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

The Crank Calls

December 2012

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NEXT MEETING
December 8, 2012 at
Chabot College, building 1500
25555 Hesperian Blvd, Hayward 94545
Doors open at 10:00 AM
Meeting starts at 11:00 AM

Upcoming Events

BAEM meetings:
December 8, 2012
Annual Potluck following December's meeting. Bring a dish to share.
2013 Membership Dues are due

MEETING NOTES

November 17, 2012

Bob Kradjian, Secretary

President Don Jones called the meeting to order promptly at 10 am.

VISITORS: Larry Pezzolo was a steady member in the Bennett Days and has re-visited us after a long absence. It is good to see you again, Larry

SHOWS: Goodguy's report: We received a check from them for the air compressor costs at the WEME Show in August. Thanks to the Goodguys!

POTLUCK LUNCHEON: Our annual Christmas luncheon will be on December 8 at 11:00 am. We will have only a brief club meeting, and then on to the great food. This event is always great occasion. The December meeting is always the second Saturday.

NEWSLETTER ISSUES: A proposal to convert the "Crank Calls" newsletter to a digital format was discussed at considerable length. This is a complex issue and we welcome your input if you were not at the meeting. We need to know how many of us have e-mail addresses, and we would also need an up to date listing of e-mail addresses. We should probably save this issue for the January meeting.

PROS:

*Less cost. This seems to be the chief argument in favor of the change to e-mail.

*There would be less work for the editor to fold, stuff, and mail the newsletter.

*The newsletter serves as a timely reminder that the meeting time is coming up.

CONS:

*Not all members have e-mail.

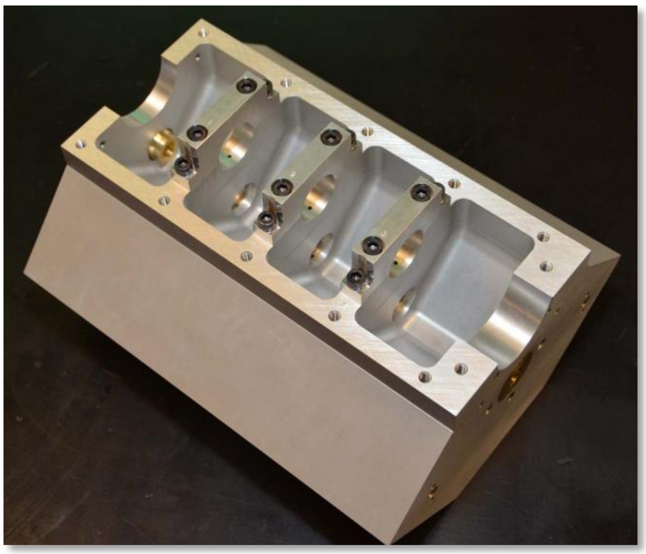
*Not all members would like to give up our traditional hard copy newsletter. This will necessitate a duplication of the newsletter, one for e-mail and the other our usual hard copy.

*Our latest expenditure for newsletter expenses was $285 for four months. Not a great expenditure in view of our solid financial picture.

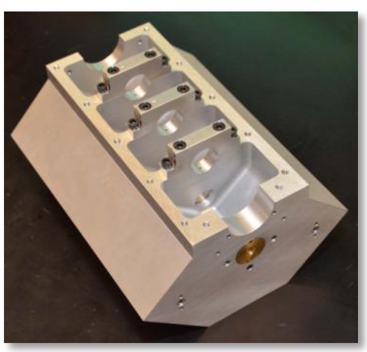
*We could ask for volunteers to do the folding and stuffing to reduce the burden on the editor.

One suggestion was to neither send the newsletter by e-mail or to mail the newsletter. Simply request the members to download it from our BAEM Club web site. It is posted promptly by our faithful Webmaster, Jim Piazza.

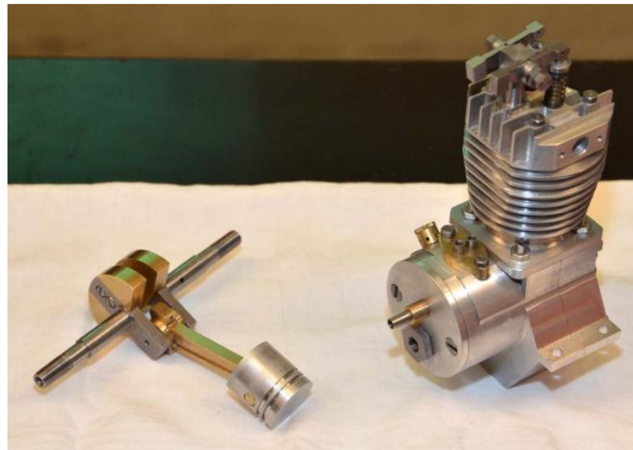
BITS AND PIECES



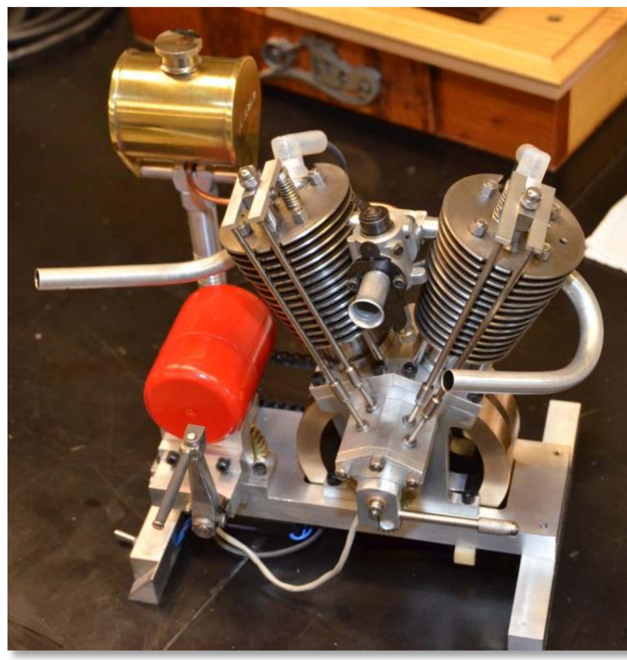
Jim Freel has been working steadily on the Black Widow block that he is carving out of solid. He has the cam bores completed including grooves in the bearing surfaces. He displayed his custom boring bar tool for accomplishing this. The cam will also have grooves. The work shows his usual impeccable finish. Although he is doing this with the "hand wheels" on a CNC capable machine, he is saving the CAD programs for others to use in the future.



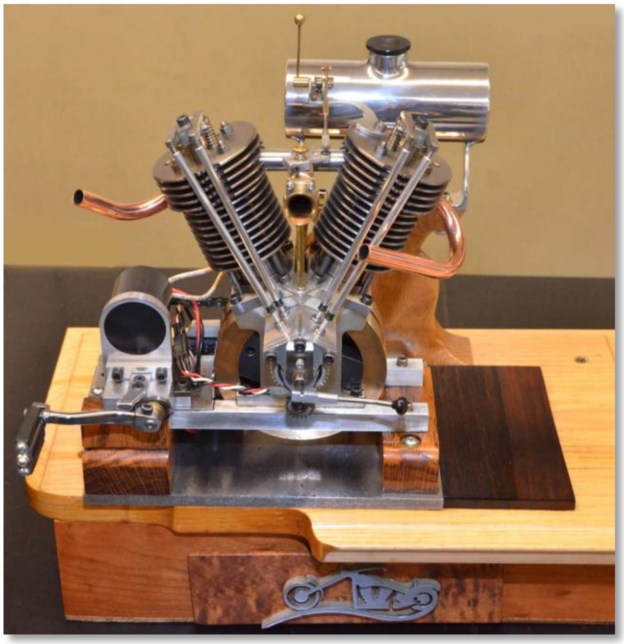
Larry Pezzolo had a nice Manson miniature lathe for an interested collector. These sell for more than $700 on E-bay. Contact Larry at lpezzolo@att.net if interested. He also had casting sets and plans some of which were snapped up by members.



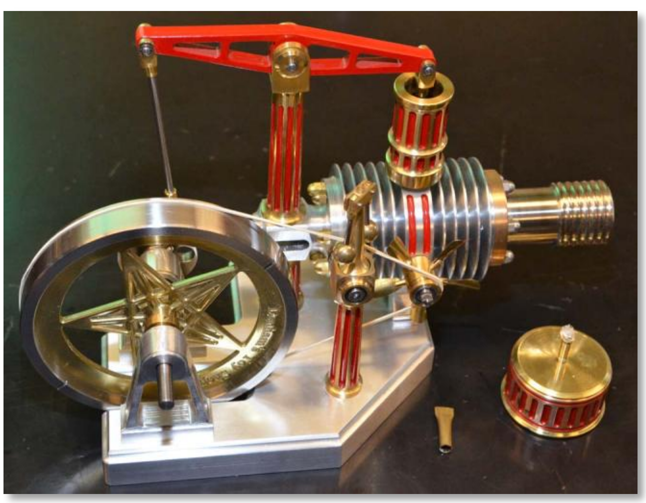
Joel Cohen is keeping very busy with nice work on "Kiwi" he is cutting from solid. His goals are to develop an accurate set of drawings and construct a good running engine. His work to date, is excellent and is up to his usual high standard. Recall that he is working on a similar and even more ambitious project with a Seal Minor.



New member Paul Denham brought in the "Hoglet" as he promised at last meeting. After he donned a hefty leather glove for his right hand, it started easily with a sharp hand push on the "kick" starter and runs well. Like most Hoglets, it idles down nicely with the ignition retarded. The engine is fitted with a rather large model airplane (Saito) carb, but Jason has narrowed the intake with a much smaller venturi insert down to 3/16". Paul has experimented with piezo lighter elements for spark. He reports that they throw a substantial spark but are not able to cope with high rpm's. He wound up with a CH Ignition system. See this on ch-ignitions.com. The twin system is $99.95, and $74.95 for a single.



I brought my Randall Cox-built Hoglet and we had them both running at the same time for a BAEM record. Now if we can get Lon Keeth to bring his along, we may have three running at once. Mike Rehmus says the Hoglet is the most popular "build" featured in his magazine.



Paul also displayed a stunningly beautiful Stirling-Cycle engine based on Jerry Howell's design. This is Howell's "Beamer". It has a 4.3" flywheel diameter. The flywheel was machined on a CNC machine. All shafts are fitted with ball bearings. There is a belt-driven cooling fan. A fly ball "governor" is also driven by the cooling fan belt, but it is for interest only and does not govern the engine. The plans are available for $19.00 and the "hard to find" materials kit is $35.00. See details at www.jerry-howell.com. Paul's little engine just hummed along nearly silently for the better part of an hour. Paul modified the design of the displacer. He made it porous and filled it with stainless steel wool. This allows the heat to replace more quickly. An Airpot glass cylinder was used with a graphite piston also from Airpot. Visit the Airpot Corporation web site at http://www.airpot.com. You will be amazed at the variety of products, many of which could be of use to a home machinist.

OTHER ITEMS:

Dwight Giles machined up a ballpoint pen with a rifle "lock and load" type bolt action used to advance the pen.

Steve Jasik likes to peruse the 'Net and come up with good buys. He found "Deal Extreme" which is dx.com to have terrific values.

He also likes www.thingiverse.com for 3D printing discussions. The Makers group offers a book that Steve thinks is a good value. It's available at: makershed.com/Make. It's titled the Make Ultimate Guide to 3D Printing. The coupon code 3DFAN should get it to you at half price. It'll be about $10 with shipping.

Rick Levesque found a closed cycle heat pipe at Alan Steel. This passive device wicks heat from the surface of a processor or other electronic device requiring cooling.

Mike reports that the digital versions of his magazine are proving to be a considerable success.

Mike Byrne gave us a lucid explanation of how to make "Turner's Cubes". They are spectacular when finished.

Roy Anderson has 17 pound circles of T-6, 6061 aluminum, one and quarter inches in thickness for sale. $25.00, a good value

TECH TOPIC

Carl Wilson

Sheesh, I did ramble on about spindles and bearings. I wasn't taking notes and don't remember what I said during the Tech Topic part of the November meeting, so I'll make this up as I go and write what I should have said.

Plain bearings are old technology but it would be a mistake to think that rolling element bearings, the newer technology, are inherently better. They are not. Each type has an advantage for spindles that model engineers might build for various purposes. These "Notes on Spindle Design for Amateurs" will compare ball bearings with sleeve (plain). To save space I will use "BB" for ball and "PB" for plain bearings. Also, much of these notes refer to the use of these bearings for grinding spindles.

Bearing Life: Both types, properly designed, built and maintained will have long lives. The life span of ball bearings is limited by lubrication and a combination of load and number of revolutions. Many BB's are pre-lubricated with a grease supply intended for the life of the bearing. If this grease deteriorates due to time or contamination, particularly water and dirt, the life of the bearing will be short. Some spindle unit designs may have lubrication ports, but too much grease is as bad as too little: too much grease causes heat build-up and consequent deterioration of the grease. Oil bath bearings need only a continuous supply of clean oil of the proper viscosity.

Given proper lubrication, the life of BB's is determined by fatigue failure of the surface of either the ball or race. Metal will begin to spall at some combination of load (force on the bearing) and number of cycles that the load. The number of cycles is determined by the spindle RPM and the number of balls in the bearing. The load is very much more effective in causing fatigue than the speed and so it is very important to select the bearing based upon that factor.

Plain bearings require more lubrication maintenance but when operated within their design ratings will have very long lives.

Spindle RPM: Both types may be designed for the speeds typical of the grinding wheels which we use. Plain bearing spindles are quite successful at constant RPM service and grinders do not usually employ a wide range of speeds. Lathes and milling machines require a wide range of speeds and here rolling element bearings will be best.

Pre-loading: Both types of bearings have a non-linear response to their operating conditions. The deflection of BB's with a load increasing from zero to the rated maximum is a non-linear curve that is initially steep and decreases with load. That is, at low loads the bearing deflects "more" than at high loads. The reason for this is at low loads only one or two balls directly opposite the applied force will carry the load. As the load increases these balls and the contact patches of the races will compress and this will bring adjacent balls into the load bearing condition and the bearing becomes effectively stiffer. Pre-loading a pair of bearings is the application of a force during the assembly of the spindle unit which "takes up" much of the initial non-linearity. This is done by loading the bearings with springs, ground spacers, or by the manufacturer during production of the bearing. The later are purchased as "duplex pairs" and are specified as light, medium, or heavy pre-load. The pre-load is applied in the axial direction but radial stiffness is also increased.

Plain bearings have an initial clearance between the spindle and the bearing which is the oil space during normal operation. When the spindle is at rest this clearance is taken up by gravity pulling the spindle down into contact with the bottom of the bearing. The spindle may be "wiggled" up and down through this clearance as there is no opposing force and the oil offers no or little resistance. But as the spindle begins to rotate the oil starts to flow within the bearing and develop a uniform pressure which lifts the spindle and centers it within the bearing. The bearing becomes stiffer. At operating speeds, the stiffness of a plain bearing will be in the range of a ball bearing.

Bearing Noise: Ball bearings are noisier than plain bearings; plain bearings can generate a more consistent roundness in the work piece. Plain bearings are widely used in precision cylindrical grinders for these reasons.

Size: Ball bearings are large diameter and narrow. Plain bearings are small diameter, and long.

Design: The design of a ball bearing spindle unit is relatively straightforward. Many bearing manufacturers issue catalogs just chock full of information including sectional views of various types of spindles. These may be used as a "cookbook" by inserting the size bearing chosen on the basis of load, spindle RPM, and allowable physical size. Extensive tables give the shaft and housing diameters and tolerances for the bearing precision. Look up those numbers and write them on the print.

A plain bearing spindle is a bit harder to design: the process may be found in many mechanical engineering textbooks. The procedure suggested by the Cast Bronze Bearing Institute is a ten step process of calculating various parameters and the end result is the difference in size between the OD of the shaft and the ID of the bearing, oil viscosity, and a calculated operating temperature. The validity of the design is verified by running the spindle until the temperature has stabilized and comparing that number with that derived in the calculations. This may require some "rinse and repeat" iteration.

Another method is to design the spindle unit with bearings that have adjustable clearances and adjust the bearing to obtain a reasonable temperature rise. Maximum allowable temperatures depend upon the lubricant.

Do it yourself: One example: a simple plain bearing at a cost of, say $5 can deliver a performance similar to a high precision ball bearing costing much more. Further, a high precision ball bearing spindle unit requires holding very tight tolerances on the shaft and housing bearing seats. One example: a very common bearing size, a 203 (17mm bore and 40mm outside diameter) in a very high precision (ABEC 7) design requires holding the shaft diameter to a total tolerance of 0.00015" and the bore to 0.0002". Yes, the number decimal places is correct and those are unilateral, not bilateral tolerances. These dimensions are very hard to hold with the machine tools commonly available to the model engineer. And they do not address the conditions of roundness, cylindricity, and concentricity. In particular, bearing housings with counter-bored bearing seats rather than through bores are very hard to maintain concentricity. It might be possible to finish the shaft diameters to size with abrasive shop roll, but the other parameters would be suspect.

Plain bearing spindles are much easier to build and may more tolerant of defects in manufacture. This makes them attractive to the model engineer for grinding and other constant speed spindles. They may be used for lathe and milling spindles but their range of usable speeds will be less than those available for ball bearings. At low speeds they may be in "boundary layer lubrication" with some metal-to-metal contact and resultant wear, and at high speeds the bearing temperature may exceed that recommended for the lubricant.