(54) Title: GEOTHERMAL SYSTEM AND TUBING THEREFOR

(57) Abstract:
A geothermal heat pump has a pump. A tubing conveys a fluid from the pump and adapted to transfer energy between the fluid and the ambient environment as the fluid travels through the tubing. The tubing has a high thermal conductivity.
ABSTRACT OF THE DISCLOSURE

A geothermal heat pump has a pump. A tubing conveys a fluid from the pump and adapted to transfer energy between the fluid and the ambient environment as the fluid travels through the tubing. The tubing has a high thermal conductivity.
TITLE OF THE INVENTION

GEOTHERMAL SYSTEM AND TUBING THEREFOR

FIELD OF THE INVENTION

[0001] The present invention relates to a geothermal system. More specifically, the present invention is concerned with to the fluid transfer structure therefor.

BACKGROUND OF THE INVENTION

[0002] Geothermal energy systems are known in the art. By way of example a geothermal heat pump utilizes the ground temperature to heat or cool a fluid through energy transfer with the ground to regulate the interior temperature of a facility. The system uses the earth as either a source of heat in the winter or as a coolant in the summer. The geothermal heat pumps take advantage of substantially consistent moderate temperatures in the shallow ground to boost efficiency and reduce operational cost. The temperature of the ground remains fairly constant except for very close to the surface while the temperature of the air above ground, and within a facility, changes relatively dramatically.

[0003] During the summer, the ground temperature below the surface is normally cooler than the ambient temperature above ground. In the winter, for those countries above the equator, the opposite is true and the temperature below the ground, particularly in northern climates, is warmer than the ambient temperature above ground. To maximize the operation of the geothermal system, the system must take advantage of the temperature differential across all seasons.

[0004] The geothermal heat pumps include a pump which pumps fluid through tubing. The tubing extends through the ground and exchanges energy with the ground to enable the fluid to either lose or gain heat dependent upon whether the temperature of the fluid is greater than or less than the temperature of the ground through which it passes. The fluid conveying system then carries
the fluid back to the home or facility above the ground to control the environment therewithin. It is known in the art to use plastic tubing to convey the fluid through the ground.

[0005] These systems, although rudimentary have been satisfactory, but fairly inefficient. First, the materials used have a low thermal conductivity, so that the necessary heat exchange between the ground and the fluid is difficult, requiring a longer run of tubing within the ground to maximize energy transfer.

[0006] Furthermore, energy is wasted because the thermal conductivity is not sufficiently high to maintain the temperature of the fluid for long stretches of travel through the ground. Therefore, the transfer of energy between the ground and the fluid continues, so that on the return trip to the facility the fluid is either heating or cooling the ground. Accordingly, a system which overcomes the shortcomings of the prior art is desired.

SUMMARY OF THE INVENTION

[0007] A system is provided having a pump. The pump is operatively coupled to a tubing having made of a high thermally conductive material. The tubing is adapted to promote the transfer of energy between a fluid contained therein and earth surrounding the pipe.

[0008] In one embodiment, the tubing is made from a high density polyethylene. In another embodiment the tubing has a thermal conductivity of about 0.4 W/(m-K). In another embodiment, the pipe includes a first section made of a high density polyethylene and a second section. The first section has a thermal conductivity one and a half to five times as great as the thermal conductivity of the second section.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] In the appended drawings:
FIG. 1 is a schematic drawing of a heat pump constructed in accordance with the invention; and

FIG. 2 is a schematic diagram of the fluid conveying section of the heat pump constructed in accordance with a second embodiment of the invention.

DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Reference is made to the FIGS. 1 and 2 in which a geothermal heat pump, generally indicated as 10, is provided. Heat pump 10 includes a pump 12 for pumping a fluid. A pipe, generally indicated as 14 conveys the fluid from pump 12 in the direction of Arrow A. At least a portion of the path of pipe 14 is through ground 100 near the facility (a house, building or the like) 102 to be controlled by heat pump 10. In a preferred embodiment, pipe 14 is a plastic tubing.

In one embodiment of the invention, pipe tubing 14 is formed of a high density polyethylene (above 0.940 g/cm³) having a high thermal conductivity, preferably about 0.5 W/(m-K) or higher, and preferably, about 0.7 W/(m-K) or higher.

At the depths through ground 20 through which tubing 14 will travel, the temperature of the earth reaches about 8°C. The desired temperature of the fluid approximates that of the temperature of the ground at the depth to which the tubing 14 travels.

The temperature of the ground changes, from the ambient temperature, as seen in FIG. 2, at the surface of the ground to the desired temperature beneath the surface. Therefore, to maximize the heat transfer efficiency in accordance with the invention, the fluid is exposed to a temperature of the ground as long as necessary until the temperature of the fluid approaches a desired temperature differential.

However, as is known in the prior art systems, the fluid traveling through
tubing 14 continues to exchange energy with the ground on its return trip as it traverses the ground temperature gradient on the return to the environment to be controlled. Accordingly, in a preferred embodiment, tube 14 includes a first section 18 and a second section 20. First section 18 has a significantly higher thermal conductivity than second section 20 significantly greater than 0.45 W/(m-K). Second section 20 is downstream of the fluid and sufficiently downstream of the return point of the path of tubing 14 (that point in which tubing 14 begins its final path towards surface 104) of ground 100.

[0017] As tubing 14 returns to the surface, the temperature gradient of the ground approaches that of the surface temperature. As a result, the fluid will exchange energy with the ground to either lose or gain temperature as it experiences this new temperature gradient. Accordingly, second section 20, having the lower thermal conductivity less than 0.3 W/(m-K), in order to prevent such temperature exchange within a fluid, should begin at a point between the return of tubing 14 to the surface and a position where the temperature gradient will result in a changing temperature of the fluid within tubing 14. In this way, the exposure of the fluid to the desired ground temperature is maximized and the possibility of energy transfer to lose the desired temperature is minimized.

[0018] In a preferred embodiment, the thermal conductivity of first section 18 is substantially higher than that of second section 20. In a preferred embodiment, the thermal conductivity of first section 18 is one and a half to three times greater than the thermal conductivity of second section 20. In a still further preferred embodiment, the thermal conductivity of second section 20 is about 0.3 W/(m-K) or less. Second section 20 which thermally isolates the fluid contained therein may be made of a low density polyethylene or a polypropylene; significantly less than 0.940 g/cm³.

[0019] During use, a fluid is pumped through tubing 14 in the direction of arrow A. As fluid traverses through section 18, the temperature of the fluid approaches, through thermal exchange with the ground, that of the ground. At the return, point F in this embodiment, the fluid passes through second section 20 before the temperature of the fluid has substantially changed.
[0020] It is to be understood that although used by the invention that the ground and the fluid make up no part of this invention.

[0021] It will thus be seen that the objects set forth above, and those made apparent from the precedent description, are efficiently obtained and, since certain changes may be made in the above construction without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description and shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense. It is also to be understood that the following claims are intended to cover all generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language might be set to fall therebetween.

[0022] Although the present invention has been described hereinabove by way of embodiments thereof, it may be modified, without departing from the nature and teachings of the subject invention as defined in the appended claims.
WHAT IS CLAIMED IS:

1. A geothermal heat system having a pump, and a tubing of high thermal conductivity in fluid communication with the pump for conveying a fluid from the pump and adapted to transfer energy between the fluid and an ambient environment as the fluid travels through the tubing.

2. The geothermal heat pump of claim 1, wherein the ambient environment is the ground.

3. The geothermal heat pump of any one of claims 1 and 2, wherein the tubing has a first section and a second section, the first section having a thermal conductivity substantially greater than the second section.

4. The geothermal heat pump of claim 3, wherein the tubing includes a return, the second section being downstream of the return.