United States Patent [19]

Fairbanks

[11] **3,785,144**

[45] **Jan. 15, 1974**

[54] **HEAT ENGINE**

[76] Inventor: **"EJ" L. Fairbanks,** 511 S. 850 East, Orem, Utah 84057

[22] Filed: **Nov. 2, 1972**

[21] Appl. No.: **303,246**

[52] **U.S. Cl.** **60/531**
[51] **Int. Cl.** **F03g 7/06**
[58] **Field of Search** 60/25, 10

[56] **References Cited**

UNITED STATES PATENTS

2,171,246	8/1939	Schweiger	60/10
2,659,215	11/1953	Massopust	60/25
3,509,716	5/1970	Avery	60/25
3,659,416	5/1972	Brown	60/25

FOREIGN PATENTS OR APPLICATIONS

924	1/1888	Great Britain	60/25

Primary Examiner—Edgar W. Geoghegan
Assistant Examiner—H. Burks
Attorney—Kay S. Cornaby et al.

[57] **ABSTRACT**

A heat engine adapted to perform work utilizing the temperature differential between hot and cold heat reservoirs as a source of energy, includes a horizontally disposed, rotatable shaft attached to one end to the center of a disc which is adapted to rotate about the longitudinal axis of the shaft. A plurality of heat exchanger sets are disposed in mutually spaced-apart relationship around the circumference of the disc. Each heat exchanger set comprises two pairs of heat exchangers, with each pair communicatingly connected with the other pair, and respectively disposed at diametrically opposing edges of the disc. Each of the pairs of heat exchangers includes two enclosed containers acting as heat exchangers and communicatingly connected with each other and adapted to be immersed simultaneously in respective hot and cold heat reservoirs disposed preferably at the bottom edge of the disc. Each heat exchange set contains a high vapor pressure liquid. When a particular container is in the hot heat reservoir, the liquid therein is heated and the vapor pressure is increased to drive liquid from the container into the container in the cold reservoir and then across the disc into the other pair of heat exchangers. As the volume of liquid increases in the opposite pair of heat exchangers, gravity forces the disc to rotate, and energy to perform work is thereby generated. In one embodiment, all containers adapted for immersion in the cold heat reservoir are replaced by a single tube-like container disposed about the circumference of the disc and connected to all heat exchanger containers which are adapted to be immersed in a hot heat reservoir.

7 Claims, 6 Drawing Figures

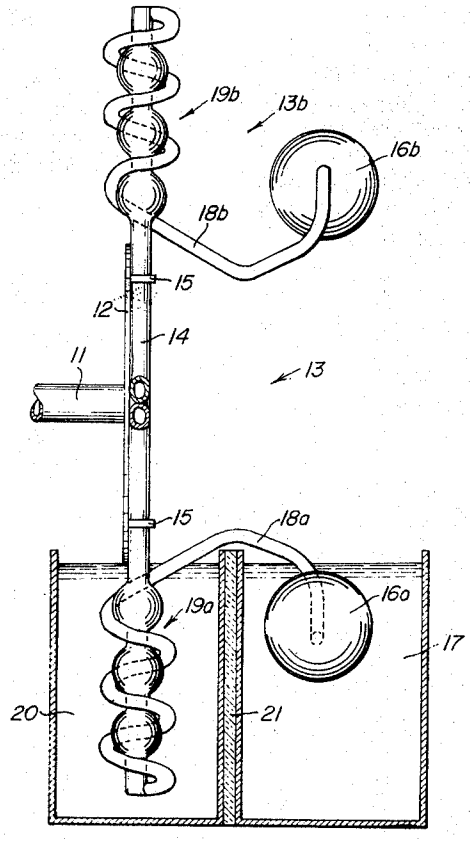


FIG. 3.

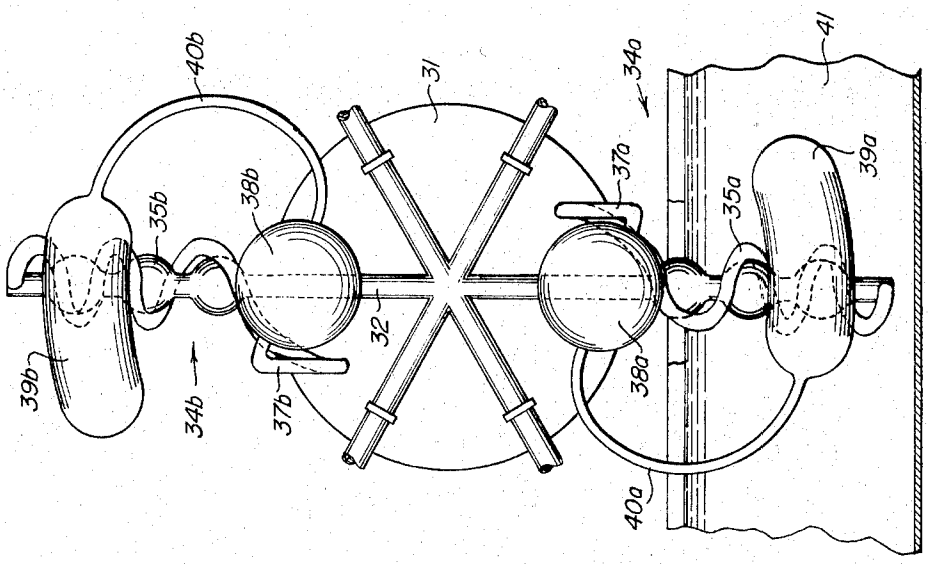


FIG. 2.

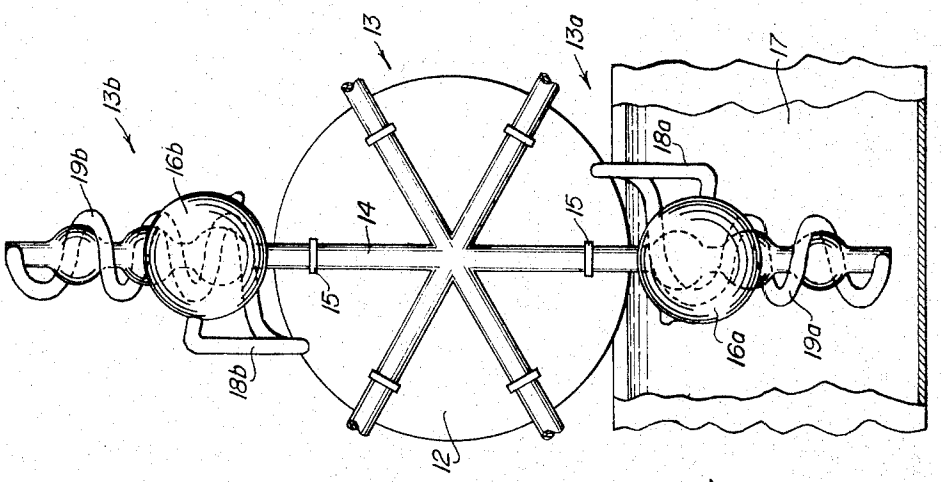


FIG. 1.

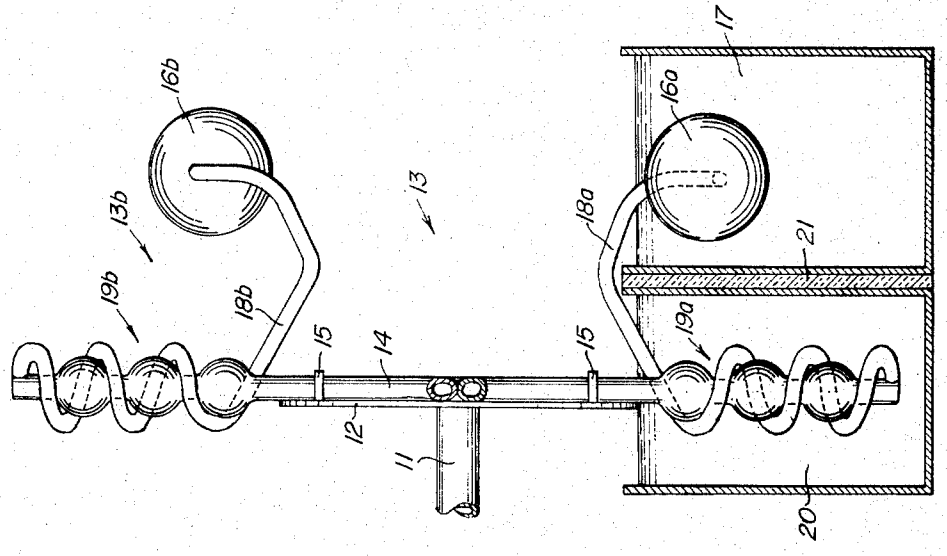


FIG. 6.

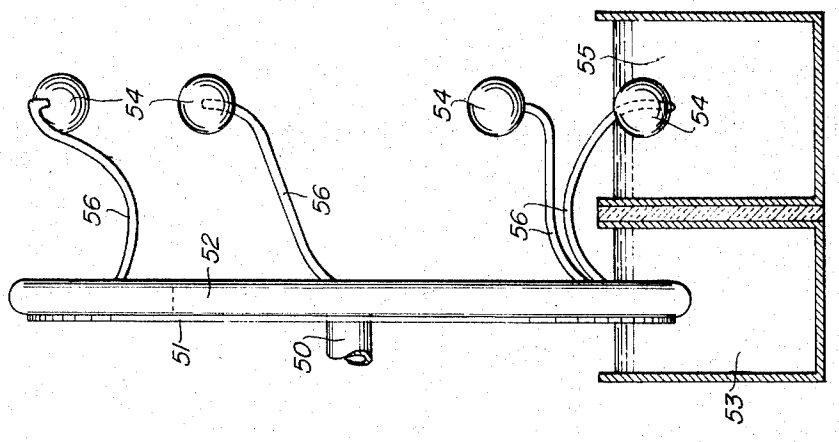


FIG. 5.

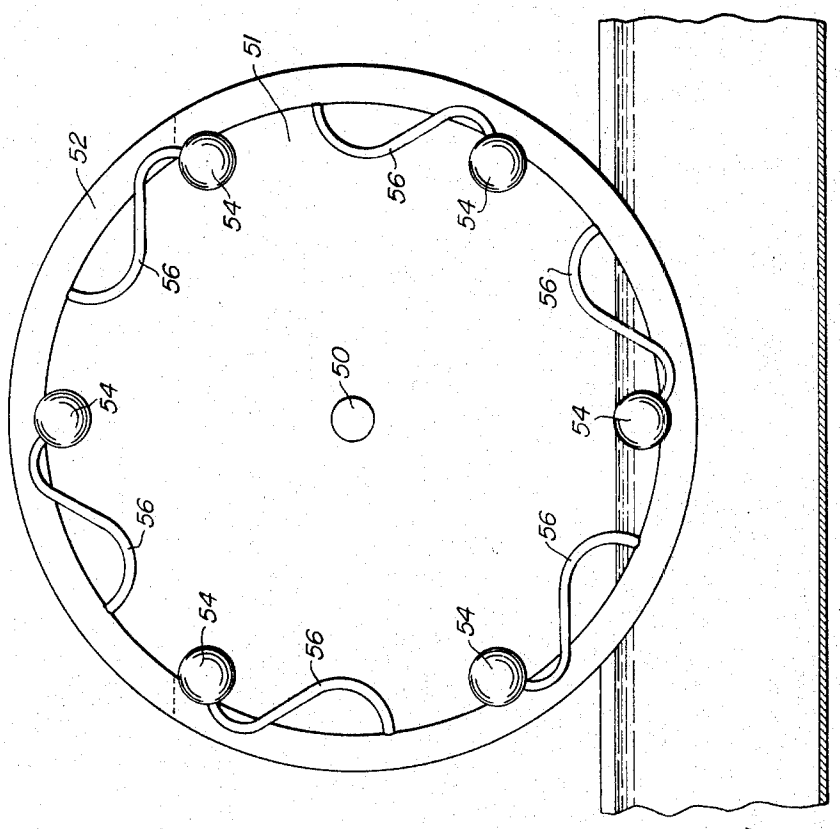
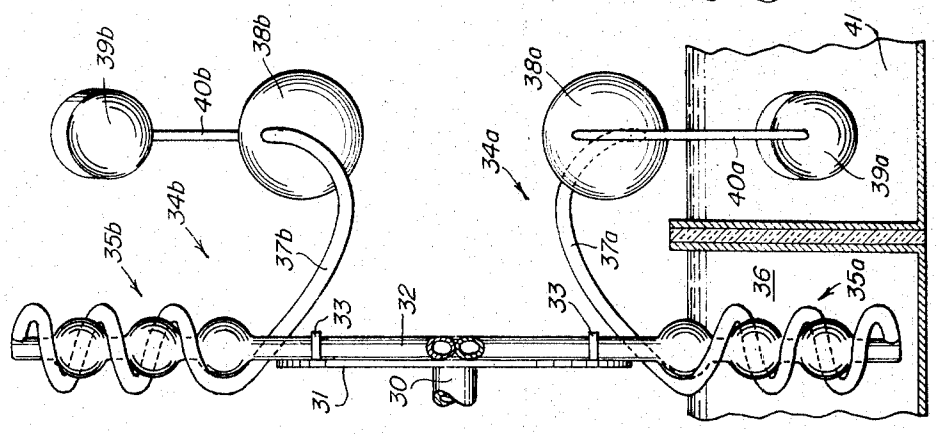


FIG. 4.



HEAT ENGINE

BACKGROUND OF THE INVENTION

1. Field

This invention relates to heat engines utilizing the temperature differential between hot and cold heat reservoirs as a source of energy.

2. State of the Art

Heat engines have long been known which use the differential in temperatures between two heat reservoirs having fluids therein at different temperatures to generate work energy. The principles of thermodynamics are applicable for transforming the potential energy in the temperature differential into energy to do work. Heat engines which have been proposed in the art and literature have uniformly included component parts which greatly reduced the efficiency of the engines, making the engines undesirable from a commercial or practical standpoint. Most notably, the heat exchange components in known heat engines are very inefficient, resulting in loss of the major portion of the energy potentially avaiable in the temperature differential.

OBJECTIVE

It was an objective in making this invention to provide a more efficient heat engine of unique design capable of converting increased amounts of potential energy into work energy.

SUMMARY OF THE INVENTION

In accordance with the invention, a heat engine is provided for converting the potential energy existing in the temperature differential between a hot and a cold heat reservoir to work energy. The engine has a horizontally disposed rotatable shaft to which may be attached devices, such as power generators and the like to utilize the work energy produced by the engine. A disc is attached at the center thereof to one end of the shaft and is adapted to rotate about the axis of the shaft. The shaft and disc are rotatably mounted on support structure.

A plurality, preferably three, of heat exchanger sets are disposed in mutually spaced-apart relationship about the circumference of the disc. Each heat exchanger set contains a high vapor pressure liquid and has two pairs of heat exchangers, each of the two pairs being disposed at diametrically opposing edges of the disc. One of the heat exchangers in each pair comprises a first enclosed container adapted to be immersed in a hot heat reservoir as the disc rotates. The container is communicatingly connected to a second enclosed container adapted to be immersed in a cold heat reservoir at the same time as the first container is being immersed in the hot heat reservoir. The second container is communicatingly connected to the corresponding container of the other pair of heat exchangers in the set, which are disposed at the diametrically opposite edge of the disc. In an alternative embodiment, the containers for immersing in the cold heat reservoir are replaced with a singe tube-like container disposed around the entire periphery of the disc and communicatingly connected to each container for immersing in hot heat reservoirs. As the disc rotates, a portion of the tube-like container is always immersed in the cold heat reservoir.

In operation, the disc can be so disposed that one pair of heat exchangers are immersed respectively in a hot and cold heat reservoir adjacent the disc at the lower edge thereof. As the liquid in the container in the hot heat reservoir is heated, the increasing vapor pressure drives liquid from the hot heat exchanger into the container immersed in the cold reservoir. The liquid is cooled as it is driven upwards into the opposite pair of heat exchangers in the same set which are disposed at the diametrically opposed edge of the disc. As the liquid is drained from the container in the hot heat reservoir and liquid flows into the upper containers, the force of gravity causes the disc to rotate to bring the heavier containers downward. This results in a new set of heat exchangers becoming operable with one pair of the new exchangers being immersed in the heat reservoirs.

THE DRAWINGS

The best mode presently contemplated of carrying out the invention is illustrated in the accompanying drawings, in which:

FIG. **1** is a side elevation of one embodiment of the invention showing the heat exchangers immersed in heat reservoirs;

FIG. **2** is a front elevation of the embodiment shown in FIG. **1**, with only one set of heat exchangers depicted in detail;

FIG. **3** is a front elevation of another embodiment of the invention, showing heat exchangers having two containers for the hot heat reservoir;

FIG. **4** is a side elevation of the embodiment shown in FIG. **3**, with only one set of heat exchangers shown in detail;

FIG. **5** is a front elevation of still another embodiment showing the container adapted for the cold heat reservoir as a single tube-like container disposed about the periphery of the disc; and

FIG. **6** is a side elevation of the embodiment shown in FIG. **5**.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

A preferred embodiment of the invention is illustrated in FIGS. **1** and **2**, and has a horizontal shaft **11** adapted for rotation about its longitudinal axis. Shaft **11** has a circular disc **12** mounted in the center thereof at one end of the shaft. Disc **12** and shaft **11** are adapted to rotate about the longitudinal axis of shaft **11** as the engine performs work. Shaft **11** can have belts, pulleys or other connecting means mounted thereon to transform the rotational power generated by the engine into useful work.

In this embodiment, three heat exchanger sets **13** are mounted in mutually spaced-apart relationship about the circumference of disc **12**. Each exchange set **13** has two pairs of heat exchangers **13***a*, **13***b*, each of the pairs being communicatingly connected through a tube **14** and being disposed at diametrically opposing edges of disc **12** and connected thereto by clamps **15** around tube **14**. Each heat exchanger pair **13***a*, **13***b* has an enclosed container as a heat exchanger in the form of a sphere **16***a*, **16***b* adapted to be fully immersed in a hot heat reservoir **17**, containing, e.g., hot water or the like. Spheres **16***a*, **16***b* are communicatingly connected respectively by means of tubes **18***a*, **18***b* with a pair of enclosed containers **19***a*, **19***b* adapted to be immersed in a cold heat reservoir **20**, e.g., cold water. Containers **19***a*, **19***b* are advantageously convoluted with multiple

sides exposing greater surfaces to the cold heat reservoir. As shown, the containers comprise a series of 3 intercommunicating spheres with spiral tubing. Containers 19*a* and 19*b* are communicatingly connected through elongate tube 14, which is attached to disc 12, and are disposed at opposite edges of disc 12. Cold and hot heat reservoirs 17 and 20 are advantageously disposed side-by-side immediately below disc 12, and are separated by an insulating partition 21.

The heat exchangers contain a high vapor pressure liquid, preferably methylene chloride or a fluoro-chloro methane refrigerant, known commercially as FREON, which fill each set of heat exchangers until containers 16*a* and 16*b* are preferably approximately ½ to ⅔ full. In operation, the volatile liquid in container 16*a* is heated by heat reservoir 17, as shown in FIGS. 1 and 2, and the vapor pressure in container 16*a* increases, forcing liquids through tube 18*a* and into container 19*a*. As the liquid passes through container 19*a* immersed in cold heat reservoir 20, it is cooled and rises through tube 14 into container 19*b* of heat exchanger pair 13*b* vertically above at the opposing edge of disc 12. After passing through container 19*b*, the liquid flows through tube 18*b* and into container 16*b*. As container 16*b* becomes heavier than container 16*a* in hot heat reservoir 17, gravity causes heat exchanger pair 13*b* to rotate downwardly in a clockwise manner, thereby lifting heat exchanger pair 13*a* out of the reservoirs and rotating the next heat exchanger pair (not shown) into the reservoirs. The procedure is repeated continuously resulting in sustained motion of disc 12 and shaft 11.

A modification of the heat engine described in connection with FIGS. 1 and 2, is shown in FIGS. 3 and 4. As in the first embodiment, the modified engine has a shaft 30, a disc 31, and elongated tube 32 attached to disc 31 by clamps 33. At either end of tube 32 are disposed two heat exchanger pairs 34*a*, 34*b*. Tube 32 is connected directly with containers 35*a* and 35 adapted for immersion in a cold heat reservoir 36. Communicating tubes 37*a* and 37*b* connect containers 35*a* and 35*b* respectively with containers 38*a* and 38*b*. New in this embodiment are a pair of enclosed containers 39*a* and 39*b* adapted to be immersed in a hot heat reservoir. The containers are communicatingly connected with containers 38*a* and 38*b* respectively by means of respective tubes 40*a* and 40*b*. Containers 38*a* and 38*b* do not become immersed in heat reservoir 41. When container 39*a* or 39*b* is in reservoir 41, the vapor pressure of the heated liquid is passed through tube 40*a* or 40*b* into container 38*a* or 38*b*, as the case may be. The increased vapor pressure in container 38*a* or 38*b* to be forced through tube 37*a* or 37*b* to container 35*a* or 35*b* and from these through the system as described above in connection with the embodiment illustrated in FIGS. 1 and 2. As an example of relative sizes, a small heat engine has containers 38*a* and 38*b* of about 4 inches in diameter, with elongate containers 39*a* and 39*b* having a diameter of about 1½ inches.

A third embodiment is depicted in FIGS. 5 and 6, wherein the shaft 50 and 51 are disposed as in the earlier described embodiments. A continuous tubular container 52 mounted on the circumferential edge of disc 51 functions as the heat exchanger for the cold heat reservoir, and is adapted to rotate with the disc, so that a portion of the tubular container is immersed in a cold heat reservoir 53 at all times. A plurality of heat exchange containers 54 are disposed in mutually spaced-apart relationship about the circumference of disc 51 and are adapted to be immersed in a hot heat reservoir 55. The containers 54 are communicatingly connected with tubular containers 52 by means of respective individual tubes 56. Preferably for a small engine, tube 52 is about 1 inch in diameter, with containers 54 being about 3 inches in diameter and the connecting tubes 56 being ½ inch in diameter. This engine functions similiarly to the previously described engines. Liquid is contained in the lower containers 54 and the tubular container up to about the dotted line shown in FIG. 5. As the containers 54 enter hot heat reservoir 55, the vapor pressure of the liquid rises to force liquid out of containers 54 into tubular container 52, where it is cooled in the cold heat reservoir. Within tubular container 52, the liquid moves upwardly and into the empty or partially empty containers 54 located at or near the upper portion of disc 51. As these containers fill with liquid, gravity causes the top-heavy disc to rotate, thereby moving another container 54 into the hot heat reservoir, while maintaining a corresponding portion of tubular container 52 in the cold heat reservoir. As in the previously described embodiments, the process is repeated continuously with succeeding containers 54 to provide a continuously rotating disc capable of producing work.

A typical small heat engine can be constructed in accordance with the invention using a disc or wheel about 26 inches in diameter, such as a conventional bicycle wheel. The disc need not be solid, but can comprise an outer rim strengthened by spokes extending radially from a central axis. The tubing and containers can be constructed of glass, thermo-plastic materials, or heat conducting metals, such as copper or aluminum. It is preferred to employ three sets of heat exchangers to provide constant motion, although more can be used, if desired. Each of the heat exchange containers is filled preferably to about ½ full to ⅔ full, with the connecting tube means and cold containers being completely filled. Preferred high vapor pressure liquids include methylene chloride and dichloro-difluoro-methane, commercially marketed under the trademark FREON II. Other refrigerants and low vapor pressure liquids can be used depending on the size of the engine and the temperature differential in the reservoirs.

When the hot heat reservoir is held at about 60°C and the cold heat reservoir at ambient temperature, the disc rotates at about one revolution per 10 seconds. The torque generated thereby is sufficient to drive a bicycle generator, creating sufficient power to light a small bulb continuously.

The heat engine operates in accordance with known principles of thermodynamics, and is unique in that it can operate with as low as 1°F differential in temperature between the heat and cold reservoirs. It is preferred to maintain a generator or governor on the engine shaft at all times to regulate the constancy of the speed of rotation and to rotation to produce an even flow of power from the engine. Without such a governor, the disc may rotate too fast, particularly if more heat exchanger sets are attached to the disc than are necessary for the amount of work to be produced or the diameter of the disc.

It is contemplated that the engine could be employed to utilize natural heat sources, such as hot water springs or lakes, to generate electrical sources, and thereby re-

duce pollution which is common in fossil fuel-consuming power generators.

Whereas this invention is illustrated and described herein with respect to certain preferred embodiments, it is to be understood that many variations are possible within the inventive concepts set forth with particularity in the appended claims.

I claim:

1. Heat engine for utilizing temperature differential between hot and cold heat reservoirs to do work, comprising in combination:

a horizontal shaft adapted for rotation about its longitudinal axis;

a disc mounted at the center thereof on one end of the shaft and adapted for rotation about the longitudinal axis of the shaft to produce work energy;

a plurality of heat exchanger sets mounted in mutually spaced-apart relationship about the circumference of the disc, each of said heat exchanger sets comprising:

first, second, third and fourth enclosed containers, said first and second containers communicatingly connected with each other through tubular means, said third and fourth containers communicatingly connected with each other through tubular means; and said second and third containers communicatingly connected with each other through tubular means; said first and second containers being disposed on the diametrically opposing edge of the disc from said third and fourth containers, the first and fourth containers being adapted for immersion in a hot heat reservoir and the second and fourth containers adapted for immersion in a cold heat reservoir as the disc rotates; and

liquid having a high vapor pressure for circulation in the heat exchangers to generate rotational motion of the disc.

2. Heat engine as set forth in claim **1,** including three heat exchanger sets uniformly spaced around the circumference of the disc.

3. Heat engine as set forth in claim **1,** wherein each of said second and third containers of each heat exchanger set comprises a series of three spheres communicatingly connected to each other surrounded by a spiral flight of tubing.

4. Heat engine as set forth in claim **1,** including fifth and sixth inclosed containers respectively communicatingly connected by tubular means to the first and fourth containers, said fifth and sixth containers adapted for immersion in a hot heat reservoir as the disc rotates.

5. Heat engine as set forth in claim **4,** wherein said first and third containers are non-immersible in a hot heat reservoir.

6. Heat engine as set forth in claim **1,** wherein heat exchange containers corresponding to the first and third containers are respectively communicatingly connected by tubular means with a single tubular container extending around the circumference of the disc, said tubular container replacing the second and third containers and adapted to have a portion thereof immersed in a cold heat reservoir at all times as the disc rotates.

7. Heat engine as set forth in claim **6,** wherein said heat exchanger containers are attached to the tubular container.

* * * * *