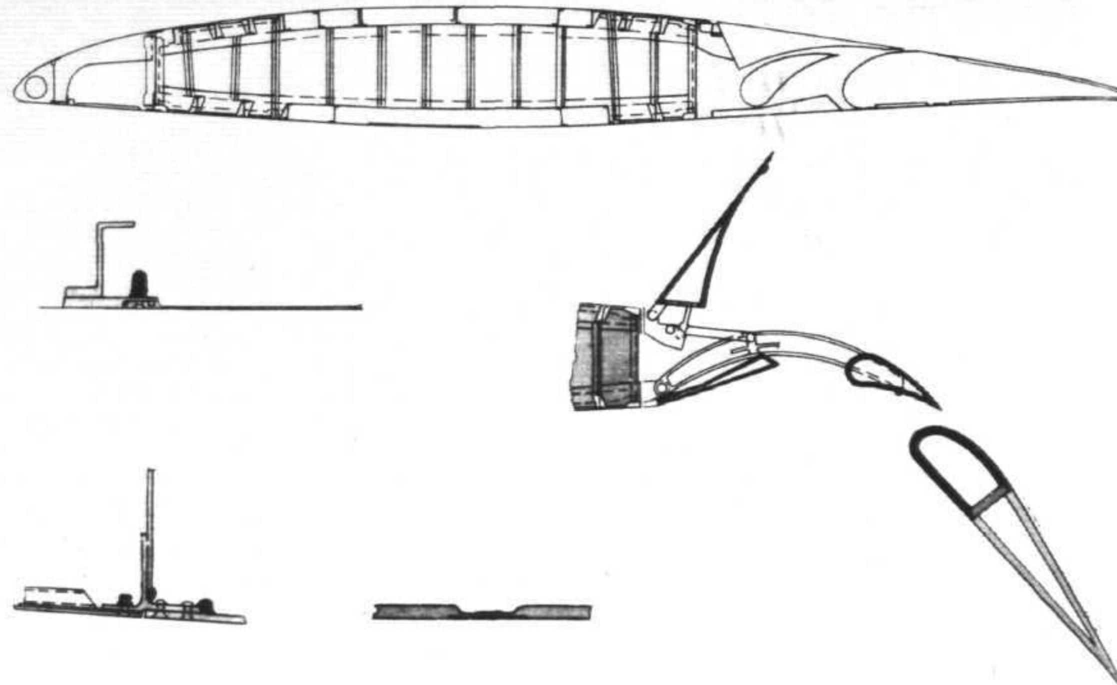
BOEING 707 REVELATIONS . . .



Newly released, this page from the Boeing 707 brochure shows (top) a typical section of the two-spar wing; the trailing-edge detail (right) illustrates operation of spoilers and flaps. The smaller details show an example of sandwich construction (right), and sections through the front spar (lower left) and, above it, under-wing access door.

convertible interior; and that the extra windows provided aisle-seat passengers with a far better view.

Design Characteristics

Mr. Curren then went on to discuss in more detail the design developments and characteristics of the 707, and his remarks are summarized below under appropriate sub-headings.

Aerodynamic development.—The wind-tunnel testing programme, which was still continuing, was conducted primarily in the Boeing wind tunnel, though two other tunnels were employed occasionally. The Boeing tunnel, with a test section of 8ft by 12ft, and capable of transonic testing up to M = 1.3, was the largest privately owned high-speed wind tunnel in the world. [The programme of tunnel testing on the three large Boeing multi-jet types—B-47, B-52 and 707—is summarized in the accompanying table.]

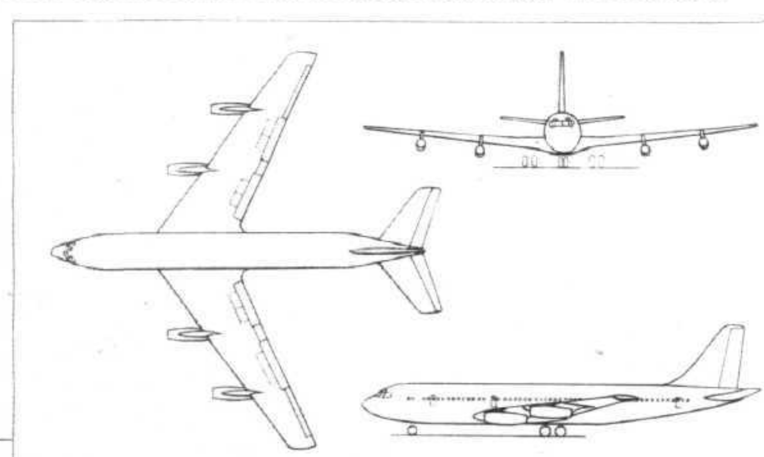
As the aerodynamic investigations and the concurrent structural and flutter tests continued, it became clear that a 35 deg swept wing represented the best compromise for a long-range, load-carrying aircraft designed to cruise near 550 m.p.h. This sweep permitted moderate wing thickness, resulting in high structural efficiency, ample fuel-carrying capacity and a high critical Mach number. In addition, it presented no stability and control problems that could not be satisfactorily solved with existing knowledge.

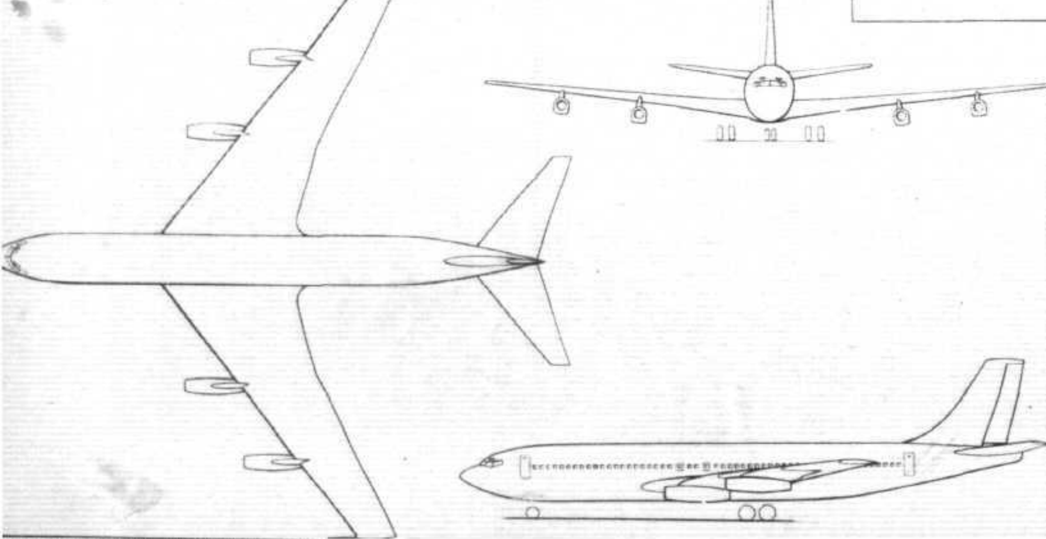
Control and stability.—Design objectives under this heading could be summarized as follows:—

(a) The control system must be fail-safe.
(b) The aircraft response must be superior to, and the pilot-effort-required less than in, previous transports, to improve the all-weather operating ability of the jet transport by reducing the pilot's workload.
(c) The finished aircraft must be an "honest" machine, in that no pitch-up or tuck-under should occur at high speed. The stall characteristics must be excellent with ample stall warning and effective control must be available in the fully stalled condition.
(d) Landing and taking-off, both in calm air and strong crosswinds, must not require new or unique piloting techniques or more than reasonable pilot proficiency.

[Before discussing the control system of the 707, Mr. Curren recalled the main features of the corresponding systems of the B-47 and B-52.] The former was a most responsive and easily controlled aircraft. All surfaces were hydraulically controlled with double boost systems on the ailerons to reduce the probability of complete failure. In addition, a manually-operated control system was also installed to provide reasonable control by the pilot if all hydraulic fluid is lost—"an ever-present hazard." The chief virtue of a hydraulic control system on a subsonic transport or bomber aircraft was that it allowed the designer to disregard unfavourable control-surface hinge moments or protect against unknown effects by using the "brute strength and awkwardness" of hydraulic pistons. Failure of such a system at high speed might result in serious control difficulties. Eventually the designer was forced into providing a manual back-up system, thus increasing weight and complication. The B-47 was an example of this development.

The B-52 control development profited by B-47 experience. On the B-52, the ailerons, elevators and rudder were manually controlled by pilot-operated control tabs. The stabilizer was adjustable, positioned by dual hydraulic motors, and provided with an emergency hand-crank adjustment in the event of hydraulic failures. To improve the low-speed lateral control characteristics, spoilers were mounted on the upper wing surface, operating in conjunction with the ailerons. These hydraulic spoilers also served as air brakes to increase drag as required by the pilot for steep descents or to reduce speed. This aircraft was a good step forward to a fail-safe control system for a high-speed configuration. After extensive flight tests and system refinement, the B-52 could





Latest general-arrangement drawings of the "small-wing" Boeing 707-120 (above) and the 707-320 Intercontinental (left). Some of the differences between the two airframes are indicated by the following dimensions (figures for the 707-320 in parentheses): wing span, 130ft 10in (141ft 6in); overall length, 134ft 6in (146ft 8in); height, 38ft 3 in (38ft 11in); tailplane span, 39ft 8in (51ft 8in); cabin exterior width, 12ft (12ft 4in); distance between fuselage centre-line and inner-pod centre-line, 27ft 2in (32ft 6in). Undercarriage track of both versions is 22ft 1in.