CONCORDE POWERPLANT

An Introduction by Bristol Siddeley Engines Ltd

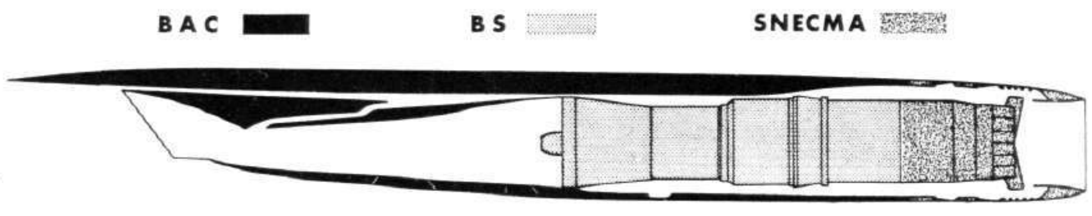

Fig 1 This diagram (which, like all those accompanying this paper, are based on BSEL/SNECMA originals) shows the division of work between the two engine firms and BAC

LAST week, on November 12, the first technical paper on the powerplant of the BAC/Sud Concorde supersonic transport to be delivered at other than a closed meeting was read before the American, British and French Pilots' Associations' symposium in London. The joint authors were Messrs T. P. Frost and J. P. Little, respectively chief test pilot and project engineer of Bristol Siddeley Engines Ltd.

The Concorde powerplant [said the lecturer] has evolved from an optimization study which showed that a medium pressure ratio turbojet would be the best compromise for a transatlantic Mach 2.2 civil aircraft. Detail design of the engine, intake and nozzle systems is currently proceeding at British Aircraft Corporation and Bristol Siddeley Engines in England and SNECMA in France.

BAC are responsible for the intake and the nacelle installation (Fig 1). Bristol Siddeley are designing and developing the Olympus 593 engine, and SNECMA are responsible for the jetpipe, reheat system, primary and secondary nozzles, silencer and thrust reverser. The powerplants are disposed in two twin underwing nacelles positioned outboard of the main undercarriage at approximately mid-semi span. This arrangement brings the intake into a region where it is sheltered under the wing, which acts as a flow-straightener and minimises the effect on intake performance of variation in angle of attack.

The intake (Fig 2) is of two-dimensional form, the cross-section of the supersonic part of the intake being constant and the shocks being plane. During supersonic cruise there are three inclined shocks, two generated by the leading edge and kink lines in the wedge and the third generated by the lower intake lip. The diffuser takes the subsonic air from downstream of the shock system and further decelerates it to a Mach number of about 0.5 at the engine intake face. The change of shape from rectangular to circular is also accomplished in this section.

Intake control (Fig 3) is effected by an upper movable ramp which functions to control the supersonic part of the intake by focusing the shock system and controlling the throat area, whilst the spill and dump doors in the lower surface of the diffuser are used to match the intake and engine flow. The aft door is used as a fine trim, whilst the forward door is used to provide extra flow at below Mach 0.4 and also as a coarse "dump" control in the event of an engine flame-out during supersonic flight. During subsonic flight the intake ramp is folded flat on the upper face of the duct, and at very low Mach numbers (below about 0.4) the dump door is opened to increase engine mass flow.

The whole intake and nacelle is being designed and constructed by BAC on behalf of the aircraft manufacturers. The techniques involved—sheet-metal work and flat control surfaces—are more within the domain of an aircraft manufacturer. In addition, there is no link between the control system of the intake and the main engine control system except that afforded by the airflow.

The Olympus 593 (Fig 4) compressor and combustion system are based on the proven components in service with the Vulcan B.2 and under development using supersonic materials for the TSR.2. Mass flow has been increased, and the revised compressor has already run for a considerable period on the test bed. Thrust has been further increased by the use of a new h-p turbine, allowing an increase in combustion temperature.

The engine is mounted by a conventional trunnion fixing on the compressor delivery casing, plus a single forward link on either side of the entry casing. Both engine and aircraft accessories are mounted on gearboxes directly on the engine. The aircraft accessories, comprising two hydraulic pumps and an a.c. generator driven through a constant-speed drive, are mounted on their own individual gearbox, which can be isolated on the ground, by means of a clutch, and driven by the low-pressure air starter to carry out aircraft systems checks. In flight the engine is protected by individual clutches between the gearbox and each accessory. Automatic clutches drop out in the event of hydraulic-pump failure, and there is a crew-operated clutch in the c.s.d. shaft. Thus, it should never be necessary to shut down an engine because of an aircraft accessory failure.

Fig 2 Simplified diagrams showing the operation of the intake

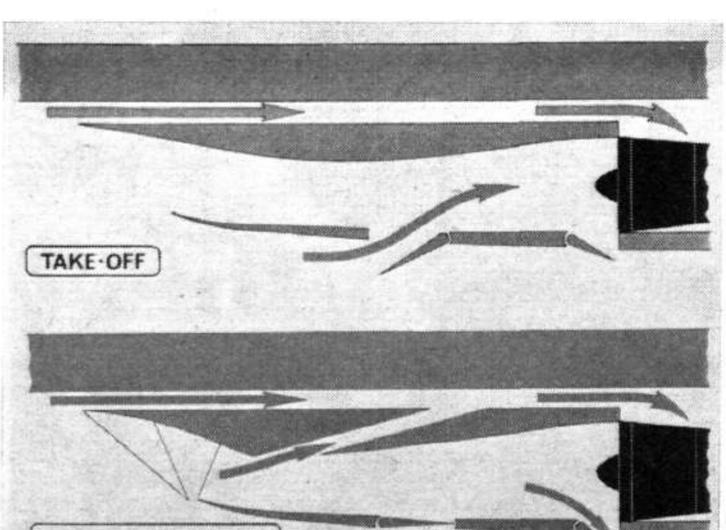

Fig 3 The intake control system. A series of sketches in this journal on June 20 last illustrate the variation in geometry of the intake and the propelling nozzle under all conditions of flight, from sea-level static to supersonic cruise at from 57,000ft to 67,000ft