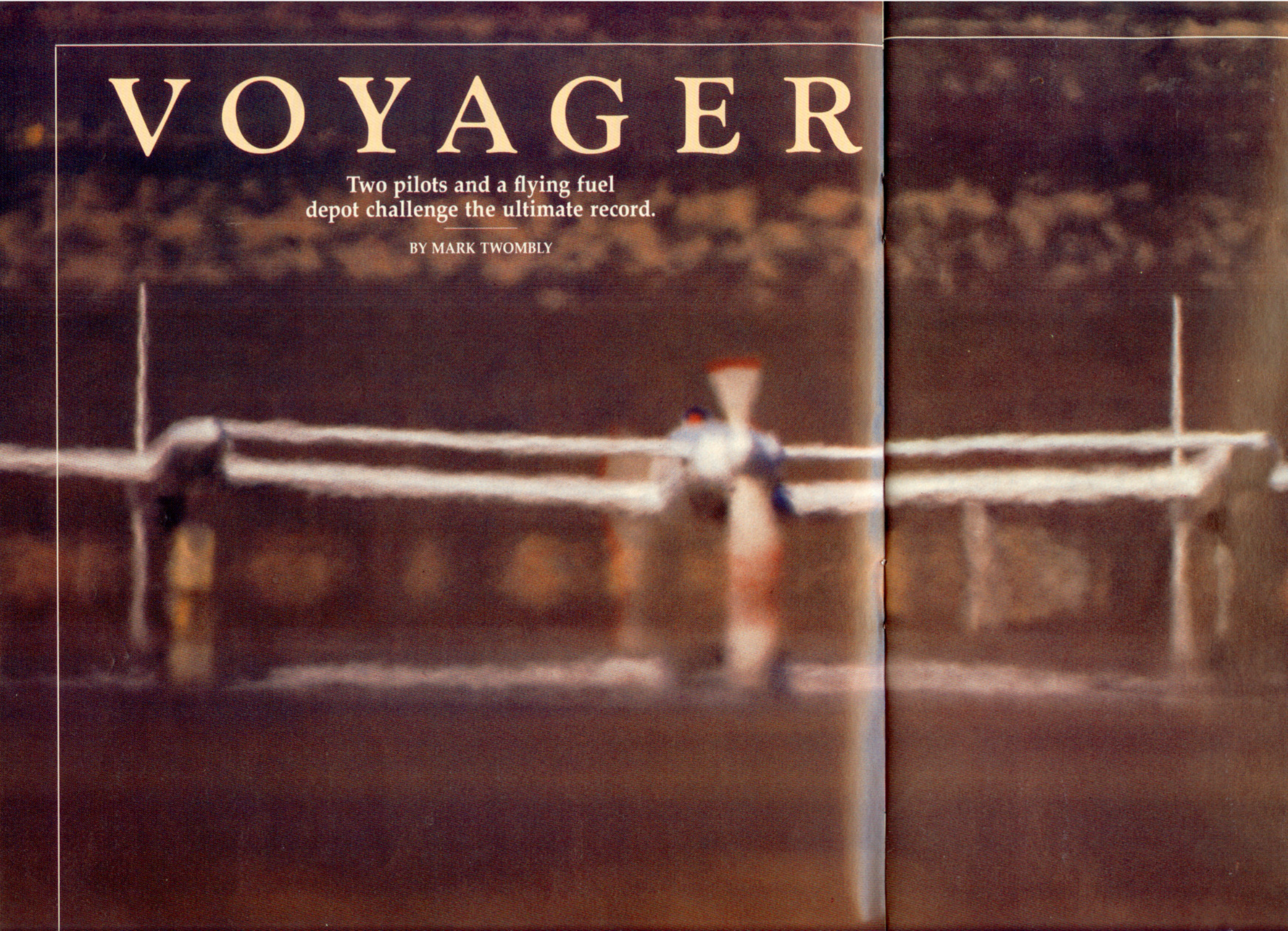
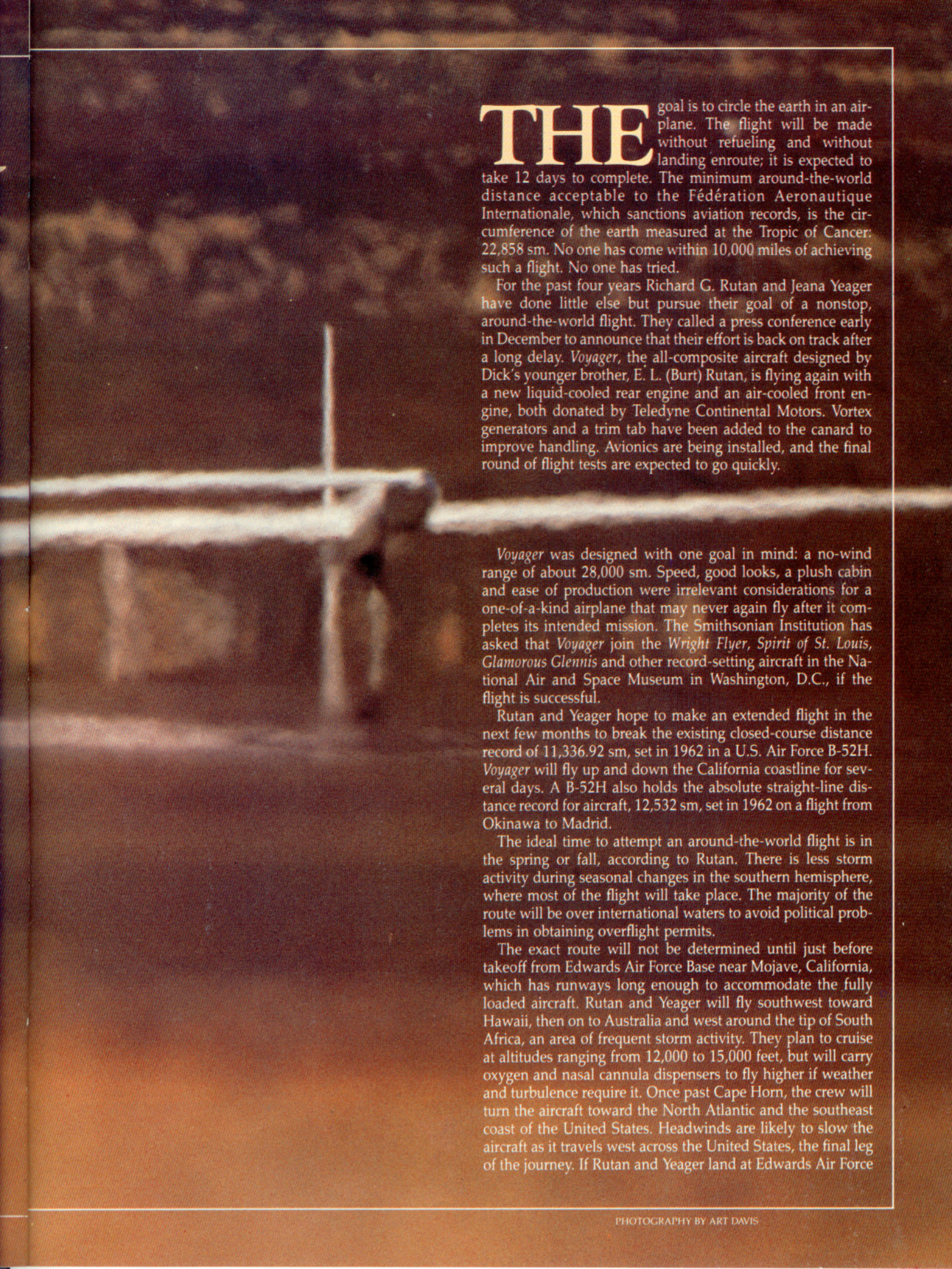
VOYAGER

Two pilots and a flying fuel depot challenge the ultimate record.

BY MARK TWOMBLY





THE goal is to circle the earth in an airplane. The flight will be made without refueling and without landing enroute; it is expected to take 12 days to complete. The minimum around-the-world distance acceptable to the Fédération Aeronautique Internationale, which sanctions aviation records, is the circumference of the earth measured at the Tropic of Cancer: 22,858 sm. No one has come within 10,000 miles of achieving such a flight. No one has tried.

For the past four years Richard G. Rutan and Jeana Yeager have done little else but pursue their goal of a nonstop, around-the-world flight. They called a press conference early in December to announce that their effort is back on track after a long delay. *Voyager*, the all-composite aircraft designed by Dick's younger brother, E. L. (Burt) Rutan, is flying again with a new liquid-cooled rear engine and an air-cooled front engine, both donated by Teledyne Continental Motors. Vortex generators and a trim tab have been added to the canard to improve handling. Avionics are being installed, and the final round of flight tests are expected to go quickly.

Voyager was designed with one goal in mind: a no-wind range of about 28,000 sm. Speed, good looks, a plush cabin and ease of production were irrelevant considerations for a one-of-a-kind airplane that may never again fly after it completes its intended mission. The Smithsonian Institution has asked that *Voyager* join the *Wright Flyer*, *Spirit of St. Louis*, *Glamorous Glennis* and other record-setting aircraft in the National Air and Space Museum in Washington, D.C., if the flight is successful.

Rutan and Yeager hope to make an extended flight in the next few months to break the existing closed-course distance record of 11,336.92 sm, set in 1962 in a U.S. Air Force B-52H. *Voyager* will fly up and down the California coastline for several days. A B-52H also holds the absolute straight-line distance record for aircraft, 12,532 sm, set in 1962 on a flight from Okinawa to Madrid.

The ideal time to attempt an around-the-world flight is in the spring or fall, according to Rutan. There is less storm activity during seasonal changes in the southern hemisphere, where most of the flight will take place. The majority of the route will be over international waters to avoid political problems in obtaining overflight permits.

The exact route will not be determined until just before takeoff from Edwards Air Force Base near Mojave, California, which has runways long enough to accommodate the fully loaded aircraft. Rutan and Yeager will fly southwest toward Hawaii, then on to Australia and west around the tip of South Africa, an area of frequent storm activity. They plan to cruise at altitudes ranging from 12,000 to 15,000 feet, but will carry oxygen and nasal cannula dispensers to fly higher if weather and turbulence require it. Once past Cape Horn, the crew will turn the aircraft toward the North Atlantic and the southeast coast of the United States. Headwinds are likely to slow the aircraft as it travels west across the United States, the final leg of the journey. If Rutan and Yeager land at Edwards Air Force

PHOTOGRAPHY BY ART DAVIS

Base, where they took off, they will have set new straight-line *and* closed-course distance records.

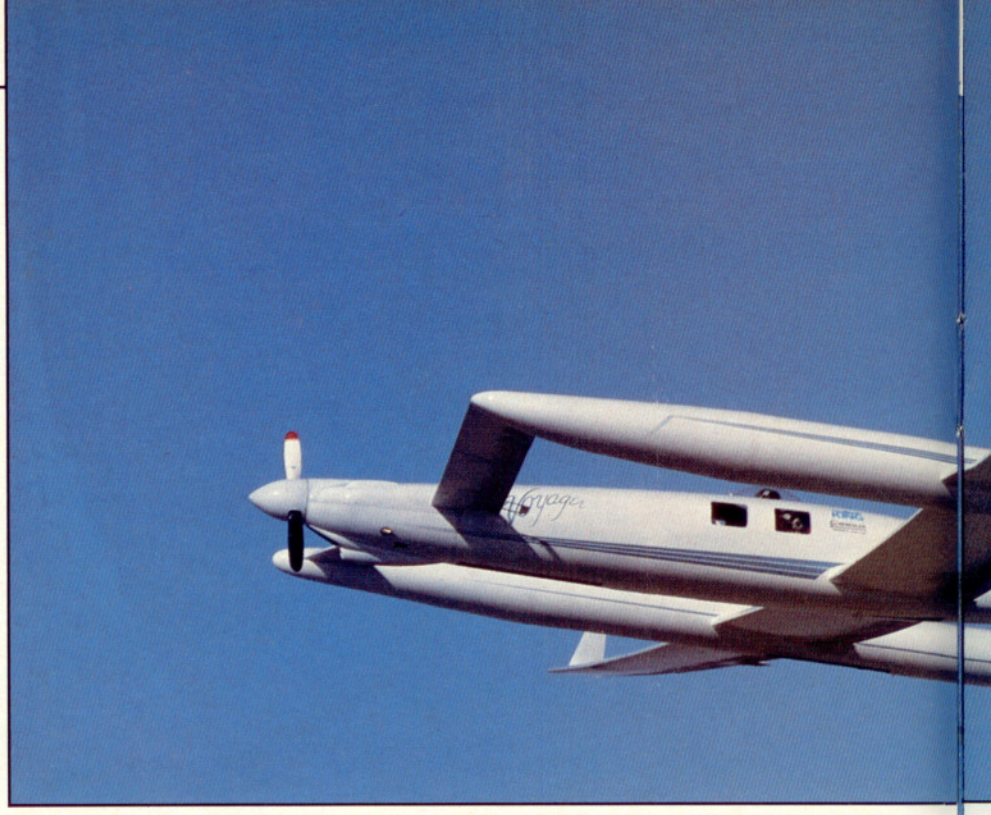
Voyager's only long-distance flight so far was a July 1984 trip from Mojave to Oshkosh, Wisconsin, for an appearance at the Experimental Aircraft Association's annual fly-in and convention. Rutan and Yeager had planned to fly nonstop to Oshkosh, but they encountered turbulence and thunderstorms soon after departing Mojave. For the next 11 hours, the slender *Voyager* fuselage bounced up and down as the long wings flexed in the gusts. Yeager, who was reclining in the cramped copilot's compartment, became ill and was bruised from the jarring turbulence. Rutan, exhausted from dodging thunderstorms and towering cumulus clouds over the Rocky Mountains, decided to land at Salinas, Kansas, for the night. Yeager and Rutan completed the flight the next day.

The Oshkosh trip confirmed the structural integrity of the aircraft in turbulence, but it also convinced the two pilots that weather will be the biggest threat to completing the world flight because of the effects of turbulence on *Voyager*'s pilots.

Yeager is a design drafting engineer, commercial illustrator and pilot who once was considered for a post as an astronaut on a reusable manned rocket. Rutan, a former air force fighter pilot, worked as a test pilot for his brother at Rutan Aircraft Factory and Scaled Composites, Incorporated.

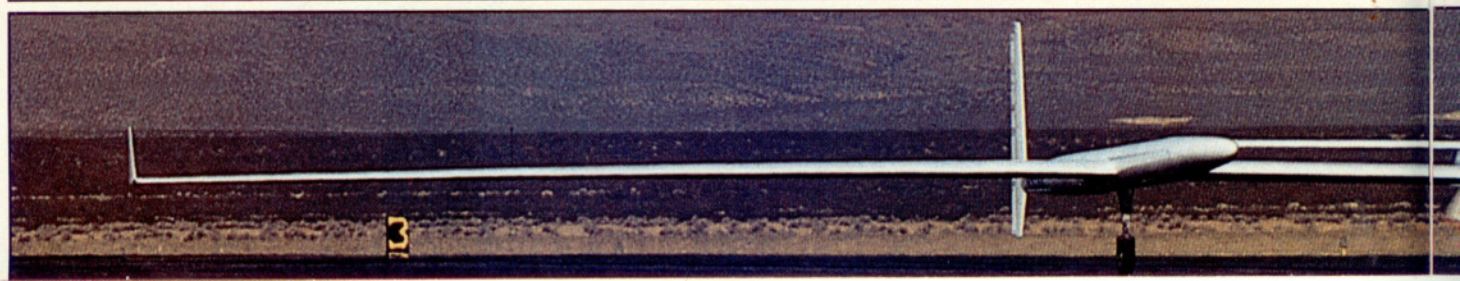
They are preparing for the record attempt by climbing mountains and following special diets. During the flight they will eat crackers and bland, foil-wrapped food that has been radiated to prevent spoilage. Food and water will be warmed by engine heat. Relief tubes will be used to dispose of liquid wastes. Fecal containment bags with solid wastes will be dropped through a small portal in the belly of the fuselage. About a month before the planned departure, Rutan and Yeager will begin to alter their circadian cycles so that, during the flight, one pilot will be sleeping while the other is at the aircraft's controls.

Voyager first rolled out of Hangar 77 at



VOYAGER

There are more comfortable ways to take an around-the-world trip. Voyager's cockpit is less than eight feet long and four feet wide. Rutan and Yeager will rotate six-hour shifts at the controls. The off-duty pilot will rest in a narrow cot next to the pilot.



the windswept Mojave airport in June 1984, about three years after Burt Rutan had first suggested to his brother that it may be possible for a lightweight, composite-construction aircraft to make a nonstop flight around the world unrefueled. Dick Rutan and Yeager formed Voyager Aircraft, Incorporated, in March 1981 to build the aircraft and organize the record attempt.

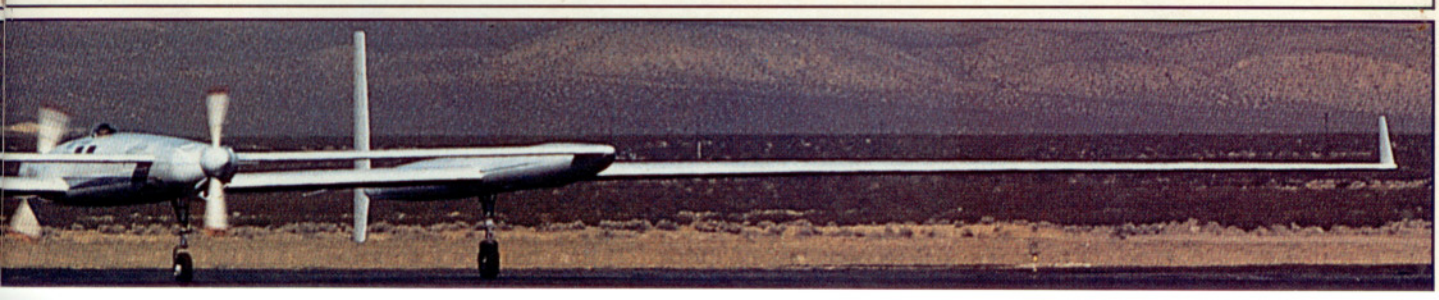
The first flight, in June 1984, was made with borrowed engines. Rutan said then that reliability was the key consideration in selecting an engine that must run continuously for about 288 hours. A nonstop, around-the-world flight is not the time to experiment with unproven powerplants. He changed his mind when Continental offered to donate a 110-hp, four-cylinder, fuel-injected IOL-200, a prototype of a line of liquid-cooled aircraft engines Continental is developing.

Rutan was attracted by the fuel efficiency of the IOL-200, since reducing fuel consumption by just one gallon per hour would save about 1,725 pounds of additional fuel weight over the 12-day flight. According to Continental, the engine has a specific fuel consumption of .375 pounds of fuel per horsepower per hour, or about five gallons per hour at 75 percent power.

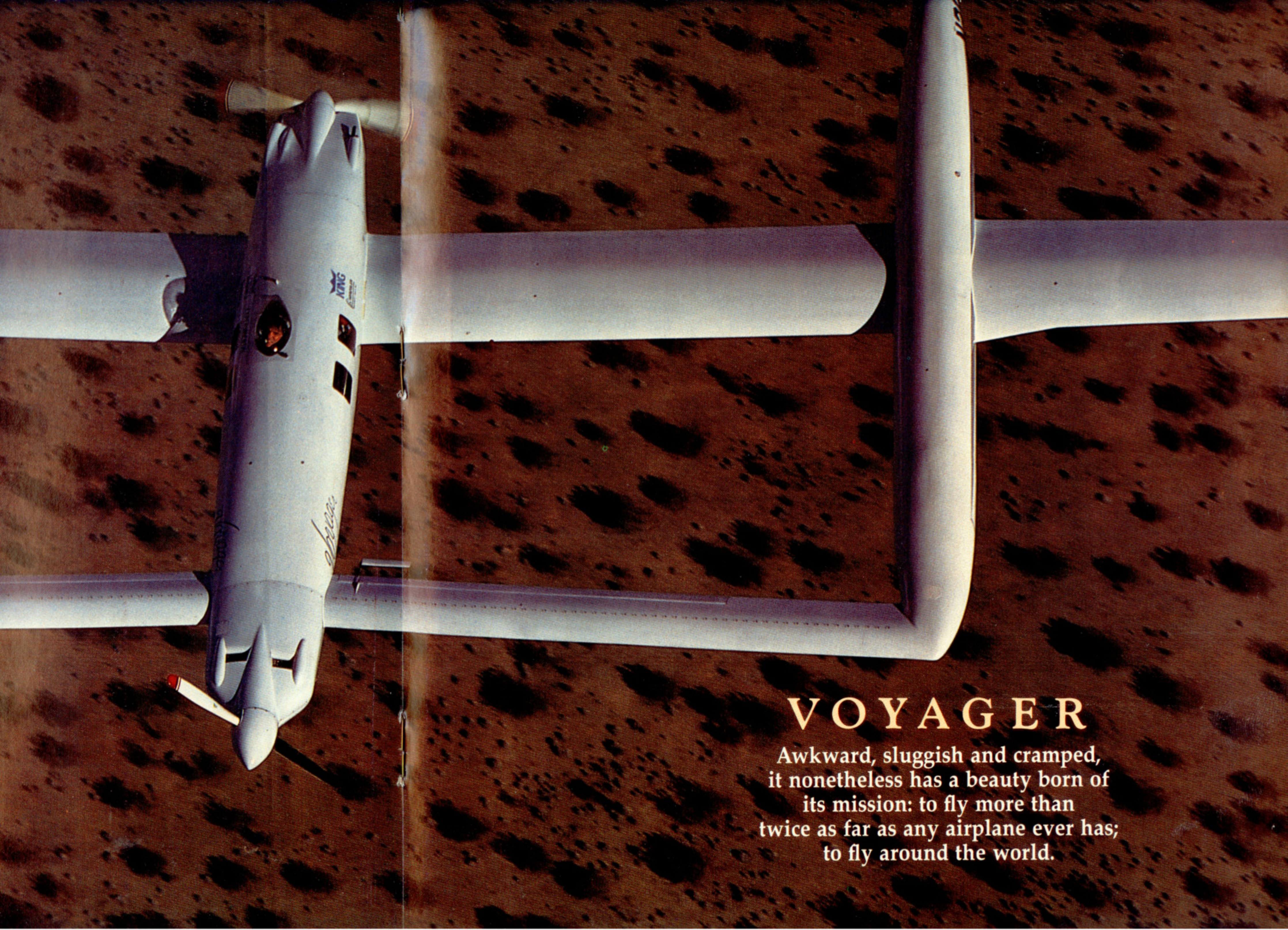
The engine potentially is more reliable than a comparable air-cooled engine. The liquid coolant, a mixture of ethylene glycol and water, is more evenly distributed among the cylinders than ram air and dissipates heat more consistently. A NACA duct on the underside of the fuselage directs cooling air to the radiator, so there are no scoops protruding into the slipstream.

Voyager's front engine is an air-cooled, four-cylinder, 130-hp O-240 that Rolls-Royce built under license from Continental. To save fuel, it will be shut down when the rear engine alone can sustain cruise flight. That should occur three to four days after takeoff, according to Rutan. The front engine may be restarted if the aircraft has to climb to higher altitudes.

Rutan claims that *Voyager* is the largest all-composite airplane ever built. Ninety percent of the structure, includ-

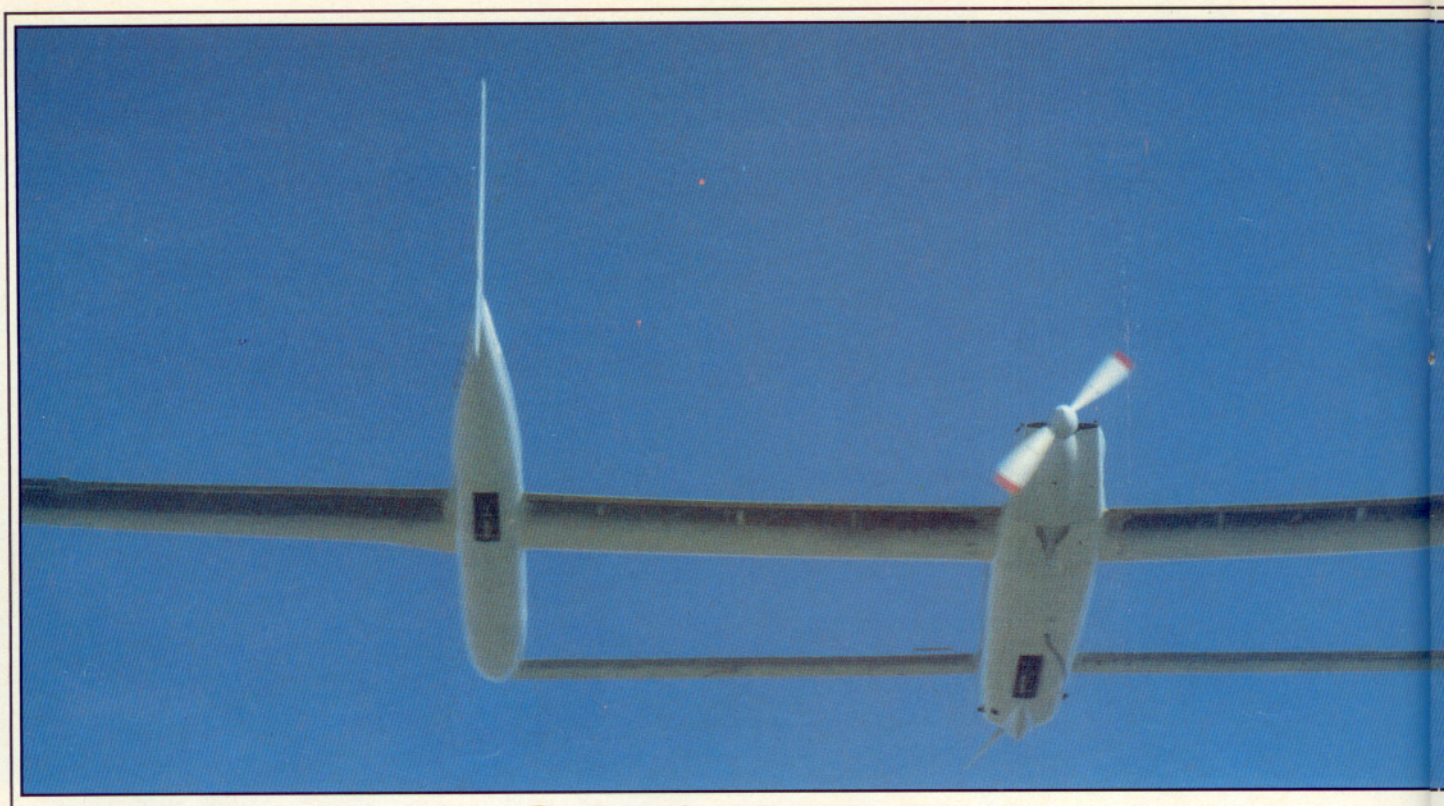


MARK TWOMBLY



VOYAGER

Awkward, sluggish and cramped, it nonetheless has a beauty born of its mission: to fly more than twice as far as any airplane ever has; to fly around the world.



VOYAGER

ing the fuselage, boom tanks and wing skins, is a composite "sandwich." Hercules Magnamite carbon fiber sheets are bonded to the top and bottom of Hexel Nomex honeycomb panels. The wing spar is made of solid carbon fiber and has been compared to a flyrod because it is so flexible.

Weight is critical on *Voyager*. Each additional pound of weight requires several pounds of additional fuel. To save weight, only 3.8 pounds of paint were used to protect the epoxy resin from harmful ultraviolet rays. The underside of the aircraft was not painted. The airframe, without landing gear, engines, propellers or avionics, weighs 939 pounds. *Voyager*'s empty weight is 1,858 pounds. At takeoff, it will weigh 11,326 pounds. The aircraft's estimated landing weight at the conclusion of the world flight is 2,276 pounds.

Voyager's 110.8-foot-long wing has an extremely narrow chord. Total wing area is only 363 square feet, and the aspect ratio is 33.8, which will enable the heavy aircraft to cruise with very little engine power.

The twin booms carry fuel, the main landing gear assemblies and the radar antenna. The boom tanks add rigidity to the canard and main wing, and they minimize center of gravity shift as fuel is consumed.

Cruise speed at the beginning of the flight will be about 105 kts. Later, with just the liquid-cooled engine operating, speed will drop to about 70 kts. A miniature electric motor adjusts propeller blade pitch.

There are 16 fuel tanks in the wings, booms, canard and fuselage, for a total fuel capacity of 1,489 gallons. It may not require a full load of fuel to complete the flight, according to Rutan. The exact amount will be determined just before takeoff and will be dictated by wind and weather forecasts.

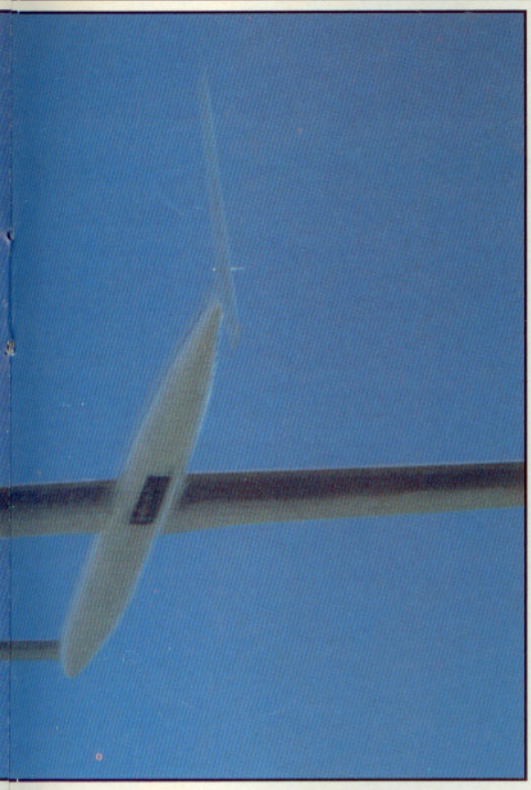
Much of the pilot's time will be spent on fuel management and record-keeping. Two electric fuel pumps, one for each side of the aircraft, will be used to transfer fuel from the tanks to a central feeder tank in the fuselage that will supply both engines. A panel-mounted computer will control the amount of fuel being transferred and will monitor fuel flow and total fuel consumed.

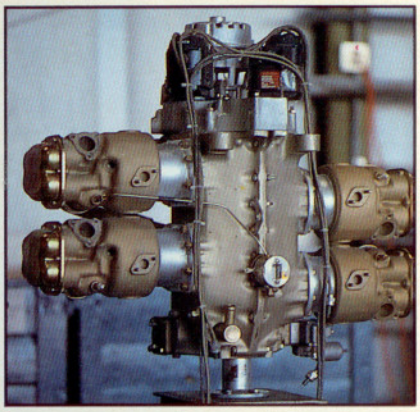
Only a small amount of fuel will be drained from a tank at one time to keep the center of gravity within limits. Maintaining proper center of gravity will be critical. The pilot will monitor center of gravity position by checking a deck angle gauge and noting elevator position.

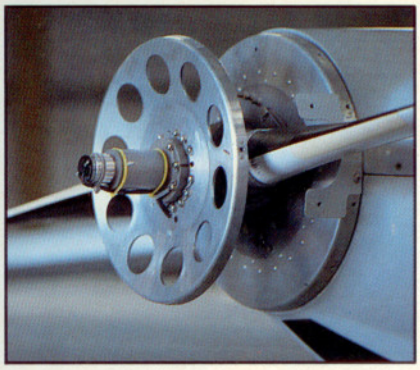
King has supplied all of the avionics. The primary navigation instrument will be a KNS 660 flight management system with VLF/omega sensors to compute position and performance data. King also programmed a KAP 150 two-axis (pitch and roll) autopilot for *Voyager*'s slow roll rate and light pitch forces. *Voyager* has ailerons, but the autopilot will command the rudder for roll control. There are no flaps. A KWX 58 four-color weather radar with 260-nm range will be used for weather avoidance.

Weather forecasts, communications, flight following and rescue efforts will be coordinated at a command center located at the National Air and Space Museum. *Voyager* will be equipped with VHF and HF communications radios and two transponders, one of which will transmit alphanumeric messages to the command center via a satellite link. Every few hours, command post personnel will update Rutan and Yeager on weather expected along the route for the next three-and-one-half days.

Voyager has cost an estimated $1 million so far, and the final cost could be $2 million. Yeager and Rutan have kept the project going on donated materials and labor, sales of souvenir items (including T-shirts and posters) and individual cash contributions. A donation of at least $100 buys admittance to the Voyager Impressive People (VIP) club. Members receive a *Voyager* patch, newsletters and invitations to special events such as pri-







vate receptions. Names of VIP members will be carried on board *Voyager* during the record attempt. So far, between 1,500 and 2,000 people have joined the club. (Donations can be sent to Voyager Aircraft, Incorporated, Hangar 77, Mojave, California 93501.)

There have been no corporate cash donations. Rutan and Yeager have rigid standards for accepting corporate sponsorship. They refuse support from cigarette and liquor manufacturers and would prefer sponsorship from American companies with an interest in aviation. One potential sponsor reportedly was turned down because the company wanted its name prominently featured on *Voyager*'s fuselage. Yeager, in particular, wants the project to be known as a grassroots effort—one that has been conceived, built and supported not by a government agency or large corporation, but by individuals.

Rutan and Yeager complain that they spend far more time looking for money than planning the flight. Recently, they hired a professional fund-raiser who believes that corporate sponsors will come forward if *Voyager* passes its first test by breaking the existing closed-course distance record.

Voyager's success is by no means assured. There are no redundant features on the aircraft, and failure of one piece of equipment can jeopardize the flight. The oxygen sypply is limited, so the crew may be unable to overfly extended areas of poor weather or turbulence. No one is sure that two people can remain healthy and alert confined for 12 days in a cockpit the size of a small pup tent. There also is concern about the potential danger from other pilots who may attempt to fly alongside *Voyager* on portions of the flight.

Some people question the purpose of the record attempt. In an age when the Mach-2 Concorde is considered to be an old-technology aircraft and an elementary school teacher has been offered a seat on a reusable space freighter, a long-distance flight in a piston-powered, propeller-driven airplane seems like a throwback to an era that ended before World War II began.

Charles Lindbergh, Wiley Post, Howard Hughes and Amelia Earhart were bold, pioneering pilots whose long-distance flights extended the technological potential of aircraft and helped change aviation from a curiosity to an accepted form of transportation. But the public's interest in aviation has since shifted to jet-powered aircraft and now to space flight. That has not dissuaded the *Voyager* crew from doggedly pursuing what Rutan calls "the last significant milestone in atmospheric flight."

Voyager is beginning to attract worldwide attention. Stories have appeared in national magazines and newspapers, and Japanese and Australian television crews covered the December press conference at Mojave. Things may not have changed that much since Lindbergh crossed the Atlantic. People still are intrigued by an unusual airplane, a colorful crew and a unique challenge. □