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(54) Method and device for cooling air

(57) Method for cooling air, characterized in that it consists in the cooling of an air stream (11) on the one hand by sending it through a primary canalization (3) of a heat exchanger (2), and by vaporizing fluid (6), in particular water, in a secondary canalization (4) of this heat exchanger (2) on the other hand by means of an auxiliary air stream (12) which is tapped off the air stream (11) leaving the primary canalization (3).

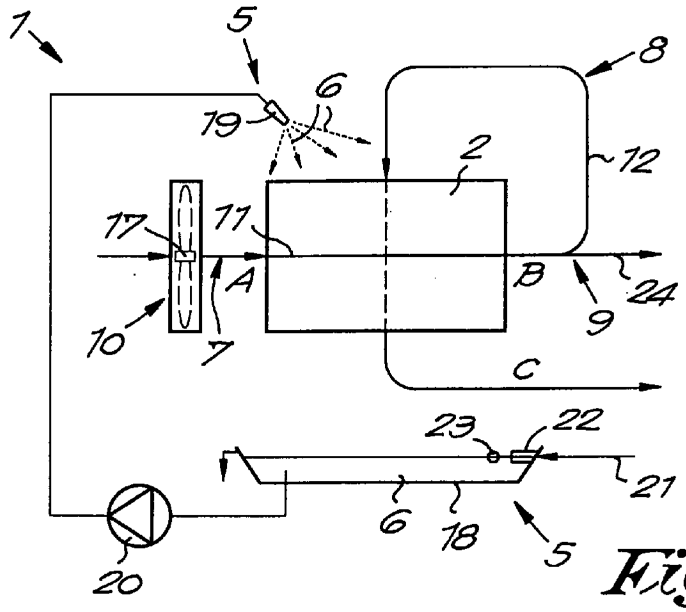

Fig.1

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Description

The present invention concerns a method and device for cooling air.

Traditionally, use is made of compression cooling devices for cooling air. Such compression cooling devices are disadvantageous, however, in that they consume a lot of energy.

Especially when very large rooms such as stables, workshops, halls, offices and such have to be cooled, this is not only disadvantageous in that a lot of energy is consumed, but also in that a costly high-voltage cabin needs to be installed to supply the required energy.

Also, the invention aims a method and device with which these disadvantages are excluded, in other words with which air can be cooled very efficiently in a relatively inexpensive manner with little energy consumption. It is meant in particular for applications in which the use of compression cooling devices is not economically feasible, but in fact it can be used for any application whatsoever.

To this end, the invention concerns a method for cooling air, characterized in that it consists in the cooling of an air stream on the one hand by sending it through a primary canalization of a heat exchanger, and by vaporizing fluid, in particular water, in a secondary canalization of this heat exchanger on the other hand by means of an auxiliary air stream which is tapped off the air stream leaving the primary canalization. The fluid to be evaporated is hereby sprayed or atomized on the walls of the secondary canalization or provided on it in any other way whatsoever.

As a cooling takes place in the secondary canalization due to the evaporation of the water, a cooling effect is created in this canalization up to practically the wet point temperature, which offers the advantage that a significant cooling effect can be created in the heat exchanger, depending on the humidity of the air in the secondary canalization.

According to the invention, use is preferably made of a heat exchanger with plates. This offers the advantage that very large evaporation surfaces are created, so that the auxiliary air stream can be limited to a minimum and so that there is little loss of energy. The use of a heat exchanger with plates also offers the advantage that large surfaces can be easily moistened by means of one and the same spray device.

Preferably, the moisture is sprayed on the plates, atomized respectively, with drops having a size in the order of 100 to 300 micrometre, which produces the best evaporation effect.

According to a preferred embodiment, the auxiliary air stream is cooled and/or dried before it can be guided through the secondary canalization. As a result, the air of the auxiliary air stream can absorb more moisture, which promotes the evaporation of the fluid.

Preferably, care will be taken, in any way whatsoever, that the air of the auxiliary air stream is supplied to the heat exchanger with a relative air humidity which is lower than 80%. Thus, one can be sure that there is always evaporation in the secondary canalization and thus cooling in the primary canalization.

According to a major aspect of the invention, the auxiliary air stream in the secondary canalization will be preferably guided in the upward direction through the heat exchanger. Thus is obtained that the auxiliary air stream is not counteracted by the chimney effect of the hot, damp air which occurs in the secondary canalization, so that the auxiliary air stream is made more efficient.

According to another major preferred embodiment, measures are taken which make sure that the air of the auxiliary air stream is evenly distributed through the secondary canalization of the heat exchanger. In particular, these measures make sure that no parts are created in the secondary canalization in which the air stands practically still.

In the case of a heat exchanger with plates, the air supply and/or the air extraction according to the invention will preferably be realized in a direction which extends diagonally or almost diagonally on the plates of the heat exchanger in order to make sure that the auxiliary air stream flows evenly distributed through the secondary canalization.

According to another possibility, which can be either or not combined with the preceding one, an obstruction is provided on the inlet of the secondary canalization, which is provided with passages in the shape of perforations, holes or such. Thus, a slight increase of pressure is created on this obstruction, so that the air is forced to spread over all the passages.

According to a preferred embodiment, with which a significant extra improvement can be made, the walls of the secondary canalization are provided with means which retain the fluid on the one hand, but which also distribute it over the surface concerned on the other hand. Preferably, these are means which provide for a hygroscopic surface. According to a practical embodiment, these means will consist of a hygroscopic coating, preferably in the shape of a hygroscopic membrane, cloth or such. The use of such means offers the advantage that the moisture is optimally distributed over the surface and is retained on the surface. This in turn offers the advantage that the walls of the secondary canalization will be moistened with great certainty over their entire surface, so that an evaporation and cooling takes place over the entire surface. This also offers the advantage that fluctuations in the supply of moisture do not immediately result in excess fluid running out of the canalization, so that a receptacle can possibly be omitted.

According to another special characteristic of the invention, the fluid to be evaporated will preferably be supplied in the secondary canalization counterflow in relation to the auxiliary air stream. This optimally prevents moisture pollution in the dry parts of the device.

Moreover, all the supplied fluid will be evaporated with great certainty, and it is practically excluded that an excess of unevaporated fluid is created on the inlet of the secondary canalization.

According to a preferred embodiment of the invention, canalizations are used both for the main air stream and for the auxiliary air stream which do not have any open receptacles and/or leak-off ladles. Thus is obtained that the air, both of the main air stream and of the auxiliary air stream, is never guided over a liquid mass, so that this air cannot absorb any moisture in undesired places and in an unpredictable way.

In particular, all the supplied fluid will preferably be evaporated according to the invention, so that collecting means such as a receptacle or leak-off ladle are no longer necessary.

The invention also concerns a device for cooling air which makes it possible to realize the above-mentioned method. This invention consists of a heat exchanger having a primary canalization and a secondary canalization; means which put fluid on the walls of the secondary canalization so as to create a cooling effect due to evaporation; pipes which provide for a main circuit through the primary canalization and an auxiliary circuit through the secondary canalization, whereby the auxiliary circuit forms a branch on the main circuit, downstream of the primary canalization; and means to create the above-mentioned air stream and auxiliary air stream.

In order to better explain the characteristics of the invention, the following preferred embodiments are described as an example only without being limitative in any way, with reference to the accompanying drawings, in which:

figure 1 schematically represents a device according to the invention;
figure 2 shows the heat exchanger of the device from figure 1 in perspective, also in a schematic way;
figure 3 illustrates the variation in temperature and humidity in a diagram for the device of figure 1;
figure 4 schematically represents a variant of the device in figure 1;
figure 5 illustrates the variation in temperature and humidity in a diagram for the device of figure 4;
figure 6 schematically represents yet another variant of the device in figure 1;
figure 7 illustrates the variation in temperature and humidity in a diagram for the device of figure 6;
figure 8 shows a variant of the heat exchanger in figure 2;
figure 9 shows a schematic section according to line IX-IX in figure 8;
figure 10 shows a section according to line X-X in figure 9 to a larger scale, for another embodiment;
figures 11 and 12 show views according to arrows F11 and F12 in figure 10 to a smaller scale;
figure 13 schematically represents a variant of the device according to the invention;
figure 14 schematically represents a section according to line XIV-XIV in figure 13;
figure 15 shows a section according to line XV-XV in figure 14 to a smaller scale;
figure 16 schematically represents another device;
figure 17 shows a practical embodiment of the part which is indicated with F17 in figure 14 to a larger scale;
figure 18 schematically represents another device according to the invention;
figure 19 shows a practical variant of the part which is indicated in figure 17;
figure 20 shows the part which is indicated with F20 in figure 19 to a larger scale.

As is represented in figures 1 and 2, the device 1 according to the invention mainly consists of a heat exchanger 2, in this case a heat exchanger with plates with a primary canalization 3 and a secondary canalization 4; spray means 5 which can put finely divided fluid 6 on the walls of the secondary canalization 4 so as to create a cooling effect due to evaporation; pipes which are not represented, providing in a main circuit 7 through the primary canalization 3 and in an auxiliary circuit 8 through the secondary canalization 4, whereby the auxiliary circuit 8 forms a branch on the main circuit 7, whose branching point 9 is situated downstream of the primary canalization 3; and means 10 to create an air stream 11 through the primary canalization 3 and an auxiliary air stream 12 through the secondary canalization 4.

The heat exchanger 2 consists of a number of plates 13-14 situated next to one another, in between which rooms 15-16 are provided which alternately form passages for the air stream 11 and the auxiliary air stream 12. The inlets, outlets respectively of these rooms 15-16 are situated such that, as represented in the figures, the air stream 11 and the auxiliary air stream 12 intersect one another in the heat exchanger 2.

The means 10 to create the air stream 11 and the auxiliary air stream 12 consist of one common fan 17 in the example represented, but it is clear that several fans or such can be incorporated in the main circuit 7 and/or the auxiliary circuit 8.

The heat exchanger 2 is erected such in this example that the secondary canalization 4 extends from top to bottom. Under the heat exchanger 2 is erected a receptacle 18 to collect any moisture dripping down.

The above-mentioned spray means 5 in this case consists of a sprinkler 19 which is fed by means of a pump 20 or such, tapping fluid 6, in particular water, from the receptacle 18. The level of the fluid 6 in the receptacle 18 is maintained thanks to a connection to a supply net 21, preferably a mains system for water. The level in the receptacle 18 can hereby be adjusted by means of a valve 22 which is controlled by a float 23.

The sprinkler 19, which in reality may have several sprinkler heads, is situated above the set of plates 13-14 and is made such that the fluid 6 concerned is sprayed over the entire surface of the plates 13-14.

The working of the device 1, as well as the accompanying method, consists in that an air stream 11 is sent through the primary canalization 3 by the means 10. This air stream 11 is split in a main air stream 24 and an auxiliary air stream 12. The auxiliary air stream 12 makes sure that the fluid 6 sprayed on the plates 13-14 by means of the spray means 5 evaporates.

The obtained effect is illustrated in the diagram of figure 3, in which the water level X in the air is represented in the abscissa, whereas the temperature T is represented in the ordinate. Further, lines R of relative humidity are represented, as well as lines H of equal enthalpy.

The different situations A, B and C which are represented in the diagram of figure 3, are situations which may occur in the places which are correspondingly indicated by A, B and C in figure 1. A cooling temperature is created on the plates 13-14 which is almost equal to the wet point temperature in point C of the diagram.

Figure 4 represents a variant in which a cooler 25 and a heat source 26, together forming a drier and which are either or not combined in one appliance, are incorporated between the above-mentioned branch point 9 and the secondary canalization 4 of the heat exchanger 2. This is preferably a conventional cooler 25 providing for a compression cooling.

The heat source is preferably adjusted such that the relative humidity of the auxiliary air stream remains below 80% behind the drier.

As explained in the introduction, a better evaporation of the fluid 6 situated on the plates 13-14 is thus obtained, which results in a better cooling effect.

The different situations A, B and C1, C2 and C3 that hereby occur are schematically represented in the diagram of figure 5.

Figure 6 represents a variant of the device 1 whereby use is made of a drier 27 in the auxiliary circuit 8 provided with a drying agent which can be regenerated, for example silica gel. The air coming from this drier 27 will normally be cooled before it is used for the evaporation of the fluid 6 in the secondary canalization 4. To this end, the heat exchanger 2 is provided in an auxiliary canalization 28 for the cooling of the auxiliary air stream 12.

According to a variant which is not represented here, use can be made of a cooler instead of the auxiliary canalization 28 which consists of a heat exchanger provided in the main air stream behind the branching point 9.

While the device 1 of figure 6 is in use, situations A, B, C1, C2 and C3 are actually obtained, as is represented in the diagram of figure 7.

From the diagrams of figures 3, 5 and 7, it is clear that lower wet point temperatures, as well as lower temperatures in point B, can be obtained with the embodiments of figures 4 and 6 than with the embodiment of figure 1, so that the final cooling effect is significantly better.

It should be noted that the above-mentioned curves in figures 3, 5 and 7 are theoretical representations and that, in the practical embodiments, the points C and C3 will rather be situated on the indicated places C4.

Figure 8 schematically represents a variant whereby the plates 13-14 are erected key-shaped, such that the secondary canalization 4 narrows according to the direction of flow. Thus is obtained that the fluid 6 sprayed between the plates 13-14 can efficiently cover the entire surface of these plates 13-14, even when the sprinkler 19 is situated above these plates 13-14.

According to figures 8 and 9, the device 1 is also equipped with an element 29 such as a perforated plate to distribute the air evenly over the different rooms 16 of the secondary canalization 4, so that the air is optimally used for the evaporation and so that the flow rate of the auxiliary air stream 12 can be limited to a minimum.

Figure 9 further illustrates how the whole can be provided with pipes or ducts 30, 31 and 32 to guide the supplied air stream 11, the auxiliary air stream 12 and the main air stream 24. The main air stream 24 hereby forms the useful part of cooled air.

Figure 10 shows a section of yet another part of a practical embodiment, whereby guiding means 33 in the shape of ribs 34-35-36-37 are provided in the primary canalization 3 which force the air of the air stream 11 to the narrowest part 38 of the rooms 15 so as to obtain an optimal heat transmission. The ribs 34-35 are hereby provided on the plates 13. The ribs 36-37 are provided on the plates 14 and end up between the ribs 34-35 when the whole is mounted, as indicated in figures 11 and 12.

According to the embodiments of the figures 10 to 12, guiding means are also provided in the secondary canalization 4 which promote the intersected circulation and which consist of ribs 39-40 in this case.

The ribs 34-35-36-37-39-40 also form reinforcements for the plates 13-14.

According to the invention, the plates 13-14 are preferably clasped together with their edges in this case. Thus, a large number of difficult connections is excluded.

The key-shaped rooms 15-16 preferably have an opening of about 2.5 mm wide on their narrowest side and an opening of about 7.5 mm wide on their widest side.

Although, as represented in figures 1, 2, 4, 6, 8 and 9, the auxiliary air stream 12 can be guided from top to bottom through the heat exchanger 2 and good results can be obtained, the inventor found that these results can even be significantly improved by guiding the auxiliary air stream 12, according to a preferred characteristic of the invention, in the upward direction through the heat exchanger, either vertically, as represented in figures 13 to 15, or upward in a diagonal direction. As mentioned in the introduction, this results in that the auxiliary air stream is not counteracted by the chimney effect in the secondary canalization. By the chimney effect is meant the natural phenomenon that hot air has a tendency to rise by itself.

As is schematically represented in figure 16, a lead-through of the auxiliary air stream 12 according to the directions which are represented in this figure, may have for a result that certain wall parts 41, which are schematically represented in figure 16 by means of a hatching, participate little in the evaporation process, as the flow rate of the air stream moving alongside of them is too low, due to the fact that the auxiliary air stream 12 tries to find the easiest way.

According to the invention, this can be remedied by making sure that the air of the auxiliary air stream flows evenly distributed through the secondary canalization 4 of the heat exchanger 2. As already described in relation to figure 8, use can be made to this end of an element 29 which is provided on the inlet of the secondary canalization 4, which forms an obstruction and is provided with perforations or such.

According to another possibility of the invention, meant to be applied in heat exchangers with plates 2, the use of such an element 29 or any other obstructive element can be excluded while an even distribution is nevertheless obtained by having the air supply 42 and/or air extraction 43 take place right before and right behind the plates 13-14 according to a direction which extends diagonally or almost diagonally on the plates 13-14, with the help of suitable ducts 44 and 45, as represented in figures 13 to 15. This implies in particular that the direction of flow at the height of the air supply 42 and/or the air extraction 43 in figure 15 forms an angle E with the direction of the perpendicular line on the surface of the plates 13-14 which is preferably smaller than 20° and better still 0°. Thus, the creation of wall parts 41 alongside which the flow of air is practically zero is excluded.

According to figure 17, the walls 46 of the secondary canalization 4 are provided with a hygroscopic coating 47, in this case a membrane which is provided against the walls 46, for example stretched around it. This coating 47 directly and indirectly offers several advantages, including the following:

- the application and distribution of the fluid 6 over the entire surface of the walls 46 is no longer critical. Thanks to the hygroscopic effect of the coating 47, the fluid will spread automatically once it has ended up on the coating 47.
- For the same reason, the fluid 6 no longer necessarily has to be sprayed and/or atomized in a finely distributed manner. It is sufficient that more or less an equal amount of fluid ends up on each of the plates 3-14.
- The sprinklers 19 no longer have to be erected such that the walls 46 are situated entirely within their field of vision. For, the hygroscopic coating 47 makes sure that the fluid 6 is distributed over the entire surface of the walls 46, even over the parts of these walls 46 which are situated outside the field of vision of the sprinklers 19.
- As the sprinklers 19 do not necessarily have to spray between the plates 13-14 anymore, the distances between these plates can be kept very short and the sprinklers 19 do no longer necessarily have to be erected in the direction of the field of the plates 13-14.

According to the most preferred embodiment, the plates 13-14 of the above-mentioned heat exchangers 2 will preferably be erected upright, and the air stream 11 will be mainly guided in the horizontal direction through the heat exchanger 2, whereas the auxiliary air stream 12 will be mainly guided through it in the vertical direction, whereas the air supply 42, the air extraction 43 respectively, of the auxiliary air stream 12 on the plates 13-14 takes place laterally, as is clearly shown in figure 14. This arrangement makes it possible, on the one hand, that all the above-described advantages can be reached, and, on the other hand, that the heat exchangers 2 can be carried out such that they can be easily built out in a modular manner, as represented in figure 18, by piling several units 48 that are similar in shape on top of one another and by fitting them on a common inlet duct 49 and outlet duct 50.

In the figures 13 to 15 and 18, the fluid 6 to be evaporated is supplied counterflow as of the outlet of the secondary canalization 4, which, as explained in the introduction, offers several extra advantages. The sprinkler 19 can hereby make a rotating movement F to and fro. The figures 13 to 15 and 18 also show that a heat exchanger 2 can be used according to the invention which does not have a receptacle, as opposed to for example the embodiment of figure 1, in which such a receptacle 18 is used. This offers the advantage that the air no longer has to be guided over a liquid mass and consequently cannot arbitrarily absorb any moisture.

However, the amount of supplied fluid 6 must be dosed such in this case that it can evaporate entirely, in other words such that there is no dripping moisture. According to figures 13 and 14, this is realized by adjusting the supply of the fluid 6 by means of a controlled regulating valve 51. The regulating valve 51 can be controlled by means of a control unit 51A and/or a sensor which supplies measured values which are directly or indirectly representative for the moistening degree in the secondary canalization or by means of any feedback whatsoever.

It should be noted that, when use is made of a fluid-absorbing and/or hygroscopic coating 47, this offers the advantage that the adjustment of the fluid supply 6 becomes less critical as said coating 47 functions as a buffer, so that fluctuations in the moistening degree occurring during the adjustment do not cause any problems.

As is schematically represented in figures 13 to 15, the heat exchanger 2 is preferably built up of longitudinal plates 13-14 according to a preferred embodiment.

According to a preferred characteristic of the invention, the distance D1 between the plates of the secondary canalization 4 will be smaller than 5 mm. This relatively small distance offers as an advantage that no excess air, which produces no evaporation effect, will flow through the secondary canalization.

According to a practical embodiment, the heat exchanger 2 will have a flow-through length L1 between the plates in the primary canalization 3 of 40 to 80 cm.

The flow-through length L2 between the plates in the secondary canalization 4, i.e. in this case the height of the plates, preferably amounts to 2 to 12 cm. The inventor found that larger lengths, i.e. in this case heights, contribute little more to a greater evaporation effect. Also, a larger length L2 has little use, and relatively small dimensions of the length L1 moreover offer the advantage that the units 48 can be made rather compact.

It should be noted that the number of plates 13-14 can be selected as a function of the flow rate to be treated. In practical embodiments, this number will be several times ten and even 100 to 200.

The plates 13-14 themselves can be made of a thin and good heat-conducting material, for example a thin metal plate. However, it was found that also other materials provided good results on condition that the plates 13-14 are maintained relatively thin. According to the invention, the plates 13-14 will preferably even be made of synthetic material, which offers the advantage that a heat exchanger 2 is obtained which is highly corrosion-resistant and which can be realized in a relatively inexpensive manner.

According to the practical embodiment, the plates 13-14 will be made of polycarbonate plate or polypropylene plate, for example with a thickness D2 of 0.3 mm.

As is represented in figure 17, use can be made for the primary canalization 3 of double- or multi-walled, hollow, extruded plates, the outer walls of which then form the plates 13 and 14. The bridges 52 reinforce the whole and provide for a larger contact surface in the primary canalization 3.

Figures 19 and 20 represent a practical embodiment in which the above-mentioned plates 13-14 are made continuously of a single corrugated plate 53, whereby the spaces 15-16 provided alternately in between are used for the formation of the primary canalization 3, the secondary canalization 4 respectively. To this end, a sealing wall 54 is provided on one side against said corrugated plate 53. Further, passages 55 are provided which connect the space under this sealing element 54 to the above-mentioned spaces 16.

The use of such a corrugated plate 53 offers the advantage that the whole can be realized in a relatively simple manner, as no separate plate structure has to be build up.

The above-mentioned corrugated plate 53 will preferably be formed starting from a flat plate, which plate will subsequently be heated, and by deforming this heated plate by sucking it in over a comb-shaped mould.

It should be noted that an obstruction for the auxiliary air stream 12 is also formed in this case near the inlet, as the air has to flow locally through the passages 55. This results in a slight pressure increase in the space under the sealing wall 54, so that the air is forced to spread entirely over this space and to flow through all the passages 55.

It should also be noted that the space 16 of the secondary canalization between the plates is freely connected to the outlet ducts 45, so that the air of the auxiliary air stream 12 can be very easily discharged, which offers the advantage that the evaporation can take place in an undisturbed manner at all times. In order to prevent that saturated air would heap up in the secondary canalization 4, a forced extraction will preferably be provided for, by means of for example a fan 56, which is only represented as an example in figure 18.

It is clear that the means for supplying the fluid 6 do not necessarily have to be spray means. Especially in the case where use is made of an absorbent or hygroscopic coating 47, a fine atomization is not necessary and one could for example also use a drip system or such.

According to the invention, an auxiliary air stream 12 will preferably also be provided with such a flow rate that the refreshment of the air in the secondary canalization 4 takes one to three volume units per second, whereby by a volume unit is meant the volume of air available in the secondary canalization 4, in particular between the plates 13-14 or other heat transfer elements of the heat exchanger 2.

It is clear that the different characteristics which have been illustrated by means of the above-described embodiments can be combined with one another at random, as will also appear from the mutual references of the claims.

It should be noted that the invention also concerns embodiments whereby only a part of the auxiliary air stream is supplied via the branch, and whereby the other part is for example drawn from the environment via a separate suction.

The present invention is by no means limited to the embodiments described as an example and represented in the accompanying drawings; on the contrary, such a method and device for cooling air can be made according to all sorts of variants while still remaining within the scope of the invention.

Claims

1. Method for cooling air, characterized in that it consists in the cooling of an air stream (11) on the one hand by sending it through a primary canalization (3) of a heat exchanger (2), and by vaporizing fluid (6), in particular water, in a secondary canalization (4) of this heat exchanger (2) on the other hand by means of an auxiliary air stream (12) which is tapped off the air stream (11) leaving the primary canalization (3).

2. Method according to claim 1, characterized in that a heat exchanger (2) is used.

3. Method according to claim 1 or 2, characterized in that the fluid (6) to be evaporated is hereby sprayed, atomized respectively, on the walls of the secondary canalization (4).

4. Method according to any of the preceding claims, characterized in that the fluid (6) is sprayed, atomized respectively, in the heat exchanger (2) with drops having a size in the order of 100 to 300 micrometre.

5. Method according to any of the preceding claims, characterized in that use is made of walls (46) for the secondary canalization (4) which are equipped with means which retain the moisture, the fluid (6) respectively on the side where the above-mentioned evaporation takes place, but which also distribute it over the surface concerned on the other hand, in particular means which provide for a hygroscopic surface.

6. Method according to claim 5, characterized in that the above-mentioned means consist of a hygroscopic coating (47), preferably in the shape of a hygroscopic membrane, cloth or such.

7. Method according to any of the preceding claims, characterized in that the auxiliary air stream (12), before it is sent through the secondary canalization (4), is treated in one of the following manners or a combination thereof:

   - cooling and/or drying;
   - cooling and/or drying by means of a conventional compression cooling;
   - drying by means of a dryer with a drying agent which can be regenerated, preferably silica gel;
   - drying by means of a drying agent which can be regenerated, followed by a cooling of said auxiliary air stream (12) before it is guided through the secondary canalization (4) by guiding it first through an auxiliary canalization (28) which is also situated in the above-mentioned heat exchanger (2).

8. Method according to any of the preceding claims, characterized in that the air stream (11) through the primary canalization (3) and the auxiliary air stream (12) through the secondary canalization (4) intersect one another in the heat exchanger (2).

9. Method according to any of the preceding claims, characterized in that the auxiliary air stream (12) in the secondary canalization (4) is guided in the upward direction through the heat exchanger (2).

10. Method according to any of the preceding claims, characterized in that measures are taken which make sure that the air of the auxiliary air stream (12) is evenly distributed through the secondary canalization (4), in particular through the heat exchanger (2).

11. Method according to claim 10, characterized in that use is made of a heat exchanger with plates (2) and in that in order to make the auxiliary air stream (12) flow evenly distributed through the heat exchanger (2), the air supply (42) and/or the air extraction (43) is realized in a direction which extends diagonally or almost diagonally on the plates (13-14) of the heat exchanger (2).

12. Method according to claim 11, characterized in that the above-mentioned air supply (42) and/or air extraction (43) is realized according to a direction forming an angle (E) with the perpendicular bisector on the plates which is smaller than 20° and preferably 0°.

13. Method according to claim 10, 11 or 12, characterized in that, in order to obtain a good distribution of the air in the secondary canalization (4), an obstruction is provided on the inlet thereof which is provided with passages (55) in the shape of perforations, holes, or such.

14. Method according to any of the preceding claims, characterized in that use is made of a heat exchanger with plates (2) whose plates (13-14) are erected upright, and in that the air stream (11) is mainly guided in the horizontal direction through the heat exchanger with plates (2), whereas the auxiliary air stream (12) is mainly guided through it in the vertical direction, whereby the air supply (42), the air extraction (43) respectively, of the auxiliary air stream (12) takes place laterally.

15. Method according to claim 14, characterized in that use is made of a heat exchanger with plates (2) which is composed of units (48) which are piled upon one another in a modular manner.

16. Method according to any of the preceding claims, characterized in that the fluid (6) to be evaporated is supplied counterflow as of the outlet of the secondary canalization (4) of the heat exchanger (2).

17. Method according to any of the preceding claims, characterized in that the air of the auxiliary air stream (12) is supplied to the heat exchanger (2) with a relative air humidity which is lower than 80%.

18. Method according to any of the preceding claims, characterized in that both for the main air stream (11) and the auxiliary air stream (12) canalizations are used which do not have any open receptacles and/or leak-off ladles.

19. Method according to any of the preceding claims, characterized in that all the supplied fluid (6) is evaporated, such that there is no dripping moisture.

20. Method according to any of the preceding claims, characterized in that an auxiliary air stream (12) is provided for with such a flow rate that the refreshment of the air in the secondary canalization (4) of the heat exchanger (2) takes 1 to 3 volume units per second, whereby by a volume unit is meant the volume of air available in the secondary canalization (4), in particular between the plates (13-14) or other heat transfer elements of the heat exchanger (2).

21. Method according to any of the preceding claims, characterized in that use is made of a heat exchanger with plates (2) having one of the following dimensions, and preferably a combination of these dimensions:

- a distance (D1) between the plates (13-14) of the secondary canalization (4) which is smaller than 5 mm;
- a flow-through length (L2) between the plates (13-14) in the secondary canalization (4), in particular a height of the plates in the case of a heat exchanger with plates, situated between 2 and 12 cm;
- a flow-through length (L1) between the plates (13-14) in the primary canalization (3) amounting to 40 to 80 cm.

22. Method according to any of the preceding claims, characterized in that the air on the outlet of the secondary canalization (4) is drained off in a forced manner.

23. Device for cooling air applying the method according to any of the preceding claims, characterized in that it consists of a heat exchanger (2) having a primary canalization (3) and a secondary canalization (4); means (5) which put fluid (6) on the walls of the secondary canalization (4) so as to create a cooling effect due to evaporation; pipes (30-31-32) which provide for a main circuit (7) through the primary canalization (3) and an auxiliary circuit (8) through the secondary canalization (4), whereby the auxiliary circuit (8) forms a branch on the main circuit (7), downstream of the primary canalization (3); and means (10) to create the above-mentioned air stream (11) and auxiliary air stream (12).

24. Device according to claim 23, characterized in that the heat exchanger (2) is a heat exchanger with plates.

25. Device according to claim 23 or 24, characterized in that the walls (46) of the secondary canalization (4) are provided with means which retain the fluid (6) until it is evaporated, and which also make sure that the fluid (6) is distributed over the surface, such as an absorbent or hygroscopic coating (47).

26. Device according to any of claims 23 to 25, characterized in that in that at least one dryer (26) has been incorporated in the auxiliary circuit (8), between the branch point (9) and the secondary canalization (4) of the heat exchanger (2).

27. Device according to any of claims 23 to 26, characterized in that on the inlet of the secondary canalization (4) is formed an obstruction with passages (55) which makes sure that the air is evenly distributed through the secondary canalization (4).

28. Device according to any of claims 23 to 27, characterized in that the air supply (42) of the secondary canalization (4) is situated lower than the air extraction (43) of this canalization (4), so that the auxiliary air stream (12) flows upward through the secondary canalization (4).

29. Device according to any of claims 23 to 28, characterized in that the heat exchanger (2) consists of a heat exchanger with plates and in that the secondary canalization (4) is provided with an air supply (42) and/or air extraction (43) which extend laterally in relation to the plates (13-14) according to a direction which extends diagonally in relation to the plates (13-14).

30. Device according to any of claims 23 to 29, characterized in that the means (5) for supplying the fluid (6) have one or several of the following characteristics:

- a sprinkler (19) which is provided counterflow in the air extraction (43) of the secondary canalization (4);
- the supply of fluid (6) which is adjusted by

means of a controlled regulating valve (51);

- the regulated supply of fluid (6) via a feedback, so that no dripping moisture is created in the secondary canalization (4).

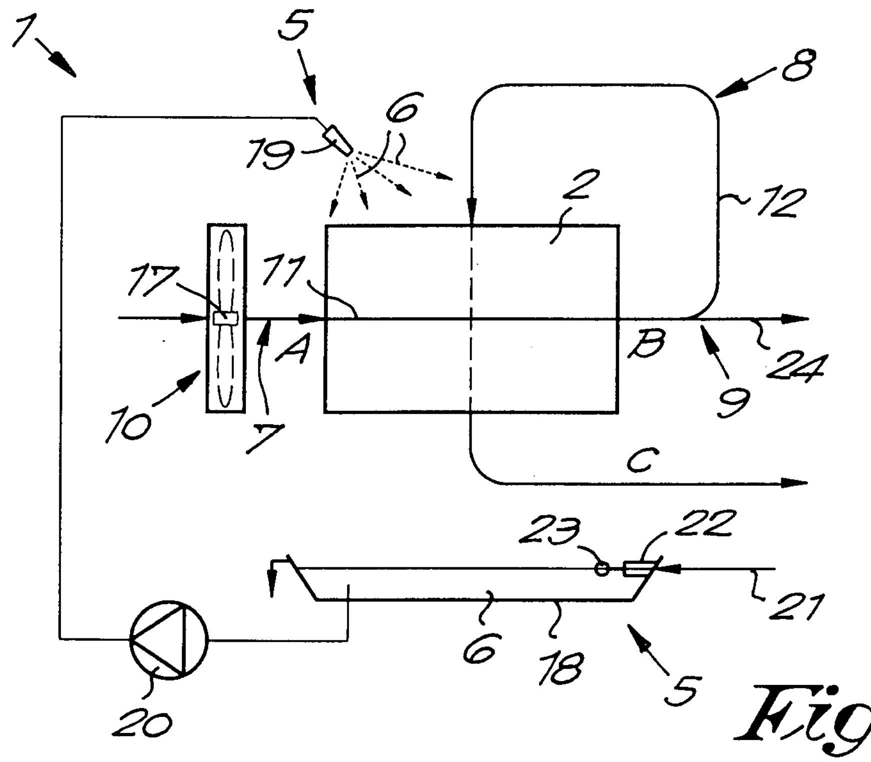

Fig.1

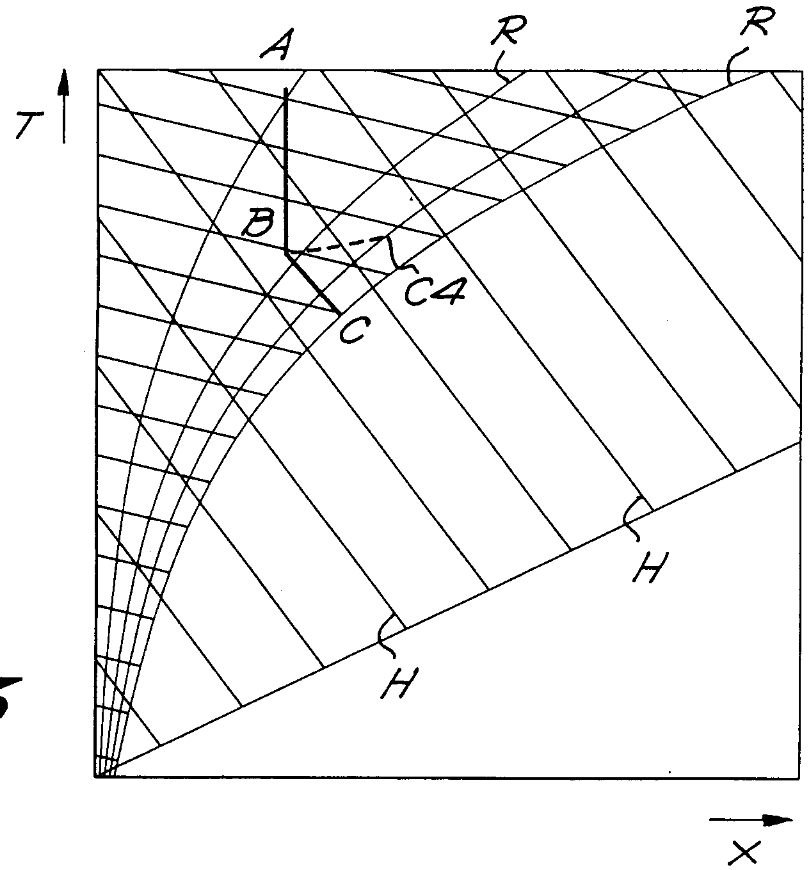

Fig.3

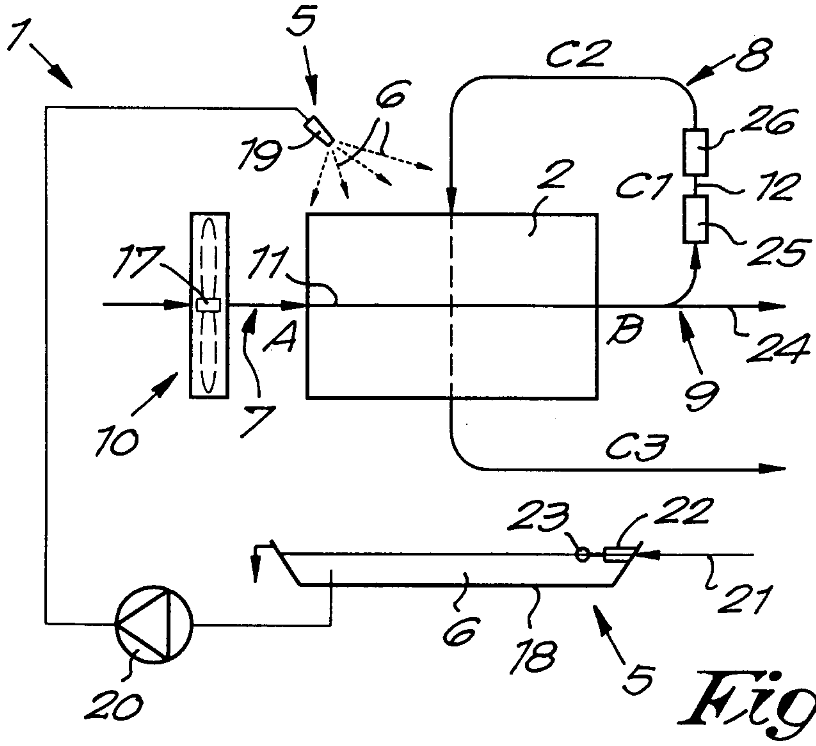
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Fig.4

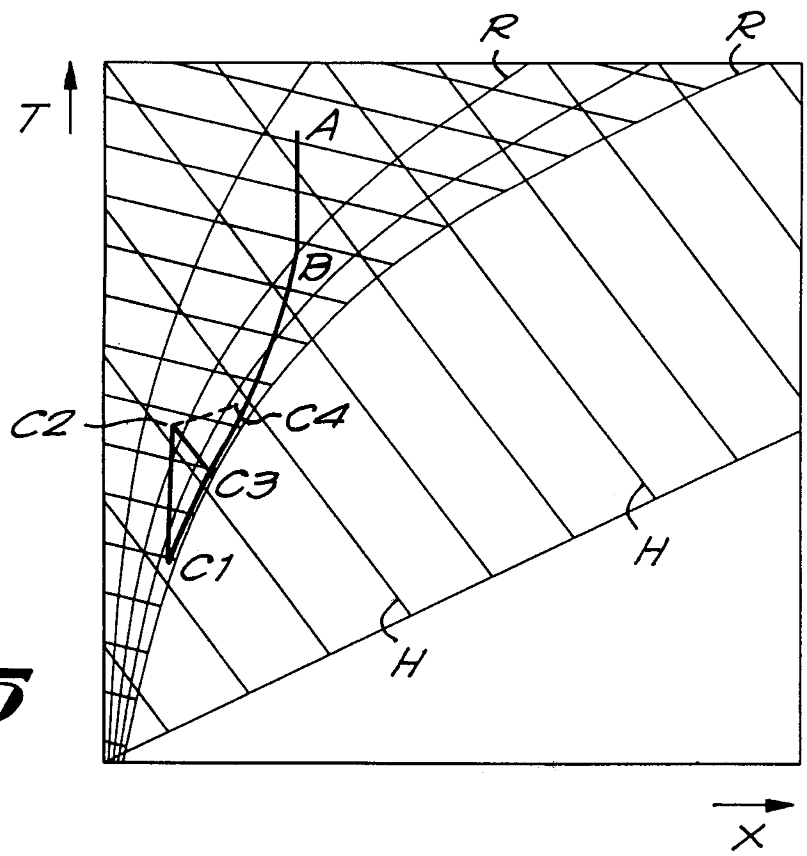
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Fig.5

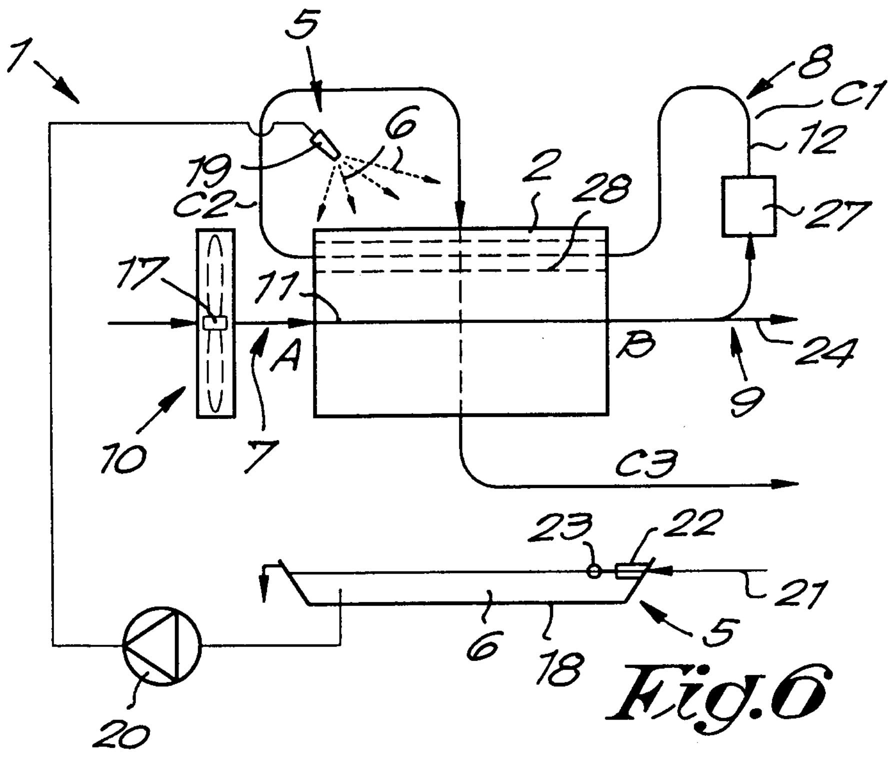
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Fig.6

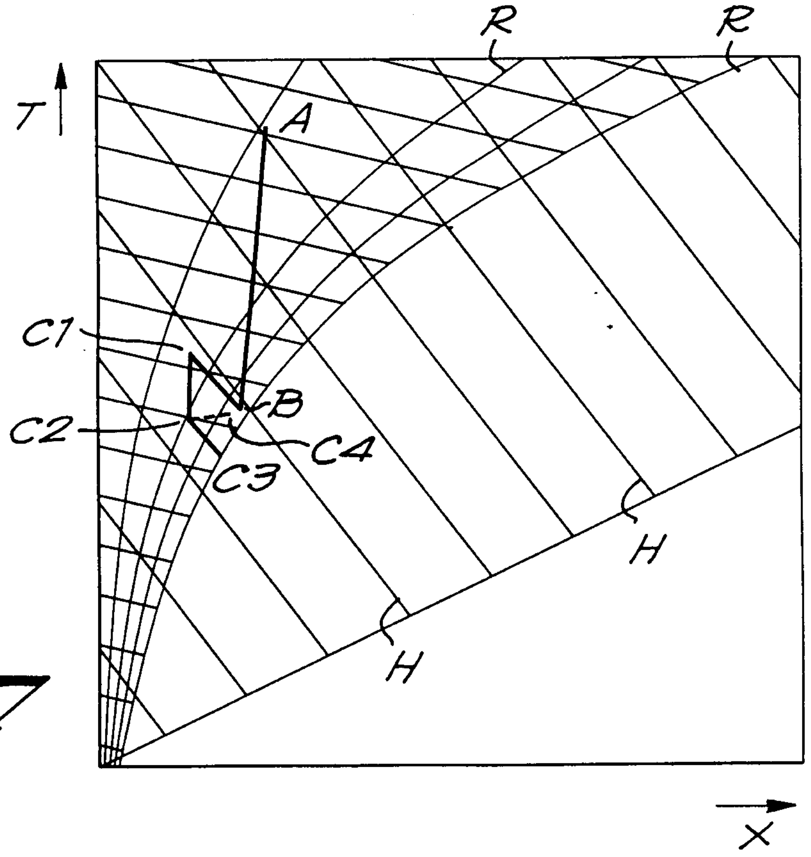
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Fig.7

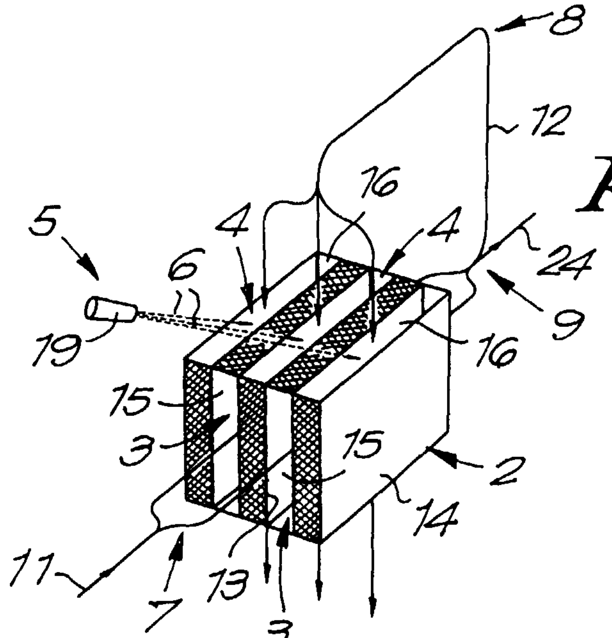

Fig.2

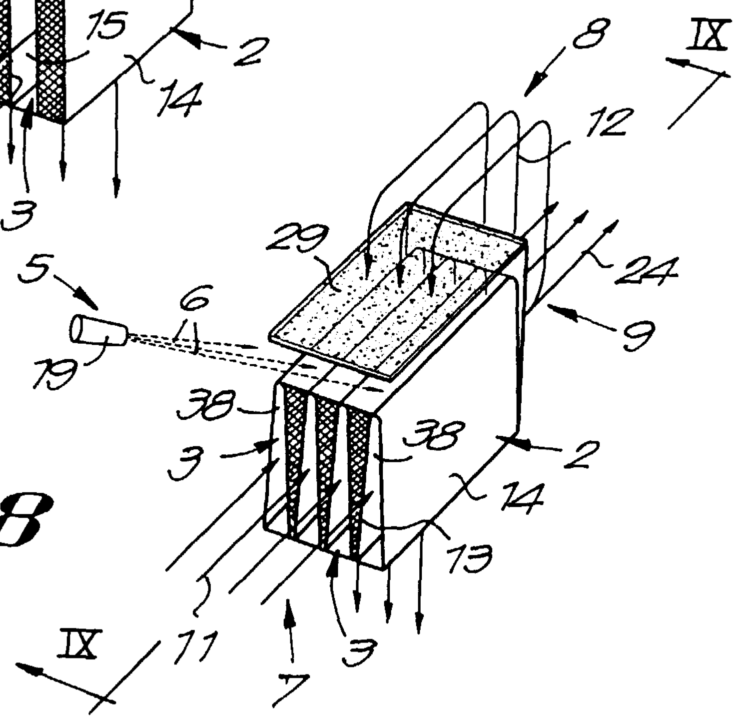

Fig.8

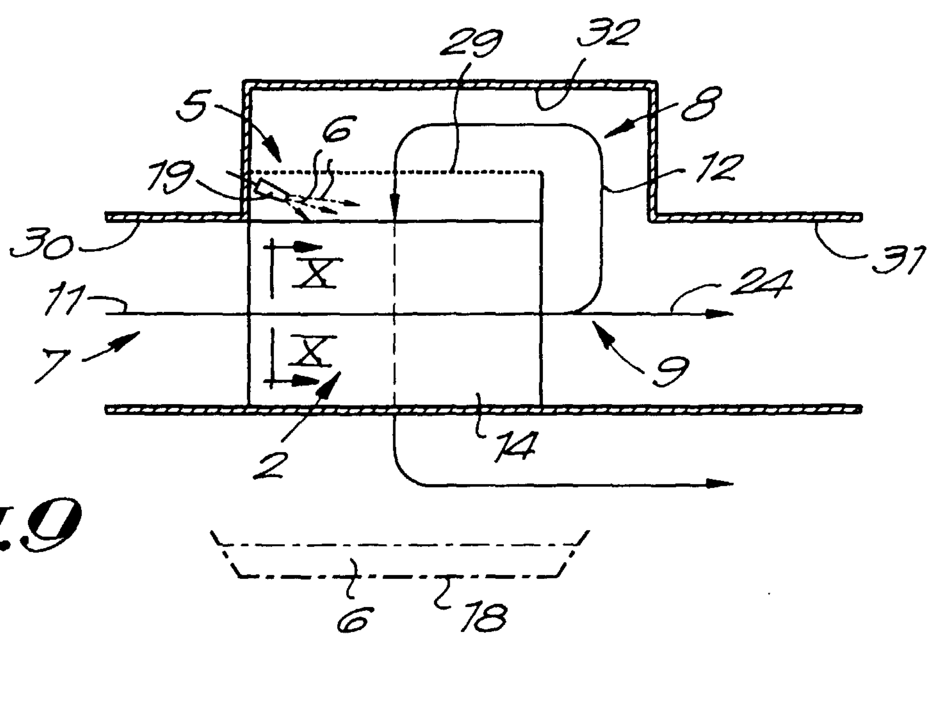

Fig.9

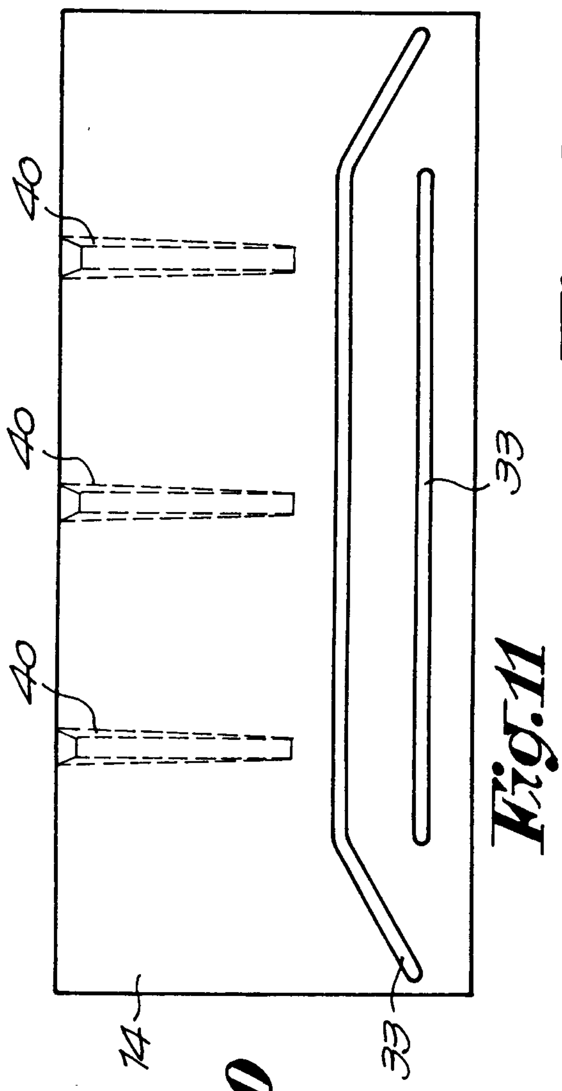

Fig.11

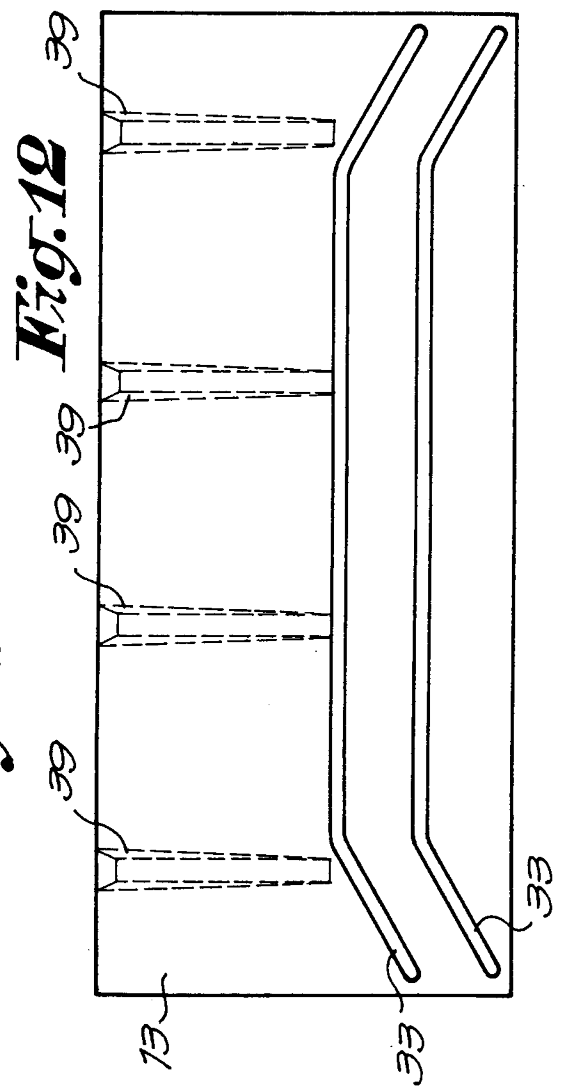

Fig.12

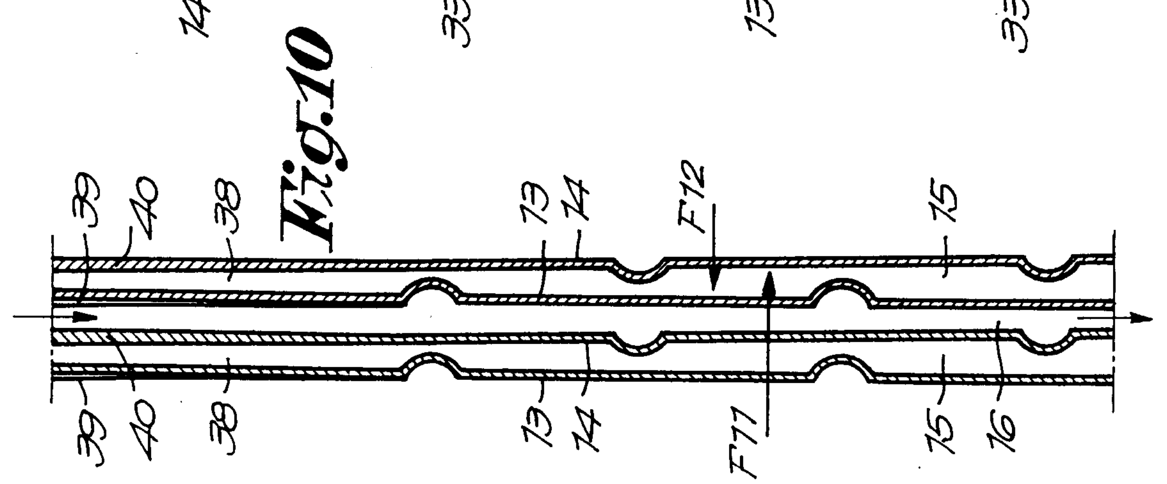

Fig.10

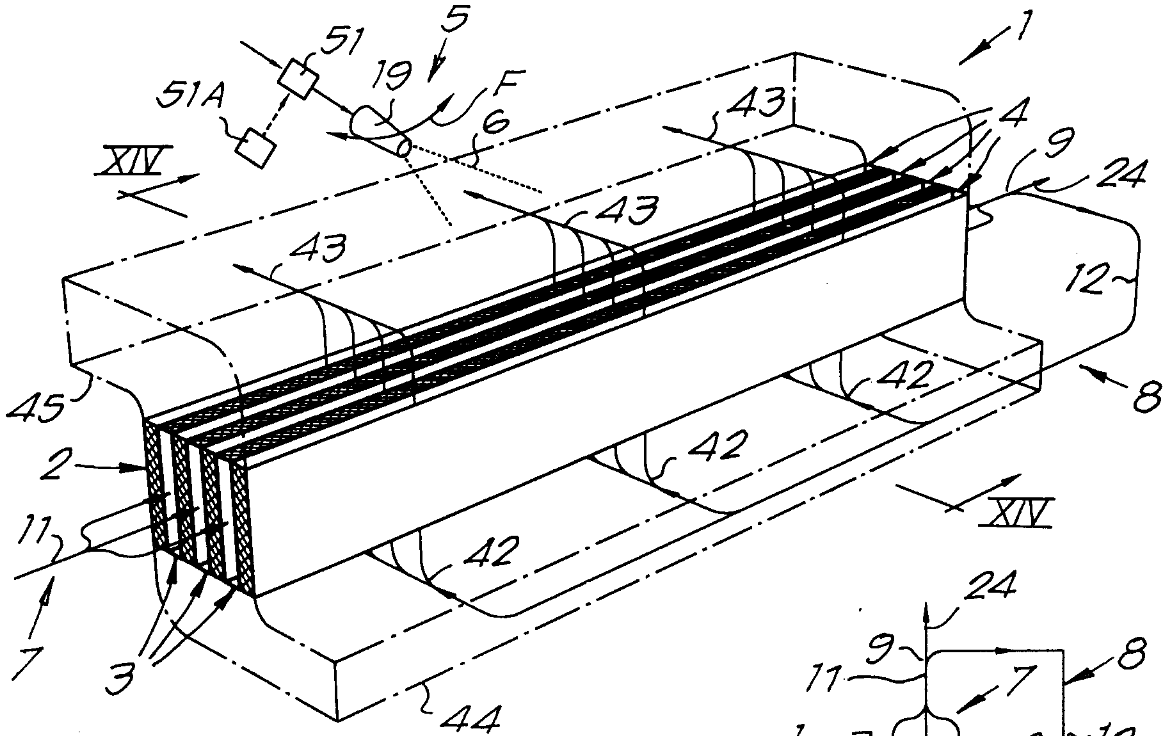

Fig.13

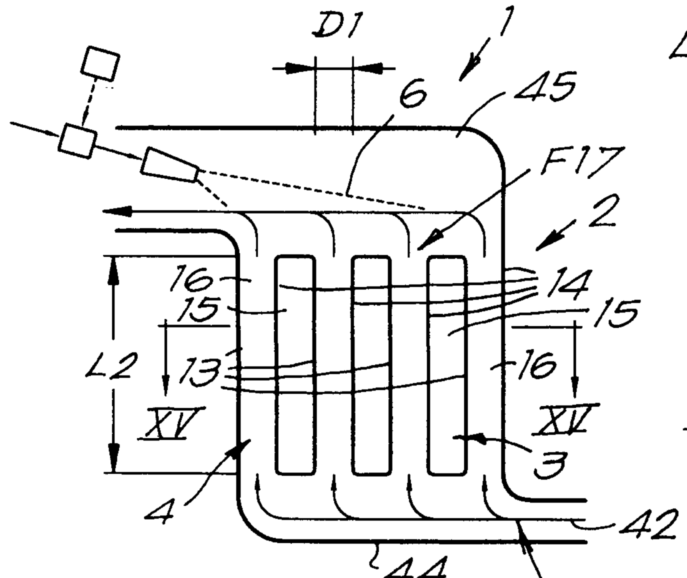

Fig.14

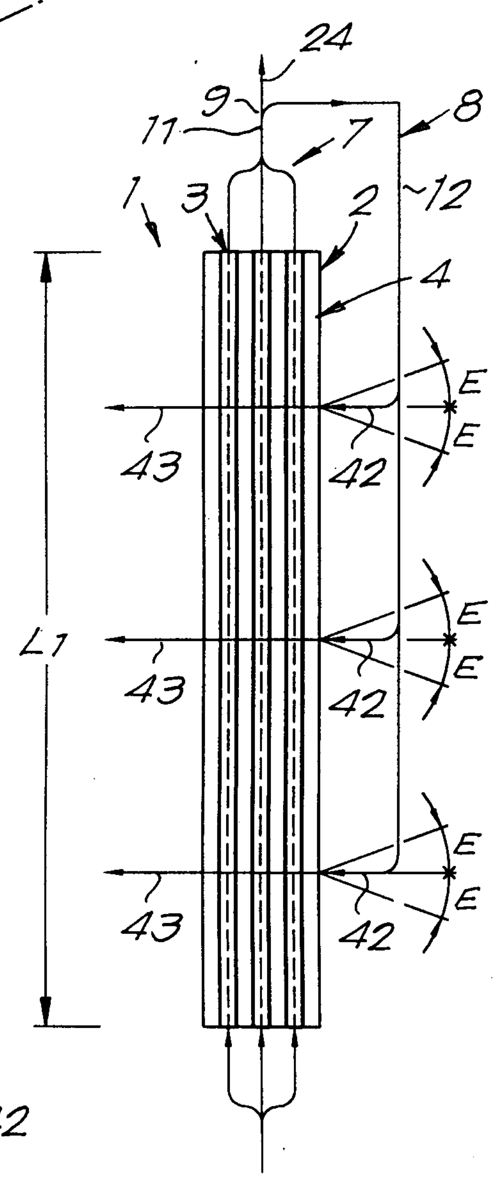

Fig.15

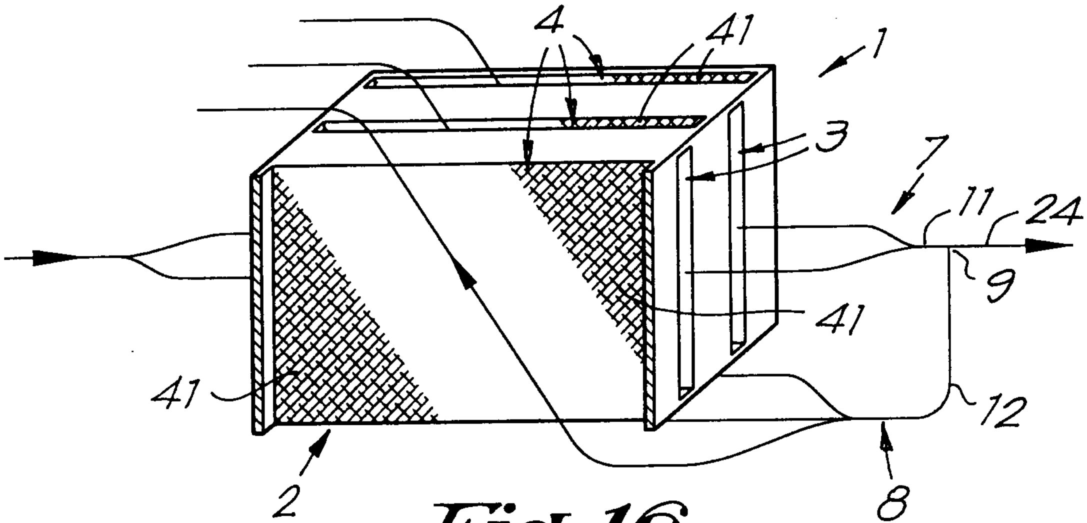
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Fig. 16

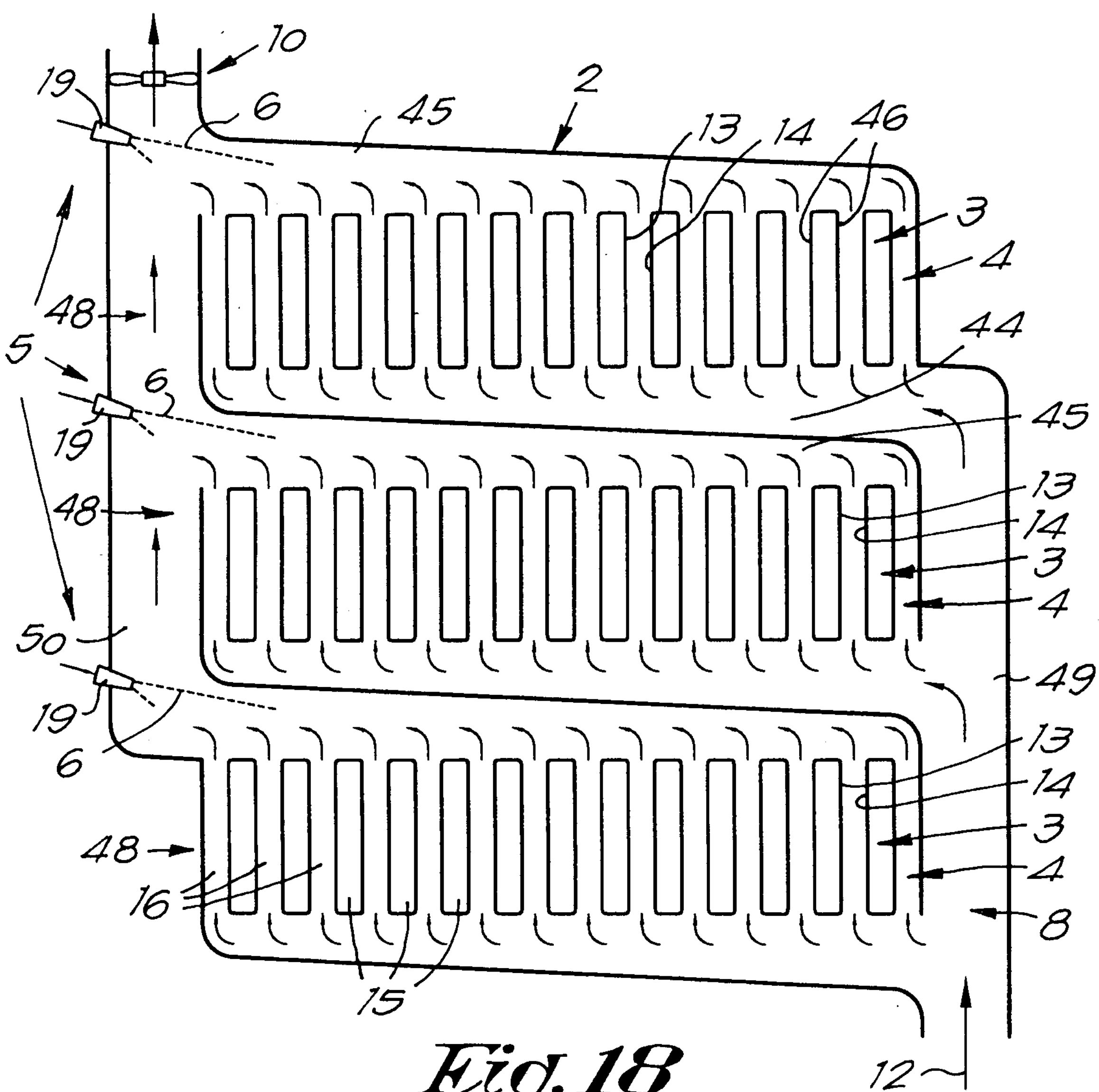
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Fig. 18

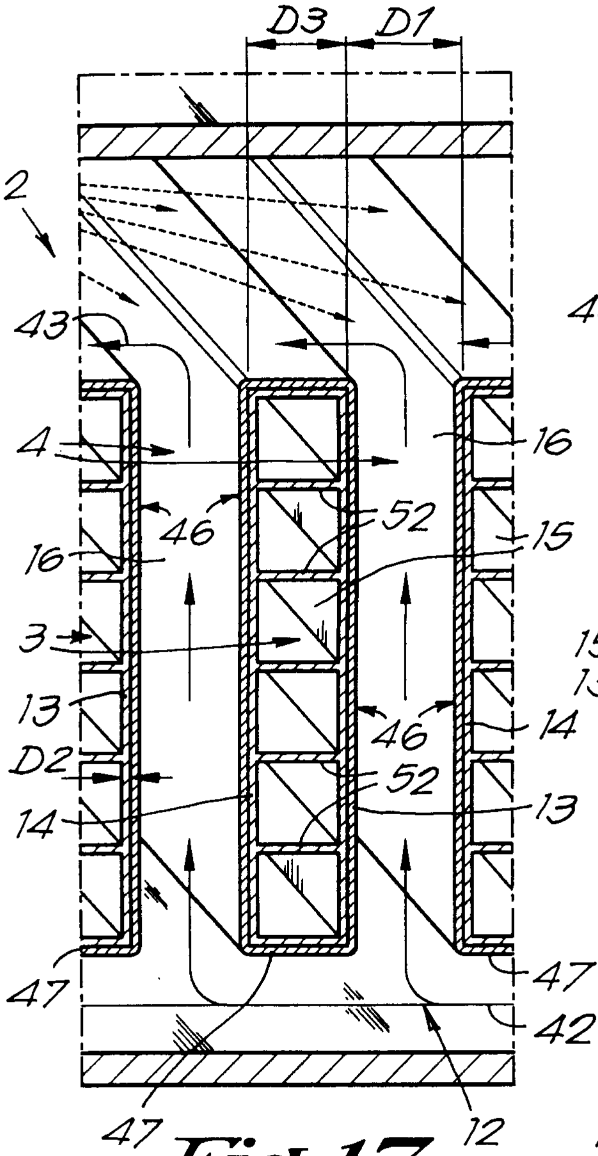

Fig.17

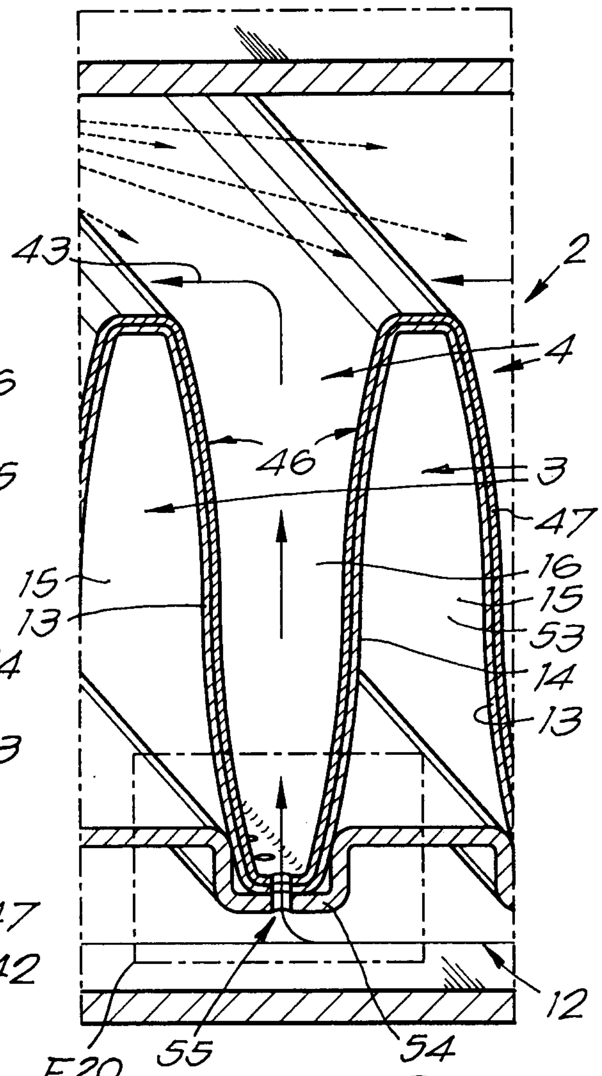

Fig.19

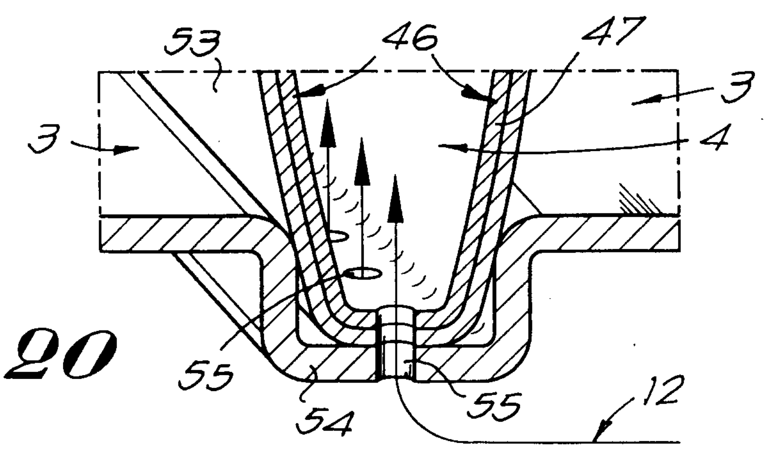

Fig.20