REDUCTION OF DETONATION EFFECTS IN GASOLINE INTERNAL COMBUSTION ENGINES USING WATER INJECTION

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Detonation (knocking) phenomena in gasoline internal combustion engines (ICE) have an unambiguously negative effect. It arises as a result of low octane number of fuel and increase as the engine overheats. Such problem is most acute in supercharged and turbocharged engines. Increasing of pressure in the cylinder inevitably leads to increasing of temperature, which accelerates detonation. For engines with high boost pressure (and an already reduced compression ratio compared to atmospheric internal combustion engines), the use of high-octane gasoline (98 or 100 octane number) does not solve the problem. One of the effective ways to reduce the temperature is water injection.

The aim of the work was to analyze the features of the processes of supplying water to the working cylinder of an internal combustion engine with spark ignition.

The following methods of supplying water to the cylinder are used: in front of the compressor; after the compressor (or into the intake manifold before its branching); and into the inlet ports of the intake manifold.

The first two methods do not ensure equal distribution of water in the cylinders, especially in manifolds with different lengths from the point of water injection to the intake valves. The third method, which is shown in Fig.1, is the most expensive, as it requires an increased number of injectors.

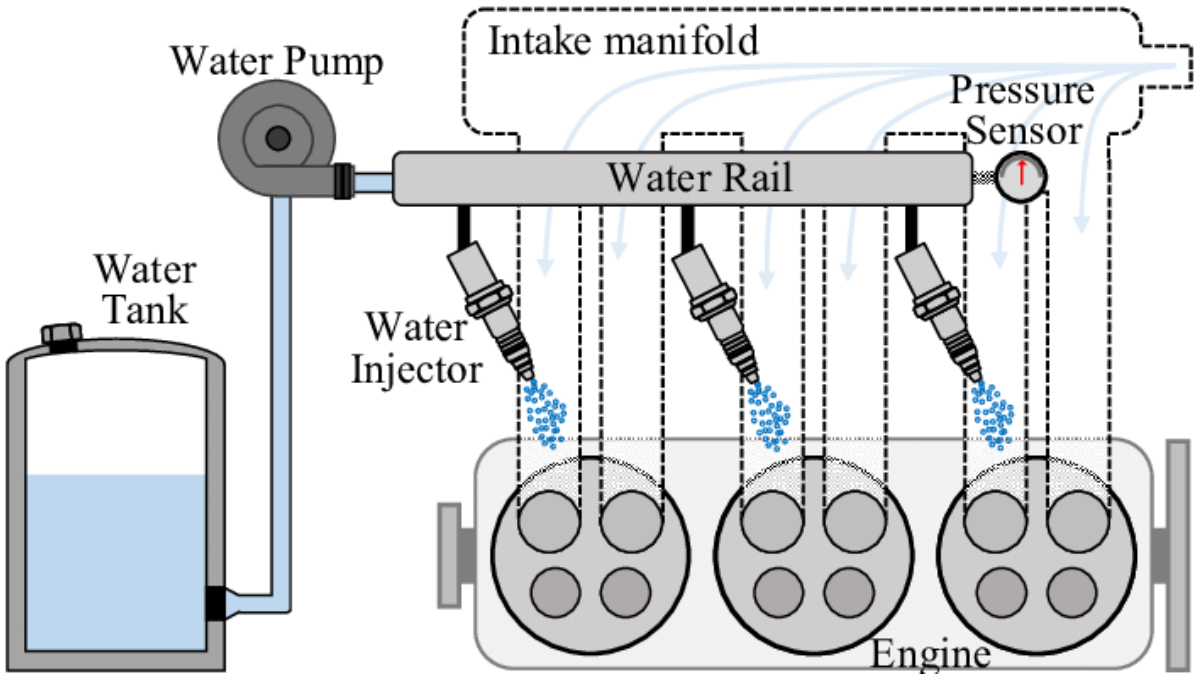

Figure 1. port injection of water

An important factor in the quality of water spray is the size of the water particles. As in the case of spraying gasoline, water must be sprayed so that the nozzle does not emit a "stream", but a water "mist". The recommended maximum droplet size is no more than 50 μm. The smaller the hole in the nozzle, the smaller the drops will be. And the heat of the fuel-air mixture, received from the walls of the intake manifold, and then from the walls of the cylinder, completes the process of spraying water.

Water is supplied to the intake not all the time, but only when the thermal state of the engine approaches the limit of detonation. The amount of water supplied depends on engine load, fuel consumption and engine speed. The water flow controller receives this information and formed water injection duration signal.

Thus, the supply of water to the combustion chamber helps to slow down the combustion process, which significantly reduces the probability of detonation. At low and medium engine speeds, this ensures more complete combustion of the fuel-air mixture. However, in addition to positive anti-knock properties, water injection also has disadvantages, in particular, corrosion of metal parts of the intake system.