

ELECTRONICALLY REGULATED COOLING SYSTEM IN INTERNAL COMBUSTION ENGINE

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One of the systems which can significantly improve internal combustion engine performances is the engine cooling system. The conventional cooling system has a lot of disadvantages which are regarded to mechanical coolant pump for liquid circulation in the cooling system.

Here a new solution of cooling system based on the implemented cooling pump driven by a DC motor is suggested. The DC motor, together with the DC fan motor, is regulated with an integral regulation system depending on the real engine temperature.

A conventional system of internal combustion engine temperature regulation is based on circulation of coolant through cooling system, and it's cooling in the heat sink. However, mechanical coolant pump, which can change a liquid stream rate, is conceived so that rotation speed, and the liquid stream as well, directly depends of internal combustion engine speed, and not of the engine temperature. That creates conditions for deviation of engine temperature and its overflow of allowed limits, under the effects of disturbances in heat transfer in the engine. Apart from the ability of damage of engine elements, such occasions can results by a variation of other parameters such as burning process parameters, arguments which a quality of regulation and an engine lifetime.

A big potential in developing of system which can eliminate a mentioned disadvantages can be found in introducing of electronic regulated cooling system. A system built like that, has a lot of advantages which are contained in a possibility of synthesis of a very flexible control structures for a functionally system control and a possibility of solving different tasks for engine temperature regulation, as well.

It is suggested a flexible solution of a temperature regulation by internal combustion engines, which gives an improving of conventional system characteristics. A base of this solution is in a constructive change of parts of elements of cooling system, so, instead of mechanical coolant pump, there is an electric pump implemented, which is, as a fan, driven by a DC motor.

Electronically Regulated Cooling System In Internal Combustion Engine

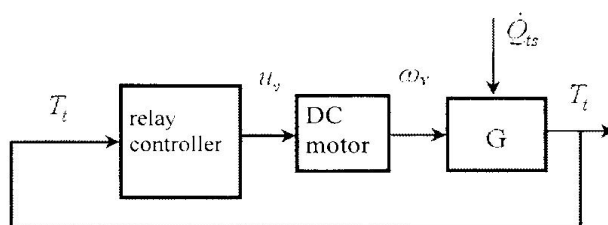


Fig. 1 Control of the conventional cooling system

Figure 1 show that by a conventional way of engine cooling, only $T_{t,ul}$ changes depend of the engine temperature T_t . That reduces a possibility of quality regulation of the engine temperature T_t , which can produce some difficulties by the engine exploitation.

A concept of the new solution of cooling requires some changes of the conventional system hardware configuration. Instead of the mechanical realization of pump for the coolant,

and relay controller of the fan revolutions per minute (rpm), it is used a microprocessor technique with a digital controller for the process controlling. Regarding the hardware, it is used the same DC motor for the fan drive, which is used for the conventional regulation. For the centrifugal pump drive is introduced a new DC motor. A control system for the speed control of the DC motor is realized in a digital technique and as a method for the controller projecting it is used a continual sliding mode in the systems with an discontinuous structure, and the control of the fan rpm is realized in the open loop.

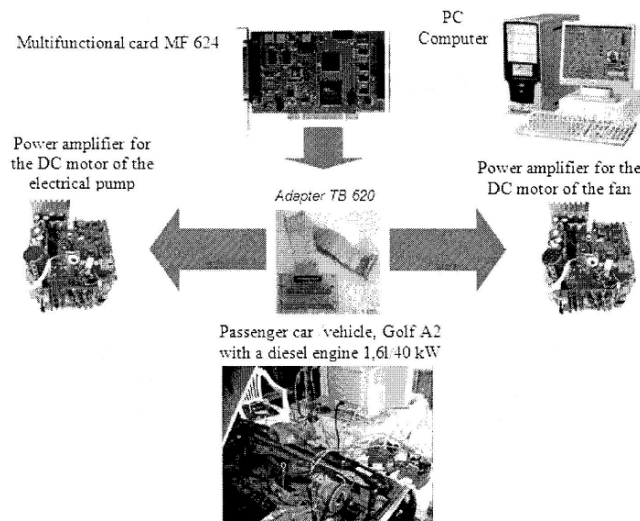


Fig. 2 Components of the realized model

A flexible control system which uses a PC platform has been used for a system projecting. The main components:

- PC computer with a MATLAB/SIMULINK – Real Time Windows Target environment, intended to be used for testing of developed control structures in the real time.
- A multifunctional card MF 624, which is used for linking MATLAB/SIMULINK environment with a real word.
- Two power amplifier (power amplifier for a DC motor of an electrical pump for coolant and power amplifier for a fan DC motor)
- TB 620 adapter, which is used for communication between the MF 624 card and the power amplifier of both motors.
- A passenger car/vehicle, Golf A2 with a diesel engine 1.6l/40 kW, presents an object with a cooling system, which has a new system of the temperature regulation.

According to the results of the practical testing of the new and conventional cooling system, we can offer these conclusions:

- A testing on the real object showed that the engine achieves a nominal temperature for a shorter time by cooling with the new cooling system.
- By new way of cooling, in the area of the nominal values, an engine temperature changes in the tighter limits regarding to the conventional system.
- By the new cooling system, a fan rpm on with the continual speed increase, according to the deviation of the temperature of the coolant from the nominal values, so the fan action is proceeding with less uproar, which is by the less temperature deviation almost pointless.
- A new cooling system has been based on idea of the temperature regulation according to the real engine temperature, so we can conclude that, under the effect of some disturbance, there are a little possibilities of overheat or under cooling of the engine.
- A shorter time of warm-up of the engine reduces a period of undesirable conditions of the fuel combustion, which affect positive on the reducing of incomplete products of combustion.

- Shorter engine run duration in the temperature beyond the nominal area has a positive effect on the quality of lubrication of the engine elements, which reflects with a longer lifetime of the engine.