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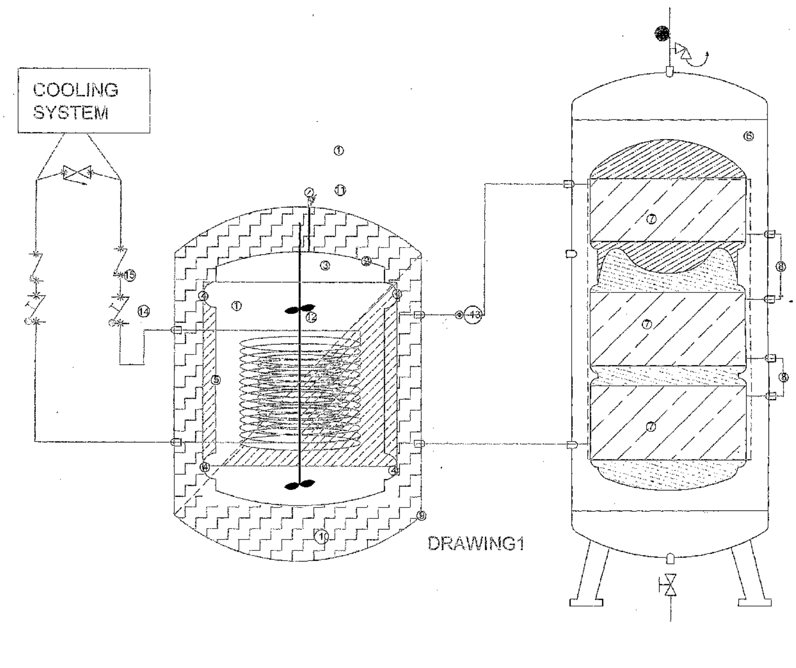
(54) Title: WATER HEATING PROCESS AND METHOD USING THERMAL ENERGY PRODUCED BY COOLING SYSTEMS.



(57) Abstract: A method and a plant employed for the utilization of heat energy produced by cooling systems in water heating applications, thus achieving energy savings. The present invention is aiming at utilizing this energy quantity, providing facilities and consumers with hot domestic water; meanwhile it shall develop suitable conditions to allow cooling of ducts and refrigerant without excessive costs of energy, thus realizing energy savings and optimal performance of cooling systems. Refrigerant mechanical condensation and compression in the cooling plants will serve to develop temperature that will be released to the environment through the surface of the pipes that belong to the refrigerant network transmission pipes. This temperature is captured by a heat storage tank (2) containing a liquid (3) possibly oil of any make-up or substance, synthetic or non-synthetic, water, de-ionised water or any other liquid presenting suitable heat conductivity coefficient, the heat storage tank (2) is enclosed within an outer jacket (5), containing a liquid of similar make-up. The heat developed in the refrigerant pipework is transmitted to the heat storage tank (2) and then - by way of induction - to the outer jacket (5) where it can be used for domestic water heating and cooling. The deployment of the plant described in this invention, will serve to entrap heat which is then used for hot water generation; no other energy source is required. Meanwhile, it serves to cool off the refrigerant pipework to achieve improved performance of the cooling plant, as the refrigerant returns to the cooling cycle at lower temperature; it also reduces electric power consumption as the stand-by apparatus will operate less, also emitting less noise to the environment, as motor operating time will be reduced.

Water heating process and method using thermal energy produced by cooling systems.

The present invention refers to a method and suitable process to generate and store domestic and commercial hot water, utilizing the heat energy released to the environment by cooling systems.

The above mentioned cooling systems are widely used in residential or industrial applications, for food preservation and cooling as well as for room or area air - conditioning. The most common cooling process is based on the principle of mechanical compression. This operation is carried out using mechanical energy which in turn is converted to heat to drive the compressor. Cooling systems utilizing the mechanical compression principle subscribe to the general rule that refrigerant liquids evaporate at varying temperatures and pressures whereas high pressure values also refer to high evaporation temperatures; when evaporating, these absorb heat from their environment. In the reverse process, when steam is converted to fluid (condensation) heat release to the environment occurs. If evaporation can take place at a specific pressure and condensation at other pressure value, then heat can be transferred to a different level. Cooling takes place when heat must be carried from a low - temperature (cold) environment to a warmer environment. The steam produced by the liquid boiling at low pressure, must be then compressed at higher pressure; thus, it can be condensed at a higher temperature. This steam compression consumes mechanical energy; the higher the difference between liquefaction and evaporation temperatures, the higher the power that must be used by the compressor for equal cooling amount.

Energy is absorbed by the refrigerant inside the heat exchanger, a device known as the evaporator. This energy is extracted from the material to be cooled, be it water, air, brine or other medium. The compressor - commonly driven by an electric motor - induces an increase in refrigerant pressure and - consequently - temperature. Then, compressed steam is cooled and liquefied inside the heat exchanger - also called the condenser - and there it releases latent heat, commonly to the atmosphere or in the water.

The cooling cycle is expressed through the Mollier pressure - enthalpy graph of the refrigerant in question.

Inside the compressor, the refrigerant gas increases both temperature and pressure. For a specific compression rate, a less efficient compressor will consume fore power and will supply hotter gas.

The gas contained in the compressor will be delivered to the condenser. First the gas will cool from the compressor discharge temperature to the condensation saturation temperature, thus releasing sensible heat.

The main portion of heat delivered to the condenser (latent heat) is manifested upon the conversion of the refrigerant from gaseous to liquid state.

The present invention refers to making use of the heat developed in the pipework of cooling plant, through the processes conducted by condensers and compressors; such heat is wasted to the environment.

Condensers belong to three categories: water cooled, air cooled and evaporative type. The heat developed on the surface of the pipework of refrigerant transfer grid may rise up to 95°C - depending on installation and season - and therefore such grids are fitted with auxiliary cooling apparatus. The heat described above is released to the environment, while keeping systems in service at low temperature constitutes a costly an energy - intensive procedure to ensure satisfactory system performance.

The present invention is aiming at utilizing this energy quantity, providing facilities and consumers with hot domestic water; meanwhile it shall develop suitable conditions to allow cooling of ducts and refrigerant without excessive costs of energy, thus realizing energy savings and optimal performance of cooling systems.

According to the invention, as shown in figure 1 illustrating the method, the pipework of the cooling plant is designed in scroll form (1). It is located in a tank designated as the heat tank (2). The latter contains a liquid (3) which can be cooling oil of any substance or make-up; synthetic or non-synthetic; water; de-ionised water; or other liquid presenting satisfactory heat conductivity coefficient. The lowest pipe of the grid constitutes the inlet of the hottest part of the pipework; this will induce heat to the liquid contained in the tank, to thermostat - controlled temperatures.

The tank shall be suitably shaped, fitted with perimeter concave sections (4). They will serve to receive the attachment of a sealed jacket surrounding the tank (5). This jacket will contain fluid of similar make-up as the content of the tank. The heat developed inside the tank (2) shall be transferred by induction to the outer jacket (5) thus creating a heat bridge.

Thereafter, the hot water contained in the outer jacket shall be delivered to a suitable hot water storage tank (6) constructed in a similar shape as the heat storage tank (2) to receive similar outer jackets (7). The hot water storage tank may be outfitted either with an integral outer jacket; or multiple jackets located on the perimeter, depending on application; these multiple jackets will allow exterior bridging between them (8). The heat developed in the water circulating in the outer jackets shall be employed to heat the liquid contained in the hot water storage tank. It should be noted that to ensure proper functioning, the tank shall be fitted with all required shelf devices e.g. fill valves and the like; it is also envisaged to install a stand-by heating resistor for water heating purposes.

The storage tank (2) and the outer jacket (5) shall be installed in a housing (9) complete with heat insulation (10) fitted with level sight glass and pressure gauge (11).

The refrigerant liquid shall be delivered to the tank with the hotter part to the underside; the conveyed amount of heat shall be consumed inside the heat tank (2). To ensure uniform heat distribution, it is envisaged to agitate the water inside the heat tank (2) by way of agitator (12) operating at low rpm.

The pipework will lead out of the tank after having cooled; this has the additional benefit of improved energy distribution and cooling plant efficiency; also lower energy consumption from the cooling system's auxiliary apparatus.

To ensure regular operation of the entire process plant, it is necessary to provide an oil circulation pump (13) on the network delivering liquid from the outer jacket (5) to the jacket of the hot water storage tank (7).

Another requirement is to use suitable slide valves (14) on the cooling liquid transfer network to isolate the entire plant from the cooling plant; also reverse operation valves (15) in the refrigerant liquid and transfer valves (16) to isolate the heating apparatus from the cooling plant, when temperature balance is effected on the system.

The whole plant shall be constructed from materials proof against electrolysis, when coming in contact with the closed liquid circuits operated by the plant.

The present invention presents considerable advantages, mainly in connection with the alternative generation of hot water and with saving energy required for cooling and air - conditioning.

The energy generated by condensation and compression of the refrigerant is converted into heat. Such heat quantity causes overworking of cooling and air - conditioning apparatus, thus it is forcibly released, commonly using electric blowers, to ensure cooling of refrigeration equipment and their optimal performance.

The deployment of the plant described in this invention, will serve to entrap heat which is then used for hot water generation; no other energy source is required. Meanwhile, it serves to cool off the refrigerant pipework to achieve improved performance of the cooling plant, as the refrigerant returns to the cooling cycle at lower temperature; it also reduces electric power consumption as the stand-by apparatus will operate less, also emitting less noise.

The following describe two invention implementation cases, with reference to the respective drawings.

Drawing 2 presents three separate cooling plants, a cooling vessel (16), a commercial refrigerator (17) and an air - conditioner (18). All these plants include one heat storage tank each, and all of them are series connected. The liquid contained in the tanks' outer jacket, is delivered to the hot water tank, which is fitted with three outer jackets bridges by respective interconnections. The heat generated by the cooling plants is delivered to the heat storage tank and thereafter to the outer jacket, where the water contained is circulating through the wall of the hot water storage tank.

Figure 3 illustrates a considerably larger application to demonstrate the plant's capability to link to other forms of energy, for hot water generation purposes, where necessary.

The refrigerant transmission networks are routed to the storage tank (19) by way of two cooling plants; also, the respective heat transmission networks led from two solar panels (20) and from the water heater (boiler) (21). The heat developed inside the tank is transmitted to the outer jacket (22) and then to the hot water tank outer jacket (23), by way of a network fitted with suitable valves; the latter will be specified depending on each application. As an alternative, subject to the application and rating of cooling plants, the boiler (21) and the solar panels (20) can be connected to the hot water tank through a conventional method, where the water shall be heated depending on the desired purpose, thus effecting a significant improvement of the energy performance of the plant.

CLAIMS

The invention sets out two primary claims, one regarding the method and another regarding the process plant.

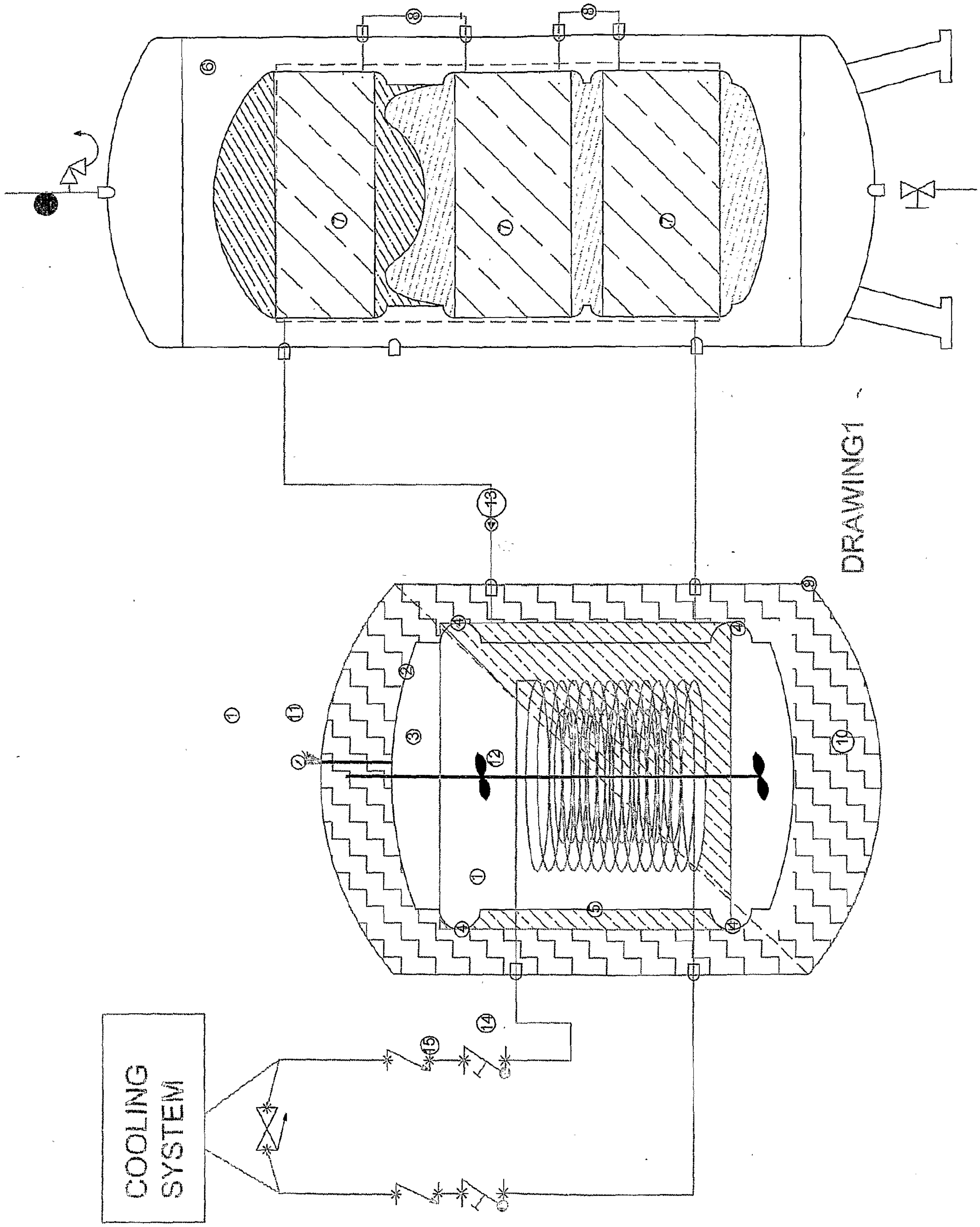
1. Refrigerant mechanical condensation and compression in the cooling plants will serve to develop temperature that will be released to the environment through the surface of the pipes that belong to the refrigerant network transmission pipes. This temperature is captured by a heat storage tank (2) containing a liquid (3) possibly oil of any make-up or substance, synthetic or non-synthetic, water, de-ionised water or any other liquid presenting suitable heat conductivity coefficient, the heat storage tank (2) is enclosed within an outer jacket (5), containing a liquid of similar make-up. The heat developed in the refrigerant pipework is transmitted to the heat storage tank (2) and then - by way of induction - to the outer jacket (5) where it can be used for domestic water heating and cooling.

2. The pipework of the cooling plant is designed in scroll form (1). It is located in a tank designated as the heat tank (2). The latter contains a liquid (3) which can be cooling oil of any substance or make-up; synthetic or non-synthetic; water; de-ionised water; or other liquid presenting satisfactory heat conductivity coefficient. The lowest pipe of the grid constitutes the inlet of the hottest part of the pipework; this will induce heat to the liquid contained in the tank, to thermostat - controlled temperatures. The tank shall be suitably shaped, fitted with perimeter concave sections (4). They will serve to receive the attachment of a sealed jacket (5). This jacket will contain fluid of similar make-up as the content of the tank. Then, the hot water contained in the outer jacket shall be delivered to a suitable hot water storage tank (6), fitted with respective outer jackets (7). The heat storage tank (2) and the outer jacket (5) shall be installed in a housing (9) complete with heat insulation (10) fitted with level sight glass and pressure gauge (11).

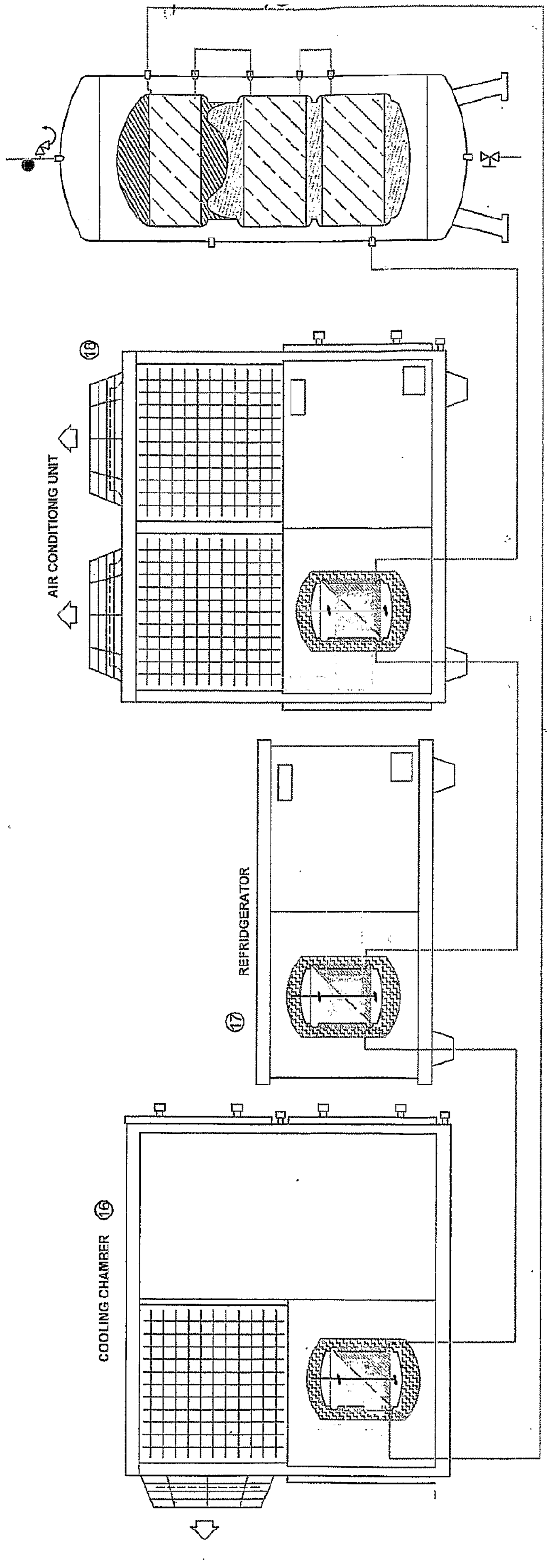
3. Pursuant to claim 2 mentioned above, the hot water storage tank may be outfitted either with an integral outer jacket; or multiple jackets located on the perimeter, depending on application; these multiple jackets will allow exterior bridging between them (8).

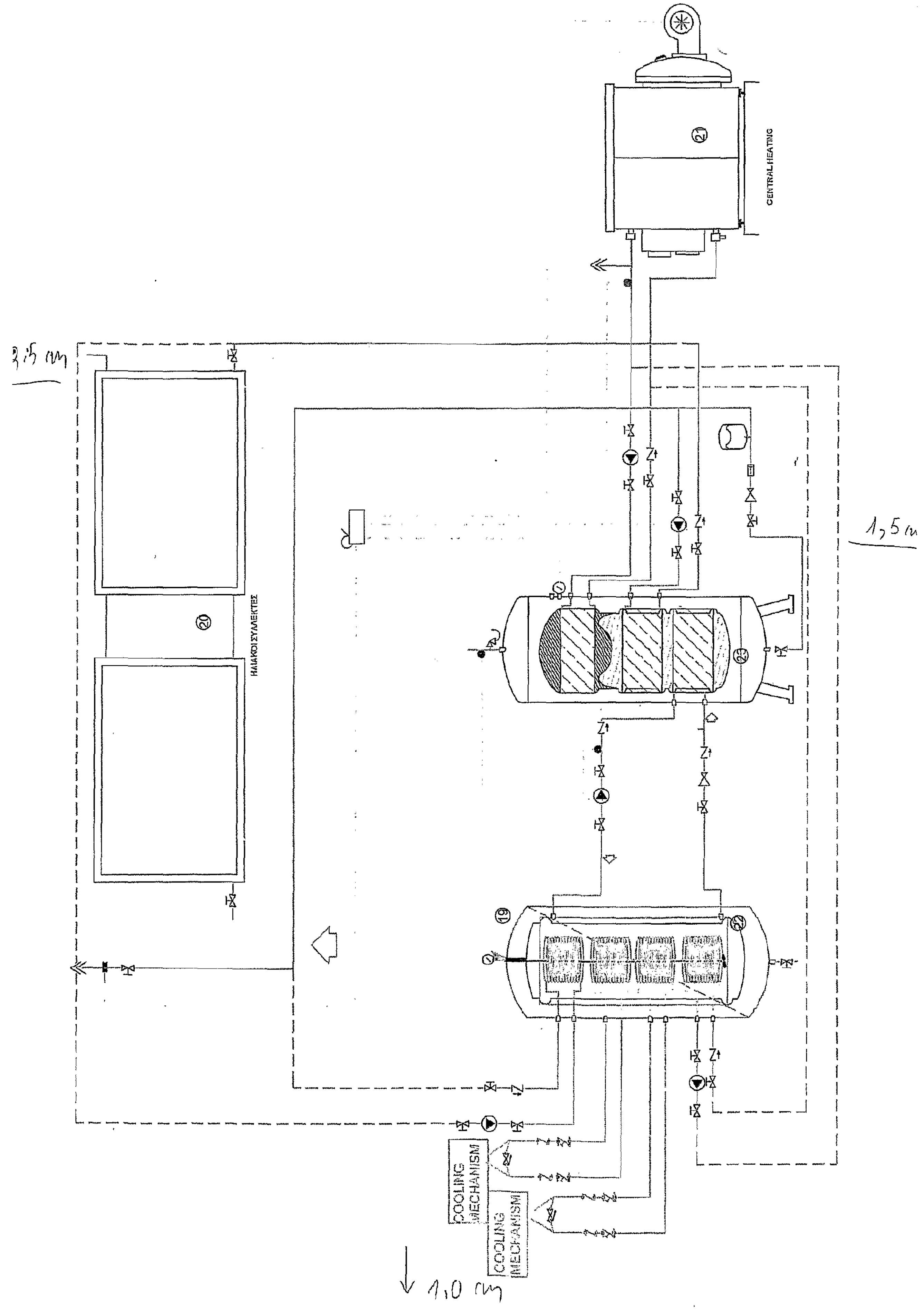
4. Pursuant to claim 2, the heat storage tank (2) may receive multiple refrigerant transmission pipeworks.

5. Lastly, pursuant to 1 and 2 above, the process plant may be integrated with, or operate alongside conventional water heating methods, e.g. solar panels and central heating boilers.



DRAWING1


AIR CONDITIONIG UNIT
18
REFRIDGERATOR
17
COOLING CHAMBER
16


CENTRAL HEATING
ΗΛΙΑΚΟΙ ΣΥΛΛΕΚΤΕΣ
COOLING MECHANISM
COOLING MECHANISM
1,5 m
1,0 m