AIRLINERS OF THE WORLD

DOUGLAS DC-8 . . .

The nose leg is essentially a scaled-up DC-7C unit arranged for twin wheels. It is equipped with two steering cylinders capable of scrubbing the nose tyres up to maximum gross weight. Steering is by rudder pedals up to 10 deg either side of centre, and by cockpit wheel for ±78 degrees thereafter. The rear swivel-mounted truck of the main gear can be unlocked for taxying when the nosewheel has been turned 40 deg either side of centre. The nose gear retracts forwards into an unpressurized box and is latched up in a similar manner to the DC-6. Mechanically-linked doors close the aperture during the final 10 per cent of the retraction cycle.

POWERPLANTS The domestic DC-8 is powered with either Pratt and Whitney JT3C-6 engines with a wet rating (for production aircraft) of 13,400 lb thrust, or by Pratt and Whitney JT4A-3s (commercial J75s) rated 15,500 lb dry. The DC-8 Intercontinental version is powered by either JT4A-3s or by Rolls-Royce Conway 507s (RCo.10) with a thrust of some 16,500 lb at sea level, I.S.A. Three hundred and fifty gal of water (no methanol) are carried for use during full-load take-offs in temperatures of more than about 50 deg F. A 10-kVA drive is provided for a water pump for each engine, and it is arranged that to avoid icing difficulties, no water will remain after two minutes' operation. Water is carried in the wing-tips and centre-section. Accessories on the Pratt and Whitney engines are mounted beneath the high-pressure compressor casing. Two drum-type oil coolers are provided, each fed with air from individual ram intakes in the lower part of the nacelle. No auxiliary intake will be provided for British engines as a fuel/oil heat exchanger will be employed. Two-shot Ficon systems are supplied for fire suppression, and the nacelle can be isolated.

Douglas have pursued an independent line of development on the problems of noise suppression and are experimenting with a combined noise suppressor and thrust reverser that is hydraulically operated and consists of clam-shell doors that fold flat into the nacelle, but are linked to join the after-ends together to deflect the jet efflux in the open position.

SYSTEMS **Flying Controls** Without the opportunity for an in-flight test programme of a representative aircraft at an early stage in the design of the DC-8, Douglas opted for fully powered systems on the ailerons and rudder, a variable-incidence tailplane operated hydraulically and servo-tab elevators. Artificial feel is employed. The ailerons are split into inner and outer portions, the inners driving the outers at low air speeds through a torsion-bar spring, so that all the portions function in unison. Above a limiting I.A.S. the air loads react against the spring to uncouple the outer sections. The rudder and aileron power units are identical except in size, and each includes a spring-tab locking linkage and spring-loaded cylinder which normally holds the tab neutral, but allows automatic manual reversion if hydraulic pressure falls. The loads in this condition are said to be no higher than on some current piston-engined transports. The elevators incorporate aerodynamic tabs and the tailplane is operated by a chain-driven two-start Acme screw through 2 deg up to 10 deg down from a hydraulic motor. An electric standby is used for autopilot drive. Four small wing spoilers—long narrow plates along the upper surface—are provided for use during landing and are not operable in flight; they are cable-linked and can be extended hydraulically after touch-down to increase the weight on the nosewheel.

Double-slotted, single spar flaps of Douglas design are employed, the short inner portion on each wing being joined to the outer portions by multiple mechanical links. Generally, the geometry is similar to that of the DC-7C, actuation being hydraulic by two rams on each flap and one on each inner section. A portion of flap in the line of each inner engine is hinged to a mechanical linkage so that it remains horizontal as the flaps come down and does not enter the jet stream. Under the belly are two large rectangular air brakes.

Air conditioning Cabin air is bled from the compressor of each engine and cooled to 400 deg F. It is then passed through four turbo-compressors, any one of which is capable of maintaining full cabin pressure. The dP is 8.77 lb/sq in (6,700ft at 40,000ft) and any one turbo-compressor can maintain it. Behind the nose undercarriage bay a closed-circuit Freon refrigeration system supplied by the Carrier Corporation is installed. Warm air is fed into trunks in the cabin roof, and into the wall, where it acts as a source of radiant heat. The air finally enters the cabin beneath the baggage racks. Overboard spill from the cabin and air turbines is ejected through a propelling nozzle on the ventral centre line. The hot air supply is also fed into rain removal air blasts on the windscreen and blow-away jets for clearing the runway beneath the engine of debris.

Fuel The wing integral tank is terminated at the inner end by the central line of the aircraft on the Intercontinental DC-8, and by an end-rib on domestic versions. The outer end-rib is spaced about three ribs from the wing tip and the manufacturing joint divides the capacity into what are termed main and auxiliary tanks. The total capacity is 14,650 Imp. gal and 18,000 Imp gal in the Intercontinental aircraft. Each engine has its own fuel and tank system interconnected by a cross-feed manifold, and an engine-driven fuel-booster pump is installed on each engine in addition to an electric tank-mounted pump. Underwing refuelling sockets are provided, through which the system can be pressure-refuelled in 16 minutes.

Hydraulics The system is powered by two engine-driven variable-displacement pumps at a pressure of 3,000 p.s.i. and operating on Skydrol 500. Hydraulic services include the undercarriage, flaps, spoilers, speed brakes, wheel brakes, nosewheel steering, engine starting air compressor, tailplane trim, and flying controls. Emergency power comes from an electric pump.

Electrics Early in the life of the DC-8 it was decided to adopt a 115/208 V three-phase 400 c/s AC system with an alternator installed on each engine and four 25 amp transformer/rectifier units to standard DC requirements. The alternator is driven by a Sundstrand drive.

De-icing All the aerodynamic surfaces of the nacelle pylon are de-iced thermally, with hot air bled from the engines. The double-skinned leading edges are fed with air from multiple-branch manifolds which exhaust into a curved diaphragm behind each leading edge. The air then escapes into the space forward of the front spar on each surface and thence to atmosphere.

FLIGHT EQUIPMENT The normal operating crew consists of a captain, first officer and "systems manager," and there is a seat for a supernumerary. The Intercontinental DC-8 has provision for a navigator.

Among the comprehensive radio equipment is search radar, housed in a heated nose radome. Most aerials are suppressed, the fin (previously described) incorporating V.O.R. windows in structural dielectric, and the whole upper part of the vertical tail is isolated to form an aerial of the correct impedance and radiation pattern. Standard equipment includes duplicated H.F. and V.H.F. communication, duplicated A.D.F. and glide slope, marker beacon, Loran, radar transponder, radio altimeter, together with flight inter-phone and public address system.

Payload Accommodation Seats and partitions are mounted on standard rails, reading lights and cold-air outlets are readily changeable, and passenger and service doors and buffets are at each end of the fuselage, so that a wide variety of interior layouts is possible. Typical layouts provide 118 to 122 seats in the first-class layout, 132 in a mixed-class and 144 tourist. Even in this configuration, the seats are pitched 40in, and coincide with the spacing of the windows. The maximum number of passengers that can be carried in a high-density arrangement is 171. Freight and baggage holds are under the floor and provide a total cargo weight of 14,150 lb, in a total cargo volume of 1,415 cu ft.

COMMERCIAL HISTORY The first DC-8 order was placed by PanAm, who bought 25 in October 1955 at a price of about £57 m. Later, this order was revised so that four aircraft (with JT4A engines) would go to Panagra early in 1960, and 21 to PanAm in December 1959. Subsequent orders have been as follows (totalling 122):—

United, October 1955, 18 with JT4 and 12 with JT3 (for subsequent re-engining) for delivery from May 1959 at £62.5 m; National, November 1955, 6 with JT3 from mid-1959 at £13.2 m; K.L.M., November 1955, 8 with JT4A (option on further 4) from March 1960 at over £18 m; Eastern, 18 JT4s, March 1960 (option on another 8 with JT4 from autumn 1961) at a total (with option) of £59 m with spares; Japan Air Lines, December 1955, 4 with JT4A from September 1960 at £9.8 m; S.A.S., December 1955, 7 with JT4A from 1960 at £18 m; Swissair, January 1956, 3 with JT4A from spring 1960 at £8.74 m; Delta, 2 JT4 and 6 with JT3 from June 1, 1959, at £12.9 m; T.C.A., May 1956, 6 with Rolls-Royce Conway from early 1960; and U.A.T., 3 with JT4 from 1960; T.A.I., 2 from 1960 and Olympic, 2 from 1960.

Progress with the wing structure and United Air Lines personnel inspecting the fuselage before the units were joined last month.