XJ99: engine in search of an airframe

One significant powerplant which has received less than its fair measure of recognition, because of the dictates of military security, is the advanced lift-jet designed jointly by Rolls-Royce and Allison for the remarkable US-FRG VTO fighter. This ambitious aircraft was cancelled in 1968, at a very early stage, for a more conventional successor, NKF, which itself gave way subsequently to MRCA. But the XJ99 powerplant was considered sufficiently promising to warrant development up to the demonstrator stage. This phase was completed last year and the project will not be resumed until definite applications have been identified. The following extract from a joint paper by the two engine firms discusses the origins of the engine and possibilities for the future.

In 1965 the American and British Governments recognised jointly that there was a requirement for an advanced lift engine for military use. A Memorandum of Understanding was signed between them, covering collaboration between the Derby Engine Division of Rolls-Royce and the Detroit Diesel Allison Division of General Motors for the design and development of such a powerplant, to be designated the RA-XJ99.

At the time of the memorandum, Rolls-Royce had completed feasibility studies, including component testing, on an advanced lift engine designated the RB.189. This project was a third-generation powerplant and was based on the unique experience built up by the company on the RB.108 and RB.162 series of lift engines. The XJ99 grew out of this work.

The function of the lift engine is to support the aircraft in vertical flight and transition, either alone or by supplementing vectored thrust from the main propulsion engines. It follows that lift engines are required only to operate intermittently and at low altitudes and that the fuel consumption is relatively less important than for propulsion engines. The cycle can therefore be simple and it becomes possible, by the use of high-duty components, to design engines which have a very low weight and volume relative to the thrust generated. Low cost, both of engine and control system, toleration of intake air-flow distortion, rapid response and minimum gyroscopic couple are also major design requirements. In addition, some applications require a large continuous air bleed to stabilise the aircraft in vertical flight.

The XJ99 offers improvements in thrust relative to weight and, in particular, to volume when compared with the RB.162. Studies have shown that, for a Vtol strike aircraft, improving the thrust-to-weight ratio offers a diminishing return, but that considerable advantages remain in improving the thrust-to-volume ratio. The principal benefit of minimising engine volume is a reduction in the size of the fuselage, a particularly attractive factor in supersonic applications.

The XJ99 is a two-shaft turbojet with a thrust in the 9,000lb class. The compressors, which have two stages in the low-pressure system, and four stages in the high-pressure spool, are both axial-flow. The two systems

An impression (top) of the AVS (Advanced Vertical Strike) fighter projected some years ago for the Luftwaffe. It was to have four swing-out XJ99 lift-jets, two P&W JTF16 vectored-thrust cruise engines of 13,000lb thrust, and a variable-geometry wing. Estimated weight was 45,000lb. It was cancelled in 1968, not unexpectedly