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**Valve assembly for connecting a heat exchanger of a hot water discharging device
to a district heating system**

Description

- 5 The invention relates to a valve assembly for connecting a heat exchanger of a hot water removal device to a district heating system, comprising a primary-side valve controlling a throughflow of heat transfer fluid through a primary side of the heat exchanger, and a pressure-controlled secondary-side valve acting on a throughflow of service water through a secondary side of the heat exchanger, the primary-side valve being operable
10 by the secondary-side valve, wherein the secondary-side valve has a valve seat arranged on a diaphragm and a stationary valve element which is formed as a cone.

Such a valve assembly is known from DE 102 54 239 A1.

- 15 Another valve assembly is known from DE 196 18 093 C2. The valve element of the primary-side valve and the valve element of the secondary-side valve are connected to each other by means of an actuation rod. If service water is tapped, the pressure at the output of the secondary-side valve drops so that the valve element of the secondary-side valve moves into an open position. At the same time, the valve element of the primary-
20 side valve is also moved further away from the valve seat thereof so that, depending on the quantity of service water removed, a corresponding quantity of heat can be tracked at the primary side of the heat exchanger.

- However, the production of such a valve assembly is relatively complex. The primary-
25 side valve and the secondary-side valve have to be adapted to each other in a relatively precise manner so that the primary-side valve does not allow too little and not too much heat exchange fluid into the primary side of the heat exchanger. The service water at the secondary side would then be either too hot or too cold. During production, relatively small tolerances thus have to be complied with.

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An object of the invention is to configure the production of the valve assembly in a simple manner.

This object is achieved with a valve assembly of the type mentioned in the introduction having the features of the characterizing portion of claim 1.

5 The rest opening is the opening which the secondary-side valve has when no service water is removed at the secondary side. In this instance, the pressure in front of and behind the secondary-side valve is practically identical. A small opening has to be present so that a pressure compensation can take place. Now, this rest opening should be able to be adjusted in the most precise manner possible. This is because the size of the rest opening determines inter alia the response speed of the primary-side valve. The
10 response speed is higher, the smaller the rest opening is. With a small rest opening, the components would have to be produced with a very high level of precision if the adjustment possibility were not provided. Since the adjustment possibility is provided, however, the components of the secondary-side valve can be produced with a reduced level of precision. The size of the rest opening is then adjusted after the production, for
15 example, in a test device which is provided for this purpose. If the secondary-side valve is also open in the rest state, it is also less susceptible to clogging at low throughflow rates. This is an additional advantage of this valve assembly.

Preferably, the secondary-side valve is arranged at one end of a housing. This facilitates
20 the adjustability. If the valve is arranged at the end of the housing, it is then possible to access the valve through a corresponding end side of the housing and to adjust the rest opening.

Preferably, the secondary-side valve has a valve seat arranged on a diaphragm and a
25 stationary valve element whose position can be adjusted relative to a rest position of the diaphragm. The rest position of the diaphragm is the position which the diaphragm assumes when the same pressure is applied at both sides or, when the diaphragm is loaded by an additional force, for example, a spring, a predetermined pressure difference is applied. If the pressure relationships over the diaphragm change, the diaphragm is
30 moved and then displaces the valve seat with respect to the valve element. Without external interventions, the valve element remains stationary in the housing so that the flow through the secondary-side valve is practically dependent only on the pressure relationships over the diaphragms. As a result of a displacement of the valve element

during adjustment, however, the relationship between pressure and flow through the secondary-side valve can change.

5 Preferably, the valve element is in the form of a cone. A cone can be produced in a relatively simple manner. With a cone, an over-proportional increase of the passage cross-section is produced with the movement of the diaphragm. This reduces the vibration tendency of the secondary-side valve.

10 Preferably, the valve element is screwed into the housing. This has two advantages. On the one hand, a screw connection between the valve element and the housing is sufficiently stable to be able to absorb the pressures which are sufficient during operation. On the other hand, by rotating the valve element in the housing, the position thereof relative to the diaphragm can be changed so that an adjustability is possible in a simple manner.

15 Preferably, the primary-side valve can be activated by the secondary-side valve by means of a tappet which is driven by means of a movable element of the secondary-side valve and acts on the valve element of the primary-side valve, wherein the tappet is so short that, in the rest state of the movable element of the secondary-side valve, it has a spacing with respect to the valve element in the open state of the primary-side valve. Consequently, the primary-side valve can be controlled independently of the secondary-side valve as long as the secondary-side valve is located in the rest state. This is always the case when no service water is removed at the secondary side. Only when service water is actually removed and the secondary-side valve opens to a predetermined degree
20 does the tappet move into abutment with the valve element of the primary-side valve and ensures that the primary-side valve opens further. The two valves at the primary side and the secondary side are thus combined only when necessary in order thus to ensure that adequate heat exchange fluid is supplied to the primary side so that the service water at the secondary side is heated to a sufficient degree.

30 Preferably, the valve element of the primary-side valve has a temperature-controlled drive. The temperature-controlled drive has a heat sensor which establishes the temperature of the service water at the secondary side, in particular behind the

secondary-side valve. Even when no service water is removed from the secondary side, the water present at that location has to be kept at a specific temperature in order to prevent a user, when drawing hot service water, from initially being surprised with cold water. Accordingly, a continuous flow of heat exchange fluid through the primary side
5 of the heat exchanger is required. This flow is ensured by the temperature-controlled drive of the primary-side valve. As long as no service water is removed, therefore, the primary-side valve functions exclusively as a temperature control valve without being influenced by the secondary-side valve. If service water is removed, however, the quantity of the primary-side heat exchange fluid is also dependent on the quantity of
10 service water removed. This quantity is signalled to the primary-side valve by the opening of the secondary-side valve.

Preferably, the tappet and the valve element of the primary-side valve come into contact by means of a contact surface which is arranged perpendicular to the movement direction
15 of the tappet. This embodiment has the significant advantage that it no longer has to be ensured that the tappet and the valve element of the primary-side valve correspond with their axes. Relatively small lateral displacements are thus readily permitted. This reduces the production costs.

20 In this instance, it is preferable for the valve element to have a projection which faces towards the tappet and against which the tappet moves into abutment. The projection which may, for example, be formed by the valve spindle of the primary-side valve being introduced into the valve element, then absorbs the forces which are applied by the tappet to the valve element. This projection may in particular be formed from a metal which is
25 much more resistant than an elastomer material which is conventionally used for the valve element. Consequently, an adequate service-life of the valve assembly can be ensured.

Preferably, the primary-side valve is arranged in a first housing portion and the
30 secondary-side valve is arranged in a second housing portion, and the two housing portions are connected to one another by a third housing portion which accommodates the actuating device with which the primary-side valve can be actuated by the secondary-side valve. Such a configuration also keeps the production costs low. The valve assembly

comprises so to speak three independent modules which can be produced separately from each other and which are combined only at a relatively late stage of the production. Each module can thus already be preadjusted if required.

- 5 Preferably, the first housing portion comprises a primary-side first connection, the second housing portion comprises a secondary-side second connection and the third housing portion comprises a primary-side second connection and a secondary-side first connection. The third housing portion is thus also used to produce the connection between the valve assembly and the heat exchanger.

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Preferably, the secondary-side diaphragm extends into a contact region between the second housing portion and the third housing portion. This has two advantages. On the one hand, the diaphragm is retained in the housing so that it assumes a defined position. On the other hand, the diaphragm which is formed from an elastomer material can be
15 used to seal the second housing portion and the third housing portion with respect to each other.

In this instance, it is preferable for the diaphragm to have an opening which is connected to the valve seat and through which service water can pass. Service water thus flows
20 through the diaphragm when service water is removed. It can thereby be ensured that the valve assembly remains compact.

Preferably, a pressure-controlled valve is connected upstream of the primary-side valve, which valve comprises a diaphragm which extends into a contact region between the
25 first housing portion and the third housing portion. In this instance, the diaphragm can also further be used to provide a seal between the two housing portions.

Preferably, the tappet is mounted in a central portion of the third housing portion. The tappet is consequently automatically retained in the correct position between the
30 primary-side valve and the secondary-side valve.

The invention is described below with reference to a preferred embodiment in connection with the drawings, in which:

Figure 1 is a schematic illustration to explain the structure of the valve assembly, and Figure 2 is a longitudinal section of the valve assembly.

Figure 1 shows a schematically illustrated heat exchanger 1 having a primary side 2 and a secondary side 3. The primary side 2 has an inlet 4 which is connected to a district heating system which is not illustrated in greater detail. The primary side 2 also has an outlet 5 which is connected via a valve assembly 6 to a return connection 7 of the district heating network.

The secondary side 3 has an input 8, through which service water flows, and an output 9, from which heated service water can be removed. There is arranged in the region of the output 9 a temperature sensor 10 whose function will be explained below. The input 8 of the secondary side 3 is connected via the valve assembly 6 to a service water connection 11, through which cold service water is supplied.

In a manner known per se, a heat exchange surface 12 is arranged between the primary side 2 and the secondary side 3 and is illustrated in this instance only schematically. In fact, the heat exchange surface 12 has a significantly larger extent.

The valve assembly 6 has a primary-side valve 20 having a valve element 21 and a valve seat 22. The valve element 21 is subjected to flow through the valve seat 22. The valve element 21 is pretensioned in the opening direction by means of a spring 23. A bellows element 24 which is connected to the temperature sensor 10 acts on the valve element 21 in the closure direction. The bellows element 24 operates counter to the force of a spring 25 which is supported on a displaceable stop 26. By adjusting the stop 26 in the direction of a double-headed arrow 27, a desired value for the temperature of the service water at the output 9 of the secondary side 3 can be adjusted.

If the temperature at the output 9 of the secondary side 3 increases, the bellows element 24 moves the valve element 21 in the direction towards the valve seat 22 and consequently throttles the flow of heat exchange fluid through the primary side. If the temperature at the output 9 of the secondary side 3 decreases, the pressure of the bellows element 24 decreases so that the valve element 21 is removed from the valve seat 22 by

the force of the springs 23, 25 in order to enable a greater throughflow of heat exchange fluid through the primary side 2. In this manner, the primary-side valve 20 is a temperature-controlled valve which is controlled by the temperature-controlled drive 28.

5 Another pressure-controlled valve 29 is arranged upstream of the primary-side valve 20. The pressure-controlled valve 29 has a diaphragm 30 which is acted on by a pressure P1 in front of the valve seat 22, on the one hand, and by a pressure P2 behind the valve seat 22, on the other hand. The diaphragm 30 displaces a throttle element 31. The function of the pressure-controlled valve 29 is known per se and is therefore not explained below.

10

The flow of service water through the secondary side 3 of the heat exchanger 1 is controlled by a secondary-side valve 40. The secondary-side valve 40 has a diaphragm 41 to which a valve seat 42 is secured. The valve seat 42 is displaced when the diaphragm 41 is moved. The valve seat 42 forms with a valve element 43 a throttle gap 44 whose
15 size changes depending on the position of the diaphragm 41.

The position of the diaphragm is determined by a pressure difference between a pressure P3 in front of the throttle gap 44 and a pressure P4 behind the throttle gap 44. This pressure difference is counteracted by the force of a compensation spring 45 which,
20 however, only begins to act after a degree of deflection of the diaphragm 41. Furthermore, the pressure difference $P3 - P4$ is naturally also counteracted by a degree of inherent tension of the diaphragm 41.

If the same forces are applied at both sides of the diaphragm 41, the throttle gap 44 then
25 forms a rest opening. The size of this rest opening can be adjusted by the valve element 43 which is constructed in this instance as a cone being able to be adjusted in a housing 46. The valve element 43 is screwed into the housing 46 so that by rotating the valve element 43 the position thereof relative to the diaphragm 41 can be changed in the pressure-free state. A rest opening which is as small as possible is desired so that the
30 secondary-side valve 40 is also not closed when no service water is removed and the pressure P3 in front of the throttle gap 44 is equal to the pressure P4 behind the throttle gap 44. Nevertheless, the rest opening should be kept as small as possible.

There is connected to the diaphragm 41 via the compensation spring 45 a tappet 47 which is accordingly also moved when the diaphragm 41 moves. This tappet 47 acts with the other end 48 thereof on the valve element 21 of the primary-side valve 20 when the diaphragm 41 has been deflected to a sufficient extent.

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However, the tappet 47 is so short that, when the diaphragm 41 is located in the idle position thereof, that is to say, there is no pressure difference applied across the diaphragm 41, the tappet 47 does not touch the valve element 21 as long as it is open.

- 10 This has the following effect: as long as no service water is removed, the throttle gap 44 has its smallest size and the diaphragm 41 is not deflected. In this situation, the end 48 of the tappet 47 does not touch the valve element 21 of the primary-side valve. The primary-side valve 20 thus operates exclusively as a temperature-controlled valve under the action of the temperature-controlled drive 28. It is thus possible in a simple manner,
15 that is to say, with simple mechanical complexity and also with a relatively simple control circuit, to ensure that the temperature at the output 9 of the secondary side 3 is always maintained at a desired value.

- If water is now removed at the secondary side 3, the pressure P_4 decreases and the
20 diaphragm 41 is deflected by means of the pressure difference $P_3 - P_4$. In this instance, the tappet 47 comes into contact with the valve element 21 and acts on it in an opening direction so that, in addition to the temperature control, an influence of the primary-side valve 20 is also produced by the quantity of service water flowing through at the secondary side.

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As soon as the water removal at the secondary side 3 is ended, the diaphragm 41 returns to its idle state and the control of the primary-side valve 20 can very quickly switch purely to a temperature control again.

- 30 Figure 2 now shows the mechanical structure of the valve assembly 6. Identical components are given the same reference numerals as in Figure 1.

The valve assembly has a first housing portion 51 which receives the primary-side valve 20, a second housing portion 52 which receives the secondary-side valve 40 and a third housing portion 53 which connects the first housing portion 51 to the second housing portion 52 and which further supports the tappet 47. The return connection 7 is arranged in the first housing portion 51. This connection forms a first connection of the primary side. The service water connection 11 is arranged in the second housing portion 52. This connection forms a second connection of the secondary side. The outlet 5 and the input 8 are arranged in the third housing portion. These two connections thus form the second connection of the primary side and a first connection of the secondary side.

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The two diaphragms 30, 41 extend to a contact region between the first housing portion 51 and the third housing portion 53 or the second housing portion 52 and the third housing portion 53. This has the advantage that the two diaphragms 30, 41 are fixed, on the one hand, by the assembly of the three housing portions, but, on the other hand, can also be used as seals between the housing portions 51-53.

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The first housing portion 51 with the primary-side valve 20, the second housing portion 52 with the secondary-side valve 40 and the third housing portion 53 with the tappet 47 can each be preassembled per se. In this instance, an orientation of the individual elements transversely relative to the movement direction thereof is required only to a relatively large extent since, for example, the tappet 47 and the valve element 21 abut each other at the end 48 via a contact surface which is arranged transversely relative to the longitudinal extent of the tappet 47. Therefore, the valve element 21 does not have to be struck precisely in the centre.

20

The valve element 21 has a spindle 32 which extends through the valve element 21 and which forms at the other side a projection 33 against which the tappet 47 abuts. This projection 33 may accordingly be produced from a metal which cooperates with the metal of the tappet 47 in a low-wear manner. The projection 33 is significantly more resistant against being acted on by the tappet 47 than the valve element 21 itself, which is generally formed from an elastomer material.

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The diaphragm 41 has an opening 49 through which the service water which has passed through the valve seat 22 flows. In order to allow this service water to also reach the input 8 of the heat exchanger, the tappet 47 is advantageously connected to the diaphragm 41 by means of a cage-like connector which is not illustrated in greater detail
5 and which, for example, has three legs which are arranged in a star-like manner.

In Figure 2, the primary-side valve 20 and the secondary-side valve 40 are illustrated in the completely closed state. In this state, the tappet 47 may abut the valve element 21, more specifically the projection 33 thereof. During operation, however, the valve
10 element 21 will lift further from the valve seat 22 than the valve seat 22 lifts from the valve element 43 so that without the removal of service water there is an effective spacing between the tappet 47 and the valve element 21.

Patentkrav

1. Ventilenhed til tilslutning af en varmeveksler (1) i en varmtvandudtagningsanordning til et fjernvarmenet med en ventil (20) på primærsiden, som styrer en gennemstrømning af et varmebærende medium gennem en primærside (2) af varmeveksleren (1), og en trykstyret ventil (40) på sekundærsiden, som indvirker på en gennemstrømning af brugsvand gennem en sekundærside (3) af varmeveksleren (1), hvor ventilen (20) på primærsiden kan betjenes via ventilen (40) på sekundærsiden, hvor ventilen (40) på sekundærsiden har et ventilsæde (42), anbragt på en membran (41), og et stationært ventilelement (43), **kendetegnet ved, at**, ventilen (40) på sekundærsiden ikke er lukket, når der ikke udtages brugsvand på sekundærsiden (3), men har en lille hvileåbning, hvor membranen (41) er i en hvileposition, og at ventilelementets (43) position kan indstilles i forhold til membranens (41) hvileposition, sådan at ventilen (40) på sekundærsiden har en hvileåbning (44), der kan indstilles.
2. Ventilenhed ifølge krav 1, **kendetegnet ved, at** ventilen (40) på sekundærsiden er anbragt på en ende af huset (46).
3. Ventilenhed ifølge krav 1 eller 2, **kendetegnet ved, at** ventilelementet (43) er udført som konus.
4. Ventilenhed ifølge krav 3, når der refereres til krav 2, **kendetegnet ved, at** ventilelementet (43) er skruet ind i huset (46).
5. Ventilenhed ifølge et af kravene 1 til 4, **kendetegnet ved, at** en ventilløfter (47) og et ventilelement (21) på ventilen (20) på primærsiden kommer i kontakt via en berøringsflade (48), som er anbragt vinkelret på ventilløfterens (47) bevægelsesretning.
6. Ventilenhed ifølge krav 5, **kendetegnet ved, at** ventilelementet (21) har et fremspring (33), der peger mod ventilløfteren (47), som ventilløfteren (47) hviler mod.
7. Ventilenhed ifølge et af kravene 1 til 6, **kendetegnet ved, at** ventilen (20) på primærsiden er anbragt i en første husdel (51) og ventilen (40) på sekundærsiden i en anden husdel (52), og de to husdele (51, 52) er forbundet med hinanden via en tredje husdel (53), som optager betjeningsanordningen, med hvilken ventilen

(20) på primærsiden kan betjenes via ventilen (40) på sekundærsiden.

5 **8.** Ventilenhed ifølge krav 7, **kendetegnet ved, at** den første husdel (51) har en første tilslutning (7) på primærsiden, den anden husdel (52) en anden tilslutning (11) på sekundærsiden og den tredje husdel (53) en anden tilslutning (5) på primærsiden og en første tilslutning (8) på sekundærsiden.

10 **9.** Ventilenhed ifølge krav 7 eller 8, **kendetegnet ved, at** membranen (41) på sekundærsiden strækker sig ind i et berøringsområde mellem den anden husdel (52) og den tredje husdel (53).

15 **10.** Ventilenhed ifølge krav 9, **kendetegnet ved, at** membranen har en åbning (49), der står i forbindelse med ventilsædet (42), og som brugsvandet kan strømme igennem.

20 **11.** Ventilenhed ifølge et af kravene 7 til 10, **kendetegnet ved, at** en trykstyret ventil (29) er forkoblet ventilen (20) på primærsiden med en membran (30), som strækker sig ind i et berøringsområde mellem den første husdel (52) og den tredje husdel (53).

12. Ventilenhed ifølge et af kravene 7 til 11, når der refereres til krav 5, **kendetegnet ved, at** ventilløfteren (47) er lejret i et midterafsnit af den tredje husdel (53).

Fig.1



