(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 600 721 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
30.11.2005 Bulletin 2005/48

(51) Int Cl.7: **F28F 19/00**, F28B 9/00, F28F 17/00

(21) Application number: **05425367.9**

(22) Date of filing: **25.05.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR LV MK YU

(30) Priority: **28.05.2004 IT fi20040120**

(71) Applicant: **Frigel Firenze S.p.a.**
50018 Scandicci FI (IT)

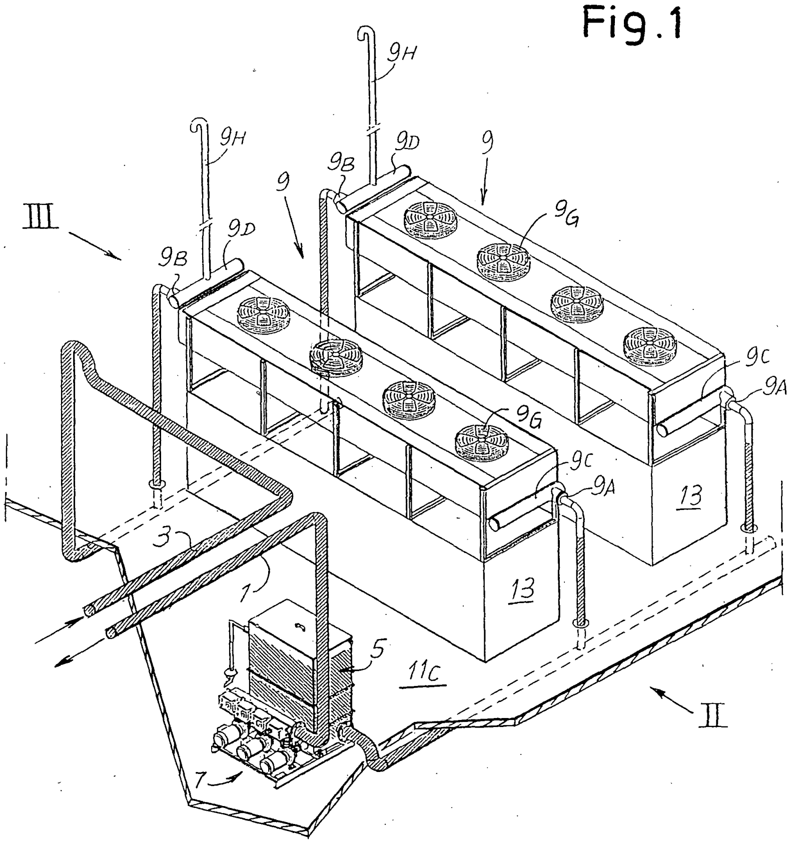
(72) Inventor: **Dorin, Filipo**
50135 Firenze (IT)

(74) Representative: **Mannucci, Michele et al**
Ufficio Tecnico Ing.A. Mannucci S.R.L,
Via della Scala 4
50123 Firenze (IT)

(54) A cooling plant and corresponding thermoconvector

(57) The plant comprises a circuit for circulation of water (or a water mixture) with a tank (5), circulation pumps (7), thermoconvectors (9) and connection pipes (1, 3). The tank (5) has a capacity greater than the volume of water contained in the thermoeonvectors (9) and in the external parts of the circuit, and said thermoconvectors (9) can be naturally self-emptying by gravity and are installed with each outlet mouth (9A) for outlet of the water at a level higher than the maximum level of the water that said tank (5) can contain.

Fig.1



Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates to a water-circulation cooling plant for premises subject to environmental temperatures below zero degrees centigrade, which can be used for example for industrial processes, such as moulding or extrusion of plastic materials. Said plants in general comprise a circuit for circulation of the cooling water of the machines for moulding, blowing, extrusion, a circuit which comprises a tank, circulation pumps, and thermoconvectors, connected to one another and to the manufacturing machines by means of pipes, the headers being set in the external environment, for example on the roof of a building.

[0002] In the case of installation in premises subject to temperatures below zero degrees centigrade, it is necessary to prevent freezing of the circulation water during any periods of stoppage of the plant, in particular in the thermoconvectors and in the parts of the piping set outside, a fact that would entail a prolonged shutdown of the plant, at the very least on account of the practically immediate failure of the copper pipes of the thermoconvectors due to freezing of the water contained therein. In general, for this reason, the majority of the pipes, the tank and the pumps are installed inside an environment in which the temperature never drops below freezing point. Furthermore, the circulation water is mixed with antifreeze liquid products, such as polyethylene glycol, in proportions that depend upon the minimum level of temperature that can be expected. For example, the amount of antifreeze liquids added, in the case of arctic climates, can reach and exceed 50% of the volume of the mixture. However, since said antifreeze liquids have heat-exchange capacities and properties clearly lower than those of water, the cooling plants must be proportioned accordingly, by increasing the surfaces of heat exchange as well as the installed power of the thermoconvectors and of the circulation pumps, with consequent higher installation and operating costs. Furthermore, reasons of environmental protection are an increasing obstacle to the use of said antifreeze products.

[0003] To prevent the aforesaid drawbacks, there have been proposed plants provided with appropriate valves, for example deflecting valves, non-return valves or the like, which are controlled, either manually or in a remote way, so that they enable emptying out of the water from the thermoconvectors upon stoppage of the plant. However, since such stoppages can occur after prolonged periods of operation, for example a number of months, said valves could get clogged or break down, thus preventing complete discharge.

[0004] In order to overcome the above drawbacks, in a plant according to the present invention, said tank has a capacity greater than the volume of water contained in the thermoconvectors and in the external parts of the circuit, and said thermoconvectors are naturally self-emptying in the sense that the thermoconvectors themselves, and the plant in which they are inserted, are configured in such a way that, upon stoppage of the pumps, there follows natural complete emptying by gravity of the thermoconvectors, without any need to intervene by actuating valves of any sort, for example deflecting valves or non-return valves. Said self-emptying thermoconvectors are installed with the mouth for outlet of the water and with the exposed parts of the pipes at a level higher than the maximum level of the water that said tank can contain. In this way, in the periods of stoppage of the plant, the water exits naturally by gravity from the thermoconvectors and said external parts of the circulation circuit and is collected in the tank, so preventing its freezing inside the thermoconvectors. It is then possible to use pure water or water mixed with a minimum amount of antifreeze products, so preventing the drawbacks mentioned above.

[0005] The invention also relates to a thermoconvector for a cooling plant of the type described above, in which the path followed by the water to be cooled, inside the thermoconvector, always has inclinations downwards in the direction leading from the inlet mouth to the outlet mouth. Furthermore, to the intake header of each thermoconvector of the plant there can be connected a vent pipe, the open end of which is set at a level that exceeds the maximum hydrostatic load that can be envisaged in said header in conditions of normal operation. In this way, in the periods of stoppage of the plant, it is possible to achieve, by gravity, complete and fast emptying of the water from the thermoconvector.

[0006] For a better understanding of the invention, there is now provided a description thereof with reference to the annexed drawings, which shows a nonlimiting example of the invention itself. In the drawings:

Figure 1 shows a partial perspective view of a cooling plant according to the invention;
Figures 2 and 3 are elevations, respectively according to the line II and III of Figure 1;
Figures 4, 5 and 6 are views similar to those of Figures 1, 2 and 3 of another embodiment of the cooling plant according to the invention;
Figure 7 is a side view of a thermoconvector, without the guard, according to the invention;
Figure 8 is a cross-sectional view according to the line VIII-VIII of Figure 7;
Figure 9 shows the detail IX, at an enlarged scale, of Figure 7;
Figure 10 is a side view of another embodiment of thermoconvector according to the invention;
Figures 11 and 12 are end views, respectively according to the lines XI-XI and XII-XII of Figure 10; and
Figure 13 is a cross-sectional view according to the line XIII-XIII of Figure 11.

[0007] Figure 1 shows, in a partial view, a water-circulation cooling plant according to the present invention, particularly suited for premises subject to environmental temperatures below zero degrees centigrade. The plant comprises: a circuit for circulation of water, or of a water mixture, with delivery pipes 1 towards machines to be cooled - for example a series of machines for moulding plastic materials (not shown in the drawings), or the like. The circuit also comprises return pipes 3 from said machines, a tank 5 open at the top and provided with an overflow outlet, circulation pumps 7 and thermoconvectors 9. The water, cooled by means of circulation of air in the thermoconvectors 9, is collected in the tank 5 and is sent by the pumps 7 - via the delivery pipes 1 - to said machines to be cooled and, from these, returns heated to the thermoconvectors 9 - via the pipes 3 - at a temperature higher than the temperature that it had in the tank 5.

[0008] As shown in Figures 2 and 3, the majority of the pipes 1, 3, the tank 5 and the pumps 7 are installed inside an environment of which, by way of indication, an outer wall 11A and a portion of the roof 11 B are shown. Said environment is heated internally at a temperature that never drops below the freezing point of the cooling water, and hence inside said parts of the cooiing circuit there is no risk of formation of ice. Instead, the thermoconvectors 9 must necessarily be installed out in the open in so far as they use the external air to cool the circulation water. In said conditions, in order to prevent any risk of formation of ice inside the thermoconvectors and the other parts of the circuit set outside, it would be necessary to add to the circulation water a big percentage of antifreeze, with the adverse effects described in the preamble.

[0009] According to the invention, the thermoconvectors 9, which in this case are located on a floor 11C coplanar with that of the rest of the plant, are raised with respect to said floor - by means of respective resting bases 13 - with the outlet mouths 9A (Figure 2) at a level L_1, which exceeds the maximum level (L_0) reached by the water in the tank 5. With reference also to Figure 7, the outlet mouth 9A and the inlet mouth 9B of the thermoconvector 9 are each applied to a respective header 9C, 9D, and said headers are connected by the nest of pipes 9E of the thermoconvector, the nest of pipes having cooling fins 9F (Figure 9) through which a series of fans 9G sucks in the external air. According to the invention, the nest of pipes 9E has straight pipes inclined downwards from the inlet to the outlet, and the inlet mouth 9B of the header 9D is set at a level L2 higher than the level L1 of the outlet mouth 9A. Furthermore, connected to the intake headers 9D of each thermoconvector is a vertical vent pipe 9H, the free end of which, which is bent to form a U set upside down, is set at a level that exceeds any other part of the plant in which water circulates of the plant by a height equal at least to the maximum hydrostatic load that can be expected in the header 9D in conditions of normal operation.

[0010] In this way, when the machines to be cooled are turned off and also the pumps 7 are stopped, for example at night or in holiday periods, all the circulation water contained in the thermoconvectors 9 exits therefrom by gravity and is collected naturally in the tank 5, the capacity of which is sufficient to contain it. There is thus avoided the serious risk that, at low external temperatures, the water will freeze in the thermoconvectors, causing failure of the pipes due to expansion and bringing about irreparable damage to the nest of pipes of the thermoconvectors.

[0011] Figures 4, 5 and 6 illustrate a plant similar to the one described above, but in which the thermoconvectors 9 are placed directly on the roof 21 B of the premises that contains the machines to be cooled, the tank 5, the pumps 7 and the delivery and return pipes 1, 3, resting on a floor 21C underneath the roof 21B. The thermoconvectors 9 are identical to those described above and are arranged according to the same modalities.

[0012] Figures 10-12 show a different type of thermoconvector 109, in which two nests of pipes 109A - altogether similar to the nest of pipes 9E of Figure 7 - are arranged to form a V with respect to one another and are surmounted by a series of fans 109B that suck in air from said V. In this way, given the same overall dimensions in plan view, it is possible to install a cooling power that is much greater than that of the configuration of Figure 7. In this case, according to the invention, the thermoconvector 109 has two intake headers 111C having inlet mouths 111D arranged in the highest part, and two output headers 111 E having outlet mouths 111 F arranged in the lowest part. The nests of pipes 109A are supported by a frame made of metal sectional elements which has pedestals 113, the height of said frame decreasing gradually, starting from the pedestal corresponding to the intake header 111C as far as the one corresponding to the output header 111 E. The nests of pipes are consequently arranged with a slight inclination with respect to the horizontal. Furthermore, connected to each inlet mouth 111D is a respective vent 112, in a way similar to what has been described in regard to the previous case, so as to ensure emptying by gravity of the thermoconvector when the operation of the plant and of the circulation pumps is interrupted, preventing any risk of blocking operation on account of internal formations of ice.

[0013] It is understood that drawings shows only one example provided merely as practical demonstration of the invention, it being possible for the present invention to vary in the forms and arrangements, without thereby departing from the scope of the idea that underlying the invention itself. The possible presence of reference numbers in the attached claims merely has the purpose of facilitating reading thereof with reference to the description, and in no way limits the field of protection represented by the claims.

Claims

1. A water-circulation cooling plant for premises subject to environmental temperatures below zero degrees centigrade, comprising a circuit for circulation of water (or of a water mixture) including a tank, circulation pumps, connection pipes, placed in an environment in which the temperature is maintained always above the freezing point of water, and thermoconvectors placed in an external environment, wherein said tank has a capacity greater than the volume of water contained in the thermoconvectors and in the parts of the circuit placed in said external environment, and wherein said thermoconvectors are naturally self-emptying by gravity and installed with a water outlet mouth set at a level higher than the maximum level of the water that said tank can contain so that, in the periods of stoppage of the plant, as the pumps are stopped, all the water flows out of the thermoconvectors and of the external ducts of the circulation circuit and is collected in the tank, without the need for actuating any valve.

2. The plant according to claim 1, wherein each thermoconvector includes an intake header connected to a vent pipe, the open end of each vent pipe being set at a level that exceeds the maximum hydrostatic load that can be expected in said header in conditions of normal operation.

3. A water-circulation cooling plant for premises subject to environmental temperatures below zero degrees centigrade, comprising a circuit for circulation of water (or of a water mixture) including a tank, circulation pumps, connection pipes, placed in an environment in which the temperature is maintained always above water freezing point, and at least a thermoconvector placed in an external environment, wherein said tank has a capacity greater than the volume of water contained in said at least one thermoconvector and in the parts of the circuit placed in said external environment, wherein said thermoconvector include at least a water inlet mouth, a water outlet mouth and a water path between said inlet mouth and said outlet mouth, and wherein said inlet mouth is arranged at a level higher than that of said outlet mouth, said path always having an inclination downwards in the direction leading from the inlet mouth to the outlet mouth.

4. The plant according to claim 3, wherein said thermoconvector includes an intake header connected to a vent pipe, the open end of each vent pipe being set at a level that exceeds the maximum hydrostatic load that can be expected in said header in conditions of normal operation

5. A thermoconvector including at least a water inlet mouth, a water outlet mouth and a water path between said inlet mouth and said outlet mouth, wherein said inlet mouth is arranged at a level higher than that of said outlet mouth, said path always having an inclination downwards in the direction leading from the inlet mouth to the outlet mouth.

6. The termoconvector according to claim 5, including an intake header, wherein said intake header is connected to a vent pipe, the open end of said vent pipe being set at a level that exceeds the maximum hydrostatic load that can be expected in said header.

7. The thermoconvector according to Claim 5 or 6, including rectilinear nests of pipes mounted inclined downwards, from an intake header to an output header.

8. The thermoconvector according to Claim 5 or 6, including two nests of pipes arranged to form a V, two intake headers and two outlet headers, each intake header having an inlet mouth set at the top end of the header, and each of the output headers having an outlet mouth set at the bottom end of the header.

Fig.1

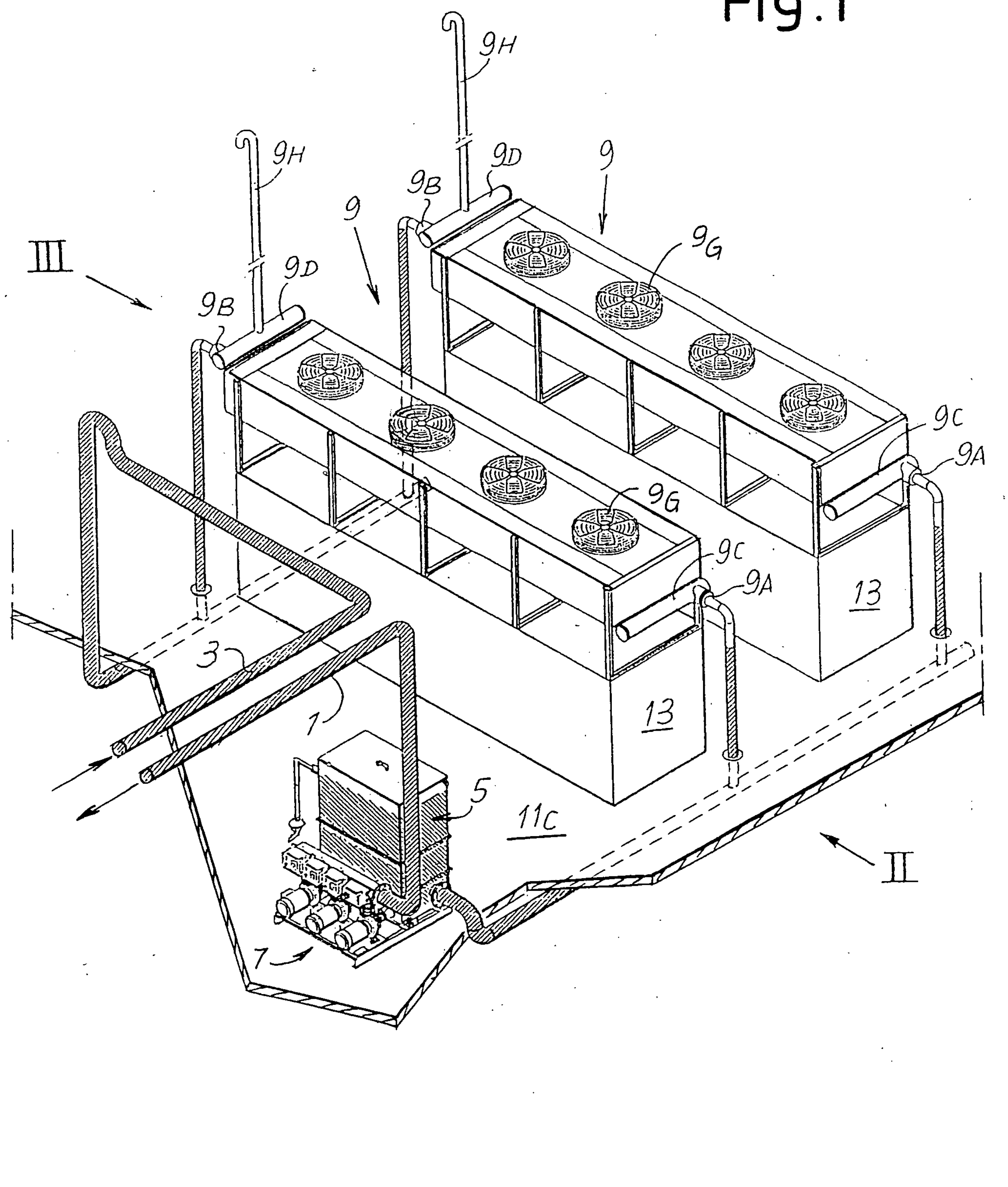


Fig.2

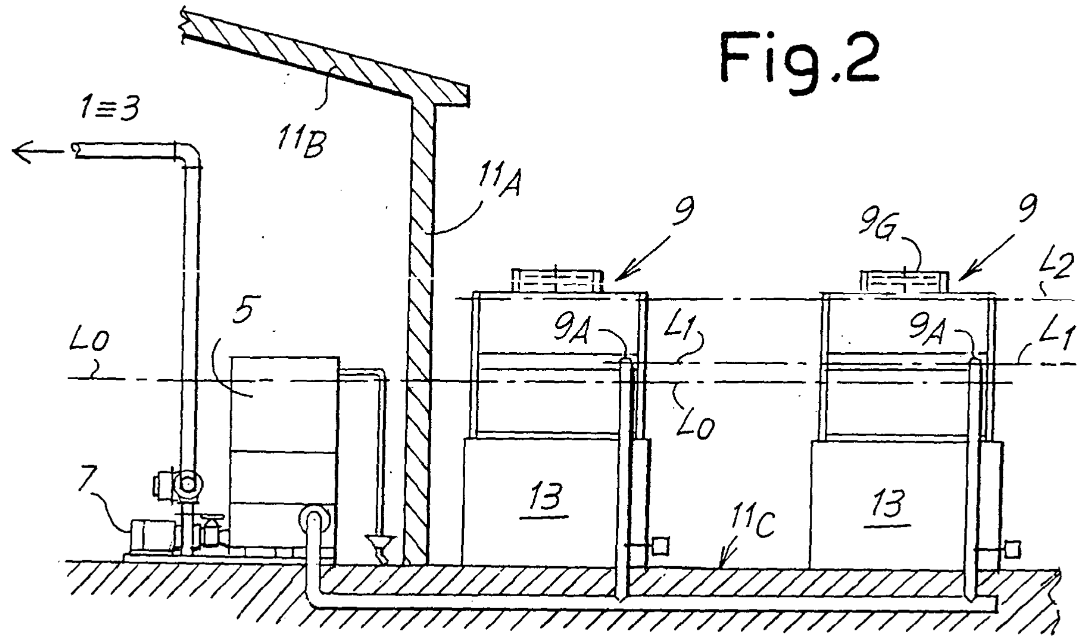


Fig.3

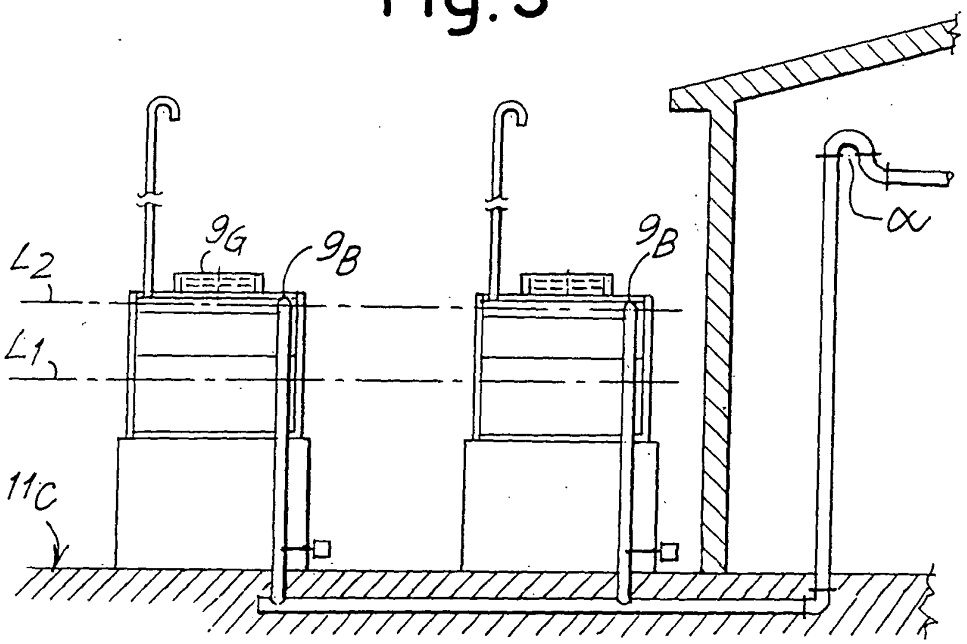
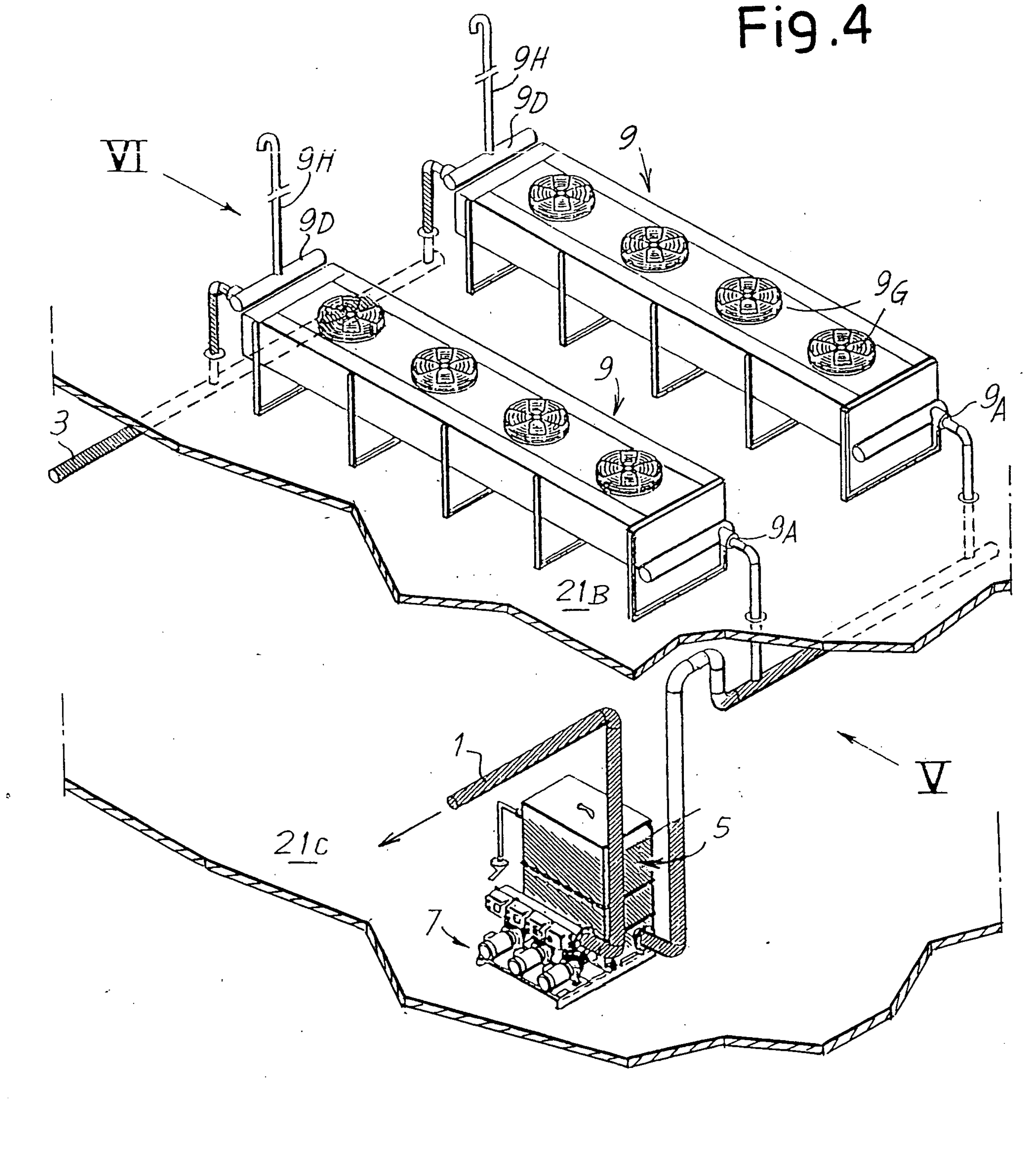


Fig.4



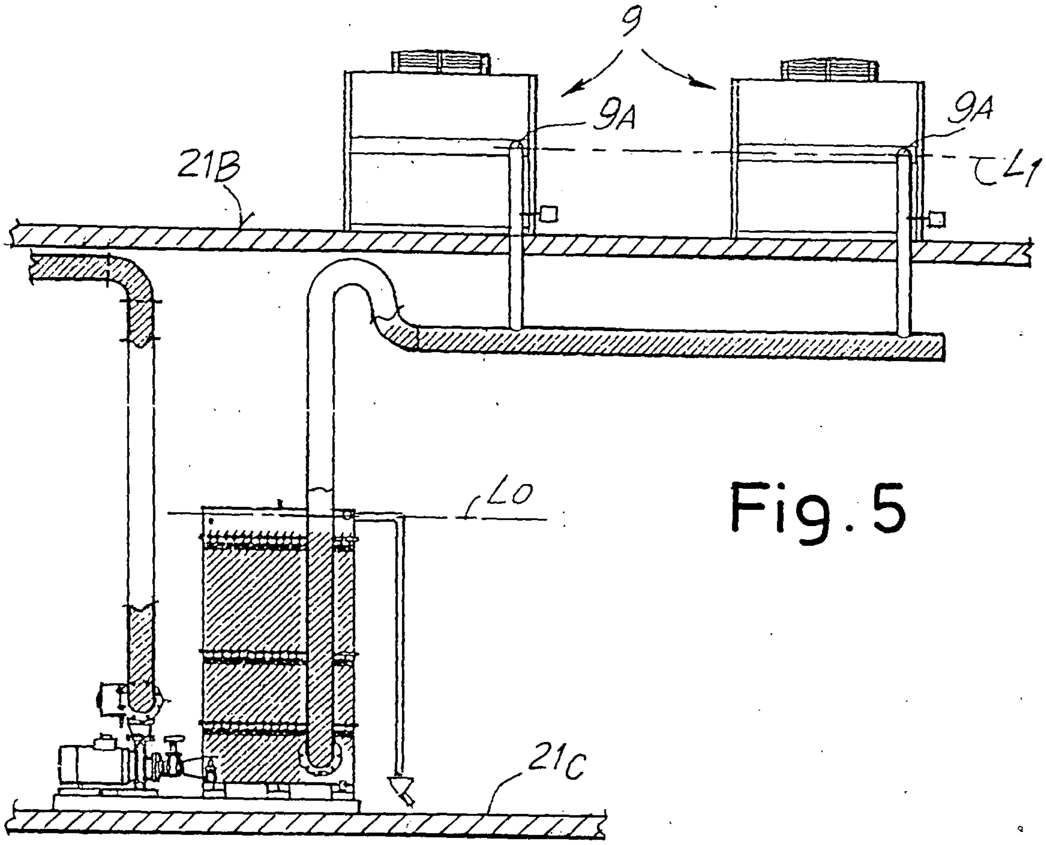
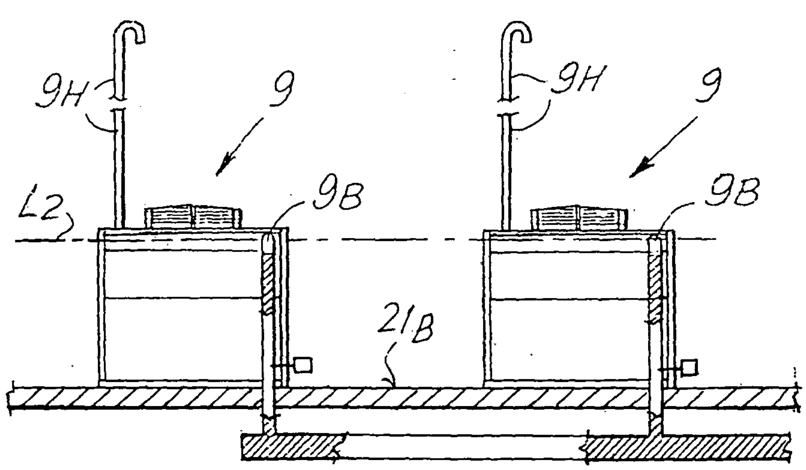


Fig. 5

Fig. 6



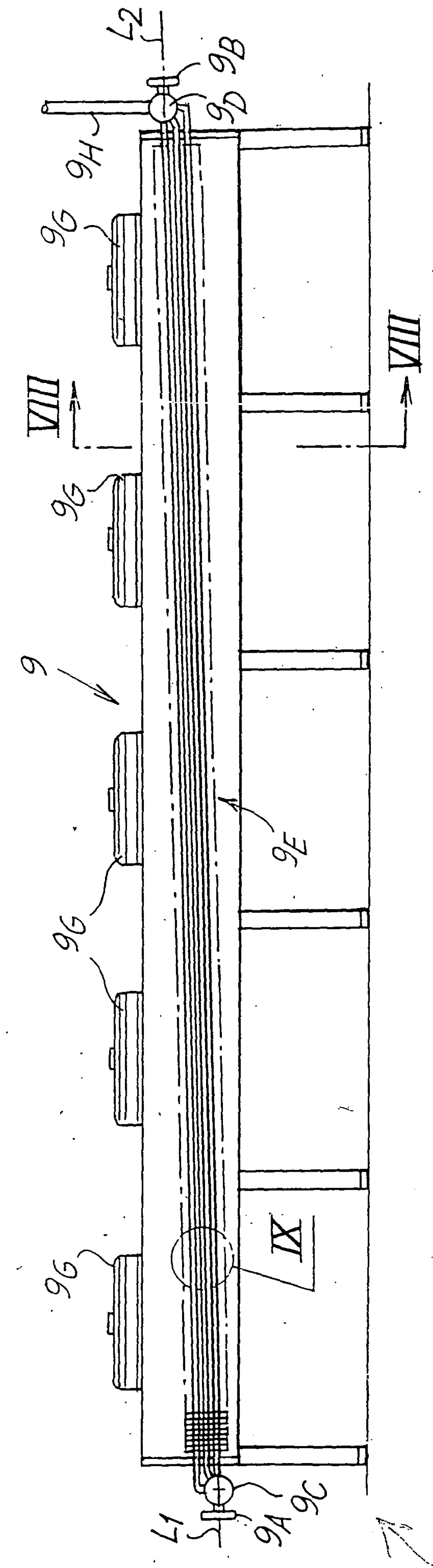


Fig.7

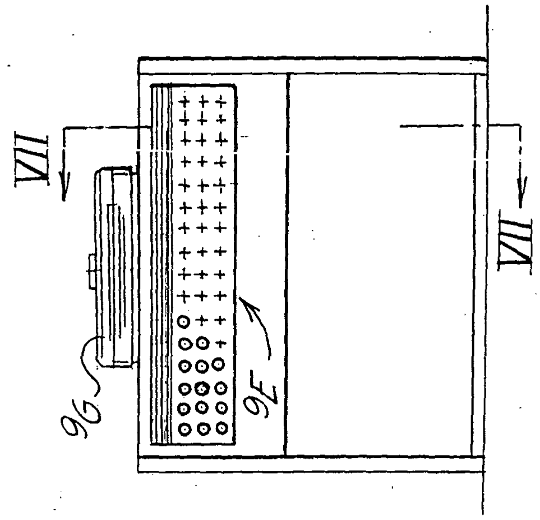


Fig.8

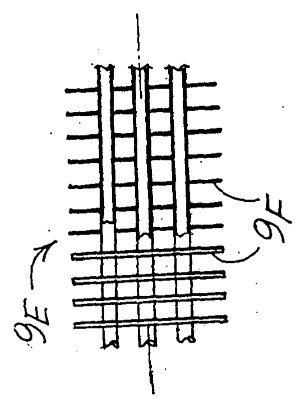


Fig.9

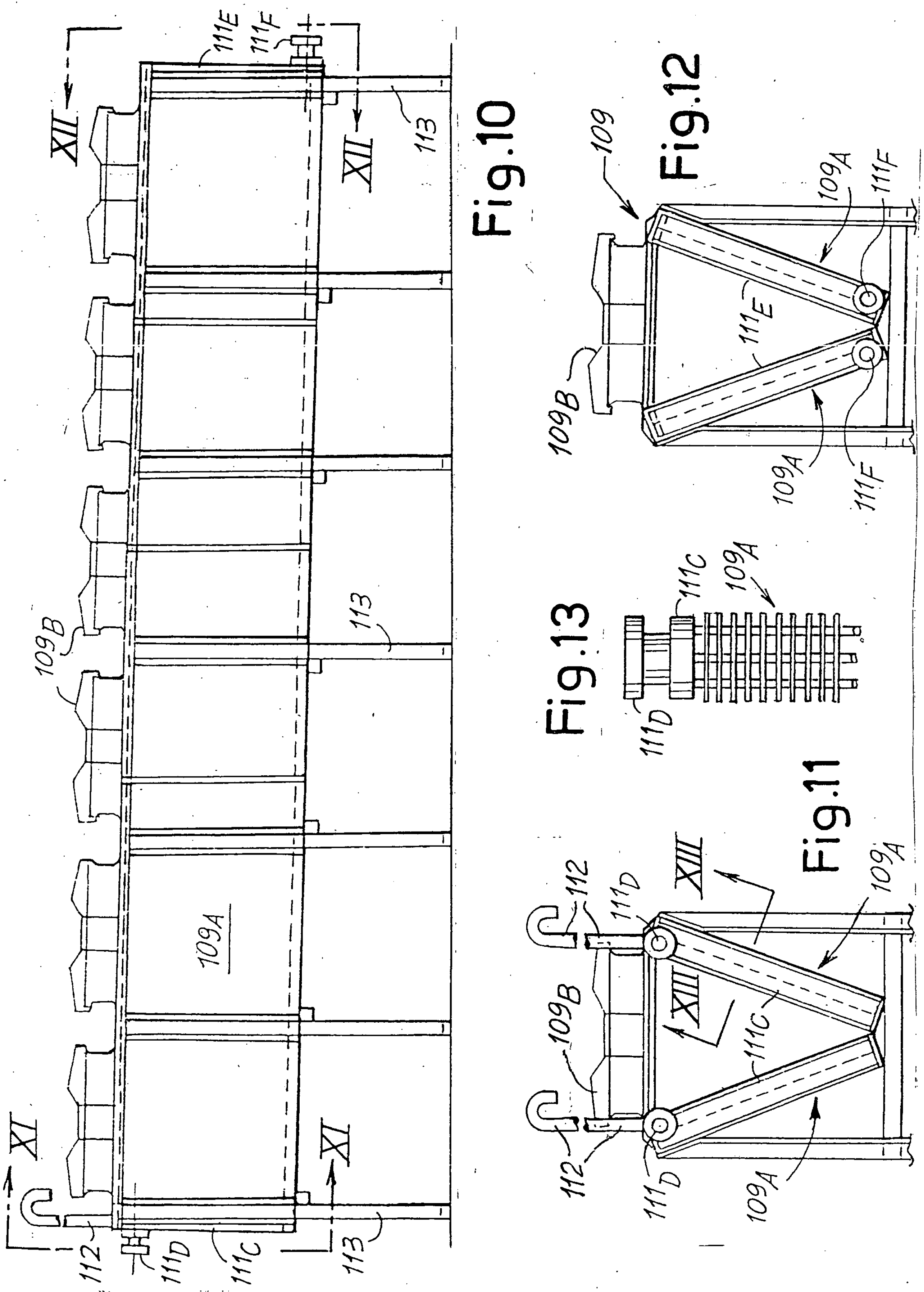


Fig.10
Fig.11
Fig.12
Fig.13
109
109A
109B
111C
111D
111E
111F
112
113
XI
XII
XIII