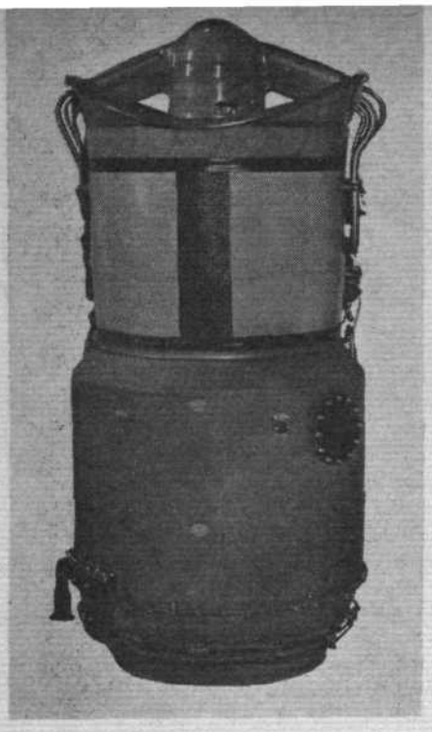

Rolls-Royce RB.162 lift engine

AERO ENGINES

ing 2,550 s.h.p., is used in all versions of the T64-BS. Compressor and turbine casings are split and allow "in-the-field" replacement of blades without rebalancing the rotor.

The 1,050 s.h.p. Nimbus turboshaft has been developed from earlier Bristol Siddeley/Turbomeca designs, with a two-stage axial compressor, steel centrifugal compressor, and redesigned blading on the turbine which has a second stage, driving the rear output shaft located between the bifurcated exhaust. The Nimbus 102 is torque limited to 685 s.h.p., thus conferring outstanding "hot-and-high" performance on the Westland Scout and Wasp. Four Nimbus 1000 Series in coupled pairs power the SR.N2 hovercraft.

Bristol Siddeley's interest in free-turbine engines at the lower end of the power range has resulted in a selection of turboshaft and turboprop powerplants covering virtually any shaft-driven V/STOL aircraft.

Auxiliary power units include the Palouste turbo-compressor, and its lighter and more powerful derivative the Cumulus, which additionally provides shaft power for an alternator. The Cumulus is installed in the TSR.2; and the Artouste, basically a Palouste with a drive extension from the rotor to a 100 h.p. output gearbox, is fitted in the Trident, Victor B.2 and CL-44. Development of these units continues in close association with Turbomeca.

In addition to the 170lb thrust PR.37 miniature rocket booster installed in the Jindivik, Bristol Siddeley have developed the BS.605, a retractable twin-chamber motor using kerosine and hydrogen peroxide, and believed to be intended for SAAF Buccaneers.

Bristol Siddeley have technical collaboration agreements with Svenska Flygmotor (ramjets), Marquardt Corporation of California (interchange of information on hypersonic air-breathing engines) and hold licences to manufacture Solar afterburners and associated equipment, and SNECMA thrust reversers.

Finally, looking ahead, two obvious engines offering a high-by-pass ratio for projects such as air bus, strategic freighter or maritime reconnaissance aircraft are a straight turbofan, unvectored BS.100 or a "fanned" Olympus. These would take advantage of today's higher turbine entry temperatures to provide by-pass ratios of four or five, giving exceptionally low fuel consumption 5 to 10 per cent less than that of existing transport engines. Because addition of a normal front or aft fan would make it too large, a "fanned" Olympus is more likely to have one or two remote exhaust-driven fans. Other high-by-pass engines and designs competing with the RB.172 and GE J1 are also projected.

ROLLASON *Rollason Aircraft and Engines Ltd, Croydon.* Rollasons produce their own developments of the French Ardem 4CO2 conversion of the Volkswagen car engine for their licence-built Druine Turbulents. Latest versions of the 4CO2, the 45 h.p. Mk 4 and 55 h.p. Mk 5, both based on the 1,500 c.c. VW, are specified in the current racer design competition sponsored by Rollasons.

ROLLS-ROYCE *Derby.* Rolls-Royce continue to hold their pre-eminent position in spite of all the vicissitudes of aviation, civil and military. Grand total of aviation production has passed 205,000 engines—170,000 piston engines including 150,000 Merlins, and 35,000 gas turbines including 29,000 military and 6,000 civil. Rolls-Royce aero engine manufacture employs more than 34,000 people in Derby, Glasgow, Barnoldswick and Crewe. Research, design and development occupies 9,000 people and 2,300,000 sq ft, nearly one-third of the total factory area. More than 11,000 Rolls-Royce engines have been built under licence abroad, and licence agreements continue in Belgium, France, Germany, India and Sweden.

Twenty-nine separate Rolls-Royce-powered military aircraft in 12 countries have entered service and eight more are under development for service during the next five years. Thirty-six armed forces of 30 countries are currently operating Rolls-Royce powered military aircraft. Sixteen different types of civil aircraft, produced by seven countries (the total ordered exceeds 1,500 aircraft) are powered by Rolls-Royce turbines. Two more types are in design, and the recently initiated Dart Convair conversion brings the total to 19.

Rolls-Royce gas turbines have completed more than 50m hours, nearly 40m of which have been in civil aircraft—an indication of the much higher utilization of civil aircraft. When the Dart entered service with a TBO of 400hr, piston engine TBOs were around 1,000hr. Today, the Dart has reached 5,000hr, the Avon and Conway over 4,000hr and the Tyne more than 3,000hr, compared with 2,000hr on typical piston engines. With a shop check at approximately half-life the Conway has reached 6,700hr, the highest TBO yet achieved.

Large numbers of Avons continue in service throughout the world, with 35 civil operators and 27 different types of military aircraft. The 12,690lb thrust RB.146 Avon 300 is an advanced version having an improved compressor with a zero stage and increased mass flow. The 16,000lb Avon 301 with reheat powers the latest marks of Lightning. Licence built in Sweden by Svenska Flygmotor, and equipped with their own design of afterburner, the RB.146 Mk 60 is rated at 17,110lb. Latest on the civil side, is the 12,725lb Avon 533, or RA.29/6. The 533R with reverser is rated at 12,600lb in the Caravelle 6R. These engines have a 17th "00" compressor stage and a two-position nozzle for improved cruise performance.

The exceptionally reliable Conway turbofan powers, in addition to the Victor B.2, three types of four-engined transport of which 117 examples have been ordered to date. The Conway first ran in 1952, flew in 1955 and was the first turbofan to enter airline service in 1960, as the 17,500lb 508 and 509 in the Boeing 707-420 and DC-8-40. It has since set the pattern for subsonic commercial turbojets. Most powerful military Conway so far announced, is the 20,600lb 201 series, the RCo.17 for the Victor B.2. With h-p compressor, outlet casing and turbine discs strengthened for higher operating pressure and temperature, the 21,825lb Conway 550, or RCo.43, is the version in production for the Super VC10, shortly to enter BOAC service.

Few details are available of the proposed Conway successor, the RB.178, a high-by-pass-ratio turbofan rated at 25,000lb take-off thrust at 9,260 r.p.m. in i.s.a. at sea-level. Weight of a complete pod applicable, for example, to the twin-jet Sud/BAC Galion, is reported to be 6,300lb.

Designed initially for short- and medium-range transports, the RB.163 Spey turbofan first ran in December 1960, and began commercial service in BEA's Tridents in March 1964. The number of Spey-powered transports on order has already reached 116. The 11,400lb Spey 511 (RSp.25), specified for the Trident 1E (511-5) and One-Eleven 300 and 400 (511-14), has an additional fifth stage added to the low-pressure compressor. It first flew in the Trident 1E in November 1964, and full ARB clearance is expected early this year. The Spey 511-5W incorporates water injection to maintain full take-off power at high ambient temperatures. One-Eleven tropical trials were completed last November at an airfield height of 2,000ft and ground temperatures up to i.s.a. +35°C, with 10,410lb water injection Spey 506-14Ws. British Government financial support for Spey 25 development includes the military Spey, RB.168, which is fundamentally similar to the civil series,