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(54) **SAWYER-SINGLETON GEOTHERMAL ENERGY TANK**

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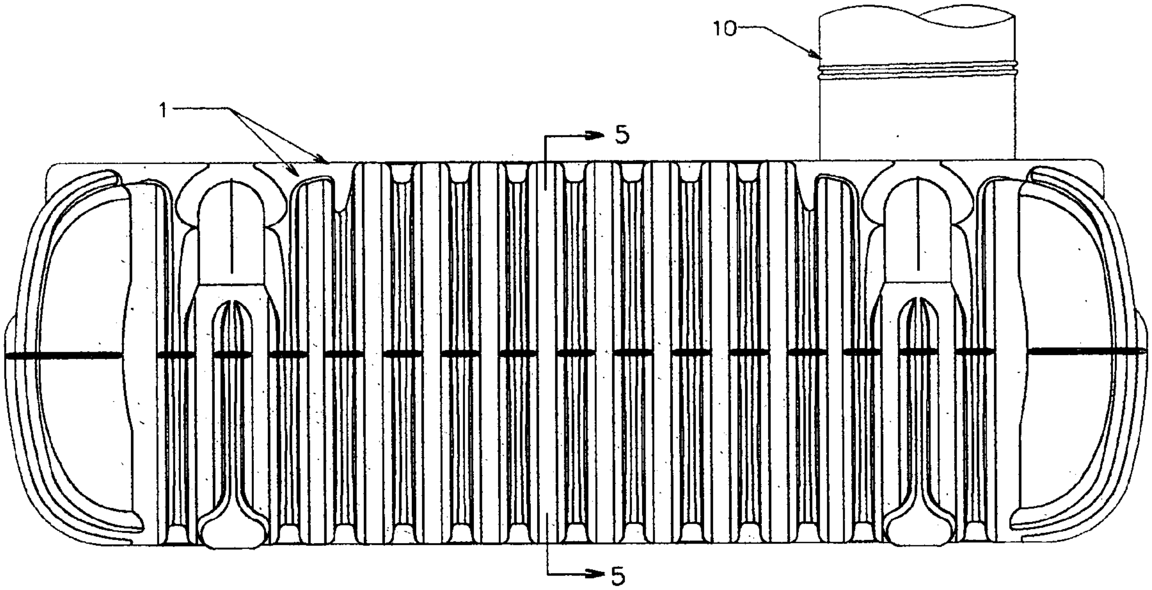
(57) **ABSTRACT**

One embodiment of a compact, closed loop geothermal energy exchange system, which is used in conjunction with geothermal heat pumps to heat and cool interior spaces, is provided. Conduit (**2**), through which process fluid flows, is configured within a containment tank (**1**) in a manner that optimizes the contact between the conduit, an interior soil mass (**4**) and the soil mass exterior to the tank. Water from a source within the geothermal zone of the earth is introduced, when necessary, to the interior of the tank by means of a temperature regulated valve (not shown) and pipes (**3**) located at the top of the tank. The interior soil mass, the exterior soil mass and the water, in combination, will regulate the temperature of the process fluid, thereby providing optimum operating fluid temperatures for geothermal heat pumps. A means of collecting the water and removing it from the tank is provided by a perforated pipe (**6**) connected to a water overflow chamber (**5**). The collected water is removed from the overflow chamber by a sump pump (**7**), and a discharge pipe (**11**).



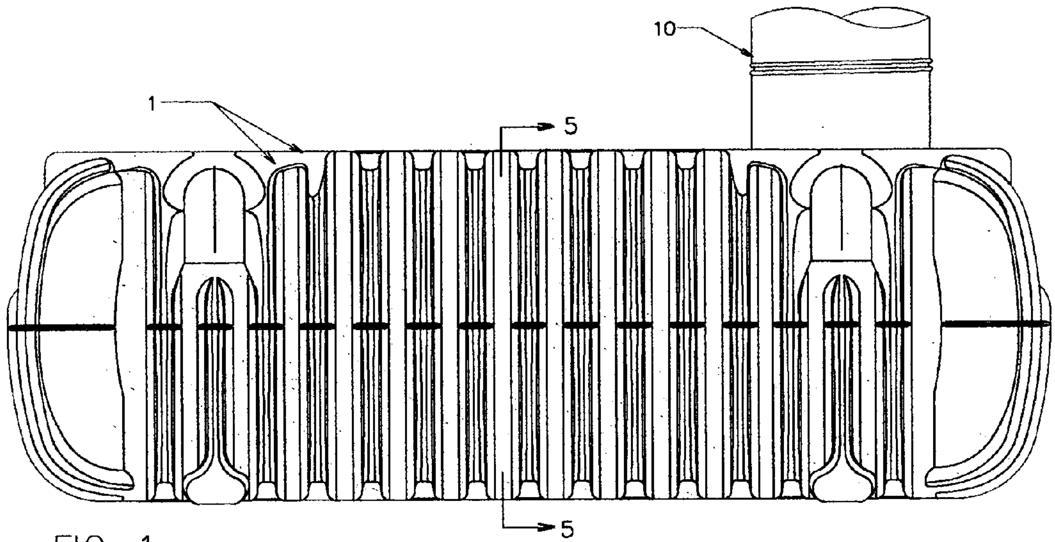


FIG. 1

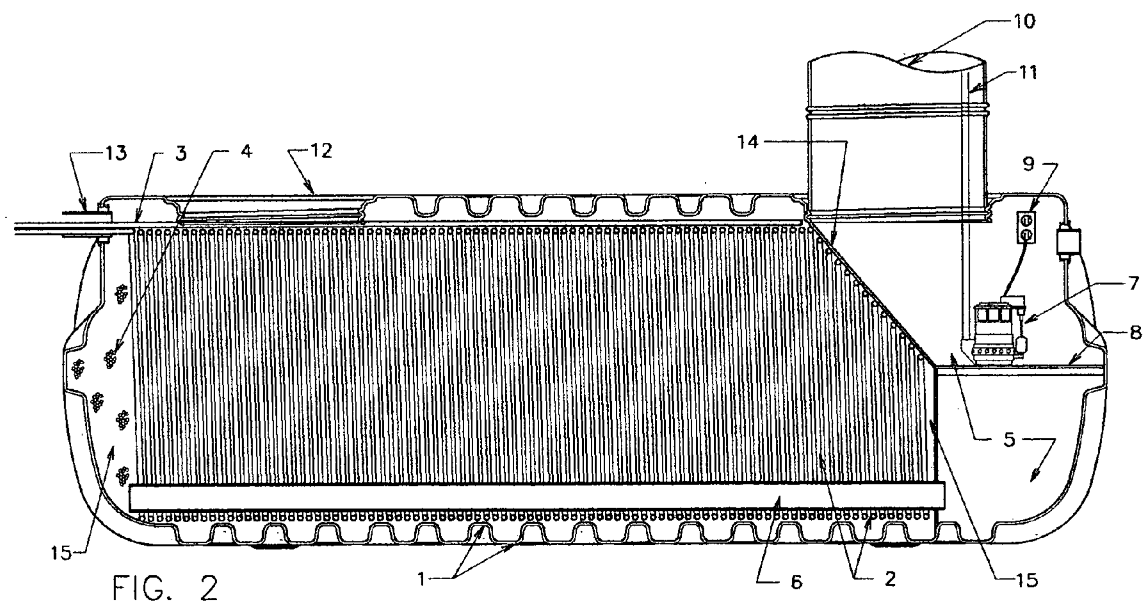


FIG. 2

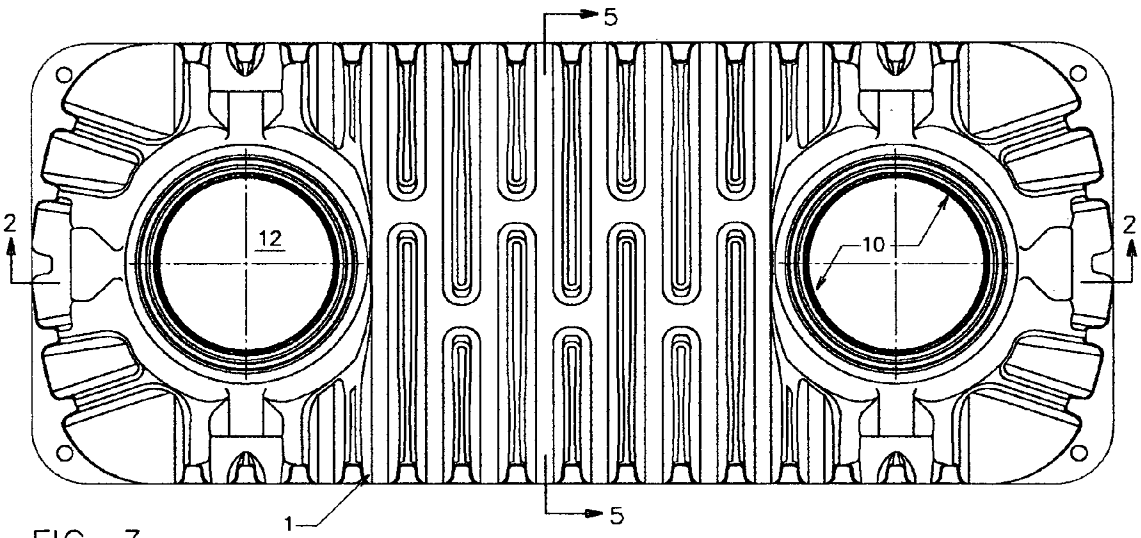


FIG. 3

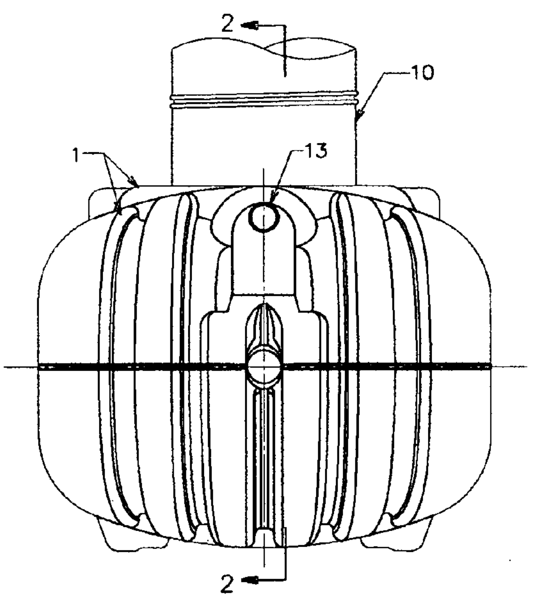


FIG. 4

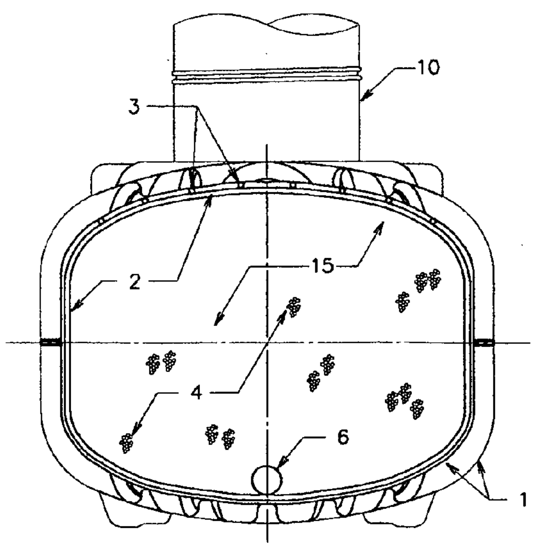


FIG. 5

SAWYER-SINGLETON GEOTHERMAL ENERGY TANK

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] Provisional Application Filed

[0002] Dec. 18, 2007

[0003] Application No. 61/007,952

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0004] "Not Applicable"

REFERENCE TO SEQUENCE LISTING, A TABLE, OR A COMPUTER PROGRAM LISTING COMPACT DISC APPENDIX

[0005] "Not Applicable"

BACKGROUND

[0006] 1. Field

[0007] This application relates to the use of the earths geothermal energy to heat and cool residential and commercial structures with a closed loop geothermal heat exchanger, which makes use of both soil mass and water to regulate the temperature of the fluid used by geothermal heat pumps.

[0008] 2. Prior Art

[0009] Geothermal energy in the context of this embodiment refers to that constant temperature of the earth that exists at a level close to the surface of the earth. That level varies somewhat from one geographical region to another but is generally agreed to be below frost level.

[0010] This constant temperature is now being tapped to heat and cool homes and commercial structures more efficiently. Presently, the systems used to tap this energy consist of essentially two parts. The first part is the indoor portion of the system, which is the mechanical portion. This portion is the geothermal heat pump. There are numerous manufacturers of these mechanical systems and they have increased in efficiency quite substantially over the last fifty years. Our embodiment does not address the indoor, mechanical portion of the system. It addresses the outdoor, civil portion of the system; the closed loop of conduit.

[0011] The outdoor portion, of the existing geothermal heating and cooling systems, serve to exchange the energy from the heat pumps with the constant geothermal energy of the earth. It does this by allowing fluids from the indoor mechanical system to circulate in conduit that is buried in the ground in the geothermal zone. There are three methods presently being used to accomplish this. They are; #1. vertical drilling, #2. horizontal trenching and #3. pond loops.

[0012] Each of the above methods uses a different method of burying the conduit in the geothermal zone. Herein lay their strengths and weaknesses.

[0013] The pond loops are the most economical means of installing conduit in the geothermal zone. Loops of conduit need only be dropped into a pond or lake which is 8 feet deep or more. The drawback for this system is that the body of water must be ¾ of an acre for each ton of cooling needed. For the sake of comparison, an eighteen hundred square feet home requires 3 tons of cooling. This equates to 2.25 acres of pond at 8 or more feet deep. Few people in rural areas have access to a body of water of this size. It is also safe to say that this method cannot be used in dense urban areas.

[0014] The horizontal trenching method of installing conduit in the geothermal zone is the next most economical. It requires a small backhoe to install a trench 5 feet deep, 5 feet wide and 145 feet long. Each trench, when filled with coiled tubing, will provide one ton of cooling. Therefore, a 1,800 sq. ft. home would require three of these trenches to attain the 3 tons of cooling capacity. The trenches would have to be spaced 15 feet apart, requiring a clear area of 45 ft. by 145 ft. Again, this is possible in rural areas, where this method of cooling the conduits is being used with great success. It, however, cannot be used in urban areas where the entire lot may only be 45 ft. by 145 ft.

[0015] The last proven method of cooling the coils from a geothermal heat pump is the vertical drill method. As the title implies, a truck or crawler mounted drill rig is used to drill holes 150 ft. into the ground and a loop of conduit 300 ft. long is installed in the hole. Each loop has the cooling capacity of one ton. Therefore, three are required for a 1,800 sq. ft. home. This method is expensive, costing from $1,500.00 to $2,000.00 per drill hole. The cost of installing a 3-ton heat pump system would be between $4,500.00 and $6,000.00, not including the mechanicals.

[0016] As with the two previous methods, a lot of space is required. In this method the space is required to maneuver large rigs and to drill the holes. This method is limited to rural and commercial uses where the cost of space is not at a premium price. It all but eliminates it from urban environments where space is limited and the drilling cost is prohibitive for most structures.

[0017] Our first embodiment, illustrated on sheets 1 of 2 and 2 of 2, is designed to be used with existing geothermal heat pumps. Said embodiment is designed to be installed in a small excavation using relatively small construction equipment, thereby opening the market for use of geothermal energy in urban areas. At this point, the lack of a cost effective, relatively small, in ground geothermal exchange system, has kept urban residents and businesses out of the highly efficient geothermal market.

[0018] The previous prior art methods described above are proven, commercially acceptable methods of providing closed loop geothermal heat exchange. To our knowledge none of these methods have patents and they are in general use in the industry.

[0019] Our search of prior art patents related to the heating and cooling of residential and commercial structures has produced the following list:

[0020] U.S. Pat. No. 6,138,744 Derek A. Coffee Oct. 31, 2000

[0021] U.S. Pat. Provisional Application No. 60/800,602 M. McCaughan May 16, 2006

[0022] U.S. Pat. Provisional Application No. 07/0068184 Mar. 29, 2007

[0023] U.S. Pat. No. 2,461,449 M. M. Smith, et al, Feb. 8, 1949

[0024] U.S. Pat. No. 3,965,972 Peterson Jun. 29, 1976

[0025] U.S. Pat. No. 4,237,859 Goettl Dec. 9, 1980

[0026] U.S. Pat. No. 4,375,831 Downing, Jr. Mar. 8, 1983

[0027] U.S. Pat. No. 4,448,237 Riley May 15, 1984

[0028] U.S. Pat. No. 4,633,676 Dittell Jan. 6, 1987

[0029] U.S. Pat. No. 4,936,110 Kuckens Jun. 26, 1990

[0030] Of those reviewed, U.S. Pat. No. 6,138,744 submitted by Derek Coffee came closest to our first embodiment. This patent pertains to a concrete container containing a portion of closed loop coil that is cooled by continuously running water from a well over the coils to provide cooling for the fluid inside the coils. The use of water is secondary in our embodiment. This is not the case with said patent that is more like the existing art of using a pond to cool the fluid in the coils. The use of said patent is feasible in a rural area with a significant water table and therefore cheap and accessible water. In urban areas where well drilling is not practical, the use of city water at the rate required by said patent is prohibitive. This is also true in arid sections of the country. This method of operation mirrors the use of ponds to provide geothermal energy.

[0031] Our first embodiment uses thin walled conduit, located on the interior walls of a tank. Said embodiment uses the soil mass outside the tank and the soil mass inside the tank as the primary geothermal exchange mediums. Water is introduced to the interior of said tank to remove heat from the interior mass, when needed. Further more, the water used in our embodiment cannot be used inside the house as potable. It will not be enough of it and after cooling the interior soil mass it will not be considered potable.

BRIEF SUMMARY OF THE INVENTION

[0032] In accordance with the first embodiment, a plastic tank is used to house thin walled tubing against its' interior walls. Said tubing will exchange energy with the soil mass outside and the soil mass inside said tank. Said tubing contains fluid which is used in conjunction with a geothermal heat pump, to cool or heat the interior of structures. Said tubing forms a closed loop system with a geothermal heat pump located in the interior of the structure. Water distributed within the geothermal zone of the earth will be used, when necessary, to regulate temperatures in said interior soil mass of said plastic tank to assist in optimizing the coil fluid temperatures.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0033] Sheet 1/2 shows a side view (FIG. **1**) and a longitudinal section (FIG. **2**) of the tank

[0034] Sheet 2/2: shows a top view (FIG. **3**), an end view (FIG. **4**) and a latitudinal section (FIG. **5**) of the tank

DRAWING—REFERENCE NUMERALS

[0035] **1**. containment tank

[0036] **2**. radiating coils

[0037] **3**. feed water pipes

[0038] **4**. interior soil mass

[0039] **5**. water overflow chamber

[0040] **6**. perforated schedule **40** plastic pipe with filter fabric sock

[0041] **7**. sump pump

[0042] **8**. pump platform

[0043] **9**. electrical supply for pump

[0044] **10**. manhole section

[0045] **11**. water discharge pipe

[0046] **12**. sealed access cover

[0047] **13**. conduit sleeve

[0048] **14**. hinged access panel

[0049] **15**. energy exchange chamber

DETAILED DESCRIPTION—FIRST EMBODIMENT

[0050] Referring to Sheets 1/2 and 2/2, the first embodiment of the closed loop geothermal energy exchange tank comprises a rectangular structure (**1**) capable of being buried within the earths' geothermal zone without failure. Attached to the interior walls of the structure is a continuous coil of 11⁄16" diameter plastic tubing spaced ½ inches apart (**2**). In contact with the plastic tubing is a mass of permeable soil (**4**), filling the interior of the energy exchange chamber. If needed, water is introduced to the interior soil mass by ¾" diameter perforated plastic pipes (**3**), which pass through a conduit sleeve (**13**) and runs the length of an energy exchange chamber (**15**) containing the plastic tubing.

[0051] The water is used to regulate the temperature of the interior soil mass when needed. The interior soil mass, in turn, removes the heat from the cooling fluid flowing within a continuous coil of plastic tubing (**2**) that forms a closed loop with the heat pump.

[0052] After interacting with the interior soil mass the water is removed from the heat exchange section of the tank by a perforated section of pipe (**6**) located near the bottom of the tank and connecting the heat exchange section of the tank with the water overflow chamber (**5**) of the tank. Water collected in the water overflow chamber is removed from this section by the use of a submersible sump pump (**7**) and a water discharge pipe (**11**). Access to the water overflow chamber, is provided by manhole sections (**10**). Access to the pump (**7**), its electrical supply (**9**) and its supporting platform (**8**) is provided through a manhole section (**10**).

[0053] The primary vehicles for energy exchange are the exterior soil mass and the interior soil mass. In most cases, the exterior soil mass will be the soil removed during the excavation for the containment tank, providing the soil has a uniform density. If the soil does not have the proper density and uniformity, it will be replaced by soil that does. This is critical since a considerable portion of the energy exchange will be between the radiating coils and the outside soil mass.

[0054] The remaining energy exchange with the radiating coils will be with the interior soil mass. The interior soil mass is installed in the containment tank thru an access cover (**12**) and an interior access panel (**14**). The interior soil mass is added on site to save on shipping cost. Water will only be used to help in cooling when the cooling capacity of both soil masses is exceeded. That occurrence will be signaled by a rise in the coil fluid temperature, measured at the heat pump. A valve (not shown) controlling the feed water will receive a signal to allow water to flow into the feed water pipes cooling the interior soil mass and the coils. Said water will continue to flow only until coolant in the coils reach a temperature that is in the optimal range for the heat pump being used.

Alternate Embodiment #1

[0055] The interior soil mass referenced in FIGS. **2** and **5** of the first embodiment is partially replaced by a light weight structure, such as Styrofoam, to reduce both the weight of the containment tank and limit the work required on site to install the interior soil mass. This light weight structure will be located at or near the center of the tank and will allow a reduced thickness of the interior soil mass to be in contact with the coils located on the interior wall of the containment tank.

Alternate Embodiment #2

[0056] The interior soil mass referenced in FIGS. **2** and **5** is partially replaced by a smaller interior tank of the same shape as the original tank. This interior tank would be located such that a reduced thickness of the interior soil mass will remain in contact with the coils located on the interior walls the containment tank. The internal tank will serve several purposes. The first being to reduce weight and jobsite labor by reducing the amount of interior soil mass required. Secondly, the interior tank will serve as the water overflow chamber, thus reducing the overall length of the containment tank and eliminating the perforated drain pipe.

[0057] The bottom of the interior tank would be perforated, allowing water to, under hydrostatic pressure, fill the interior tank. The sump pump, the pump platform, the water discharge pipe, the power source and the manhole extension section, would be incorporated into the interior tank.

Alternate Embodiment #3

[0058] The interior soil mass in the First Embodiment, Alternate Embodiment #1 and Alternate Embodiment #2 is replaced with a light-weight material which is water permeable, highly conductive and durable.

ADVANTAGES

[0059] From the descriptions above, a number of advantages some embodiments of our Geothermal Energy Exchange Tank becomes obvious:

[0060] (a) Using a tank to protect the conduit containing the coolant, allows for a thinner walled conduit and better energy transfers between the soil masses and the cooling fluid.

[0061] (b) Using water to assist in energy exchange allows for a more compact tank that, with the use of a temperature operated valve, provides optimum temperatures for a wide variety of geothermal heat pumps.

[0062] (c) Varying soil types have made geothermal heat pump efficiencies unpredictable. With the use of uniform soils and water infusion, our embodiment makes the efficiency of each brand of geothermal pump predictable.

[0063] (d) The size and configuration of our embodiments make it physically and economically possible to install these tanks in the average urban lot, bringing geothermal heating and cooling to urban areas, where it has not been utilized, because of the restrictions of prior art.

[0064] (e) With the use of light-weight interior soil mass, it becomes economically possible to ship tanks that have been sealed at the factory, eliminating most of the work in the field.

[0065] (f) The 30% to 50% energy savings realized by geothermal heat pump users, can now be realized in urban areas, thus saving customers money and allowing utilities to delay new power plant construction.

[0066] (g) The life expectancy of our geothermal energy exchange tank is expected to approach 50 years, making it an extremely reliable component. The sump pump and the temperature valve could have shorter lives, but they are relatively inexpensive and easily accessible for maintenance.

[0067] In a time of soaring energy prices and the movement toward greener alternatives to power generation, our embodiment will allow the vast majority of people to have access to an energy efficient method of heating and cooling their homes and businesses at an installation price that is competitive with air exchange heating and cooling systems.

[0068] Although the descriptions above contain many specifics, these should not be construed as limiting the scope of the embodiments but as merely providing illustrations of some of the presently preferred embodiments. Thus the scope of the embodiments should be determined by the appended claims and their legal equivalents rather than by the examples given.

1. A method for optimizing the temperature of process fluids used in a closed loop geothermal heat pump systems, by utilizing the constant geothermal energy of the earth to act on said fluid in a confined space, comprising the following steps;

a. providing a containment tank in which conduit, through which said process fluids flow, can be configured for optimum protection and optimum contact with exterior and interior soil masses.

b. providing said containment tank with adequate structural integrity to be buried within the geothermal zone of the earth, without damage to said containment tank or said conduit.

c. providing soil masses, interior and exterior to said vessel, that will allow the thermodynamic transfer of energy between said process fluid and said soil masses.

d. providing said internal soil mass with a particle gradation that renders said internal soil mass permeable to water.

e. said water can be supplied from any source that lies within earths geothermal zone.

f. providing a method to introduce said water to the interior spaces of said vessel, when necessary, to assist said interior and exterior masses in optimizing the temperature of said process fluids.

g. providing a method of collecting and removing said water from said vessel.

2. The invention of claim **1**, wherein said interior soil mass is replaced by a light-weight artificial or natural material with similar permeability.

3. The invention of claim **1**, wherein a portion of said soil mass is replaced with a light-weight structure or an interior tank.

* * * * *