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MEAN MACHINES

THIS is a story about boys and their toys. Big boys, with hot, explosive toys. Which is not to say, of course, that women aren't interested in functional home-made turbojets—the kind that spew sheets of concentrated, super-hot flame and scream like a million tortured souls. It's just that most women would probably need a good reason to build one.

But not your do-it-yourself, build-it-from-scrap turbo man. If you cobble together some junk, and it can spit fire and whine like a pack of distressed wolves, does it really have to do anything else? "There doesn't have to be any real-world application," says Gaylen Springer, a 59-year-old shopping centre developer who lives in rural Oregon. "The excitement is just in making all that smoke and flame and noise."

Like numerous other fellows scattered around the globe, Springer has devoted a distinct chunk of his life to designing and building large, throbbing, overheated turbine engines. He can't seem to stop himself. Neither can the others, even though theirs is an awfully lonely calling.

"I thought I was the only one out there who wanted to make a jet engine out of an automobile turbocharger," recalls Larry Berg, a 49-year-old semiretired owner of a computer parts mail-order company. "I thought I was like Edison, or the guy who invented the wheel—out there all alone." But a few years ago, on the Web, he discovered a lot of other guys, including Springer: turbojet comrades, builders and wannabes. "Now we all share information," he says, "including some really cool pictures and audio."

For those who may not have built one recently, turbojets are the engines of nearly all modern commercial and military aircraft. But their working principle—jet propulsion—dates all the way back to 150 BC, when a Greek named Hero created a toy called an aeolipile, that rotated atop a pot of boiling water as steam exited several nozzles radially arranged around a wheel.

The Chinese built on this heroic notion by creating rockets able to scare off enemies and liven up holidays. Leonardo da Vinci later sketched a contraption that used hot gases flowing up a chimney to rotate cooking meat. But it was the Italian engineer Giovanni Branca in 1629 who first used jets of steam to actually operate a piece of machinery—and the Germans, more than 300 years later, who built the first operable jet aeroplane. Now the evolutionary history of the turbojet has reached right into the super-sophisticated workshops of insurance salesmen and auto-parts dealers.

The turbo's appeal lies in its simplicity. "An internal combustion engine is limited by how fast it can accelerate its components," says Mark Nye, a 36-year-old Canadian from Mississauga, Ontario, whose company makes attachments for heavy equipment. "There's all of this stuff that wigwags back and forth and seems so bogus. The only limits on a turbine are how fast it can spin and how much heat it can take. In theory, that means you can always make more power."

'Then a flame about six feet long shot out of the nozzle. And th

Like an automobile engine, a jet turbine operates by burning a mixture of air and vaporised fuel. The combustion of this mixture creates hot gases that rapidly expand. In a car, these gases push pistons, coupled to a crankshaft and ultimately the

In garages and sheds all over the world, they're building jet engines. And it's all just a bit of noisy, overheated fun, claims *Scott LaFee*

Illustrations: Spike Gerrell

wheels—with other components like springs and valves involved along the way. A basic turbojet, by contrast, consists of just three main parts: compressor, combustion chamber and turbine (see Diagram, p 38). The compressor at the front has a series of rotating aerofoil blades that spin like a giant fan to suck in air, then push it back through ever smaller ducts to the combustion chamber.

Here the now highly pressurised air is combined and burnt with fuel at temperatures that can exceed 1400 °C. The resulting hot gases force their way out of the chamber through a bladed turbine, which uses a small part of that kinetic energy to spin the compressor fans. The rest of the energy goes into the blistering hot gas that races backwards through the exhaust nozzle at speeds of 2000 kilometres per hour or more, exerting an equal and opposite forward thrust on the engine and anything attached to it.

So now you know why guys like Springer and Nye spend lots of time and money (well, some money) building turbines rather than mowing the lawn. Or maybe you don't.

"I've got to say, when I built my first turbine, everybody thought I was nuts," says Berg, who also lives in Oregon. "That was one of the biggest challenges. When your neighbours think you're nuts, when they keep asking why you're doing this, it can be very distracting."

Berg made his first turbine engine in 1994, with little idea of what he was doing. "I thought you just had this flame of explosion that caused the turbine to turn." For parts, he purchased an old automobile turbocharger from a neighbour for $20. Then, through trial and error, he attached various bits of pipe, some confiscated from a vacuum cleaner, assorted metal couplings and pumps, a $1·49 tyre pressure gauge and other scrounged odds and ends. Remarkably, it worked . . . for exactly one minute.

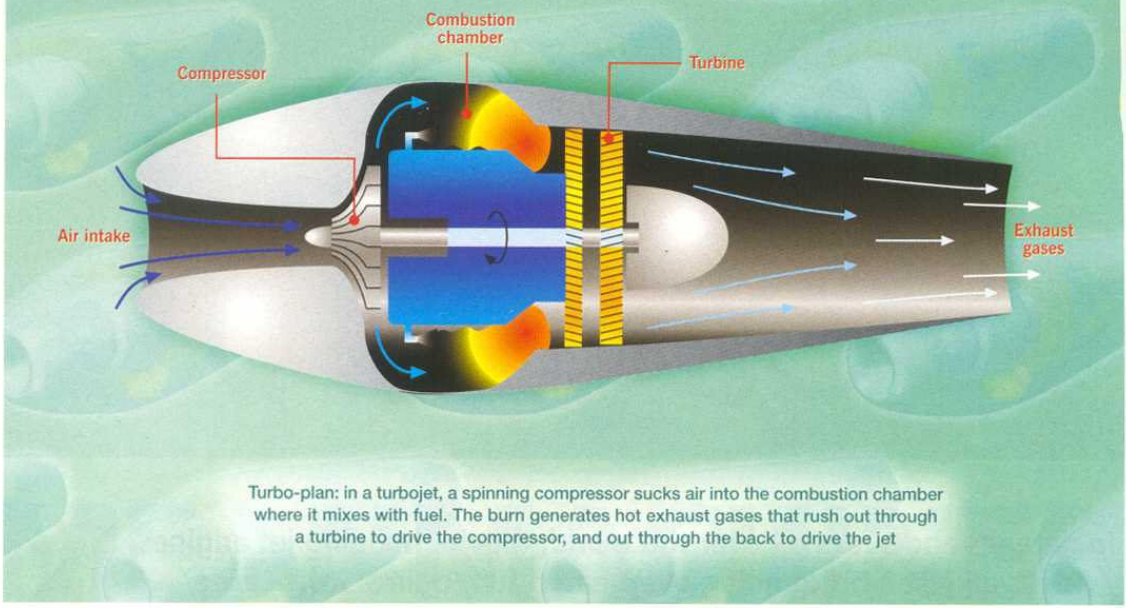
"I could never get it started again, but I was hooked after that," says Berg. "Just listening to a jet engine spool up, going faster and faster, louder and louder . . . You start to wonder when it's going to end. Maybe when it explodes."

Two years later, working alongside his 75-year-old father, Berg built a second engine. "It was a kind of father-son thing," he recalls. "We finished it, took it outside and fired it up. There wasn't any measurable thrust, but it ran unassisted and made a lot of noise. My dad looked at it, we smiled, did a 'high five' and then he said he was cold and was going home. When he got home, he turned on the TV, lit a cigarette and died. I'm still trying to figure all that out."

While Berg was content simply to prove concepts—that coffee cans make good combustion chamber liners, for example—other builders are more ambitious, designing engines with, uh, applications.

Some Finnish aficionados recently crafted an engine from, among other things: the oil pump off an old car, an electric motor from a cleaning machine, a motorcycle battery, an injection nozzle from a dismantled Russian bomber and a starter stripped from a defunct leaf blower. They then welded the jet onto an old bicycle, which proved to be "far too weak to withstand the weight of the jet, driver and auxiliary systems", says team member Kimmo Ahola. So Ahola and colleagues added more support piping,

engine was gaining speed, and more speed, and I was running'



Turbo-plan: in a turbojet, a spinning compressor sucks air into the combustion chamber where it mixes with fuel. The burn generates hot exhaust gases that rush out through a turbine to drive the compressor, and out through the back to drive the jet

'You can never really tell if these things are absolutely safe'

plus training wheels to keep the whole thing upright.

Then they entered their invention in the annual parking lot drag race at Tampere University of Technology, provoking more than a few stares, many of them reportedly admiring. The turbo bike, says Ahola, "performed fantastically". It won—not the race—but "the honourable record of lowest speed". And the Finns aren't finished yet. They have since built a second engine, mounted on a moped and dubbed, cryptically, Eunuch 2.

Eating fire

Barring a technological breakthrough, it appears unlikely that the Finns, or anyone else for that matter, will market a turbocharged moped in the near future. Indeed, most makers of home-made turbojets seem content simply to indulge in a bit of intellectual exercise and, if they are smart enough, avoid a catastrophic explosion. The latter, of course, remains an everpresent possibility.

Nye remembers running an engine that suffered an internal breakdown and spurted bits of molten metal parts. Then there's Charlie Napier, an auto body shop owner in Coos Bay, Oregon (the state is a hotbed for amateur turbojet makers). Napier recounts this story on his website: "I started my engine the other day. It was sounding kind of odd, like a low slow drumbeat. I looked around and everything seemed fine, so I put her to the wood. After reaching max revs, the noise level had increased—it sounded like a series of small explosions.

"I then noticed that I had not hooked up the air supply to my air-atomised fuel injectors. 'Shit', I said, and I reached down and plugged her in, which turned out to be a very bad thing to do. My injectors don't have a check valve in the air line and the whole time, unbeknownst to me, the engine was pumping fuel into the air supply plumbing side of the injectors.

"Anyways, this caused a huge—and I mean huge—explosion. It was so loud my night watchman, who lives about half a mile away, ran over to see if I was dead. Then a flame about six feet long shot out of the nozzle. The whole time the engine was gaining speed . . . and I was running, yelling to my friends 'Run away.'"

Fortunately for Napier and his watchman, the engine conked out after consuming all of its fuel. "It was a little bit scary," says Napier. "You can never really tell if these things are absolutely safe."

So why not do something else, something that won't remotely threaten one's life? Napier chuckles. He's heard the question before. Heck, they all have. "Why do I want to build turbojets?" He ponders the query, then answers, "They're so cool."

Spoken like a true turbo-fan. □

Scott LaFee is a journalist working on the *San Diego Union-Tribune.*

Further information: Larry Berg's turbojet website is at **http://home.cdsnet.net/~purple/projects/turbine/top.htm**

Going for the burn: an enthusiast juices up his jet