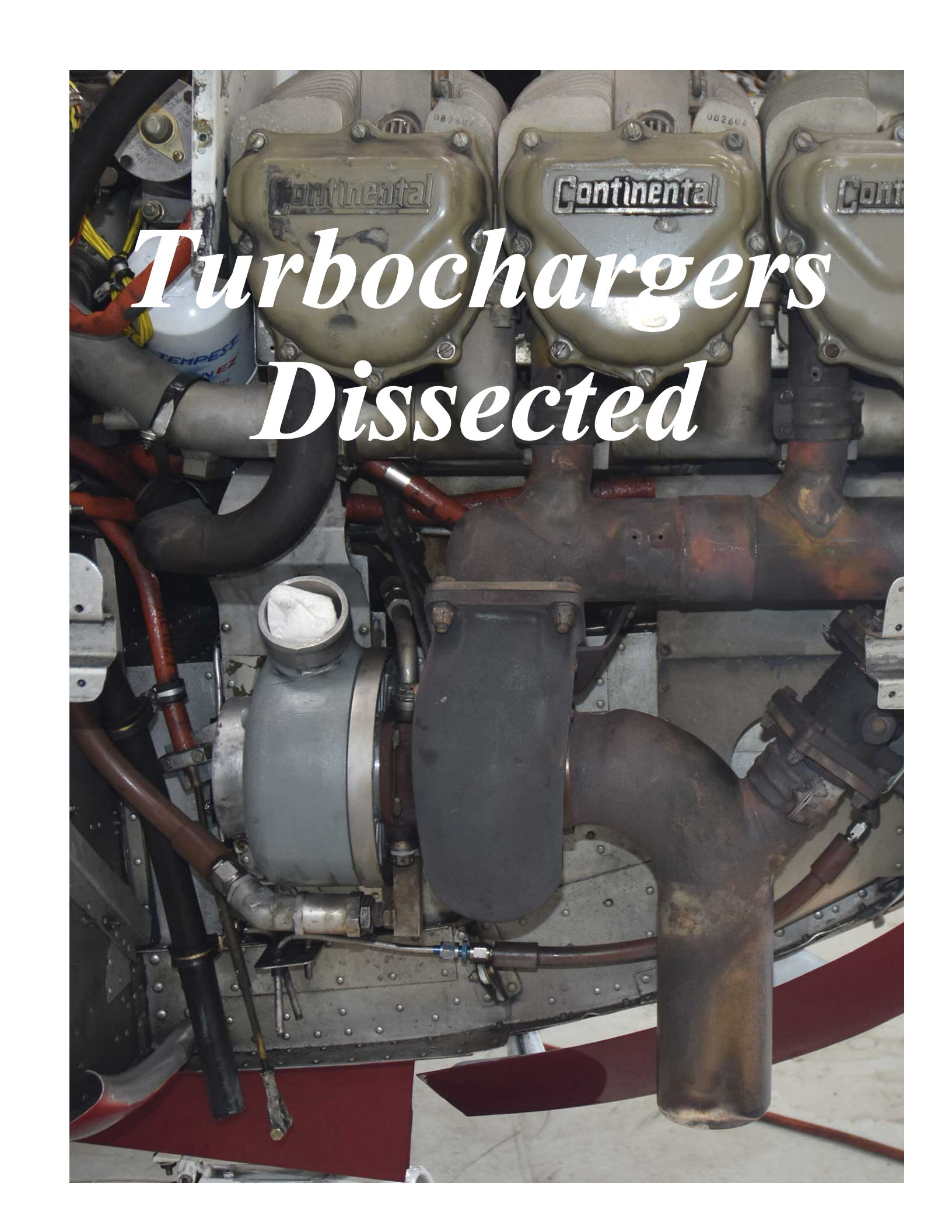


A photograph of a multi-engine aircraft, likely a Cessna 441, showing the engine compartment. Three Continental turbosuperchargers are visible, each with the brand name 'Continental' embossed on its housing. The engines are mounted on a red-painted metal frame. Various hoses, pipes, and mechanical components are visible around the engines. The text 'Turbochargers Dissected' is overlaid in a large, white, serif font.

Turbochargers Dissected

Aircraft Turbochargers Dissected

By Mike Jones

Cessna Pilots Magazine, originally published as a sidebar: July 2023

The technology of turbocharging is based in research from the 19th century when two clever German innovators, Daimler and Diesel, were experimenting with more efficient engines. They were beaten to the punch in 1905 by a Swiss engineer named Dr. Alfred Büchi who received the first patent on a “forced induction” turbocharger on a marine engine. In 1918 an American engineer, Sanford Moss, installed the first turbocharger on an airplane. But the technology never really “took off” (forgive me!) because the technology was limited by the metallurgy and engineering capabilities of the time, specifically for bearings and thermal control.

A turbocharger is added to an aircraft engine because the atmosphere thins with altitude. An engine needs a 17:1 air-to-fuel mixture to burn efficiently. We lean normally-aspirated engines as we climb to avoid too much fuel going into the cylinder, “flooding” the engine. A turbocharger reverses this process: instead of taking away fuel, it adds more air into the combustion chamber. This sustains the 17:1 ratio despite the thinning atmosphere.

A turbocharger is a big, heavy, clunky iron casting on the side of your engine. It usually has two sets of fan blades riding on a shared axle. One side of the turbo is the hot “exhaust side” and the other side is the cooler “air side.”

(By the way, “cool” is a relative term; I am told turbochargers glow red-hot as we chug down the magenta line.)



The exhaust manifold on a turbocharged airplane engine collects all the super-hot, flame-filled exhaust gasses coming out of each cylinder and routes those gasses into the “exhaust side” of the turbocharger. The gasses hit the turbine blades and force the turbine assembly to spin, quickly reaching thousands of RPM. But, since the two fan blade systems share an axle, if the exhaust side drives the air-side of the turbo to spin-up as well.

Meanwhile, cool outside air has been forced into the air-side turbo by both the prop at the front of the plane and the actual motion of the airplane through the air. The air-side turbo captures that air and compresses it. This thicker, oxygen-dense air then is routed into each cylinder. The extra oxygen means the engine is able to burn more fuel which makes more power which lets us go faster which makes us smile. In aeronautical terms, smiles are good.

It's almost like we're getting something for nothing. If the turbocharger wasn't in the path of the exhaust, all that extra energy and heat would simply be dumped overboard and lost. The turbocharger captures some of that energy and puts it to work for a second time.



Despite all the complexity and weight, turbocharged airplanes offer amazing performance upgrades. I have personally had my Centurion T210 up to 27,000 feet several times. One time I was avoiding build-ups and turbulence as I jumped over the Rockies. Air traffic control called me out to a passing Southwest jet, who voiced his surprise to find a single-engine Cessna sharing his lofty perch.

Another memorable occasion I topped a thunderstorm near Atlanta. I sailed along in CAVU skies as the heavy-haulers churned through turbulence and rain four miles below me. Even lower altitudes can be productive: I once caught the lower edge of the jet-stream at 19,000 feet and flew from Omaha to

Boston in under four hours. I was so high and racing along so fast I needed to start my descent over Buffalo, New York, 400 miles west of my destination.

I love my turbo.

About the Author

Dr. Mike Jones is an entrepreneur who uses his business expertise to help G.A. airports across the country improve their governance and operations, speeding them on their way to more revenues, grants, and community support. He also helps protect them from avaricious developers and reverse the damage caused by ineffectual politicians. He's been writing for this magazine for nearly a decade, flown 800 Young Eagle missions, and put 4,000 hours in his logbook. He's always accessible at PilotMike2012@gmail.com.

