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Discussion

Discussion: "Design Improvements to a Biomass Stirling Engine Using Mathematical Analysis and 3D CFD Modeling" [Mahkamov, K., 2006, ASME J. Energy Resour. Technol., 128, pp 203–215]

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I was interested in the above paper since the engine involved incorporates the same spherical rocker arm seals as were used on the valve mechanism of a solar thermal water pump which I built and tested in the 1980s (Solar Energy, **31**(5), pp. 523–525). This form of transverse rocker beam drive and seal design was suggested to me by Richard Kinnersly, the designer of the Stirling engine, which is the subject of Dr. Mahkamov's paper.

Although conversion of the engine to α mode may increase the power output, there are other considerations, relating to the realization of a practical engine. Given that the engine uses dry lubrication, temperature and pressure stresses on the rings of the (hot) expansion piston in α mode may be such as to compromise their operating life. Engine design involves more than thermodynamics and fluid flow.

Could the author explain why there are only two indicator diagram loops in Fig. 6, as against three in Fig. 14? Since, in the γ engine, there are three moving boundaries where work can be performed on the working fluid three loops would seem to be correct. (In the α engine two loops—as per Fig. 17—is correct.)

It is stated on p. 207 that "the numerical results discussed in the following sections are presented for the engine with biaxial asymmetric piston motion." Would the author please explain to the uninitiated reader what he means? The present writer took the trouble to check the Vc curve of Fig. 3 (incorrectly labeled?). From this it was deduced that the piston motion is simply that of a system where the con-rod to stroke ratio is 1.26:1, with TDC occurring at zero degrees. If that is what Dr. Mahkamov means, it would be useful if he could say so.

One of the problems the present writer had in following Dr. Mahkamov's paper was the constant changing of nomenclature for the three pressured spaces that act on piston surfaces in the original γ engine. The nomenclature, as far as this writer understands it, is set out in the Table 1. Those relating to Fig. 6 are totally obscure. Is Pc of $PcVc$ relating to the displacer piston side or the power piston side?

Those for Fig. 13 are not defined in the paper although one assumes that they are the same as for the temperatures defined in Fig. 11. Would the author please clarify Fig. 6 and confirm the identity of the other symbols shown in Table 1?

It would have been interesting to see γ mode engine numerical solutions with the piston crown entrapment eradicated and the regenerator with 40% porosity to compare with the α mode results. Is the author able to provide this information?

In the conclusions, Dr. Mahkamov states "In general preliminary tests indicate that numerical predictions … are in good agreement with experimental data…." Could the author provide measured experimental data?

Table 1 Nomenclature

		Fig. 1	Fig. 6	Fig. 13	Fig. 14
Displacer piston (hot side)	Expansion	8	Pe (of $PeVe$)	$P1$	$P1$ (of $P1V1$)
	Compression	5	Pc? (of $PcVc$)	$P7$	$P2$ (of $P2V2$)
Power piston (cold side)	Compression	6	Pc? (of $PcVc$)	$P5$	$P3$ (of $P3V3$)