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(54) Tempering clamp

Temperklemme

Pince de trempe

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Description

Field of the invention

[0001] The present invention relates to a tempering clamp for a sample container used for holding the container and heating or cooling the sample contained within the container.

Description of the related art

[0002] Generally, sample holders known in the art are rigid and inflexible and therefore, hardly suitable for providing tolerance compensation of different sample holders or sample tubes.

[0003] It is known in the art to use sample holders together with tempering elements in the domain of chemistry and medical science in order to temper, i.e. to heat or to cool, the sample contained within the sample holder.

[0004] Using conical or conical/cylindrical formed sample tubes a close contact can be achieved by pressing against the conical part of the heating element by pressure from above. For this, an additional corresponding device is necessary allowing for axial force transmission, for example, by a pressing lid. During tempering, the sample tube is not accessible at all even not from above. Therefore, no sample tubes can be used which form part of a microfluidic environment as a microfluidic chip.

[0005] US 5 795 547 A describes an apparatus for automatic performance of temperature cycles in a number of test tubes. The apparatus comprises a casing and a hinged lid being connected by the hinge of the lid. Within the casing a unit heater is provided which holds the test tubes and has an annular arrangement of recesses, each recess serving as a chamber for holding the lower part of a test tube.

[0006] US 20132/0244047 2 describes a PCR apparatus for holding a test tube, which comprises a heat insulating mount having a main body provided with a receiving space for receiving a bottom of the test tube and a lateral channel for receiving a heating member.

Summary of the invention

[0007] In contrast thereto, the invention proposes a tempering clamp according to claim 1, for holding a sample container and for tempering a sample contained within the sample container. The tempering clamp comprises first and second clamping jaws movably, especially manually movably, connected by a spring element, and first and second tempering elements. The first tempering element is associated, e.g. connected or attached, to the first clamping jaw and the second tempering element is associated, e.g. connected or attached, to the second clamping jaw.

[0008] In one embodiment, a first heat insulator is attached to the first tempering element and a second heat insulator is attached to the second tempering element.

[0009] Furthermore, the first and second heat insulators can be cooling elements.

[0010] In another embodiment, the first and second tempering elements are adapted for heating and/or cooling the sample. Peltier elements can be used as tempering elements.

[0011] In one embodiment, an element is provided for effecting contact pressure in axial direction.

[0012] Furthermore, the spring element comprises a spring steel sheet.

[0013] For monitoring and controlling the tempering process a temperature sensor can be provided. Further sensors, e.g. for pH-value, oxygen partial pressure, etc., can be provided. In one embodiment, the spring element is biased. Furthermore, outer surfaces of the tempering clamp can constitute an inwardly directed V-form. This can be achieved, for example, by biasing the spring element.

[0014] Moreover, the tempering clamp can be adapted to receive a microfluidic chip.

[0015] A method for holding a sample container and tempering a sample contained within the sample container uses a tempering clamp according to one of claims 1 to 12.

[0016] In one embodiment, the tempering process is monitored by a sensor inserted into the sample container from above.

[0017] The present application proposes a clamp serving as a heating element which is suitable for holding a sample tube serving as a sample container to be tempered and holding the sample holder with a radial pressure. In one embodiment, the clamp comprises two half shells reproducing the three-dimensional structure of the sample tube. However, the cavity between the half shells can be slightly smaller than the volume of the sample tube. The two half shells are connected by a flat spring which will be extended during insertion of the sample tube into the cavity between the half shells automatically building a radial contact pressure onto the outside surface of the sample tube.

[0018] Further features and embodiments of the invention will become apparent from the description and the accompanying drawings.

Brief description of the Drawings

[0019] In the drawings,

Figure 1 is an overall view of a tempering clamp according to the invention in exploded view,

Figure 2 is an overall view of the tempering clamp shown in figure 1 in assembled condition,

Figure 3 is a rear view of the tempering clamp,

Figure 4 is an overall view of the tempering clamp and a sample view inserted into the tempering clamp,

Figure 5 is a view of a detail in figure 4.

Detailed Description

[0020] The figures are described cohesively and in overlapping fashion, the same reference numerals denoting identical parts.

[0021] Figure 1 shows an embodiment of the tempering clamp in exploded view generally denoted with reference number 10. The tempering clamp 10 shown comprises a first clamping jaw 12 and a second clamping jaw 14 connected by a spring steel sheet 16. Furthermore, the drawing shows a first peltier element 20, a second peltier element 22, a first cooling element 24, a second cooling element 26, a temperature sensor 28, and a number of fastening elements 30.

[0022] The spring steel sheet 16 is the spring element connecting the two clamping jaws forming the half shells of the tempering clamp 10. In the shown embodiment the peltier elements 20, 22 are the tempering elements being able to heat and to cool. The cooling elements 24, 26 serve as insulating elements. These cooling elements 24, 26 are constructed as blocks having cooling fins.

[0023] Figure 2 illustrates the tempering clamp 10 assembled in front view. The drawing shows the first clamping jaw 12, the second clamping jaw 14 connected and pressed together by the spring steel sheet 16, the first peltier element 20, the second peltier element 22, the first cooling element 24, the second cooling element 26, and the temperature sensor 28.

[0024] Figure 3 shows the tempering clamp 10 in rear view illustrating the rear side of the tempering clamp 10 with the spring steel sheet 16 connecting the first clamping jaw 24 and the second clamping jaw 26 at their rear edges fixed by the fastening elements 30.

[0025] Figure 4 shows the tempering clamp 10 together with a sample tube 50 inserted into the tempering clamp 10, especially in between the two clamping jaws 12 and 14 of the tempering clamp 10. Furthermore, a microfluidic chip is attached to the tempering clamp 10. The tempering clamp 10 serves as a lysis clamp the microfluidic chip is attached to.

[0026] Figure 5 shows a detail of figure 4 encircled and denoted with reference number 52. The drawing shows the sample tube 50 inserted in between the two clamping jaws 12, 14. The sample tube 50 is securely fixed in the cavity between the two clamping jaws 12, 14 by means of the contact pressure caused by the spring element connecting the two clamping jaws 12, 14. As the sample tube is slightly bigger than the cavity in the tempering clamp there is a gap 54 between the front edges 62, 64 of the two clamping jaws 12, 14.

[0027] The tempering clamp according to the invention can be used for sample tubes which are rigidly connected to a microfluidic chip and can be heated up to 60 °C. The sample contained in the sample tube can contain biological cells in suspension and a so-called lysis buffer. By influence of the buffer and the increased temperature,

the cells will be decomposed, that means lysed.

[0028] After completion of the lysis, the liquid overlap of the sample tube will be transferred into the microfluidic of the chips. Therefore, the lid on the sample tube must be manipulated.

[0029] In this case, the head room filled by air of the tube will be pressurized by pumping air so that liquid can rise through a riser pipe. It is also possible to work with negative pressure. In both cases, it must be accessible by corresponding pipes. On the chip, there are micro-mechanic valves which can be operated by external actors.

[0030] Furthermore, applications for the tempering clamp are in the field of a thermostating chamber for incubation, biochemical reactions as amplification reactions, kinetic measurements or similar applications needing a rapid heat transportation.

[0031] The application enables a fast heat transfer from a heating block to a sample tube containing a sample, in many cases a liquid sample.

[0032] For this purpose, the tempering clamp provides a close contact of the heating element by radial contact pressure onto the sample tube to compensate for tolerances of the heating element and the sample tube. The contact pressure should be automatically adjusted by insertion of the sample tube into the heating element.

[0033] Manual adjustment of the contact pressure or other measures and arrangements, as, for example, additional components or manipulation by the user, should be avoided.

[0034] To solve this problem, the invention provides in one embodiment a heatable sample tube holder in form of a clamp or bracket consisting of two half shells being connected by a flat spring element. The spring element causes a pressure being effective in radial direction by insertion of the sample tube by means of contact faces of the clamp onto the wall of the sample tube.

[0035] The two half shells form a cavity in between each other correspondig to the form of the sample tube. It is to be noted that the outer circumference or outer volume of the sample tube should be slightly bigger than the inner circumference or inner volume, respectively, of the clamp to cause the spring contact pressure.

[0036] In one embodiment, the sample tube is cylindrical. Accordingly, the two half shells as well form a cylindrical cavity. The outer surfaces of the clamp can be plane in order to attach the heating elements an the body of the flat spring. Thereby, in one embodiment, the result is a clamp having a rectangular or quadratic layout, projected alongside the cylindrical axis.

[0037] In another embodiment, the outer surfaces of the clamp the flat spring is attached to constitute a flat inwardly directed V-form. Thus, the flat spring is biased and having the same spring constant the contact caused by insertion of a sample tube is higher in comparison with a clamp having a rectangular layout.

[0038] The cavity in between the two half shells can be conical, conical/cylindrical in shape. The conical part

should be in the lower part of the cavity in case the sample tube is inserted top down.

[0039] The clamp according to the inventions provides for an optimal thermal contact between the heating element and the sample container to be tempered by radial pressing the heated contact faces without the need for using additional components or additional manual steps.

[0040] The contact pressure is defined to a certain extent by the spring constant and the difference in dimension between the inner volume of the cavity of the clamp and the outer volume of the sample tube. In case fastening faces being in V-form to each other the pressure is additionally defined by the bias force and the structure of the layout of the tempering clamp for the flat spring.

[0041] Furthermore, the sample tube remains accessible from above during tempering. Therefore, a fluidic functional part, for example a microfluidic chip, can be connected to the sample tube by means of a suitable adapter as a thread, bayonet, plug or clip connection. In this manner fluidic processes can be performed with the fluid contained within the sample tube.

[0042] Alternatively, the processes within the tempered sample tube can be monitored by means of an optical aperture or corresponding optical detection and supervising devices. The tempering procedure can be supervised by detectors or sensors inserted from above (temperature, pH-value, oxygen partial pressure, etc.). Furthermore, the sample tube can be charged or discharged from above. Moreover, the pressure in the region above the liquid can be increased or decreased.

Claims

1. Tempering clamp for holding a sample container and for tempering a sample contained within the sample container and having first and second tempering elements, **characterized in that** the tempering clamp (10) comprises first and second clamping jaws (12, 14) movably connected by a spring element, wherein the first tempering element is associated to the first clamping jaw (12) and the second tempering element is associated to the second clamping jaw (14).
2. Tempering clamp according to claim 1, wherein a first heat insulator is attached to the first tempering element and a second heat insulator is attached to the second tempering element.
3. Tempering clamp according to claim 2, wherein the first and second heat insulators are cooling elements (24, 26).
4. Tempering clamp according to one of claims 1 to 3, wherein the first and second tempering elements are adapted for heating the sample.

5. Tempering clamp according to one of claims 1 to 4, wherein the first and second tempering elements are adapted for cooling the sample.
6. Tempering clamp according to one of claims 1 to 5, wherein peltier elements (20, 22) are used as tempering elements.
7. Tempering clamp according to one of claims 1 to 6, wherein an element is provided for effecting contact pressure in axial direction of the sample.
8. Tempering clamp according to one of claims 1 to 7, wherein the spring element comprises a spring steel sheet (16).
9. Tempering clamp according to one of claims 1 to 8, further comprising a temperature sensor (28).
10. Tempering clamp according to one of claims 1 to 9, wherein the spring element is biased.
11. Tempering clamp according to one of claims 1 to 10, wherein outer surfaces of the tampering clamp (10) constitute an inwardly directed V-form.
12. Tempering clamp according to one of claims 1 to 11, wherein the tempering clamp (10) is adapted to receive a microfluidic chip.
13. Method for holding a sample container and tempering a sample contained within the sample container, using a tempering clamp (10) according to one of claims 1 to 12.
14. Method according to claim 13, wherein the tempering process is monitored by a sensor inserted into the sample container from above.

Patentansprüche

1. Temperklemme zum Halten eines Probenbehälters und zum Tempern einer im Probenbehälter enthaltenen Probe, wobei die Temperklemme erste und zweite Temperelemente aufweist, **dadurch gekennzeichnet, dass** die Temperklemme (10) erste und zweite Klemmbacken (12, 14) umfasst, die durch ein Federelement beweglich verbunden sind, wobei das erste Temperelement der ersten Klemmbacke (12) zugeordnet ist und das zweite Temperelement der zweiten Klemmbacke (14) zugeordnet ist.
2. Temperklemme nach Anspruch 1, wobei ein erster Wärmeisolator an dem ersten Temperelement angebracht ist und ein zweiter Wärmeisolator an dem zweiten Temperelement angebracht ist.

3. Temperklemme nach Anspruch 2, wobei der erste und der zweite Wärmeisolator Kühlelemente (24, 26) sind.
4. Temperklemme nach einem der Ansprüche 1 bis 3, wobei das erste und das zweite Temperaturelement zum Erwärmen der Probe ausgelegt sind.
5. Temperklemme nach einem der Ansprüche 1 bis 4, wobei das erste und das zweite Temperaturelement zum Kühlen der Probe ausgelegt sind.
6. Temperklemme nach einem der Ansprüche 1 bis 5, wobei Peltierelemente (20, 22) als Temperaturelemente verwendet werden.
7. Temperklemme nach einem der Ansprüche 1 bis 6, wobei ein Element zum Ausüben von Anpresskraft in axialer Richtung der Probe vorgesehen ist.
8. Temperklemme nach einem der Ansprüche 1 bis 7, wobei das Federelement ein Federstahlblech (16) umfasst.
9. Temperklemme nach einem der Ansprüche 1 bis 8, die ferner einen Temperatursensor (28) umfasst.
10. Temperklemme nach einem der Ansprüche 1 bis 9, wobei das Federelement vorgespannt ist.
11. Temperklemme nach einem der Ansprüche 1 bis 10, wobei Außenflächen der Temperklemme (10) eine nach innen gerichtete V-Form bilden.
12. Temperklemme nach einem der Ansprüche 1 bis 11, wobei die Temperklemme (10) zur Aufnahme eines mikrofluidischen Chips ausgelegt ist.
13. Verfahren zum Halten eines Probenbehälters und Tempern einer im Probenbehälter enthaltenen Probe unter Verwendung einer Temperklemme (10) nach einem der Ansprüche 1 bis 12.
14. Verfahren nach Anspruch 13, wobei der Tempervorgang durch einen von oben in den Probenbehälter eingesetzten Sensor überwacht wird.

Revendications

1. Pince de trempe pour tenir un récipient d'échantillon et pour tempérer un échantillon contenu dans le récipient d'échantillon et comportant des premier et second éléments de trempe, **caractérisée en ce que** la pince de trempe (10) comprend des première et seconde mâchoires de serrage (12, 14) reliées de manière amovible par un élément de ressort, le premier élément de trempe étant associé à la pre-

mière mâchoire de serrage (12) et le second élément de trempe étant associé à la seconde mâchoire de serrage (14).

2. Pince de trempe selon la revendication 1, un premier isolant thermique étant fixé au premier élément de trempe et un second isolant thermique étant fixé au second élément de trempe.
3. Pince de trempe selon la revendication 2, les premier et second isolants thermiques étant des éléments de refroidissement (24, 26).
4. Pince de trempe selon l'une des revendications 1 à 3, les premier et second éléments de trempe étant conçus pour le chauffage de l'échantillon.
5. Pince de trempe selon l'une des revendications 1 à 4, les premier et second éléments de trempe étant conçus pour le refroidissement de l'échantillon.
6. Pince de trempe selon l'une des revendications 1 à 5, les éléments Peltier (20, 22) étant utilisés comme éléments de trempe.
7. Pince de trempe selon l'une des revendications 1 à 6, un élément étant fourni pour effectuer une pression de contact dans la direction axiale de l'échantillon.
8. Pince de trempe selon l'une des revendications 1 à 7, l'élément de ressort comprenant une feuille d'acier à ressort (16).
9. Pince de trempe selon l'une des revendications 1 à 8, comprenant en outre un capteur de température (28).
10. Pince de trempe selon l'une des revendications 1 à 9, l'élément élastique étant précontraint.
11. Pince de trempe selon l'une des revendications 1 à 10, les surfaces extérieures de la pince de trempe (10) ayant une forme en V orientée vers l'intérieur.
12. Pince de trempe selon l'une des revendications 1 à 11, la pince de trempe (10) étant conçue pour recevoir une puce microfluidique.
13. Procédé pour tenir un récipient d'échantillon et pour tempérer un échantillon contenu dans le récipient d'échantillon à l'aide d'une pince de trempe (10) selon l'une des revendications 1 à 12.
14. Procédé selon la revendication 13, le processus de trempe étant surveillé par un capteur inséré dans le récipient d'échantillon depuis le haut.

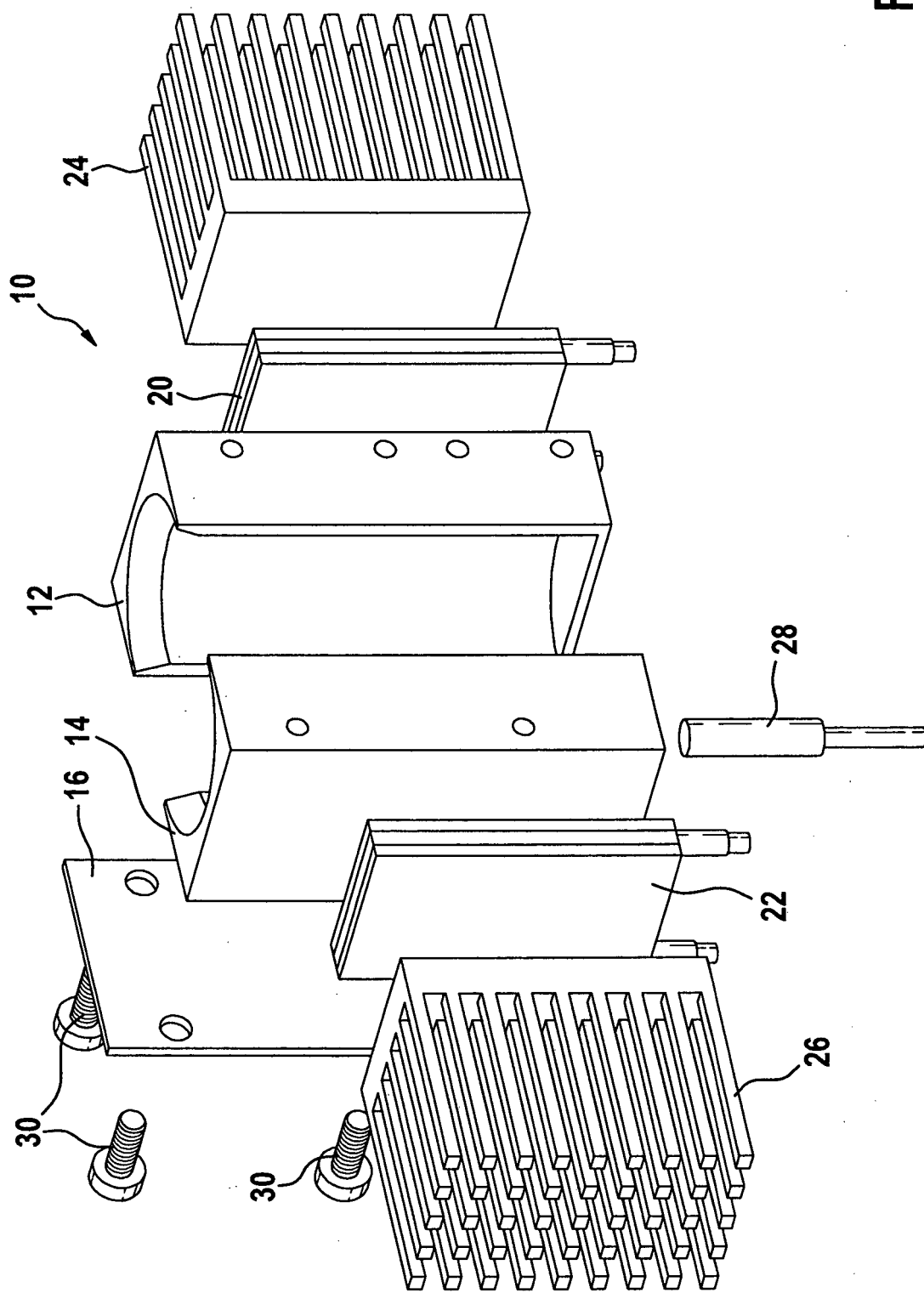


Fig. 1

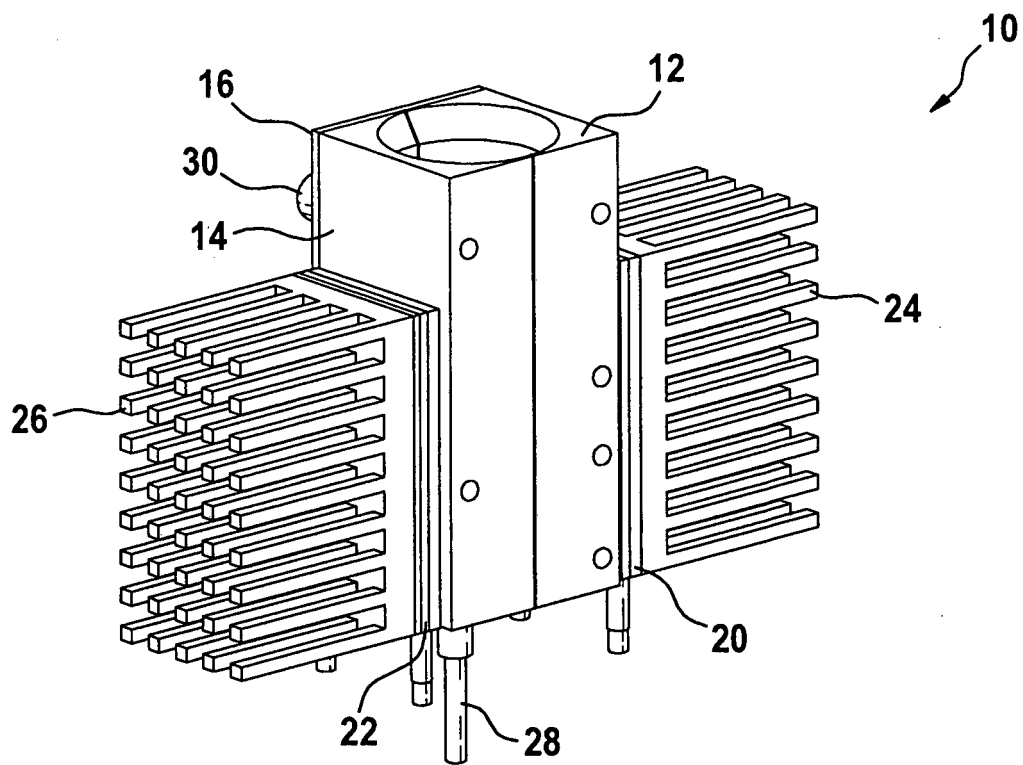


Fig. 2

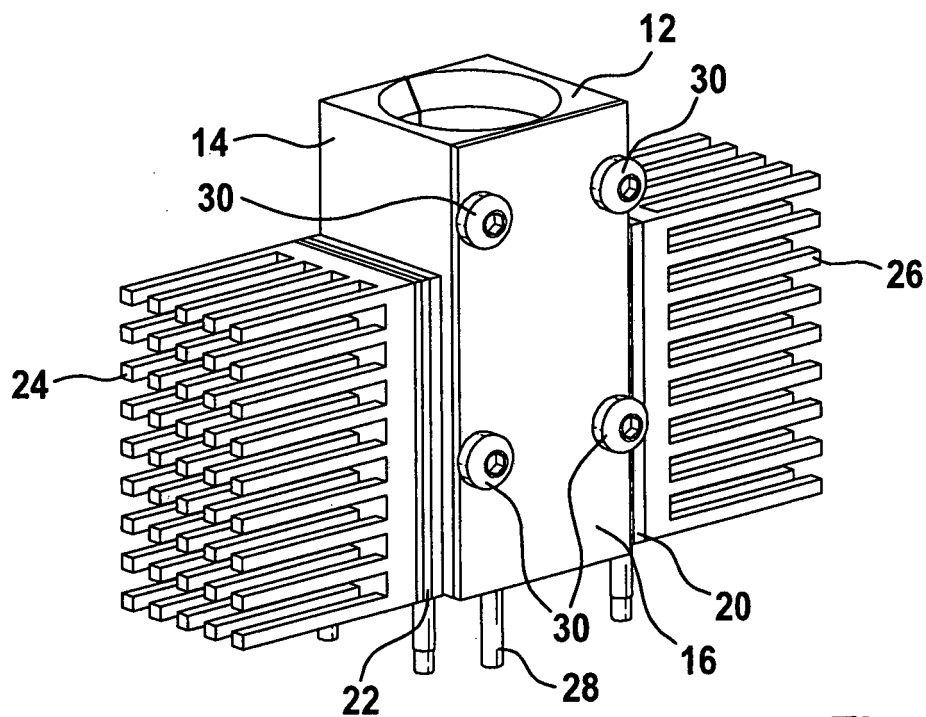
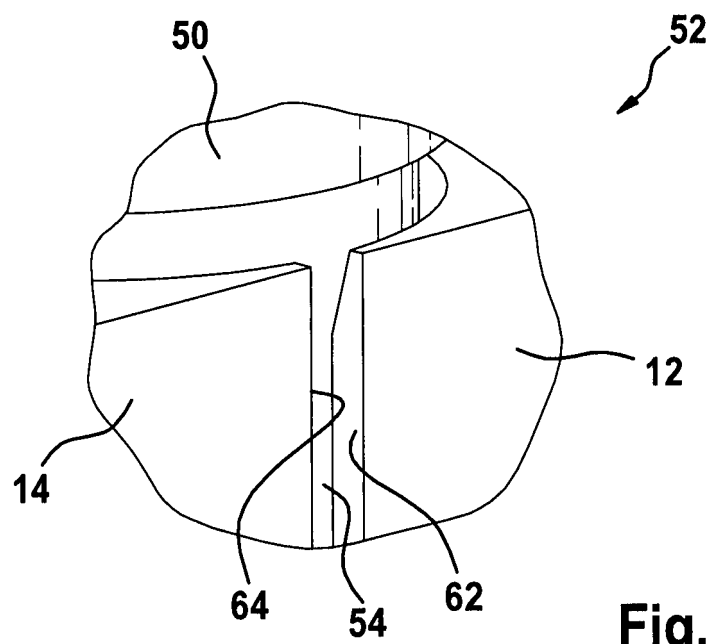
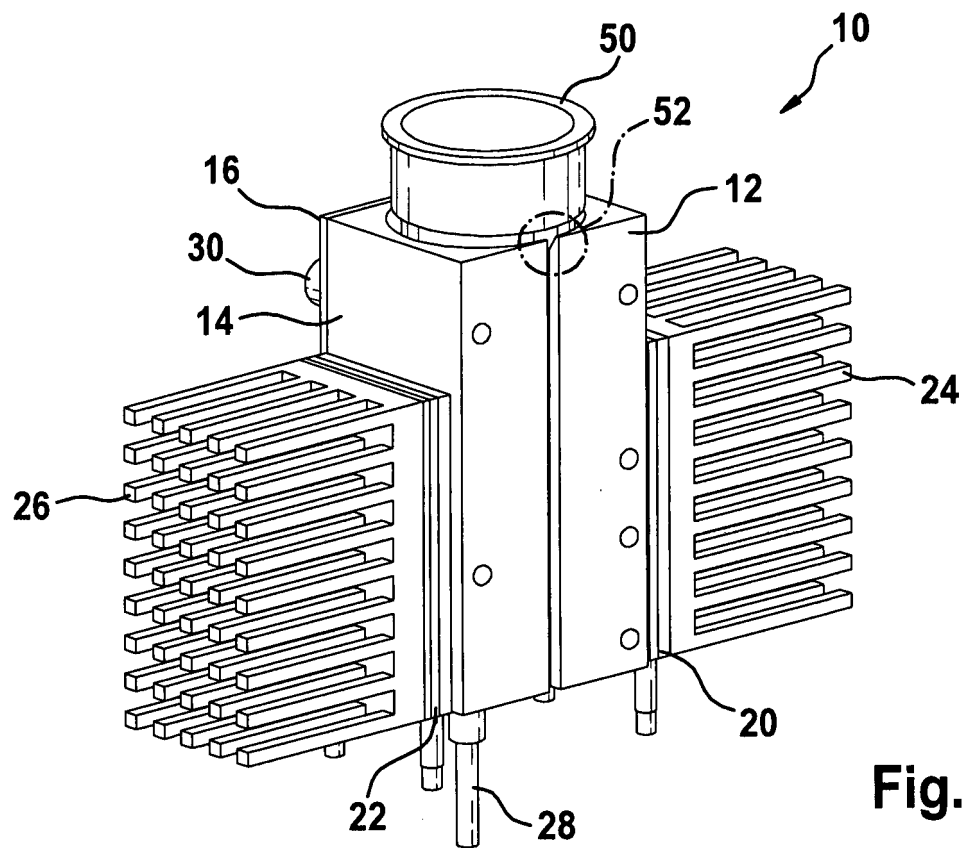


Fig. 3



REFERENCES CITED IN THE DESCRIPTION

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