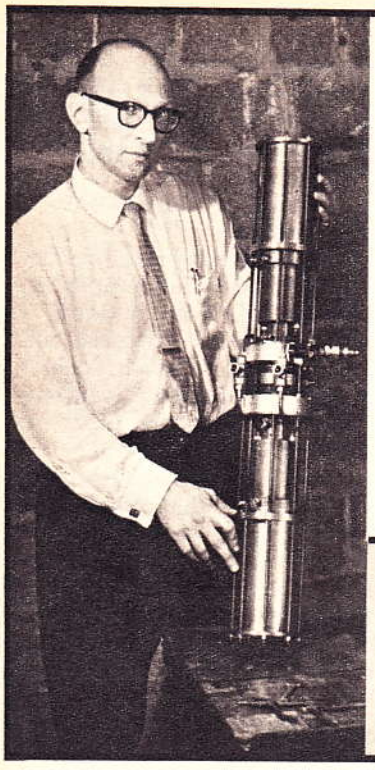
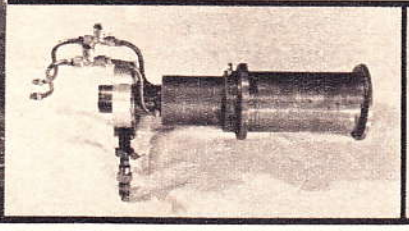
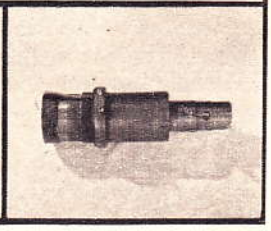


Mr. Kosoff's WONDERFUL NEW ENGINE

This $200 free-piston engine weighs only 40 pounds, with a mechanical efficiency rated at better than 80 per cent.





INVENTOR KOSOFF and his free-piston engine, left. The engine's cylinders are ½ inch thick and weigh between six and seven pounds but need only be 1/8 or 1/16 inch thick and weigh two pounds. Combustion chamber and manifold assembly, center; cylinder, right.

By Robert Gannon

IT LOOKS like a piece of stovepipe and weighs about 40 pounds. If it lives up to the claims of its 33-year-old inventor, Harold Kosoff of Philadelphia, this revolutionary new engine installed in your basement for an estimated $200 would, among other things, supply electricity at about one-sixth the cost of what you now pay.

The machine is a free-piston engine, and it consists essentially of a closed-end tube with two loose pistons separated by a combustion chamber. When fuel ignites in the center, the pistons fly apart, compress air in the two ends of the tube, bounce on the trapped air, then rush back toward the center, where they ignite more fuel.

The engine runs with no discernible vibration, a minimum of noise and a high degree of efficiency. It can use a variety of fuels—it has been run on propane and butane gas, alcohol and gasoline. In addition, the 20-hp power plant is so simply constructed it could be manufactured for far less than anything else around. In fact, inventor Kosoff built the free-piston engine in his garage with a lathe and a drill press. By using lighter, thinner materials its weight should be cut from 40 to about 20 pounds.

Kosoff is extremely proud of his creation. When we interviewed him for MI he said:

"It's hard to talk about the engine without sounding immodest. But, really, I can't think of anything since the advent of the internal combustion engine that this can be likened to. Unless I'm completely wrong, this is the first major breakthrough in engine technology in maybe 75 years."

Most engines turn things—a wheel, a pulley and belt, a drive shaft—but Kosoff's doesn't. It pumps. And this fact

—that it's a combination motor and compressor—is what makes it appear so promising.

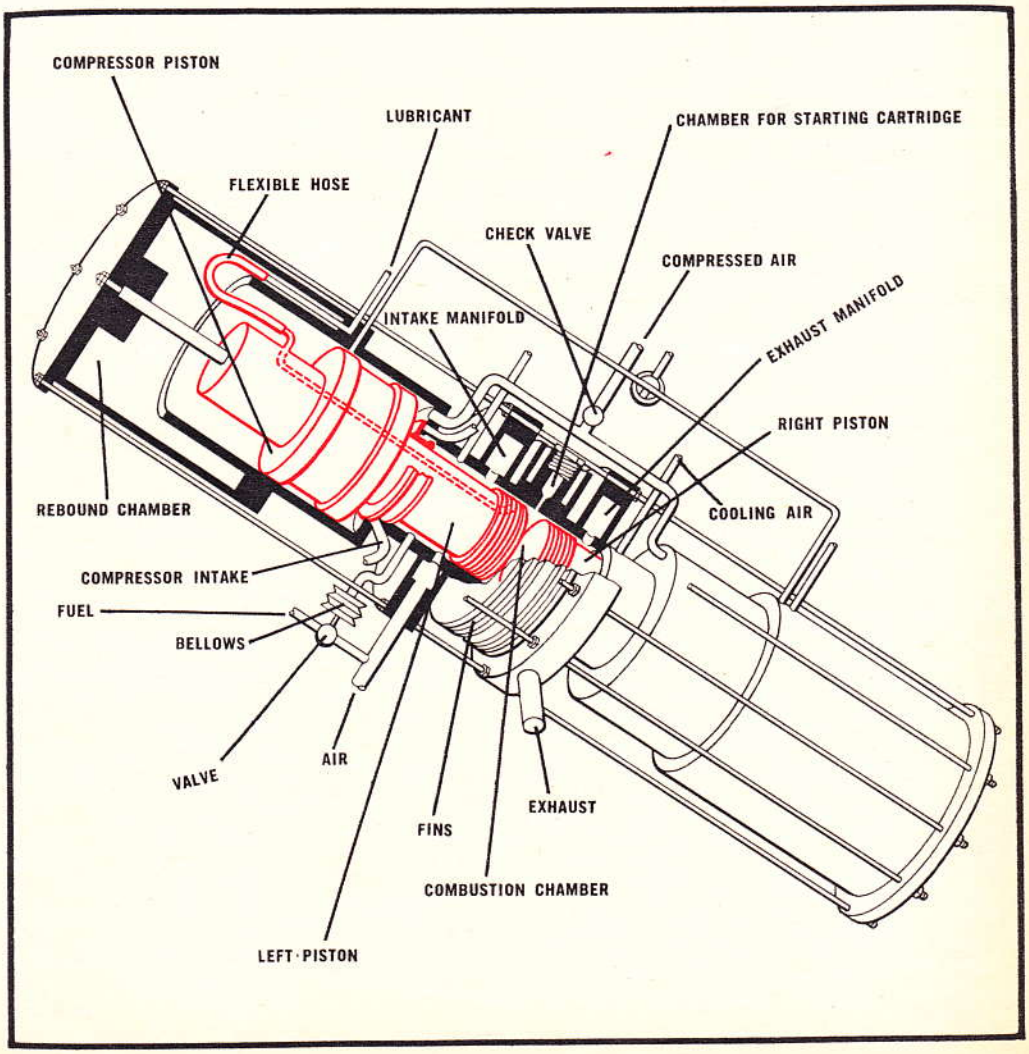
For example, take efficiency—the amount of fuel used for the amount of work produced—this probably is the most important factor in comparing one engine to another. Here Kosoff's machine rates high for two reasons: high compression ratio and a minimum of moving parts.

The compression ratio is roughly 16: 1, close to the theoretical practical limit and about the same as a diesel, one of the most efficient of all engines.

Kosoff's engine has only two moving parts, the pistons. It has no crankshaft, bearings, wrist pins, valves, power take-offs, tappets, etc. What's more, the pistons have been undercut so that there are only two square inches of contact surface to produce friction.

"Originally I calculated the mechanical efficiency to be about 80 per cent," said Kosoff. "I was delighted. But I've had to revise my thinking. It's higher."

The two pistons are identical. Running full speed, they are so well balanced that if it weren't for the noise (about as much as from a model-airplane engine running without a muffler) you'd hardly know the [*Continued on page* 139]



in spite of a crackup in a bog last year. Before the accident, caused by gusty wind, chief designer Wimpenny had flown 933 yards to win a prize of 50 pounds for the first man-powered plane to fly more than half a mile. Both Puffin and Sumpac have flown through turns of 70-80 degrees.

The Puffin people have a lot of faith in an all-new wing they have for Puffin Mark II, which they are now building. The Sumpac people feel equally confident about a newly modified Sumpac. Many of the original group have left the University but new members have joined it. Andrew Lassiere, group chairman, says the new Sumpac will soon be ready.

These two still hold the lead although there is lots of manpowered activity around the United Kingdom. The Royal Aeronautics Society, made up of Britain's top aviation experts, gathered a fund of 5,000 pounds shortly after the Kremer prize was announced; the RAS fund was to aid contenders with good designs but no money to work with. The group was deluged with requests but so far has made grants to only five. Southhampton, the de Havilland group, Southend made three. Two others have received grants, one called the Woodford Group, which has a pedal-plane design, and one called the Farnborough Man-Powered Ornithopter Club, which has, as its name implies, a wing-flapping design. The details of the last-mentioned are secret, but just knowing it's in the race must warm the hearts of old wing-flapping enthusiasts everywhere. •

Wonderful New Engine

[*Continued from page* 71]

engine is going. You lift it and it vibrates like an electric drill.

But what can an engine do that only pumps—that doesn't directly turn a drive shaft? Plenty. Kosoff hooks his prototype to a compressed air tank and fills it at the rate of 60 cubic feet per minute. That's faster than the rate of service station air compressors. "The gas compression market is a $600-million-a-year business," said Kosoff with a faraway look. "That includes pneumatic road-building machines, commercial spray-paint equipment, building construction gear. Every manufacturer has

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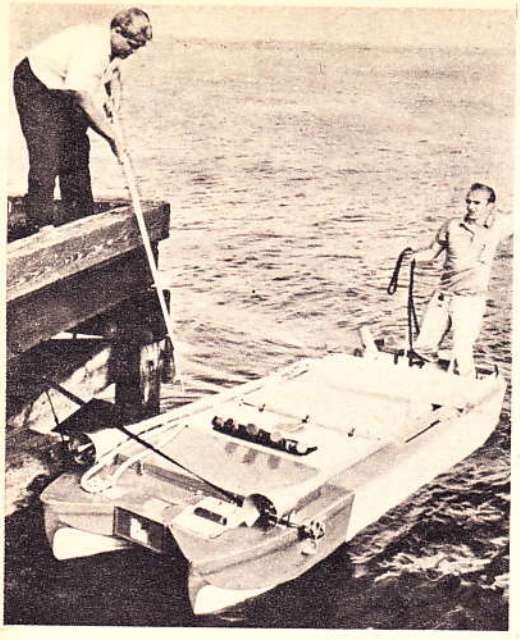
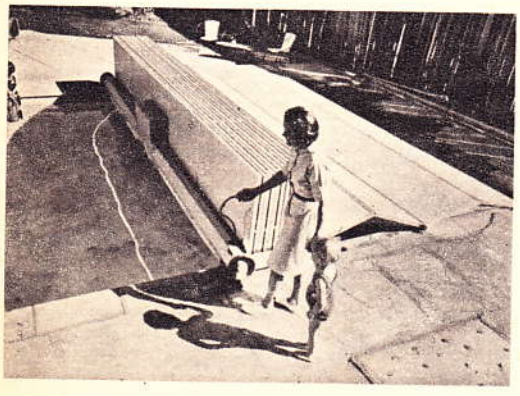


RECOVERY BOAT tested for Air Force retrieves space capsules down at sea. Electronically guided vessel drops from plane, maneuvers to capsule, cuts loose capsule's chute, then fires net over capsule. Masts at each side of boat erect themselves when operation is complete. The plane returns, trailing trapeze gear that snares the masts, picks up capsule, then boat.



ACCORDION FOLDED swimming pool cover needs no big muscles to operate it. Electrically powered all-metal top runs on wheels, can be rolled away to garage for quick out-of-sight storage. Its switch is on a cord that can be unplugged to prevent tots from removing cover, getting into dutch. Pool-Deck, Inc., 1600 South Union Ave., Bakersfield, Calif., is the maker.

Wonderful New Engine

[*Continued from page* 139]

a source of compressed air; every machine shop has a compressor.

"A two-hp engine/air compressor combination such as those used in gas stations costs about $500. I believe my engine could be sold for less than $200."

But the great expectation for the future of the free-piston engine is in generating electrical current, Kosoff believes. With magnets inserted into the pistons and coils wound around the cylinders, a generator would be created that conceivably could produce electricity for about a half-cent per kilowatt. That's six to ten times cheaper than the utility companies charge, the inventor says.

Though he hasn't made a working generator yet, Kosoff calculates that if his prototype were adapted it would produce from four to six kilowatts, enough for an average home. The engine runs at the rate of 3,700 ignition cycles per minute now. With a slight change of piston weight, that could be changed to 3,600—perfect for 60-cycle current.

"A five-kilowatt electric generator operated by gas (as used in ranges) could be sold for less than $200. As a bonus, the heat of the exhaust could be diverted to the hot water tank. You'd get hot water free."

To use a free-piston engine for a car the pumping action would have to be converted to shaft rotation. The way to do that, according to a Kosoff patent, is to pump hydraulic fluid under high pressure past the blades of a turbine—which would spin the turbine shaft.

He feels that a free-piston-engine-driven car should get 40 mpg, mainly because such friction-producing items as gears, differential, drive shaft, etc., would be missing and the total car weight reduced by about 1,000 pounds. "You'd also have a better ride, because you'd have eliminated the biggest source of vibration—the conventional engine."

Kosoff's been working on his engine for a long time. He started back in high school when "for some reason I became interested in perpetual motion machines, approached from a thermodynamic point of view."

He checked the market and found en-

gines called "free piston" that looked promising. Trouble was, the pistons weren't truly free. They were synchronized by mechanical connections. "I suddenly got an intuition," he said, "that those linkages weren't necessary."

By the time Kosoff discovered how to do without them (with an ingenious self-regulating air valve system that eliminated 80 per cent of all moving parts) he had received his B.A. in physics from Philadelphia's Temple University, studied mechanical engineering at Drexel Institute and become a part-time computer programmer.

As he got nearer to achieving a working model development problems got tougher and he spent more time in the garage and less time on program computers. One problem was how to start the engine. One method would be to give it a blast of air to drive the pistons apart. But Kosoff had no such equipment and, besides, the machine was designed for use where no compressed air would be available.

Solution: a 22 shell with the slug replaced by Sterno to keep the powder from falling out. To start the engine, a shell is placed in an aperture in the ignition chamber, a cover is screwed on and a small firing hammer on a spring slipped into place. It takes about 15 seconds. But it took six weeks to work it out.

Now that the engine is completed, Kosoff's problem is to find a company interested in developing it further. A similar engine, loudly touted as "free piston," was introduced in this country a few years ago. But because of excessive moving parts and complications, the engine proved too expensive.

Kosoff says he has tried to interest 25 companies, without success. Since his patent has been issued, however, the publicity has brought letters of inquiry from foreign manufacturers and a few small American companies.

It's been a long tough road for Kosoff. "Instead of spending money for photography or hot rods or something, I put it into the engine," he said. (He admits he's so broke he had to sell his shop equipment.) "I excluded everything else from my life for years. Now we'll see. Ask me in six months if it has been worth it." By then I should know." •