TUNE-UP A DIESEL EXPERIMENTAL SINGLE CYLINDER ENGINE WITH A COMMON-RAIL INJECTION EQUIPMENT

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ABSTRACT - For tuning an experimental single cylinder engine with a high pressure injection equipment it recommended to follows some steps. The paper presents a practical solution to control the injection equipment regarding the start of injection, the injection's adjustable advance included, also adjustable injection's time duration at different engine's characteristics. An electronic unit process the Top Dead Center crankshaft marker allowing an adjustable delay for a properly injection timing and duration.

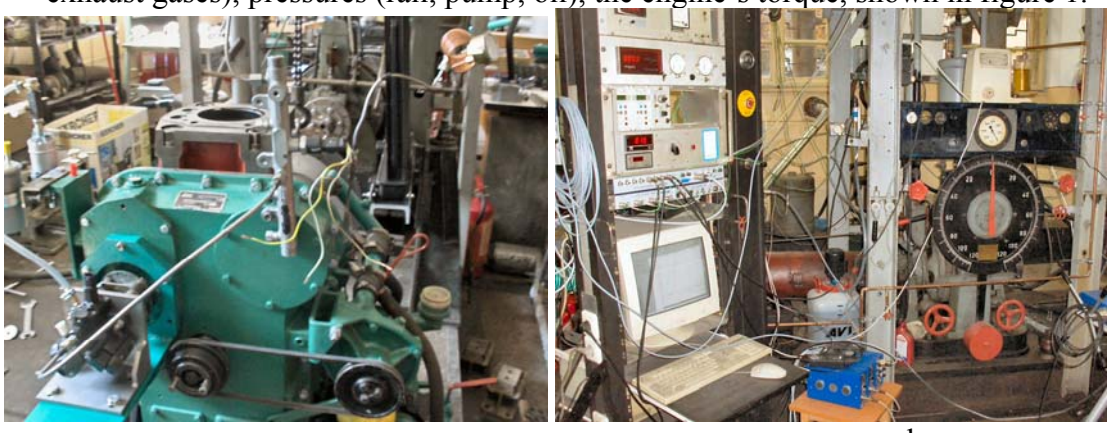
THE OBJECTIVES

For the single cylinder experimental engine it's propose an electronic management system, manualy controlled, purposing finde the main characteristic engine's working points.

THE RESEARCH CONDITIONS

1. Standard atmospheric conditions;
2. The elastic mounting of a powertrain to the test bench, using a hydraulic brake, 200 kW / 2500 rpm.
3. The following parameters were measured:

- The rotational speed of the engine, the temperatures (inlet air, oil, cooling water, exhaust gases), pressures (rail, pump, oil), the engine's torque, shown in figure 1.



a b

Figure 1 a – the engine on the test bench, b – control panel.

THE CHOICE OF THE TDC MARKER, AND THE START INJECTION MARKER

The flywheel is marked up to 0.5^0 CA, so that it can be precisely marked the start of injection. This marking should be positioned with cca 40^0 BTDC and will be validated by another marking placed on the camshaft in the properly position, as shown in figure 2.

This way, it can be obtained a control range within the injection advance can be adjusted.

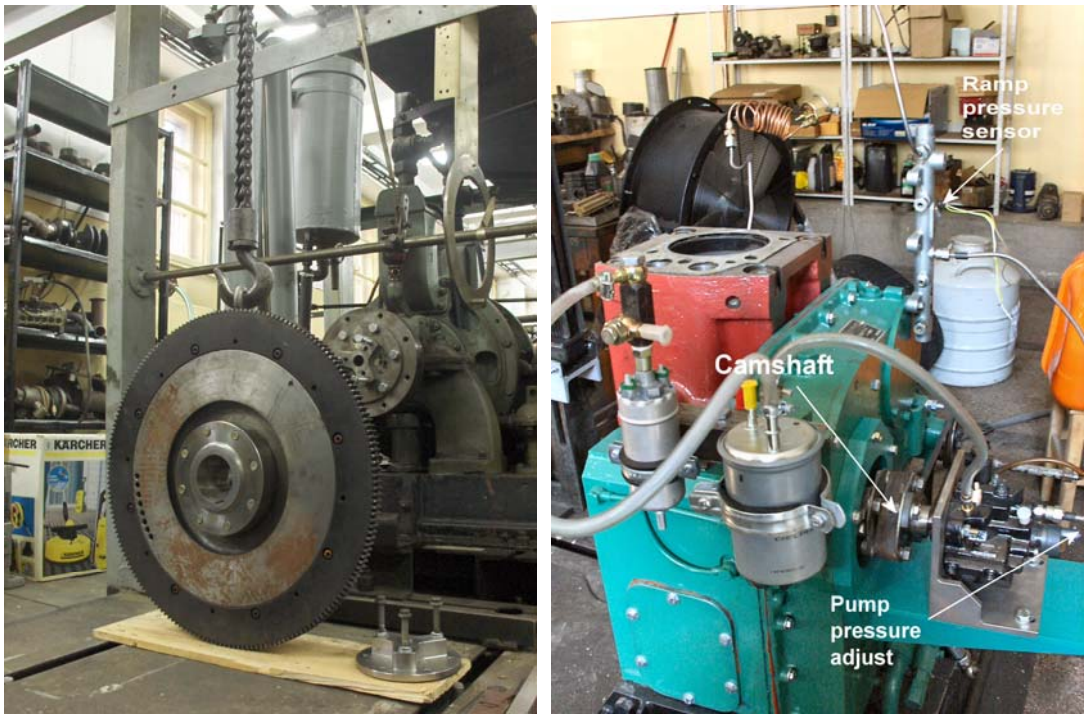


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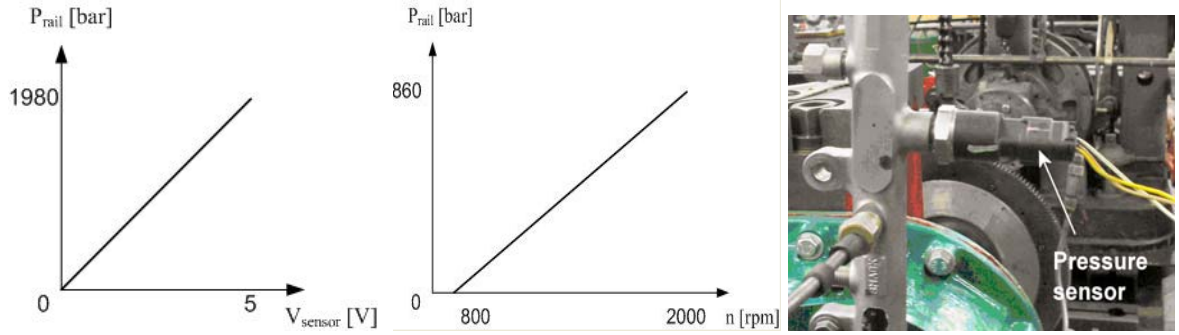
Figure 2 a – Flywheel, b – camshaft.

SETTING THE SENSORS

The rail pressure sensor delivers a pressure deppending linear voltage in the range 0…5 V, with which it's possible to adjust the pump pressure by PMW controlling the linear electrovalve, like is presented in figure 3.



a b c

Figure 3 a – transfer characteristic of rail pressure sensor; b – rail pressure vs. engine speed; c – pressure sensor.

INJECTION TIMMING AND INJECTION TIME INTERVAL DRIVEN LOGIC

Two Hall sensors, one on the crankshaft, other on the camshaft, validate the start injection electrical puls, the logic of acting the injector in the properly time moment shown in figure 4.

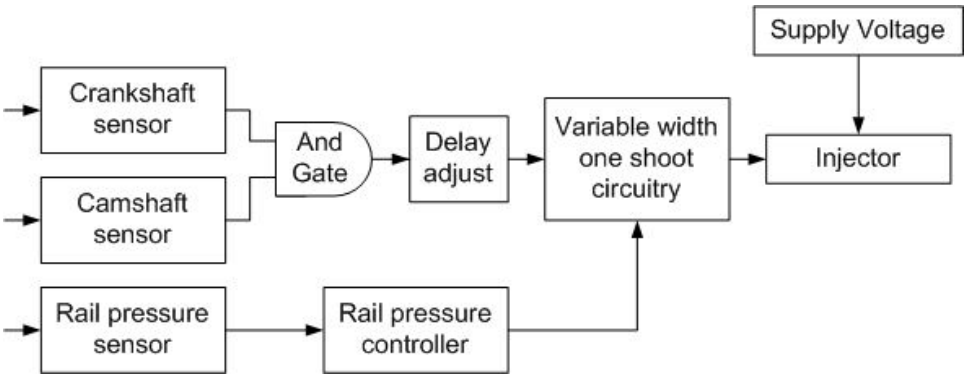


Figure 4 - Injector acting logic.

INJECTION TIMMING ADJUST

It can be adjusted the injection delay and injection duration as following:

- Manual control of start injection T_{start};
- Manual control of the injection delay T_{delay}, starting to 40^0 CA;
- Manual control of injection time T_{inj}, all this shown in figure 5.

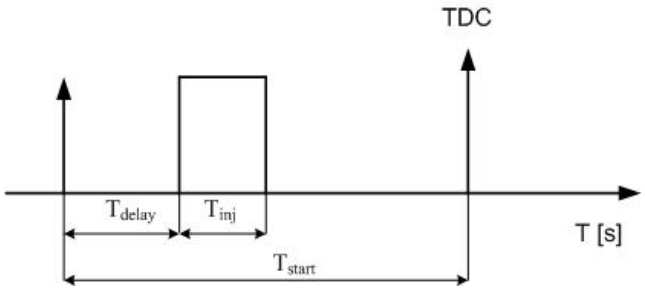


Figure 5 - Timing the injector.

CONCLUSIONS AND FURTHER DEVELOPMENT

The conclusions will be validated by experimental researches to the engine's test bench, using the exhaust emissions as feedback.
The TDC cannot be dynamicaly established, so it's necessarly for an exactly positioning to validate by indicated diagram, by using a pressure sensor, as shown in figure 6.

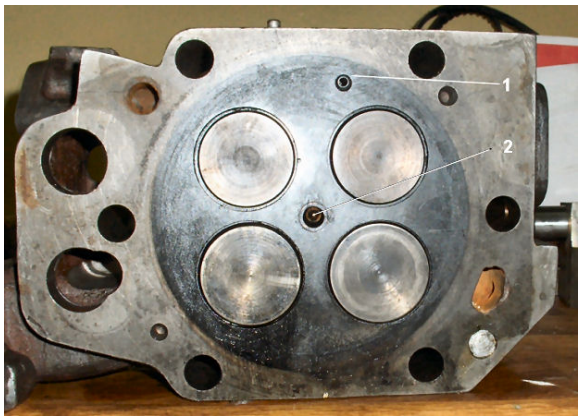


Figure 6 - The pressure sensor placement 1 – pressure sensor, 2 – injector.

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