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(71) Applicant(s)
Mauro De Giusti; Enrico Medessi

(72) Inventor(s)
Enrico Medessi

(74) Agent/Attorney
HODGKINSON OLD McINNES,Level 3, 20 Alfred Street,MILSONS POINT NSW 2061

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(71) Applicant *(for all designated States except US)*: DE GIUSTI, Mauro [IT/IT]; Vicolo Nuovo, 17, I-31020 S. Vendemiano (IT).

(71)(72) Applicant and Inventor: MEDESSI, Enrico [IT/IT]; Via Garzarolli, 134, I-34170 Gorizia (IT).

(74) Agent: D'AGOSTINI, Giovanni; D'Agostini Organizzazione S.r.l., Via G. Giusti, 17, I-33100 Udine (IT).

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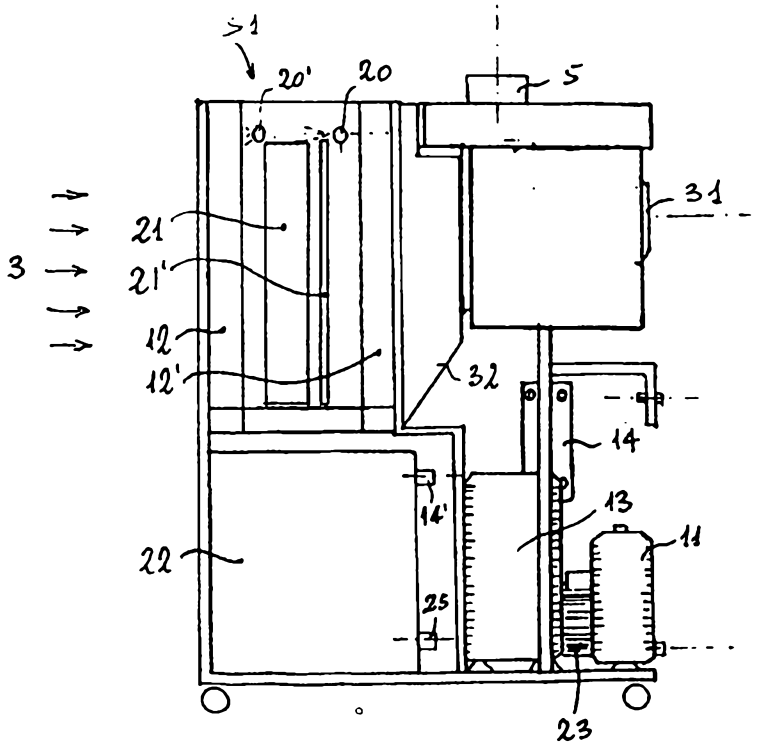
(54) Title: UNIVERSAL EQUIPMENT FOR THE COOLING FLUID REGENERATION IN HEAT EXCHANGE CIRCUITS

(57) Abstract

Cooling equipment, which may be connected to the water discharge from a working or operating machine with water (20/20') cooling circuit (2) and makes it re-circulate once cooled (24), characterised in that said cooling equipment comprises: at least one placing for cooling tower (21-21') substantially with water cooling package for wetting and evaporation of an extended surface; at least an air flow generator device (3-31) which hits and crosses said placing for cooling tower (21-21') for easing the falling water evaporation; at least one closed cycle frigorific circuit (1) whose condensing means (12) are placed at least downstream (12') of said placing for cooling tower (21-21') respect to said air flow (3-31) and whose evaporator (14) is placed downstream of said water circuit (2) for exchanging heat with the cooled water (22) in said cooling tower (21-21') for then making it re-circulate again in said operating machine (24).



DESCRIPTION

UNIVERSAL EQUIPMENT FOR THE COOLING FLUID REGENERATION IN HEAT EXCHANGE CIRCUITS

Technical Field

The present invention has for object a universal equipment for the cooling fluid regeneration in heat exchange circuits.

The invention finds particular even if not exclusive application in the water cooling sector of heat exchange circuits in the industrial art machines such as for example in the ice cream production machines or in the plastic material moulding machines (moulds cooling), etc.

Background Art

It is known that in the art there are many types of machines which use system water cooling circuits which is then generally discharged and wasted without being regenerated which involves high costs consumption of the water which nowadays is so precious.

The cooling water generally exits at a temperature about 35-40° C.

For avoiding the high costs deriving from the cooling water waste some equipment was studied which makes the water re-circulate by cooling it.

This equipment is substantially made like a cooling tower involving the recirculation of the water outlet from the machine which must be cooled, subjecting it to a heat exchange by a passage through a forced air-jet, also by using the evaporating system, the whole eventually and preferably combined with the heat exchange with a frigorific circuit condensing panels.

In the cooling towers and in the water-air exchangers of the evaporating type in general, the temperature at which the water may be regenerated cannot go below the temperature of the humid bulb of

the air used.

In the water-air exchangers of the non-evaporating type (example dry finned exchangers), the temperature at which the water may be regenerated cannot go below the temperature of the dry bulb of the air used and thus the temperature decrease is even more limited.

Also auxiliary cooling arts which use condensers operating in closed cycle frigorific circuits have the drawback of being hardly suitable to the different year periods or to the different specifical needs.

It should also be considered that if the cooling apparatus does not always cool the machine water to be cooled in proportion, a vicious circle which may really endanger the machine work and even damage it may occur.

These problems may obviously be reduced if the machine is cooled by using the disposable system water, because in this case the system water during the day has substantially always the same temperature, therefore it would be only necessary to vary the water delivery for perfectly running the machine to be cooled, but this solution would be extremely expensive and also poorly effective in Summertime, therefore it is certainly more convenient using equipment of the type as in this invention, thus substantially realising a closed circuit.

In case of a closed circuit cooling as above stated, if the cooling apparatus does not eliminate all the temperature increase, which the working machine yields, the closed circuit water temperature, tends to continuously increase in a vicious cycle which is difficult to be eliminated with the unavoidable operating machine damage.

If for example the increase of the water temperature which circulates in the operating machine is of 15°C, it is obvious that the cooling apparatus should exactly subtract 15°C, because if it subtracts 14°C, at

every water recirculation, the water will increase its temperature just a little less than one degree and even if progressively less, the point is reached in which the work is really endangered and the machine (operating) is damaged for inadequate cooling of the same operating machine circuit.

Vice versa if the cooling apparatus subtracts too much temperature, in such a case the working machine would be subjected to a work in non-optimal temperature conditions.

DE 296 06 863 U1 (BKZ ANLAGENBAU GMBH), discloses a device for cooling liquids, especially coolants having a freezing coolant closed circuit.

FR 2 544 470 A (HIROSS INTERNATIONAL CORP. S.A.), discloses a cooling unit for cooling fluids in an air condition installation with vent supply.

Purpose of the present invention

The purpose of the present invention is that of obviating the above mentioned drawbacks by creating an equipment which is able to supply a controlled cooling which is proportional to the working machine needs, independently of the same machine working charge and of the environmental temperature and also able to be adapted to any cooling condition, both by cooling tower means, and by frigorific means and also by using both of them.

Diclosure of the invention essence

These and other purposes are reached as claimed by a cooling equipment, which may be connected to the water discharge from a water cooled working machine or operating machine and makes it recirculate once cooled, characterised in that said cooling equipment includes:

- at least one placing for the cooling tower substantially like a water cooling package for extended surface wetting and evaporation;
- at least an air draft generator device which hits and goes through said cooling tower position for easing the falling water evaporation;
- at least a closed cycle frigorific circuit:
- whose condensing means are placed at least downstream of said cooling tower placing with respect to said air flow draft and
- whose evaporator is placed downstream of said water circuit for exchanging heat with the water cooled in said cooling tower for then making it recirculate again in said operating machine;
- said condensing means being two, one placed upstream and one downstream of said placing for cooling tower and one and/or the other being able to be activated or, vice versa, excluded.

Thus the immediate advantage of making the cooling system more effective and with a higher yield also if the temperature of the water to be cooled is rather low (reduced heat exchange thermal head) is obtained.

In the preferred solution said condensing means are placed both upstream and downstream of said tower thus making possible a maximum cooling by operating both of them or an optimal working by actioning the one upstream or the one downstream.

As much advantageously the following additional means are provided:

- water temperature sensing means (Te) on the entry of the hot water to be cooled, and controlled valve means for discharging the hot water on entry in certain conditions;
- between said hot water entry and the cold water exit, means for letting in cold water from the supplying system;
- on the cooled water exit, cooled water temperature sensing means

(Tu);

- means for comparing one and/or the other temperature and at least the exit one (Tu) for operating said valve means for the hot water discharge and cold water inlet on entry.

Thus the further advantage of being able to perfectly calibrate the cooling plant with a poor water loss for a rational operation of the working machine and cooling equipment is obtained.

Advantageously the panel in contact with the cooling tower is extractable, thus making possible a further cooling form valid for certain conditions by operating only the frigorific circuit.

Description of some preferred forms of embodiment

These and other advantages will appear from the following description of a preferred solution, with the aid of the enclosed drawings whose execution details are not to be considered as limitative but only given as examples.

Figure 1 is a side elevation schematic view of the equipment with covering panel in which it is shown that on the side there are neither connections nor controls for making possible an adhesion to a wall or to another equipment.

Figure 2 is a rear elevation view of the equipment seen from the side where the connection pipes connect the water to the system, and of the circuit water which must be cooled in an the operating machine.

Figure 3 is a side elevation view of the machine without the lateral covering panel showing the internal apparatus and devices.

Figure 4 is a front view of the equipment in which a large mouth contacting the panelling for the heat exchange with the environmental air which is sucked towards the machine interior can be seen.

Figure 5 shows the equipment interior on the other side where the package contacting the cooling tower has been extracted for alternative functioning or for replacement operations;

Figure 6 shows the equipment interior from the back side with the respective covering panel removed as in Fig. 2.

Figure 7 shows a top view of the equipment displaying the panels for the heat exchange with the external air flow of which the central one contacting the cooling tower or cooling package, is extractable and interchangeable.

Figure 8 shows the top view of the machine displaying the control panel position on the respective upper corner side.

Referring to the figures it may be noticed that:

- The frigorific circuit 1 is indicated with the devices from 11 to 14, where 11 is the compressor 12 and 12' are the condensers placed upstream and downstream of the cooling tower indicated with 20-21; 13 is a frigorific liquid receiver and 14 is its evaporator.

- The water cooling circuit 2 comprises the entry means (20) with sprayers (20,20') one at the cooling tower (20) and the second one (20') at the first upstream condenser (12), means for collecting the water beneath said cooling panels, made up of a collection tank 22, from which by means of a water recirculation pump 23 and exit duct (14') it is conveyed to the heat exchange with the evaporator (14) for then being recirculated by the discharge connection (24) in the operating machine to be cooled.

The water collection tank 22 will suitably also have a discharge piping (25).

- The water circuit 3 is obtained by the motor-fan 31-31' suction and discharged upwards 5.

The air 3 passes through the first condenser 12, the cooling panel for evaporation 21 and the respective drops separator 21' and finally through the second condenser (12').

The water yield back connections are:

- system cold water entry for reintegration and eventual additional cooling in case of need (20");
- warm water entry (20') to be refrigerated of the operating circuit. without passage to the cooling tower but only to the heat exchange with the evaporator (14);
- alternative hot water entry of the operating circuit to be cooled (20) in maximum temperature conditions and for which a maximum heat exchange is required with maximum temperature lowering;
- entry hot water discharge in case of need or of particular intervention, as also explained hereinafter.

The control board is indicated with 4' and the respective box containing the electric, programming and control equipment is indicated with 4.

Auxiliary intervention solutions

In the preferred solution at the entry (20/20') a valve (advantageously an electro valve) for the hot water discharge (24') and a valve (advantageously an electro valve) for the system cold water entry (20") is provided.

For example when the exit temperature Tu is too high (e.g. >25°C) the program activates the discharging of a certain amount of hot water from the respective valve and an inlet of corresponding cold water from the other respective valve.

Thus the cooling circuit is balanced again.

Of course it is also possible operating on parameters which concern

also the entry temperature (Te), etc.

At the air entry from the outside 3 the air temperature is the environmental one Ta.

The air is heated at Tm>Ta passing through the condensing means (12) becoming dry.

In the meantime on entry (20,20') the working fluid (liquid) has a temperature Te>Tm and therefore in the tower (21) this working fluid is cooled at a certain value, while the air comes out from the opposite side (5) at a temperature TF>Tm.

The heat exchanges yield (12,21) may be improved by using an external evaporative system e.g. in drops or water spraying (20,20').

Before being discharged (24) the working fluid is made pass through the evaporator 14 of the frigorific circuit, thus obtaining a further cooling at a temperature Tu<Te.

The exit temperature Tu may thus reach also extremely low values respect to the environmental temperature and arrive also about 0°C.

Advantageously said evaporator (14) in a more effective alternative solution is immersed in said water collection tank (22).

Advantageously said air forced circulation means, comprise means able to reverse the air flow for obtaining the upstream arrangement of a downstream means and vice versa.

Thus the great advantage of a maximum flexibility by using also only one condensing means is obtained.

As it can be noticed by the figures the cooling equipment advantageously has a parallelepiped-like box shape having at the top the control panel (4-4') and with a first air flow heat exchange compartment (3-S1), for inserting both cooling tower panels (21-12") and frigorific circuit heat exchange panels (12,12'), and also both of

them, water delivery means(20,20') being arranged at the top and a collection tank of the same water (22) being arranged at the bottom for its recirculation (24) in a cooling operating cycle of an operating or working machine. By this structure the advantage of using one or the other of the systems or both of them according to the specifical needs is obtained.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. Cooling equipment, which may be connected to the water discharge from a working or operating machine with water cooling circuit and makes it recirculate once cooled wherein said cooling equipment comprises:

- at least one placing for cooling tower substantially with water cooling package for wetting and evaporation of an extended surface;

- at least an air flow generator device which hits and goes through said placing for cooling tower for easing the falling water evaporation;

- at least one closed cycle frigorific circuit:

- whose condensing means are placed at least downstream of said placing for cooling tower respect to said air flow; and

- whose evaporator is placed downstream of said water circuit for exchanging heat with the cooled water in said cooling tower for then making it recirculate again in said operating machine, and wherein said condensing means are two, one placed upstream and one downstream of said placing for cooling tower and one and/or the other may be activated or vice versa excluded.

2. The cooling equipment according to claim 1, wherein said condensing means, or one and/or the other are associated to water spraying means from said cooling water drawing and recirculation circuit of the operating machine for its simultaneous cooling by evaporation.

3. The cooling equipment according to any one of the previous claims, wherein said placing for cooling tower is associated to water spraying means from said cooling water drawing and recirculation circuit of the operating machine for its simultaneous cooling by evaporation.

4. The cooling equipment according to any one of the previous claims, wherein said placing for cooling tower is open/openable at the top in order to allow the extraction of the respective cooling panel for intervention or replacement but also for functioning in the cooling also without it.

5. The cooling equipment according to any one of the previous claims, wherein beneath said placing for cooling tower and condensers, a water collection tank is installed.

6. The cooling equipment according to the previous claim, wherein said water cooled in said tank is conveyed to the heat exchange with said evaporator.

7. The cooling equipment according to claim 6, wherein said evaporator is immersed for the heat exchange in said tank.

8. The cooling equipment according to any one of the previous claims, wherein it is provided that:

- upon the hot water entry of the operating circuit to be cooled, said cooling equipment comprises water temperature sensing means and controlled valve means for discharging the hot water on entry in determinate conditions;

- between said hot water entry of the operating circuit to be cooled, and the cooled water exit, said cooling equipment comprises means for letting in cold water from the supplying system;

- upon the cooled water exit, said cooling equipment comprises cooled water temperature sensing means;

- said cooling equipment comprises means for comparing one and/or the other temperature and at least the exit one for operating said hot water discharge valve means and cold water inlet on entry.

9. The cooling equipment according to the previous claim, wherein the positioning of said cold water inlet means is carried out after said temperature sensing means on entry and before said temperature sensing means on exit.

10. The cooling equipment according to any one of the previous claims, wherein the cold water inlet from the system for the re-integration is positioned between the cooling tower and the frigorific circuit evaporator.

11. The cooling equipment according to any one of the previous claims wherein said valve means are electro-valve means.

12. The cooling equipment according to any one of the previous claims wherein said cooling equipment comprises some air ventilation means able to invert the air flow.

13. The cooling equipment, which may be connected to the water discharge from a water cooled working or operating machine and makes it recirculate once cooled, according to any one of the previous claims, wherein said cooling equipment has a parallelepiped-like shaped box with the control panel at the top and with an air flow first heat exchange compartment for inserting both panels for cooling tower and heat exchange panels for frigorific circuit, and both, water delivery means being placed at the top and a collection tank of the same water being placed at the bottom for its recirculation in a cooling operating cycle of an operating or working machine.

14. Cooling equipment, which may be connected to the water discharge from a working or operating machine with water cooling circuit and makes it recirculate once cooled, said cooling equipment being substantially as herein described with reference to Figs. 1-4 and 6 or Fig. 5 or to Figs. 1-4 and 6 as modified by Fig. 7 or Fig. 8 of the drawings.

15. A method of cooling fluid regeneration in heat exchange circuits as claimed in any one of claims 1-14.

16. A method of cooling fluid regeneration in heat exchange circuits, said method being substantially as herein described with reference to Figs. 1-4 and Figs 6-8 of the drawings.

Dated this 26th day of September 2001

ENRICO MEDESSI and MAURO DE GIUSTI

By

HODGKINSON OLD McINNES

Patent Attorneys for the Applicant

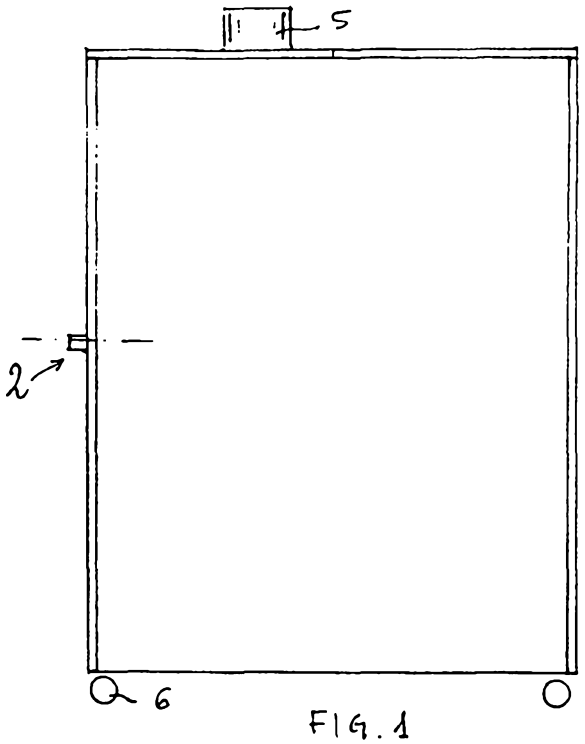


FIG. 1

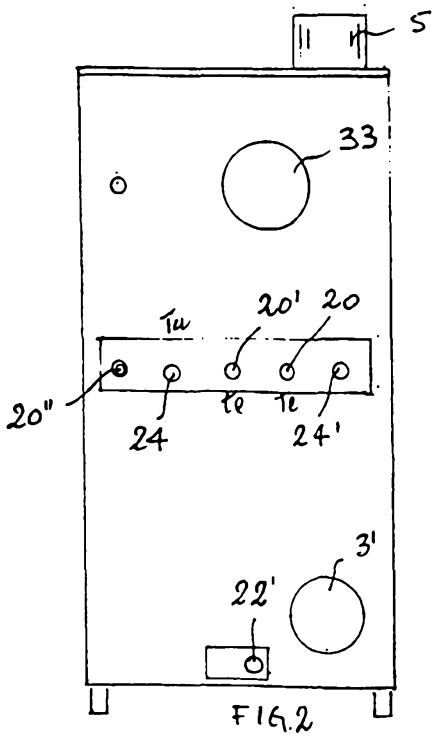


FIG.2

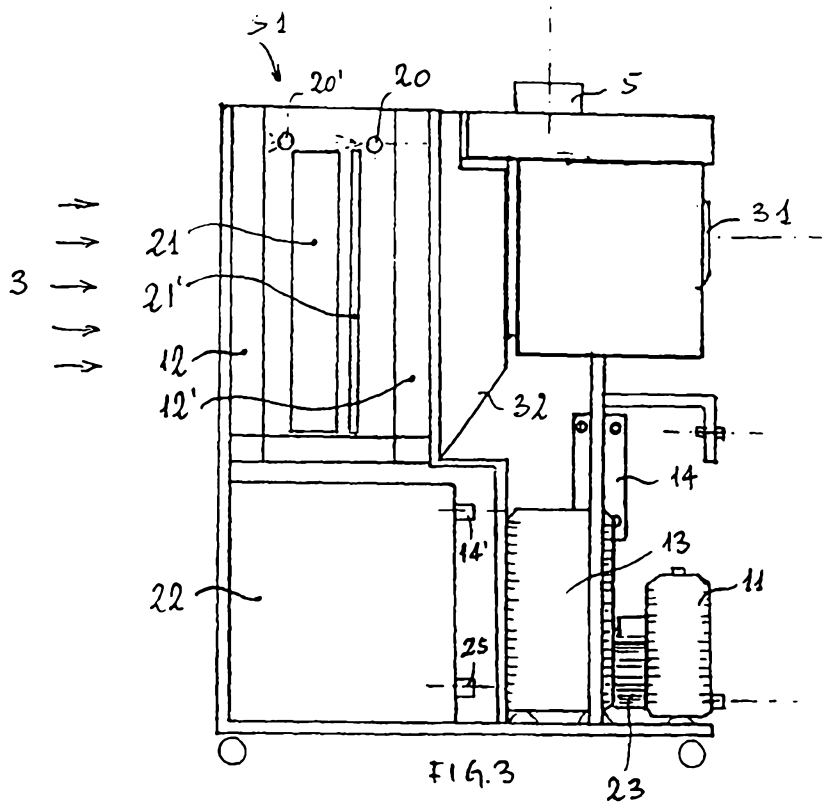


FIG.3

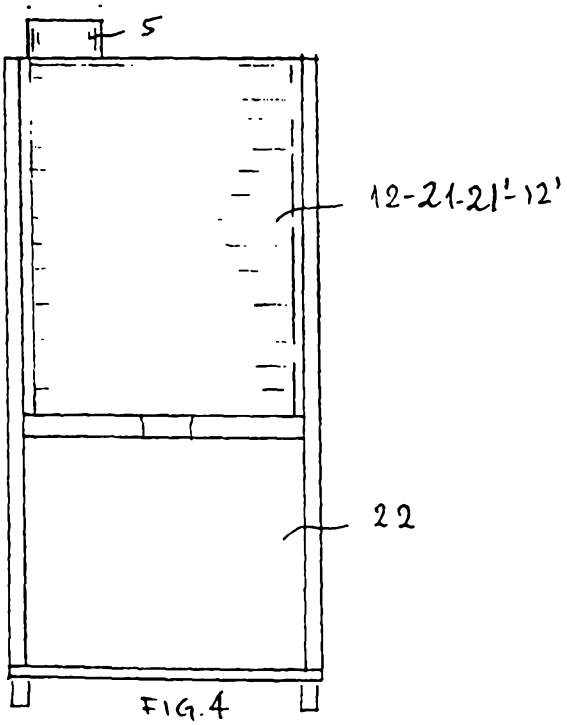


FIG.4

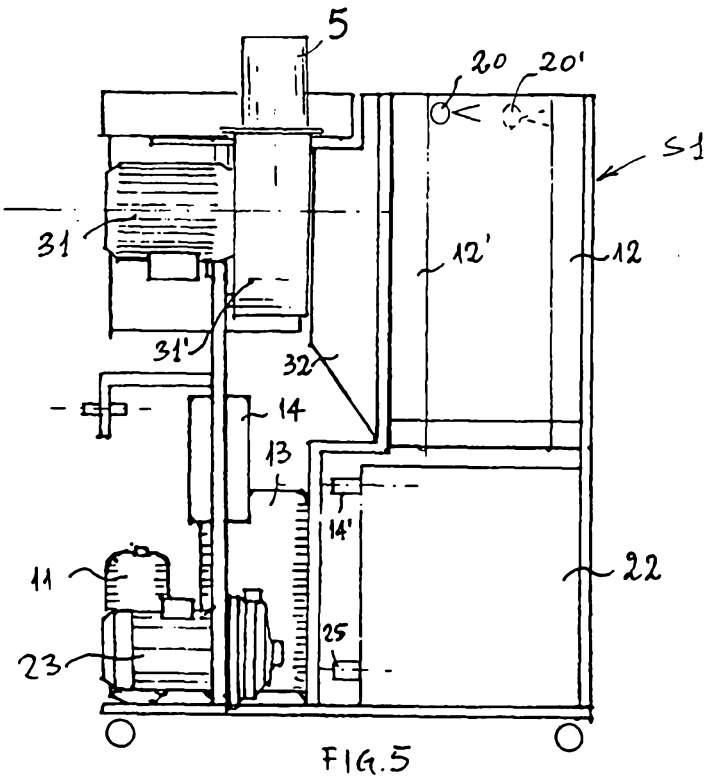

5
20
20'
S1
31
12'
12
31'
32
14
13
14'
11
22
23
25

FIG.5

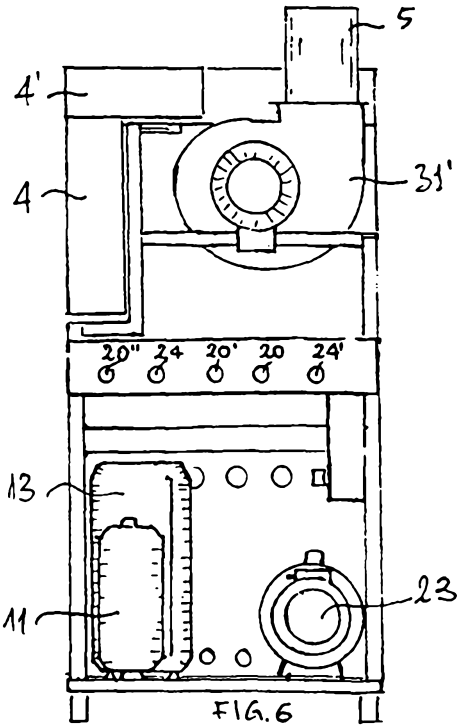

5
4'
4
31'
20"
24
20'
20
24'
13
11
23

FIG.6

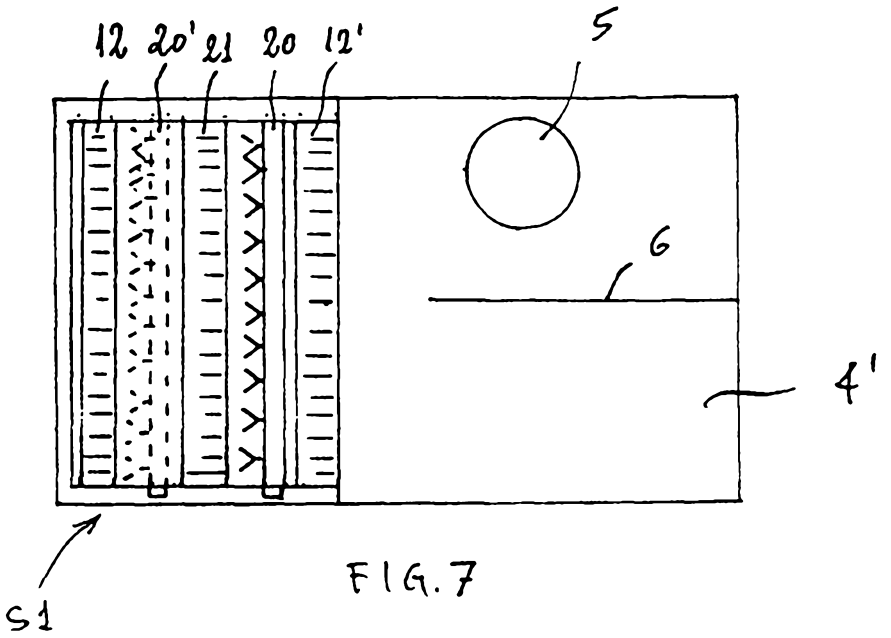


FIG. 7

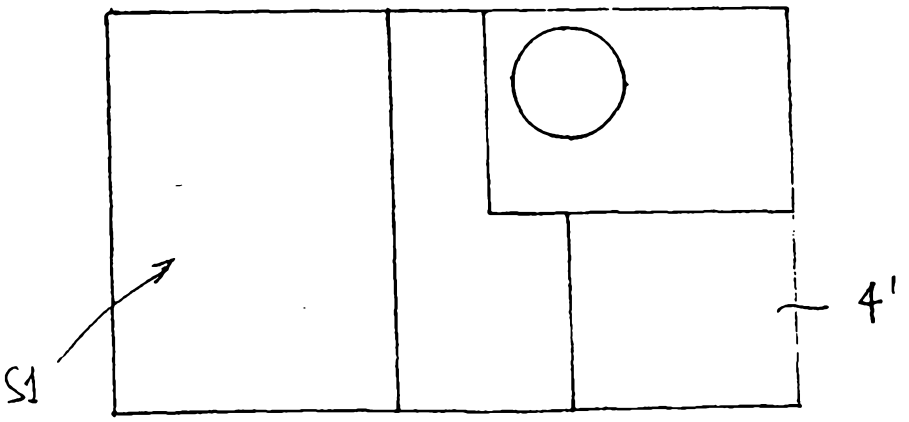


FIG. 8