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(54) **COMBINED CHILLER AND BOILER HVAC SYSTEM IN A SINGLE OUTDOOR OPERATING UNIT**

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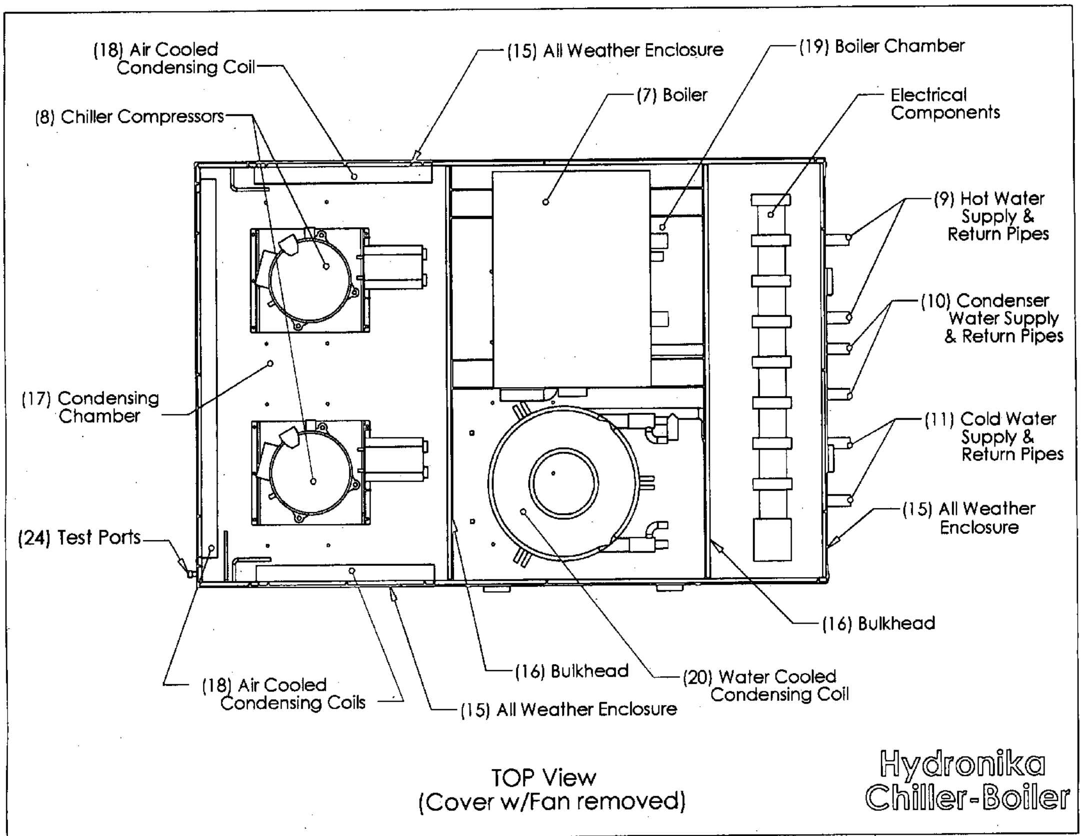
(57) **ABSTRACT**

A combined chiller-boiler HVAC system which integrates all operating components including the boiler, chiller, distribution pumps, condenser coils, condenser fans and controls onto one single enclosed platform built for installation exterior to the structure being served and designed to produce heated or cooling fluid sequentially or simultaneously in differing areas of a building on demand. This system utilizes both air and water cooling whereby waste heat absorbed during a water cooling cycle, can be captured and re-directed for other uses.



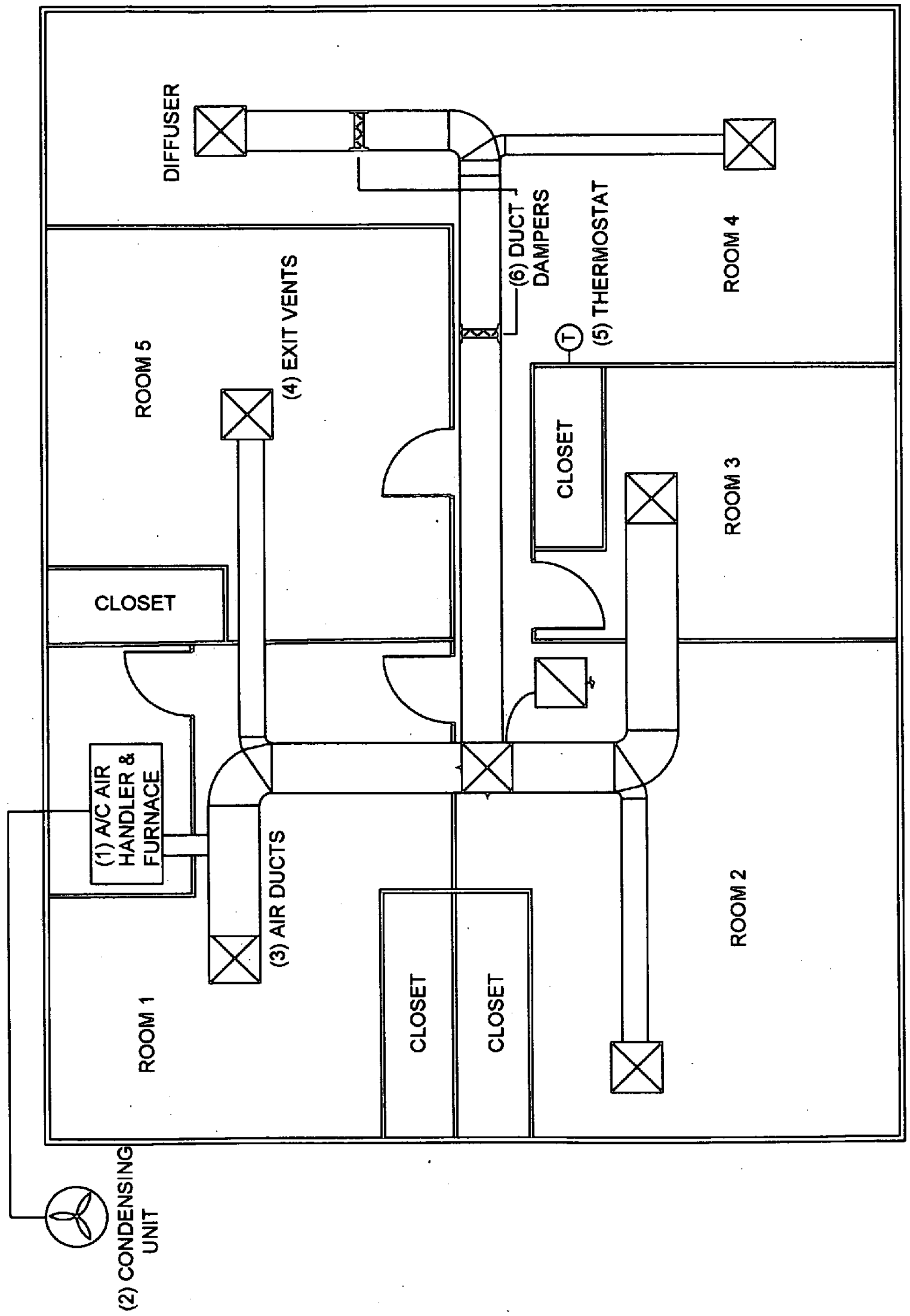


FIG. 1 FORCED AIR SYSTEM

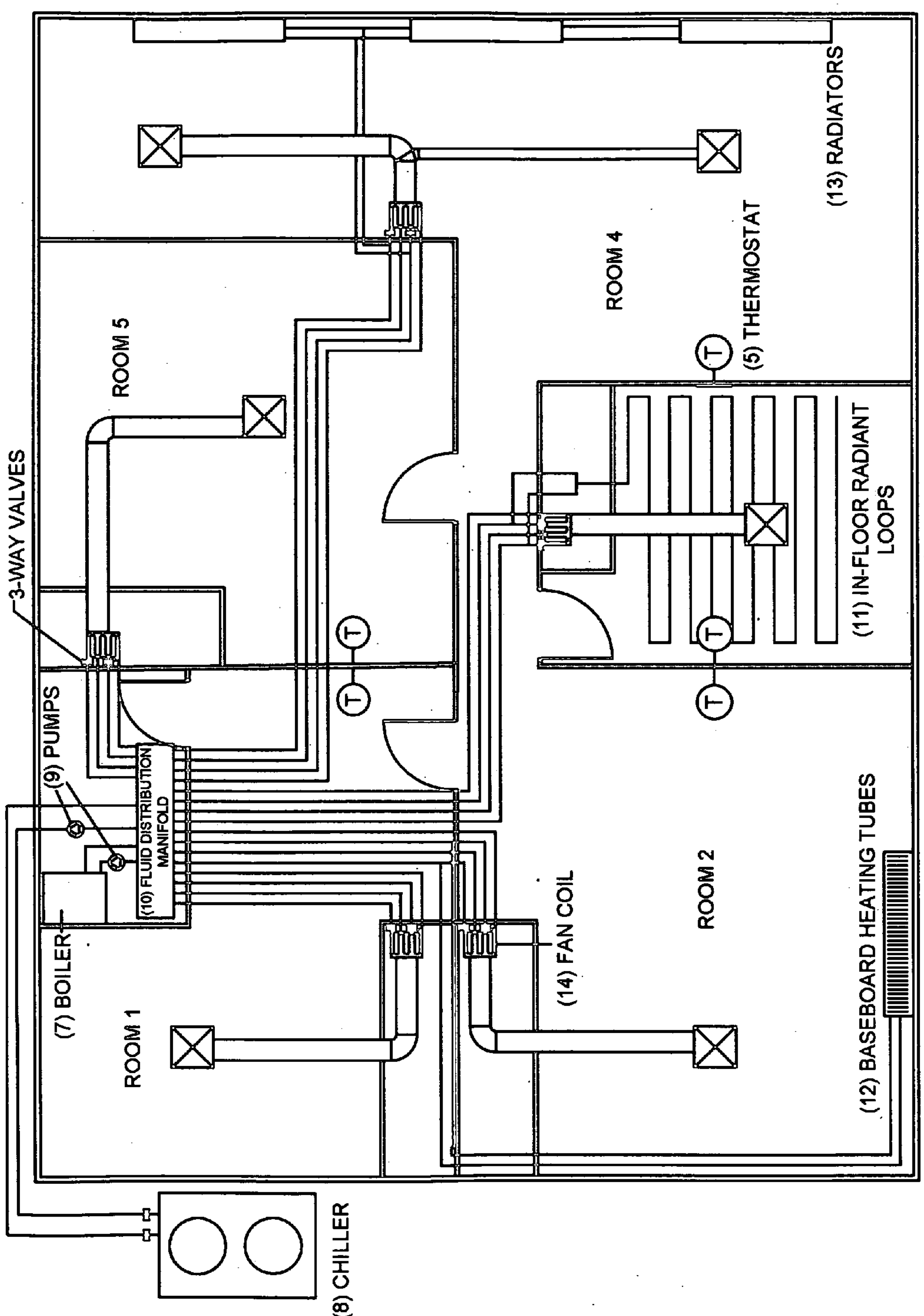


FIG. 2 HYDRONIC 4-PIPE SYSTEM

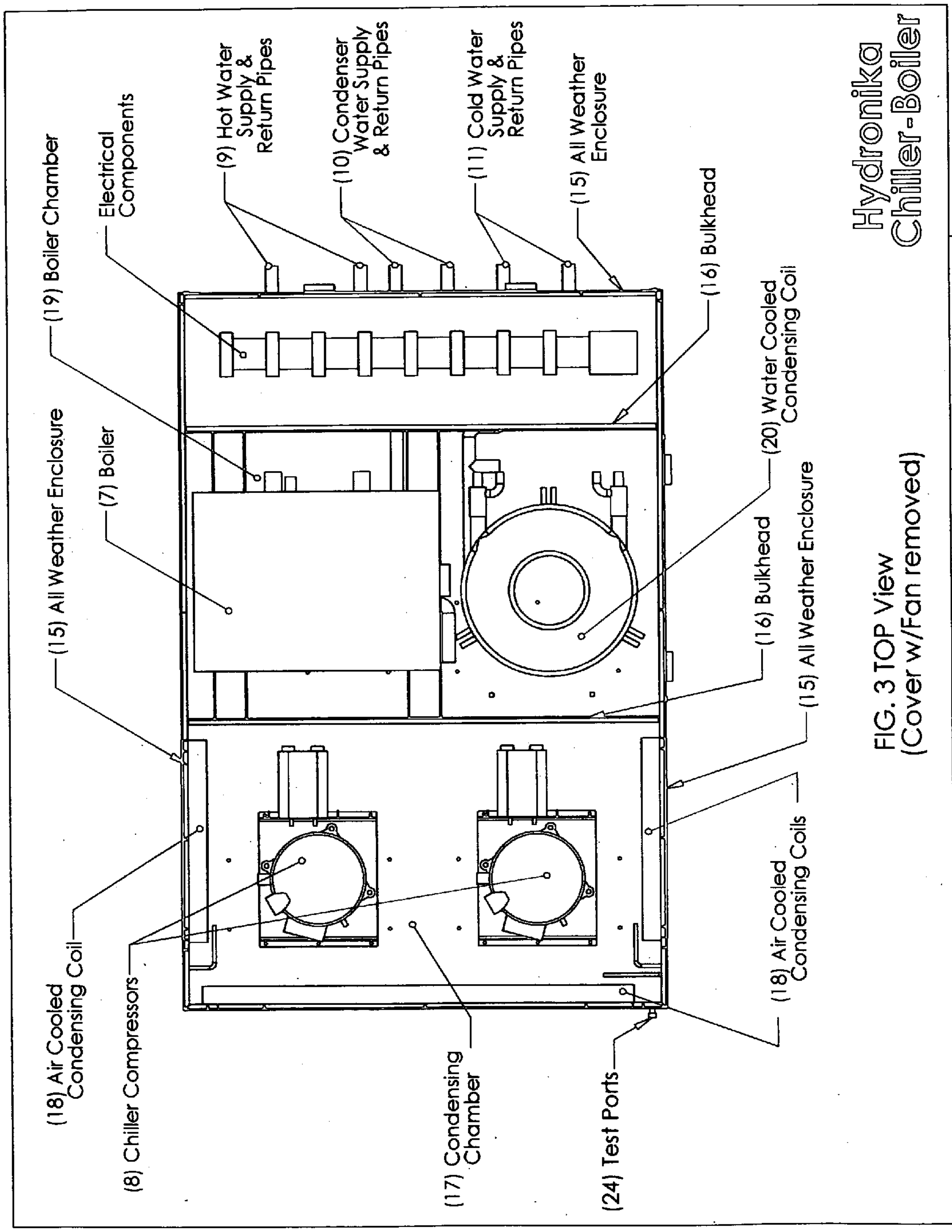


FIG. 3 TOP View
(Cover w/Fan removed)

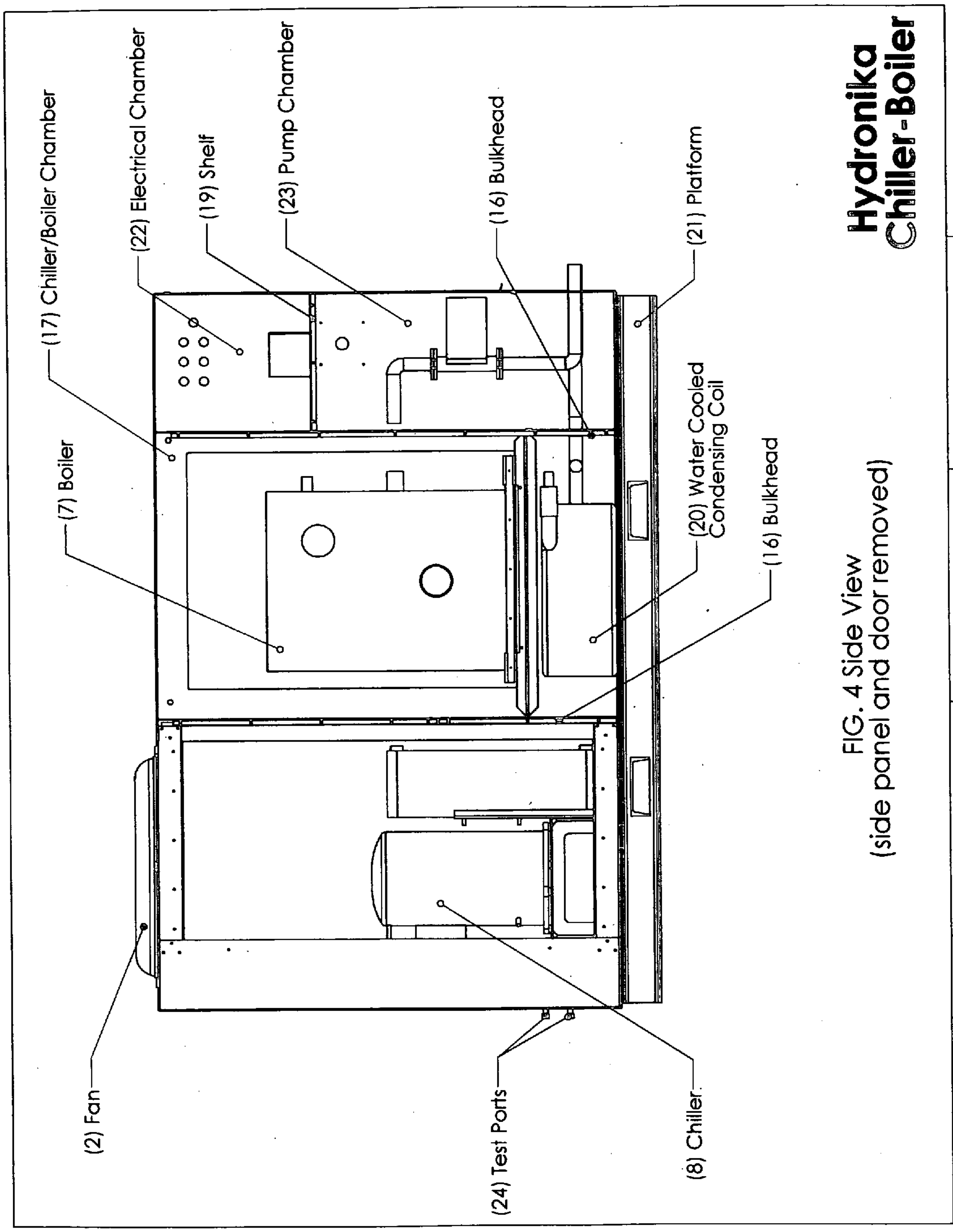


FIG. 4 Side View
(side panel and door removed)

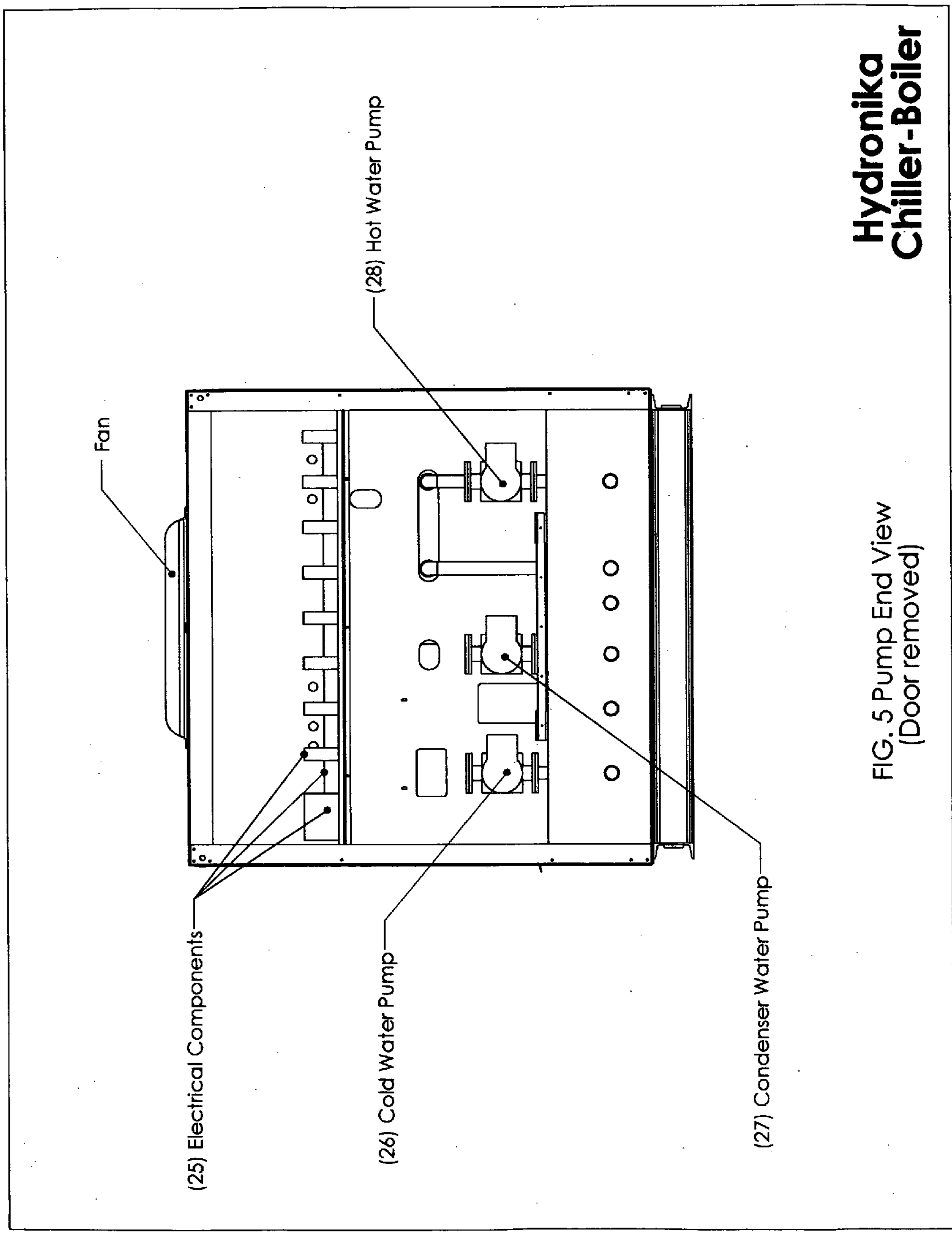


FIG. 5 Pump End View
(Door removed)

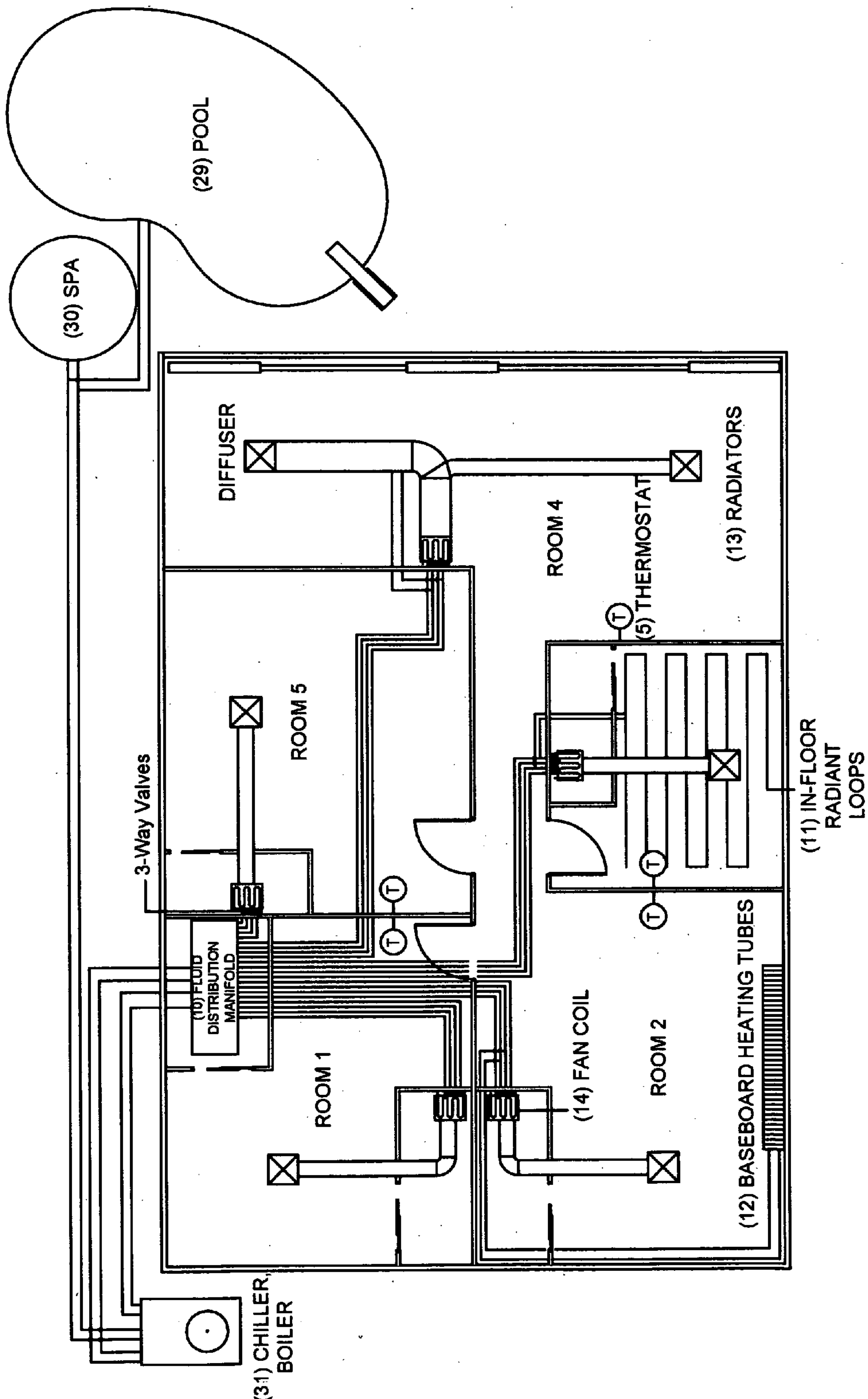


FIG. 6 CHILLER BOILER COMBINATION 6-PIPE SYSTEM

COMBINED CHILLER AND BOILER HVAC SYSTEM IN A SINGLE OUTDOOR OPERATING UNIT

[0001] No federally sponsored research and development association exists with this invention. As such, there are no rights associated therewith.

BACKGROUND OF THE INVENTION

[0002] This invention is related to the methods used to supply heating and cooling to residential and commercial buildings which ordinarily require two separate systems, one for heating and another for cooling.

[0003] Typical applications of heat and/or cooling within commercial and/or residential building provide either heating or cooling. There are numerous building configurations or "use" applications where it is desired or required to supply heat in one area and cooling in another. Medical-professional buildings, hospitals, computer rooms and large or multi storied residential housing frequently need selective heating and cooling, Current equipment utilizes a separate heat source and a separate cooling source. The heat source is placed inside the building and the cooling source is placed outside the building. Heating and cooling systems have traditionally been divided between forced air systems and fluid based systems.

[0004] Typical forced air systems use furnaces to generate heat and direct expansion type air conditioners to generate cooling. The output of the two systems is normally carried through common duct work. The typical forced air system will only permit a choice of either heating or cooling. Usually there is a single thermostat controlling the entire system. Air flow to individual spaces is controlled manually through air duct registers or using electrically activated dampers receiving their operating signals from additional thermostats. Current forced air equipment cannot deliver simultaneous heating or cooling to selected areas where they serve the same structure. Furthermore, once a forced air system shuts off after satisfying the demand, all warm or cold air in the ducts dissipates with no thermal retention and thus, the energy required to create warm or cold air is completely lost. Forced air systems are noisy and by the nature of their operation, spread dust, mold and germs throughout a building.

[0005] Water based systems, referred to as hydronics, utilize Boilers and Chillers to generate hot and cold fluids. Modern boilers, as defined by ASME, are pressurized vessels and distinguish themselves from earlier atmospheric boiler technology by achieving higher efficiencies using less fuel. All boilers present a certain risk of explosion when improperly installed or poorly maintained. Boilers require exhaust stacks when installed indoors.

[0006] In a hydronic heating system a fluid media conveys heat throughout the structure with a piping array permitting radiant heat through in-floor tubing loops, baseboard mounted heating tubes, fan coils or radiators Cooling fluids are routed to fan coil units or in-ceiling radiant cooling systems to provide cooling and dehumidification to selected spaces. In hydronic systems pumps distribute the hot and cold fluids and are usually installed indoors usually in a mechanical room designated for this use, however Boilers are still installed indoors and Chillers outdoors Chillers are commonly comprised of a compressor, an evaporator, condenser coils and one or more fans to draw air across condenser coils used to cool refrigerant gases discharged from the compressor. Only very large commercial chillers (30 ton rating and larger) utilize water as coolant for the condenser coils. There are no small chillers that combine water and air cooling methods. Using a combination of water cooled and air cooled condenser because:

[0007] a) Cooling water temperatures tend to be cooler than ambient air;

[0008] b) Fan motors run less if water is designed into a Chiller circuitry as the first priority for condenser coil cooling.

[0009] In current systems controls for both the boilers and chillers are installed indoors. Typically each component is assembled and installed individually at the job site by skilled technicians and these systems must be proven and tested on the job site. This is a costly and time consuming process.

[0010] There are a number of objectives to the Hydronika chiller-boiler.

[0011] An object of the invention is to provide a single outdoor unit that combines heating and cooling functions into a single energy efficient package utilizing fluids as a heat transfer medium instead of air.

[0012] Another object of the invention is to save energy by prioritizing condenser cooling using water first and air second.

[0013] Another object of the invention is to use warmed, rejected condenser cooling water for another heating use such as a pool or spa.

[0014] Another object of the invention is to provide a factory pre-tested unit to the job site.

[0015] Another object of the invention is to support the application flexibility of heating and cooling with or without out ductwork.

[0016] Another object of the invention is to save space and create flexibility in building design by eliminating soffits and ductwork associated with forced air distribution systems.

[0017] Another object of the invention is the ability to control temperature in individual rooms and environments as well as provide dissimilar temperatures simultaneously with a single device.

[0018] Another object of the invention is to minimize the distribution of mold, dry rot and similar airborne health hazards created by forced air ducted systems.

[0019] Another object of the invention is to remove a fire hazard and a potential source of carbon monoxide by relocating the boiler to the outside of a building without compromising heating and cooling performance.

[0020] Another object of the invention is to eliminate the need for exhaust stacks used by boilers installed inside a building, by relocating the boiler to the outside of the building.

[0021] Another object of the invention is to reduce space requirements in a building using hydronics by relocating the pumps and controls to the outside of the building.

SUMMARY OF THE INVENTION

[0022] The preferred embodiment of the invention is a single unit which combines the heating and cooling systems into in one packaged unit deliberately arranged in a novel way to ensure specified performance unlike any other HVAC device.

[0023] The invention is an outdoor installed, completely integrated heating ventilating and air conditioning (HVAC) system complete with pumping and control units arranged in a novel way.

[0024] The invention creates hot (using a boiler) and cold fluids (using a chiller) for distribution employing a variety of HVAC fluid technologies such as: in-floor radiant heating systems, on-wall radiant systems, heating and cooling fan coils, in ceiling radiant cooling panels, and ducted or ductless air handlers. The unit can also produce heated fluid for indirect fired hot water tanks, driveway/sidewalk de icing systems and swimming pools.

[0025] The invention can produce hot and cold fluids sequentially or simultaneously depending on the call signal from one or more thermostats. This is necessary in a number of circumstances such as in a medical office or in a structure housing art, computer storage and medical storage. In residential structures of varying configurations room control of temperature is essential to comfort and energy efficiency.

[0026] The invention is able to cool condenser heat produced by the chiller utilizing air, water, or both as required by the operating conditions. When the chiller is operating, and is being cooled using water, thermal transfer occurs and warms the cooling water. The warmed water can be redirected to an appropriate storage tank for use in heating the building or be diverted to a spa or swimming pool as well as an indirect fired hot water tank for potable use.

[0027] The invention is factory assembled and 100% tested prior to shipment offering singular reliability, installation, and maintenance advantages.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] FIG. **1** illustrates a typical forced air system.

[0029] FIG. **2** illustrates a typical hydronic **4** pipe fluid system.

[0030] FIG. **3** illustrates a top view of the invention showing the locations of the components in the condensing chamber and boiler chamber as well as a top view of the electrical components and the supply/return pipes. It also shows the all weather enclosure of the invention.

[0031] FIG. **4** illustrates a side view showing the position of the chiller and boiler as well as the electrical chamber and pump chamber.

[0032] FIG. **5** illustrates an end view of the invention showing the position of the pumps and the electrical components.

[0033] FIG. **6** illustrates a plan view of the invention as a six pipe system connected to a hydronic heating and cooling system for the building and including pool and spa heating using waste heat from the condenser cooling cycle.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0034] FIG. **1** shows a typical forced air system employing a heating unit furnace (**1**) installed in the building and the air conditioning condenser (**2**) portion of the air conditioning system installed a the exterior of the building. Either heated or cooled air can be selected to be delivered throughout the building via a series of ducts (**3**) to adjustable exit vents (**4**) located in the individual rooms in the building. FIG. **1** illustration is a small version of a forced air system however anyone knowledgeable in the state of the art knows that in larger structures there is simply more extensive duct work and larger capacity units. Typically, one thermostat (**5**) controls the entire system.

[0035] In more complex forced air systems where greater control of temperature gradients is required, the ducting may be further divided into zones which can be manually or electronically adjusted, or programmed to operate automatically, utilizing duct dampers (**6**) driven by additional thermostats. It must be understood that in these systems there is only a choice between heating or cooling at any given time.

[0036] FIG. **2** shows a typical hydronic fluid system where the heating unit boiler (**7**) is installed in the building and the chiller (**8**) is installed outside of the building. In a hydronic system heated fluid from the boiler is delivered using pumps (**9**) throughout the structure utilizing a fluid distribution manifold (**10**) to a variety of heating end distribution technologies such as: in-floor radiant loops (**11**), baseboard mounted heating tubes (**12**), radiators (**13**). Cooled fluid from the chiller (**8**) is delivered using pumps (**9**) and a fluid distribution manifold (**10**) to fan coil units (**14**) in each space. A favored distribution technology in such systems is a four pipe fan coil unit (**14**) that can accept hot and cold fluids to heat or cool a space accordingly. Thermostats (**5**) control the individual distribution technologies creating separate temperature conditions (hot or cold) per space from the same hydronic loop.

[0037] FIG. **3** illustrates the all weather enclosure (**15**) with distinct bulkhead divisions (**16**) that create separate chambers (**17**) for air cooled condensers (**18**) and chillers (**8**) and a separate chamber (**19**) for boilers (**7**). The condensing chamber (**17**) operates in a negative-pressure environment when the fans are operating which allows air to be drawn through the condensing coils. The boiler is isolated from the negative pressure chamber by a bulkhead that allows the boiler to operate in the required positive pressure environment at the same time as the cooling chamber is in a negative pressure state.

[0038] FIG. **3** also illustrates the positioning of the water cooled condensing coil (**20**).

[0039] FIG. **4** illustrates the entire chiller and boiler system contained on one integrated platform (**21**). FIG. **4** further identifies separate chambers for electrical controls (**22**) and pumps (**23**). All components are interconnected yet separated by chambers to perform their intended functions with maximum efficiency.

[0040] FIG. **4** further identifies the external chiller test ports (**24**). This unique positioning allows for chiller service while the unit is running without the risk of false performance readings because the air flow across the condensers is not disturbed as there is no removal of any service panels during a running test.

[0041] FIG. **5** illustrates the separation of the electrical components (**25**) in the electrical chamber (**22**) from the pumps (**26**), (**27**), (**28**) in the pump chamber (**23**). This separation enhances serviceability and operating safety as "wet" components are separated from "dry" components.

[0042] FIG. **6** is a plan view of a fully employed residential combined hydronic fluid heating and air conditioning system (**31**) located at a convenient place near the residence. The system is commonly referred to as a six pipe design as it utilizes both fluid and air cooling methods.

[0043] The fluid cooling source in this illustration is the pool (**29**) and the spa (**30**). Such a system is designed to utilize fluid first as this prevents the condenser fan from running, thus saving energy. Warmed cooling fluid returns to the pool (**29**) and spa (**30**) but could be diverted to any other technology where this heat could serve a function such as an indirect fired potable hot water tank. If the fluid cooling is insufficient to draw down the temperature, the condenser fan starts next and draws air across the condenser coils to complete the cooling cycle.

[0044] FIG. **6** further illustrates the combination hydronic fluid heating and air conditioning system connected to the same heating and cooling technologies as outlined in FIG. **2**.

[0045] It can also be understood that there is a distinct advantage wherein the entire HVAC operational system is self contained and can be installed at the most convenient location where it is easily serviced while freeing interior structural space of that which is normally occupied by the boiler (**7**) and its operating components.

[0046] Therefore it can be readily seen that a chiller and boiler system that can be efficiently combined into one unit which provides numerous functional, structural, performance, health and safety advantages has numerous novel utility and design advantages.

What is claimed is:

1. A hydronic combined heating and cooling HVAC system mounted on a platform wherein all the principle operating components and controls are combined into one programmable pressurized efficient operational unit for installation exterior to the structure being served.

2. A hydronic combined heating and cooling HVAC system mounted on a platform wherein the principle operating components are compartmented into areas appropriate to their functional purposes of a negative pressure condenser cooling chamber, a positive pressure boiler chamber, an isolated electrical chamber, and a separate pump chamber. The integrity of air pressures in the chambers is preserved under maintenance conditions through the use of external test ports that eliminate the need to remove any enclosure panels.

3. A hydronic combined heating and cooling system mounted on a platform wherein each separate compartmented functional area is individually accessible for service without disturbing any other functional area including testing of the chiller operation

4. A hydronic combined heating and cooling system whose compartmenting arrangement is not necessarily restricted to the current juxtaposition of the principle operating components as long as the positioning of the components maintain their appropriate functions and maintain the serviceability.

5. A hydronic combined heating and cooling system that can be programmed to deliver heating or cooling sequentially or simultaneously to different areas or rooms in the same structure.

6. A hydronic combined heating and cooling system designed for all weather installation exterior to the structure it serves suitable for ground mounting, roof mounting and subgrade mounting provided the appropriate clearances around the unit are maintained.

7. A hydronic combined heating and cooling system that removes condenser heat by using water, air or both and when using water can recover waste heat and convert that heat to useful purposes such as heating a swimming pool, a spa or potable water.

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