German utility model no. DE202022102094U1

Thermoelectric Generator for Efficient Power Generation for Home and Office Use

Description

Due to the Seebeck effect, thermoelectric generators convert heat into electrical energy. In 1821, the principle of a thermocouple was described by physicist Thomas Johann Seebeck.

The efficiency of thermoelectric generators is currently low because only a small part of the Carnot efficiency is converted. A major advantage compared to other electricity-generating methods, however, is that there are no moving parts that can wear out. As a result, they are used where solar cells/photovoltaics cannot or can only poorly be used for energy production: for example, in space probes far from the sun or under a car to utilize exhaust heat.

The materials currently used for thermoelectric generators are mainly semiconductors or combinations thereof, such as lead telluride PbTe, bismuth telluride Bi2Te3, silicon/germanium SiGe, iron/silicon FeSi2, bismuth/antimony BiSb. Doped semiconductors have good electrical conductivity and poor thermal conductivity. Therefore, they are well suited for use in thermoelectric generators, among other applications. To obtain usable voltages, many individual p- and n-doped thermoelements are connected in series. The exemplary layered structure of a thermoelectric generator is as follows: ceramic on the hot side, interrupted metal bridges each connecting a p- and an n-doped semiconductor, p- and n-doped semiconductors, interrupted metal bridges, ceramic on the cold side, with current tapped at the first and last metal bridge.

As relevant power generators, they have often played only a minor role so far. However, thermoelectric generators produce electricity from the hot exhaust stream of a car, for example, 200 watts.

There are many patent documents on the subject of thermoelectric generators, see also IPC H01L35/00 and depending on the installation in the device used, in the corresponding chapters of the IPC. The following are some publication numbers relevant to the invention with the corresponding references mentioned as examples:

- DE102013213535B3, Fundamentals for inexpensive and non-toxic thermoelectric generators,
- WO002016205058A1, combined use, e.g., with photovoltaics and coverings,
- CN000214069829U, a lens used for concentrating sunlight and thus greater heat as well as externally attached cooling fins,
- DE102011005206A1, combined with a flat tube,
- DE102013204166A1, with a thermal reservoir,
- DE102012208406A1, the near-window use for cooling and heating,
- DE102012016642A1, the temperature difference between indoor spaces and a radiator is used,
- WO002010133814A1, as a power supply for an additional device such as a lamp and charging a battery.

My invention is based on the further development of thermoelectric generators for efficient use.

The existing solutions fulfill their corresponding function according to the circumstances but do not have the possibilities of the above-mentioned invention.

The possibility of a quickly installable thermoelectric generator with relevant power generation is desired, and the invention specified in Claim 1 of a thermoelectric generator for efficient power generation on a radiator for home and office use meets these requirements.

An example embodiment:

Solar cells/photovoltaics have been used for a long time to generate electricity not only in the domestic sector. Unfortunately, the yield is (very) low in winter, during the heating season.

For effective power generation by thermoelectric generators, the largest possible temperature difference is required. According to Claim 2, the invention allows the combination of outdoor cold (e.g., 5 degrees Celsius) with the radiator temperature (e.g., 55 degrees). Thus, there is at least a theoretical temperature difference of 50 degrees. Even if the temperature difference is not comparable to that of car exhaust and ambient air, the significantly larger contact area of a radiator (e.g., 2x0.8 sqm) compensates for some of the low power generation.

Thus, the present invention should be seen as a complement to an existing photovoltaic system or, if the installation of solar cells is not possible, as a standalone system.

Only thermoelectric generators specifically designed for power production should be used, as Peltier elements for cooling and/or heating usually have lower efficiency.

Figures 1 (frontal view) and 2 (side view) show a typical installation of thermoelectric generators. The small pump that transports the heat or cold-transmitting fluid (corresponding to a collector fluid) can be operated with the generated electricity or external electricity (as shown in Claim 3) and is not shown for clarity. According to Claim 4, the flat tube 8 on the inside of the room is drawn slightly smaller than the plate 7 with the thermoelectric generators in Figure 1 to make the setup more manageable. The radiator 6 is shown in the background here.

The lines of the "collector fluid" 5 (from inside to outside and back again) must be well insulated (as shown in Claim 5) and can be routed through the window frame 2 with little effort according to Claim 6. Of course, slightly more elaborate drilling through the masonry 9 is also possible. No potentially climate-damaging "refrigerant" and no high fluid pressure are required (as shown in Claim 7).

The installation of the invention can also be carried out by hobby craftsmen, unlike a central heating system or combination with a central heating system. Since no potentially environmentally harmful refrigerants are used, there are also no corresponding regulations.

Good thermal conductivity between the radiator and the thermoelectric generators (or transmission of the radiator's "cold" in summer) is crucial for power yield. According to Claim 8, the thermal conductivity of the materials used is of great importance. The thermal conductivity of commonly used metals in descending order is: silver Ag, copper Cu, then aluminum Al.

Depending on the radiator type, 1 to 4 plates with many "thermoelements" can be used (as shown in Claim 9). According to Claim 10, the plates can be attached to the radiator with magnets, hung, screwed, or clamped with levers/clamps. Common radiator areas are, for example, 0.8 or 0.6 sqm.

The heat conduction plates made of metal should have exactly fitting elevations for the individual thermoelectric generator modules (as shown in Claim 11) and be provided with thermal paste.

According to Claim 12, the flat tube on the inside 8 must be well insulated to prevent the room air from cooling down.

At the beginning of the warm or cold season, the cold and hot poles of the thermoelectric generators "change sides," and therefore the plates with the thermoelectric generator modules are "reversed" (as shown in Claim 13). The plate with the heating-side thermoelectric generators from winter moves to the other side of the flat tank in the room. The removable insulation in the room also changes sides.

According to Claim 14, it is advantageous to attach a thin black metal plate to the flat tube in the outdoor area in summer (magnetically, hung, clamped with a lever, etc.) to heat the fluid in the outer flat tube more strongly.

If the plates with the thermoelectric generators are not to be attached directly to the radiator, a distance can be created with a U-shaped heat conductor (viewed from the side) (as shown in Claim 15).

According to Claim 16, a larger insulated flat tank can be installed in the outdoor area for summer so that collector fluid/hot solution/solar fluid can circulate even at night.

Optionally, in winter, additional cooling fins can be attached in the outdoor area (as shown in Claim 17) (in summer, these serve as "heat fins") to increase effectiveness through the then colder circulating fluid.

Of course, thermoelectric generators can also be attached to a central heating system, as there are greater temperature differences. However, in the future, there will be fewer gas and oil heating systems with high-temperature differences, as heat pumps will increasingly be installed. According to Claim 18, thermoelectric generators could also be installed directly at the supply outlet of the heat pump heating system in the basement. However, the advantage in terms of electricity yield is not great compared to thermoelectric generators installed on the radiator (apart from the aesthetics). Installation on the central heating system should, of course, be carried out by skilled craftsmen.

Thus, in the cold season, only a small part of the heat generated by the heating system is "consumed" by the thermoelectric generators, generating a relevant amount of electricity throughout the day and possibly at several radiators. The generated electricity can, of course, also be used for a heat pump. A small contribution to the energy transition, which can largely be done by oneself.

Reference List

1. Window sash
2. Window frame
3. Windowsill
4. Power connection (output)
5. Insulated fluid lines
6. Radiator
7. Plate with thermoelectric generators
8. Insulated flat tube indoor
9. Masonry
10. Flat tube exterior/heat exchanger

Claims

1. Thermoelectric generator for efficient power generation for home and office use, characterized in that it is mounted on a radiator with the heating side in winter and is heated by external heat in summer.

2. Thermoelectric generator for efficient power generation for home and office use, according to claim 1, characterized in that the cooling side of the thermoelectric generator is cooled by outdoor cold in winter and by room temperature in summer.

3. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims,

characterized in that a pump that circulates the heat or cold-transmitting fluid ("collector fluid") is operated with the generated electricity or with external power.

4. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims, characterized in that an insulated flat tube is installed in the room on the thermoelectric generator.

5. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims, characterized in that in winter, the lines with cold "collector fluid" or in summer, the lines with hot fluid are insulated from inside to outside and back again.

6. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims, characterized in that the lines are routed through the window frame or through the masonry.

7. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims, characterized in that no potentially climate-damaging refrigerant is used and no high fluid pressure is generated.

8. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims, characterized in that the materials used have high thermal conductivity where appropriate (e.g., silver Ag, copper Cu, or aluminum Al).

9. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims, characterized in that depending on the radiator type, 1 to 4 plates with many "thermoelements" are installed.

10. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims, characterized in that the plates with the thermoelectric generators are attached to the radiator using magnets, hung, screwed, or clamped with levers/clamps.

11. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims, characterized in that the heat conduction plates made of metal have precisely fitting elevations for the thermoelectric generator modules and are provided with thermal paste.

12. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims, characterized in that the flat tube in the room/on the inside is insulated.

13. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims, characterized in that at the beginning of the warm season or at the beginning of the cold season, the plates with the thermoelectric generator modules are "reversed" and also the removable insulation of the flat tube in the room "changes sides."

14. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims, characterized in that in summer, a thin black metal plate is attached to the flat tube in the outdoor area (magnetically, hung, screwed, clamped with a lever, etc.).

15. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims, characterized in that the plates with the thermoelectric generators are not attached directly to the radiator but with a U-shaped heat conductor (viewed from the side).

16. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims, characterized in that a larger insulated flat tank is installed instead of the flat tube in the outdoor area.

17. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims, characterized in that additional cooling fins or "heat fins" are attached to the flat tube or flat tank in the outdoor area.

18. Thermoelectric generator for efficient power generation for home and office use, according to one of the preceding claims, characterized in that the thermoelectric generators are installed directly at the supply outlet of a heat pump.

Fig. 1

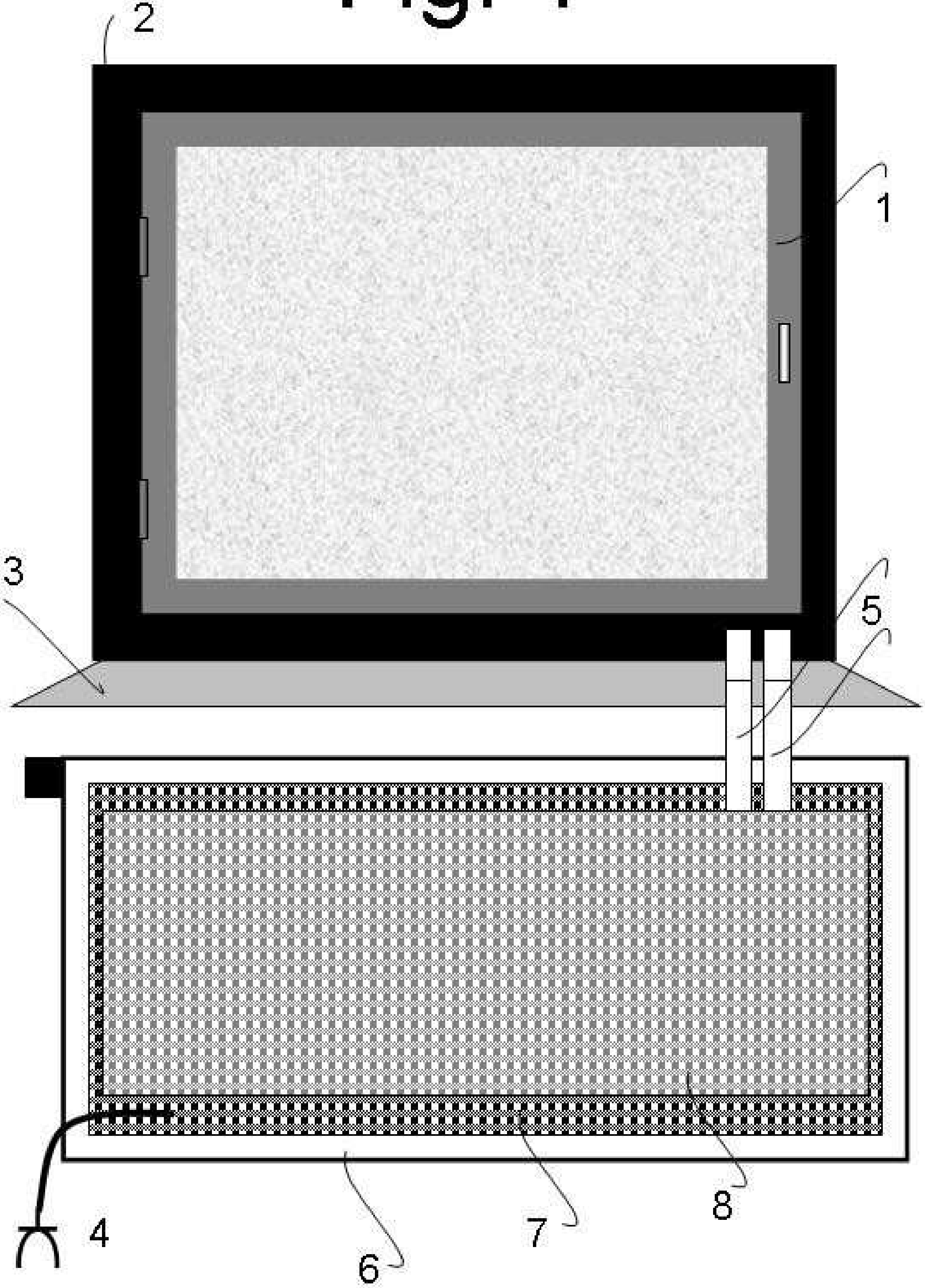

Fig. 2