Stirling Engine

2008 - 2009
Stirling Engine Feasibility Study of an 80 to 100 Hp Engine and of Improvement Potential for Emissions and Fuel Economy. Final Report
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The Story of the Rice Husk Energy Project in Bangladesh
Energy Research Abstracts
How I Built a 5-Hp Stirling Engine
The Philips Stirling Engine
Assessment of a 40-kilowatt Stirling Engine for Underground Mining Applications
Test Results and Facility Description for a 40-kilowatt Stirling Engine
An Illustrated Guide
Liquid Piston Stirling Engines
Designing and Building Experimental Model Stirling Engines
Stirling Engines
A Beginners Guide

COMPTON GLOVER

2008 - 2009 Createspace Independent Pub
An assessment of alternative power sources for underground mining applications was performed. A 40-kW Stirling research engine was tested to evaluate its performance and emission characteristics when operated with helium working gas and diesel fuel. The engine, the test facility, and the test procedures are described. Performance and emission data for the engine operating with helium working gas and diesel fuel are reported and compared with data obtained with hydrogen working gas and unleaded gasoline fuel. Helium diesel test results are compared with the characteristics of current diesel engines and other Stirling engines. External surface temperature data are also presented. Emission and temperature results are compared with the Federal requirements for diesel underground mine engines. The durability potential of Stirling engines is discussed on the basis of the experience gained during the engine tests.
Stirling Engine Feasibility Study of an 80 to 100 Hp Engine and of Improvement Potential for Emissions and Fuel Economy. Final Report
CreateSpace
The Ringbom engine, an elegant simplification of the Stirling, is increasingly emerging as a viable, multipurpose engine. Despite its technical elegance, high-speed stable operation capabilities, and potential as an environment-friendly energy source, the advantages manifest in Ringbom design have been slowly realized, due in large to part to its often enigmatic operating regime. This book presents for the first time a clear, tractable mathematical model of the dynamic properties of the Ringbom, resulting in a theorem that offers a complete characterization of the stable operating mode of the engine. The author here details the research leading to the development of the Ringbom and illustrates theoretical results, engine characteristics, and design principles using data from actual Ringbom engines. Throughout the book, the author emphasizes an understanding of Ringbom engine properties through closed form mathematical analysis and lucidly details how his mathematical derivations apply to real engines. Extensive descriptions of the engine hardware are included to aid those interested in their construction. Mechanical, electrical, and chemical engineers concerned with power systems, power generation, energy conservation, solar energy, and low-temperature physics will find this monograph a comprehensive and technically rich introduction to Stirling Ringbom engine technology.
STIRLING ENGINES A, B, Г, Ringbom, MANSON Engine: 18 Engines You Can Build
Elsevier Science Limited
"Everyone needs power. Merrick Lockwood wants to use stirling engines to make that power. This book tells how Mr. Lockwood and his team, spent several years developing a simple, low tech, 5-HP Stirling engine in Dhaka, Bangladesh. It's the story of what worked then and what didn't along with Mr. lockwood's advice on which approaches would work well today. Lockwood's team built a Stirling

engine that could burn agricultural garbage (in this case rice husks), however different burners could be designed today to burn previously wasted fuels. Lockwood shows how he used the simple ideas from historic Stirling engines along with his team's innovations to make his engines work. This book is filled with detailed descriptions of Mr. Lookwood's engines along with 34 pages of drawings that have survived. The book includes 184 photographs that show the tools, and methods of fabrication that Lookwood used."--Publisher's description.

More Ltd Stirling Engines You Can Build Without a Machine Shop Van Nostrand Reinhold Company

In this project we are setting out to produce a Stirling Engine that will run on focused sunlight. The target power production will be 50 watts with a DC Generator which we will then use to charge a battery bank. Stirling Engines are external combustion engines that are able to run off of relatively small temperature differentials and they have an extremely high theoretical efficiency. This allows the Stirling engine to be used in various applications such as waste heat recovery and as a renewable energy source. This report covers the theoretical analysis of material strengths as well as a dimensional analysis of the engine itself to ensure that we are working with a productive design.

Stirling Engines Springer Science & Business Media

Mechatronics is a synergic discipline integrating precise mechanics, electrotechnics, electronics and IT technologies. The main goal of mechatronical approach to design of complex products is to achieve new quality of their utility value at reasonable price. Successful accomplishment of this task would not be possible without application of advanced software and hardware tools for simulation of design, technologies and production control and also for simulation of behavior of these products in order to provide the highest possible level of spatial and functional integration of the final product. This book brings a review of the current state of the art in mechatronics, as presented at the 8th International Conference Mechatronics 2009, organized by the Brno Technical University, Faculty of Mechanical Engineering, Czech Republic. The specific topics of the conference are Modelling and Simulation, Metrology & Diagnostics, Sensorics & Photonics, Control & Robotics, MEMS Design & Mechatronic Products, Production Machines and Biomechanics. The selected contributions provide an insight into the current development of these scientific disciplines, present the new results of research and development and indicate the trends of development in the interdisciplinary field of mechatronic systems. Therefore, the book provides the latest and helpful information both for the R&D specialists and for the designers working in mechatronics and related fields.

Final Report Wiley-Blackwell

This book provides invaluable and detailed information on building and optimizing Stirling engines. It's clear organization and the clarity of explanations and instructions have made the original Italian

language version of this book a huge success with Stirling Engine enthusiasts. All 260 pages are printed entirely in color and contain a large number of photos and illustrations. 18 of the authors' miniature engines are presented, each with a technical description, geometric characteristics and performance data, photos, and engine technical data sheets. "Excel" files for the necessary calculations can be obtained free of charge by sending an e-mail to the author. These were created by the author for each type of engines, namely Stirling Alpha, Beta, range engines, Ringbom (vertical and horizontal cylinder) and Manson. These make it easy to both design an engine and optimize it; these calculations include all engine volumes, both functional and "dead". The text is organized so it can be understood by readers with varying degrees of knowledge: to facilitate reading, we have grouped the mathematical notes that are not essential for initial understanding at the end of the relevant chapters. The basic thermodynamic concepts are explained in these notes. The text concerns two engines types: the Stirling (including the Ringbom model, which is the best known), and the Manson, sometimes called the Ruppel engine. There are similarities between the two theoretical cycles used in each; in one respect, however, they differ considerably: the cycle used in a Stirling engine produces mechanical energy by utilizing a gas that is hermetically sealed inside; in fact, the seal is not perfect: some inevitable minor losses occur. In contrast, the Manson is not a closed cycle. The engine that uses the Stirling cycle can be made in three configurations, generally called Alfa, Beta, Gamma, in addition to a fourth, the Ringbom type, in which the displacer is "free", i.e. not connected to the crank mechanism. An important consideration for the Beta and Gamma types is the optimization of output power by establishing the correct ratio between the volume of the displacer and the volume of the working cylinder, factoring different temperatures. Efficiency is calculated and examined. The book begins with the Gamma type, which is the easiest to understand, then the remaining Alfa, Beta and Ringbom types, the latter a "free-piston" engine, and concludes with the Manson type.

Eleven Stirling Engine Projects You Can Build

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Semiannual, with semiannual and annual indexes. References to all scientific and technical literature coming from DOE, its laboratories, energy centers, and contractors. Includes all works deriving from DOE, other related government-sponsored information, and foreign nonnuclear information. Arranged under 39 categories, e.g., Biomedical sciences, basic studies; Biomedical sciences, applied studies; Health and safety; and Fusion energy. Entry gives bibliographical information and abstract. Corporate, author, subject, report number indexes.

A Stirling Engine Computer Model for Performance Calculations

Oxford University Press

The objectives of the Automotive Stifling Engine (ASE) Development project were to transfer European Stirling engine technology to the United States and develop an ASE that would

demonstrate a 30% improvement in combined metro-highway fuel economy over a comparable spark ignition (SI) engine in the same production vehicle. In addition, the ASE should demonstrate the potential for reduced emissions levels while maintaining the performance characteristics of SI engines. Mechanical Technology Incorporated (MTI) developed the ASE in an evolutionary manner, starting with the test and evaluation of an existing stationary Stirling engine and proceeding through two experimental engine designs: the Mod I and the Mod II. Engine technology development resulted in elimination of strategic materials, increased power density, higher temperature and efficiency operation, reduced system complexity, long-life seals, and low-cost manufacturing designs. Mod Ii engine dynamometer tests demonstrated that the engine system configuration had accomplished its performance goals for power (60 kW) and efficiency (38.5%) to within a few percent. Tests with the Mod II installed in a delivery van demonstrated a combined fuel economy improvement consistent with engine performance goals and the potential for low emissions levels. A modified version of the Mod II was identified as a manufacturable ASE design for commercial production. In conjunction with engine technology development, technology transfer proceeded through two ancillary efforts: the Industry Test and Evaluation Program (ITEP) and the NASA Technology Utilization (TU) project. The ITEP served to introduce Stirling technology to industry, and the TU project provided vehicle field demonstrations for thirdparty evaluation in everyday use and accomplished more than 3100 hr and 8,000 miles of field operation. To extend technology transfer beyond the ASE project, a Space Act Agreement between MTI and NASA-Lewis Research Center allowed utilization of project resources for additional development work and emissions testing as part of an industry-funded Stirling Natural Gas Engine program.

Stirling Engine Design Manual CRC Press

This report presents the results of a six-month design and analysis study to develop and furnish a conceptual design of a radioisotope-powered thermodynamic engine to serve as the power source in an implantable circulatory support system. The study establishes the technical feasibility of a Stirling cycle engine using radioisotope fuel. Thermodynamic operating principles are given, and design and operating details of the power source are described. Shielding requirements and radiation level at the power source surfaces are presented parametrically."

Demonstration of a free piston Stirling engine driven linear alternator system Concept Publishing Company

The Regenerator and the Stirling Engine examines the basic scientific and engineering principles of the Regenerator and the Stirling engine. Drawing upon his own research and collaboration with engine developers, Allan J Organ offers solutions to many of the problems which have prevented these engines operating at the levels of efficiency of which they are theoretically capable. The Regenerator and the

Stirling Engine offers practising engineers and designers specific guidelines for building in optimum thermodynamic performance at the design stage. COMPLETE CONTENTS: Bridging the gap The Stirling cycle Heat transfer – and the price Similarity and scaling; Energetic similarity In support of similarity Hausen revised Connectivity and thermal shorting Real particle trajectories – natural co-ordinates The Stirling regenerator The Ritz rotary regenerator Compressibility effects Regenerator flow impedance Complex admittance – experimental corroboration Steady-flow Cf–Nre correlations inferred from linear-wave analysis Optimization Part I: without the computer Optimization Part II: cyclic steady state Elements of combustion Design study Hobbyhorse Origins Appendices

Assessment of the State of Technology of Automotive Stirling Engines CreateSpace DEFINITION AND NOMENCLATURE A Stirling engine is a mechanical device which operates on a closed regenerative thermodynamic cycle with cyclic compression and expansion of the working fluid at different temperature levels. The flow of working fluid is controlled only by the internal volume changes, there are no valves and, overall, there is a net conversion of heat to work or vice-versa. This generalized definition embraces a large family of machines with different functions; characteristics and configurations. It includes both rotary and reciprocating systems utilizing mechanisms of varying complexity. It covers machines capable of operating as a prime mover or power system converting heat supplied at high tempera ture to output work and waste heat at a lower temperature. It also covers work-consuming machines used as refrigerating systems and heat pumps abstracting heat from a low temperature source and delivering this plus the heat equivalent of the work consumed to a higher tem perature. Finally it covers work-consuming devices used as pressure generators compressing a fluid from a low pressure to a higher pres sure. Very similar machines exist which operate on an open regen erative cycle where the flow of working fluid is controlled by valves. For convenience these may be called Ericsson engines but unfortunate ly the distinction is not widely established and regenerative machines of both types are frequently called 'Stirling engines'.

The History, Science, and Reality of the Perfect Engine Oxford University Press, USA This book is about the Stirling engine and its development from the heavy cast-iron machine of the nineteenth century into the efficient high-speed engine of today. It is not a handbook: it does not tell the reader how to build a Stirling engine. It is rather the history of a research effort spanning nearly fifty years, together with an outline of principles, some technical details and descriptions of the more important engines. No one will dispute the position of Philips as the pioneer of the modern Stirling engine. Hence the title of the book, hence also the contents, which are confined largely to the Philips work on the subject. Valuable work has been done elsewhere but this is discussed only marginally in order to keep the book within a reasonable size. The book

is addressed to a wide audience on an academic level. The first two chapters can be read by the technically interested layman but after that some engineering background and elementary mathematics are generally necessary.Heat engines are traditionally the engineer's route to thermodynamics: in this context, the Stirling engine, which is the simplest of all heat engines, is more suited as a practical example than either the steam engine or the internal-combustion engine. The book is also addressed to historians of technology, from the viewpoint of the twentieth century revival of the Stirling engine as well as its nineteenth century origins.

Ringbom Stirling Engines Рипол Классик

Here is everything you need to know to build your own low temperature differential (LTD) Stirling engines without a machine shop. These efficient hot air engines will run while sitting on a cup of hot water, and can be fine-tuned to run from the heat of a warm hand. Four engine projects are included. Each project includes a parts list, detailed drawings, and illustrated step-by-step assembly instructions. The parts and materials needed for these projects are easily obtained from local hardware stores and model shops, or ordered online. Jim Larsen's innovative approach to Stirling engine design helps you achieve success while keeping costs low. All of the engines described in this book are based on a conventional pancake style LTD Stirling engine format. These projects introduce the use of Teflon tubing as an alternative to expensive ball bearings. An entire chapter is devoted to the research and testing of various materials for hand crafted bearings. The plans in this book are detailed and complete. This collection of engine designs is a stand-alone companion to Jim Larsen's first book, "Three LTD Stirling Engines You Can Build Without a Machine Shop."

Environmentally Friendly Stirling Engines, Their Applications Worldwide and Into Space Amer Society of Mechanical

As part of the SP-100 program, a phase 1 effort to design a free-piston Stirling engine (FPSE) for a space dynamic power conversion system was completed. SP-100 is a combined DOD/DOE/NASA program to develop nuclear power for space. This work was completed in the initial phases of the SP-100 program prior to the power conversion concept selection for the Ground Engineering System (GES). Stirling engine technology development as a growth option for SP-100 is continuing after this phase 1 effort. Following a review of various engine concepts, a single-cylinder engine with a linear alternator was selected for the remainder of the study. The relationships of specific mass and efficiency versus temperature ratio were determined for a power output of 25 kWe. This parametric study was done for a temperature ratio range of 1.5 to 2.0 and for hot-end temperatures of 875 K and 1075 K. A conceptual design of a 1080 K FPSE with a linear alternator producing 25 kWe output was completed. This was a single-cylinder engine designed for a 62,000 hour life and a temperature ratio of 2.0. The heat transport systems were pumped liquid-metal loops on both the hot and cold ends.

These specifications were selected to match the SP-100 power system designs that were being evaluated at that time. The hot end of the engine used both refractory and superalloy materials; the hot-end pressure vessel featured an insulated design that allowed use of the superalloy material. The design was supported by the hardware demonstration of two of the component concepts - the hydrodynamic gas bearing for the displacer and the dynamic balance system. The hydrodynamic gas bearing was demonstrated on a test rig. The dynamic balance system was tested on the 1 kW RE-1000 engine at NASA Lewis. Penswick, L. Barry and Beale, William T. and Wood, J. Gary Unspecified Center ENGINE DESIGN; HEAT TRANSFER; PISTON ENGINES; SPACE POWER REACTORS; STIRLING ENGINES; GAS BEARINGS; HEAT RESISTANT ALLOYS; PRESSURE VESSELS; REFRA...

Application of the Radioisotope-fueled Stirling Engine to Circulatory Support Systems Createspace Independent Pub

My history with stirling engines. -- A brief history of stirling engines. -- The stirling engine explained. -- What makes a good striling engine? -- Working with aluminum. -- Working with acrylic. -- Thermoforming vinyl. -- Tools needed for these projects. -- Engine #1 - the reciprocating stirling engine. -- Engine #2 - horizontal flywheel magnetic drive stirling engine. -- Engine #3 - vertical flywheel magnetic drive stirling engine. -- Appendices.

Engines You Can Build Crowood Press (UK)

Here is a collection of eleven Stirling engine projects, including five new groundbreaking designs by Jim Larsen. Now you can build simple pop can Stirling engines that look sharp and run incredibly well. The air cooled pop can engines will run for hours over a simple candle flame. Unlike most pop can engines, these don't need ice for cooling, so there is no mess to clean up and they can be run almost anywhere. And the Quick and Easy Stirling Engine will have you running your first Stirling engine in just a few hours. Jim Larsen's original designs made for this collection include: Single Chamber Pop Can Stirling Engine Dual Chamber Pop Can Stirling Engine Walking Beam Pop Can Stirling Engine Horizontal Pop Can Stirling Engine Quick and Easy Stirling Engine Kit builders will enjoy the detailed reviews of 4 commercially available kits. These kits are reviewed and tested for ease of assembly and performance. Building a Stirling engine kit can be a rewarding and satisfying experience, and you want to pick the kit that is right for you. You will discover what it takes to assemble and run these four engines: Thames and Kosmos Stirling Engine Car and Experiment Kit Think Geek Stirling Engine Kit by Inpro Solar MM5 Coffee Cup Stirling Engine Kit by the American Stirling Company Grizzly H8102 Stirling Engine Machined Kit The collection is rounded out by two classic designs that have pleased thousands of builders over the years. Many have enjoyed success building these classic designs: The SFA Stirling Engine Project (Stephen F. Austin University) Easy to Build Stirling Engine (Geocities/TheRecentPast)

Energy: a Continuing Bibliography with Indexes Stirling EnginesA Beginners Guide

The original Air Engines

(also known as a heat, hot air, caloric, or Stirling engines), predated the modern internal combustion engine. This early engine design always had great potential for high efficiency/low emission power generation. However, the primary obstacle to its practical use in the past has been the lack of sufficiently heat resistant materials. This obstacle has now been eliminated due to the higher strength of modern materials and alloys. Several companies in the U.S. and abroad are successfully marketing new machines based on the Air Engine concept. Allan Organ and Theodor Finkelstein are two of the most respected researchers in the field of Air Engines. Finkelstein is considered a pioneer of Stirling cycle simulation. The historical portion of the book is based on four famous articles he published in 1959. The rest of the chapters assess the development of the air engine and put it in the modern context, as well as investigate its future potential and applications. The audience for this book includes mechanical engineers working in power related industries, as well as researchers, academics, and advanced students concerned with recent developments in power generation. Co-published by Professional Engineering Publishing, UK, and ASME Press.

Stirling Cycle Engines

John Wiley & Sons

Some 200 years after the original invention, internal design of a Stirling engine has come to be considered a specialist task, calling for extensive experience and for access to sophisticated computer modelling. The low parts-count of the type is negated by the complexity of the gas processes by which heat is converted to work. Design is perceived as problematic largely because those interactions are neither intuitively evident, nor capable of being made visible by laboratory experiment. There can be little doubt that the situation stands in the way of wider application of this elegant concept. Stirling Cycle Engines re-visits the design challenge, doing so in three stages. Firstly, unrealistic expectations are dispelled: chasing the Carnot efficiency is a guarantee of disappointment, since the Stirling engine has no such pretentions. Secondly, no matter how complex the gas processes, they embody a degree of intrinsic similarity from engine to engine. Suitably exploited, this means that a single computation serves for an infinite number of design conditions. Thirdly, guidelines resulting from the new approach are condensed to high-resolution design charts – nomograms. Appropriately designed, the Stirling engine promises high thermal efficiency, quiet operation and the ability to operate from a wide range of heat sources. Stirling Cycle Engines offers tools for expediting feasibility studies and for easing the task of designing for a novel application. Key features: Expectations are re-set to realistic goals. The formulation throughout highlights what the thermodynamic processes of different engines have in common rather than what distinguishes them. Design by scaling is extended, corroborated, reduced to the use of charts and fully Illustrated. Results of extensive computer modelling are condensed down to high-resolution

Nomograms. Worked examples feature throughout. Prime movers (and coolers) operating on the Stirling cycle are of increasing interest to industry, the military (stealth submarines) and space agencies. Stirling Cycle Engines fills a gap in the technical literature and is a comprehensive manual for researchers and practitioners. In particular, it will support effort world-wide to exploit potential for such applications as small-scale CHP (combined heat and power), solar energy conversion and utilization of low-grade heat.
Stirling Engine Vineeth CS A study was made to evaluate the potential of a Stirling engine for significant improvement in emissions and fuel economy over the present-day internal combustion engine and to initiate, on the basis of the experience gained in the Ford/Philips 170 hp Stirling engine development program, the design of an engine in the 80 to 100 hp range suitable for use in a passenger car in the 2,500 to 3,000 lb weight class. The final report given covers two major tasks. Task I was the Contractor-financed testing of a 170 hp Stirling engine powered Torino passenger vehicle. The fuel economy of the 170 hp Stirling engine-powered Torino approximates that of similar 1977 model year production passenger vehicles in a comparable weight class, with comparable performance. Emissions meet the objective of 0.41/3.4/0.4 grams per mile (HC/CO/NO/sub x/). Task II was a design study of an 80 to 100 hp engine in a passenger car in the 2,500 to 3000 lb weight class based on the 170 hp Torino installation. The baseline vehicle selected for comparison purposes is a 1976 Pinto with a 2.3 liter 4-cylinder engine. The engine is rated 84 hp, with 4 double-acting cylinders, each of 98 cc displacement (4 to 98), and utilizes a swashplate drive. The swashplate Stirling engines did not package well in the compact car. Despite optimization of the engine to achieve minimum length, the Stirling powered compact car was 89 mm (3.5 inches) longer than its Pinto baseline. Fuel economy of the swashplate engine was adversely affected by attempts to fit it within the Pinto engine compartment. The 4 cylinder-dual crankshaft Stirling engine resulted in a very attractive vehicle. The engine packaged within the confines of the Pinto engine compartment. However, the packageable engine did not incorporate the rotary preheater as used on the swashplate engine. Emissions and noise level objectives could be met.
Bio-energy for Rural Energisation Springer Science & Business Media Hot air engines, often called Stirling engines, are among the most interesting and intriguing engines ever to be designed. They run on just about any fuel, from salad oil and hydrogen to solar and geothermal energy. They produce a rotary motion that can be used to power anything, from boats and buggies to fridges and fans. This book demonstrates how to design, build, and optimise Stirling engines. A broad selection of Roy’s engines is described, giving a valuable insight into the many different types and a great deal of information relating to the home manufacture of these engines is included in the workshop section.