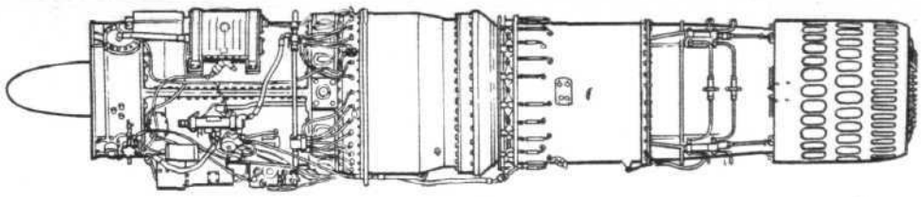
AERO ENGINES 1957 . . .



Wright J65-W-6. Single-shaft turbojet with afterburner. Thirteen-stage compressor, annular combustion chamber with 36 vaporizing burners and two-stage turbine. Diameter, 37.9in; length, 195in; dry weight, 2,780 lb; mass flow, 120 lb/sec; pressure ratio, 7:1; maximum thrust, 11,200 lb with reheat, at 8,200 r.p.m., with s.f.c. of 1.97. The basic engine has a dry rating of 7,800 lb thrust with s.f.c. of 0.91.

WRIGHT. *The Wright Aeronautical Division of the Curtiss-Wright Corpn., Wood-Ridge, N.J.* For many years Wright have been world leaders in aircraft propulsion, yet their performance in the gas-turbine era has been disappointing. Undoubtedly the Turbo-Compound is an outstanding powerplant, in spite of a relatively high incidence of mechanical trouble, and Wright have also done a fine job in developing and mass-producing the J65 Sapphire to a basic British design; yet no engine of Wright design has achieved success since the R-3350 of almost twenty years ago.

The company's first gas-turbine was the big T35 Typhoon turboprop which got as far as the flying stage. In 1950 the company obtained a profusion of licences in respect of British gas-turbines designed by Armstrong Siddeley and Bristol, and the Sapphire and Olympus were each chosen to form the basis of an American turbojet, as described below. Attempts to convert these engines into ambitious turboprops were unsuccessful, and even the development of the basic J67 has proved to be long and protracted. Only now is it likely to achieve success as part of an exceedingly interesting dual-cycle powerplant which, if financial considerations do not first cause its cancellation, may lead to an attractive system of propulsion for high-supersonic aircraft. Efforts are now being made to enter the commercial field with the TJ-38 turbojet. All responsibility for piston engines other than the Turbo-Compound is vested in Lycoming (*q.v.*).

At present Wright Aeronautical Division is concentrating on large engines, and units up to 7,500 lb-thrust and comparable turboprops are the responsibility of the Turbomotor Division, which was organized in January 1956 with headquarters at Hempstead, N.J. Headquarters of W.A.D. is still at Wood-Ridge although it is scheduled to be relocated in the neighbourhood of Suffern, N.J.; the main research and development establishment is being steadily built up on a vast 85-sq-mile site named Quehanna in central Pennsylvania, and a further extensive estate west of the Rockies has been allocated to future rocket and ramjet development.

Other products of the corporation include Turbolectric propellers, simulators and related equipment by the Electronics Division; a variety of engine and airframe detail parts by the Marquette Metal Products Division; the Aerophysics Development Corporation, who have designed hypersonic test vehicles and the Dart anti-tank weapon system; the Utica-Bend Corporation who mass-produce the Dart missile and hold a U.S. Army study-contract for a 250 e.h.p. turboshaft engine (independent of one held by the Turbomotor Division); a Metals Processing Division; and Caldwell-Wright Airport, Inc., who *inter alia* maintain the corporation's experimental aircraft. Curtiss-Wright Europe, N.V., is a wholly owned subsidiary in the Netherlands principally concerned with service-support of U.S.A.F. and NATO J65s.

Recent developments by the Propeller Division include: a very neat thrust-reverser for turbojets "from 2,000 to 25,000 lb-thrust" which has been fully developed during four years of rig running; an all-mechanical engine speed control for helicopters, offering unique advantages; and a variable-exhaust-nozzle control system for advanced turbojets giving infinite variation over a wide range of conditions.

In August last year Curtiss-Wright undertook a three-year advisory management agreement to assist Studebaker-Packard, and took a twelve-year lease on two S-P plants. Aerophysics Development and Utica-Bend, both previously mentioned, were purchased from S-P to implement Wright's missile programmes. Utica-Bend is also overhauling J47 turbojets and making J57 parts for Ford.

Earlier this year Curtiss-Wright and Studebaker-Packard jointly associated themselves with the great German firm of Daimler-Benz, and all three organizations are to co-operate in research, production and sales on a world-wide scale. Total Curtiss-Wright backlog at the beginning of the year was over $746m, and the number of employees 32,237, an increase of over 4,300 compared with 1955.

J65. In 1950 Wright recognized that the basic design of the British Sapphire turbojet was sufficiently outstanding for it to command acceptance in the American market. After purchasing a licence, the engine was converted to U.S. standards and flown beneath a B-17, and in 1951 it was bought by the U.S. Air Force as the powerplant of the Republic F-84F and Martin B-57 (Canberra).

Since that time a variety of J65s have become widely used by the U.S. Air Force and have flown at high supersonic speeds in F-104 prototypes. Over 1,000 J65s have also been delivered to the Navy for use in the FJ-3 and -4 Fury, F11F Tiger and Regulus II. Compared with the British Sapphire 100, the J65 incorporates complete detail redesign; the example illustrated is a typical fighter engine for the F11F-1 Tiger, with a steel ribless compressor casing and a short afterburner. Second-source production was undertaken by Buick between 1952 and early 1956, and approximately 10,300 J65s have now been manufactured. The rate of production has already appreciably slowed and next year deliveries will be required only for the Fury FJ-4B.

Naturally Wright wished to extract from the J65 the maximum amount of business, both in the military and commercial fields. Considerable behind-the-scenes activity has followed two main paths. One branch has aimed at the establishment in America of an advanced military Sapphire (200-series derivation). Cool, long-life engines would have been offered to the U.S.A.F. for re-engining B-47s, a proposal which was at one time very seriously considered and would have meant a requirement for some 20,000 engines. At the same time a hot, afterburning fighter engine would have been offered to the Navy, particularly for advanced versions of the Tiger. The other branch of investigation concerned an engine designated TJ-31F, a cool commercial turbojet which, it was hoped, would be sold to transport manufacturers. Unfortunately neither scheme has come to fruition, largely as a result of factors unconnected with the engines themselves.

During 1956 the two XB-47D test-bed aircraft flew many hours with the Wright T49 turboprop. Here one is seen from a KC-97 tanker.

J67. When Wright bought the Olympus licence in 1950 they decided that, as the engine needed substantial development in any case, they would themselves work on it to produce a wholly American engine of increased thrust. A U.S.A.F. development contract was awarded for an engine designated J67. By way of the intermediate TJ-32B, this engine is now nearing the definitive stage. Early on, however, the U.S.A.F. saw that Wright could not develop a usable engine as fast as Pratt and Whitney (or Bristol) and no production of the J67 was ordered. It does, however, find a niche in the company's dual-cycle work, referred to overleaf.

J47. A particularly ambitious proposal of the Wright Aeronautical Division was the evolution, from the Olympus/J67 series, of a turboprop of some 15,000 h.p. As far as is known, the project is dead.

T49. Unlike the preceding engine, this turboprop version of the J65 Sapphire not only reached the hardware stage but also accomplished a fair amount of flying in a pair of XB-47Ds. The big single-shaft turboprops replaced the inboard twin-J47 nacelles, and drove large ducted-spinner propellers. The XB-47D did not inspire confidence among those who flew it, and virtually all development has now ceased. One of the original aims of the programme had been to produce a de-rated constant-power engine for commercial use.

TJ-38 (company designation). Announcement of this very attractive commercial turbojet was made in May of this year. After considerable market-study it was decided to offer to the airlines a cool-running version of the second-generation Olympus—i.e., a derivative of the Olympus 510 series in replacement of a previous Wright proposal for the series-550 engine. Actual detailed engineering of the TJ-38 was conducted by Bristol, and the British firm have a fairly close counterpart in the Zephyr (*q.v.*).

Wright/Bristol TJ-38 Zephyr. Two-spool commercial turbojet. Five-stage low-pressure compressor, seven-stage high-pressure compressor, can-annular combustion chamber with eight flame tubes, single-stage high-pressure turbine and single-stage low-pressure turbine. Overall diameter, 41in; length from intake to exhaust flange, 121in; dry weight, equipped, 3,600 lb; mass flow, not stated; pressure ratio, 10.5:1; maximum thrust, 12,500 lb with turbine-entry temperature of 1,000 deg K and s.f.c. of 0.718; cruise rating at Mach 0.8 at 36,089ft, 3,000 lb thrust with s.f.c. of 0.88. In appearance the Zephyr will closely resemble the Olympus 6 (p. 114).

Turbine-inlet temperature in the TJ-38 is only 1,340 deg F, and several major advantages accrue as a direct consequence: the rated dry thrust of 12,500 lb can be held in adverse temperature or altitude conditions; water injection is not required; noise level is exceedingly low (and is further reduced by a segmented propelling nozzle); and reliability and service-life should be exceptional. Wright have pointed out that the basic Olympus design is backed up by over 30,000 hr of full-scale running, and that it should soon be possible to achieve full certification and work up to a very long overhaul period. As the accompanying data reveal, the specific consumption and weight are also exceedingly attractive. Roy T. Hurley, Curtiss-Wright chairman and president,