

What next for auto emissions control?

(or)

Is there a Honda in your future?

by John H. Douglas

When engineers would tell Henry Ford something could not be done, his favorite reply was simply, "Go do it." As if following his advice, the Honda Motor Co. Ltd. of Japan has apparently accomplished something Detroit engineers said couldn't be done—meeting the 1975 auto emissions standards of the Clean Air Act through a simple, fundamental modification of the conventional reciprocating engine, without substantially raising its cost or lowering fuel economy.

As a result, American automobile companies, which have been gambling on expensive catalytic converters, added to a car's exhaust system to meet pollution control standards, will face stiff competition when new interim regulations go into effect in 1975.

Honda's winner is a version of a "stratified charge" engine, which beats exhaust emissions by burning an exceptionally lean mixture of gasoline and air. Since such a mixture cannot be ignited by a spark plug, the problem facing engineers was how to form a small pocket of richer mixture (a stratified charge) around the plug to initiate combustion.

Attempts to solve this problem centered, in the United States, on carefully injecting the more volatile charge right beside the spark plug. After three years of effort, work on this approach has almost ceased. Meanwhile, Honda engineers tried isolating the spark plug

in a little chamber of its own above the main cylinder. They then used two separate carburetors to supply the different mixtures of fuel to the two chambers. After the spark plug ignites the rich fuel mixture in its little "pre-ignition chamber," flame travels down into the cylinder proper, exploding the lean mixture to drive the piston. Adding a fancy name, "compound vortex controlled combustion" (cvcc), Honda took the engine to the Committee on Motor Vehicle Emissions of the National Academy of Sciences, which found it the "most promising" candidate to fulfill the provisions of the Clean Air Act.

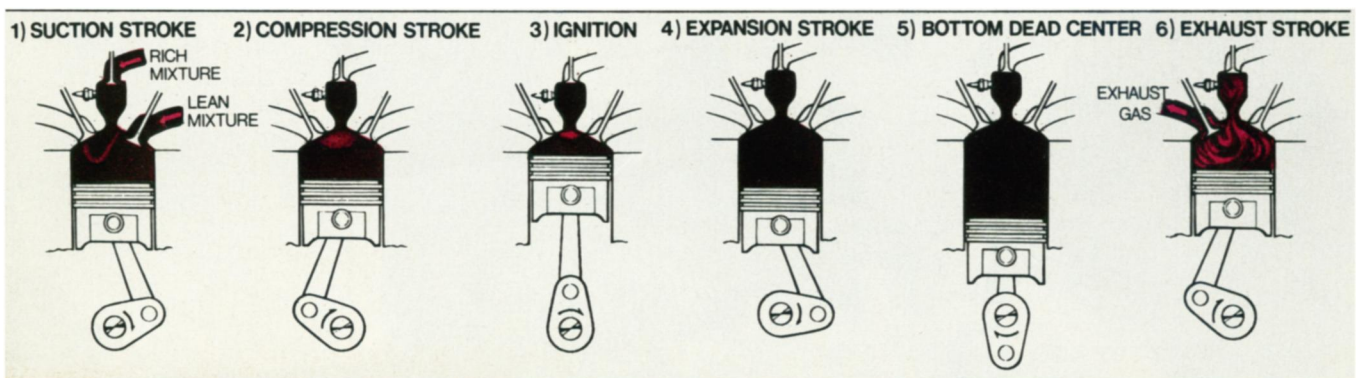
Catalytic converters that would be needed to meet the Clean Air Act standards channel exhaust fumes over two sets of ceramic bars or pellets coated with metals that can promote further chemical reactions in the combustion by-products. The first set reduces nitrogen oxides, the second promotes further burning of hydrocarbons and carbon monoxide.

The NAS committee found catalyst systems relatively fragile. During warm-up, they found, the catalysts are too cold to work efficiently; while cruising downhill they overheat. Gasoline with high lead or sulfur content quickly "poisons" the catalysts. Stop-and-go traffic stresses the system through successive heating and cooling and pulsing the flow of exhaust gases. The fuel

mixture is too "rich" for optimum performance during idle and too "lean" at high speeds. Even when working properly, the catalysts would have to be recharged at intervals, using some of the most expensive metals known (platinum, ruthenium and palladium), much of which would have to be imported from South Africa and the Soviet Union.

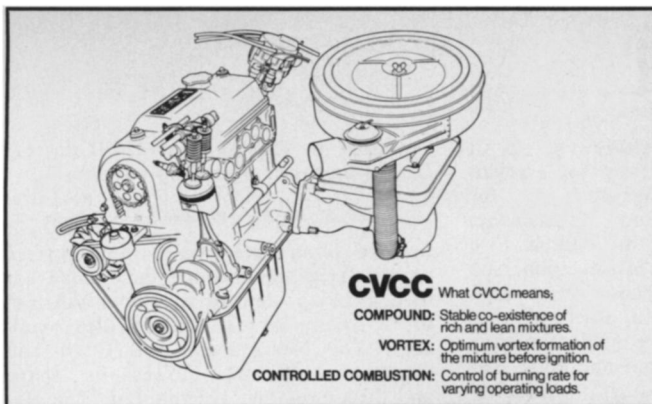
Environmental Protection Agency Administrator William Ruckelshaus has now set the stage for a showdown between the technologies of catalysts and stratified charge engines. By applying strict standards for auto emissions in California in 1975 (SN: 4/21/73, p. 252), where Japanese auto manufacturers sell the largest proportion of their products, Ruckelshaus said he was allowing consumers to choose between alternate systems "in the open marketplace."

American auto manufacturers are understandably apprehensive at the prospect of competing with such Japanese technology, in the immediate future. SCIENCE NEWS has learned that, in addition to facing the Honda cvcc in 1975, American cars will probably have to compete with some form of stratified charge engine from Datsun and Toyota, as well. Toyota has reportedly entered negotiations with Honda to produce cvcc-driven cars under license, while Datsun (Nissan Motor Co.) is said to be trying to develop a



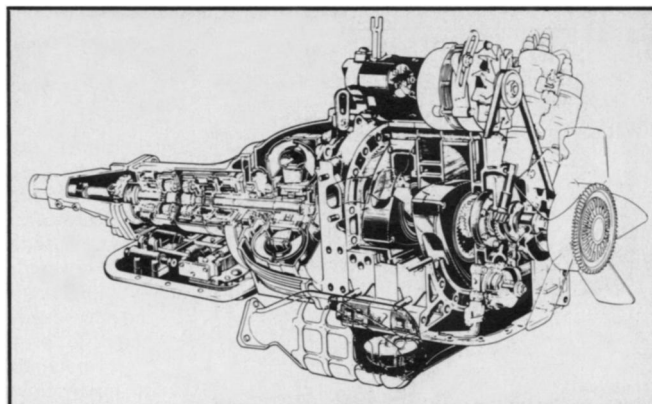
Honda Motor Co. Ltd.

The six-part cycle of the Honda cvcc stratified charge engine: Two different fuel mixtures and a pre-ignition.



Honda Motor Co. Ltd.

NAS calls Honda's CVCC the "most promising candidate."



Toyko Kogyo Co.

Mazda's system performed more reliably than catalysts.

stratified charge engine with fuel injection as well as carburetion. Honda alone is expected to market as many as 250,000 of its cars in California in 1975.

The interim standards set up by the EPA would require only one set of catalysts for California in 1975—to remove hydrocarbons and carbon monoxide. The 1976 standards of the present law would require addition of the second set of catalysts—to remove nitrogen oxides—but Ruckelshaus told a Senate subcommittee last week that the original studies conducted to set the nitrogen oxides standards were in error and that less stringent standards should be set.

Other engine systems may also play important roles in the coming competition:

- Because of its high-temperature exhaust gases, the Wankel engine can easily use a thermal reactor rather than a catalyst system to complete the burning of hydrocarbons and carbon monoxide. In tests so far, the thermal reactor system has performed more reliably than the catalysts, and Mazda (Toyo Kogyo Co.) has already demonstrated ability to meet the 1975 standards. But the Wankel—thermal reactor system uses 30 percent more gasoline than the comparable piston engine.

- The automotive turbine engine has resurfaced. Engineers from General Motors, Ford and International Harvester told a conference of the American Society of Mechanical Engineers this month of recent advances that promise to make the gas turbine the automotive "engine of the 1980's," in the words of the GM engineer. The engineers said that, based on laboratory tests, the turbines could probably meet the tough 1976 emissions standards, but problems of cost, fuel economy, durability and operation under stop-and-go conditions must be solved before the system is competitive.

- Diesel cars have long been favorites, particularly for taxis, in parts of the world where gasoline prices are very high. The Mercedes Benz diesel ex-

ceeds the nitrogen oxide standard of 1976, but revision of the standard could make the diesel an important contender because of its fuel economy and low maintenance cost. The engines are relatively smelly and noisy, but manufacturers report promising new developments, including a rotary diesel similar in construction to the Wankel.

- Electrically powered vehicles would be efficient and virtually pollution free, but fuel cells are still too expensive for personal cars, and batteries give only about 50 to 80 miles driving range between charges. Engineers are also resurrecting two historical curiosities for examination in the light of new technology—the so-called Stirling and Rankine engines. Originally the Stirling engine used heated expanding air as a source of power, and the most familiar Rankine engine is just the steam engine, though both can use other fluids. NAS saw potential in the Stirling engine, saying it might turn out to be superior to both gasoline and diesel systems within the decade.

Detroit's reaction to the recent Ruckelshaus decision followed a pattern established over the last few years of rising environmental concern—vice-presidents scurried to Capitol Hill and fanned out across the lecture circuit to repeat, "It can't be done." Full-page

ads trumpeted the same message. Legal counsels huddled in anticipation of another round of court suits. This time, however, the automakers face a formidable array of foes. The Wall Street Journal editorialized that time had run out for stalling on adopting new technology to meet the standards, and said the industry, "above all else, must demonstrate good faith." Sen. Edmund Muskie (D-Maine) condemned what he called "outrageous violations" of existing law by auto manufacturers, including installation of emission control devices on 1973 models that would automatically shut off under many normal driving conditions. Sen. Jennings Randolph (D-W.Va.), whose Public Works Committee is ultimately responsible for overseeing the EPA, said he agreed with the Ruckelshaus decision and saw no reason for further delay.

Rising fuel prices and possible gasoline rationing may ultimately decide the issue. The impact of efficient, economical, low-emission Japanese cars could have an impact on the American automotive market that small European cars had during the 60's, Ruckelshaus told a Senate hearing. To that Muskie replied, "Maybe Honda can do more to keep the American automobile industry in line than the U.S. Congress can." □

Mazda's clean-air system combines rotary engine and a thermal reactor to complete burning of emissions.

Toyo Kogyo Co.

