ME95 Product Realization
"Moriya Stirling Engine Fan Project"

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Abstract

ME95 "Product Realization," is an interdisciplinary, sophomore course in the Mechanical Engineering undergraduate program that provides an introduction to the product development process, including design, fabrication, assembly and testing. Different techniques are compared for their costs and limitations. The course includes a multi-team project that involves fabrication of components for assembly into a complex, functioning system.

Two sections of one- and two-person teams work together to fabricate parts and assemble two functioning Stirling Engine Fans from a variety of ferrous and nonferrous materials and different joining methods using mills, lathes, drills, press brakes and other manufacturing equipment.

Introduction

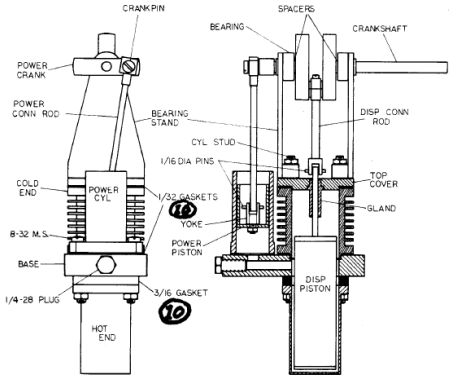
The ability to produce and manipulate materials to satisfy engineering design requirements are historical drivers to the development and advancement of human societies. ME95 "Product Development" emphasizes fundamental aspects related to fabrication and shaping of engineering materials: casting, forming, machining, joining, etc. Project-based laboratory experience emphasizes teamwork, communication and collaboration.

The primary goals of this course are 1) To understand how manufacturing is incorporated into the different stages of the design process; 2) To demonstrate a basic understanding of various manufacturing processes such as material removal, joining, deformation, solidification, automation, etc.; and 3) To utilize basic proficiency with manual machining processes on the lathe and mill.

[1] Senet, J.M., "A 10-inch Stirling Engine Powered Fan...Moriya", *Steam and Stirling* , W.C. Fitt, ed, Wildwood Pub, Transverse City, MI, ISBN 0-914104-06 (1980)

Stirling Engine Fan

The Stirling Engine Fan project is based on an article[1] published by an engineering professor and machinist-hobbyist in 1980 detailing the fabrication, assembly and operation of the Moriya Stirling Engine Fan. The two-cylinder (i.e., two-pistons: power and displacer) Stirling Engine uses air as a "working fluid" and an alcohol lamp as a heat source.



Cross Sections of Moriya Stirling Engine Fan

Final assembly of One Version of Moriya Stirling Engine Fan

Process Plans, Drawings and Assembly

To begin the project each group of students is assigned part(s0 to fabricate. Students then produce draft process plans and drawings to fabricate the parts. After obtaining approval to proceed, the proper raw stock (geometry and material) as well as initial training (typically mill or lathe) to fabricate the part is provided. Upon completion, the part is inspected and, if approved, the student creates the final process plan and the part is added to the parts inventory for final assembly. If not approved, the part is reworked until correct. Assembly of the Moriya Stirling Engine Fan using threaded fasteners commences when the inventory of approved parts is complete. Close attention is paid to sealing all leaks at gasketed mating surfaces, joints, and threaded plugs. After light lubrication of sliding surfaces, performance testing commences by applying heat from an alcohol lamp to the hot end.

Summary/Conclusions

While lectures and homework in ME95 "Product Development" provide the substance part of the course, the project provides the experiential, application part of the course. In a proposed "spiral curriculum" in Mechanical Engineering the Moriya Stirling Engine Fan project would help students reinforce concepts and practice by being revisiting the same project from different viewpoints in their coursework. For example, students would 1) create solid model files and plan drawings of Stirling engine parts in their introductory engineering graphics courses, 2) fabricate and assemble actual Stirling engine parts in their product development course, 3) analyze thermodynamics and heat transfer of the Stirling Engine in their respective courses and 4) evaluate machine dynamics and machine elements of the Stirling engine in their respective courses. Currently students "see" the Stirling engine project only in ME95 but already they are excited and yearning to learn more about Stirling engines, manufacturing, thermodynamics and heat transfer.