

THE B-29

almost instant approval, and on June 1—twenty days after Hitler had invaded the Low Countries—Boeing was authorized to construct wind tunnel models and a mock-up of the slightly revised model known as the XB-29. This was identical to the Model 345 except that gross weight had again been increased.

Wind tunnel tests of the XB-29, conducted at the University of Washington, the California Institute of Technology and the National Advisory Committee for Aeronautics wind tunnels, so impressed the Air Forces that on August 24th, 1940, Boeing was authorized to build three full-sized XB-29 prototypes.

On May 17th, 1941, before the first of these experimental models had been completed in Seattle, the Army had become convinced that the Boeing design would fill a vital role in the nation's aerial offensive strategy and ordered the B-29 into quantity production at the Boeing Wichita plant.

The first flight test was on September 21st with the aircraft in the air for one hour and 15 minutes. Testing continued throughout the rest of 1942, through 1943 and into 1944.

Engineering Achievements in the B-29

When Boeing received the go-ahead signal from the Army on building wind tunnel models of the B-29, the first concern was the development of a wing which would deliver the performance required. The Boeing Aerodynamics Unit for several months had been working on a wing and was pleased with its promise. But the Army was demanding higher speed, longer range and greater overall performance, so development was undertaken on a still newer wing. The result was the Boeing "117" aerofoil, a wing possessing remarkable qualities exceeding those of any previous design.

The "117" offered greater range performance because



ROOM FOR STOWAWAYS: The huge fin of the B-29. It was flight-tested on a reduced scale on a Fortress.

of refinements in drag characteristics. The Army, however, was uncertain of the wing because of its high loading. This, they feared, would reduce ceiling and affect handling characteristics during take-offs and landings. Boeing argued, and justified its argument, that the desired ceilings could be obtained, and that excellent landing and take-off characteristics would be provided through the use of the Boeing-created flap which would counteract high wing-loading.

Wind tunnel tests verified this position to the satisfaction of the Army representatives, and construction of the three experimental models was ordered.

Wing Construction

The Boeing "117" wing is of web-type construction rather than the tubular spar construction of the Flying Fortress wing. A heavy extruded duralumin flange was selected for the web spar. Weighing 255 pounds when machined, this flange is said to be the largest extrusion ever used in a production aircraft.

The improved features of the Boeing "117" wings are: Decreased drag per pound of lift; increased thickness of the inter-spar area, permitting greater strength of the primary structure and greater volume in which to carry fuel; better stall warning and more gradual stalling characteristics. As finally developed, the wing has a span of 141.2ft. with an aspect ratio of 11.5. The high aspect ratio results in high wing efficiency because a lower percentage of air loss occurs at the wing tips, and so induced drag is kept low.

The trailing edge is approximately straight except for the portion between the inboard nacelles and the fuselage. The trailing edge of the flap in this portion hooks downward, decreasing aerodynamic interference between the wing and the body, and minimizing tail buffeting during climb.

The $4\frac{1}{2}$ -degree dihedral angle of the wing, the 7-degree sweep-back and the large vertical fin make the machine very stable, both in direction and in roll, suppressing any tendency to slip or skid. Any tendency to fall off on one wing during a stall is immediately converted into a bank and then into a glide, straight ahead, a desirable characteristic.

High wing loading requires large wing flap area to reduce the speed of landings and distance of take-offs. The Boeing flap achieves for the B-29 a landing speed the same as that of the Boeing B-17. To decrease the take-off distance and speed, the flaps are extended 25 degrees at take-off. The flaps roll back and down, increasing the wing area and the downwash angle of the air leaving the wing. When the flaps are extended the total wing area is increased 19 per cent.

The Controls

Although, as indicated above, the demand for aerodynamic cleanness was paramount in the development of the Boeing B-29, control and stability were given equal attention. When necessary, sacrifice in performance was made to achieve greater stability, resulting in an aircraft easy to fly and with no undesirable ground or flight characteristics. Control forces are even lighter than in the B-17. Problems of developing control surfaces that would give adequate control and maximum stability for a machine of this size were many. At first it was thought that hydraulic boost of the flight controls would be necessary. However, by continued study and by wind-tunnel tests, and by use of Boeing control tabs, control surfaces were developed that require no more control effort than those on much smaller machines. The result is a simpler, less expensive, less vulnerable and more easily maintained control system than would have been the case with a hydraulic "boost" system, and at the same time one which retains the important pilot "feel" of the controls. Operation of the rudder actually requires less effort than that of the Flying Fortress.

The newly developed ailerons not only are aerodynamically and statically balanced, but also have combination