FIRE-BREATHIER

Reggie Fountain and the case for turbine power

by Bill Pike

UPSTAIRS DOWNSTAIRS-Looks like the cockpit of an average Fountain 42' Lightning, especially with Reggie behind the wheel. But down in the basement, the twin Rolls-Royce H-1000 turbines are anything but

average.

COOL IT-Exhaust exits through twin plenums, port and starboard, beneath the swim platform (see above). A stream of raw water is sprayed via pumps into the exhaust ducts of each turbine so gases are cooled before exit.

WITH A MELLIFLUOUS Louisiana-oil-patch drawl, the technical erudition of a High-Energy Particle Physicist and the cool insouciance of an ace chopper jockey. Ted McIntyre's become the in-thing around Fountain Powerboats these days. The reason has nothing to do with drawl, erudition or chutzpah, however. During the past year or so, as President of Marine Turbine Technologies (MTT) of Broussard, Louisiana, Ted's become a friend and close business associate of Fountain's Chief Executive Officer, Reggie Fountain. And Fountain, a steely-eyed pragmatist if ever there was one, is convinced that Ted and his turbines are the "wave of the future", at least for high-performance boat buyers at the top end of the marketplace. Fountain believes in turbine power not only because it's "totally wild" and carries with it a public perception that puts his North Carolina company "way-the-heck-and-gone-out there," on the leading edge of marine technology, but also because turbine power has a lot of practical advantages.

Far Freaking Out

Turbines, of course, have been around for years. They first became popular in the aviation field in the early 50's and are used extensively by the military today, not only in aircraft, but also in marine applications. Recreational and racing boat-builders began to experiment with them during the 70's, dabbing in turbine-powered cruisers, sport cruisers, even sport fishermen. But turbines never really caught on. Early units tended to burn mucho fuel and, due to the heavy use of cast-iron components in them, their horse-power-to-weight ratios were never all that appealing. Things change. Fountain says he's on the very verge of offering lightweight, fuel-efficient off-the-shelf, optional turbine packages. Imagine picking up a Fountain brochure in

some showroom somewhere and discovering that, right alongside the MerCruiser and Volvo Penta stern-drive turbine options from Rolls-Royce, Pratt & Whitney, Lycoming and Allison. Sound far fetched? Fountain already has one turbine-powered boat up and running, a 42' Lighting, with a woolly pair of 1,050-hp Rolls-Royce Grone H-1000s under her engine hatches, turning a humongous set of 18" x 31" four-bladed stainless steel props through MerCruiser Six drives. In repose, this red-white-and-black fire-breathing beauty looks like any other off-the-rack Fountain, except for a few extra air-intake louvers around the gunwales aft and the word "Turbine" unobtrusively stenciled above the Fountain logo at the stern. The idea behind building this very special Lightning, which, incidentally, saw service last year as one of two official pace boats for the American Powerboat Association, was to prove that a production Fountain, with a production interior, could be happily wedded-and stay webbed-to a set of ex-helicopter turbines.

If Fountain could demonstrate, both to himself and to his financial advisors, the smooth adaptability of the turbine to the marine scene, as well as some semblance of cost-effectiveness inherent in a turbine scheme, he figured the leap of faith required to begin stocking the shelves of his warehouses with "turbine modules" was pretty darn short. One success could be parlayed into many more. A partnership was formed. Fountain began calling McIntyre "Teddy Turbine". He also began showing signs of turbine mania, based on a conviction that MTT could "deliver the goods". He was convinced that MTT could so thoroughly fit its power plants that few boat-building adaptations would be necessary. Also, Fountain knew that MTT's connections with oil-field aviation would ensure a steady supply of comparatively low-priced second-hand turbines that would be reliable and safe in boats, although they were no longer fit for helicopter duty.

The Advantage of Being Weird

Right now, Fountain's first turbine powered Lightning is roughly a year old. By just about every measurement Fountain can think of, the boat's a success, with proven reliability. I recently tested the thing on Pamlico Sound and was suitably impressed. In slick-calm water, with Fountain, Ted and me in the cockpit, and fuel tanks brim-full of Jet-A, she turned in a rarefied top-end speed of...95mph. Checking the performance chart accompanying this story, you'll notice the boat did this speed with a total fuel burn of 160 gph. This is certainly not a negligible amount, particularly when you consider that Jet-A sells for about $1.75/gal. at your local airport. But there are some ameliorating considerations. Bear in mind that a turbine like the Rolls-Royce Gnome H-1000 is quite democratic in its approach to fuel. Kerosene (approx. $1.10/gal.) and #2 diesel fuel (approx. $1.20/gal.), available at almost any marina in the land, is just as useable as Jet-A. And while a Gnome H-1000's maximum fuel burn ain't peanuts, it stacks up quite handsomely against a reciprocating engine's. For example, one 525-hp Mercruiser HP575 slurps down approximately 48 gph at wide-open throttle. To equal the horsepower in a pair of Gnomes, no fewer that four HP575s would be required. Total fuel consumption for these babies is going to be something like 192 gph at WOT. Consider weight, too. With transmissions, water pumps and alternators, two Gnomes H-1000 turbines will weigh in at about 1,250 pounds. The weight of four HP575s is going to be about four times as much, as is the cubic feet of volume required for installation. Not only is the turbine's horsepower/weight ratio good by comparison with a reciprocating engine's, so is its overhaul frequency. With heavy-duty use, typical race engines like the HP575s will require major attention every 200 hours or less. The Gnomes can go approximately 1,500 hours between overhauls. One last thing. As briefly noted before, no extraordinary modifications are called for.

Our turbine-powered Lightning did not offer one whit, structurally, from any other production 42-footer. Same deep-V hull, Klegecell-cored hull sides and deck. Same interior, with leather upholstery and enclosed head. No structural differences anywhere, in fact, not even in the machinery spaces. The turbines chassis fit right in, as smooth as a Blue Tick fits the front seat of a pickup.

The Ol' Fighter Pilot

Frankly, shepherding a turbine-powered 42' Lightning over the Pamlico at 95 mph is much like driving any other well-built and well-engineered V-bottom boat at such a speed. Drive, trim tab and engine controls are used in the conventional manner. So what's the real turbine difference? An ex-fighter pilot once told me, "Really, Bill, the funniest thing about jets is starting them up." I'd never fully appreciated this observation until the transpiration of the turbine test on the Pamlico. Today, if you asked me to name the realest and wildest difference between turbine and conventional power in a boat, I'd tell you "start-up procedure". In the next few paragraphs, I'm going to try to describe it. At the same time, I'm going to try to describe how a turbine works. Because, informationally speaking, I'm trying to kill two birds with one stone, the whole thing may sound terribly complicated. It's not. With Ted's help. I learned how to "light-off" a turbine in about ten minutes and soon discovered that I could perform the entire startup scenario in about 20 seconds.

As you work your way through the rest of this story, it may help to refer to the diagram (which is labeled) and to the photograph of the Lightning's steering console, which is much like the consoles of other Fountains, except for a couple of details.

Notice, for example, the four, small gauges uppermost in the picture of the console. The outside pair are the Compressor gauges and the inside pair are "EGT" or Exhaust Gas Temperature gauges. To the right of the Compressor and EGT gauges are two chrome-plated T-shaped, push/pull handles called High Pressure Fuel valves. To the immediate left of the Compressor and the EGT gauges are two "BRAKE" switches, followed by two Master switches, which can be set at "START" or "RUN". To the left of them are the switches that activate the fuel pumps. About dead center of the dashboard is an on/off toggle called the Temperature Control switch.

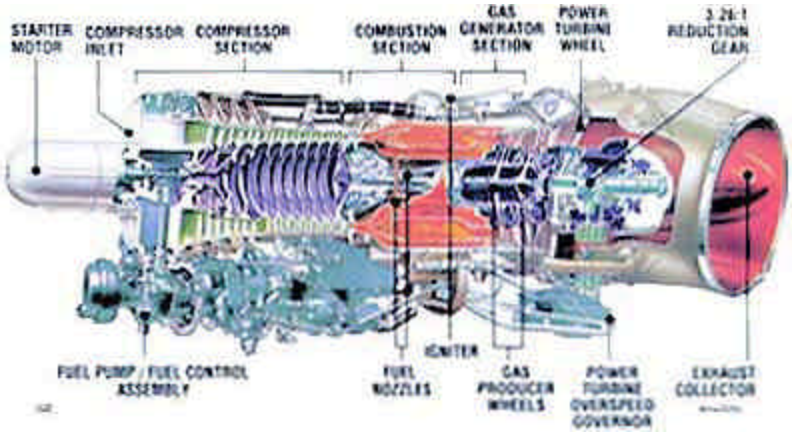
Once you've familiarized yourself with these steering console extras, you can put yourself in the right frame of mind to continue reading by digging up a stereophonic version of Wagner's Ride of the Valkyries. I'd advise playing it a maximum dB-A while

you slog along through the paragraphs, periodically envisioning yourself down at the marina, standing over the controls of your own turbine boat, flipping toggles and switches like Tom Cruise in "Top Gun", while a banshee wail rises steadily in the background. Here goes!

1)Flip the Temperature Control switch. This activates a governor-type control package, especially installed by Ted and MTT. It automatically limits operating temperature of the turbine to 670 degrees Centigrade by diverting fuel flow. Overtemp situations can burn up the Gas Generator Section, just abaft the Combustion Section.
2) Flip the Master switches for the turbine you wish to crank to "START". You put one turbine entirely on line before commencing to start the other. Flip the Fuel Pump switch. The fuel pump (located forward on the port side of each engine) begins to pressurize fuel and send it to the Fuel Control System.
3) The key-type ignition switches are below the steering wheel and to starboard. Turn the appropriate key in the switch and hold it open. This energizes the Starter Motor (bolted to the center of the Compressor Section inlet at the front of the engine) and also activates the Igniter, a high-energy spark-plug-like device in the Combustion Section.
Numerous circular sets of airfoil-shaped blades in the forward end of the engine (the Compressor Section) begin to revolve, accelerating air against stationary sets of blades. Pressure increases because the blades are progressively smaller but more numerous and intensely populated as the air works its way aft toward the Combustion Section. The Gnome turbine has ten sets of stationary and rotary blades in its Compressor Section and develops an ultimate pressure ratio of 8.1:1. Eventually, the blades of the Compressor Section accelerates to about 16 percent of their maximum rotational speed, which is approximately 26,300 rpm. Once the Compressor gauges on the dashboard of the boat show this, it's time for the fun stuff.
4) Initiate start. To do this, simply open the High Pressure Fuel valve by pushing down. Through a series of nozzles that atomize it, fuel is delivered to the Combustion Section of the turbine, which already contains air under pressure via the Compressor Section and spark from the Igniter.
5) When you hear the engine light off, advance the throttle gently to increase operating temperature to between 450 and 600 degrees Centigrade. The engine idles at about 50 percent of maximum rotational speed.
6) Release the start key and flip the Master Switch to the "RUN" position, thus activating the 12v charging system. The engine should be idling nicely now. It should sound sort of like a 747 waiting to taxi. People will tend to gather around, like from a couple of miles away.

What's happening inside the engine? Compressed air and fuel in the Combustion Section are burning violently. Expanding gases are pushing into the Gas Generator Section of the turbine, which contains two Gas Producer Wheels (GPWs) and stationary nozzles. Once through the GPWs, the accelerated and expanded gas then

encounters the Power Turbine Wheel (and nozzle), which is mounted on a shaft that's separate from the GPWs and Compressor wheels. The blades on the Power Turbine Wheel turn from 19,000 to 20,300 rpm maximum, which is slightly slower than the GPW's maximum rotational speed, because its blades are larger. Also, frictional losses in the drive train retard the Power Turbine Wheel's motion, primarily because it's the device that drives the reduction gear (3.26:1) and, in turn, the output shaft.



Shifting and Other Oddities

Admittedly, I've so far hit the positive aspects of turbines pretty heavily. There are drawbacks. First of all, shifting into forward or reverse on our test boat proved to be a little weird. Because turbines deliver near instantaneous torque by comparison with reciprocating engines, conventional transmissions will not hold up the way they might, with smaller, 650-hp Lycomings or any of the other, less powerful (less torquey) turbines Ted marinizes, in the engine room. The substitute transmission on our test boat (a MerCruiser Daytona crash box, commonly used in race boats), demands a little boat handling finesse from the operator. To get a better understanding of why, let's go back to our startup procedure, for a moment. Remember? We'd left the Lightning idling in her slip at 50 percent (or approximately 3000 rpm at the transmission output shaft). Now, in order to shift from neutral into reverse or forward gear, the operator of the boat must push a Brake Switch mounted on the dash that stops the turbine output shaft by means of a caliper brake. As I mentioned earlier, this shaft (and the Power Turbine Wheel that turns it) is not physically coupled to the forward part of the engine so the Compressor and Gas Producer Wheels located there continue to turn, or "spool", at full idle. With the brake engaged, the output shaft will stop and the shaft tach on the dash will drop to zero. The operator then shifts and subsequently pushes the brake switch again, to release the brake. With the engine in gear, rpms drop to about 400 because of the water resistance inherent in big props with lots of pitch. (A brief note-the Brake Switches on the dash can be pushed to stop the props from turning... for no other reason than to slow the boat's motion. First vessel I've come across that literally has brakes!) Besides needing crash box shifts for mega-horsepower units, there are a couple of other factors that make marine turbine a little problematic:

*Service on turbines, for example, may not be as easy to come by as service on reciprocating engines. Prompt action means being close to an

airport, perhaps, or Ted McIntyre. *Decibel readings were high on our test boat. Our readings ranged from 103dB-As at 1000 rpm to 107 dB-As at WOT or 5200 rpm. Pretty loud.

*Exhaust heat is another touted turbine problem. Aboard our test boat, however, the exhausts were vented beneath the swim platform and cooled via jets of water pumped into them. A fine spray was blown astern when the turbines were operating. Not much hotter than a hot shower at the Hyatt.

*And then there's the matter of money. With twin 1,050-hp Gnomes, a 42' Lightning retails for about $396,850. Whew. A 42' Lightning, with triple Merc 502s, sells for a lot less (about $212,620).

Install a set of 950-hp turbocharged race engines and you're talking a cool $289,000, which, by comparison with the turbine package, starts to sound cheap.

Is it really worth all that up-front money to forego reciprocating race engines and join the edge-dwelling turbine crowd? For go-fast enthusiasts with big bucks, maybe. Particularly when you consider advantages like reduced operating and maintenance costs, better fuel efficiency and improved horse-power-to-weight ratio, as well as certain other intriguing intangibles...like the thrill of lighting off you own jet engine and the spine-tingling chill you get from the haunting wail of a matched set of turbines, whooping across a broad expanse of flat water on a breathless Carolina afternoon.

PROPULSION AND PERFORMANCE
Fountain 42' Lightning

Standard power: twin 350-hp 454 MerCruiser Magnum V-8 gasoline stern drives

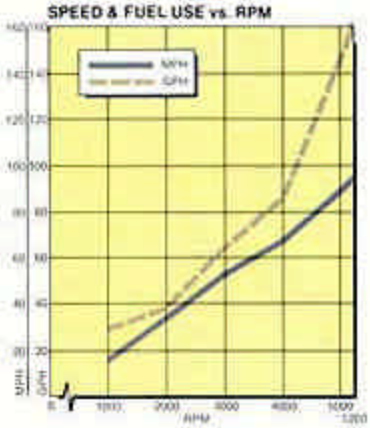
Optional power: various MerCruiser V-8 gasoline stern-drive engines (some turbocharged), up to a total of 1,900 hp; various turbine power options.

Test boat power: twin 1,050-hp Rolls-Royce gas turbine engines w/standard Rolls Royce reduction gear box (3.26:1) swinging 18" x 31" four-bladed stainless steel propellers through MerCruiser Six drives with a 1.35:1 reduction

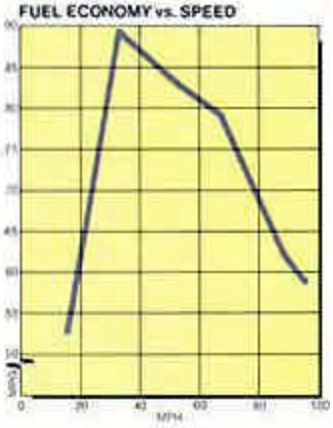
speed				fuel use		efficiency			operation	
rpm	knots	mph	% of max.	gph	% of max.	naut. mpg	stat. mpg	n. mi. range	angle	sound level
1000	13.9	16.0	17	30.0	19	0.46	0.53	94	2.5	103
2000	29.6	34.0	36	38.0	24	0.78	0.89	158	1.0	101
3000	46.1	53.0	56	64.0	40	0.72	0.83	146	1.0	105
4000	59.1	68.0	72	86.0	54	0.69	0.79	140	1.0	108
5000	77.4	89.0	94	144.0	90	0.54	0.62	109	0.0	109
5200	82.6	95.0	100	160.0	100	0.52	0.59	105	0.0	107

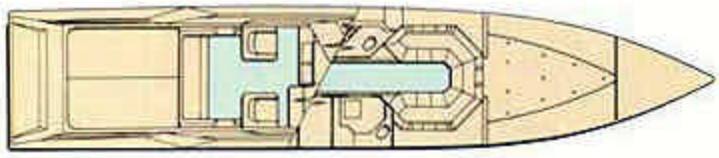
Advertised fuel capacity 236 gal. Range based on 90 percent of that figure. Performance measured with three persons aboard, full fuel, empty water. Sound levels taken at helm, in dB-A.

SPEED & FUEL USE vs. RPM



FUEL ECONOMY vs. SPEED





LOA (w/swim platform)	42'0"
Beam	8'6"
Draft (drives down)	3'3"
Displacement (lbs., approx.)	8,600
Freeboard forward	3'2"
Freeboard aft	1'1"
Max cabin headroom	4'8"
Bridge clearance (to top of radar arch)	6'0"
Fuel capacity (gal.) (in 4 tanks)	236
Water capacity (gal.)	13
Base price (w/twin Rolls-Royce Gnome H-1000s)	$396,850
Designer	Reggie Fountain

Standard equipment (*major items*): Two molded-in foredeck hatches; integrated swim platform; electric horn; hydraulic bolster helm seats; Stewart-Warner instrumentation; 5" Gemini racing compass; Nordskog speedo; Zero Effort throttles and shifts; welded ss bow-rails; motorized engine hatch; K-Plane heavy-duty trim tabs; mechanical indicators for tabs and trim; porta-potti; insulated ice chest; Sony AM/FM stereo cassette w/4 speakers and graphic equalizer; three-color Imron graphics; Lovett 900-gph automatic/manual bilge pumps; external tie bar.