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(54) **HEAT EXCHANGER FOR A TRANSFORMER**

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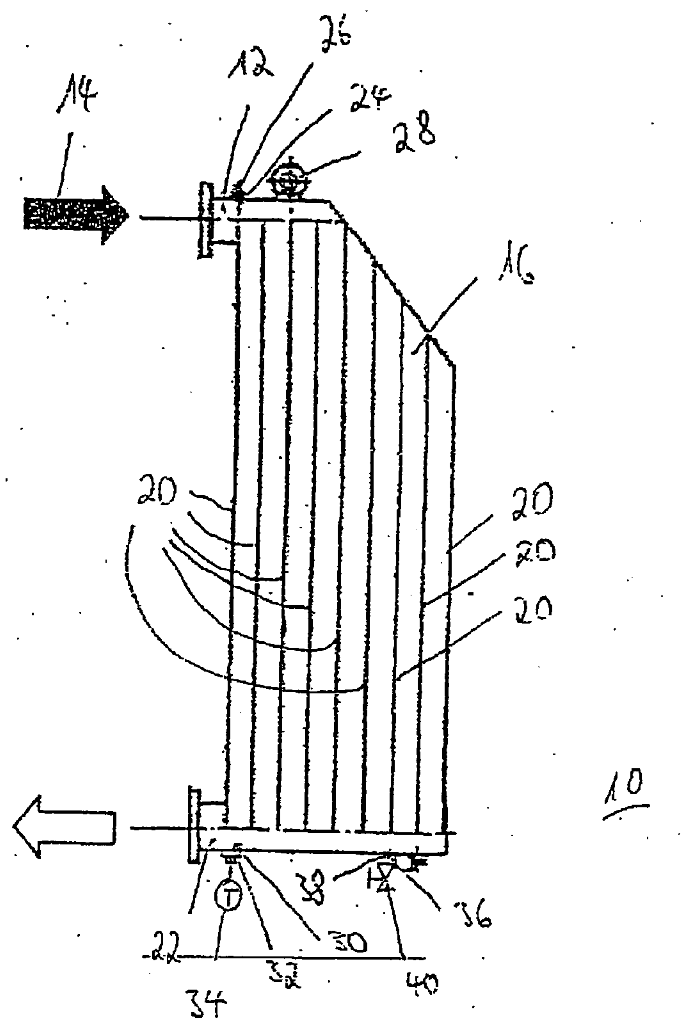
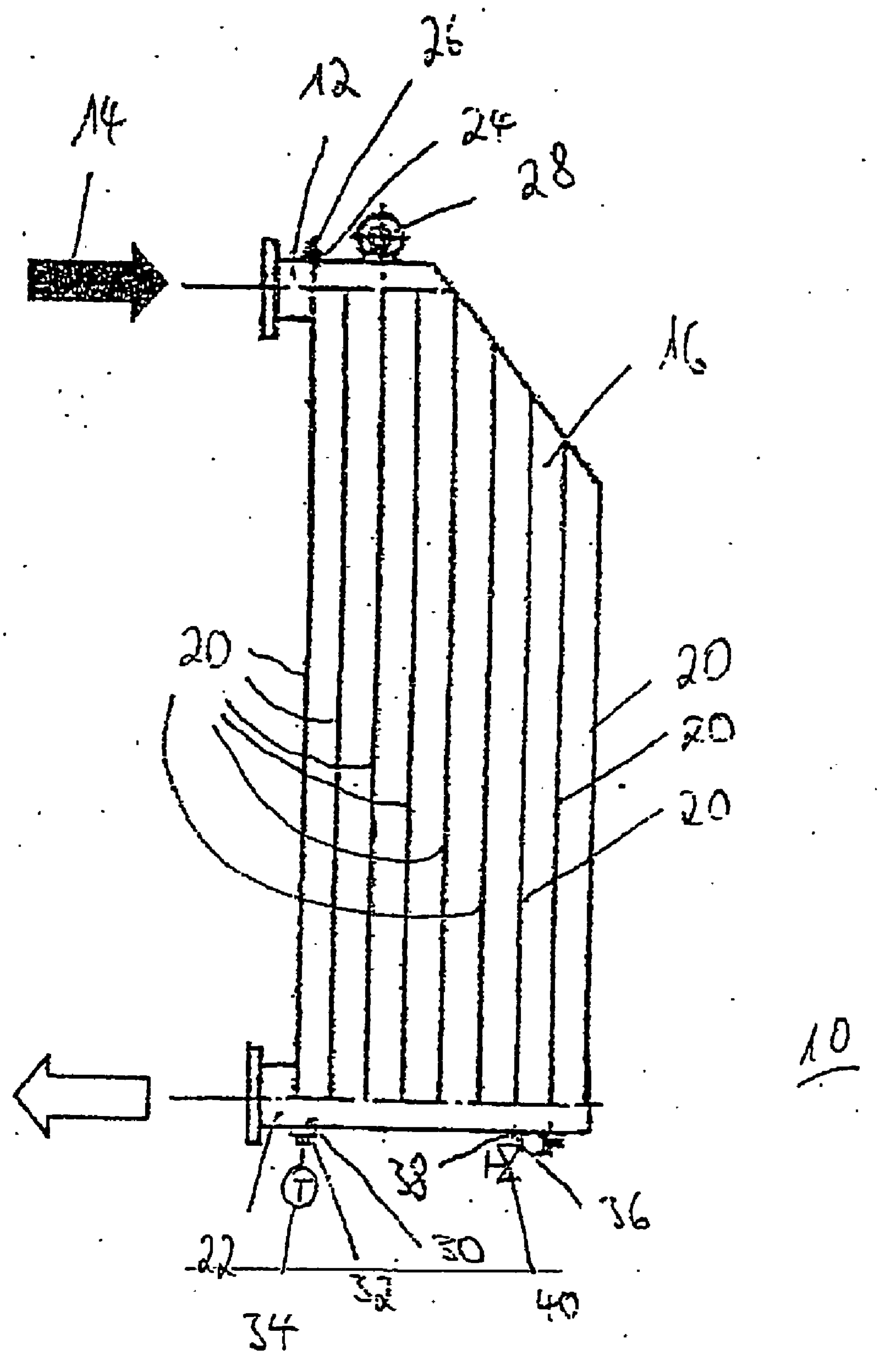
(57) **ABSTRACT**

The invention relates to a heat exchanger for a transformer for a transformer comprising a heat exchanger medium, which can be introduced into a heat exchanger element via a feed element, and can be evacuated from the heat exchanging element via a discharge element. The invention involves a first temperature measurement of a feed flow of the heat exchanger medium and a second temperature measurement of a discharge flow of the heat exchanger medium. A first opening is provided in the feed element, inside of which a first temperature probe is positioned at a predetermined location inside the feed flow during operation of the heat exchanger, and a second opening is provided in the discharge element, inside of which a second temperature probe is positioned at a predetermined location in the discharge flow during operation of the heat exchanger.





Single Figure

HEAT EXCHANGER FOR A TRANSFORMER

[0001] The invention relates to a heat exchanger, in particular for a transformer, comprising a heat exchanging medium which can be led via a feed element into a heat exchanging element and can be led via a discharge element out of the heat exchanging element, comprising a first temperature measurement of a feed current of the heat exchanger medium and comprising a second temperature measurement of a discharge current of the heat exchanging medium.

[0002] It is commonly known that transformers can be used for a multiplicity of applications. In particular, power transformers of 5 MVA transformation capacity radiate a considerably quantity of heat during operation, which is usually released into the environment via heat exchangers. For this purpose, a cooling circuit is generally provided, so that the heat exchanger can also, where appropriate, be disposed remote from the transformer.

[0003] A customary configuration of a heat exchanging circuit of this type provides that one or more, often identically designed heat exchangers are respectively supplied with heat exchanging medium via a feed socket. A specially designed surface of the heat exchanger then ensures an optimal heat transfer to a second heat carrier medium, which is also involved in the heat exchanging process as a recooling medium. This can be, for example, the ambient air or, indeed, a liquid, depending on how the heat exchanger is structured.

[0004] For the checking of the thermal balance of such heat exchangers, it is prescribed under the general rules of technology and standardization that both the feed temperature of the heat exchanging medium and the discharge temperature of the heat exchanging medium from the heat exchanger are measured. For this purpose, special pipe sections are flange-connected directly to the feed socket and discharge socket, respectively, of the heat exchanger, an immersion sleeve being welded or screwed into these pipe sections, which immersion sleeve receives a thermometer. In an arrangement of this type, the measured temperature in the feed-in and in the outflow, respectively, of the heat exchanger is measured only after a certain time lag, since a temperature change is relayed first to the material of the immersion sleeve and afterwards to the thermometer.

[0005] Furthermore, the temperature-measuring pipe sections must be taken into account when planning the design of the transformer. The dimensions of the transformer with the heat exchanger will turn out to be correspondingly sized.

[0006] Based on the above prior art, the object of the invention is to define a heat exchanger for a transformer in which the measurement is improved.

[0007] This object is achieved by the inventive heat exchanger for a transformer, having the features stated in patent claim **1**.

[0008] Accordingly, the heat exchanger according to the invention is characterized in that in the feed element there is disposed a first opening, in which, during operation of the heat exchanger, a first temperature probe can be positioned at a predetermined location in the feed current, and in that in the discharge element there is disposed a second opening, in which, during operation of the heat exchanger, a second temperature probe is positioned at a predetermined location in the discharge current.

[0009] Consequently, it is provided according to the invention that the temperature measurement is now conducted on the heat exchanger itself. The previously known pipe sections with, respectively, a temperature measuring instrument which, according to the previously known prior art, has been flange-connected to the heat exchanger, are thus dispensed with. In this way, the design is simplified and the options for arranging a heat exchanger with a transformer are increased.

[0010] Moreover, the position of the temperature measurement is now directly at the inlet and at the outlet, respectively, of the heat exchanging medium on the heat exchanger, thereby ensuring that the temperatures of the heat exchanging medium are measured in the heat exchanger itself. Possible sources of error or disturbance influences for the temperature measurement, from the previous temperature-measuring point outside the heat exchanger in the pipe sections up to the points on the heat exchanger which are defined according to the invention, are thereby avoided.

[0011] In an advantageous embodiment of the subject of the invention, it is provided that in the first opening there is additionally disposed a ventilation device.

[0012] For servicing reasons, in connection with filling a heat exchanger with heat exchanger oil, for example, a ventilation device in the form of a ventilation cock or ventilation plug is usually placed at a geodetically high point on the heat exchanger. If the feed current and discharge current, respectively, of the heat exchanger is also realized at a geodetically high point, it is provided according to the invention that the first or the second opening accommodates a combined function element comprising both functions.

[0013] One possible embodiment of a dual-function element consists in the emptying device being configured such that the temperature probe can be inserted through it or past it into the feed and discharge element, respectively, so that the particular temperature probe reaches its predetermined position. The corresponding embodiments of the ventilation device are known to the person skilled in the art.

[0014] The structure of the heat exchanger as a whole is thereby simplified. The creation of an additional opening for a separate ventilation device is dispensed with.

[0015] It is particularly advantageous if the first and/or the second opening has a sealing element, through which the corresponding temperature probe can be inserted in a heat-exchange-medium-tight manner.

[0016] In this inventive embodiment of the heat exchanger, the hitherto customary immersion sleeve, which prevents an escape of heat exchanging medium from a closed system, is avoided. An arrangement of this type, moreover, enables the temperature measurement to be realized directly in the heat exchanger medium. A dead time in the temperature measurement, caused by the immersion sleeve, is avoided.

[0017] Further advantageous embodiments of the heat exchanger according to the invention can be derived from the further dependent claims.

[0018] The invention, an advantageous embodiment thereof and improvements of the invention, as well as particular advantages of the invention, shall be explained and described in greater detail with reference to the illustrative embodiment represented in the drawing, wherein:

the single FIGURE shows a transformer cooler.

[0019] The single FIGURE shows a cooler **10**, which serves as a recooler for a cooling circuit of a power transformer, neither the power transformer nor other details of the cooling circuit being represented in this FIGURE. The power transformer recooled with the cooler **10** has a transformation capacity of about 15 MVA, in the illustrated example the single cooler **10** being adequately dimensioned for the recooling of the heat generated by the power transformer.

[0020] It is readily conceivable, however, that, if necessary, a plurality of such coolers **10** are connected in parallel in the cooling circuit or that a heat exchanger face commensurate to the cooling requirements is fitted to the cooler **10**, so that the cooling capacity of this unit is suitably increased.

[0021] The illustrated example shows the cooler **10** as an upright heat exchanger, so that by at the bottom in the FIGURE is meant geodetically "at the bottom". Accordingly in the FIGURE, at the top of the cooler **10**, a feed socket **12** is shown, the flow direction of the inflowing coolant being indicated by a first arrow **14**. The feed socket **12** is configured as a pipe section, which, on the one hand, is connected to a cooler element **16** and, on the other hand, has a first flange **18** provided, in particular, for direct connection to the power transformer or a connecting pipe of the coolant circuit.

[0022] The inflowing coolant, in this example a heat exchanger oil, which is often used in transformer cooling circuits, flows through the feed socket **12** to the cooler element **16**, whereupon the coolant current is divided into a plurality of ribs **20**, so that a plurality of coolant currents are formed, running from top to bottom through the cooling element **16**. In the lower region of the cooling element **16**, the coolant subcurrents reconverge into a common discharge current. This common discharge current makes its way through a discharge socket **22** back to the power transformer or into the coolant circuit.

[0023] In order to reinforce the cooling effect, the ribs **20** can be blown through, for example by a forced convection flow, by the air which surrounds them. For this, fans (not represented in this FIGURE) are normally used, the generated air current of which is sufficiently strong that a desired temperature of the coolant is established in the discharge current.

[0024] At the highest point of the pipe in the feed socket **12**, namely approximately at the interface between the pipe section and the cooler element **16**, a first opening **24** is disposed in the feed socket **12**. In the chosen representation, the first sealing element **26**, which is disposed in the first opening **24**, is also shown. With this first sealing element **26**, a combined apparatus comprising ventilation element and thermocouple can be inserted in a medium-tight manner into the first opening **24**. This combined apparatus is not shown in the single FIGURE, but is known to the person skilled in the art.

[0025] The ventilation device is necessary, particularly in the filling of the coolant circuit or of the cooler **10**, to ventilate the air collecting at the highest points of the particular circuit or of the cooler **10**, which air is gradually displaced by the cooling medium filled into the coolant circuit. The adoption of a further technical function, which, according to the invention, can be realized at the same point in the first opening **24**, is the temperature measurement with a first thermocouple. According to the invention, the first thermocouple can now be brought to a position in the pipe section of the feed socket **12** which, according to the invention, best corresponds to the actual feed temperature of the cooler **10**. Moreover, the first sealing element **26** seals the first thermocouple in the region of the first opening **24** against a possible escape of coolant from the cooling system. In this example, the otherwise necessary immersion sleeve for sealing an opening in a pipe is avoided. The measurement value recording is thereby made directly by the thermocouple in the coolant and not indirectly via the material of the immersion sleeve and, hence, such that it is damped and time-delayed. The measurement has in this way become more accurate and faster.

[0026] In the illustrated example, yet another advantage is apparent. In the upper region of the cooling element **16** there is also shown an eyelet **28**, by which, for example in the assembly operation, the complete cooler **10** can be hung from a hoist. Due to the space-saving dual function of temperature measurement and ventilation in the first opening **24**, moreover, no further space is required, from the design aspect, in the upper region of the cooling element **16**. Thus, a greater design freedom also exists, namely with respect to a design of the cooling element **16**, for example in its beveled upper region, as represented. In the chosen example, this design takes into account a special spatial assembly requirement relating to the place of installation of the cooler **10**.

[0027] In the lower region, the two functions of temperature measurement and coolant run-off are realized at various positions. Thus, a second opening **30** is disposed on a lowly point of the pipe section of the discharge socket **22** and is provided with a second sealing element **32**. The second sealing element **32** is designed with a ductile plastic compound and fully closes off the second opening **30**, so that no coolant in the inner region of the cooling element **16** or of the discharge socket **22** is able to escape, even if there is no thermocouple inserted. The plastic compound is made sufficiently ductile, however, and is provided with a further opening, to enable the rod-like part of a second thermocouple to be inserted through the plastic compound and the second opening **30** and to be fixed in a desired position.

[0028] For the fixing there are various options available, for example that the rod-like part of the thermocouple is provided with an appropriate stop or with an appropriate screw connection. Further fixing options are known to the person skilled in the art. In the FIGURE, the thermocouple **34** is shown in purely symbolic representation. A third opening **36** is likewise arranged on a lower point of the cooler element **16**, yet at a sufficient distance from the second opening **30** that the devices introduced into the openings **30**, **36** do not influence or disturb one another. To the third opening **36** there is connected a connection element **38**, which is suitable for receiving a drainage device, here a shut-off valve **40**. The shut-off valve **40** is represented merely as a symbol and is constructed, for example, as a shut-off ball cock or shut-off slide valve.

[0029] With the above-described arrangement according to the invention, it is possible to conduct very accurate temperature measurements directly in the feed and discharge currents of the cooler **10** in a particularly simple manner. Such measurements on coolers are normally prescribed by standards, to allow the functionality of a heat exchanger to be monitored. One option for processing the measurement data consists in relaying these to a process control system of the transformer, of the coolant circuit or of an integrated plant, which process control system carries out the evaluation of the measurement and, if necessary, also the editing of the measurement data. Moreover, the option exists of further processing of the measurement data, for example by the formation of temperature differences or statistical analyses. These functions can also be performed on the spot by appropriate measuring instruments. These are not, however, represented in the FIGURE. In any event, the measurement value recording in the specified manner is an improvement on that which has hitherto been known.

Reference symbol list	
10	cooler
12	feed socket
14	first arrow
16	cooling element
18	flange
20	ribs
22	discharge socket
24	first opening
26	first sealing element
28	eyelet
30	second opening
32	second sealing element
34	thermocouple
36	third opening
38	connection element
40	shut-off valve

1. A heat exchanger for a transformer, comprising a heat exchanger medium which can be led via a feed element into a heat exchanging element and can be led via a discharge element out of a heat exchanging element, comprising a first temperature measurement of a feed current of the heat exchanger medium and comprising a second temperature measurement of a discharge current of the heat exchanging medium, wherein in the feed element there is disposed a first opening, in which, during operation of the heat exchanger, a first temperature probe is positioned at a predetermined location in the feed current, and in that in the discharge element there is disposed a second opening, in which, during operation of the heat exchanger, a second temperature probe is positioned at a predetermined location in the discharge current.

2. The heat exchanger as claimed in claim **1**, wherein in the first opening there is additionally disposed a ventilation device.

3. The heat exchanger as claimed in claim **1**, wherein in the second opening there is additionally disposed a ventilation device.

4. The heat exchanger as claimed in claim **1**, wherein the first and/or the second opening has a sealing element, through which the corresponding temperature probe can be inserted in a heat-exchange-medium-tight manner.

5. The heat exchanger as claimed in claim **1**, wherein the temperature probe is a thermocouple.

6. The heat exchanger as claimed in claim **1**, wherein the temperature probe is protected by an immersion sleeve.

7. The heat exchanger as claimed in claim **2**, wherein in the second opening there is additionally disposed a ventilation device.

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