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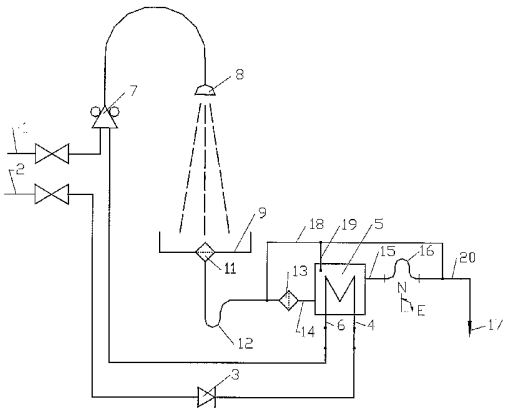
(54) Title: WASTE WATER PIPING WITH HEAT EXCHANGER FOR BATHING INSTALLATIONS



(57) Abstract: The invention relates to waste water piping with heat exchanger for bathing installations, for example a shower unit, which consists of basin (9), coarse and fine filters of waste water (11, 13), trap (12), heat exchanger (5), level controller (16) and air by-pass pipe (18), wherein in the waste water pipe (15) exiting the heat exchanger (5) a vertical level controller (16) is used creating an overflow barrier allowing emptying of the heat exchanger. The air by-pass pipe (18) positioned higher than the bottom of basin (9) by-passes heat exchanger (5) and level controller (16) channels air beyond trap (12) into sewage (17) via waste water drain (20). The heat exchanger (5) is preferably a heat exchanger element (31) made of copper pipes wound in reverse directions, which is preferably placed inside the wider section of waste water piping (30) so that this section of the piping is constantly filled with waste water with the aid of the level controller (16), and the heat exchanger element (31) connected at one end through the end cap (34) of the waste water pipe (30) can be easily removed under sanitary conditions using a plastic bag longer than the heat exchange element as a protective cover for the latter, which is placed with its mouth over the waste water pipe (30) from the side of end cap (34).

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WASTE WATER PIPING WITH HEAT EXCHANGER FOR BATHING INSTALLATIONS

This invention relates to waste water piping with new type of components for bathing installations (for example a shower unit) that are equipped with heat exchangers. In such bathing installations the heat energy of waste water is transferred to heated fresh water either directly or by an intermediate heat carrier.

Fitting the waste water piping with additional components according to this invention allows reducing the hydraulic resistance and the maintenance need of waste water piping and heat exchanger, making maintenance simpler and safer, and prolonging the service life of heat exchanger.

Several waste water heat exchanger systems allowing utilization of heat energy in waste water are known where heat exchangers of various construction and heat transfer characteristics are installed in the basin or under it. As examples, the specifications of inventions DE-3633321-A1, DE-3919543-A1, DE-3919544-A1, DE-3717720, DE-19817031, GB-2342146, NZ-314983 and EE-200100541 can be given. Fresh water flows through heat exchangers separated from the waste water. When using the shower, fresh water is warmed up and supplied either directly into the shower mixer or directed to the water heater. The main disadvantage of these inventions is rapid fouling since some air and impurities will remain in the heat exchanger and this is a hotbed for bacteria. For some solutions, e.g. DE-19817031A and EE-200100541, the heat exchanger drains after use. Therefore washing waste gathering on water surface is deposited on the heat exchanger element and dried on it forming a hotbed for bacteria. In other solutions where there is no trap in the basin's waste water drain, e.g. DE-3919543-A1, emission of bad smell, need for frequent cleaning or demand for large amounts of cleansing agent for frequent disinfection of heat exchanger create problems.

The closest solution to the present invention is disclosed in EE-200100541, that relates to a shower unit with a multi-pipe heat exchanger foreseen for households, health institutions, sports facilities, military sanitary units, hotels, summer cottages and other

places. The shower unit consists of a heat exchanger of novel construction, shower waste water trap, fresh water supply pipes, shower mixer (preferably with a thermostat), clean hot water supply pipes, shower basin, electronic unit with a display, temperature sensor and flow sensor of fresh water. The heat exchanger with a plastic shell is installed under the shower basin or close to it. Underflow and overflow barriers are incorporated into the heat exchanger before its waste water outlet. The underflow barrier allows outflow of the more cooled bottom layer of waste water while obstructing outflow of warmer waste water from upper layers that increases the heat exchange factor. The overflow barrier provides required water level in the heat exchanger so that the tubes of heat exchanger element are covered with water and draining through a small outlet in the bottom section of the overflow barrier.

The primary disadvantage of this unit is that some air will remain inside the heat exchanger and after use the heat exchanger will drain resulting in favourable conditions for the corrosion of metal parts and replication of aerobic bacteria and other micro-organisms, which during longer periods of inactivity dry and stick to the heat exchanger element together with washing waste deteriorating heat transfer and leading to clogging of the heat exchanger. The overflow barrier incorporated in the heat exchanger isn't designed to keep the heat exchanger fully filled with water, this results in favourable conditions for the bacteria to replicate.

Another significant disadvantage is the obstructed flow of waste water through the trap, because an air and foam lock is formed in the connector between the trap and heat exchanger, which creates additional hydraulic resistance resulting in gathering of washing water in the shower base bottom. The air that has passed through the trap can flow neither forward, because air cannot flow downward exceeding buoyancy, nor backward, because the trap obstructs outflow of air. For sanitary reasons, the trap cannot be excluded, because disinfection of the whole heat exchanger would consume extensive amounts of disinfection agent, which at the same time would be discharged from the heat exchanger through the drain outlet in a short period.

The third disadvantage is that the water level in heat exchanger changes during use and draining and therefore impurities lighter than water can accumulate between the surfaces of heat exchanger element.

The fourth disadvantage is that the aeration pipe of the heat exchanger must be connected to the shower basin above water level in order to avoid waste water outflow through the aeration tube. Gases with unpleasant smell may emit from the aeration tube. Connecting the aeration tube to the ventilation system is often complicated for engineering reasons.

The fifth disadvantage is that the bottom drain outlet of the overflow barrier that keeps water level stable in the heat exchanger may become clogged with time; for this reason the heat exchanger will fail to drain and the possibility of failsafe and complete emptying is lost. When disconnecting the heat exchanger, waste water that potentially contains caustic cleansing agents, may flow out through the outlets.

The sixth disadvantage is that in case the heat exchanger is clogged in some implementations unacceptably high hydrostatic pressure may be applied on the plastic shell of heat exchanger, which may result in leakage.

The object of the invention is to reduce fouling and corrosion of the heat exchanger and its need for maintenance; to decrease the waste water flow resistance caused by air and foam accumulation in the waste water pipe between trap and heat exchanger; to enhance the waste water filter; to avoid the need of connecting a air vent to the ventilation system; to provide a reliable option for waste water discharge, and to limit the maximum waste water pressure on the heat exchanger.

These aims are reached by fitting a level controller in the waste water drain exiting the heat exchanger, keeping the heat exchanger constantly filled with waste water due to which the washing waste lighter than water cannot deposit and dry on the heat exchanger element; no place is left for anaerobic bacteria that can multiply only in very limited numbers in the foam and dirt stuck to surfaces, being located in the water flow and accessible to cleansing and disinfection agents. In the outlet of the basin a coarse filter is arranged; after it an enhanced fine filter for the removal of hair from the waste water follows. The fine filter, preferably made of mesh and fixed on a frame of conic form, can be placed into the outlet in trap of the basin, or as a separate unit connected after the trap. In the first case the filter element can be removed from the basin outlet for cleaning or replacing by first removing the coarse filter; in the second case through a separate cleaning plug. As a result of these enhancements, fouling of the heat exchanger will

decelerate and its maintenance need will significantly decrease. Since the emission of air into the waste water contour is lower, corrosion of the heat exchanger will also decelerate and the service life of the heat exchanger element will extend.

One of the reasons for higher flow resistance is the accumulation of air and foam carried during washing by waste water rapidly flowing in the waste water pipe between the trap and heat exchanger. It can move neither forward, due to buoyancy, nor backward, because the trap filled with water is blocking the flow. The trap cannot be excluded for sanitary reasons, because bad-smelling gases may be formed in the heat exchanger due to the activities of bacteria. At the same time frequent disinfection would demand big amounts of chemicals that are mostly hazardous to the environment. The problem has been solved with an air by-pass pipe that begins from the upper section or side of the waste water drain from the trap and ends in between the level controller and sewer connector. The by-pass pipe is taken in at least one place, preferably in the vicinity of the trap higher than the water level in the basin in order to avoid the waste water flow mainly via the by-pass pipe. The air vent of the heat exchanger is connected to the by-pass pipe or the drain between level controller and sewer connector. Some washing waste lighter than water can exit with foam via the air vent. This also excludes the need to connect the air vent to the ventilation system and the peak pressure of waste water on the heat exchanger will be limited. When the waste water pressure increases due to clogging or excessive water flow to the heat exchanger, water flows to the sewer pipe through the air by-pass pipe.

The possibility of reliably discharging waste water from the heat exchanger for the purpose of disconnecting waste water piping is provided by turning the level controller fitted with elastic seals into horizontal position or by adding it an optional valve that can be opened. The outlet of the heat exchanger is located as low as possible allowing complete discharge of waste water when the level controller is turned into horizontal position. In order to avoid level controller turning into horizontal position at random it is provided with a fixer for vertical position preferably in the form of a square ring placed on the level controller.

For the maximum simplification and unification of the structure, manufacturing and installation of the heat exchanger, it is advantageous to insert the heat exchanger element

in the wider section of the waste water piping, which can be a standard drain preferably with a diameter wider than the rest of waste water piping or a special plastic tank that can be preferably opened. The wider pipe section containing the unified heat exchanger element has waste water connections at the side and at the end. The connector port of the heat exchanger that opens upward can also have the function of air outlet allowing thus to exclude a separate air outlet. The end port is preferably the waste water outlet and is preferably located below the axis of the wider pipe section, enabling to empty the heat exchanger completely to the sewer system. Both clean water connections of the heat exchanger element are brought in sealed through the end cap allowing simple and sanitary removal of the heat exchanger element for cleaning or repair.

The heat exchanger element consists of several parallel preferably copper pipes or plates preferably wound in opposite directions around the axis and connected between the collectors joining the pipes or plates. The heat exchanger element has a preferably plastic core shorter than the heat exchanger element allowing channeling waste water and passing it through the collector aperture. One of the connecting pipes of the heat exchanger element is led through the plastic core. For a plate-type heat exchanger element, the core is not obligatory.

In order to remove the heat exchanger element from the piping, the clean water connectors are disconnected, and for preventing their fouling they are temporarily plugged; the end cap is opened and the heat exchanger element is pulled into a plastic bag longer than the element, which is previously pulled over the wider section of the waste water piping housing the unified exchanger, and is later tightly closed. This enables sanitized transportation of the fouled heat exchanger element to the cleaning site.

Figures 1-7 describe two preferable design examples, level controller and filter.

Fig. 1 shows the circuit diagram of a shower unit with heat exchanger.

Fig. 2 shows the front view of the waste water piping for a heat exchanger installed under the basin.

Fig. 3 shows the perspective view of waste water piping for a heat exchanger installed under the basin.

Fig. 4 shows the front and top views and cross-section A-A of the level controller.

Fig. 5 a shows the front view of the heat exchanger installed in the waste water pipe.

Fig. 5 b shows the heat exchanger element of heat exchanger installed in the waste water pipe.

Fig. 6 shows the cross-section of the fine filter inserted in the trap.

Fig. 7 shows the cross-section of the fine filter inserted as a separate unit after the trap.

The unit consists preferably of thermostat mixer 7 with shower head 8, single- or multisectional heat exchanger 5 that can be opened, basin 9 with a coarse filter 11 in the outlet, fine filter 13, trap 12 that can be implemented in combination with the coarse filter 11 and fine filter 13, air by-pass pipe 18, turnable level controller 16 and a waste water drain 20 channelled to the sewer pipe 17.

From tap 1 hot water and from tap 2 cold water are introduced into the unit. Hot water is directly delivered into the mixer 7 whereas cold water passes through spring-relief control valve 3 and enters via the fresh water inlet 4, the heat exchanger 5 and the outlet 6 of the heat exchanger 5. Heat exchange from waste water to cold water flowing from tap 2 takes place in heat exchanger 5. Preheated cold water allows decreasing the amount of hot water required in mixer 7 to obtain washing water of predetermined temperature. Mixed warm washing water flows out of the shower head 8; thereafter washing process follows and the washing water is gathered in basin 9 and inlet of coarse filter 11 matched with the basin outlet; from there the waste water flows into the trap 12 designed to stop spreading of bad smelling gases, and to the fine filter 13 that may be located inside trap 12 or as a separate unit and filtrates most of impurities like hair and fluff from waste water; due to hydrostatic pressure the waste water flows forward through waste water port 14 and the waste water tube of heat exchanger 5 in contact with the heat exchanger element 31 in which cold water flows in the opposite direction passing most of its heat energy to fresh water; significantly cooler waste water flows out of heat exchanger 5 through waste water outlet 15 and reaches level controller 16, which makes a barrier to the waste water overflow at a height that approximately equals to the required waste water level in heat exchanger 5 and thereby keeps heat exchanger 5 filled with water, so it contains as little air as possible; the axially turnable level controller 16 is connected to the sewer pipe 17 that allows emptying the heat exchanger 5 by turning the level controller from normal vertical position "N" to horizontal emptying position "E". The level controller 16 can optionally comprise a drain valve for empting the heat exchanger 5.

With waste water also air gets in the waste water piping and may obstruct the flow of waste water. To avoid this obstruction such air is directed via air by-pass pipe 18 past the heat exchanger and level controller to drain 20 of sewer pipe 17. At least one section of air by-pass pipe 18 is positioned higher than the water level in basin 9, to prevent waste water penetrating air by-pass pipe 18 instead flowing mainly through heat exchanger 5. Waste water can flow through by-pass pipe 18 only when the heat exchanger 5 cannot receive a rapidly increased volume of water or in case heat exchanger 5 is clogged. When air reaches heat exchanger 5, it exits through air vent 19 or through waste water port 14 into by-pass pipe 18 and via the latter to the waste water drain 20 leading to sewer pipe 17.

For the maximum simplification and unification of the structure, manufacturing and installation of heat exchanger 5, it is advantageous to locate the heat exchanger element 31 in the wider section of waste water piping 30, which is preferably a waste water pipe with a standard diameter, or a special plastic tank that can be opened. The wider section of waste water piping 30 that houses the unified heat exchanger element waste water ports 14 and 15 at the end and on the side. The connector side port 14, which is located higher than the axis of the wider pipe section 30 or opens upward, can carry the function of air discharge and so a separate air vent isn't required. The end cap port 15 is preferably a waste water outlet and is preferably located lower than the axis of the wider pipe section 30, allowing complete emptying of the heat exchanger 5 into the sewer pipe. Both fresh water connections 4 and 6 of heat exchanger element 31 are passed sealed through the end cap 34 by help of elastic packings 35 enabling thus simple and sanitary removal of the heat exchanger element 31 for cleaning or repair.

The heat exchanger element 31 consists of several parallel preferably copper pipes or plates preferably wound in opposite directions around the axis and connected between collectors 33 that join the pipes or plates. The heat exchanger element 31 has preferably a plastic core 32 for channeling waste water being preferably shorter than the heat exchanger element 31 allowing flow of waste water through the aperture 36 of collector 33. One of the connection pipes of heat exchanger element 31 is led through the plastic core 32. For a plate-type heat exchanger element 31 the core is not obligatory.

For removing the heat exchanger element 31 from the piping, fresh water connections 4

and 6 are disconnected and then plugged with temporary plugs to avoid fouling; the end plug 34 is unplugged and the heat exchanger element 31 is pulled into a plastic bag longer than the heat exchanger element, which has been earlier placed over the wider section 30 of waste water piping where the unified heat exchanger element 31 is located, and are then tightly sealed. This allows sanitary transport of the fouled heat exchanger element 31 to the cleaning site.

CLAIMS

1. Waste water piping with heat exchanger for bathing installations comprising a basin (9) with the outlet equipped with a filter (11) on the bottom, which is connected to the trap (12) with its outlet connected to air by-pass (18), fine filter (13) and waste water heat exchanger (5) in the outlet of which level controller (16) is located with drain (20) connected to air by-pass pipe (18), and sewer pipe (17) **characterized in that** the outlet (15) of heat exchanger (5) installed in the waste water pipe is connected to level controller (16) and air by-pass pipe (18) is connected between waste water trap (12) and heat exchanger (5), being connected to air vent (19) of the heat exchanger (5) and its other end is connected via waste water drain (20) to sewer pipe (17).

2. Waste water piping with heat exchanger for bathing installations according to Claim 1 **characterized in that** the raised part of level controller (16) connected to the waste water port (15) of the heat exchanger (5) keeps the heat exchanger filled with water to the maximum water level forming a barrier to waste water outflow.

3. Waste water piping with heat exchanger for bathing installations according to Claims 1 and 2 **characterized in that** the level controller (16) allows emptying the heat exchanger (5) either by turning it to horizontal position, or by opening a respective valve; resulting in the waste water outflow barrier of level controller (16) dropping lower than the minimum water level in the heat exchanger (5).

4. Waste water piping with heat exchanger for bathing installations according to Claims 1-3 **characterized in that** the level controller (16) has a preferably quadrangular support (50) or flat bottom that provides stable upright position of the level controller (16).

5. Waste water piping with heat exchanger for bathing installations according to Claim 1, **characterized in that** the air by-pass pipe (18) is positioned higher than the basin (9) bottom .

6. Waste water piping with heat exchanger for bathing installations according to Claims 1 and 5 **characterized in that** the air by-pass pipe (18) is positioned in its full length, or at least in one section higher than the bottom of the basin (9).

7. Waste water piping with heat exchanger for bathing installations according to Claim 1 **characterized in that** the air vent (19) of heat exchanger (5) is connected to the air by-pass pipe (18).

8. Waste water piping with heat exchanger for bathing installations according to Claim 1, **characterized in that** the trap (12) is equipped with a coarse filter (11) and fine filter (13) that can be removed from the bottom of the basin.

9. Waste water piping with heat exchanger for bathing installations according to Claim 1 **characterized in that** the fine filter (13) is placed in the sewer pipe after trap outlet (12) and has a separate cleaning port.

10. Waste water piping with heat exchanger for bathing installations according to Claim 1 **characterized in that** the preferably a cylindrical unified heat exchanger element (31) is placed in the wider section of waste water piping (30).

11. Waste water piping with heat exchanger for bathing installations according to Claims 1 and 10 **characterized in that** the wider section of waste water piping (30) that houses the unified heat exchanger element (31) has waste water ports (14 and 15) on the side or on the top and at the end.

12. Waste water piping with heat exchanger for bathing installations according to Claims 1, 10 and 11 **characterized in that** both fresh water connectors of the heat exchanger element (31) have been brought in sealed through the end cap (34) allowing simple and sanitary removal of the heat exchanger element for cleaning or repair.

13. Waste water piping with heat exchanger for bathing installations according to Claims 1, 10, 11 and 12 **characterized in that** the heat exchanger element (31) consists of several parallel copper tubes wound in reverse directions, or copper plates, which are connected in between collectors (33).

14. Waste water piping with heat exchanger for bathing installations according to Claims 1, 10, 11, 12 and 13 **characterized in that** the heat exchanger element (31) has

preferably a plastic core (32) that is shorter than heat exchanger element (31) for channeling the flow of waste water.

15. Waste water piping with heat exchanger for bathing installations according to Claims 1, 10, 11 and 12 **characterized in that** when removing the heat exchanger element (31), it is pulled into a plastic bag with its mouth over the wider section of waste water piping (30) in which the unified heat exchanger element (31) is located.

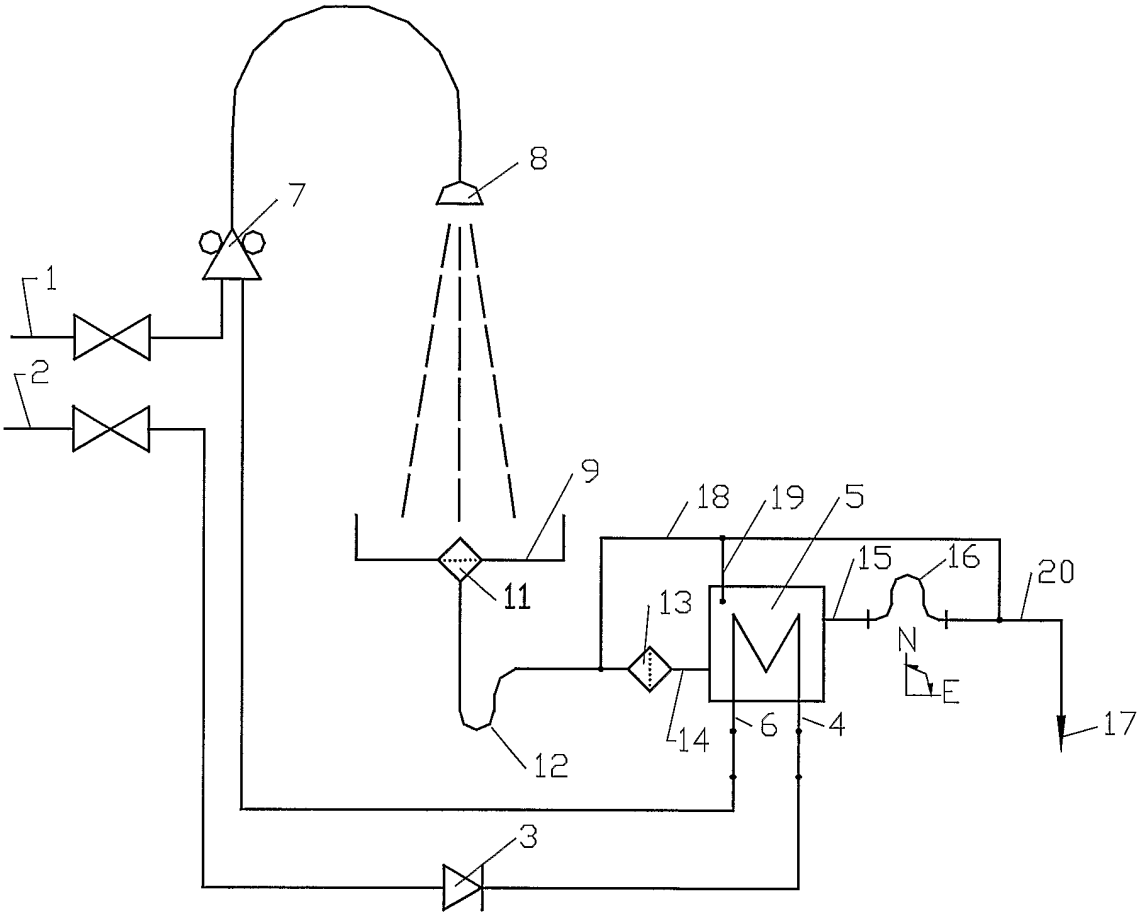

Fig. 1

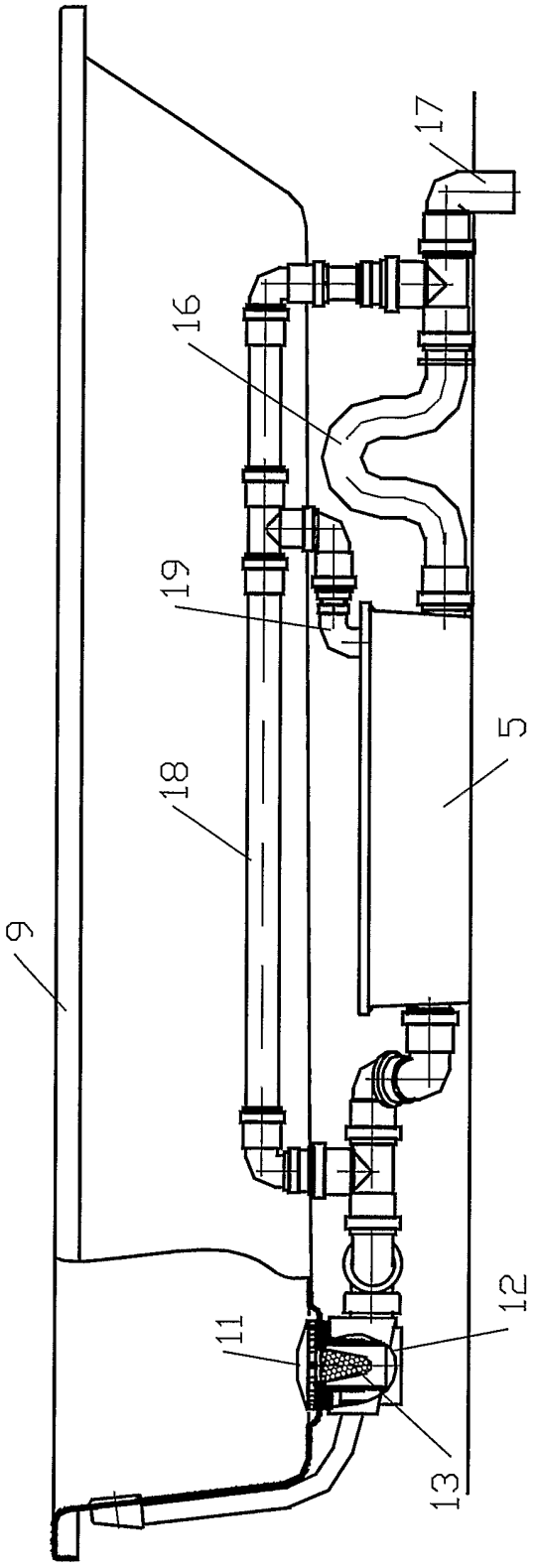

Fig. 2.

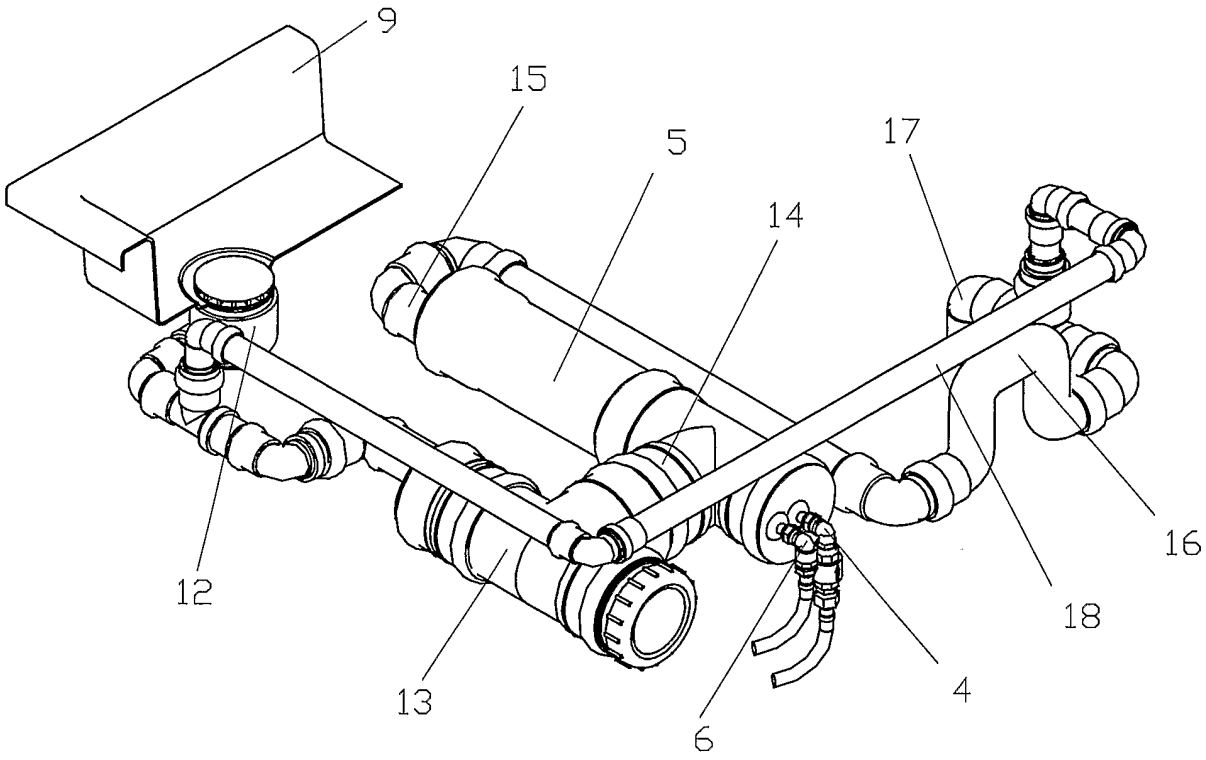

Fig. 3.

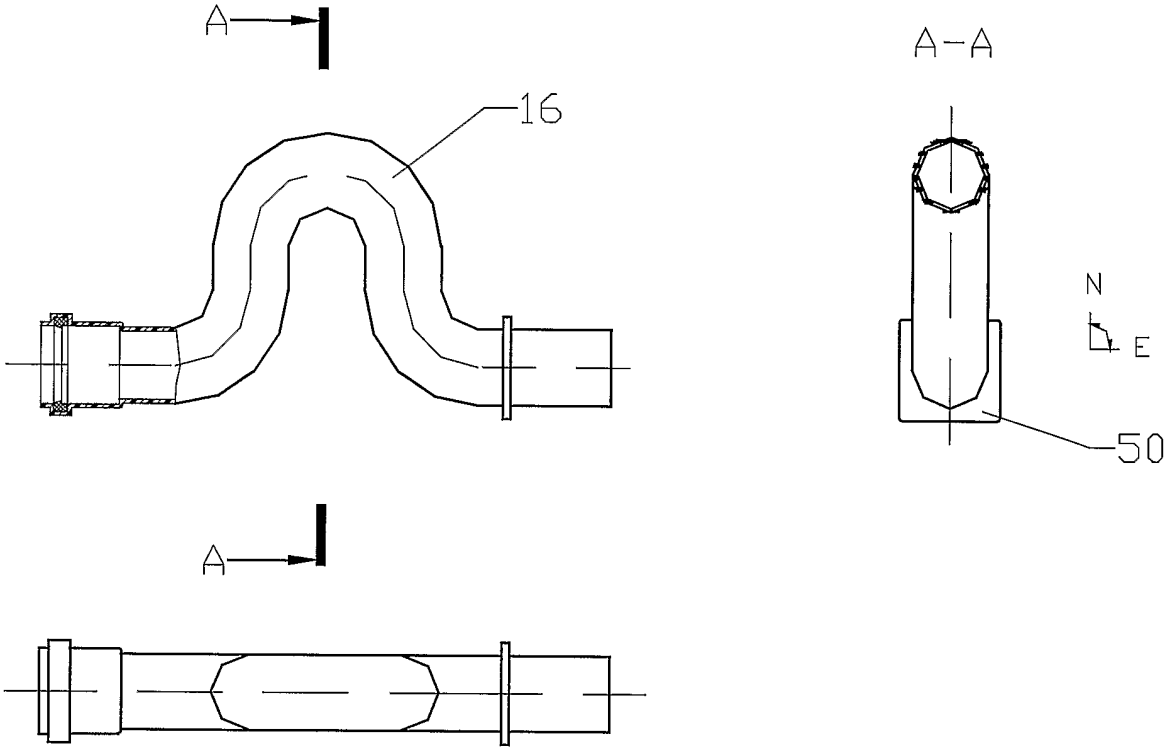

Fig. 4.

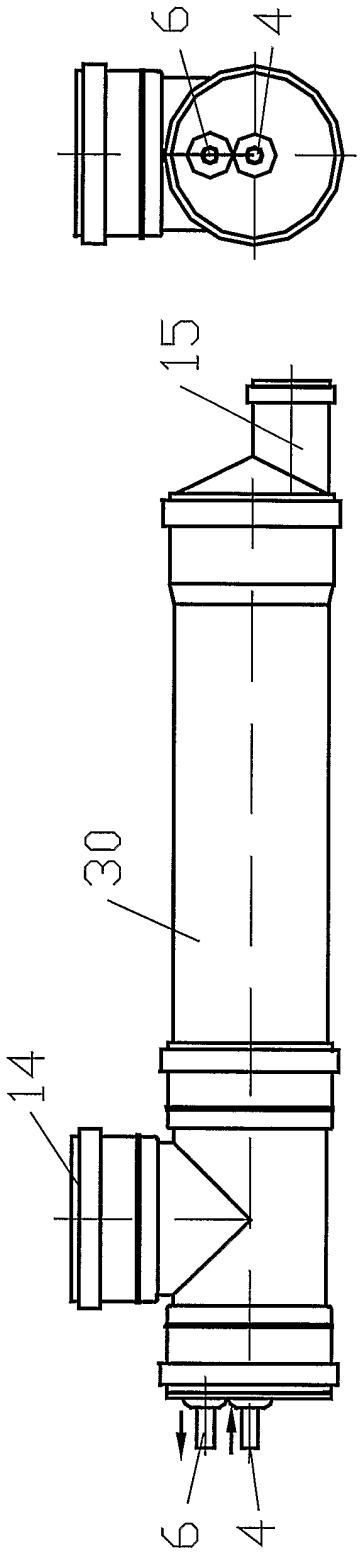

Fig. 5 a.

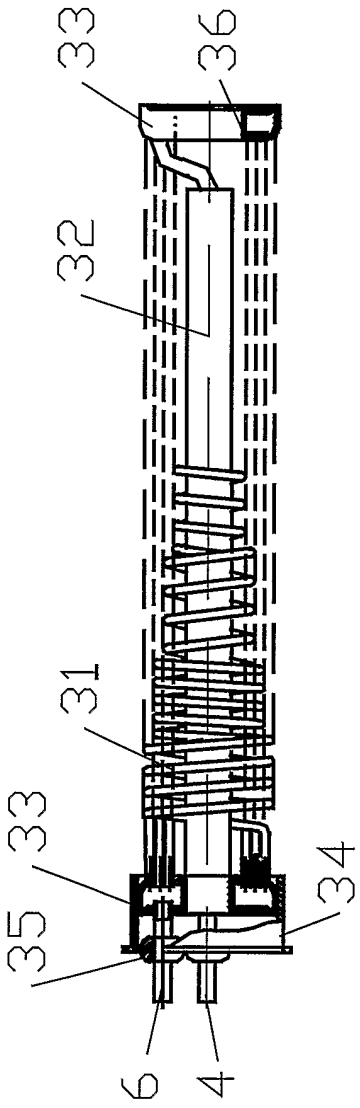

Fig. 5 b.

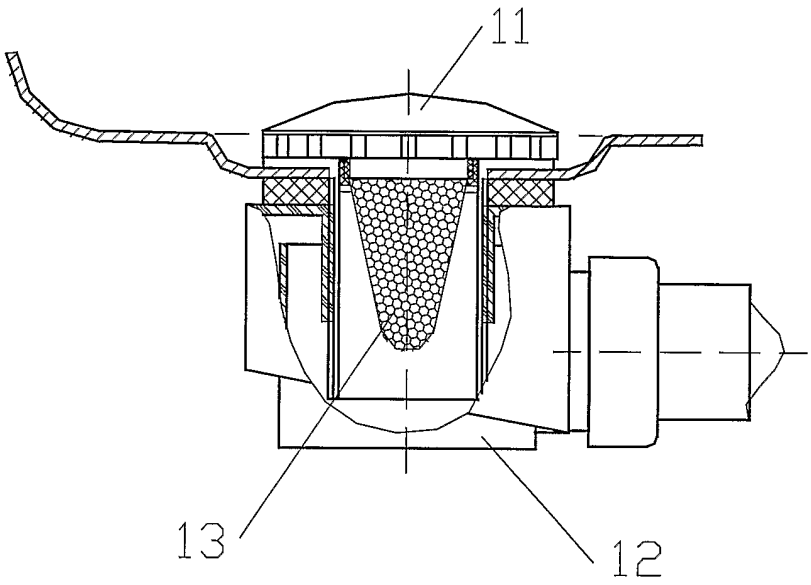

Fig. 6.

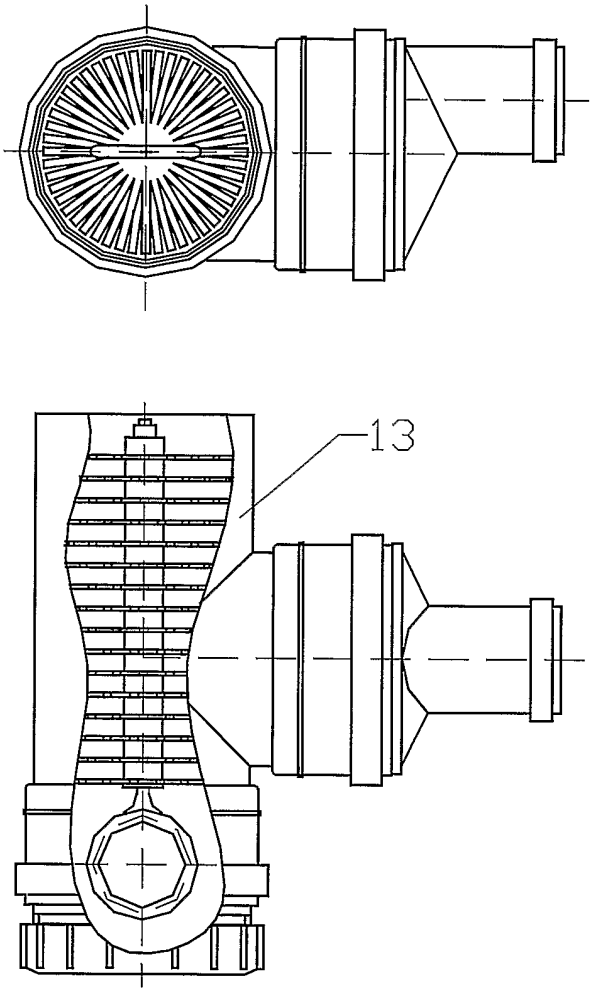

Fig. 7.

INTERNATIONAL SEARCH REPORT

PCT/EE2005/000001

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E03C1/00 F24D17/00 F24D19/08 F28F21/00

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E03C F24D F28D F28F

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EE 200 100 541 A (AS ECOWIN) 16 June 2003 (2003-06-16) the whole document	1
A	"ANNOUNCEMENT" POPULAR MECHANICS, THE HEARST CORPORATION, US, vol. 171, no. 6, 1 June 1994 (1994-06-01), page 26, XP000486560 ISSN: 0032-4558 abstract	1
A	CA 2 200 233 A1 (SALASIDIS, ROBERT) 18 September 1998 (1998-09-18) figures 1,3	1

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
29 April 2005	13/05/2005

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EE2005/000001

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 385 785 A (JULES * WOOD) 3 September 2003 (2003-09-03) page 1, paragraphs 3,6	1
A	GB 2 379 006 A (DAVID * THOMAS; PETER * THOMAS) 26 February 2003 (2003-02-26) pages 2,3; figures 1-3	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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CA 2200233	A1	18-09-1998	NONE	
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GB 2379006	A	26-02-2003	NONE	