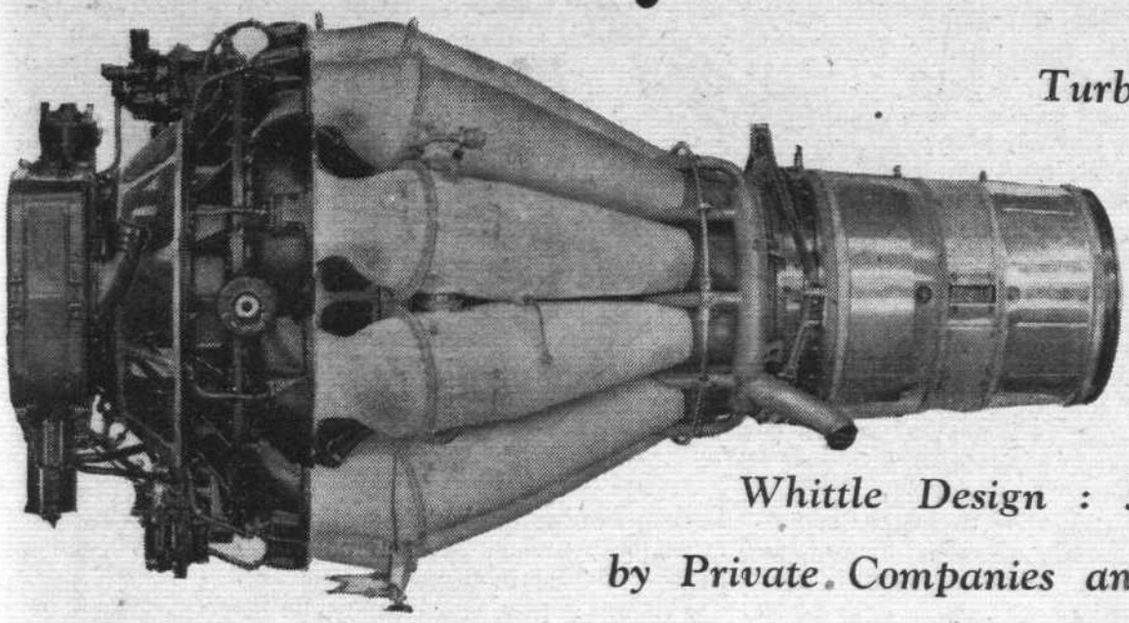
Rolls-Royce Derwent



Turbine Jet Engines in the Gloster Meteor : Rapid Development of Original Whittle Design : Joint Enterprise by Private Companies and Air Ministry

THIS is more than a description of a new type of aircraft propulsion unit. It is an account, necessarily brief and incomplete, of a remarkable co-operative effort by individuals, firms and the State. Under war conditions every phase of the activity, the design, development, production and testing, had to be conducted in the closest secrecy, and to the credit of all concerned there were no leakages of information.

Tribute must be paid initially to Air Commodore F. Whittle. His was the first conception of the constant-pressure gas turbine and centrifugal compressor combination for a jet-propulsion unit. His first patent was deposited in 1930, and for a number of years it was only his dogged perseverance that overcame the indifference, lack of support, and even incredulity he encountered. It must be emphasised, however, that it was not merely a blind faith but an informed conviction that enabled him to continue his efforts. No more insistent advocates of this view could be found than Rolls-Royce officials concerned in the development of the engine. Although many mechanical and structural features have been altered, the original design was fundamentally sound aerodynamically. On the latest engines such vitally important components as the compressor and turbine still follow the original design or embody the original Whittle principles.

The first active interest of the Rolls-Royce organisation was in 1938 when, on the initiative of Mr. Hives, the general manager, a department for research and design of gas turbines for use as aircraft propulsion units was established. In 1940 testing rigs for aerofoils, bearings and combustion chambers were set up and the data accumulated were of great value in ensuing years in solving problems arising in engine development. Towards the end of 1940 the company was directly engaged in the manufacture of components for Whittle jet engines. Next year an intensive study of centrifugal compressors for Whittle engines was undertaken to ascertain the causes of and the means of eliminating surging. A special testing rig was built on which the compressors were driven by a Rolls-Royce Vulture engine developing 2,000 h.p.

All these activities were conducted as private ventures, but subsequently support was received from the Air Ministry. It must be remembered that in this period the organisation was heavily burdened with the development of piston engines for the war effort. Late in 1941, on Air Ministry direction, Rolls-Royce undertook the building of a Whittle-type engine designated WR1. At that time there were three major limiting factors, the turbine blades, operating temperatures and rotational speeds. The WR1 was designed with low blade stresses in order to demonstrate that the gas turbine could be made completely reliable. Considerations of weight and space occupied were subordinated to this end. Actually, with a maximum diameter of 54in. over the compressor casing and a weight of 1,100 lb., the engine developed a thrust of 2,000 lb. For the purpose intended this was regarded as quite satisfactory, and two engines were built for intensive test and investigation, and complete parts for a further six units were produced.

Jet History

The early history of the development of the Whittle engine was given by Air Commodore F. Whittle in a paper read before the Institution of Mechanical Engineers on October 5th, 1945, and reported in *Flight*, October 11th, 1945. This carried the development up to the W2B engine, which was built by the Rover Co. In March, 1943, Rolls-Royce took over the W2B/23 jet engine. At this period there was a parallel activity on the aircraft side. The Gloster Co. was proceeding with the design and development of a twin-engined, high-speed aircraft in readiness for the projected turbine jet units.

DATA

Compression ratio	3.9 : 1
Maximum jet pipe temperature	690 deg. C.
Rotation—viewed from rear	anti-clockwise
Thrust—combat and take-off	2,000 lb. at 16,600 r.p.m.
Thrust—cruising	1,550 lb. at 15,000 r.p.m.
Thrust—idling	120 lb. at 5,000 r.p.m.
Fuel	Aviation Kerosene
Fuel consumption—combat	2,360 lb./hr
Fuel consumption—cruising	1,820 lb./hr
Fuel consumption—idling	470 lb./hr.
Lubricating oil tank capacity	22 pints
Lubricating oil consumption—all ratings	1 pt./hr.