TURBINE BONANZA

While others fiddle, Allison blazes ahead with a private turboprop.

BY MARK M. LACAGNINA

Timing is a critical element in the success or failure of any new concept or design. Powered flight, a concept proposed centuries ago by visionaries such as Roger Bacon and Leonardo da Vinci, remained little more than whimsy until society and technology were ready for it. The first mechanism generally credited with achieving powered flight used wing-warping for flight control. It worked well enough 80 years ago but would be only of passing interest to modern aerodynamic engineers. Conversely, such things as stall fences and boosted controls, designs that have applications today, would have been of little use to the Wrights.

One of the most intriguing concepts in general aviation today is the turbine single. Two years ago, there was a rush of development for civil applications (turbine singles long have been used for military pilot training and other specialized operations). Several companies and private designers set off in various directions to see if they could make the concept of a general aviation turbine single a reality. So far, the results have been mixed.

As noted in the August issue of *Pilot* (see "Turbine 206," by Edward G. Tripp, p. 28), the timing, at least for utility applications, does appear to be right. Soloy Conversions has received 20 orders to date for its Turbine 206, the first turbine single certificated; and Cessna Aircraft has 50 orders from Federal Express for the Caravan.

But what about a turbine single for private business or personal transportation? Most of the development efforts for these applications have been either abandoned or put on the back burner due to lack of adequate financing or because those involved in the projects do not believe the time (that is, the market) is right.

There is at least one exception. The Allison Gas Turbine Division of General Motors, which is working with Soloy on the Allison-powered Turbine 206 and other applications, believes the time is, indeed, right for a nonutility turbine single. The company currently is test-flying a Turbine Bonanza with the intent of obtaining a supplemental type certificate (STC) for a conversion package by the middle of next year. Allison plans to certify turbine conversions for the Beech A36 Bonanza models, first, and then to proceed with the 33- and 35-series Bonanzas.

Allison's testbed is a 1979 Model A36 with a 420-shp 250-B17C engine installed by Soloy. The engine currently is used in several foreign-aircraft applications, including the Australian GAF Nomad N22B, the Partenavia Spartacus, the Pilatus Britten-Norman Turbine Islander and the Siai-Marchetti SF.260TP and SF.600TP. The engine is being used in another turbine single project in this country—Jerry Dietrick's Windecker Eagle Allison Turboprop—but, as reported earlier, the project is experiencing little progress.

According to Allison, the Bonanza's turbine engine and three-blade Hartzell propeller weigh about 200 pounds less than the 285-hp Teledyne Continental IO-520 piston engine and McCauley prop that were replaced. This is not directly translatable to increased payload, however, because each gallon of jet fuel in the Turbine Bonanza's fuel tanks weighs about 0.7 pounds more than the avgas previously required for the piston engine. The lighter engine was installed in such a way as to require no changes to the Bonanza's certificated center-of-gravity limits. As a result, the propeller arc is 22 inches farther forward.

When I visited Allison's Indianapolis headquarters in July, the Turbine Bonanza had been flown only about 100 hours. Specifications for the conversion were far from frozen. R. Frederick (Fritz) Harvey, Allison's director of small aircraft engine products, and F. Jack Schweibold, the company's chief test pilot, had a long list of tweaks and things-to-try still to be accomplished.

Therefore, the final design of the Allison Turbine Bonanza may look somewhat different from the aircraft I flew and photographed in July. The ram-air scoop on top of the cowl will be replaced with a flush-mounted, NACA-type duct. The cabin air inlets will be relocated from the wing roots to a location isolated from the path of exhaust gases. A forward baggage compartment will be fabricated in the nose of the aircraft. Engine controls and instruments will be rearranged.

The winglets and tip tanks that appear in the photographs accompanying this article may or may not be a part of the finished aircraft. Allison is concerned with the potential for directional controllability problems during

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takeoff and slow-speed, high-power operations because of the high torque produced by the engine. The company has found that the winglets improve controllability as well as increase cruise speed by four or five knots, and various winglet designs will be evaluated. Also, rather than using winglets, the company may derate the engine below 420 shp and establish a minimum control airspeed. A McCauley prop, as well as the Hartzell, will be evaluated. In addition, because the turbine engine burns more fuel, the Bonanza's standard 74 gallons of usable-fuel capacity will be supplemented to provide reasonable endurance. Several methods, including tip tanks, are being considered for this.

Keeping exhaust fumes out of the unpressurized cabin is a major concern. The exhaust ducts, which exit the nacelle above and ahead of the nose-gear doors, may be lengthened and routed back through the nacelle to exit through the openings for the cowl flaps (which will be removed). Noise suppression is another concern: Allison wants the cabin "whisper-quiet." Air conditioning will be part of the conversion package.

The Allison 250-B17C is a free-turbine, turboprop engine. In the Turbine Bonanza installation, air enters the engine's gas-generator section through an inlet below the propeller spinner. Intake air is compressed by six axial compressor stages to about seven times normal atmospheric pressure. The compressed air flows back through two tubes and enters the combustion chamber at the rear of the engine, where it is mixed with fuel and ignited. The hot combustion gases expand and flow forward into the turbine section of the engine. The gases travel through, and power, a total of four turbine stages before leaving the engine through exhaust ducts. The first two stages are called the compressor turbine. They are linked with a shaft to the compressor stages in the gas-generator section of the engine. The second two stages, called the free-power turbine, turn the propeller through a reduction gearbox. At 100-percent engine speed, the free-power turbine stages rotate at 33,290 rpm, and the gas-generator stages spin at 50,970 rpm. Maximum propeller speed is 2,030 rpm.

TURBINE BONANZA

Allison has a long list of things to try. The winglets and tip tanks may or may not be part of the kit.

The powerplant is managed with two controls: a power lever and a condition lever. Both are connected to a power coordinator, which manages the fuel control unit and the propeller governor. The controls have three positions. In the center position, the power control causes the engine to idle (either ground idle or flight idle, depending on which way the lever is twisted). With the power lever all the way forward, the engine and propeller produce full forward thrust; all the way back, full reverse (Beta) thrust. The aft position of the condition lever cuts off the supply of fuel to the combustion chamber; the central position initiates fuel flow. As it is advanced from the central to the forward position, the

condition lever brings the propeller out of feather.

Engine gauges are arranged in two clusters. The first includes propeller rpm, turbine outlet temperature and torque (the force, in pounds per square inch, being exerted by the engine to turn the prop shaft). The second cluster includes compressor rpm (expressed as a percentage), oil temperature and oil pressure.

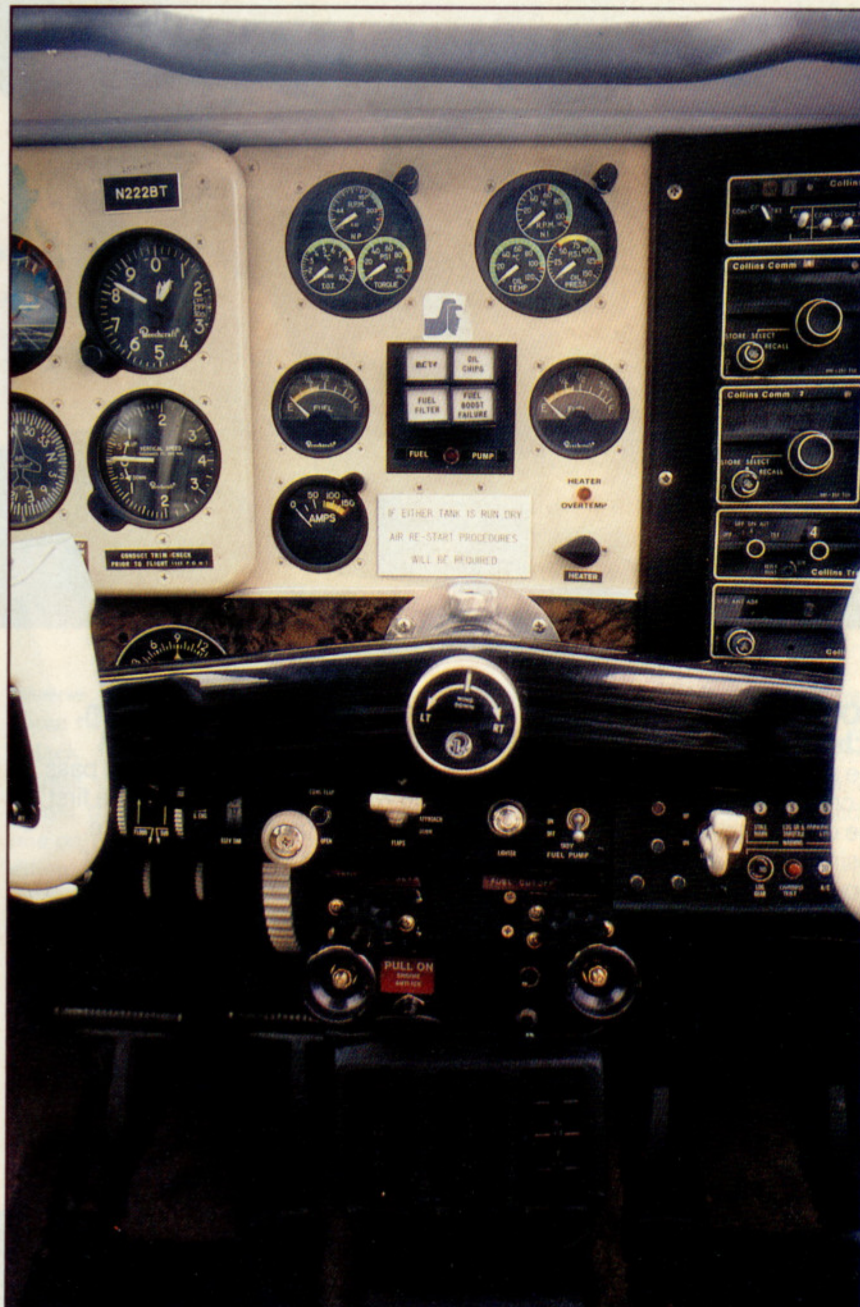
There are four large annunciators in the center of the panel. One annunciator indicates that the propeller is in the Beta mode (reverse). Another warns that metal particles have been detected in the engine oil or gearbox oil. The other two indicate activation of the fuel filter bypass valve and failure of the fuel-boost system.

A pilot with experience in an A36 Bonanza or a similar high-performance piston single will find power management actually much less complex in the Turbine Bonanza. However, the latter requires as much—if not more, in some cases—attention to operating procedures and limitations to preclude expensive, unscheduled maintenance.

Allison's recommended time between major overhauls of the 250-B17C engine is 3,500 hours. The cost is about $20,000. Hot-section inspections must be performed every 1,750 hours or 3,000 cycles and cost between $7,000 and $10,000, according to the company.

Weather conditions were marginal during my visit with Allison, and my evaluation flight in the Turbine Bonanza, N250AT (née N222BT), comprised a short hop from Indianapolis International to Eagle Creek Airport for a series of takeoffs and landings and a quick excursion to 10,000 feet on vectors from Indianapolis Approach.

After a bit of fumbling with the engine controls, which must be twisted as well as pushed and pulled, I found the transition to the Turbine Bonanza to be relatively straightforward. I had been forewarned about the need for right rudder and aileron during takeoff, but the deck angle took me by surprise. At 96 knots, the best rate-of-climb speed, all forward visibility vanished, the attitude indicator showed about 17 degrees nose-up, and the VSI indicated more than 2,000 fpm. I found 120 knots initial and 140 knots for cruise-climb to provide adequate visibility over the long nose and good performance. The Turbine Bonanza uses about half as much runway on takeoff as an unconverted A36. Landings, with



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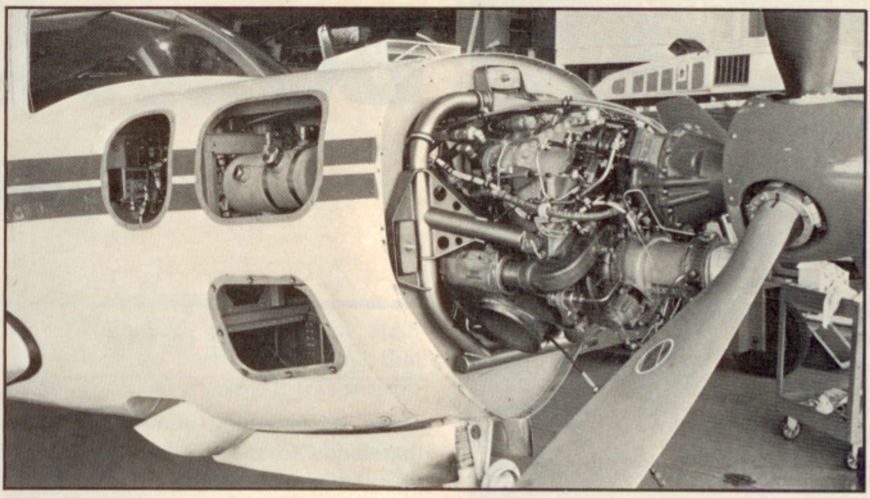
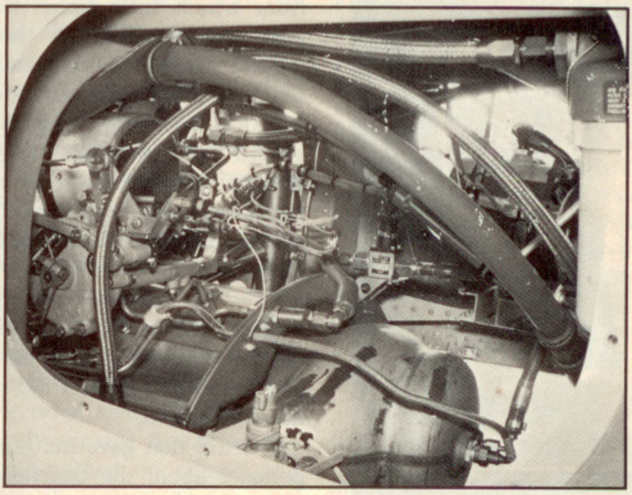
TURBINE BONANZA



Installation of the 420-shp Allison 250-B17C engine in the Beech A36 Bonanza was performed by Soloy Conversions. The photo above shows the engine's gas-generator section and reduction gearbox. The oil reservoir is visible within the inspection area beneath the ram-air scoop, which will be replaced with a NACA-type duct. The combustion chamber and four-stage turbine housing appear in the photo below. Recommended TBO of the engine is 3,500 hours.



reverse thrust, are even shorter—by about two-fifths.

Jack Schweibold demonstrated a couple of engine restarts. They required three hands: one on the yoke, one on the starter and one on the condition lever. One of the things-to-try on Schweibold's list is a starter button on the yoke. It should make restarts much easier for the single pilot.

FAA certification standards for a turbine-single conversion require the airspeed previously designated as Vno, the maximum structural cruising speed, to be redesignated as the new Vne, the never-exceed speed. Vne for the Turbine Bonanza, therefore, is 166 knots. I found that after leveling off from a climb, the airplane quickly will exceed this limit if power is not pulled back right away.

Allison has just begun to assemble performance data. Preliminary figures for N250AT, with the winglets and tip tanks, show 200 knots, true (156 knots, indicated) at 60-percent power and 14,000 feet, while burning 158 pounds (23.5 gallons) of jet fuel per hour.

The company will have a second Turbine Bonanza flying by November. It will be an earlier-model A36 produced with a 14-volt electrical system. The system will be changed to 28-volts capacity for the conversion. According to Fritz Harvey, the target price for the conversion is "under $200,000."

Is the market ready for an unpressurized, private-use turbine single? The commotions created by Allison's airplane at the American Bonanza Society's convention and at the Oshkosh show indicate that the timing may be just right. Allison is going to find out for sure. □