ISTVÁN LAKATOS:
EFFECT OF TIMING OF THE CHARGE EXCHANGE OF FOUR-STROKE, UNCHARGED OTTO ENGINES
MAJOR RESULTS OF A PHD THESIS

By developing and using a mathematical model and performing and evaluating laboratory experiments the following novel scientific results have been obtained (the novelty in the statements below is that they refer to OHC (single-camshaft) engines):

1. I established that in the case of OHC (single-camshaft) engines (i.e. identical phase shifts in sign and magnitude for the intake and exhaust stages) the indicated power as well as the tractive power exerted by the vehicle were both dependent on the magnitude of the phase shift. The diagrams recorded as a function of the phase shift had a distinct optimum. Adjusting to this optimum could result in an increase of 3-7 % compared to the nominal power of the engine.

   The values of the indicated power and the tractive power exerted by the vehicle varied as a function of load and engine speed in the following way:

   the engine required a camshaft-crankshaft adjustment

   1.1. at low speed and low load as „lag" (compared to the factory-setting)

   1.2. at partial load and medium speed as „advance",

   1.3. at full load typically as „lag"

2. Based on the experimental results I concluded that in the case of OHC engines the indicated specific fuel consumption and the specific vehicle consumption depended on the magnitude of the phase shift. The diagrams recorded as a function of the phase shift had a distinct optimum. Adjusting to this optimum could result in a reduction of 2-6 % compared to the nominal specific fuel consumption.

   The values of the indicated specific fuel consumption and the specific vehicle consumption varied as a function load and engine speed in such a way that it required adjustments as „lag" compared to the factory settings. Its magnitude decreased as the engine speed increased.

3. In the case of emission of exhaust gases the following conclusions can be drawn:

   3.1. The rate of carbon-monoxide emission does not depend on the angle between the camshaft and the crankshaft in the OHC (single camshaft) engines, either.

   3.2. At given working points the overall emission of NO_x and HC from the OHC (single camshaft) engines can be reduced by adjusting the angle between the camshaft and the crankshaft during operation (HC emission can be reduced by 7-11 %). This improvement results from the reduction in the maximum temperature of the explosion and the increase in the ratio of unburnt gases). The engine in the tests required adjustment as „lag" and „advance" at low speed/load and at medium speed/load, respectively. (In further studies aimed at determining more accurate values it should be noted that any reduction in the emission which is accomplished with engine adjustment needs to rely on the projected values of the torque and fuel consumption of the engine. Therefore this method is limited to partial load and low or medium engine speed.)

4. In a summary evaluation of the aforementioned results I concluded that valve timing during operation is also meaningful for OHC (single camshaft) engines. It requires a feedback from the operational state of the engine (phase-adequate timing and control). (The elaboration of the control strategy calls for further research).

5. The „measured” and „calculated” values of mechanical efficiency do not vary significantly as a function of the angle between the camshaft and the crankshaft. Therefore it can be concluded that they do not influence the location of the optima: that is, the optima for the indicated values and those measured at the wheel are directly comparable.

ISTVÁN LAKATOS, PHD:
EFFECT OF TIMING OF THE CHARGE EXCHANGE OF FOUR-STROKE, UNCHARGED OTTO ENGINES
PHD THESIS

Today the adjustable valve-timing systems are indispensable parts of engines in the more expensive brands of vehicles. They are exclusively installed in double camshaft (DOHC) engines. Their use in the simpler and less expensive single camshaft engines has not been considered.

In my work I studied this field by developing an engine-cycle model as well as performing roll bench tests. In my multi-regression studies I wanted to answer the question whether it was an advantage to adjust the angle between the camshaft and the crankshaft in OHC (single camshaft) engines during operation. I evaluated the following variables as a function of the angle between the camshaft and the crankshaft:

- indicated power and tractive power,
- indicated specific fuel consumption and specific vehicle consumption, and
- emission of pollutants (CO, HC, NOx).

For the studies I selected three types of characteristics, identical for the modelling and experiments:

- resisting-force graph for flat surfaces (Fv v2)
- resisting-force graph for slight gradient (Fv v2), as well as external (at full load) torque characteristics.

The experiments were carried out in steady-state operation of the engine. It means that the operational and adjustment parameters of the engine – with the exception of the control parameters under study, as a matter of course – were kept constant at the recorded working points.

From the experiments the following conclusions were drawn:

in the case of OHC (single-camshaft) engines (i.e. identical phase shifts in sign and magnitude for the intake and exhaust stages)

1. The indicated power as well as the tractive power exerted by the vehicle were both dependent on the magnitude of the phase shift. The diagrams recorded as a function of the phase shift had a distinct optimum.
2. the indicated specific fuel consumption and the specific vehicle consumption depended on the magnitude of the phase shift. The diagrams recorded as a function of the phase shift had a distinct optimum.
3. the carbon-monoxide emission cannot be reduced by the operational adjustment of the angle between the camshaft and the crankshaft, but at given working points the overall emission of NOx and HC can be reduced by the adjustment of the angle between the camshaft and the crankshaft during operation.
4. In a summary evaluation of the aforementioned results I concluded that valve timing during the operation is also meaningful for OHC engines. It requires a feedback from the operational state of the engine (phase-adequate timing and control).

ISTVÁN LAKATOS, PHD:
EFFECT OF TIMING OF THE CHARGE EXCHANGE OF FOUR-STROKE, UNCHARGED OTTO ENGINES
PHD THESIS

In the thesis the effect of timing on the operation of engines is studied in OHC (single camshaft) engines. The author developed a mathem atical model and performed roll bench tests for the studies. In his work he evaluated the effect of the angle between the camshaft and the crankshaft on the operational parameters of the engine.

The results showed that with respect to indicated power, tractive power, indicated specific fuel consumption, specific vehicle consumption, and emission of pollutants (CO, HC, NOx) operational valve timing is also meaningful for OHC (single camshaft) engines. It requires a feedback from the operational state of the engine (phase-adequate timing and control).