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This project was Phase I of a multiphased program for the design and development of Stirling engines for stationary power generation applications in the 500 to 3000 horsepower range. Phase I comprised the conceptual design and associated cost estimates of a stationary Stirling engine capable of being fueled by a variety of heat sources, with emphasis on coal firing, followed by the preparation of a plan for implementing the design, fabrication and testing of a demonstration engine by 1985. The development and evaluation of conceptual designs have been separated into two broad categories: the A designs which represent the present state-of-the-art and which are demonstrable by 1985 with minimum technical risk; and the B designs which involve advanced technology and therefore would require significant research and development prior to demonstration and commercialization, but which may ultimately offer advantages in terms of lower cost, better performance, or higher reliability. The majority of the effort in Phase I was devoted to the A designs. Popular Science gives our readers the information and tools to improve their technology and their world. The core belief that Popular Science and our readers share: The future is going to be better, and science and technology are the driving forces that will help make it better. 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 Two centuries after the original invention, the Stirling engine is now a commercial reality as the core component of domestic CHP (combined heat and power) – a technology offering substantial savings in raw energy utilization relative to centralized power generation. The threat of climate change requires a net reduction in hydrocarbon consumption and in emissions of 'greenhouse' gases whilst sustaining economic growth. Development of technologies such as CHP addresses both these needs. Meeting the challenge involves addressing a range of issues: a long-standing mismatch between inherently favourable internal efficiency and wasteful external heating provision; a dearth of heat transfer and flow data appropriate to the task of first-principles design; the limited rpm capability when operating with air (and nitrogen) as working fluid. All of these matters are explored in depth in The air engine: Stirling cycle power for a sustainable future. The account includes previously unpublished insights into the personality and potential of two related regenerative prime movers - the pressure-wave and thermal-lag engines. Contains previously unpublished insights into the pressure-wave and thermal-lag engines Deals with a technology offering scope for saving energy and reducing harmful emissions without compromising economic growth Identifies and discusses issues of design and their implementation Two centuries after the original invention, the Stirling engine is now a commercial reality as the core component of domestic CHP (combined heat and power)--a technology offering substantial savings in raw energy utilization relative to centralized power generation. Meeting the challenge involves addressing a range of issues: a long-standing mismatch between inherently favourable internal efficiency and wasteful external heating provision; a dearth of heat transfer and flow data appropriate to the task of first-principles design; the limited rpm capability when operating with air (and nitrogen) as working fluid. The account includes previously unpublished insights into the personality and potential of two related regenerative prime movers--the pressure-wave and thermal-lag engines. -- 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. The design of an advanced Stirling engine is considered for potential use in Air Force mobile electric power generator sets. The prospects for acceptable reliability appears good due to new approaches to recognized Stirling problem areas; sealing, heater head and control. The present design appears suitable for a 30kW set, but Air Force needs would be best suited by development of a 60kW unit. Standardization would be facilitated by using the 60kW Stirling engine and associated auxiliaries in a 30kW set. Final design drawings have been completed in the 30kW engine but construction and tests are required to establish that both design criteria for the engine and mobile power requirements are met. Originator-supplied keywords include: Heat pipe, and Combustor control. Vol. for 1955 includes an issue with title Product design handbook issue; 1956, Product design digest issue; 1957, Design digest issue. 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." For this year's Senior Project Design, we will be inheriting last year's Alpha Stirling Engine with the intention of improving upon the design to have a functional prototype. With that, this will incorporate several design changes and different testing methods. From those changes, this will provide us with a baseline as far as the validity of analysis for this design. With further analysis of last year's engine, we noticed that it was faulty due to wrong assumptions and modelling. Last year's design team modelled the engine as a single piston, single cylinder engine. With the two pre-existing piston cylinders on their past design, we believe it wasn't appropriate for their design choice. This year we will pursue a different design provided by a text written by James R. Senft. This text will provide us with engineering drawings for a complete assembly on this type of air engine. Our main objective this year is to focus less on the dynamic analysis of Stirling Engines, but more on the potential applications it can be used in. This report will contain our iterative process of our final design and a brief analysis on the importance of scaling these engines in size. A program plan and schedule for the implementation of the proposed conceptual designs through the remaining four phases of the overall large Stirling engine development program was prepared. The objective of Phase II is to prepare more detailed designs of the conceptual designs prepared in Phase I. At the conclusion of Phase II, a state-of-the-art design will be selected from the candidate designs developed in Phase I for development. The objective of Phase III is to prepare manufacturing drawings of the candidate engine design. Also, detailed manufacturing drawings of both 373 kW (500 hp) and 746 kW (1000 hp) power pack skid systems will be completed. The power pack skid systems will include the generator, supporting skid, controls, and other supporting auxiliary subsystems. The Stirling cycle engine system (combustion system, Stirling engine, and heat transport system) will be mounted in the power pack skid system. The objective of Phase IV is to procure parts for prototype engines and two power pack skid systems and to assemble Engines No. 1 and 2. The objective of Phase V is to perform extensive laboratory and demonstration testing of the Stirling engines and power pack skid systems, to determine the system performance and cost and commercialization strategy. Scheduled over a 6 yr period the cost of phases II through V is estimated at $22,063,000. (LCL). This collection of essays and reviews represents the most significant and comprehensive writing on Shakespeare's A Comedy of Errors. Miola's edited work also features a comprehensive critical history, coupled with a full bibliography and photographs of major productions of the play from around the world. In the collection, there are five previously unpublished essays. The topics covered in these new essays are women in the play, the play's debt to contemporary theater, its critical and performance histories in Germany and Japan, the metrical variety of the play, and the distinctly modern perspective on the play as containing dark and disturbing elements. To compliment these new essays, the collection features significant scholarship and commentary on The Comedy of Errors that is published in obscure and difficulty accessible journals, newspapers, and other sources. This collection brings together these essays for the first time. The first phase of the design and development of Stirling engines for stationary power generation applications in the 373 kW (500 hp) to 2237 kW (3000 hp) range was completed. The tasks in Phase I include conceptual designs of large Stirling cycle stationary engines and program plan for implementing Phases II through V. Four different heater head designs and five different machine designs were prepared in sufficient detail to select a design recommended for development in the near future. A second order analysis was developed for examining the various loss mechanisms in the Stirling engine and for predicting the thermodynamic performance of these engines. The predicted engine thermal brake efficiency excluding combustion efficiency is approximately 42% which exceeds the design objective of 40%. The combustion system designs were prepared for both a clean fuel combustion system and a two-stage atmospheric fluidized bed combustion system. The calculated combustion efficiency of the former is 90% and of the latter is 80%. Heat transport systems, i.e., a heat exchanger for the clean fuel combustion system and a sodium heat pipe system for coal and other nonclean fuel combustion systems were selected. The cost analysis showed that for clean fuels combustion the proposed 2237 kW (3000 hp) system production cost is $478,242 or $214/kW ($159/hp) which is approximately 1.86 times the cost of a comparable size diesel engine. For solid coal combustion the proposed 2237 kW (3000 hp) system production cost is approximately $2,246,242 which corresponds to a cost to power capacity ratio of $1004/kW ($749/hp). The two-stage atmospheric fluidized bed combustion system represents 81% of the total cost; the engine represents 14% depending on the future price differential between coal and conventional clean fuels, a short payback period of the proposed Stirling cycle engine/FBC system may justify the initial cost. (LCL). SOLIDWORKS 2019 Quick Start introduces the new user to the basics of using SOLIDWORKS 3D CAD software in five easy lessons. This book is intended for the student or designer that needs to learn SOLIDWORKS quickly and effectively for senior capstone, machine design, kinematics, dynamics, and other engineering and technology projects that use SOLIDWORKS as a tool. Engineers in industry are expected to have SOLIDWORKS skills for their company’s next project. Students need to learn SOLIDWORKS without taking a formal CAD course. Based on years of teaching SOLIDWORKS to engineering students, SOLIDWORKS 2019 Quick Start concentrates on the areas where the new user improves efficiency in the design modeling process. By learning the correct SOLIDWORKS skills and file management techniques, you gain the most knowledge in the shortest period of time. You develop a mini Stirling Engine and investigate the proper design intent and constraints. The mini Stirling Engine is based on the external combustion, closed cycle engine of Scottish inventor Robert Stirling. In addition to 3D modeling, the engine can be used to teach and connect many engineering and physics principles. You begin with an overview of SOLIDWORKS and the User Interface (UI), its menus, toolbars and commands. With a quick pace, you learn the essentials of 2D sketching, part and assembly creation, perform motion study, develop detailed part and assembly drawings and much more. 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. Publisher description Mechanical Technology Incorporated is developing a 1 KWe Free-Piston Stirling ENgine

(FPSE) Power System. The plan for testing the demonstrator power system is presented. The test hardware is a Free-Piston Stirling Engine prime mover driving a linear alternator. The demonstrator system is basically a modular assembly. The modules are the reciprocating alternator section, engine section, heater head insulation package assembly, and the pressure vessel. The test objective is to demonstrate a system with greater than 30% overall efficiency at 1 KW, 45 hz operating conditions, and to identify and isolate engine losses to provide a basis for future engine improvements. Presents eleven projects demonstrating how to build simple, fun, and educational Stirling engines from available kits. Popular Science gives our readers the information and tools to improve their technology and their world. The core belief that Popular Science and our readers share: The future is going to be better, and science and technology are the driving forces that will help make it better. Comprehensive Energy Systems provides a unified source of information covering the entire spectrum of energy, one of the most significant issues humanity has to face. This comprehensive book describes traditional and novel energy systems, from single generation to multi-generation, also covering theory and applications. In addition, it also presents high-level coverage on energy policies, strategies, environmental impacts and sustainable development. No other published work covers such breadth of topics in similar depth. High-level sections include Energy Fundamentals, Energy Materials, Energy Production, Energy Conversion, and Energy Management. Offers the most comprehensive resource available on the topic of energy systems Presents an authoritative resource authored and edited by leading experts in the field Consolidates information currently scattered in publications from different research fields (engineering as well as physics, chemistry, environmental sciences and economics), thus ensuring a common standard and language "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.