PNGV℠

PARTNERSHIP FOR A NEW GENERATION OF VEHICLES

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

NATIONAL VEHICLE AND FUEL EMISSIONS LABORATORY

ENGINE TECHNOLOGY FOR THE FUTURE

PARTNERSHIP FOR A NEW GENERATION OF VEHICLES

This engine represents one of the major areas of research that the U.S. Environmental Protection Agency (EPA) is undertaking under the auspices of the Partnership for a New Generation of Vehicles (PNGV). This historic partnership between the federal government and General Motors, Ford, and Chrysler, formed in September 1993, aims to "reinvent the car." The objective is to develop an affordable family car that is clean and safe, matches the performance of today's models, and gets three times better gas mileage.

Today's midsize family sedans (Lumina, Taurus, Concorde) have fuel economies of about 27 mpg on the combined EPA city/highway fuel economy test. The PNGV goal is to develop a prototype family sedan that achieves **80 mpg**. Such a car would emit **67% less carbon dioxide** than today's cars and would be a turning point in environmental history. Carbon dioxide is the most important "global warming gas," and tripling automotive fuel economy would be a big step toward controlling worldwide emissions of global warming gases.

In addition to the environmental goal of reduced carbon dioxide emissions, the PNGV program reflects several other important public policy objectives:

- Reduce our nation's dependence on imported oil
- Improve the international competitiveness of domestic automakers
- Focus federal research on important civilian priorities

U.S. ENVIRONMENTAL PROTECTION AGENCY ROLE IN THE PARTNERSHIP FOR A NEW GENERATION OF VEHICLES

EPA is proud and excited to be a part of PNGV and has dedicated its automotive technology development program to achieving the 80 mpg goal.

In addition to EPA, the following federal departments are sponsoring research as part of the overall PNGV program:

- Department of Commerce
- Department of Energy
- Department of Defense
- Department of Transportation
- National Aeronautics and Space Administration
- National Science Foundation

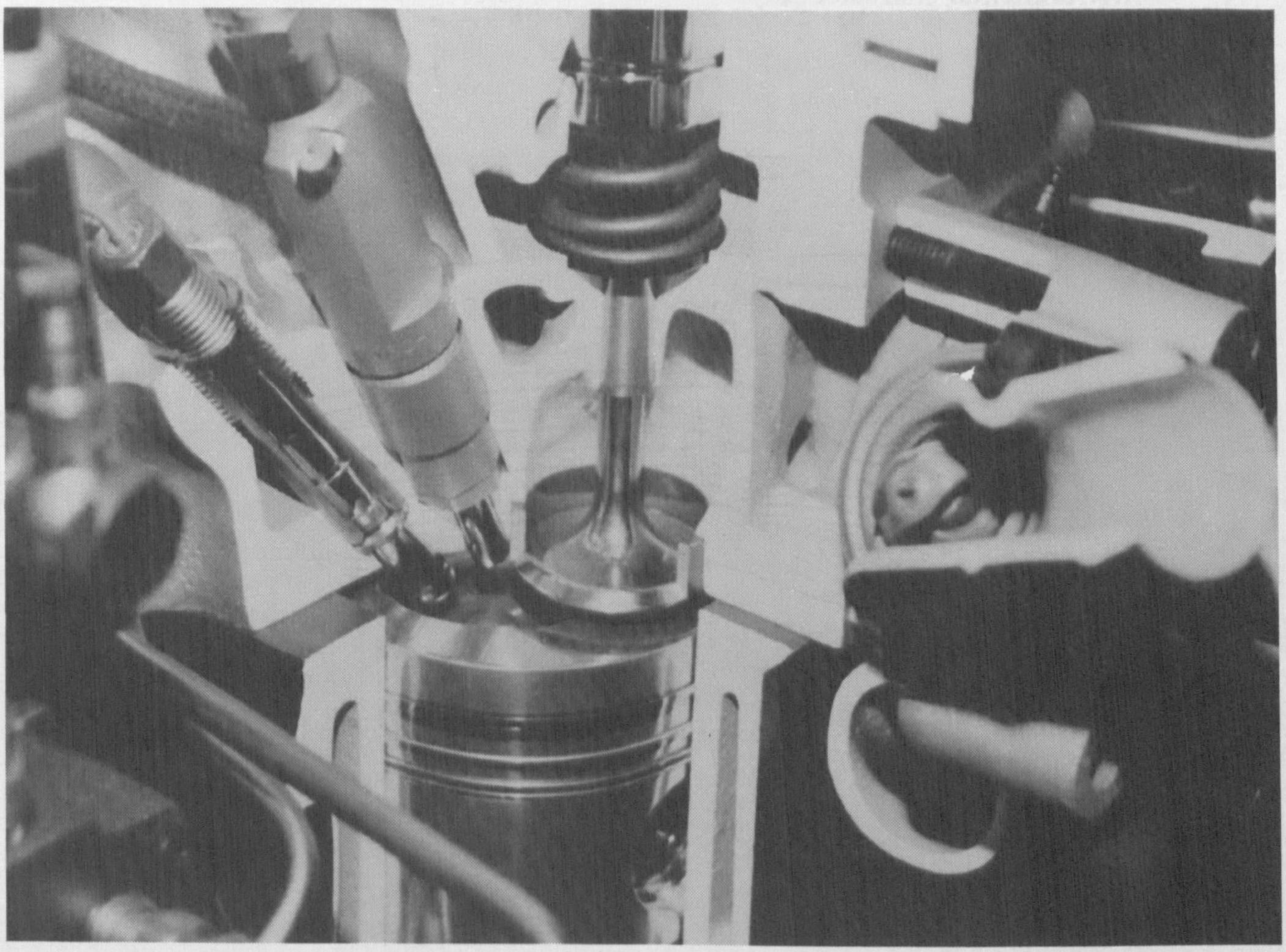
PNGV research is investigating a wide range of automotive technologies that could potentially power the cars of the 21st Century: fuel cells, gas turbines, batteries, flywheels, ultracapacitors, compressed fluids, and various combinations of these technologies in hybrid vehicle configurations. EPA has been asked to take the lead in two areas: renewable alcohol-fueled engines and pneumatic/hydraulic secondary energy storage systems. EPA's participation in this project is based at its National Vehicle and Fuel Emissions Laboratory (NVFEL) in Ann Arbor, Michigan.

EPA's long-term plan is to develop hybrid vehicle components that contribute to meeting the 80 mpg goal. The hybrid system will use a small, alcohol-fueled engine like this one for most driving and a pneumatic/hydraulic energy storage system to supply extra power for occasional demands such as heavy accelerations. This approach will also use regenerative braking to save energy. The engine development work is being carried out in concert with engine design companies, while much of the remaining effort is being done in-house at NVFEL. The goal of this program is to provide the domestic auto industry with the best possible options for achieving the performance objectives at the lowest possible cost.

BASIC COMBUSTION PROCESS

Air enters the combustion chamber through an intake manifold and runners (yellow). After the intake valve closes and the piston travels upward to increase the pressure, fuel is directly injected into the chamber by the high-pressure fuel injector to initiate combustion. The glow plug aids the combustion process by heating the air/fuel mixture to promote ignition. After ignition, gas expansion pushes down on the piston to create a rotational force on the crankshaft. The crankshaft is connected to a transmission and eventually to a vehicle's wheels. As the piston again travels upward, the gases are pushed past the exhaust valve, through the exhaust manifold and runners (red), and through a catalytic converter, which reduces the amount of pollutants produced during combustion. The green areas represent coolant passages through which coolant is circulated in order to maintain engine temperatures to avoid overheating.

This engine, though much smaller, is very similar in design to Diesel engines used predominately in large trucks and buses. Gasoline engines used in most cars require good mixing of the air and fuel vapor prior to the onset of combustion and utilize spark plugs to initiate combustion.

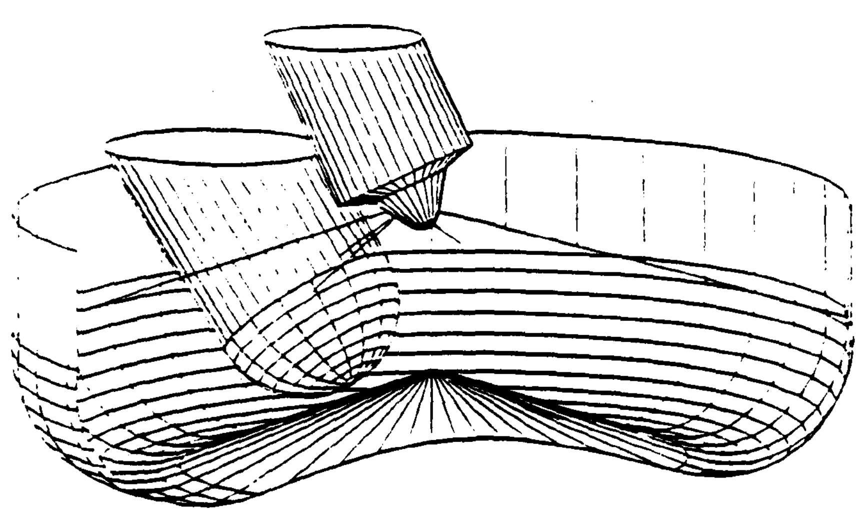


METHANOL FUEL INJECTION

This is a direct-injection, stratified charge, methanol-fueled engine. Air enters the combustion chamber via the intake manifold and runners (yellow) with high air swirl intensity in the chamber to aid fuel vaporization. The methanol fuel is then injected directly into the combustion chamber by a high-pressure fuel injector that produces a spray of very small fuel particles that will vaporize easily.

The fuel is directed toward a bowl in the piston. A glow plug, located next to the fuel injector, creates a hot surface that helps ignite the fuel and enhances further combustion.

This engine has been designed for methanol, an alcohol which is currently produced from natural gas but which could also be made from coal, wood, or garbage. With very simple modifications, this engine can also use ethanol produced from corn, other grains, wood, or garbage. Both methanol and ethanol are excellent automotive fuels with excellent environmental characteristics.



Technical and Project Assistance

Technology Development Group
National Vehicle and Fuel Emissions Laboratory
U.S. Environmental Protection Agency
Ann Arbor, MI

Combustion System Development Contractor

FEV Engine Technology, Inc.
Southfield, MI

Cutaway Engine Project Contractor

Cutaway Services, Inc.
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