about 0.7 at military power even with a turbine-inlet temperature well below 1,750°F. Holding down top temperature has enabled Allison to produce the 250 as a full-power engine (instead of 192 h.p.) on a 100°F day. The control system was evolved around the simplest mechanical/hydraulic concept capable of performing the required functions automatically, and has worked well during intensive bench running.

Manufacturing costs are critical in establishing the market potential of an engine of this character. Typifying their bold approach, Allison have evolved a method by which complete compressor rotor stages are precision cast in an aluminium/cobalt alloy or reinforced plastic, the resulting assembly of disc and blades requiring virtually no machining and costing less than a third of an equivalent part produced by any other method. From the precision-cast centrifugal stage the air is delivered through a vaneless diffuser to a collector scroll, thence passing to the rear through lateral pipes to the single combustion chamber. The hot gases move forward through the gas-generator and power turbines and are discharged through an exhaust hood projecting straight downwards.

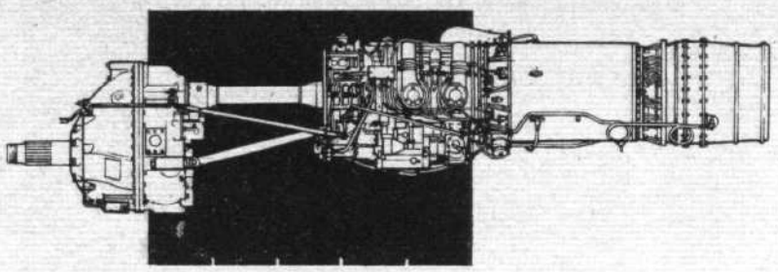
The backbone of the engine is the gearcase; the compressor is bolted on the front, the combustion chamber is bolted to the rear and inside is the train of spur gears which take the power to an upper output shaft turning at 6,000 r.p.m. From the latter, drives can be taken to front or rear, and in the turboprop version a planetary reduction gear provides a final output at 2,000 r.p.m. An additional train from the gas-generator assembly provides drives to the accessory pads on the front and rear faces of the gearcase.

Military sponsorship has been obtained in the form of a joint development contract from the Army and Air Force as the T63. A considerable number of pre-production engines are undergoing intensive development for all types of light aircraft, helicopters, VTOL platforms and similar devices. Certification may be obtained this year, and it is unofficially suggested that the selling price for a turboshaft unit may not exceed £2,000.

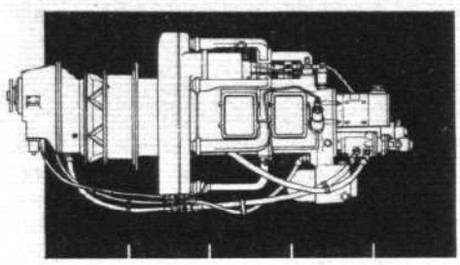
Model 252 A project consisting of the fore and aft ends of a pair of Model 250 engines bolted to a common gearcase and driving a single output shaft. The 252 has been designed in detail in both turboshaft and turboprop forms but has not yet been built.

Model 501 As the commercial derivative of the T56, the 501 is a highly developed engine, in airline service powering Lockheed Electras since January 1959. Unlike the military engine, the propeller axis lies below that of the power section. Several hundred 501-D13s are now operating at an overhaul life of 1,000hr. Admittedly the Allison is a simple engine, but the company deserve considerable credit for having made it a genuine thousand-hour powerplant, with no teardown or parts-replacement at any intermediate point. No other US gas turbine has achieved this goal.

Among its features are: β-control of the 14ft 6in propeller; a system for reducing r.p.m. on the ground, and so make less offensive noise, while maintaining constant-speed operation at all other times; and provision for bleed-air anti-icing and an air-turbine starter. At present the D13 is being marketed as an integrated package, which has been bought by one operator as part of an Allison programme to revitalize the Convair-Liner. The company have also evolved the 501-D15, corresponding roughly to the T56-A-7, in which minor improvements (including shrouded first and second turbine stages) have raised the mass flow and pressure ratio to the same levels as those of its military counterpart (*q.v.*).



Allison 501-D13 Commercial single-shaft turboprop. Fourteen-stage compressor, can-annular combustion chamber with six flame tubes and four-stage turbine. Overall width, 27in; max overall height, 36in; length as depicted, 145.2in; dry weight, bare, 1,750lb; max rating, 3,460 s.h.p. (3,740 e.h.p.) at 13,820 r.p.m. with mass flow of 39lb/sec, pressure ratio of 9:1 and s.f.c. of 0.54; max cont rating at 25,000ft at 360 kt, 1,850 s.h.p. (1,905 e.h.p.) at 13,820 r.p.m. with s.f.c. of 0.46.



Boeing Model 520-8 Free-turbine turboprop. Rear intake to double-entry centrifugal compressor, two reverse-flow combustion chambers, inward-radial compressor turbine, independent axial power turbine, multi-stage spur reduction gears and annular front exhaust. Overall diameter, 25in; length, 59in (68.67in over spinner); dry weight, 275lb; max rating, 550 s.h.p. at 2,400 output r.p.m. with s.f.c. of 0.65; guaranteed minimum rating, 520 s.h.p. (540 e.h.p. assuming 59lb jet thrust) at 2,300 r.p.m. with max s.f.c. of 0.66lb/hr/s.h.p.; estimated rating with 25hr life at 40,000ft and 400kt, 270 s.h.p. with s.f.c. of 0.5.

Model 550 Since 1955 Allison have had under development a turboprop which represents a natural outgrowth of the Model 501, with a two-spool compressor. A development contract was placed by the US Air Force, the engine receiving the military designation of T61. Matched with a special Aeroproducts propeller, it was intended eventually to power the Lockheed Super Hercules. Despite substantial commercial interest, headed by PanAm and Slick, and pressure by Congress to buy the aircraft for MATS, no order for the Super Hercules materialized and no other application for the engine has been announced. The development contract finally expired last November 30 and development has virtually ceased. Total USAF funding had amounted to $35m. When the contract came to an end four YT61-A-1s were running on the bench, a YC-130B was being modified to take a T61 in the No. 3 position and the 50hr test was scheduled for this month.

The original design power of 5,500 e.h.p. was substantially exceeded on the bench, but the s.f.c. was never really competitive. Design features include: a low-pressure compressor with six stages within a tapering casing; a high-pressure compressor with eight stages of blading and an untapered casing; a can-annular combustion chamber with ten flame tubes; a single-stage high-pressure turbine; and a four-stage low-pressure turbine driving through a central shaft to the low-pressure compressor and thence to the propeller reduction gear carried remotely on a lower level.

Dry engine weight is quoted as 2,240lb. Bench running enabled the following ratings to be established (sea-level standard day): take-off, 6,500 e.h.p. (6,102 s.h.p. + 996lb thrust) with minimum s.f.c. of 0.5 and turbine inlet temperature of 1,855°F; military rating, 6,235 (5,873 + 905)/0.505/1,855; normal, 5,635 (5,294 + 853)/0.515/1,775; 90 per cent cruise, 5,070 (4,770 + 750)/0.535/1,735; 75 per cent cruise, 4,225 (3,966 + 647)/0.56/1,650. Guaranteed s.f.c. at normal power at 320kt at 35,000ft was to be 0.51.

T56 Well over 1,000 of these single-shaft turboprops are in service with the US Air Force as the powerplant of the Lockheed C-130 Hercules. Most of the engines in use are of the T56-A-1A and A-9 types, both rated at 3,460 s.h.p. (3,750 e.h.p.) and installed in C-130As driving a three-blade 15ft Curtiss propeller. These engines have now been superseded by the T56-A-7, rated at 3,755 s.h.p. (4,050 e.h.p.), which is matched with a four-blade Aeroproducts propeller in the C-130B. These engines were described in our earlier Aero Engines issues, such as that for July 26, 1957. About to enter production for the Lockheed P3V (ASW Electra) is the T56-A-10W, which incorporates a water-injection system and other detailed improvements. Maximum rating is 4,585 e.h.p.

BOEING *Industrial Products Division, Boeing Airplane Co, Seattle 24, Washington.* For 17 years this company has been active in the field of small turbines, and the 502 series has established a high reputation for reliability and trouble-free service in marine, industrial, vehicular and aircraft applications. Bench testing began in 1947, the output being 100 h.p. and the s.f.c. 1.8; the current production version is the 502-10CA, rated at 240 s.h.p. with s.f.c. of unity. Almost 1,000 similar engines have been delivered, and six variants are currently in production or under test. One turboprop—the 325 s.h.p. 502-10W—is aimed at the business-aircraft market and will undergo FAA certification tests this year. Other aircraft applications include shaft- and tip-drive helicopters and the Radioplane RP-77D target drone for

The new Boeing Model 520 has a centrifugal compressor which achieves the record pressure ratio for such a unit of 6.5 : 1. The compressor is seen here, together with its turbine, of the inwards-radial-flow variety