Stratojets in the United Kingdom

AN IMPORTANT FEATURE of the training and mobility programme of Strategic Air Command, U.S.A.F., is the 90-day rotational tour of duty periodically undertaken by its many Bomb Wings at overseas bases in the Pacific, North Africa and the United Kingdom. The degree of significance attached to the operations from the U.K. is reflected in the construction by the U.S.A.F. of several new and extensive bomber bases, with concrete runways over 3,000 yards in length, and capable of handling the largest, fastest and heaviest bomber aircraft now in service.

Among these new strategic American bases on British soil are Greenham Common, Brize Norton, Upper Heyford and Fairford. The last-named, in Gloucestershire, has just received a full Wing of 45 Boeing B-47B Stratojet multi-engined medium bombers for three months' training. This unit, the 306th (Medium) Bomb Wing, commanded by Col. Michael McCoy, U.S.A.F., was the first American unit to receive the B-47, and its aircraft were the first Stratojets to touch down away from the American mainland.

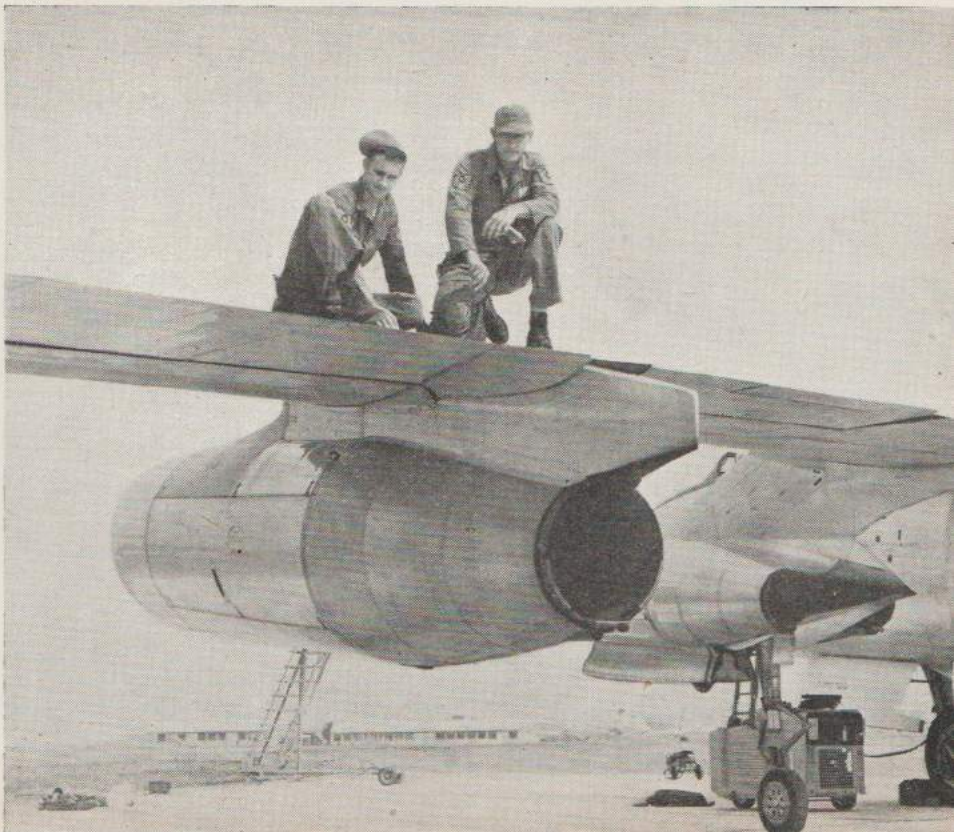
Parent base of the 306th Bomb Wing is McDill A.F.B., Tampa, Florida, where more of the 400 or so Stratojets now in service also equip the 305th Bomb Wing. Prior to the mass flight across the Atlantic, Col. McCoy led a "pathfinding" flight of two B-47s to Fairford, where they arrived on April 7, after flying 3,120 miles in 5 hr. 21 min., at 555 m.p.h. On June 2, the first 15 B-47s took off from McDill for Fairford, via Limestone, Maine, to be followed on two successive days by the remaining 30. The best speed achieved on the Limestone-Fairford non-stop leg was 575 m.p.h., during an elapsed time of 5 hr. 22 min.

Better speeds might have been recorded but for bad weather conditions over the U.K. which necessitated stacking and GCA landings. There were no worries about fuel, however. After the 3,120-mile leg, the B-47s still had sufficient fuel to divert to North Africa if necessary, and in any case, they were accompanied across by no fewer than 20 Boeing KC-97E aerial tankers which were available for flight refuelling.

The KC-97s, from the 306th Air Refuelling Squadron, are remaining in the U.K. for the training period, to work in co-operation with the B-47s, and are stationed at Mildenhall, Suffolk. They are equipped with the Boeing flying-boom system for aerial refuelling, to engage with an inlet in the upper part of the nose of the B-47. But in addition to refuelling gear, they also carry substantial loads of freight and equipment.

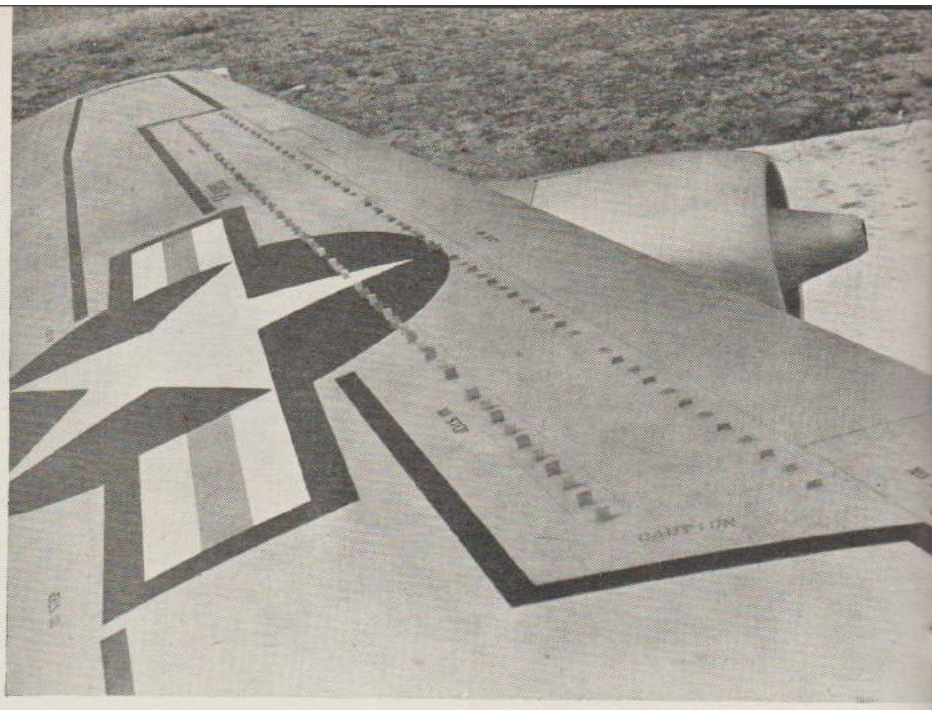
The refuelling tanks and equipment are quickly removable from the KC-97s, which are military versions of the well-known Stratocruiser, and in a matter of six hours, a tanker can be made available to carry personnel or military loads.

In the United States, the B-47 Wings form part of the 6th Air Division of the 2nd Air Force, but while in the U.K. they are administered by the 7th Air Division, S.A.C., commanded by Brig-Gen. J. C. Selser, U.S.A.F. The 306th Wing comprises three squadrons—the 367th, 368th and 369th Bomb Squadrons



"Aeroplane" photographs

Top, a B-47B from the 306th Bomb Wing takes-off at Fairford, Glos., on a training flight. Right, servicing the port outboard GE-J47A-23 jet engine of a B-47. The short tailpipes made possible by podded engines are apparent in this view, and the port outrigger undercarriage is also visible.



These fixed vertical tabs on the wings of the B-47 act as vortex generators and increase the lateral control and stability at high speeds as explained in the text.

—which began converting from B-29s in October, 1950.

Despite the fact that the B-47 is considerably heavier than the piston-engined B-29, it is operated by a crew of only three, compared with about 11 for the older aeroplane. The crew comprises a pilot, a co-pilot and an observer, but the many unusual features of this jet bomber demand rather unusual qualities from its personnel.

Thus, although the co-pilot has full dual control, and shares to a certain extent the normal flying duties of the pilot, he is also responsible for operating the only armament carried by the B-47—two remotely controlled 12.7-mm. machine-guns in the tail, sighted periscopically from the rear of the cockpit, the co-pilot having a swivel seat—as well as the HF radio, managing the fuel in air tanking, and making astro shots for navigation. The observer's duties involve navigation and bombing, both visual and by radar, and keeping the log and recording fixes.

At the present time, an experiment is being conducted with the use of five crews in the Wing, all of whom are not only pilots, but are checked-out aircraft commanders, the idea being that each crew member could undertake any of the others' duties if required. Although it is not very evident, there is a narrow walkway on the port side of the long tandem cockpit, leading down to the pressurized compartment in the nose, so that the various positions are interchangeable. In these select crews, both the pilot and co-pilot have also qualified as bomb-aimers, navigators and radar operators, and average about 3,000 hours' flying experience each.

Pilot trainees for B-47s are almost invariably volunteers who are selected on their experience from Strategic Air Command, M.A.T.S., or even Fighter Command, since in many ways the Stratojet handles more like a fighter than a bomber. All, so far, are veterans of World War II, but nevertheless about 18 months' conversion is required to produce a qualified B-47 pilot. Much of this time is taken up by the full-scale navigator's training course which is undergone by the pilots, where for nine months, navigation and visual and radar bombing is taught on the Douglas C-47, the new Convair T-29 and the North American B-25, for a total of 250 hours' flying.

Then follows what for the majority of the pilots is their first jet experience, when 35 hours' familiarization is given on the Lockheed T-33 fighter-trainer during a two months' course. The accent on this course is on jet instrument-flying and cruise control. After the T-33 course, the pilots move on to the B-47 ground school at Pinecastle A.F.B., and then to the Stratojet transition flight of Air Training Command for two to three months' conversion. In all, about 65 hours' flying is completed on the B-47 before crewing up takes place, and the personnel move on to the squadrons.

From the flying point of view, the B-47—despite its size and complexity—is quite straightforward. But the unusual bicycle undercarriage necessitates an equally unusual technique for ground handling—and the landing attitude is particularly critical. In passing, it may be mentioned that the undercarriage layout was an inevitable result of the podded engine and thin wing combination, which restricts the load and stowage capacity entirely to the fuselage.

The B-47 has two double-wheel main undercarriage units—similar, incidentally, to the main undercarriage of the Boeing B-50—mounted in tandem below the fuselage, the front unit being steerable for taxi-ing. A small outrigger leg extends from each inner engine pod and provides a degree of balance for the B-47, although a marked amount of roll can occur on the ground, and the ailerons must be used to keep laterally level at well below the normal take-off and landing speeds.

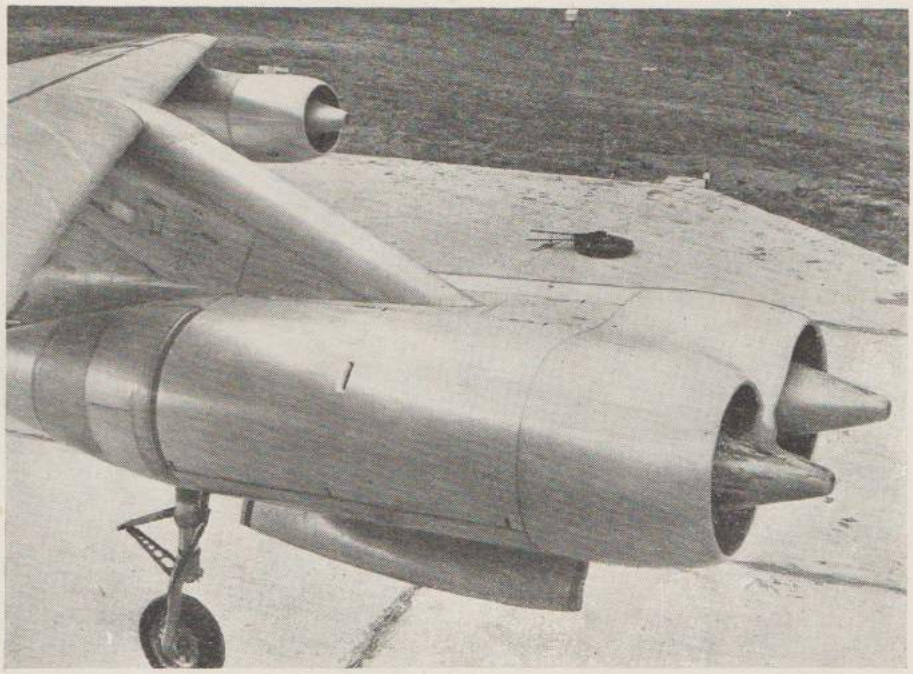
Because of the tandem layout, it is not possible to vary the B-47's ground angle, which is set at 8° incidence. Take-off, therefore, is simply a matter of neutral trim and elevator, the distance having been previously and precisely computed on the fuel state and gross weight. Landing, on the other hand, involves both precise flying and accurate mathematics, since it is vital that both sets of mainwheels touch down together, otherwise porpoising results, particularly if the front mainwheels touch down first, and the only remedy is to go round again.

To ensure touching down at the critical landing attitude, the approach speed is computed for every landing weight. On the glide path, the airspeed must be kept within the extraordinary margin of two knots from the computed airspeed. This naturally varies widely according to the touch-down weight of the B-47, which is at a normal maximum of 120,000 lb. for landing, but in general, the crews prefer to get the weight down to 106,000 lb. if possible. At the normal landing weight, the B-47 crosses the hedge at about 120 knots.

The runway at Fairford is 9,800 ft. in length, but this is considered just a little on the short side for the B-47, which requires a stopping distance after touch-down of 7,200 ft. with brakes. The wheel brakes on the B-47 are of the anti-skid type, with a sensing unit to release the braking effect whenever the wheels lock, for optimum stopping efficiency. In addition, apart from practice landings, which are always " rollers " or " touches-

" *Aeroplane* " *photographs*

Fuselage detail on the B-47, showing the forward-retracting mainwheels, the installation for the RATOG units, and forward of those, the bomb doors.



The co-pilot's view of the port inner and outer engine nacelles and their mountings. The outrigger undercarriage leg retracts forwards into the nacelle, which also houses a landing light.

and goes," a tail braking parachute is always used for the final landing to reduce the stopping distance.

The tail parachute is approximately 35 ft. in diameter, and is released from a small trapdoor on the underside of the tail, some time after the aircraft has touched down. In cross-wind conditions, it is necessary both to crab the B-47 and to hold the windward wing down, but once on the runway, it tends to straighten up itself and presents no real difficulty.

In view of the widely divergent design approach of the B-47 to our own "V"-bombers, it is of interest to note the virtues claimed by the Americans for the podded engine configuration, which is perpetuated in the B-47's successor, the 400,000-lb. B-52, and the Boeing jet transport prototype "Project X." The Boeing wing is really the governing consideration, being not only medium swept, but also of extremely thin section, making it impossible to mount the engines internally. Fuselage installation of the engines was considered and abandoned.

The suspended pod was thought to offer the advantages of simplicity of maintenance because the engines are completely accessible and near the ground, of improving the stall-warning and stall characteristics of the swept wing, stabilizing the wing torsion loads by extending the C.G. forward of the leading-edge, and obtaining maximum engine performance through direct ram effect and a short tailpipe.

In practice, most of the advantages of the podded engine seem to outweigh the disadvantages, and certainly the installation of the B-47's six GE J-47-A-23 turbo-jets is a popular feature with its crews, who regard it as a particularly safe airframe/engine combination. All fuel in the B-47, except when the enormous 1,780-U.S.-gallon external wing tanks are carried, is stowed in the fuselage, well away from the engines, greatly reducing the fire risk, while an engine fire cannot endanger the airframe structure.

Turbine failure is a hazard which is none the less serious for being occasional, and can have disastrous results on the highly-stressed structure of a jet aeroplane. In that respect, we heard from the Fairford Wing of a B-47 which suffered turbine failure in one of the inner engines, causing damage to its partner and severing the fuel lines to the outer engine on that side. With three engines out on one side, the B-47 was able to return to base safely at a weight of 146,000 lb.

Despite the distances of the engines from the aircraft centre-line, trim changes seem to be easily coped with by the power-operated controls, and the pods allow re-engining or power increases to be made with the minimum modification. The original B-47 used only 4,000 lb. of thrust from each of its J-35 engines, but the B-47B has been boosted by an increase of 1,200 lb. per engine, the only modifications being increased cowling length and a strengthened strut mounting. A substantial weight saving is also claimed over buried engine installations in the wing structure, which is uninterrupted by banjo spars or other complicated engine mountings.

Exposed engine pods naturally offer a considerable amount of drag, but by careful design, the Boeing company claim to have reduced the engine drag to 18% of the total drag figure, and effectively countered even that under certain conditions by increasing the wing span by 9%. Pods also offer fascinating possibilities in increasing power by simply adding more engines, as has been done with the Convair B-36, and the Chase Aviatruc glider which suddenly became a jet transport, but whether pods are suitable or not for sonic speeds remains to be seen.

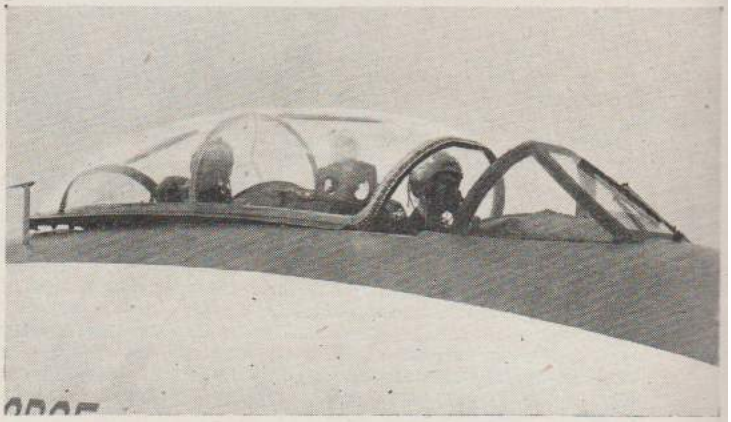
The flexing characteristics of the B-47 wing are by now well known, but it is perhaps not generally realized that the tips flex in flight as much as 5 ft. On the ground, the wings droop to a marked anhedral, but this disappears in flight. Apparently this flexibility results in a very smooth riding aircraft in turbulence, as most of the bumps are damped out by the wings and the fuselage remains largely unaffected. The flexibility is achieved by an extraordinarily thick wing skin, which is $\frac{5}{8}$-in. thick at the root, tapering to $\frac{3}{16}$-in. at the tip, and milled from 75S-T6 aluminium alloy.

A tough plastic covering protects the skin surface from damage and scratches during manufacture, to ensure minimum performance losses in subsequent flight. On the aircraft in service it is, therefore, a little odd to see on the upper surface

"Aeroplane" photographs

As this B-47 flashes by the camera at Fairford on its landing run, the tail trapdoor opens, and the braking parachute begins to deploy.

Left, Major L. E. Gunter, and Capts. R. R. Barto and A. T. Brent, of the 369th Sqn., enter their B-47. Note their helmets, visors and extra-bulky parachute packs. Right, this view of the B-47 shows the marked ground anhedral of the wing. The bulge beneath the cockpit houses radar gear, while in the extreme nose is an optical bomb sight. Below, pilot and co-pilot in their long cockpit, with the radio compass aerial in between.



of the wings two long rows of small aerofoil section blades, aligned chordwise, and stretching out transversely towards the tips. These blades are fixed in position, and serve as "vortex generators," to improve lateral control and stability at high angles of attack in the speed range around Mach 0.8 and 0.9.

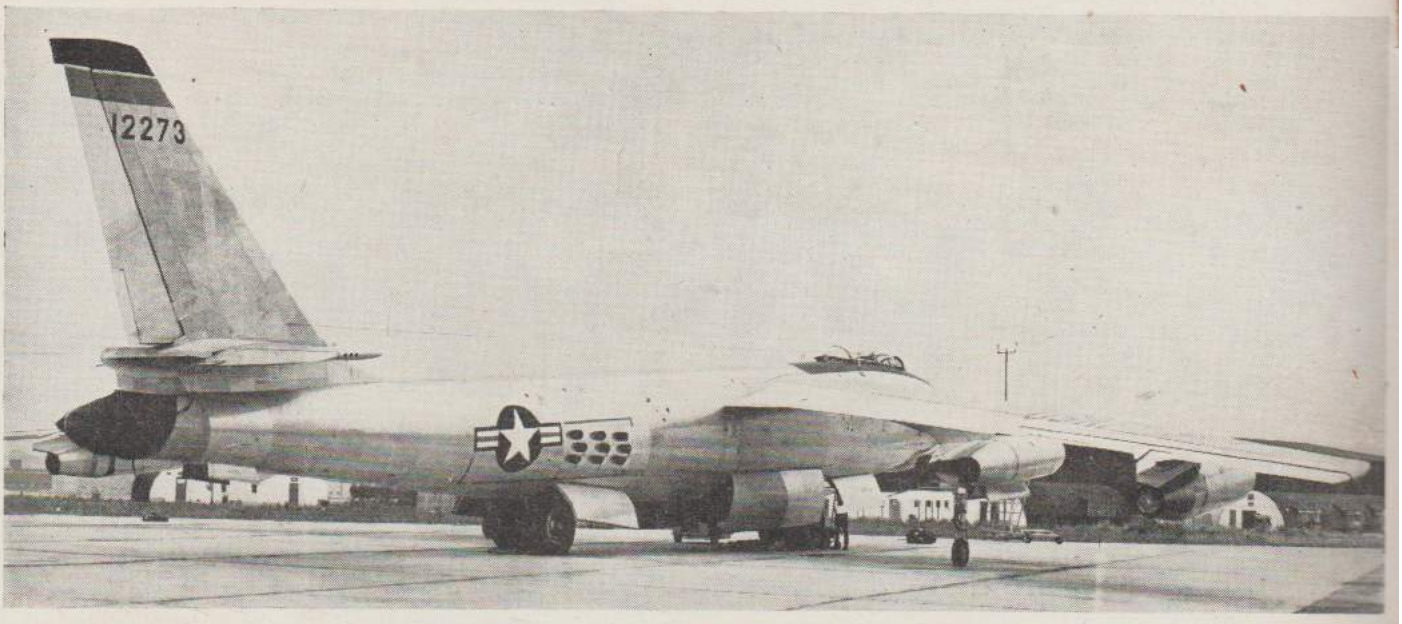
Swept-wings are prone to tip-stalling under those conditions, because of local shock waves on the upper surface between 30-40% chord, and the vortex generators, placed at 20-30% chord, are able to overcome the trouble by re-energizing the boundary layer through mixing it up with the free-stream air. This gives the boundary layer increased velocity and assists it to remain more stable behind the shock-wave area and hence less ready to separate from the surface behind the shock-wave.

A low-speed aid to lateral control and stability on the B-47 is provided in the outer section of the Fowler-type flaps, which "spill" or return to neutral, when the aileron is deflected upwards. Raising the flaps causes a pronounced sink at low airspeeds, and there is therefore an electrical link with the airspeed indicator which prevents the flaps from retracting to less than 22% of their travel below 195 knots.

The stalling characteristics are apparently perfectly straightforward, with ample warning, and no tendency to drop a wing. At Fairford, the B-47s are compelled to turn fairly sharply to port immediately after take-off, in one direction, at about 200 knots before establishing their initial climb of 4,000 ft./min., to avoid the circuit of a nearby R.A.F. flying training station.

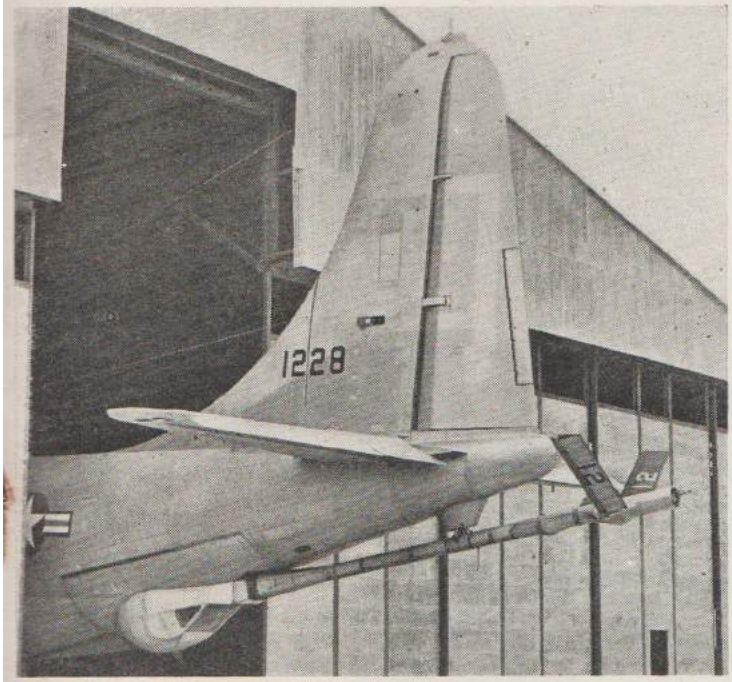
Normal gross weight of the B-47 is 175,000 lb., of which "more than 20,000 lb." is of bombs, but it is capable of operating at an overload weight of 185,000 lb. if required. For marginal runways at this weight, or under tropical conditions, RATOG is used, there being permanent provision on each side of the fuselage for the installation of 18 solid-fuel rockets, giving a total emergency thrust of 20,000 lb. This is not likely to be required in the U.K.

While in England, the 306th Bomb Wing is making the maximum use of all available training facilities, and is undertaking an intensive flying programme. Some of the B-47 missions are as long as 14 hours, although the average is about



6 hours, and the flight plans on a "local" training flight frequently take the multi-jet aircraft over North Africa. Celestial navigation, night flying and gunnery are also practised, about 1,200 rounds of 12.7 mm. ammunition usually being fired on the range.

Each squadron has three flights of five aircraft and crews, and one flight undertakes training schedules per day, the remainder attending ground school lectures. Personnel are flying about 50 hours per month, and finding that much of it is under instrument conditions in this country, but are quite happy with the behaviour of the aircraft. About once per week, exercises are undertaken jointly with the Wing's tankers, and practice refuellings made under all sorts of weather conditions.



Normal operating ceiling of the B-47 is above 40,000 ft., at which height it is naturally a difficult target, at about 600 m.p.h. The large hydraulically-actuated "bubble" canopy for the pilot and co-pilot is designed to withstand a large pressure differential, but unlike our Canberra crews, B-47 personnel are not provided with emergency pressure waistcoats. They do have, however, the standard "jet"-type B-4 parachute, which is 28 ft. in diameter instead of 24 ft., with quick-release attachments on the lift-webs to jettison the canopy on the ground. The 28-ft. diameter canopy gives a slower descent, but is considerably more bulky than the smaller type and partially accounts for the new U.S.A.F. standard crew weight of 250 lb., compared with 200 lb. for war-time crew members. The B-4 parachutes also incorporate a barometric release pre-set to 5,000 ft. Present service Stratojets, which are B-47B-46-BW series, are not fitted with ejection seats for any of the crew, but later production aircraft will have two for the pilot and co-pilot, and a ventral chute for the observer.

One last unusual feature in a rather unusual aircraft is that the B-47 has no air-brakes. Instead, for rapid descents from altitude, the undercarriage can be lowered, below a relatively high limiting speed, and provides sufficient drag to enable a substantial rate of descent to be achieved at a comfortable airspeed.

The B-47 is certainly a remarkable engineering achievement, particularly when it is realized that it is a war-time design, and that the prototype first flew in December, 1947. Its distinctive shape and six banners of black smoke are now a familiar sight in British skies, and both the R.A.F. and the U.S.A.F. are looking forward with interest to its participation in the forthcoming air exercises. In flight, its large size results in a deceptive impression of slow speed, but from the experience gained with the Canberra, we can be sure that at its operating altitude it will provide an elusive and worthy target, as well as providing invaluable practice, for the British air defence organization.—J.E.F.

Left, a rear view of the B-47. Right, a Boeing KC-97E of the 306th Air Refuelling Squadron, which is an integral part of the B-47 Wing, performing both tanker and freighter duties. Above, is a close-up of the refuelling boom and operator's position on the KC-97, showing the control surfaces with which the telescopic boom is guided into the nose socket of the B-47.

"Aeroplane" photographs