstream of throttling portion 25a. Accordingly, with the simple constitution where the above-mentioned turbulence generating portion is not provided, a flow speed of cleaning water which flows into the throttling portion can be increased. As a result, a pulsation effect of a jet flow of cleaning water spouted out from exit portion 23a of discharge opening 23 of nozzle spout portion 26 can be increased.

THIRD EXEMPLARY EMBODIMENT

[0096] Hereinafter, a sanitary cleaning device according to the third exemplary embodiment of the present invention is described with reference to Fig. 15.

[0097] FIG. 15 is a cross-sectional view of a pulsation pump according to the third exemplary embodiment of the present invention.

[0098] As shown in FIG. 15, the sanitary cleaning device according this exemplary embodiment differs from the sanitary cleaning devices of the above-mentioned respective exemplary embodiments in that water pump 14 is formed of pulsation pump 14a. Other constitutions and the manner of operation and advantageous effects of the sanitary cleaning device of this exemplary embodiment are equal to those of the sanitary cleaning device of the above-mentioned exemplary embodiments and hence, the detailed description of other constitutions and the manner of operation and advantageous effects of the sanitary cleaning device of this exemplary embodiment is omitted. The example is described where pulsation pump 14a is formed of positive displacement pump 14a.

[0099] Firstly, the constitution and the manner of operation of the positive displacement pump which is a pulsation pump mounted in a body portion of the sanitary cleaning device according this exemplary embodiment are described with reference to FIG. 15.

[0100] As shown in FIG. 15, positive displacement pump 14a includes at least: pump body portion 81 having column-shaped space 82; pressure-supply piston 83; motor 86; link mechanism 89 and the like. In such a constitution, column-shaped space 82 of pump body portion 81 is divided into pump chamber 82a and pump chamber 82b by pressure-supply piston 83.

[0101] Inflow portion 84 for cleaning water is formed on one side portion of pump body portion 81, and outflow portion 85 for cleaning water is formed on the other side portion of pump body portion 81. Inflow portion 84 is connected to heat exchanger 12 through body part cleaning water flow passage 202, and outflow portion 85 is connected to changeover valve 16 through body part cleaning water flow passage 202.

[0102] Gear 87 mounted on a rotary shaft of motor 86 and gear 88 connected to link mechanism 89 are meshed with each other and hence, the rotational movement of motor 86 is converted into reciprocating movement of pressure-supply piston 83 by way of link mechanism 89. That is, when motor 86 is rotated, pressure-supply piston 83 is moved in a reciprocating manner by way of gear 87, gear 88 and link mechanism 89.

[0103] Due to such a constitution, positive displacement pump 14a performs the following manner of operation.

[0104] Firstly, when pressure-supply piston 83 moves in the downward direction so that the volume of pump chamber 82a is increased, a pressure in pump chamber 82a becomes lower than a pressure in inflow portion 84. Accordingly, cleaning water in heat exchanger 12 is supplied to pump chamber 82a from inflow portion 84a.

[0105] On the other hand, when pressure-supply piston 83 moves in the upward direction so that the volume of pump chamber 82a is decreased, pressure in pump chamber 82a becomes higher than a pressure in outflow portion 85. Accordingly, cleaning water supplied to pump chamber 82a is discharged to outflow portion 85a.

[0106] When cleaning water in pump chamber 82a is discharged from outflow portion 85a accordingly, cleaning water is supplied to pump chamber 82b from inflow portion 84b. Then, when cleaning water in pump chamber 82a is supplied from inflow portion 84a, cleaning water

in pump chamber 82b is discharged from outflow portion 85b.

[0107] That is, due to the upward and downward movement of pressure-supply piston 83, a pressure is applied to cleaning water in pump chamber 82a and cleaning water in pump chamber 82b alternately. Further, by changing a reciprocating speed of pressure-supply piston 83 within one rotation, it is possible to impart periodical pulsation to cleaning water in inflow portion 84. In this case, with respect to a pulsation pressure of cleaning water, the lowest pressure at the time of pulsation becomes substantially equal to an inflow pressure of positive displacement pump 14a. On the other hand, the highest pressure of pulsation pressure becomes a pressure corresponding to a load of positive displacement pump 14a and a speed of change in volume of positive displacement pump 14a. Accordingly, cleaning water to which a pulsation pressure is applied is discharged from outflow portion 85 of positive displacement 14a.

[0108] As described above, according to this exemplary embodiment, due to an operation of pulsation pump 14a which is positive displacement pump 14a, cleaning water to which pulsation is imparted in advance flows into nozzle spout portion 26 through inflow passage 21, direction-changing portion 27, introducing passage 22 of body part cleaning nozzle 1. Therefore, disturbance of cleaning water such as a vortex at direction-changing portion 27 is accelerated by pulsating cleaning water. Accordingly, it is possible to impart a higher pulsation effect to a jet flow of cleaning water spouted out from exit portion 23a of discharge opening 23 of nozzle spout portion 26 which constitutes a sharply-narrowed flow passage.

[0109] In a conventional body part cleaning nozzle, to ensure a cleaning effect and a clean feeling, a powerful and expensive pulsation pump was necessary.

[0110] To the contrary, according to this exemplary embodiment, as described in conjunction with the first exemplary embodiment, it is possible to impart pulsation to a jet flow of cleaning water by nozzle spout portion 26. Accordingly, as pulsation pump 14a, pulsation pump 14a with a smaller pulsation pressure can be used. Further, due to such a constitution, it is possible to effectively spout out a jet flow of cleaning water formed of divided water masses of a size by which a good clean feeling can be acquired from exit portion 23a of discharge opening 23 of nozzle spout portion 26. Accordingly, pulsation pump 14a of a low cost can be used by reducing a load of pulsation pump 14a. As a result, it is possible to realize a sanitary cleaning device which can realize a low cost.

[0111] As described above, the present invention provides the sanitary cleaning device which discharges supplied cleaning water toward a body part from the body part cleaning nozzle, wherein the body part cleaning nozzle includes the inflow passage, the introducing passage, and the nozzle spout portion having the discharge opening. The inflow passage is connected to one end of the introducing passage via a direction-changing portion having a throttling portion. The nozzle spout portion is formed of a sharply-narrowed flow passage which is connected to another end of the introducing passage and whose flow passage cross-sectional area is sharply reduced by the introducing passage and the discharge opening.

[0112] Due to such a constitution, the throttling portion is disposed in the direction-changing portion which connects the inflow passage and the introducing passage of the body part cleaning nozzle to each other. Accordingly, a flow speed of cleaning water which is injected into the direction-changing portion from the inflow passage is increased at the throttling portion. In a state where the flow speed is high, cleaning water impinges on the inner wall surface of the introducing passage and, at the same time, the flow direction is diverted by the direction-changing portion and hence, the turbulence of flow such as a vortex is generated in cleaning water. As a result, a high pulsation effect is imparted to a jet flow of cleaning water and hence, cleaning water can be spouted out from the discharge opening of the nozzle spout portion.

[0113] Further, due to the provision of the nozzle spout portion which forms the sharply-narrowed flow passage, cleaning water which flows into the nozzle spout portion spouts out from the discharge opening in a contracted flow. At this point of time, in the nozzle spout portion, a space is formed between an outer periphery of a jet flow of cleaning water which forms a contracted flow and an inner peripheral wall of the discharge opening toward the discharge opening. Then, air flows into the space formed between the outer periphery of the jet flow of cleaning water and the inner peripheral wall of the discharge opening from the outside, and a vortex is generated due to cleaning water outside the outer periphery of the jet flow in a contracted flow and air whereby cleaning water and air are mixed to each other. At this point of time, a mixing phenomenon of cleaning water and air is not uniform and hence, air and cleaning water flow out in the form of mixed masses. Accordingly, it is possible to impart pulsation to cleaning water spouted out from the discharge opening of the nozzle spout portion. As a result, it is possible to provide a sanitary cleaning device which exhibits a high cleaning effect and to give an enhanced clean feeling to a user even when a flow rate of cleaning water is small. In this case, when a flow speed of cleaning water is sufficiently fast, cavitation occurs at a vortex or the corner of the inflow portion of the discharge opening of the nozzle spout portion as an initiation point. As a result, it is possible to impart the larger pulsation to cleaning water.

[0114] By forming the sharply-narrowed flow passage at the exit portion of the discharge opening of the nozzle spout portion, a contracted flow of cleaning water forms the minimum diameter portion. Further, a gap is formed between a jet flow of cleaning water and the inner peripheral wall of the discharge opening. Due to such a constitution, the discharging direction of a jet flow of cleaning water is not influenced by the inner peripheral wall of the discharge opening. As a result, it is possible

to impart the degree of freedom to the direction that a jet flow of cleaning water is discharged (for example, the longitudinal direction that the body part cleaning nozzle projects). Further, a vortex generated in the space formed by the outer periphery of a jet flow of cleaning water and the inner peripheral wall of the discharge opening changes in terms of time as well as in terms of space. Accordingly, it is possible to impart an action of swinging in the discharge direction of a jet flow of cleaning water in accordance with a change in a vortex.

[0115] Further, according to the sanitary cleaning device of the present invention, in the nozzle spout portion, aspect ratio (L/D) between diameter D and flow passage length L of the discharge opening may be set to a value which falls within a range from 0.25 to 0.75. Further, in the nozzle spout portion, aspect ratio (L/D) between diameter D of the discharge opening and flow passage length L of the discharge opening may be set to a value which falls within a range from 0.4 to 0.7.

[0116] Due to such a constitution, it is possible to make the minimum diameter portion (maximum flow speed portion) of the contracted flow portion generated in the discharge opening of the nozzle spout portion approximately agree with (including "agree with") the position of the exit portion of the discharge opening. Accordingly, at the position of the exit portion of the discharge opening, a space formed by an outer periphery of a jet flow of cleaning water and the inner peripheral wall of the discharge opening becomes maximum. An opening area for air which flows into the negative pressure portion generated at the contracted flow portion formed in the discharge opening of the nozzle spout portion becomes maximum and hence, air can easily flow into the negative pressure portion. Accordingly, air which flows into the negative pressure portion and cleaning water are effectively mixed with each other and hence, even when a flow rate of jet flow of cleaning water from the body part cleaning nozzle is small, cleaning water can be divided into water masses by which a user can acquire a strong clean feeling. As a result, even when a flow rate of jet flow of cleaning water from body part cleaning nozzle is small, it is possible to realize a sanitary cleaning device having a high cleaning effect and a clean feeling.

[0117] Further, by setting aspect ratio (L/D) to a value which falls within a range from 0.25 to 0.75 or within a range from 0.4 to 0.7, it is possible to configure the exit portion of the discharge opening of the nozzle spout portion such that a space formed between the outer periphery of a jet flow and the inner peripheral wall of the discharge opening becomes maximum. Accordingly, outside air flows into the space and, at the same time, air is easily taken in a jet flow of cleaning water. Then, air taken in the jet flow of cleaning water increases a volume of the jet flow of cleaning water thus increasing a diameter of an outer periphery of the jet flow. In this case, the outer periphery of the jet flow of cleaning water is allowed to sufficiently spread into the space and hence, due to air taken in cleaning water, even when a flow rate of jet flow of cleaning water from the body part cleaning nozzle is small, it is possible to divide cleaning water into water masses by which a user can acquire a strong clean feeling. Due to a pulsation jet flow generated by divided water masses, a load change width of a jet flow which impinges on a part to be cleaned is increased. As a result, even when a flow rate of jet flow of cleaning water from the body part cleaning nozzle is small, it is possible to realize a sanitary cleaning device which acquires a high cleaning effect and a clean feeling.

[0118] According to the sanitary cleaning device of the present invention, the direction-changing portion may be configured such that the flow direction of cleaning water which flows in the inflow passage and the flow direction of cleaning water which flows in the introducing passage may be changed at a right angle. Due to such a constitution, cleaning water which flows into the introducing passage from the inflow passage impinges on the inner wall surface of the introducing passage and hence, a flow speed distribution of cleaning water which advances to the nozzle spout portion changes. Then, a jet flow of cleaning water is divided at the nozzle spout portion which constitutes the sharply-narrowed flow passage and, at the same time, cleaning water in the direction (longitudinal direction) that the body part cleaning nozzle projects is discharged while being swung. As a result, it is possible to realize a sanitary cleaning device which acquires a high cleaning effect and gives an excellent clean feeling.

[0119] According to the sanitary cleaning device of the present invention, an inflow portion of the discharge opening of the nozzle spout portion connected to the introducing passage may have a corner formed into an acute angle between an outer region of inflow portion and an inner peripheral wall of the discharge opening. Due to such a constitution, the flow of cleaning water can be peeled off with certainty by a portion of the corner at the inflow portion of the discharge opening of the nozzle spout portion. In this case, the corner acts so as to allow air from the outside to easily flow into the negative pressure portion generated by the reducing flow portion formed by the nozzle spout portion. As a result, even when a flow rate of jet flow of cleaning water from the body part cleaning nozzle is small, cleaning water is divided into water masses of a size which can give a strong clean feeling, and thus further enhance a cleaning effect and a clean feeling.

[0120] According to the sanitary cleaning device of the present invention, the inflow portion of the discharge opening may have a burr that projects toward an introducing passage side. Due to such a constitution, by ensuring an edge of the corner of the inflow portion of the discharge opening of the nozzle spout portion, it is possible to surely peel off the flow of cleaning water by the edge portion of the corner. In this case, the corner acts so as to allow air from the outside to easily flow into the negative pressure portion generated by the reducing flow portion formed by the nozzle spout portion. As a result,

even when a flow rate of jet flow of cleaning water from the body part cleaning nozzle is small, cleaning water is divided into water masses of a size which can give a strong clean feeling, and thus further enhance a cleaning effect and a clean feeling.

[0121] According to the sanitary cleaning device of the present invention, a turbulence generating portion which disturbs the flow of the cleaning water flowing into the introducing passage from the inflow passage through the throttling portion may be formed in the inflow passage at a direction-changing portion side. Further, the turbulence generating portion may be formed of a projection formed in an extending manner toward the discharge opening from a bottom portion of the introducing passage. Due to such a constitution, the turbulence of the flow of cleaning water which flows into the introducing passage is accelerated and hence, a pulsation effect of cleaning water which is spouted out from the nozzle spout portion can be further enhanced.

[0122] According to the sanitary cleaning device of the present invention, the projection may be formed into a shape of a prism. Due to such a constitution, the turbulence of the flow of cleaning water which flows into the introducing passage can be further accelerated.

[0123] According to the sanitary cleaning device of the present invention, an upper surface of the projection may be inclined downwardly with increase in distance from one side adjacent to the throttling portion. Due to such a constitution, the turbulence of the flow of cleaning water which flows into the introducing passage can be further accelerated.

[0124] According to the sanitary cleaning device of the present invention, the upper surface of the projection is located at a height within a range twice a distance between a lowest portion of the inflow port and the throttling portion, when the height is measured from the lowest portion of the inflow port that constitutes the direction-changing portion. Due to such a constitution, the flow of cleaning water which flows into the introducing passage can be effectively disturbed.

[0125] According to the sanitary cleaning device of the present invention, a pulsation pump may be disposed upstream of the body part cleaning nozzle. Due to such a constitution, by making use of the pulsation generated by the nozzle spout portion, it is possible to use the pulsation pump with a smaller pulsation pressure. As a result, it is possible to divide a jet flow of cleaning water from the nozzle spout portion into water masses of a size which can acquire a more preferable clean feeling and, at the same time, a load of the pulsation pump can be decreased.

INDUSTRIAL APPLICABILITY

[0126] The present invention can enhance a cleaning effect and a clean feeling by dividing a jet flow of cleaning water into water masses of a size which can acquire a strong clean feeling even when a flow rate of jet flow of cleaning water is small. Accordingly, the present invention is applicable not only to a hot water cleaning toilet bowl seat but also applications such as a sanitary cleaning device for cleaning face, head, hands, legs and the like and cleaning of animals such as pets or non-living matters.

REFERENCE MARKS IN THE DRAWINGS

[0127]

1	body part cleaning nozzle (buttock nozzle)
2	bidet nozzle
3	nozzle cleaning nozzle
4	control part
5	branch faucet
6	strainer
7	electromagnetic valve
8	atmosphere release portion
8a	tank
9	constant flow regulating valve
12	heat exchanger
13a, 13b	temperature sensor
14	water pump
14a	positive displacement pump (pulsation pump)
15	buffer tank
16	changeover valve
20	nozzle portion
21	inflow passage
21a	lowest portion
22	introducing passage
22a	inner wall surface
22b	bottom portion
23	discharge opening
23a	exit portion
23b	inflow portion
23c	corner
23d	inner peripheral wall
25	turbulence generating portion
25a	throttling portion
25b, 25c	projection
25c1	upper surface
26	nozzle spout portion
27	direction-changing portion
28	contracted flow curve
28a	minimum diameter portion
29	vortex
31	vacuum breaker
40	toilet bowl nozzle
51	relief valve
81	pump body portion
82	column-shaped space
82a	pump chamber
82b	pump chamber
83	pressure-supply piston
84, 84a, 84b	inflow portion

85, 85a, 85b	outflow portion
86	motor
87, 88	gear
89	link mechanism
100	sanitary cleaning device
200	body portion
201	water supply pipe
202	body part cleaning water flow passage
205	toilet bowl cleaning water flow passage
300	remote control unit
301	controller body portion
302	stop switch
303	buttock switch (buttock cleaning button)
304	bidet switch (bidet cleaning button)
305	wide cleaning switch
306	rhythm cleaning switch
307	water power setting switch
309	movement cleaning switch
310	cleaning position setting switch
400	toilet seat portion
500	lid portion
600	entrance detection sensor
610	sitting detection sensor
700	toilet bowl
1000	toilet device

Claims

1. A sanitary cleaning device which discharges supplied cleaning water toward a body part from a body part cleaning nozzle, wherein
the body part cleaning nozzle includes: an inflow passage; an introducing passage; and a nozzle spout portion having a discharge opening,
the inflow passage is connected to one end of the introducing passage via a direction-changing portion having a throttling portion, and
the nozzle spout portion is connected to another end of the introducing passage, and includes a sharply-narrowed flow passage which is formed by the introducing passage and the discharge opening and where a cross section of a flow passage is sharply reduced.

2. The sanitary cleaning device according to claim 1, wherein, in the nozzle spout portion, an aspect ratio (L/D) between a diameter D and a flow passage length L of the discharge opening is set to a value of 0.25 to 0.75.

3. The sanitary cleaning device according to claim 1, wherein, in the nozzle spout portion, an aspect ratio (L/D) between a diameter D and a flow passage length L of the discharge opening is set to a value of 0.4 to 0.7.

4. The sanitary cleaning device according to claim 1, wherein the direction-changing portion changes a flow direction of the cleaning water which flows in the inflow passage and the introducing passage into approximately a right angle.

5. The sanitary cleaning device according to claim 1, wherein an inflow portion of the discharge opening of the nozzle spout portion connected to the introducing passage has a corner formed into an acute angle between an outer region of the inflow portion and an inner peripheral wall of the discharge opening.

6. The sanitary cleaning device according to claim 1, wherein the inflow portion of the discharge opening has a burr that projects toward an introducing passage side.

7. The sanitary cleaning device according to claim 1, wherein the introducing passage at a direction-changing portion side has a turbulence generating portion which disturbs a flow of the cleaning water flowing from the inflow passage through the throttling portion.

8. The sanitary cleaning device according to claim 7, wherein the turbulence generating portion is formed of a projection extending toward the discharge opening from a bottom portion of the introducing passage.

9. The sanitary cleaning device according to claim 8, wherein the projection is formed into a shape of a prism.

10. The sanitary cleaning device according to claim 8 or claim 9, wherein an upper surface of the projection is inclined downwardly with increase in distance from one side adjacent to the throttling portion.

11. The sanitary cleaning device according to claim 8, wherein an upper surface of the projection is located at a height within a range twice a distance between a lowest portion of the inflow passage and the throttling portion, when the height is measured from the lowest portion of the inflow passage that constitutes the direction-changing portion.

12. The sanitary cleaning device according to claim 1, wherein a pulsation pump is provided upstream of the body part cleaning nozzle.

FIG. 1

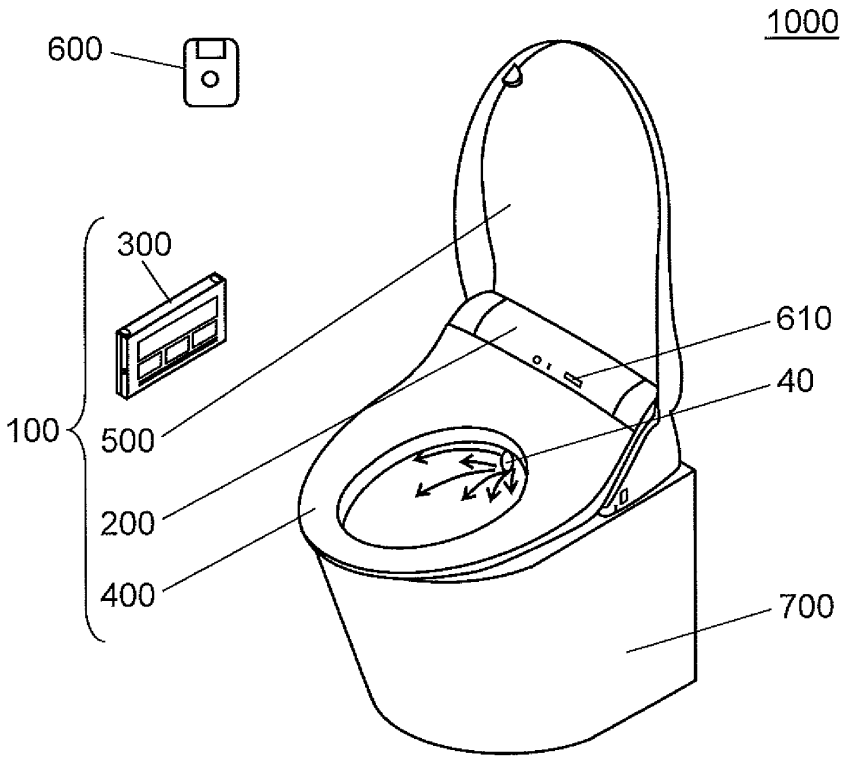

1000
600
300
100
500
200
400
610
40
700

FIG. 2

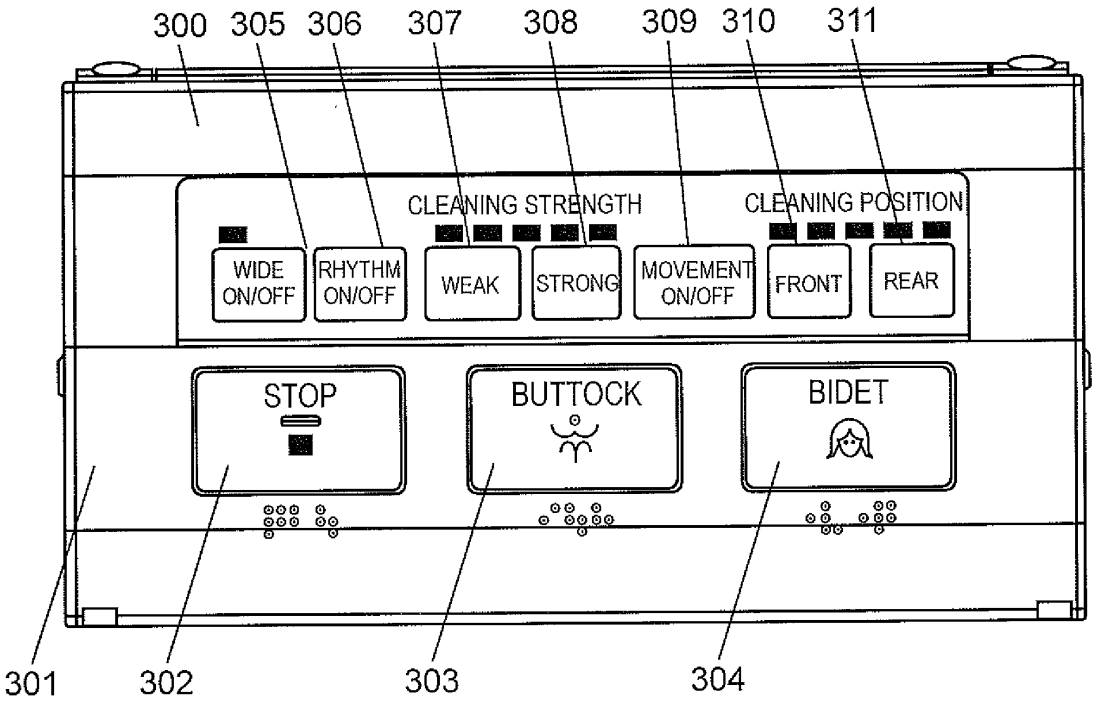

300
305
306
307
308
309
310
311
CLEANING STRENGTH
CLEANING POSITION
WIDE ON/OFF
RHYTHM ON/OFF
WEAK
STRONG
MOVEMENT ON/OFF
FRONT
REAR
STOP
BUTTOCK
BIDET
301
302
303
304

FIG. 3

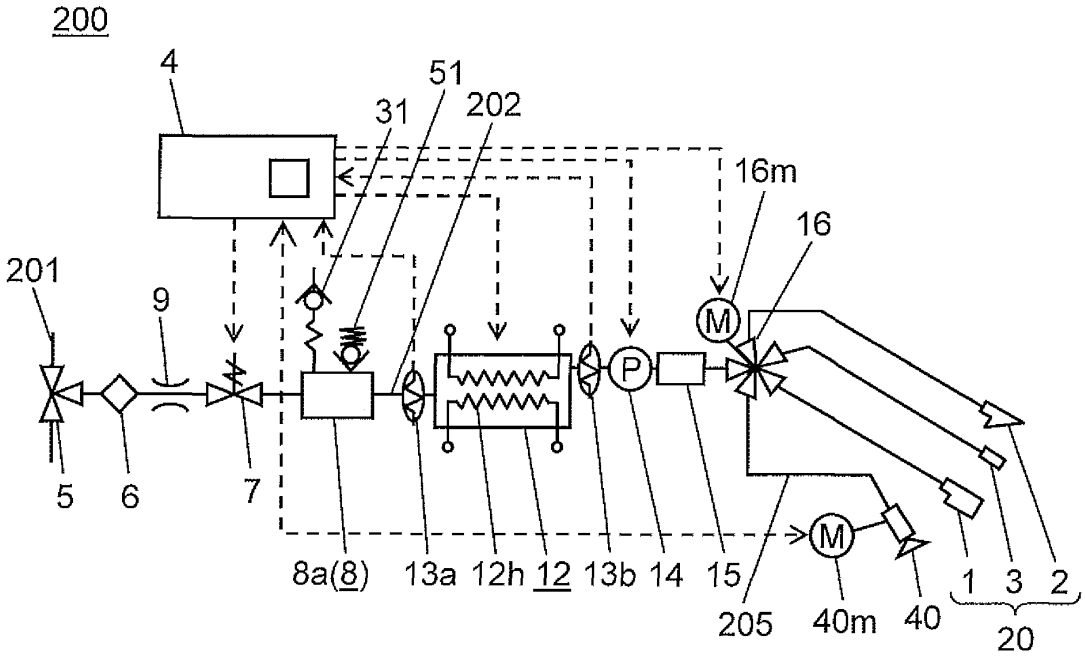

200
4
51
31
202
16m
16
201
9
M
P
5
6
7
8a(8)
13a
12h
12
13b
14
15
M
1
3
2
205
40m
40
20

FIG. 4

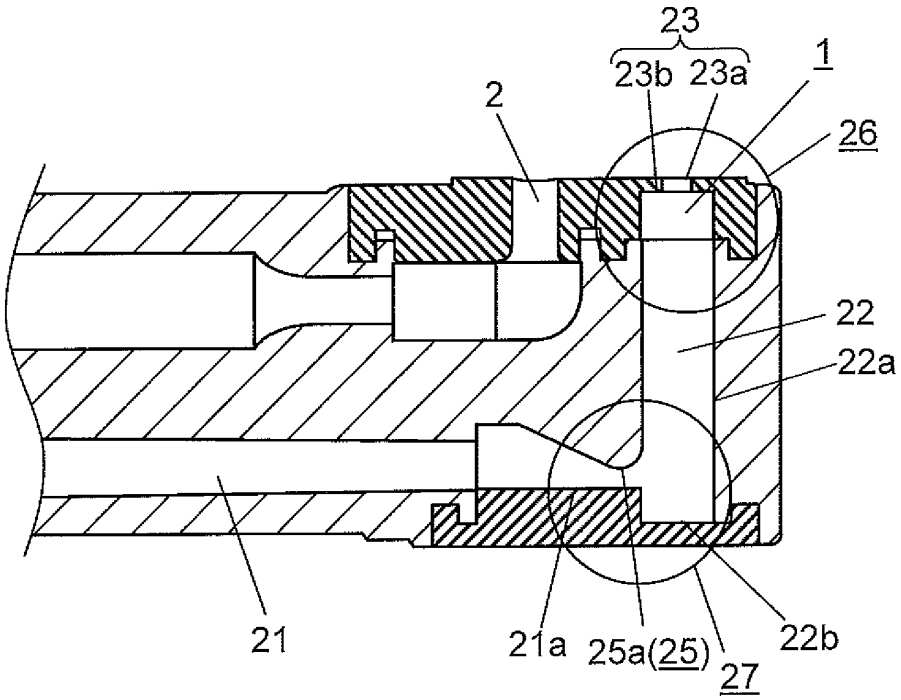

23
23b
23a
1
2
26
22
22a
21
21a
25a(25)
27
22b

FIG. 5

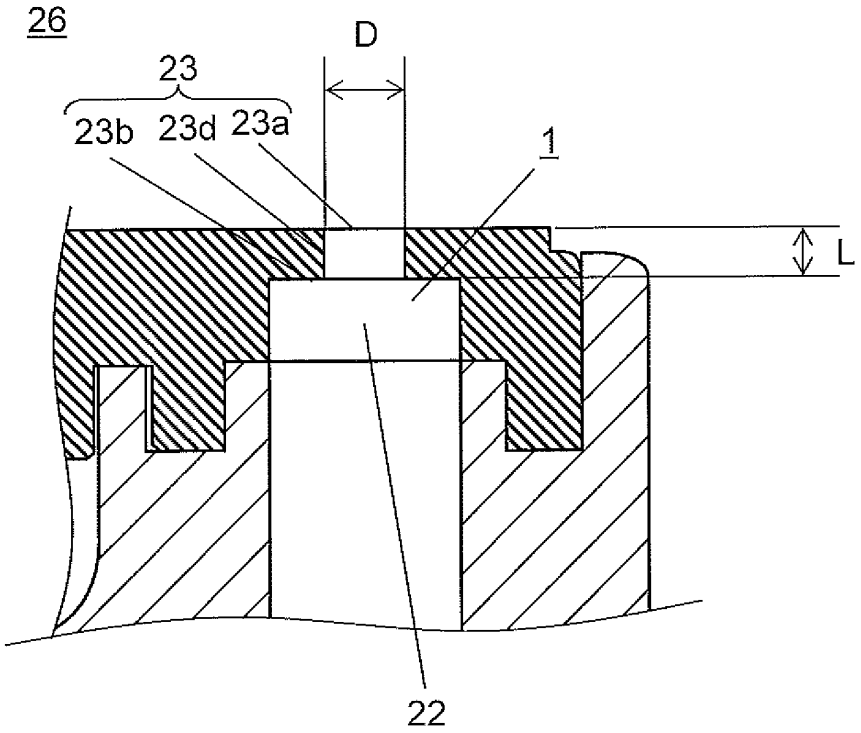

26
D
23
23b
23d
23a
1
L
22

FIG. 6

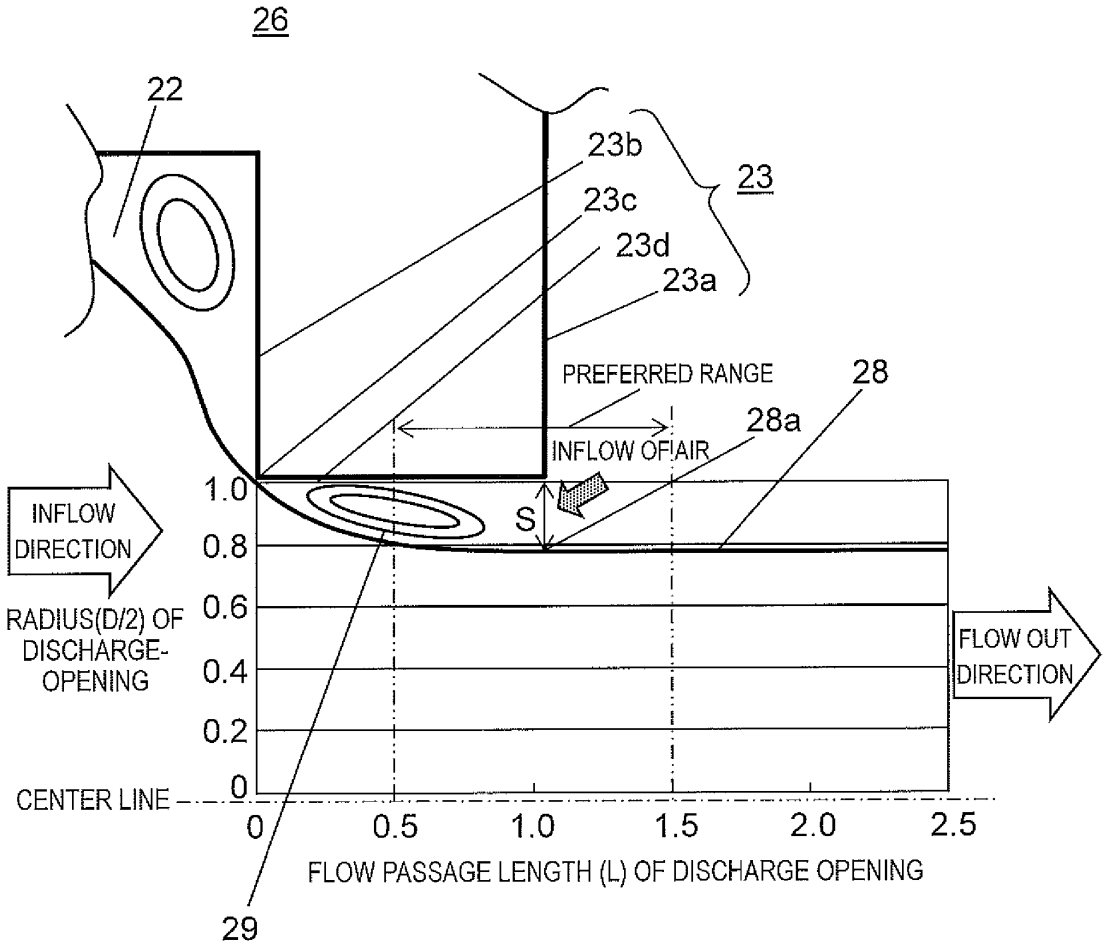

26
22
23b
23c
23d
23a
23
PREFERRED RANGE
28
28a
INFLOW OF AIR
S
INFLOW DIRECTION
RADIUS(D/2) OF DISCHARGE-OPENING
1.0
0.8
0.6
0.4
0.2
0
CENTER LINE
FLOW OUT DIRECTION
0
0.5
1.0
1.5
2.0
2.5
FLOW PASSAGE LENGTH (L) OF DISCHARGE OPENING
29

FIG. 7

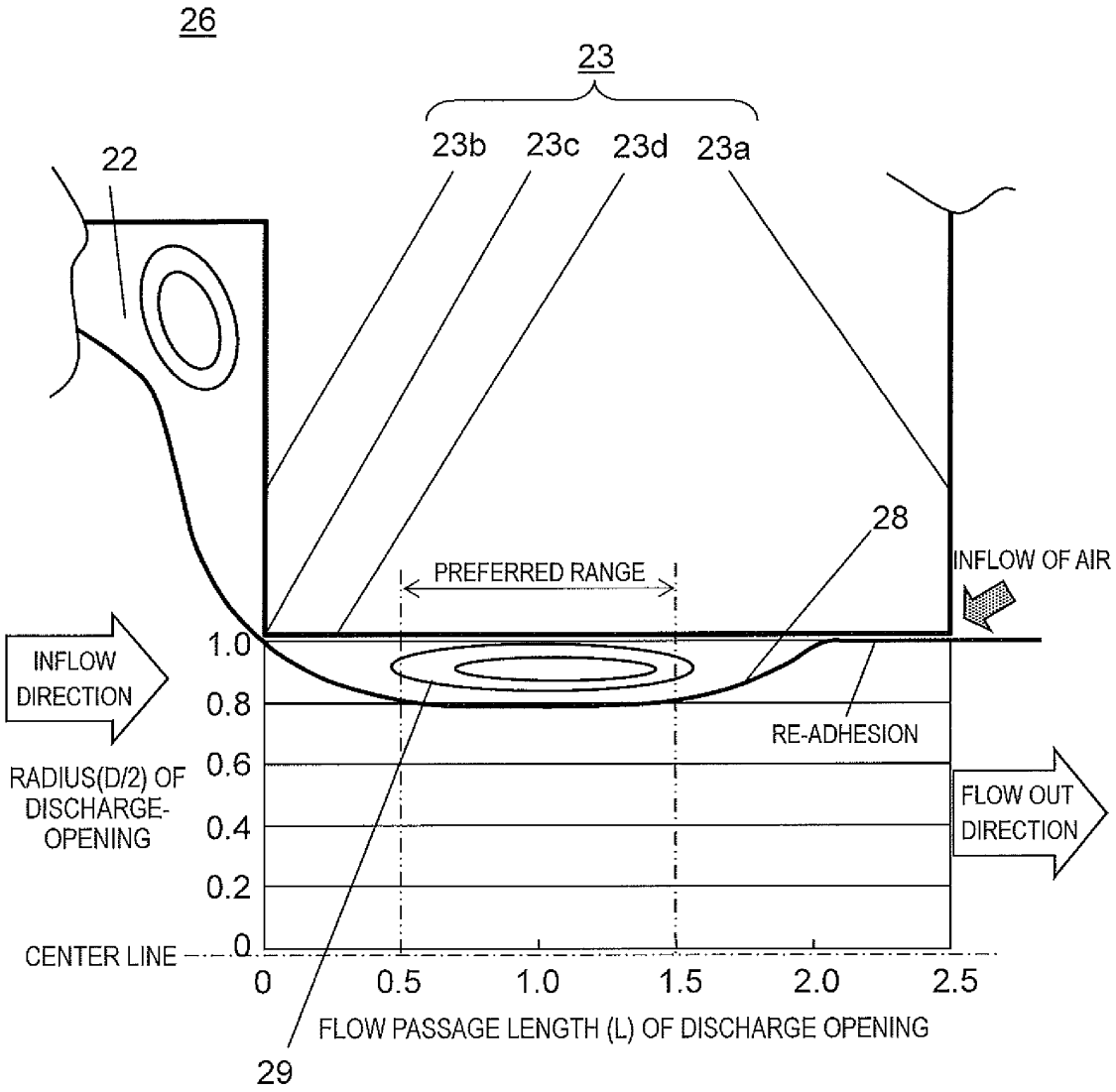

26
23
22
23b
23c
23d
23a
28
PREFERRED RANGE
INFLOW OF AIR
INFLOW DIRECTION
1.0
0.8
0.6
0.4
0.2
0
RE-ADHESION
RADIUS(D/2) OF DISCHARGE-OPENING
FLOW OUT DIRECTION
CENTER LINE
0
0.5
1.0
1.5
2.0
2.5
FLOW PASSAGE LENGTH (L) OF DISCHARGE OPENING
29

FIG. 8

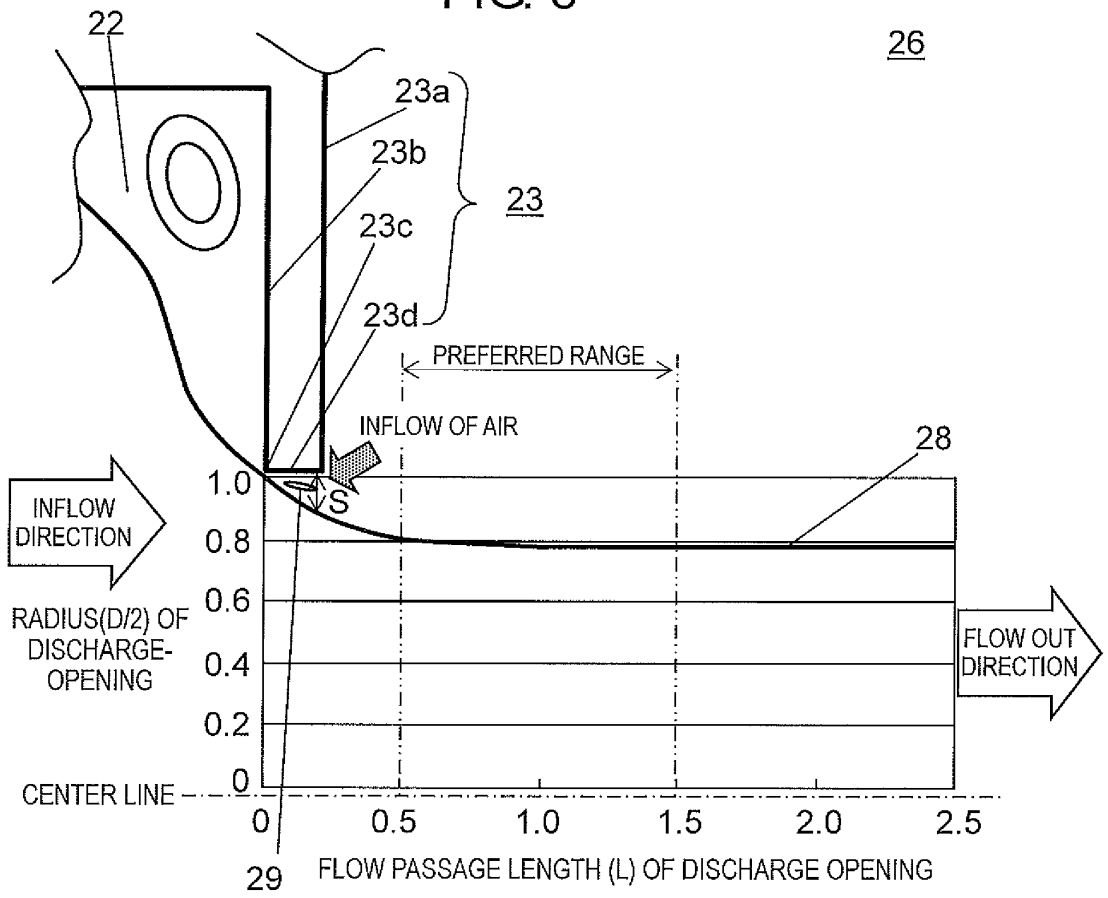

22
26
23a
23b
23c
23d
23
PREFERRED RANGE
INFLOW OF AIR
28
INFLOW DIRECTION
S
1.0
0.8
0.6
0.4
0.2
0
RADIUS(D/2) OF DISCHARGE-OPENING
FLOW OUT DIRECTION
CENTER LINE
0
0.5
1.0
1.5
2.0
2.5
29
FLOW PASSAGE LENGTH (L) OF DISCHARGE OPENING

FIG. 9

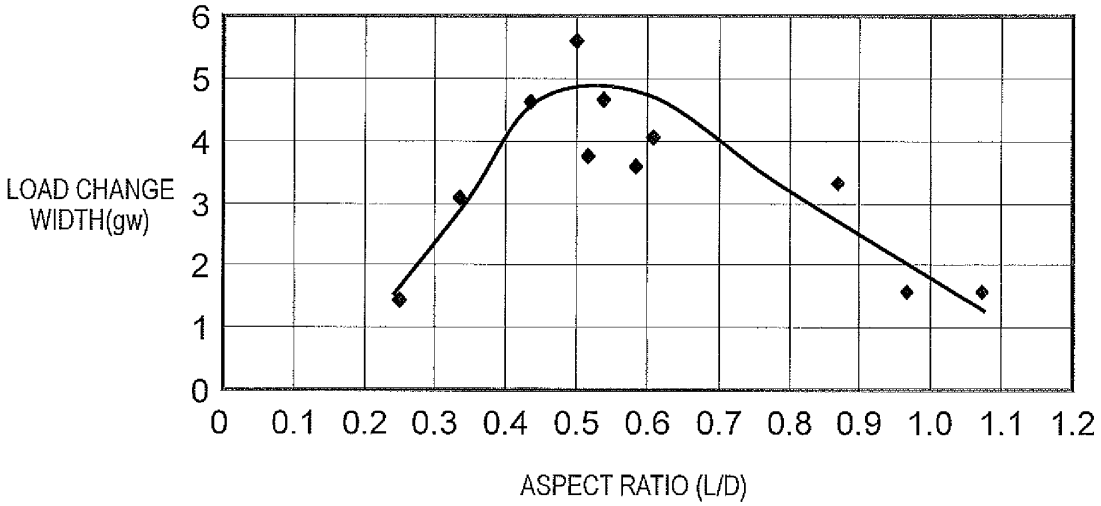

6
5
4
3
2
1
0
LOAD CHANGE WIDTH(gw)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
ASPECT RATIO (L/D)

FIG. 10

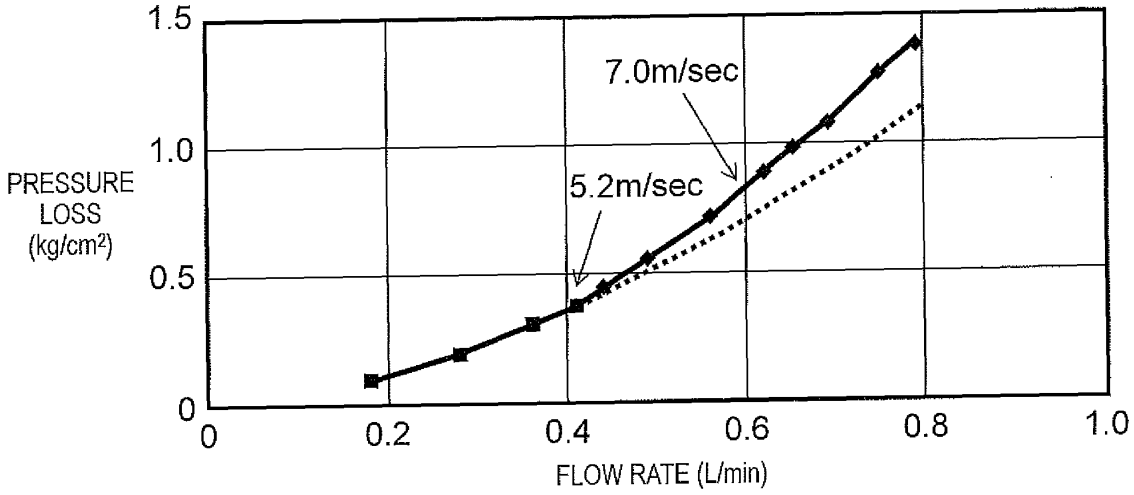

1.5
1.0
0.5
0
PRESSURE LOSS (kg/cm²)
7.0m/sec
5.2m/sec
0
0.2
0.4
0.6
0.8
1.0
FLOW RATE (L/min)

FIG. 11

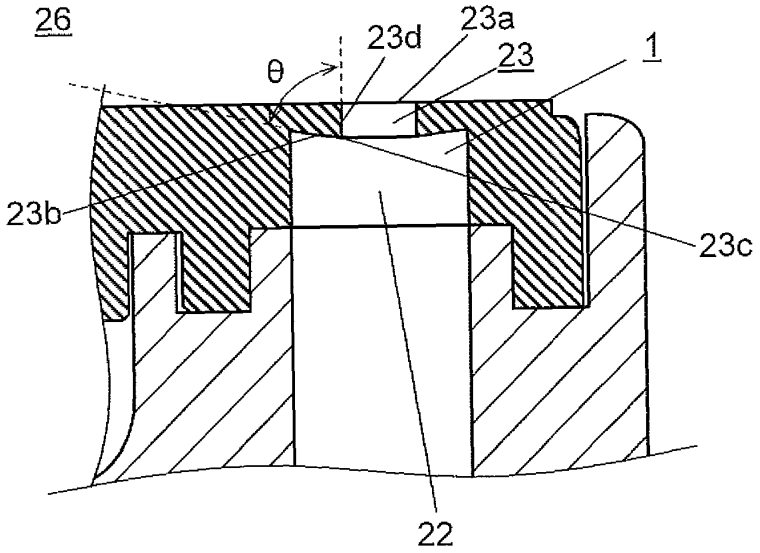

26
θ
23d
23a
23
1
23b
23c
22

FIG. 12

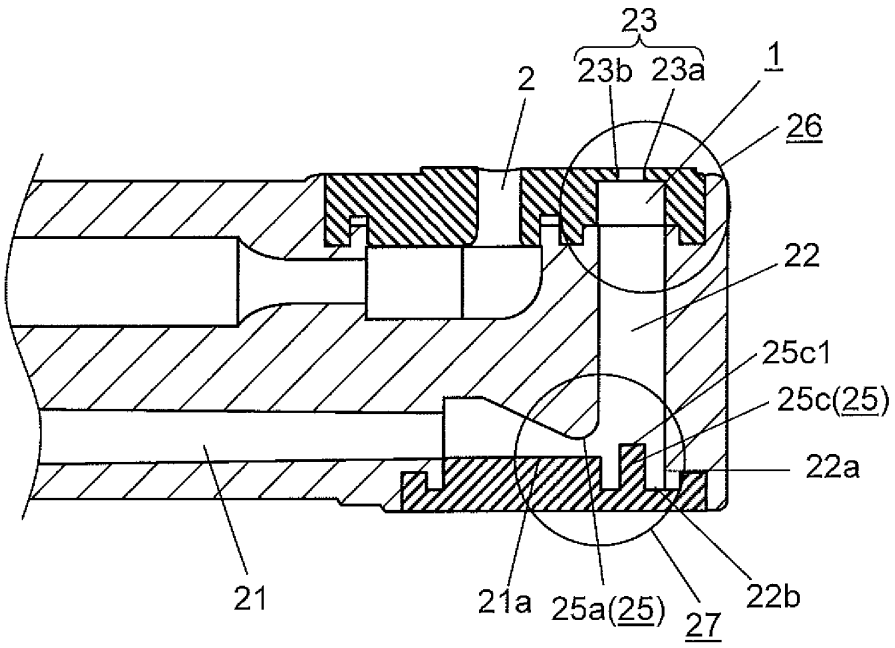

23
23b
23a
1
2
26
22
25c1
25c(25)
22a
21
21a
25a(25)
27
22b

FIG. 13

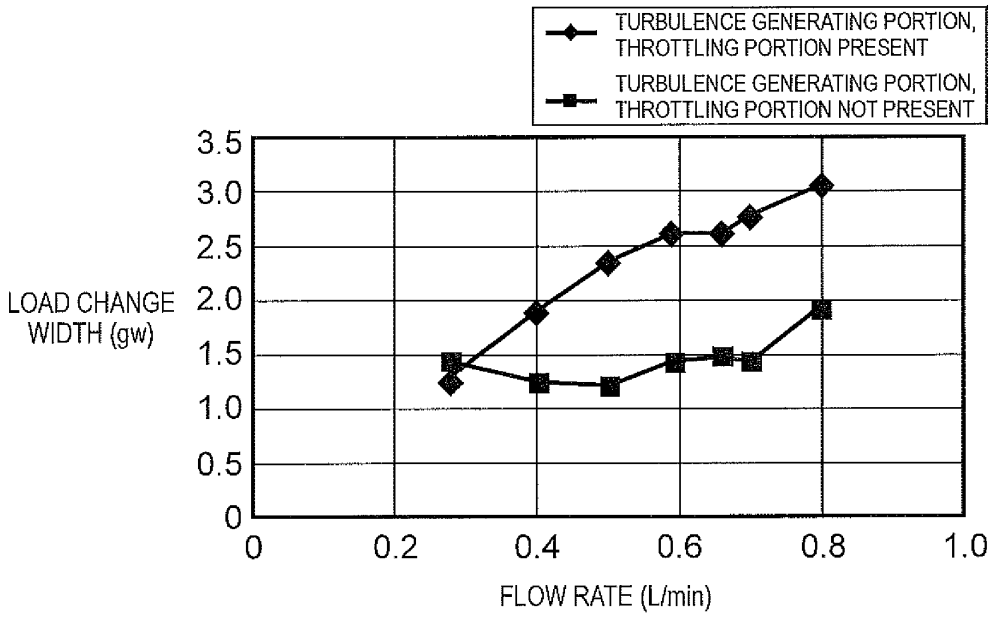

TURBULENCE GENERATING PORTION, THROTTLING PORTION PRESENT
TURBULENCE GENERATING PORTION, THROTTLING PORTION NOT PRESENT
LOAD CHANGE WIDTH (gw)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0
0.2
0.4
0.6
0.8
1.0
FLOW RATE (L/min)

FIG. 14

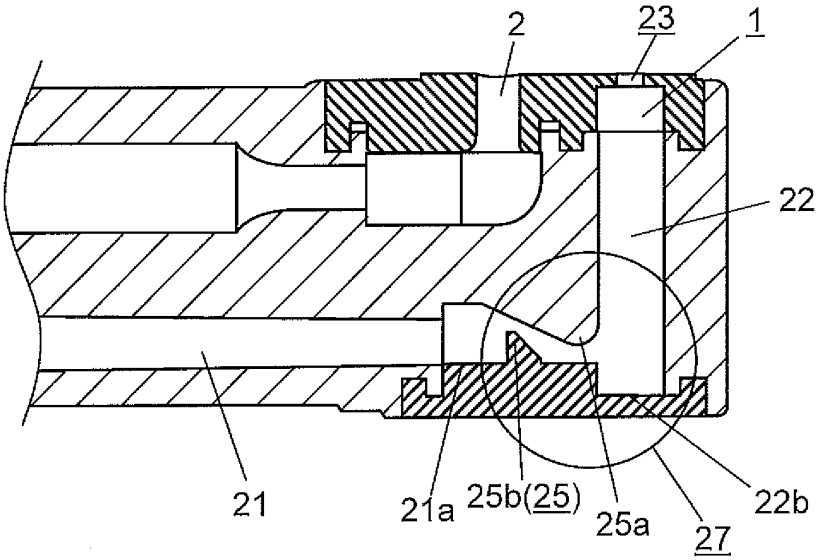
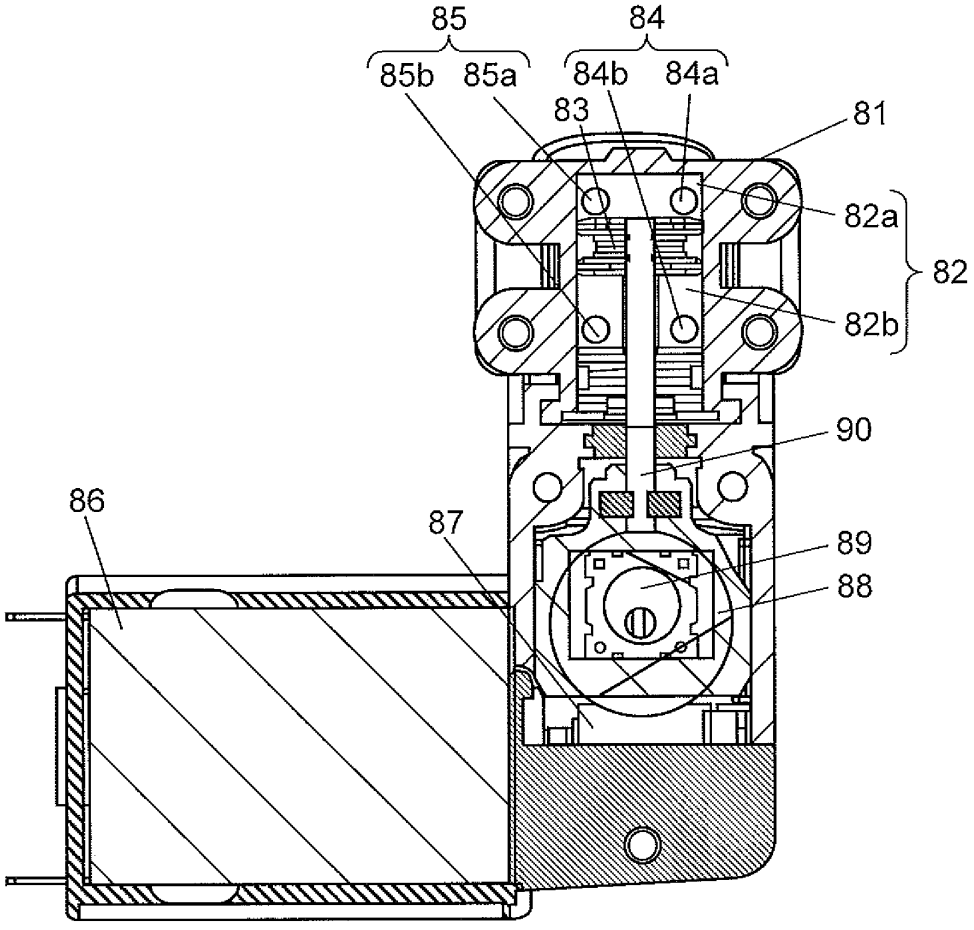

2
23
1
22
21
21a
25b(25)
25a
27
22b

FIG. 15


85
84
85b
85a
84b
84a
83
81
82a
82
82b
90
86
87
89
88

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/001289

A. CLASSIFICATION OF SUBJECT MATTER
E03D9/08(2006.01)i

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)
E03D9/08

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2013
Kokai Jitsuyo Shinan Koho	1971-2013	Toroku Jitsuyo Shinan Koho	1994-2013

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2011-190577 A (Panasonic Corp.), 29 September 2011 (29.09.2011), paragraphs [0028] to [0074]; fig. 3, 6, 8 & WO 2011/111339 A1 & CN 102365411 A & TW 201139802 A	1,4,12 2,3,5-11
Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 34125/1986(Laid-open No. 148682/1987) (Hitachi Chemical Co., Ltd.), 19 September 1987 (19.09.1987), page 3, line 4 to page 4, line 20; fig. 4 (Family: none)	1,4,12 2,3,5-11

☒ 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
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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
18 March, 2013 (18.03.13)	02 April, 2013 (02.04.13)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/001289

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2006-348545 A (Matsushita Electric Industrial Co., Ltd.), 28 December 2006 (28.12.2006), paragraph [0016]; fig. 3 (Family: none)	12
A	JP 2007-23674 A (Matsushita Electric Industrial Co., Ltd.), 01 February 2007 (01.02.2007), paragraph [0027]; fig. 4 (Family: none)	2,3

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2000120141 A **[0010]**
- JP 2003083205 A **[0010]**