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(54) **High-efficiency combined boiler**

Kombinierter Brennwertkessel

Chaudière mixte à haut rendement

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Description

This invention relates to a gas-fired central-heating (CH) boiler with a provision for supplying hot sanitary water, according to the preamble of claim 1. Such a boiler is known from FR-A-2672113.

Such so-called combined boilers are well known and comprise a gas burner, a heat exchanger arranged in the path of the flue gases and included in a closed CH water circuit with a delivery pipe to radiators or other space heating elements and a return pipe, the sanitary water provision being adapted for the indirect uptake, by way of the heated CH water, of heat generated by the burner.

With regard to the manner of heating the sanitary water, a distinction is made between the through-flow principle and the storage principle. In a combined boiler according to the through-flow principle, a sanitary water coil, connected at one end to the water mains and at whose other end hot water can be tapped for household use, extends through a vessel entirely filled with water from the closed CH water circuit. With a combined boiler according to the storage principle, an amount of water for household use is stored in a vessel through which extends a coil-shaped part of the delivery CH water pipe.

In both cases, sanitary water is indirectly heated by CH water heated in the heat exchanger of the boiler.

The present invention concerns a combined boiler according to the storage principle. In combined boilers, the supply of hot sanitary water takes priority over the space heating function, i.e. upon a demand for sanitary water, the circulation of heated CH water is short-circuited over the CH water coil in the storage vessel, so that the heat produced by the burner is exclusively used for the benefit of sanitary water. Upon a demand for space heating, however, heated CH water always flows through the storage vessel. This makes it impossible to prevent a situation where, in winter for instance, when in the morning the temperature in the house is to be raised from 15° to 20° and the heat demand on the CH installation persists for a long period, too much heat is supplied to the sanitary water supply, i.e. the temperature in the storage vessel exceeds the set value (60-80°C). This leads to the switch-off of the burner and stagnation of the space heating process.

The object of the present invention is to provide a combined boiler which does not have this drawback. A boiler according to the invention is characterized by the characterizing part of claim 1. The invention is based on the insight that if the burner is switched off by the thermostat of the sanitary water vessel, at least as long as the circulation pump works, CH water that no longer receives heat from the boiler heat exchanger can draw heat from the storage vessel functioning as a heat accumulator, until the temperature in the storage vessel has fallen to the extent where where the burner is switched on again.

It is true that this also occurs in known combined boilers according to the storage principle, where a coil forms part of the CH water supply to radators, but it occurs in a little effective manner. The fact is a coil-shaped pipe section through which flows a large amount of CH water of a temperature of, for instance, 80-90°C, may be sufficient for bringing a relatively small amount of samitary water in the storage vessel to a temperature of 60°C, but, conversely, the amount of heat that can be drawn from the sanitary water in the storage vessel is inadequate for an effective heat transfer by way of the coil to the much larger amount of CH water flowing through.

The effect contemplated, viz. the transfer of heat accumulated in the storage vessel filled with sanitary water, to a sufficient extent to meet the demand for space heating as long as the burner is switched off by the thermostat of the storage vessel, can be realized in that, in a combined boiler which is equipped with a burner and a heat exchanger for transferring heat of flue gases to CH water (CH heat exchanger), as well as with a storage vessel for sanitary water, according to the invention, the CH heat exchanger is at least partly immersed in sanitary water and is adapted for direct heat exchange between passing flue gases, passing CH water and sanitary water in the storage vessel.

The most important improvement over the prior art achieved through these features is that heat transfer from flue gas to sanitary water and to CH water takes place directly in the same heat exchanger, which, by virtue of the greater heat-transfer capacity present, can take place more effectively than indirectly by way of CH water being passed through a coil in a storage vessel.

Further, it is an advantage that, using the same heat exchanger, sanitary water can be rapidly heated, directly by flue gas, and thereby the contents of the storage vessel can be better maintained at the required temperature. Also, in the off-condition of the burner, heat can be better transferred from the sanitary water to CH water.

In further elaboration of the invention, in order to ensure a good heat transfer from flue gases both to the CH water and to sanitary water, the heat exchanger may comprise a flue gas passage bounded on one side by a CH water channel and on the other by a wall portion in direct contact with sanitary water present in the storage vessel, this wall portion being at least locally in heat-transmissive contact with the CH water passage.

In further elaboration of the invention, the heat-transmissive contact between the wall portion in contact with sanitary water on the one hand and the CH water channel on the other can be provided by heating surface-enlarging elements which extend in the flue gas passage and are in direct communication both with a CH water passage and with the wall portion referred to.

When the burner is in operation, hot flue gases flow along the heating surface-enlarging elements and heat is transferred both to CH water flowing through the water passage and to sanitary water present on the other side

of the wall portion referred to.

Thus a demand for space heating can be met while at the same time sanitary water in the storage vessel is maintained at the required temperature. Upon a demand for sanitary water, as soon as the temperature in the storage vessel has fallen below a set value, the CH water circuit is short-circuited, so that all of the heat produced by the burner is used for the benefit of the sanitary water.

If, however, the demand for CH water persists for a long time, whereby the flue gases produced by the burner give off heat not only to the CH water but at the same time to the sanitary water in the storage vessel as well, so that the temperature in that vessel exceeds the set maximum value, the burner is switched off. Then the CH water flowing through the heat exchanger can for some time withdraw heat from the sanitary water vessel by way of the heating surface-enlarging elements referred to, until the temperature of the sanitary water vessel has decreased to the extent where the burner switches on again.

When a demand for space heating arises only after a long period of time, it may even suffice initially to operate exclusively the circulation pump of the CH system, allowing CH water to withdraw heat from the sanitary water in the storage vessel, until the temperature thereof has fallen to the point where the burner switches on and both CH water and sanitary water are heated by flue gases.

In a preferred embodiment of the invention, the heat exchanger, made from light metal, may form part of a premix gas/air burner in a housing with a sidewall and a closed end wall, the burner being arrranged centrally within the sidewall with the combustion space facing the end wall, the flue gas duct, in which extend the heating surface-enlarging elements, being bounded by the above-mentioned sidewall of the housing and the CH water passage arranged substantially coaxially between the burner and the sidewall.

In this way a burner/heat exchanger unit is obtained which has a housing part, bounded by a closed end wall, extending only partly into a storage vessel for sanitary water, i.e. only that portion of the housing where the combustion chamber is located and the flue gases have their highest temperature, is located within the storage vessel, and the part of the housing where the flue gases leave the housing is located outside the storage vessel. In the part of the housing located outside the storage vessel, egressing flue gases can no longer be heated by hot water in the storage vessel and they move in countercurrent with return CH water flowing in the water passage. In the process, the flue gases can give off their residual heat to the return CH water and be cooled to 60-70°C. The part of the burner/heat exchanger unit located outside the storage vessel thus operates as an economizer in that the flue gases present therein condense, thereby further giving off heat, and the boiler can therefore be qualified as a High-Efficiency boiler.

Depending on the depth to which the housing is inserted into the storage vessel, the capacity of the boiler can be varied form 5 kW to 25 kW. This means that with a single appliance, the greater part of the market with regard to households can be covered.

The boiler according to the invention can be manufactured in similar sizes to known combined boilers of the storage principle, at lower cost and providing more convenience in use than comparable combined boilers. In fact, by virtue of the direct heating of the sanitary water in the storage vessel by the flue gases, a more rapid heating can be obtained, so that sanitary water is practically always available. Further, the burner may be made of modulating design.

To clarify the invention, one exemplary embodiment of the High-Efficiency combined boiler will be described with reference to the accompanying drawings.

Fig. 1 is a diagrammatic longitudinal elevation of the boiler;

Fig. 1A shows the course of the water in the CH water passage in the heat exchanger according to Fig. 1; and

Fig. 2 shows an exemplary embodiment of a control diagram of the boiler according to Fig. 1.

According to the drawings, in particular Fig. 1, a burner/heat exchanger assembly 1 extends partly into a storage vessel 2 for sanitary water. The depth of insertion is variable, i.e. the assembly 1 projects outside the vessel 2 over a variable distance a.

The vessel 2 comprises an inlet 3 for cold sanitary water S and a tap 4 for hot sanitary water. Indicated by 5 is a sensor having the function of a maximum-thermostat, control thermostat and priority thermostat.

The burner/heat exchanger assembly 1 comprises a housing, for instance cylindrical, with a sidewall 6 and a closed end wall 7. Arranged substantially coaxially within the housing 6, 7 are a burner 8 with a combustion chamber 9 and a CH water passage 10 with an inlet 11 for return CH water and a discharge 12 for heated CH water, connected with a space heater, such as a radiator 13 (see Fig. 2).

The burner 8 is of the premix type, with a mixing chamber 14 which is supplied with air by a fan 15 and with gas through a pipe 16.

The CH water passage 10, together with the sidewall 6 of the housing 6, 7, bounds a flue gas duct 17 communicating with the combustion chamber 9 near the closed end wall 7 of the housing 6, 7. The flue gas passage 17 ends in a discharge 18, connectible to, for instance, a flue.

The course of the water in the CH water passage 10 is indicated diagrammatically in Fig. 1A, i.e. return CH water enters at 11 and flows upwards following an interrupted helical path to a discharge 12 extending straight down.

The CH water passage 10 is directly connected with

the housing sidewall 6 through heating surface-enlarging projections 19 extending transversly through the flue gas duct 17.

The combined boiler operates as follows:

The storage vessel 2, made of stainless steel or enamelled on the inside in view of the storage of drinking water, is filled by way of the inlet 3 and supplemented when hot water is withdrawn from the vessel through the tap 4.

Flue gas flows from the combustion chamber 9 along the inside of the housing end wall 7 into the flue gas duct 17 to the discharge 18. In the process, the flue gas, which may have a temperature of 1400°C in the combustion chamber 9, gives off heat directly to the light metal-cast CH water passage 10 and to the housing sidewall 6, and indirectly by way of the projections 19. Thus the CH water flowing in the passage 10 substantially in countercurrent with the flue gases, as well as the sanitary water S in the vessel 2 are heated. In the process, the housing sidewall 6 will assume a temperature 10-15°C higher than the temperature of the sanitary water in the vessel 2. Before leaving the unit 1, flue gas flows through the part of the housing where the mixing chamber 14 of the burner is located and the part of the housing which projects outside the vessel 2 over a distance a. In the last-mentioned paths, the flue gas is further cooled through heat release to combustible mixture in the mixing chamber and to incoming return CH water which only has a temperature of about 20°C, so that the flue gas entering the flue has only a temperature of about 60°C. In this last path, the flue gases condense, so that condensation heat is used as well, which makes the boiler a High-Efficiency boiler.

When upon prolonged demand for space heating - whereby the burner is in operation for a long time and during that time gives off heat not only to the CH water but also to sanitary water in the vessel 2 - the temperature in the vessel 2 may rise to such an extent that the burner is switched off by the maximum thermostat sensor 5.

Outgoing CH water can nevertheless be heated, viz. by transfer, through the projections 19, of accumulated heat from the vessel 2, until the temperature in the vessel 2 has fallen to the extent where the sensor 5 controls the ignition of the burner.

As shown in Fig. 2, the combined boiler 1 may be equipped with a standard circulation pump 20, a standard DC fan 15 and a standard three-way valve 21 for short-circuiting the CH circuit. Instead of using a three-way valve, it is also possible to switch the pump 20 in the case where the radiators in a space to be heated are provided with thermostat valves.

Included in the gas supply duct 12 is a gas valve 22 suitable for use with an electrical (spark or heater plug) ignition.

The pump can be driven so as to continue operating for a specified time after switch-off.

Three NTCs (resistive temperature sensors) 23 or other thermostats provide for the observation of the temperature, on the basis of which the maximum-limitation is implemented, the control thermostat is controlled, the preferred control for hot sanitary water and similar functions are controlled.

Claims

1. A combined boiler, which is equipped with a burner (8) and a heat exchanger (10,19,6) for transferring heat of flue gases to central-heating (CH) water, and with a storage vessel (2) for sanitary water (S), wherein the heat exchanger (10,19,6) is at least partly immersed in sanitary water (S) and is adapted for direct heat exchange between through-flowing flue gases, through-flowing CH water, and sanitary water in the storage vessel (2), characterized in that the burner (8) and the heat exchanger (10,19,6) are combined in an assembly (1) which enters the storage vessel (2) from one side, whereby in use the flue gases leave the assembly near the side from which the assembly is entered in the vessel.

2. A boiler according to claim 1, characterized in that the heat exchanger (10, 19, 6) comprises a flue gas passage (17) which is bounded on one side by a CH water channel (10) and on the other by a wall portion (6) which is in direct contact with sanitary water (S) present in the storage vessel (2), said wall portion being at least locally in heat-transmissive contact with the CH water channel (10).

3. A boiler according to claim 2, characterized in that heating surface-enlarging elements (19) extend in the flue gas passage (17) and are in direct communication both with a CH water passage (10) and with said wall portion (6).

4. A boiler according to claim 3, characterized in that the heat exchanger (10, 19, 6), made of light metal, forms part of a premix gas/air burner (8) in a housing (6, 7) with a sidewall (6) and a closed end wall (7), the burner (8) being arranged centrally within the sidewall (6) with the combustion space (9) facing the end wall (7), the flue gas duct (17) in which extend the heating surface-enlarging elements (19) being bounded by said sidewall (6) of the housing (6, 7) and the CH water passage (10) arranged substantially coaxially between the burner (8) and the sidewall (6).

5. A boiler according to any one of the preceeding claims, characterized in that the depth to which the assembly (1) is inserted into the storage vessel (2) is adjustable, such that the capacity of the boiler can be varied.

Patentansprüche

1. Kombinierter Kessel, der mit einem Brenner (8) und einem Wärmeaustauscher (10, 19, 6) zum Übertragen von Wärme von Verbrennungsgasen an Wasser einer Zentralheizung (CH) und mit einem Speicherkessel (2) für Sanitärwasser (S) ausgestattet ist, wobei der Wärmeaustauscher (10, 19, 6) zumindest teilweise in Sanitärwasser (S) eingetaucht ist und für einen direkten Wärmeaustausch zwischen hindurchströmenden Verbrennungsgasen, hindurchströmendem CH-Wasser und Sanitärwasser in dem Speicherkessel (2) angepaßt ist,
dadurch gekennzeichnet, daß
der Brenner (8) und der Wärmeaustauscher (10, 19, 6) in einer Baueinheit (1) kombiniert sind, welche in den Speicherkessel (2) von einer Seite eintritt, wodurch die Verbrennungsgase die Baueinheit bei Gebrauch in der Nähe der Seite verlassen, von der die Baueinheit in den Kessel eingesetzt wird.

2. Kessel gemäß Anspruch 1, dadurch gekennzeichnet, daß der Wärmeaustauscher (10, 19, 6) einen Durchgang (17) für das Verbrennungsgas aufweist, der auf einer Seite durch einen CH-Wasserkanal (10) und auf der anderen Seite durch einen Wandabschnitt (6) begrenzt wird, der mit dem in dem Speicherkessel (2) befindlichen Sanitärwasser (S) in direktem Kontakt steht, wobei der Wandabschnitt zumindest lokal in Wärmeübergangs-Kontakt mit dem CH-Wasserkanal (10) steht.

3. Kessel gemäß Anspruch 2, dadurch gekennzeichnet, daß Heizflächen vergrößernde Elemente (19) in den Durchgang (17) für das Verbrennungsgas ragen und in direkter Verbindung sowohl mit einem CH-Wasserdurchgang (10) und mit dem Wandabschnitt (6) stehen.

4. Kessel gemäß Anspruch 3, dadurch gekennzeichnet, daß der aus Leichtmetall hergestellte Wärmeaustauscher (10, 19, 6) einen Teil eines Gas/Luftbrenners (8) mit Vormischung in einem Gehäuse (6, 7) mit einer Seitenwand (6) und einer geschlossenen Endwand (7) bildet, wobei der Brenner (8) zentral innerhalb der Seitenwand (6) mit dem der Endwand (7) gegenüberliegenden Verbrennungsraum (9) angeordnet ist, die Leitung (17) für das Verbrennungsgas, in welche die die Heizflächen vergrößernden Elemente (19) ragen, durch die Seitenwand (6) des Gehäuses (6, 7) begrenzt wird und wobei der CH-Wasserdurchgang (10) im wesentlichen koaxial zwischen dem Brenner (8) und der Seitenwand (6) angeordnet ist.

5. Kessel gemäß einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Tiefe, bis zu der die Baueinheit (1) in den Speicherkessel (2) eingesetzt wird, einstellbar ist, so daß die Kapazität des Kessels verändert werden kann.

Revendications

1. Une chaudière combinée ou mixte, qui est équipée d'un brûleur (8) et d'un échangeur de chaleur (10, 19, 6) pour transférer la chaleur de gaz brûlés à de l'eau de chauffage central (CH), et d'un récipient de stockage (2) pour de l'eau sanitaire (S), dans laquelle l'échangeur de chaleur (10, 19, 6) est au moins partiellement immergé dans l'eau sanitaire (S) et est apte à l'échange de chaleur direct entre les gaz brûlés s'écoulant à travers, l'eau de chauffage central s'écoulant à travers, et l'eau sanitaire dans le récipient de stockage (2), caractérisée en ce que le brûleur (8) et l'échangeur de chaleur (10, 19, 6) sont combinés en un ensemble (1) qui pénètre dans le récipient de stockage (2) d'un côté, de telle manière qu'en service les gaz brûlés quittent l'ensemble à proximité de la face à partir de laquelle l'ensemble a pénétré dans le récipient.

2. Une chaudière selon la revendication 1, caractérisée en ce que l'échangeur de chaleur (10, 19, 6) comporte un passage de gaz brûlés (17) qui est délimité d'un côté par un canal (10) d'eau de chauffage central et de l'autre côté par une partie de paroi (6) qui est en contact direct avec l'eau sanitaire (S) présente dans le récipient de stockage (2), ladite partie de paroi étant au moins localement en contact de transmission de chaleur avec le canal (10) d'eau de chauffage central.

3. Une chaudière selon la revendication 2, caractérisée en ce que des éléments (19) d'augmentation de la surface de chauffage s'étendent dans le passage de gaz brûlés (17) et sont en communication directe à la fois avec un passage d'eau de chauffage central (10) et avec ladite partie de paroi (6).

4. Une chaudière selon la revendication 3, caractérisée en ce que l'échangeur de chaleur (10, 19, 6), réalisé en métal léger, forme une partie d'un brûleur à prémélange gaz/air (8) dans un boîtier (6, 7) muni d'une paroi latérale (6) et d'une paroi d'extrémité fermée (7), le brûleur (8) étant disposé au centre, à l'intérieur de la paroi latérale (6) avec l'espace de combustion (9) faisant face à la paroi d'extrémité (7), le conduit de gaz brûlés (17) dans lequel s'étendent les éléments (19) d'augmentation de la surface de chauffage étant délimité par ladite paroi latérale (6) du boîtier (6, 7), et par le passage (10) d'eau de chauffage central, disposé de façon sensiblement coaxiale entre le brûleur (8) et la paroi latérale (6).

5. Une chaudière selon l'une quelconque des reven-

dications précédentes, caractérisée en ce que la profondeur d'insertion de l'ensemble (1) dans le récipient de stockage (2) est réglable, de telle façon que l'on puisse faire varier la capacité de la chaudière.

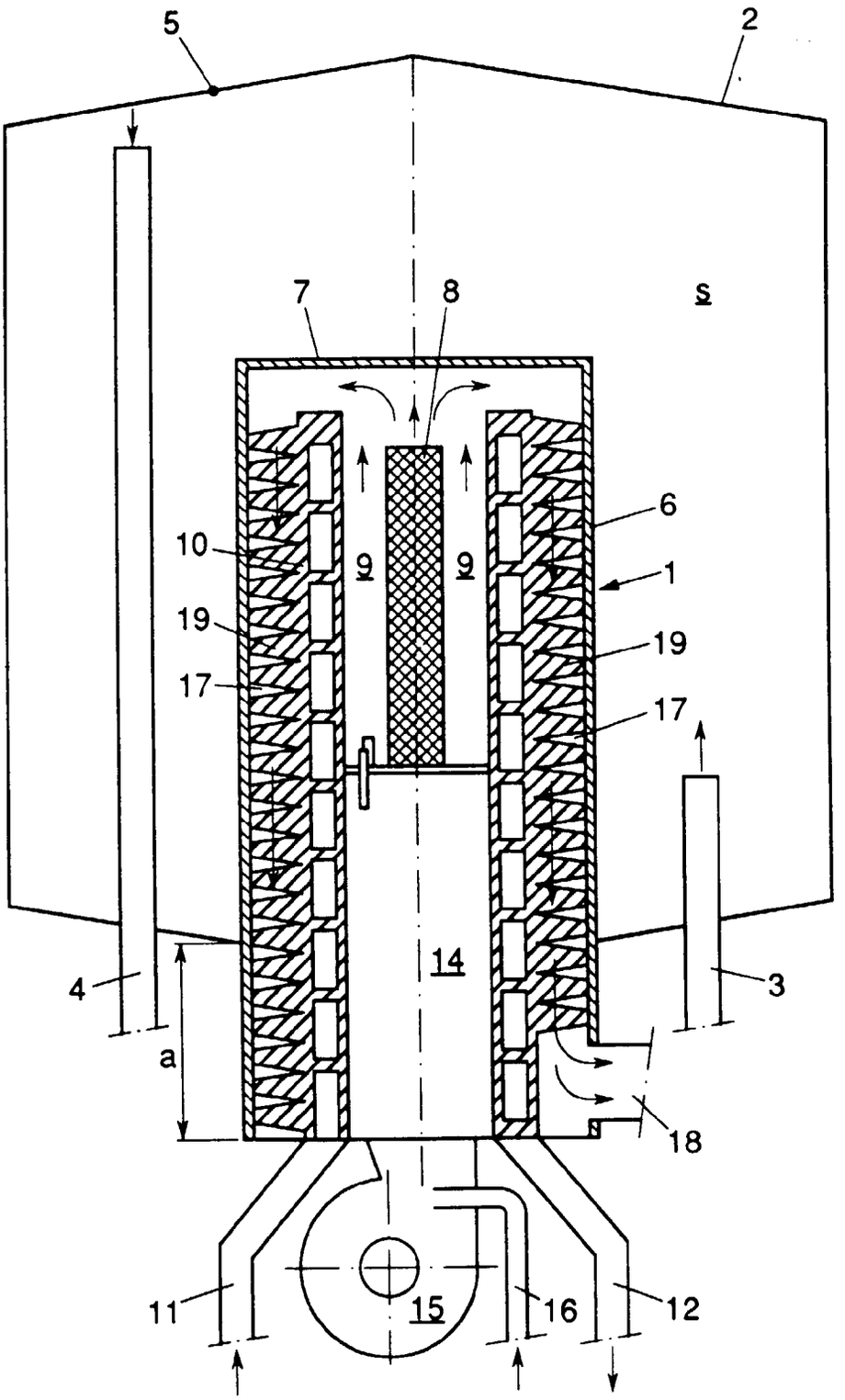


FIG. 1

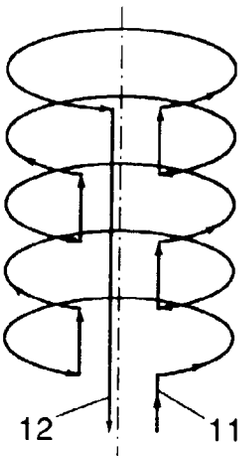


FIG. 1A

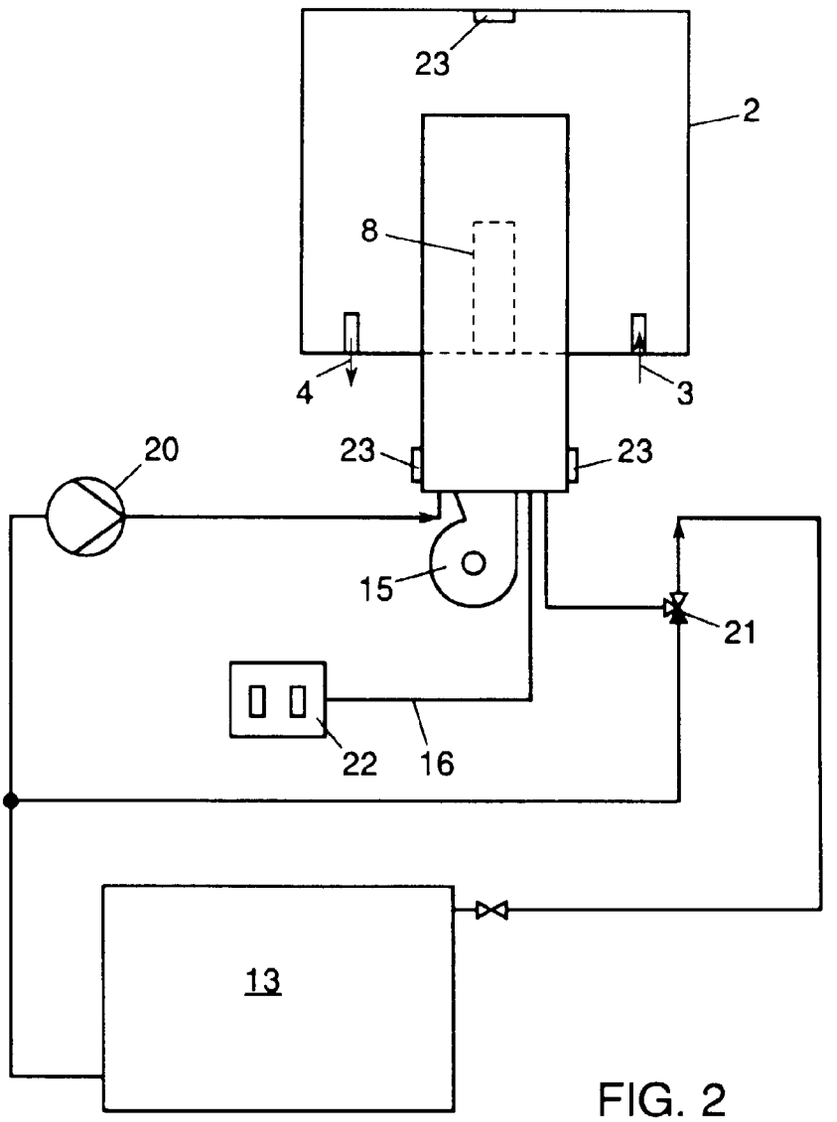


FIG. 2