The Bay Area Engine Modelers Club, Branch 57 of EDGE&TA

**MEMBERSHIP**
**$25.00 US**
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# The Crank Calls

March 2008


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NEXT MEETING
March 15, 2008 at
Chabot College, building 1400
25555 Hesperian Blvd, Hayward 94545
Doors open at 9 AM
Meeting Starts at 10 AM

**Upcoming Events**
CA Antique Farm Show, Tulare, Apr. 19-20
NAMES, Toledo, OH Apr. 19-20
Dream Machine, Half Moon Bay, Apr. 27
Antique Farm Eqpt Show, Woodland, June 20-22
Hillsborough Concours, May 4

## MEETING NOTES

**2-15-08**
**Carl Wilson**

The new president of BAEM, Don Jones, began the February meeting with the introduction of guests and new members: William Zurbick, father of Larry Z. - one of our members: they are both interested in building scale model engines. And Lon Keeth who "… would like to build a Hoglet, Little Devil, a steam engine, and then a multi-cylinder." Lon was busily gathering information and pictures of Dwight and Georges's Little Devils.

First Pop honors were awarded to George Gravatt: one of the three Red Devils that he and Dwight are building ran for a minute and a half, but George says that it did not run well. With George on the job, shouldn't take too long to make things right.

We have a new home! President Don Jones has made arrangements for BAEM meet at Chabot College in Hayward. The cost to the club as a whole is nominal: we will function as an advisory committee to the machine tool program. Note that the cost to you as an individual is $2 for parking. The ticket machines take dollar bills. Free parking is available on the street and in the flea market parking lot. See the sidebar for directions to the college.

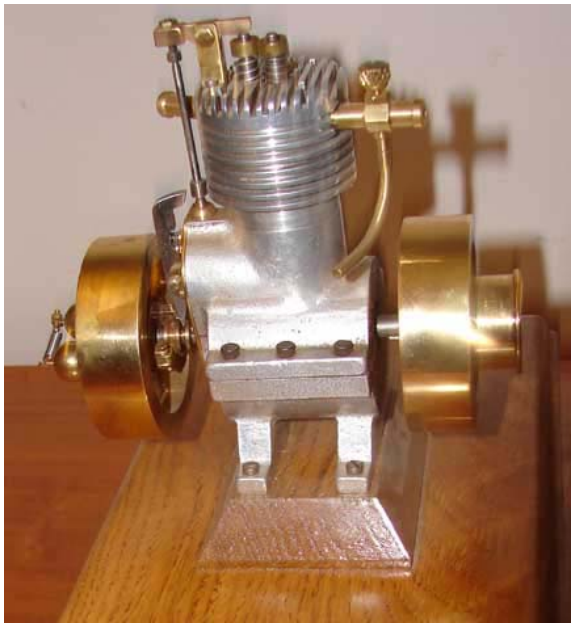
Planning for the club show has been on hold while Dick Pretel tried to convince the San Mateo County Fire Department that our use of gasoline inside the exhibition hall at the county fairgrounds was not a fire hazard. He hopes to meet with the fire department sometime during the week after the meeting. Mike Rehmus will reserve our prior site in Vallejo as a backup. This just in as I write the newsletter: the fire department has not responded to Dick's request for a meeting and at this time (2-25-08) it is likely that the show will be held in Vallejo.

Mike Rehmus gave us a "sneak preview" of changes coming to Model Engine Builder. He is going to begin including build articles on steam and Stirling engines, and to whet our appetite; the first non-IC engine centerfold will be published soon. Rich Carlstedt's magnificent model of the engine of John Erickson's steam ship Monitor will be featured. Excellent photos of this model are here: http://www.stationarysteam.com/index.htm

From Robert Allen: "My father, Bob Allen, who was a member of BAEM for many years passed away at home Friday evening, Feb. 29th. He had attended meetings since they were held at Paul Bennet's in Hayward. Bob Allen He was diagnosed with multiple myeloma in 1997 and fought it successfully for much longer than the doctors thought possible." Bob served as editor of the Crank Calls for several years.

Dick Remington displayed his Golden Eagle designed by Bob Shores. This is a limited memorial edition of the Silver Eagle, cast in bronze, and sold by Bob Shores' widow, Margaret.

The Red Devil that won George Gravatt First Pop honors.



Dwight Giles' Little Devil with air-cooled cylinder and head. Dwight turned the OD of the cylinder casting and shrunk on an aluminum sleeve. The fins were turned by plunging a parting tool full depth through the sleeve and into the casting.

George Gravatt's Little Devil with water-cooled cylinder.

Shannon Lile explains the operation of the Stirling cycle hot air engine using this diagrammatic representation.

**TECH TOPICS: HOT AIR ENGINES**

The year is 1712 and the owners of coal and tin mines in England have a problem. Their mineshafts have been sunk below the water table, water is filling the lowest workings, and they require pumping. Thomas Newcomen built the first useful steam engine in this year

for pumping duty at a coal mine. Steam power had arrived! In the following century steam powered what became known as the Industrial Revolution. But all was not well. Without a boiler, a steam engine is a cold collection of iron parts and the boiler became the problem. In the century following the first Newcomen engine, boiler pressures rose from barely above atmospheric to 150 psi (Richard Trevithick, 1802.) The available materials, fabrication methods, and standards of safe operation and maintenance were inadequate for these pressures, and boiler explosions with consequent loss of life and property were frequent.

There was room for another type of motive power and in 1818 Robert Stirling, a Church of Scotland clergyman, built his first hot air engine to pump water from a quarry in England. There were earlier hot air engines but the invention by Stirling of the thermal "regenerator" and the closed cycle made the hot air engine a practical and safe device. The working fluid, as the name implies, is air: unlike hot pressurized water in a boiler, hot air under pressure is non-explosive and thus safer than steam. Like a boiler and steam engine, a hot air engine is classed as an external combustion engine, that is, the fuel is consumed outside the engine rather than inside the cylinder. The EC engine is able to burn a wide variety and quality of fuels, and because combustion takes place at ambient pressure, there is less smog-producing byproducts.

The major parts of a Stirling cycle engine are shown in Shannon's diagram above. At his right hand is the furnace: shovel the fuel in and light the fire. Above the furnace is the hot end of the displacer cylinder. The displacer piston is at the cold end of the cylinder and just visible are some wavy lines outside the cylinder that represent the cold water jacket. Not shown is the joint and gasket between the hot and cold ends of the cylinder that separate the two temperature regions and prevent direct flow of heat between them. The displacer cylinder and piston form a double acting pair and the displacer rod must travel in a straight line so there is a guide (crosshead) at the top of the cylinder. Because the Stirling cycle is closed the piston rod must also pass through a sealing gland to prevent leakage of the working fluid. There is a connecting rod from the crosshead to the crankpin on the flywheel. To the right of the flywheel is the power piston and cylinder: this is a single acting pair and has only a connecting rod. Note that in this example the two cylinders share the crankpin and are at 90 degrees to each other: this phase relationship between the two is essential for operation. A transfer pipe connects the two cylinders and changes in the pressure of the air in the displacer cylinder are transferred to the power cylinder. The displacer piston is a loose fit in its cylinder, actually there is quite a bit of space between them. The regenerator, frequently a wire mesh element, may be placed in the space between the cylinder and piston. (For more information see the Wikipedia article cited below.)

The Stirling hot air engine is theoretically capable of high efficiencies, but there are difficulties in the real world:

1. They tend be large and heavy for their power output
2. The design of the regenerator is difficult and requires special materials
3. The hot end may also require special materials
4. Pressurizing the system will increase efficiency, but this introduces the problem of sealing the moving parts. Helium is an excellent working fluid but it is difficult to seal.
5. Placing the displacer and power cylinders as close together as possible improves thermal efficiency at the cost of considerable mechanical complexity
6. The Stirling hot air engine is not suitable for varying output (automobiles) and it requires a warm-up period.

Shannon provided these notes:

# Hot Air and Stirling Engines, an overview

For a general discussion of Stirling Cycle engines, including animations of different styles of engines, see http://en.wikipedia.org/wiki/Stirling_engine.

For a university level discussion, for those with a math or engineering background, see http://www.ent.ohiou.edu/~urieli/stirling/me422.html.

A unit to provide combined heat and electrical power, may be seen at http://www.whispertech.co.nz/index.html. Nice unit, but expensive.

A vast array of links to other info on Stirling Engine development, including info on model Stirlings, see http://www.bekkoame.ne.jp/~khirata/english/others.htm.

**Some Current Uses for a Stirling Engine**

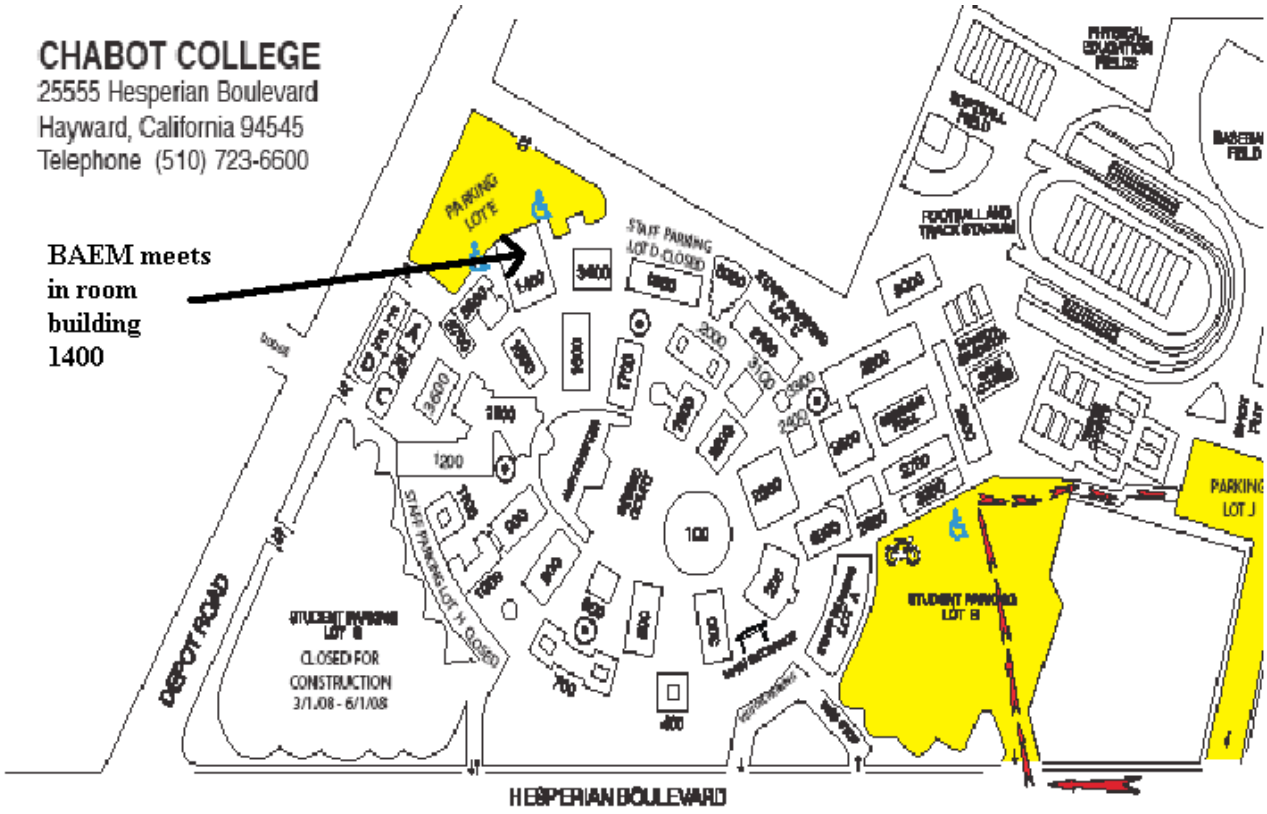
Heats homes in The Netherlands with 50-75 hp engine.
Provides basic power (5 hp) in Bangladesh by burning rice husks on the hot side of the engine (Lockwood engine).
Provides basic power to remote African villages by burning wood (1-5 hp Van Arsdell-Howard University engine).
Coleman (The Outdoor Company) of the U.S. makes a Stirling powered camping freezer, which unlike thermoelectric units, will maintain freezing temperatures in 100* F ambient, with only 24 watts consumption.
Power oceanographic exploration submarine for Jacques Costeau, the Saga, so his team can quietly sneak up on the fishies and the whalies.
Power military submarines almost as quiet as nuclear—a 1300 hp Stirling engine drives subs in the Swedish and Danish fleets
Powers remote scientific research stations in Antarctica, providing power to run the experiments, the telescope, and send back data to scientists in warmer locations.
Provides power to homes and businesses in Las Vegas, Nevada. The heat source is a series of solar collectors.
Whispertech of New Zealand makes a combined electrical generator and hot water supply for yachts.

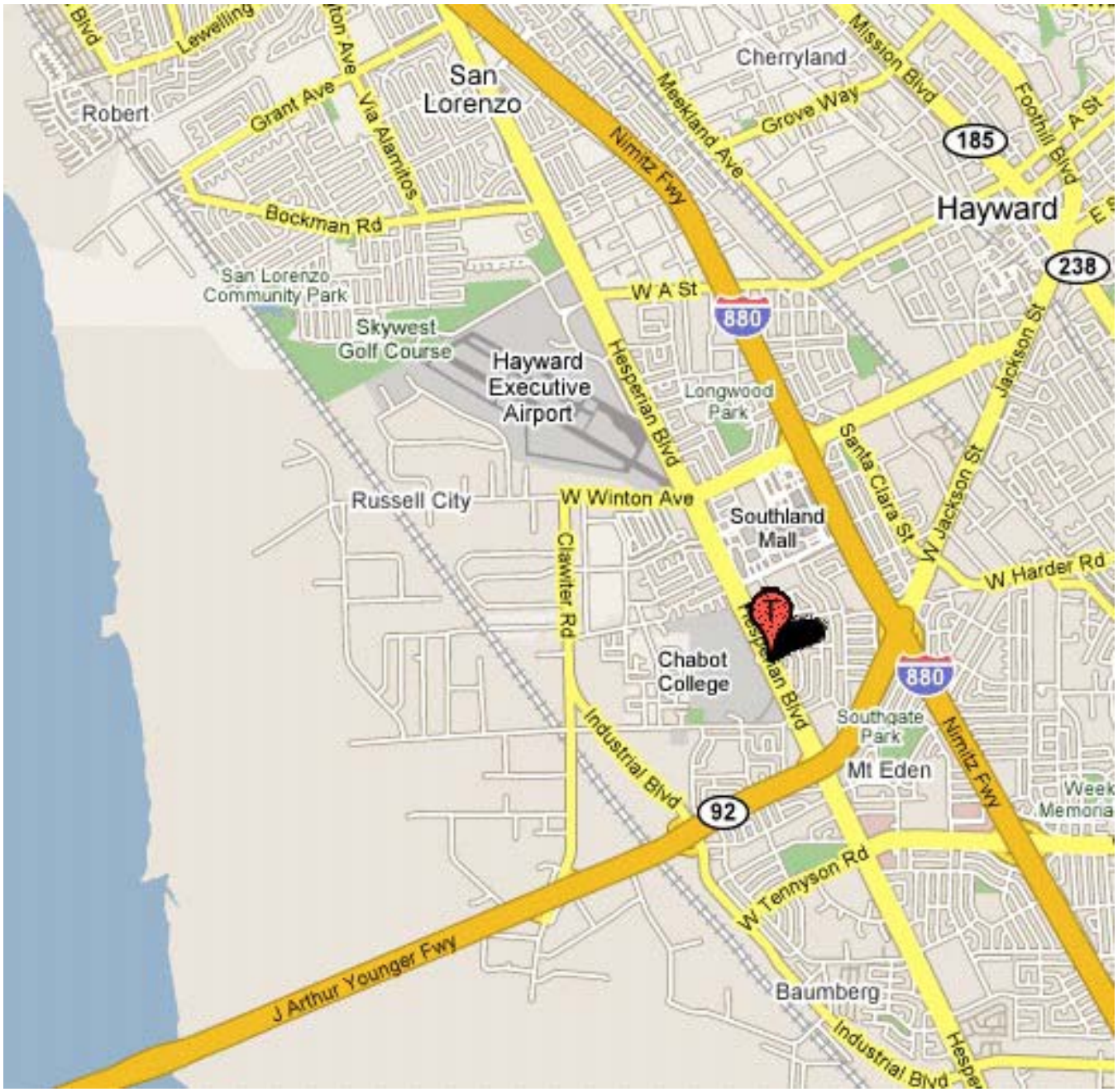
**Historical uses of Sterling engines**

A Car: an experimental AMC Spirit was powered by a Stirling engine in the 1970's.
Fans: from the 1880's to 1930's, fans were often powered by Stirling engines.
As a veritable replacement for any steam engine, the Stirling engine is much safer—which is why the Reverend Robert Stirling invented it in 1816!
Refrigerators and freezers: Sun Power of Athens, Ohio developed Stirling-powered refrigeration units in the 1980's but they did not dent the market

Stirling cycle coolers generate liquid oxygen and liquid nitrogen in labs all around the world. It's a moderately priced way to do so!
Domestic water pumps: 1870's to 1920's. Rider Ericcson, Caloric, and others built thousands of these.
Sewing Machines: 1870'w to 1920's

# Directions to our new meeting place:
# Parking is off Depot Rd
# BAEM meeting is in bldg 1400
# See next page for an area map






Area map, Red T points to Chabot College