

Efficient Engine

Grail engine would cut cars' cost, could run on a variety of fuels

By MICHAEL STRAND
Salina Journal

CHAPMAN — Borrow a unique design from a French World War I fighter, a trio of 21st century spark plugs whose spark lasts just nanoseconds, a few other off-the-shelf parts and proven technologies — and put them all into a two-stroke engine.

The end result could be an engine for cars, motorcycles, lawn mowers and such that is more fuel efficient, produces fewer emissions and is significantly easier and cheaper to manufacture.

For years, Matthew Riley had been working on ways to lower the emissions of rotary engines but had hit a dead-end and started looking at more conventional two-stroke engines commonly found in chain saws, edgers and other small equipment.

In many two-stroke engines, the oil and gasoline are mixed, and the oil burns with the fuel.

Reducing the pollution from such engines meant getting the oil out of the exhaust, said Riley, an engineer who lives in McPherson. Most of the work in that direction, he said, focused on trying to recover the oil from the exhaust.

"That was a very complicated solution and wasn't working well," he said.

Much simpler, at least in theory, was to keep the oil out of the combustion chamber in the first place.

That was a little over a year ago; today, Riley is CEO and chief research scientist of Grail Engine Technologies, with corporate headquarters in Chapman, in the Kansas Racing Museum, owned by local lawyer Doug Thompson, who is Grail's corporate attorney.

The company has stacks of engineering drawings, a plastic model built in conjunction with Salina Area Technical College, and partnerships with nationally known and local companies.

3 spark plugs per cylinder

Look at the model and the drawings, and several questions quickly surface.

Where you'd expect to see two, three or four intake and exhaust valves in the cylinder head, there's just one, an exhaust valve. But there are spaces for multiple spark plugs — three per cylinder in the latest design.

As Riley pulls the piston and connecting arm out of the cylinder of the model, the answer to the question of "Where's the intake valve?" is answered with another question — it's there, in the center of the piston. But why?

It's a design that's been around for a century, Riley said, appearing in the Gnome radial engines used on several fighters in World War I, and it's a key to many of the other features of the Grail engine.

Having an intake valve in the piston — along with off-the-shelf Lucas oil additive that keeps the oil adhering to parts — keeps the engine oil out of the combustion chamber.

That's important, Riley explained, because air enters the combustion chamber from the crankcase, which is designed to have a much smaller volume than a typical crankcase. Because of that smaller volume, it develops a slight positive pressure as the piston comes down. Having the intake valve in the piston means more room on top of the cylinder head for those three or more spark plugs, plus a fuel injector.

And multiple spark plugs are important, as they serve to do more than just ignite the air-fuel mixture.

Instead, Riley said, the plugs create a rapid expansion of air and fuel, as well as a shock wave in the cylinder, increasing compression ahead of a normal ignition



Photos by TOM DORSEY / Salina Journal
Matthew Riley, CEO and chief research scientist of Grail Engine Technologies, holds a plastic model of an air-cooled cylinder of a Grail engine. A Grail engine could run on a variety of fuels, including gasoline, diesel, hydrogen, propane and natural gas.

wave so that the air and fuel mixture spontaneously combusts the remaining gasses, similar to what happens in a diesel engine.

It will burn cleaner

To get that effect, Riley uses Pulstar spark plugs, which have been on the market only for a few years and generate a spark 10 times as powerful as a normal plug, in a much shorter period of time. They're available by special-order at many auto parts stores, at around \$25 each.

The upstroke of the piston produces a compression ratio of about 10 to 1, Riley said, while the ignition forces the compression to about 13 or 14 to 1.

It's called "forced semi-homogeneous charge compression ignition;" it, too, is a time-tested technology that leads to a faster, cleaner burn at lower temperatures, which reduces emissions.

"The ignition blast increases compression beyond 10 to 1, without the loss of power from further compressing using the upstroke," Riley said.

The shock wave is further focused by a hemispherical-shaped cylinder top, commonly known as "hemispherical detonation," and a hemispherical piston face.

"Try cupping your hands and clapping," Riley said. "Notice the difference from



The Grail engine features a valve in the piston.

when your hands are flat."

A lot more horsepower

The design also means any given Grail engine could run on a variety of fuels, including gasoline, diesel, hydrogen, propane, natural gas and others.

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Receiving a windfall? Set goals before you spend it

Examine your debt load and consider paying off high-interest balances

By EILEEN AJ CONNELLY
The Associated Press

It could happen to you. A surprise inheritance, a lawsuit settlement, a lottery prize or perhaps a buyout from your employer could mean you suddenly find yourself with extra cash.

Chances are, it won't be a \$300 million Powerball jackpot. But even a far smaller windfall can help provide financial security if you handle it wisely.

The key is to think first, spend later.

Before you buy a round for everyone at the pub or spread the word on your Facebook page, financial advisers say you should quietly assess your current situation. Taking stock of your short- and long-term goals, debts and other personal circumstances will help you decide the best way to use the money. Plus, keeping the news to yourself will give you time to make decisions before relatives, friends, charities or questionable investment schemes can try to stake claims on your emotions.

Correct past mistakes

If you receive a fairly modest amount, say \$10,000 to \$50,000, a good use may be to repair some potential problems.

For instance, when examining your debt load, you should certainly focus on any high-interest balances.

The average household carries more than \$8,000 in credit card debt and the average interest rate is up to about 13.5 percent. Making only minimum payments and adding no more charges, it would take nearly 10 years to pay that balance, costing an additional \$3,000 in interest.

Using your windfall to pay down that debt would not only remove the burden of monthly payments, but save more in interest than you could expect to make by investing the same amount in the stock market. The vast majority of the time, paying down debt is going to be "at the top of my list," said Ronald Myers, a planner with Associated Investor Services in Fort Lauderdale, Fla.

Identify goals

In the same way, removing other financial obligations that cause stress or cost a lot could help dramatically improve your financial situation. This will allow you to use future earnings to reach your goals.

Typically, advisers say people who come into modest amounts don't seek financial advice. Even those who receive more substantial sums, like \$100,000 to \$500,000, often don't seek help, which may be a mistake. Without some guidance, the temptation may be to spend that money in ways that could cause problems or disappointments later on.

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Taxidermist preserves, displays creatures

Bob Helm turned his hobby into a business in 1985

By DAVID CLOUSTON
Salina Journal

Lift the lid and peer inside Bob Helm's washing machine — if you dare. Something inside might be staring back.

All right — not staring, exactly, since the animal skins he works with don't have eyes. Still, he learned the hard way that it was better to install a washing machine at his taxidermy shop than to risk his wife's ire by sneaking them into the machine at home.

"That's how I got in trouble most at home," Helm said, grinning. "Hair would show up in the washing machine every once in a while and I would say, 'Oh, I

WORK force

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forgot to tell you, I spun out something.'"

The washer helps prepare animal skins for mounting.

"I do my own tanning for mounting purposes," he said. And after the skins come out of the tanning bath, he runs them through the wash and a spin cycle.

"It cleans the hair and the skin and makes it all nice and shiny again," he said. "You can even spin out birds, like turkeys, just to get the water out of the feathers. Put them on a gentle spin."

Helm, a retired Salina city employee, always has had an artistic side. He started out painting landscapes, then switched to taxidermy. His interest in the trade was sparked when he and his brother decided to have a duck mounted from one of their first hunts together.

"I took a home correspondence course from a company in Nebraska," Helm said. "From there, I got involved with the Kansas Association of Taxidermists. And being involved in that organization, I got

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JEFF COOPER / Salina Journal

- NAME: Bob Helm Sr.
- AGE: 58
- OCCUPATION: Taxidermist and owner of Bob's Creative Taxidermy
- YEARS ON THE JOB: In business since 1985