the wing-fan exit louvers. Lateral stick provided roll control through differential actuation of the wing-fan exit louvers. Fan-mode (low) speed was controlled through a stick-mounted "beep" switch which changed the fan exit louver angle. Pedal movement provided yaw through differential actuation of fan exit louver angle.

The RPM of the two J85 turbojet engines was independently controlled by the throttles, which were locked together and mechanically connected to the twist-grip of the collective lever. Wing fan rpm was neither governed (like the gas turbine-powered helicopter) nor independently controlled, but rather was determined by the combination of the gas power input to the fan from the J85 engines and the loading due to fan flow, which was sensitive to air flow conditions at the fan inlets. The pilot thus used J85 RPM as a direct reading reference for power settings.

Lessons Learned

Originally designed to validate the lift-fan aircraft concept, the 12,500 lb. (maximum gross weight) XV-5A was evaluated in late 1966 by 15 test pilots (the "XV-5A Fan Club") including the author. Two aircraft were built, but one was totally destroyed during an official flight demonstration in April 1965, and in October 1966 the second was extensively damaged during trials to evaluate the aircraft's potential as a strike escort/rescue aircraft for the Vietnam War. Although the pilot in the second accident also suffered fatal injuries, damage to the aircraft was moderate, and it was rebuilt and modified to become the XV-5B. The first flight of the XV-5B took place in July 1968, and flight tests continued until January 1971.

The following discussion of lessons learned is predicated on these two tragic accidents as well as 4 selected operational aspects of the XV-5A and XV-5B: 1) Merits of Gas-Driven Lift-Fans, 2) Pitch-Fan Limitations, 3) Conversion System Characteristics and 4) Instrument Approach Operations. A more in-depth discussion of lessons learned from Ryan Vertifan flight test experience is contained in Ref. 4.

Merits of Gas-Driven Lift-Fans

One of the outstanding safety features of the gas-driven lift-fan concept was the robustness of the lift-fans themselves! The absence of drive shafts, shaft bearings, gear boxes and the attendant pressure lubrication systems resulted in relatively low maintenance headaches and high pilot confidence. The only indicators associated with the three lift-fans installed in the XV-5 were rpm and fan cavity temperature. Pilot monitoring of fan machinery health was thus reduced to a minimum which was highly desirable for a single-piloted aircraft. Lift-fans have proven to be highly resistant to ingestion of foreign objects which was a plus for remote site operations.

A pilot-operated rescue hoist was fitted to the left side of the fuselage just ahead of the wing fan for use in the strike escort/rescue evaluations. An evaluation pilot was fatally injured while performing a low-speed, steep descent "pick-up" maneuver when the heavily-weighted rescue collar was ingested into the left wing fan. The pilot unsuccessfully ejected when the damaged fan caused the aircraft to roll to the left and settle rapidly. However, post-accident analysis revealed that despite the ingestion of the rescue collar and its weight, the wing-fan continued to operate and produce enough lift force for the pilot to hold a wings-level roll attitude and to reduce descent rate to a value that may have allowed him to survive the ensuing "emergency landing" had he stayed with the aircraft. This was a grim testimony as to the ruggedness of the lift-fan. The rescue hoist installation and post-accident damage to the aircraft are evident in the photograph of figure 3.

Pitch Fan Limitations

The 36 inch nose fan provided adequate pitch control in fan mode, but was responsible for a couple of adverse handling characteristics. The strong momentum drag of the pitch-fan caused the aircraft to exhibit negative weather-cock stability during sideward translations in hover and negative directional stability during translational maneu-