

March 2011

# HIT & MISS

Journal of the Western Antique Power Associates



Amberg gas-illumination plant, fans, and KY-KO power unit from the collection of Gerd Maier

## HOT AIR ENGINES

THEY'RE NOT JUST FOR PUMPING WATER BY ROB SKINNER

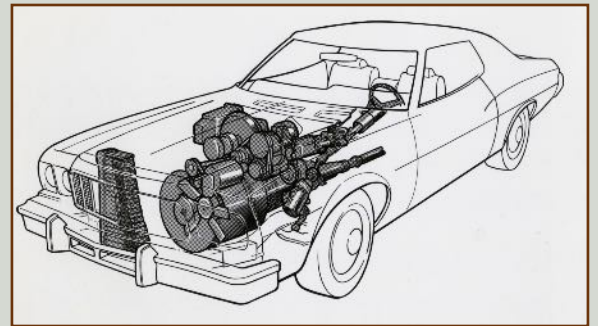
Hot air, or "Stirling Cycle," engines are a somewhat eclectic subset of the antique engine hobby. Some enthusiasts go so far as to specialize exclusively in hot air engines. From the examples often seen at shows, it would be easy to make the assumption that the big engines were just used for pumping water, and the small engines were just used for fanning air. Nothing could be further from the truth.

Stirling cycle engines have been used for purposes such as propelling ships and submarines, running generators for military radios, and producing illuminating gas for homes and theaters.

Nowadays, we often read in the news media of various forms of power generation for electricity and transportation: photovoltaic solar power, wind power, electric vehicles, and sometimes we even hear mention of the Stirling engine. Most often, the use of Stirling engines is in regards to utilizing the waste heat from other power generation processes. But the Stirling engine has also been used in modern times as a more efficient and environmentally friendly method of propelling automobiles.

It was thirty five years ago, on April 14, 1976, that the Ford Motor Company, in conjunction with Philips

Company of the Netherlands, unveiled the world's first Stirling engine powered passenger car. At the time, the world was winding down from the energy crises of the early 1970s, and there was much interest in automobiles with greater fuel efficiency.



Only minor modifications are necessary to package the Ford-Philips Stirling engine in a 1975 Torino. The engine mates to a conventional Ford C4 transmission. The Stirling is considered a leading alternative-engine candidate because of its potential for low emission and noise levels, improved fuel economy, smoothness of operation, and ability to operate on a variety of fuels.



Ford Motor Company research executives Norman D. Postma, Ernest W. Kitzner, Emmett J. Horton, and Jack D. Collins inspect the experimental Stirling engine in a 1975 Torino. Ford Research Vice President Dr. W. Dale Compton said vehicle testing is just beginning with the engine, and that solutions to engineering and manufacturing problems would take at least ten years.

Since 1968, Philips had been experimenting with a sixty horsepower, four-cylinder swashplate engine. Ford decided to utilize the Philips design, in a configuration that used four cylinders of 215cc displacement, and which generated 170 horsepower.

In antique engines, the working gas is air. In order to achieve the high power output needed in an automobile, the working gas of the 4-215 engine is hydrogen, maintained in the range of 3000 psi. Hydrogen is a much smaller molecule than the components of air, and has much better heat-transfer characteristics. It also presents the problem of hydrogen embrittlement of the high temperature engine components. To meet this challenge, high temperature alloys were used in the construction of the engine. It was intended to use cheaper materials in subsequent phases of development.

Power control on the antique engines was achieved by temperature differential; in other words, building a bigger fire. To achieve the "instant throttle" characteristics required by a modern

automobile, the temperature of the heater head of the 4-215 engine is maintained at a constant 1382° Fahrenheit. Power output is changed by varying the pressure of the hydrogen gas within the engine.

Starting the 4-215 engine is not much different than starting the comparable 351 cid internal combustion engine of the time.

Warm-up time is about fifteen seconds.

The noise created by the Stirling engine powered Torino is substantially less than the internal combustion engine, as the combustion process is constant. The noise level was measured at 68 dba, about 15 dba lower than comparable passenger cars of the period.

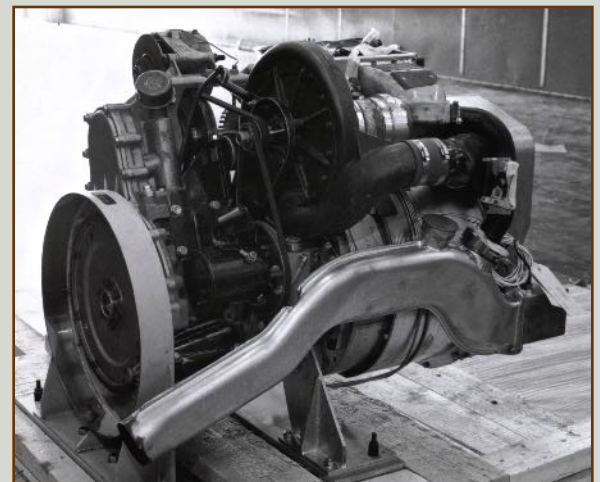
Some of the unresolved issues of Ford/Philips project were elimination of waste heat, sealing the high-pressure hydrogen within the engine, safety concerns for dealing with high pressure hydrogen, and maintaining low emissions over the life of the automobile.

These challenges, along with substantial refinements in the reliability and efficiency of the internal combustion engine, led to the abandonment of the Stirling engine for the propulsion of automobiles.

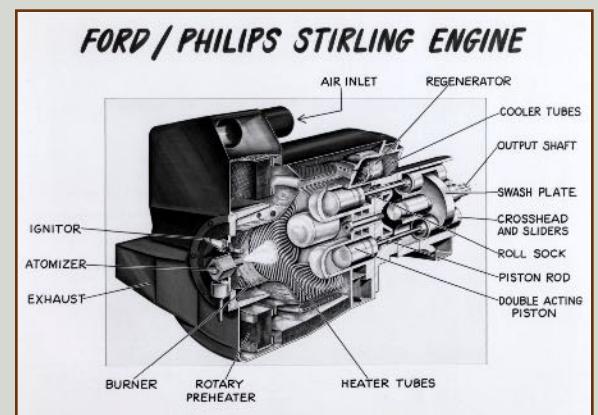
For more information on antique Stirling engines, and to purchase his books on the subject, visit Gerd Maier at <http://www.stirlingmaier.com>

Photographs and data regarding the Ford-Philips engine and Stirling powered Ford Torino are from the library of Rob Skinner.

Comparison between Stirling & IC	4-215 Stirling	1975 351-2V
Cylinders	4 cyl.	8 cyl.
Displacement	52 cid	351 cid
Horsepower	170 hp @ 4000 rpm	150 hp @ 3800 rpm
Torque	300 ft-lb @ 1400 rpm	244 ft-lb @ 2800 rpm
MPG City	13.9	10.3
MPG Highway	20.2	16.3
0-60 MPH	12.6 sec	15.8 sec
25-60 MPH	10.2 sec	11.2 sec
50-80 MPH	12.8 sec	19.5 sec



The compact shape of the Ford-Philips 4-215 Stirling engine is illustrated by this rear side view.



Major components of the 4-215 engine are illustrated in this cutaway drawing. Located at the front (left) is the burner, where atomized fuel is ignited, providing the heat source for increasing the temperature of the working gas in the heater/head tubes. Also shown is the swashplate, which serves the same function as the crankshaft in a conventional engine, converting the linear motion of the pistons into a rotary motion.

# MINUTES OF THE BOARD OF DIRECTORS MEETING HELD FEBRUARY 11, 2010

**Board Members Present:** Tom Millett, Bob Smith, Jack Johnson, Joe Siddons, Bob Swan, Jim Davis & Leroy Overstreet.

**Board Members excused:** Dan Kato, Craig Maxwell & Kelley Garcia.

**Members present:** Cody Johnson, Frank Moody, Don Hunter, Dutch Bankston, David Paul, Dave Ruhland, and Gus Lukrofka.

**Visitors:** Heather (Davis) Pack, Hunter Pack & Sailor Pack.

In Dan Kato's absence, Secretary Tom Millett called the meeting to order at 6:30 p.m.

Flag Salute led by Bob Smith.

## **REPORTS:**

**President:** Absent

**Vice President:** No report.

**Secretary:** On a motion by Jack Johnson and seconded by Joe Siddons, the minutes of the February 11, 2011 were approved with one correction (under the Vice President's report) the word seric should be services.

**Treasurer:** Treasurer Kelley Garcia absent. Bob Smith presented the treasurer's report that he received from Treasurer Garcia by e-mail. The report is the year end report with detailed info for the entire year. Inflows (money taken in) total \$5,195.37. Outflows total \$6,654.81. However, that figure includes a transfer of funds to the museum fund as required. On motion by Bob Smith and seconded by Jack Johnson, report was received and filed.

**Membership:** Jim Davis reported that Bob DeVoe has reached life member status. Bob sent \$35 as a gift to the general fund. The board members thanked Bob. After review of WAPA Charter Members under 80

years of age, only Bill Baldwin qualifies for life status. Jim notified Bill of his special designation. And thanked him for his work in starting the WAPA organization.

87% of members have renewed 2011 membership. 84 members are paid. Jim noted that we have a bad e-mail address for John Madole and Phil Sigmon. Ellie Klenske did not renew.

**Purchasing:** Leroy Overstreet had nothing to report.

**Shows:** Jim Davis mentioned a TV show called "Pawn Stars".

Bob Smith reported that the Highland Citrus Festival is on March 26th. He moved to sanction it. Seconded by Jack Johnson. Passed unanimously. The Antique Farm Equipment show is on April 15, 16 and 17 in Tulare, CA.

The Negotiating Committee consisting of Bob Smith, Rob Skinner, and Tom Millett have met with Knott's Berry Farm officials. They want us to put on a nine day event from April 16 through the 24th. On a motion by Smith & seconded by Leroy Overstreet the show was sanctioned. Negotiations on terms of the contract are forthcoming. Once negotiations have concluded, the Planning Committee will take over. That committee consists of Bob Smith, Kelley Garcia, Larry Evans and Ken Evans.

Don Hunter presented the idea for a tour at the Vernon Power Plant. There are five, eight cylinder, double acting two stroke, 8,000 HP engines there. Member Dutch Bankston will arrange the tour. Dutch needs a commitment of members wishing to take part in the tour. There is only one chance to see them because there will be no other tours in the future. He needs two possible dates. It was decided that it will be at 10:00 a.m. on either Tuesday, March 8 or Thursday, March 17. The tour lasts approximately 45 minutes. Dutch will

arrange for the tour to have the number of participants not to exceed forty. Information will be put out over the internet.

**Library:** Jack Johnson asked that he be permitted to dispose of the training aid machines that have been in the library for years and are totally outdated. On motion by Jack Johnson & seconded by Jim Davis, the vote was unanimous to let Jack dispose of the machines as he sees fit.

**Safety:** Joe Siddons had nothing.

**Museum:** Craig Maxwell absent.

**Glendora Castle:** No report.

**Cal Poly Restoration Project:** Bob Smith reported on the progress of work on the orchard sprayer and tractor restorations. He also reported that there was a nice article about our work in the Poly Post.

**Editor Report:** Rob Skinner absent.

**Unfinished Business:** None

**New Business:** None

**Announcements:** Gus Lukrofka mentioned that he has an offer for a tour in the Covina Hills. He will arrange for it and get back with the board.

**Adjournment:** 7:55 p.m.

## **Tom Millett, Secretary**

The Western Antique Power Associates is a 501(c)3 organization comprised of individuals who are dedicated to the preservation of antique engines, agricultural equipment, industrial tools, and other machinery that is part of our heritage.

For more information, please visit us at [www.wapa.us](http://www.wapa.us).



Tulare: Engines, tractors, quilts, flowers, crafts, food, and a good time for all!

## UPCOMING EVENTS

### **Board of Directors Meeting April 8, 2nd Friday of the Month 6:30 p.m. – 8:30 p.m.**

The WAPA Board of Directors meeting is held at Heritage Park in Santa Fe Springs. All members are welcome and encouraged to attend. If you have ideas on how WAPA can become a better club, or if you just want to come and join in the festivities, please join us.

Heritage Park Rd. is located just south of Telegraph Road just west of Norwalk Boulevard. The meeting is held in the train depot next to the steam locomotive.

### **March 26, Saturday Highland Citrus Harvest Festival 10:00 a.m. – 3:30 p.m. Show Chairman: Bob Smith**

Highland is always a fun show with plenty of spectators and other displays to look at. Our display is on Center Street, north of Main Street, in Highland. There is ample space and ample parking. Bring your own shade and water.

### **April 15-17 Tulare California Antique Farm Equipment Show**

Collectors come from across the United States to attend California's largest antique farm equipment show. In addition to the hundreds of engines and tractors, there is a nice swap meet, auction, tractor parade, steak dinner, and displays of interest to the whole family. Tulare is about 175 miles, or three hours, from downtown Los Angeles.

WAPA will have our own display area, in the usual spot. You can sign up at the front gate when you arrive, or better, download the entry form from [www.antiquefarmshow.org](http://www.antiquefarmshow.org).

Dick and Maureen Bouma traditionally host a breakfast in our display area on Saturday morning. If you plan on attending, please contact them at [corvette59@verizon.net](mailto:corvette59@verizon.net) so they will be able to plan accordingly.

If you have any questions, contact Rob Skinner at [editor@wapa.us](mailto:editor@wapa.us).

### **April 16, Saturday Heritage Park Children's Day 12:00 p.m. – 4:00 p.m. Show Chairman: Bob Smith**

Heritage Park is where we hold our monthly board meetings. They've asked WAPA to put together a few hands-on displays for their annual event. This is a small event. For further details, contact Bob Smith at [smith@diamondpointe.us](mailto:smith@diamondpointe.us).

### **April 16-24 Knott's Berry Farm**

WAPA has been invited to participate in Knott's Berry Farm's Country Fair Days. It's a nine day period in which we will display engines and grind corn.

It's been twelve years since WAPA has put together a display for Knott's. In years past, Knott's was a focal point for our club's efforts, building camaraderie, exposing the club to the public, and earning us necessary funds to do fun things for our members.

Everyone should try to sign up for a shift or two. It's a lot of fun, and hopefully our enthusiasm will show the Knott's management that WAPA is a valuable addition to their event roster.

The Knott's Planning Committee consists of:

Bob Smith [smith@diamondpointe.us](mailto:smith@diamondpointe.us) 909-435-9978  
Ken Evans [kencevans@sbcglobal.net](mailto:kencevans@sbcglobal.net) 626-683-8372  
Larry Evan [LEVANS44@roadrunner.com](mailto:LEVANS44@roadrunner.com) 626-574-8904  
Kelley Garcia [kgarcia@rustyiron.com](mailto:kgarcia@rustyiron.com) 562-694-2301