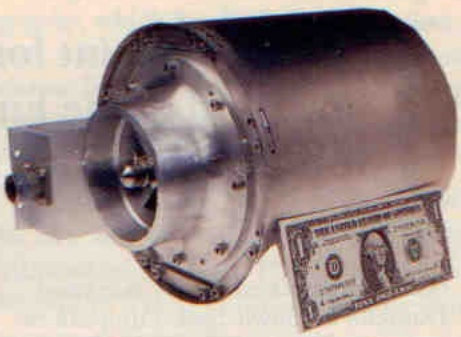
TDI Uses Automobile Parts For Expendable UAV Engines

JAMES OTT/DETROIT

Technical Directions Inc. is attempting to gain a market niche for small low-cost turbine engines that are designed to power expendable unmanned aerial vehicles.

The Ortonville, Mich., company is completing the development of the TDI-J7 turbojet engine, a 100-lb.-thrust powerplant. The development engine, the product of seven years' work, incorporates low-cost automotive manufacturing methods to achieve its goal of low cost and expendability.

Designed by TDI associates including Vern E. Brooks, president and veteran of the small turbine industry, the TDI-J7 is a 7-in. dia. engine using production turbocharger rotating components, a radial compressor and radial turbine wheel, and other equipment such as a straddle mounted annular combustor with a centrifugal fuel atomizer.



The TDI-J7 small, 21-lb. turbojet engine produces 100-lb.-thrust and can propel a 250-lb. vehicle at Mach 0.8 for five minutes. The rated turbine speed is 96,000 rpms.

Chief application of the engines would be as powerplants for decoys or targets. Brooks foresees the engine type in tactical and surveillance UAVs if the philosophy would shift from the current trend of sophisticated, multirole UAV to expendable ones.

TDI is completing the development stage of the engine and has achieved 92-95% of its goals. Brooks said the 100-lb.-thrust engine is being designed for the mission of powering a 250-lb. vehicle at high subsonic speeds for up to five minutes.

A U.S. patent has been approved, and a European patent is pending. Discussions are underway with potential customers to apply the engine to a small aircraft. The company is looking for orders for a pre-production build of engines to verify the production tooling and gain flight experience.

Brooks said a proprietary feature of the engine is the use of fuel to cool and lubricate bearings. The process begins with the metering of fuel into the engine through a positive displacement fuel pump. The fuel is mixed with a small por-

tion of the discharged air from the compressor to pass the fuel through the engine. The air-and-fuel mixture cools internal engine components and also cools and lubricates the bearings. In the cooling process, the fuel is preheated. A centrifugal fuel slinger atomizes the fuel into fine droplets.

"The combination of the preheated fuel and the very fine fuel droplets formed by the rotary atomizer provide a combustion system with a wide operating range using only a minimum of combustor volume," Brooks said.

EASY STARTING RESULTS from the use of low inertia design rotating engine components. "Engine cranking power for starting is significantly reduced by igniting the combustor at only a few percent of engine speed, and then permitting the engine to assist itself in the cranking mode," Brooks said.

The fuel slinger, which dispenses with the need to pressurize the fuel for atomization, permits the use of a single low-cost positive displacement fuel pump for pressurizing and metering the fuel. Since no lubricating oil is needed, there is additional capacity for fuel for increased range.

Full authority electronic engine control employs a low-cost automotive microprocessor to perform starting, acceleration, steady state governing and fail-safe operations. It is built by Electronic Concepts and Engineering Inc., Toledo.

BROOKS SAID MEETING the low-cost goal was the principal challenge TDI faced. Because of price constraints, production rotating components had to be used, requiring special care and testing of parts. TDI operates its own facility to test, develop and evaluate engine performance.

"From the very beginning our push was expendable engines, something you use for a few minutes and throw away," Brooks said, "so you've got to make them cheap enough to make that attractive."

TDI estimates a world market of 2,020 vehicles by the year 2002. The TDI-J7 would cost $13,000 if production were at 50 units a year. "Based on consumer interest . . . it appears as if the international market will be developing first," he said.

Export permits have been obtained from the U.S. State Dept. to proceed with negotiations. Spain is one country TDI is negotiating with.

Brooks credits the technology development to U.S. government contracts and extensive in-house studies. TDI has participated in Broad Agency Announcement and Small Business Innovative Research contracts from the U.S. Army Missile Command, Huntsville, Ala.

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EDITED BY BRUCE D. NORDWALL

SANDIA NATIONAL LABORATORIES/California, Livermore, has fabricated a working microelectronic device using extreme ultraviolet light (EUVL) lithography, which Sandia believes is a first. The product was a field effect transistor, a basic building block for integrated circuits, with a gate width of 0.1 micron. Scientists see EUVL, at 13.4 nanometers wavelength, as an extension of optical lithography, using photons and reflective mirrors instead of lenses. The task now is to scale up for production. Sandia expects costs to be competitive with optical lithography, but with higher throughput and yields.

THE FAA HAS COMMISSIONED THE FIRST of 44 air route surveillance radars (ARSR-4) at Tamiami, Fla., to track aircraft out to 250 naut. mi. and up to 100,000 ft. The 3-D radar made by Northrop Grumman's (formerly Westinghouse's) Electronic Sensors and Systems Div. is designed to meet both the needs of the Miami Air Route Traffic Control Center and military air defense. The Florida installation is the first of 44 ordered by the FAA for use around the coastal U.S., Hawaii, Guam and Guantanamo Bay, Cuba.

TELEPHONICS WILL MANUFACTURE and install an air route traffic control center in Guangzhou, China. The fully automated civil ATC system will use the company's proven multi-radar fusion tracking system and display targets in a 1,000 X 1,000-mi. area. The company plans to deliver hardware by the end of the year and have the system operational by the end of 1997.

SIGNAL PROCESSING TECHNOLOGIES is producing commercial versions of a high-speed, six-bit analog-to-digital converter developed for an undisclosed military radar program. The full-parallel flash ADC has sample rates of 1 gigasample/sec. and operates over a 1.4-GHz. bandwidth. A low input-capacitance of 8 picofarads eliminates the need for external track-and-hold amplifiers, according to the company. A primary advantage over previous flash converters is 256 built-in preamplifiers that act as buffers to stabilize input capacitance as input voltage and frequency vary. Full-parallel means the flash converts analog to digital in one clock cycle, in parallel. The SPT7610 ADC can be used in radars, electronic warfare systems, direct radio-frequency down-conversion and for capturing transients in nuclear physics applications. Based in Colorado Springs, SPT is a subsidiary of Toko Inc.

THE U.S. BALLISTIC MISSILE DEFENSE Organization intends to award a sole-source contract to Anacapa Associates Inc. to study ballistic missile wake effects. The effort is to characterize the wake effects associated with theater missile defense (TMD) type targets to determine radar scattering from these effects, and then to model radar wavelengths of interest, target reentry velocities and altitude, and target material type.

THE U.S. AIR FORCE IS INSTALLING Danish satellite communications systems on 324 Air Mobility Command aircraft to track and communicate digitally with its aircraft around the world. Thrane & Thrane manufactures the system, which will transmit the aircraft's GPS position to Air Mobility Command control center at Scott AFB, Ill., via the Inmarsat-C satellite system. The TT-3024 Aero-C system also has two-way message capability for e-mail, telex or fax. The system being installed on the command's C-5, C-141 and KC-10 aircraft weighs less than 15 lb. The L-band (1.5-1.6 GHz.) communication link to the satellite will give global coverage to the limit of the Inmarsat footprint—more than 70 deg. N. and S. Lat. LandSea, U.S. supplier of the 324 systems, will provide checkout and worldwide training.