Air Ship/Aircraft Propulsion System

An alternative powering source using conventional Brayton Cycle Gas Turbines which is Cheaper, Safer, and absolutely Green, no NOX, no SOX, No Co^2 with much less noise.

It is long understood that internal Combustion Engines (ICE), generally have better weight to power ratios than most other propulsion systems and that the Brayton Cycle gas turbine has the best weight to power ratio of any ICE. However, there are two problems with all combustion: first it is never complete, at the best more than 30% is never burnt it ends up as pollutants, CO^2 and deposits which reduce engine life; secondly hydrocarbons that are traditionally used for engine combustion has an energy density that is modest at the best, with 46.9 kJ/kg being the highest of common used fuels.

We propose using a Brayton Cycle turbine with a non-combustion power source to provide the 500-700^{O}C needed to drive the turbine. We would replace the burning of hydrocarbon or any other combustibles, with a heat exchanger in the combustor canister and used heat supplied from the patented Perryman Thermal Battery. The Perryman battery stores energy at temperature of up to 1800^{o}C, this thermal battery has the highest available (with the exception of a nuclear pile, but with the advantage of no radiation). The Perryman battery has energy density of 593.2 MJ/L) by volume) or as the weight is important 356.0 kJ/kg (mass). This high energy density combined with the natural advantage of Brayton Cycle turbine weight to power. This is more than 7.5 time more energy that the best hydrocarbon fuel and eliminates the efficiency problems of incomplete combustion.

Considerations

Initial Cost

The system would cost less than 50 percent of installing electro-chemical batteries and brushless DC electric motors

Operating cost

- The system would be charge from any electrical source such as the grid and would be dependent on the cost per kilowatt of electricity used to charge the thermal battery. As the thermal battery system requires a negligible amount maintenance other than recharging when the thermal cells are spent, their operating cost is less that a hundred dollars year for thermal cell populated with 20 thermal cores which represents 154 kW/hrs. of thermal storage. (this is based on an operating delta of between 1800^{O}C and 620 ^{O}C the lowest operating temperature of the recommended Boeing T50-BO-10 / 502-14 turboshaft turbine whose inlet temperature: Jet pipe temperature is: 1,140 °F (616 °C at 330 hp (246.08 kW). The maintenance of the turbine engine would be the same or less what is normally expected that is required on a typical turboshaft engine. (Based on a similar Rolls Royce 250 turboshaft engine the maintenance would be under $367 per operational hour) To power this or the recommended Boeing T50 turboshaft unit you would need two thermal cells populated with 20 spherical thermal cores each for one-hour flight time.

- (https://www.aopa.org/news-and-media/all-news/2016/october/31/hourly-operating-costs)

Energy Economics

As fuel cost has the largest impact on aircraft operation the present cost of $77.99* per hour for jet fuel as compared to $5.66 if you purchase the electricity a low night rates ($0.03 per kW/hr.) or $24.5 if you purchase the electricity at high day time rates (0.13 per kW/hr.). This amounts to saving of between 1300% and 300% depending on where you buy your electricity when using the Perryman Thermal Battery with the same T50 turboshaft engine. * based on North American December cost of Jet Fuel (http://www.iata.org/publications/economics/fuel-monitor/Pages/index.aspx)

Long Term Economic Considerations

The turboshaft engine with proper maintenance operational life exceeds 60,000 operation hours, with the advantage of no particulates, carbon build up and tar form incomplete hydrocarbon based fuel combustion, the engine life should almost double. The Perryman Thermal Battery will last more than 40 years of continuous use, with unlimited charging/discharge cycles.

Safety

There are three levels containment redundancy built into the Inertial dampened adaptation of the Perryman Thermal Battery. The spherical thermal cores are encapsulated in a non-magnetic alloy which has the same strength of stainless steel, the density and hardness of the cores refractory approaches that of diamond and is composed of many successive layers encapsulating the molten metal phase change alloys. The walls of the tubular thermal cells are multi layered with a very strong space age refractory, carbon fiber composite similar to what many aircraft are constructed, the final layer is a similar ballistic composite material that is used on battle tanks, the cell holders, the tubes that are attached to the aircraft are constructed using the same material along with an additional thin coating that can take hundreds of “G” force impacts. Keep in mind in the over one hundred years of carry the million tons of molten steel by rail, which is the technology the Perryman Thermal battery evolved from. There has never been a fatal or serious spillage, rupturing or failure of containment, we enhance this containment by many fold. Jet engine simplicity and reliability is the safest internal combustion engines and we use heat not combustible fuel to drive this engine so the risk of fire does not exist.

Maturity of the Technology

Jet engines speak for themselves, the use of heat without combustion was tested for tens of thousands of hours in the 1950 when GE and Pratt Whitney were testing the use of nuclear energy to keep a bomber aloft for weeks. The storage of high temperature metals is century old and the transport by rail and truck well over a century old, we base our design as well as having the same manufacturer who is behind this very mature containment system manufacture our thermal core units. Our development is 10 years old terrestrial semi commercial testing has been in progress of several years.

Manufacturing Time Table
From testable prototype to fully operational units demonstrated on a T50 or similar based on the delivery outline attached to this presentation in under 9 months.

The Technological Driver and the Technologies

Energy Density

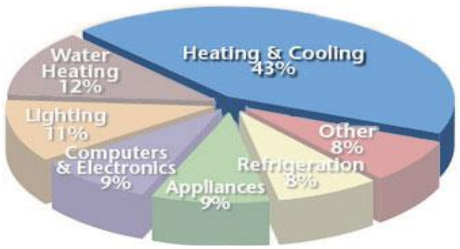
The essential technological breakthrough of the Perryman Thermal Battery

We have added a chart extracted from the calculation of Hofstra University energy research unit comparing different forms of energy.

Energy Density of the Perryman Thermal Battery overwhelming Advantage

Only Nuclear exceed the Perryman Thermal Battery storage capacity

Selected Fuels	energy density	
	by mass	*by volume*
	MJ/kg	MJ/L
nuclear fission (of U-235) (Used in Nuclear Power Plants)	77,000,000	1,500,000,000
anthracite coal	32.5	72.4
diesel fuel/residential heating oil	45.8	38.7
Gasoline	46.9	34.6
Jet fuel (Kerosene)	43.3	37.4



Thermal energy is energy in its most useful and flexible form. It is the basis for all propulsion, it is the most widely used form of energy and it is the form of energy that can be stored longest as well as the form of energy mankind has used longest

biodiesel oil (vegetable oil)	42.20	30.53
gasohol (10% ethanol 90% gasoline)	43.54	28.06
Ethanol	30	24
liquid hydrogen	143	10.1
compressed natural gas at 200 bars	53.6	10
Wood	6 - 17	1.8 - 3.2
natural gas		.038
Generation 3 Perryman Thermal Storage unit with encasement	**356.0**	**593.2**

Heat Engines and Perryman thermal battery Energy to Weight using Turboshaft Engines** &***

To power the propulsion of any aircraft, truck, train or ship, heat is needed, here you can see the hard numbers. A combination of turboshaft engine using direct heat as energy source as opposed to burning hydrocarbons has the best weight to power possible.

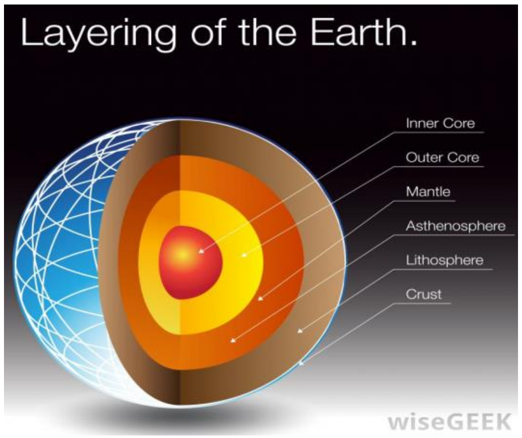
Combination of turboshaft engine using direct heat as energy source as opposed to burning hydrocarbons

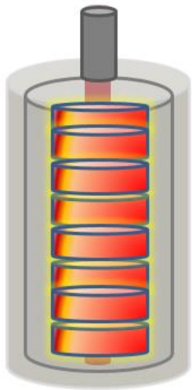
Heat Engine Type	**SI**	**English**	**SI**	**English**	**Primary Uses**	***Perryman Battery*** **Energy Kilo-Joules-to-weight ratio**	***Perryman Battery*** **Energy-Thermal to-weight ratio**	**Combined energy to weight Perryman battery with Turboshaft**
Boeing T50-BO-10 / 502-14)	410.13 kW	550 hp	3.616 kW/kg	2.2 hp/lb	Small Aircraft Helicopters, large sub killer Drones	**3600** kJ/kg	**106.6 kW/Thermal/kg**	**109.161 kW/kg**
	Peak Power Output	**Peak Power Output**	**Power-to-Weight Ratio**					
GE LM6000 marine turboshaft Brayton gas turbine	30,200 kW	40,500 hp	1.31 kW/kg	0.80 hp/lb	GTS Millennium cruise ship, QM2 ocean liner			**107.31 kW/kg**

**We have summarized and compared the noted battery/ electric motor combination showing the weight to energy ratio at the beginning of the addended charts.

***We have also, addended graphs showing most types of electro-chemical storage as well as a good cross section of electric motors including the types used in many electric cars and aircraft. The batteries and electric motors of note are highlighted.

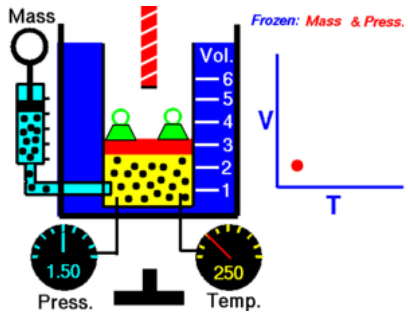
How Thermal Energy is Contained





In order to better understand the Perryman Battery, first we do not store and retrieve energy through an electrical chemical reaction like a lithium Ion battery but as pure thermal energy similar to the way molten salt batteries work. However, we take advantage of the mass and higher heat capacity of metals and metal alloy to store many time more energy that any thermal battery. Our terrestrial and transportable storage batteries use the same knowhow and experience used by steel mills and high school kilns. The many layers of refractory slow the movement of the thermal energy to a point where it almost static. The phenomena are call thermal dynamic quasistatic, and it imitated the way the Earth has been storing energy for many billions of years. An extremely hot core and many layers of materials that when you dig a hole a few meters deep almost anywhere around the planet you will find the same temperature 55^{O}F. Likewise, our core is several thousand degrees yet the outside never exceeds 60 degrees. Our thermal batteries range from grid size units that are 6 x 2.4 m and store up 32 MW/hrs. thermal to home size units with 700 kW/hrs. thermal, we have recently developed an inertia dampened variation which is small enough to in cars and aircraft, we illustrate this thermal storage units below. This design is very flexible as we can populate the battery so we can deliver 77 kW/hrs. thermal up too many hundreds of megawatts, depending the number of spherical thermal cores you add to the battery system. The thermal cores are populated in protective tubes, the tubes are customized as the application and energy need. If a large amount of energy is needed more populated tubes can be added, so whatever the energy demand it can be accommodated by varying the quantity of spherical thermal cores or adding more tube filled with cores. If the space for the battery need to be distributed in several places to design or weigh optimization it a matter of installing the tubes where needed and running thermal transfer conduits to where the heat is needed.

NOTE…Perryman thermal battery and all thermal storage is energy is made up from molecular kinetic energy and latent phase energy. Heat engines are able to convert thermal energy in the form of a temperature gradient between a hot source and a cold sink into other desirable mechanical work. Heat pumps take mechanical work to regenerate thermal energy in a temperature gradient. Care should be made when interpreting propulsive power, especially for jet engines and rockets, deliverable from heat engines to a vehicle



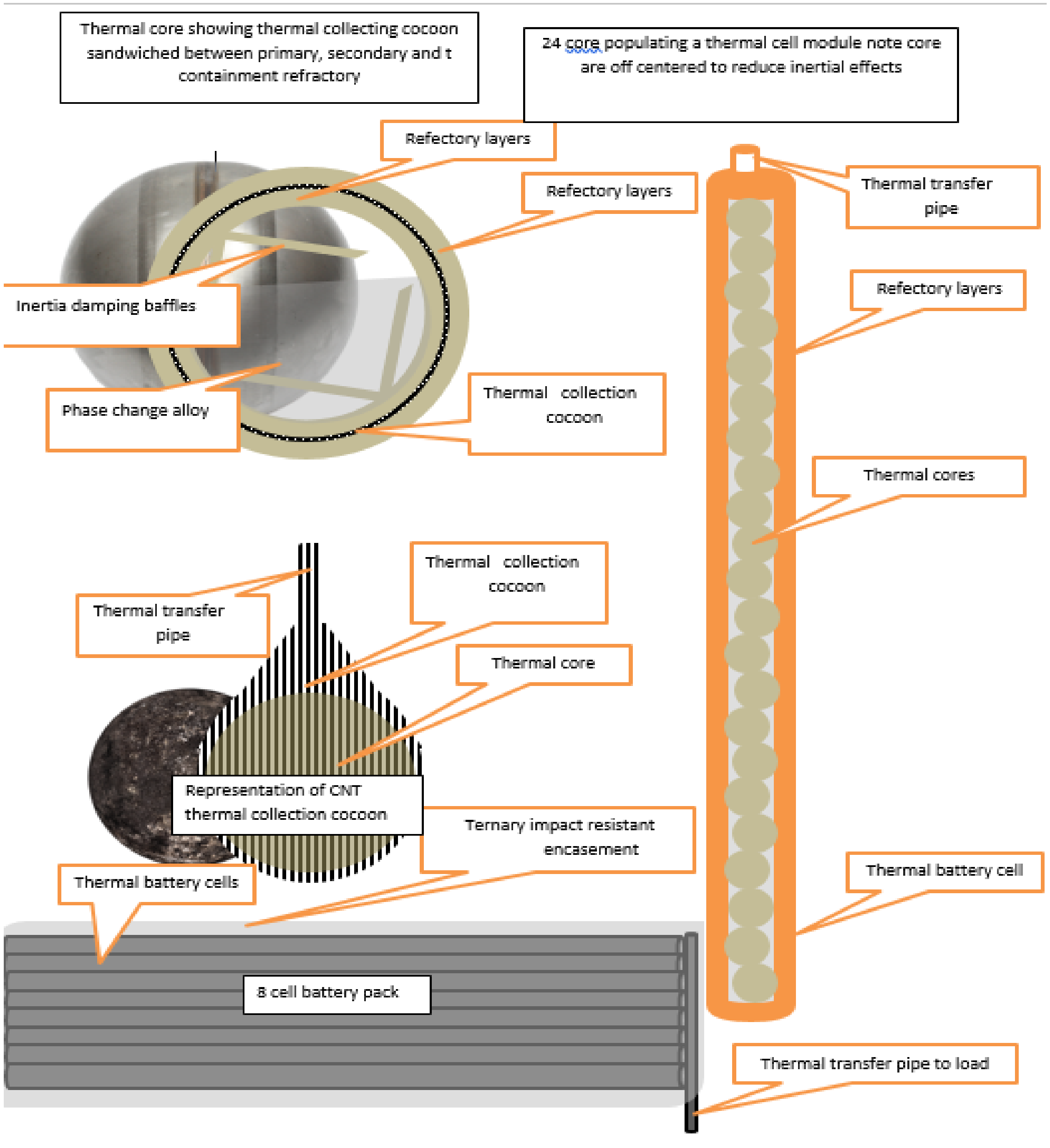
All systems of propulsion require only heat and a drive gas or fluid, we provide the best heat source available

The Physic behind the adaptation of heat to drive Internal Combustion Engine

This proposal is driven by an understanding that it is wisher to build on existing technology and industrial infrastructure, then trying to reinvent the wheel by introducing a solution that will need to create a new industry, production methods and infrastructure.   We see the turboshaft engine, that was first introduces 50 years ago as a tried and well proven method to propel and aircraft. We understand that the largest limitations are cost, the environmental impact, long term reliability, safety and maintenance consideration. In air craft weight to power considerations are also paramount. Staying with the well proven Brayton Cycle Gas Engine check All the boxes, if we can find a better system to power this engine than combustion of dirty expensive burning of hydrocarbons. Here is where the "Charles Law and heat laws offer a simple solution, create a new way to deliver thermal energy other than burning fuel. We have accomplished with the Perryman Thermal Battery. Pure clean heat delivers rapidly at the perfect temperature and with the ability to heat air more evenly and efficiently than any form of combustion.

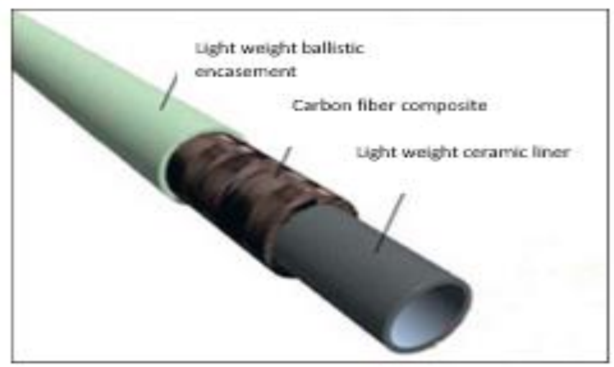
With the high density thermal battery provide a massive weight to power advantage over any electro-chemical battery and a 11/1 advantage over kerosene.

Illustration of the Inertial Dampened Thermal Storage system, which can be scaled from 77Kw/hr. to many Megawatts and can be easily modified to fit almost anywhere



Details of the Tubular Thermal Cell and the Holders that allow the to be attached to the Aircraft

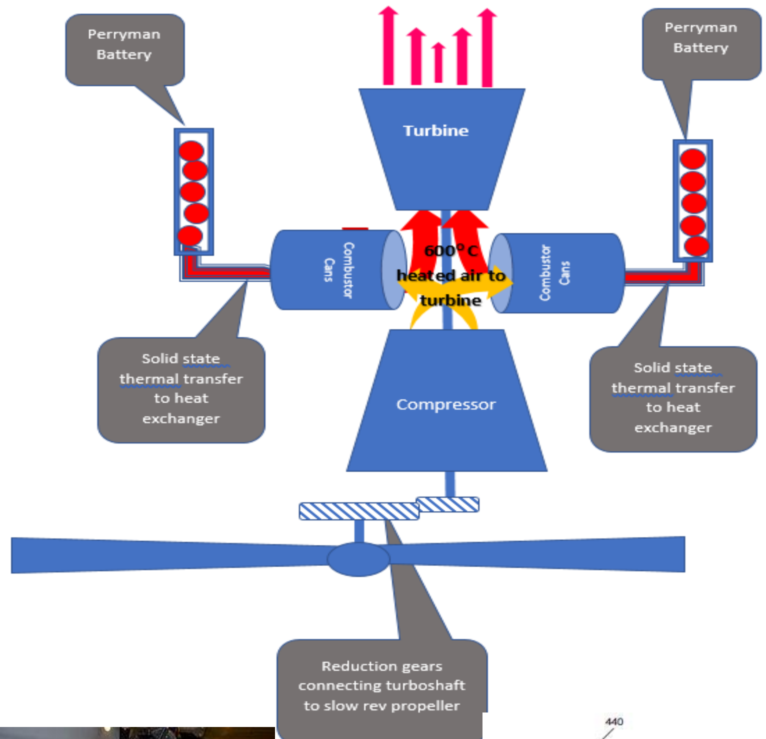
The battery cell is a hollow multi-layer tube made of light weight ceramics composites with the spherical thermal cores and thermal transfer system are factory sealed in. The Thermal cells can be removed from the holder shown below for charging and once charged slide back into their holders which are securely attached to the air craft

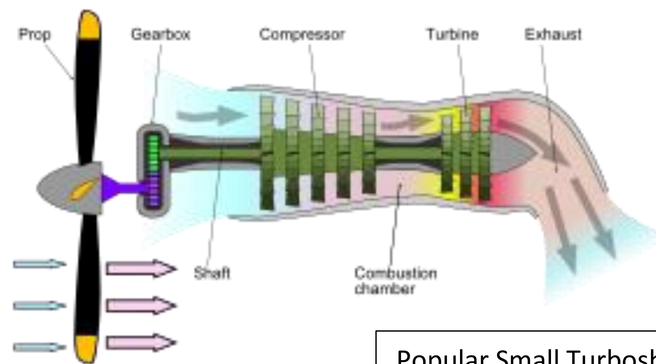


This tube holds the thermal battery cell it is attached to the aircraft. Like the thermal battery cell, it can vary in length and can be installed in harmony with the aircraft design. These holders can be contacted side by side one the aircraft and easily accessed external to facilitate rapid collection of the thermal cell so they can be removed and after being recharged, the thermal cell can be easily and rapidly re-inserted into the holder and reconnected to the thermal transfer system, much as in the same way as an electro-chemical cell is replaced in a flashlight. The weight to energy ratio includes the weight of the holder, thermal cells and the spherical thermal cores,

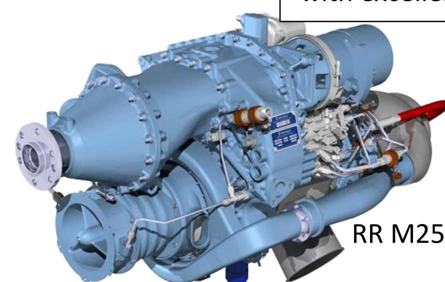
Propulsion is accomplished using turboshaft Brayton Cycle turbine engine retrofitted with heat exchanger in the combustor cans as per Virgil Perryman's Non-combustion energy source and configuration for brayton cycle heat engines US Patent number: 9470148

Diagram of Turboshaft Engines



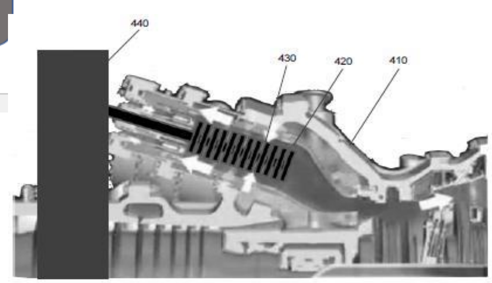


Popular Small Turboshaft Engines with excellent weight to power

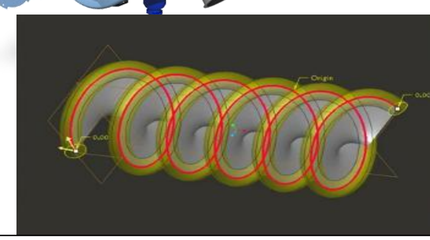


RR M250

T50-BO-10 / 502-14) Manufactured for Boeing, this turboshaft has been a main line power plant for over 50 years

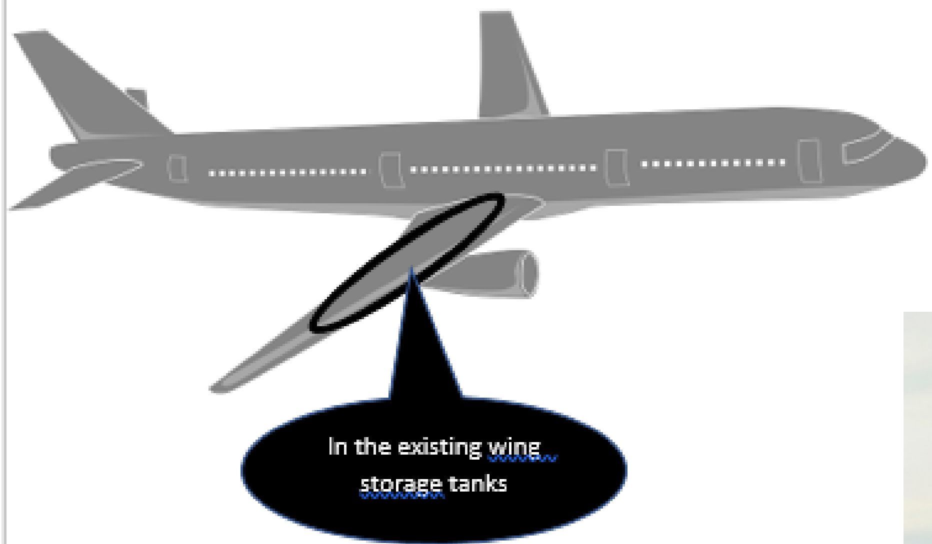


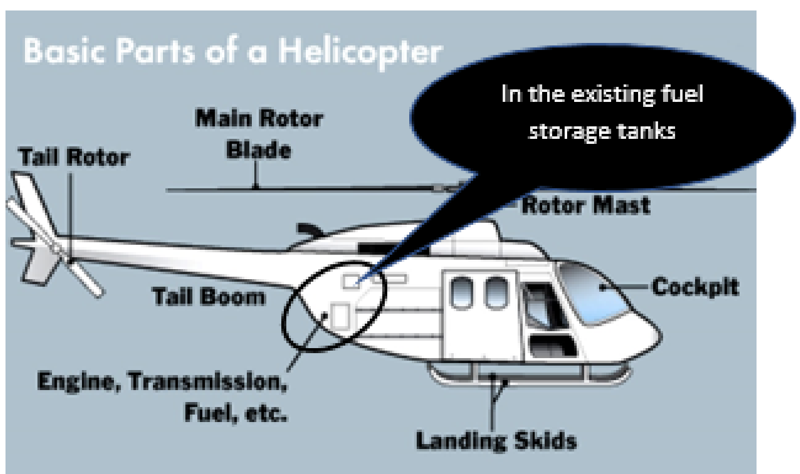
Drawing from the Virgil Perryman Patented Non-Combustion Brayton Cycle Gas Turbine Adaptation



An illustration of the heat exchanger that is inserted into the combustor can of Brayton Cycle Gas turbine can delivery the thermal energy to power the without burning fuel

The Thermal cells and their holders can be retrofitted into the existing fuel storage of any aircraft.

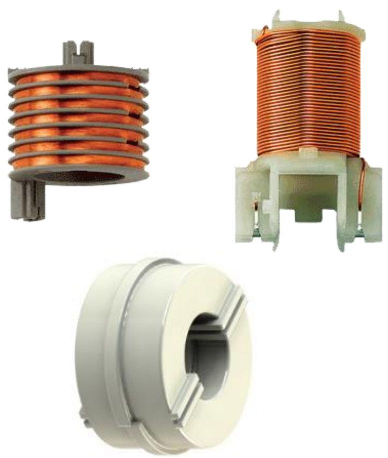




CHARGING SYSTEM

The most efficient method to turn electricity into heat, magnetic induction with less than 1.68% loses

We use an induction system to convert line voltage into the heat that melts the phase change annoys that are contained deep in our spherical thermal cores. The magnetic field does the work, exciting the atoms of the metal so much until the melt. This induction system is the same as you use on your induction stove tops or Hobs and is used extensively in all form of metallurgy from the nationhood pawn shops recovery of gold jewelry to melting hundreds of tons of steel at steel mills



Copper induction coil and copper coils which are encased in ceramic jackets (shown on the left) than populated into the insulated charging tube. The Perryman Thermal cell which is populated with the thermal cores is inserted into a charging tube and can be fully charged between 5 -10 minutes depending on power options. The charged Thermal cell can be removed by hand and re-inserted into its holder on the aircraft. Although the phase change metals deep inside thermal core is 1800OC fully charged the thermal cell can be safely handled with ungloved hands. Several charging tubes can be clustered together so enough energy to stay aloft for several days could be charged in a few hours. The induction charging system is made by giant manufactures such as Inductotherm Group http://www.inductothermgroup.com/product/induction-melting-furnaces/. Siemens as well as smaller US based manufacturer such as Grievecorp and JPW Engineers and Design, http://www.grievecorp.com/index.php, http://www.jpwdesign.com/

The Proposed Propulsion Solutions

By combining four smaller Boeing (T50-BO-10 / 502-14) or two larger 520-6 with a power output of 330 hp (246.08 kW) and 550 hp (410.13 kW respectively with Perryman inertial dampened thermal batteries delivering enough energy to provide 24 hours of sustained flight the of each battery system would weight approximately 500 kilograms dependent on distribution of cell holders if holders are distributed over a larger area the weight would slightly increases. Inclusive of the weight of the four 502-14 system would weight 892 kgs., and the two 520-6 would weight 726 kgs.

The cost of the four remanufacture and re-air certified T50 502-14 inclusive of adapting, testing and installing the battery system with the capacity to provide 24 hours of sustained flight will **cost approximately $1, 700,000 depending of design parameter of the Airship**

The cost of the two remanufacture and re-air certified T50 520-6 inclusive of adapting, testing and installing the battery system with the capacity to provide 24 hours of sustained flight will **cost approximately $1, 550,000 depending of design parameter of the Airship**

*Either solution can be enhanced to provide enough electrical generation to power various environmental requirement, lighting and electrical sub-systems. De-icing and HVAC can be furnished using waste heat and absorption chilling***.**

Either unit turbine can be adapted with a directional trust system which can be used during lifting and lateral positing for and addition cost by a Boeing approved subcontractor. The flight time can be increased by adding additional batteries, and is only limited to cost, space and weight constraints.
Dependent of design constraints the turbine engine could be re-engineered to rotate to more aggressively assist during lift-off and steering.

The remanufacture and re-air certified turboshaft engines and battery system can be ready for installation in approximately 9-months dependent of modifications or adaptive requirement of the airship.

Data sheets, independent documentary evidence, specifications, performance data, comparative charts and detail of the adaption and project delivery can be supplied on request.

around the world because of it efficiency and safety.