The Cockpit of
the Constellation

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AIR TRAINING CORPS GAZETTE

Vol. IV No. 10 OCTOBER 1944

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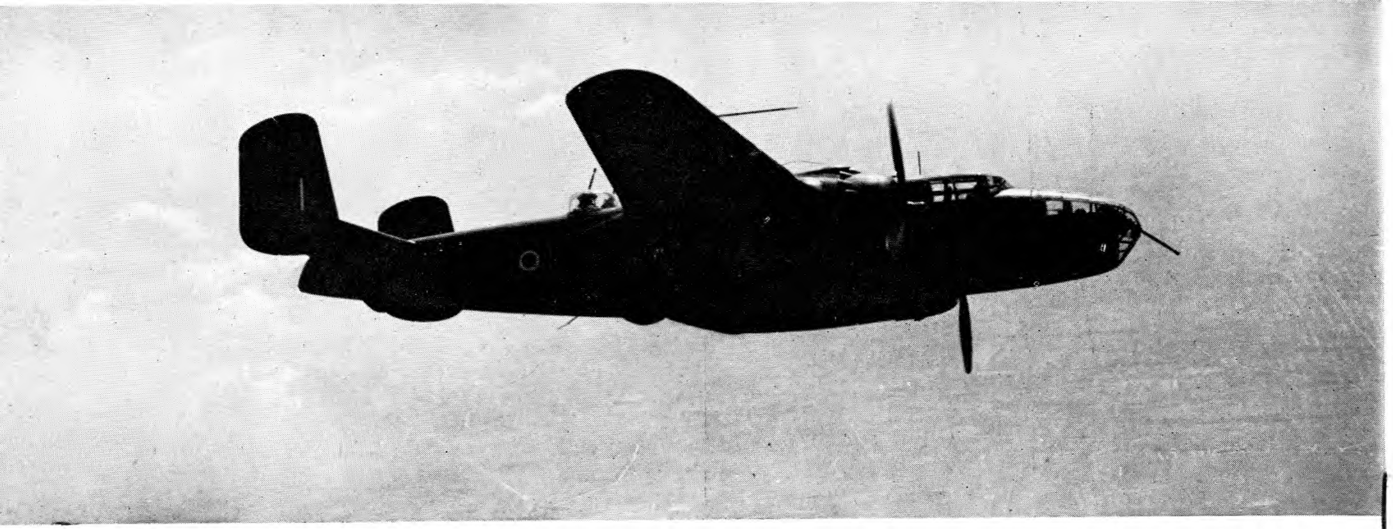

The Mitchell seen in the top picture is one of the older version extensively used in European operations. The gaping sharks' teeth belong to a South Pacific Mitchell, one of the many dishing it out to the Japs, armed with a handy 75-mm. cannon. These aircraft have been known to sink Jap ships with one burst.

AIR TRAINING CORPS GAZETTE

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What of the Future?

ON Sunday, September 10th, a service was held in Liverpool Cathedral to commemorate the establishment of the Air Training Corps. Between 800 and 1,000 officers and cadets of the Liverpool Wing attended, and the Chief Commandant addressed the congregation before the service. He spoke as follows:

"Let me remind you of Field Marshal Sir B. L. Montgomery's Order to the forces under his command after the successful landings on the beaches in Normandy. He asked them to thank, with him, Almighty God, for the victory which had been given us. We must be thankful, too, now for the victories which are being given to us everywhere in the different parts of the world in which we are fighting; and here especially in this Cathedral, at this A.T.C. service, let us give thanks. We must, however, not forget that with victory come responsibilities. It is my sincere conviction that God has given us the task of leading the world. I could offer myself no other explanation for the deliverances which He has afforded us out of the dark times through which we have passed in this war."

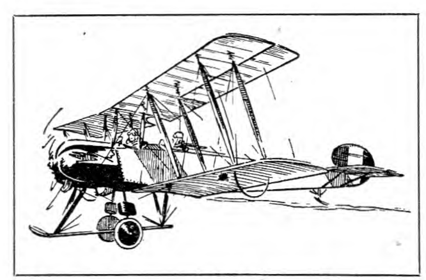
How does this affect us in the A.T.C.? Victory over the enemy air forces has been achieved, fortunately with fewer casualties than we had originally anticipated. Thus fewer from the A.T.C. will be wanted now to replace casualties; but do not think for a moment that your time spent with the A.T.C. in training has not been profitably employed. It has helped to build up your character to meet the demands of life in its many forms; it has also shown the world that you in the A.T.C. have given up your time to undertake training and be prepared to support the R.A.F. by joining her in her hour of need. For this the nation and the R.A.F. are truly grateful to you.

What of the future? As our contribution to the maintenance of world peace in the future we must have a strong, well-trained, well-equipped Royal Air Force. As you have supported the R.A.F. in time of war, it is your duty to continue that support in the not less difficult times of peace.

The Government have declared that it is their intention that the Air Training Corps should be kept on after the war as a separate entity under the Air Ministry, as part of the voluntary service of youth. You have had happy times in the A.T.C., you have made lots of good friendships that will last for life, you have become fit in mind and body, you have acquired knowledge that you never thought possible before you joined the A.T.C. and you have the knowledge that you have served your country well by making yourself fitted to join the R.A.F. You will have equally happy, if not happier and fuller, times in the A.T.C. in the future. The nation will continue to need you, not only as cadets prepared and ready to join the R.A.F., but as citizens with a lively and cheerful outlook and a determination that Britain in the near future must be second to none in the world in the air.

Therefore do not let the A.T.C. down by leaving it or staying away from parades. The nation continues to need you now, and will need you even more after the war. Stay in the A.T.C., then, and show your friends that you are proud to wear its uniform. They will, I feel sure, be as proud of you as you are proud of being members of this fine feature of our national life.

E. L. GOSSAGE, Air Marshal,
Chief Commandant and Director General, Air Training Corps.



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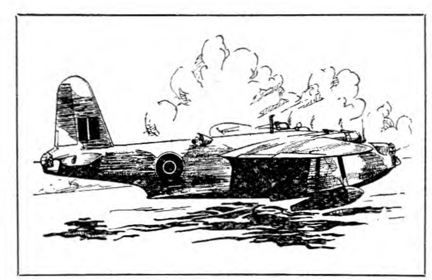

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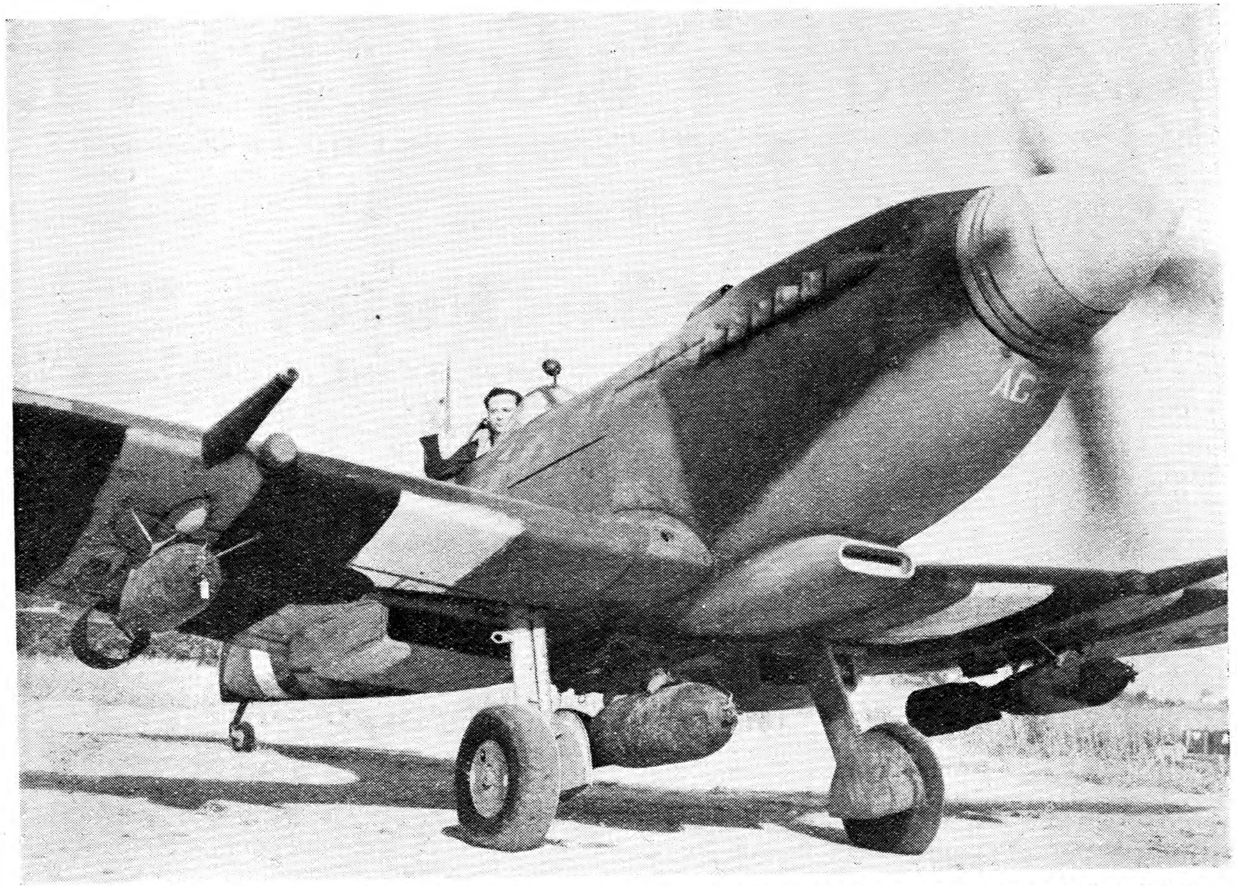


A Spitfire IX in Normandy carrying two 250-lb. bombs and one 500-lb. bomb. In the cockpit is Wing-Commander A. G. Page, D.F.C.

The Spit-Bomber

by

Flight-Lieut. M. H. Pocock

SINCE the beginning of the war, when Spitfires flew with eight Brownings, there have been added progressively cannons, long-range fuel tanks and bombs. At each new addition the pilot thought the aircraft would just "waffle into the air" on take-off and "drop like a stone on landing." But now, even with two 250-pounders, the Spit-Bomber is a very pleasant aircraft to fly.

They Fly Everywhere

The Spitfires on Malta were the first to operate with bombs against targets in Sicily. That was during Malta's hard days when every available aircraft had to be put to its fullest use. The Tactical Air Force in North Africa were the first to use them in support of the Army—Spitfire Vcs carrying one 250 pounder under each wing. During the final stages of that campaign they were responsible for much of the confusion behind German lines. Since then they have flown in Sicily, Italy, Burma, and now France.

Types of operation include normal fighter sweeps, strafing road convoys, bombing German aerodromes, shipping, tank concentrations and artillery positions.

Tactical Use

Advantages of the Spit-Bomber? Accurate bombing can be ensured with very little practice, they can fly without escort, their speed enables them to achieve surprise and withdraw quickly, they can often operate when the weather is too bad for the "heavies" (witness the first few weeks of the Normandy campaign), and with their cannons, machine-guns and bombs they carry almost as much destructive power as any other type of aircraft and weapons suitable for many different types of target.

I flew with a Spit-Bomber squadron in North Africa where we always used it as a dive-bomber (Spitfires are often used in low-level bombing attacks). An account of our raid on Protville Aerodrome, 10 miles north of Tunis, where Ju 52s had been reported ready to evacuate special troops and technicians, will illustrate our normal tactics.

The squadron flew out in two sixes, the second six being stepped up and back 500 feet and being responsible for seeing enemy fighters; each six flew in three pairs.

None Got Away

The target was pin-pointed from about 12,000 feet as we approached it from the west. The C.O. ordered "Echelon Starboard" and began a gentle turn to port to circle the target. It was just possible to pick out the airfield below (it was really nothing more than a landing strip and a few blast bays). Five Ju 52s were dispersed along the length of the landing strip. The C.O. immediately selected one, positioned himself vertically above it so that it was hidden under the wing, half-rolled and went down vertically using his gun-sight as a bomb-sight and released his bombs in the dive. We all followed, each pilot selecting a "52" and diving vertically on to it. I saw one of the "52s" receive a direct hit as I was on the way down and bombs were bursting all around the others. During the dive we left the black puffs of heavy flak above us and came down to 3,000 feet within range of the lighter stuff, so that the pull-out involved a sharp turn to evade the tracer that could be seen coming up.

As we looked around after the pull-out we could see the bomb-holes close to the other 52s, and almost certainly they were holed by shrapnel. But the C.O. wasn't satisfied and he decided to go in and machine-gun them.

As we commenced the shallow dive clusters of about 30 grey puffs began bursting near us from the 88-mm. guns below. We went down in three waves of four line-abreast and on the way down again I saw the C.O. get strikes on his Ju 52—a flame shooting out of the starboard engine. Little red flashes could be seen all over the other German aircraft where they were being hit by cannon-shells and bullets.

By the time we had finished our attacks and were across the aerodrome at "0" feet, three of the 52s could be seen on fire. The C.O. also saw a gun-pit that had received a direct hit from one of our bombs. We had the pleasure of visiting Protville later when it was being used by R.A.F. squadrons, and we saw the 52s. Not one of them got away.

Strafing Road Transport

Using the same tactics against road convoys we were able very often to surprise the Germans. They could never tell, as we were flying at about 12,000 feet, whether we carried bombs or not. They probably saw Spitfires five or six times a day and could not run for cover every time they saw a British fighter, and so they would drive on until the bombs began to fall. Then they would panic. They would jump from trucks still travelling fast and scramble on all fours into the ditch, the truck often turning into the ditch too.

Imagine the situation when a few hundred fighters are always over the battle area and all of them potential bomb-carriers. What is the enemy to do? If only 20 per cent. of our fighters carried bombs it would be enough to keep him on edge and cause him to make many needless dashes for cover, probably at last taking a chance and being bombed. It means that the enemy supplies take longer to reach him and that a lot of them never do. And the moral effect is terrific.

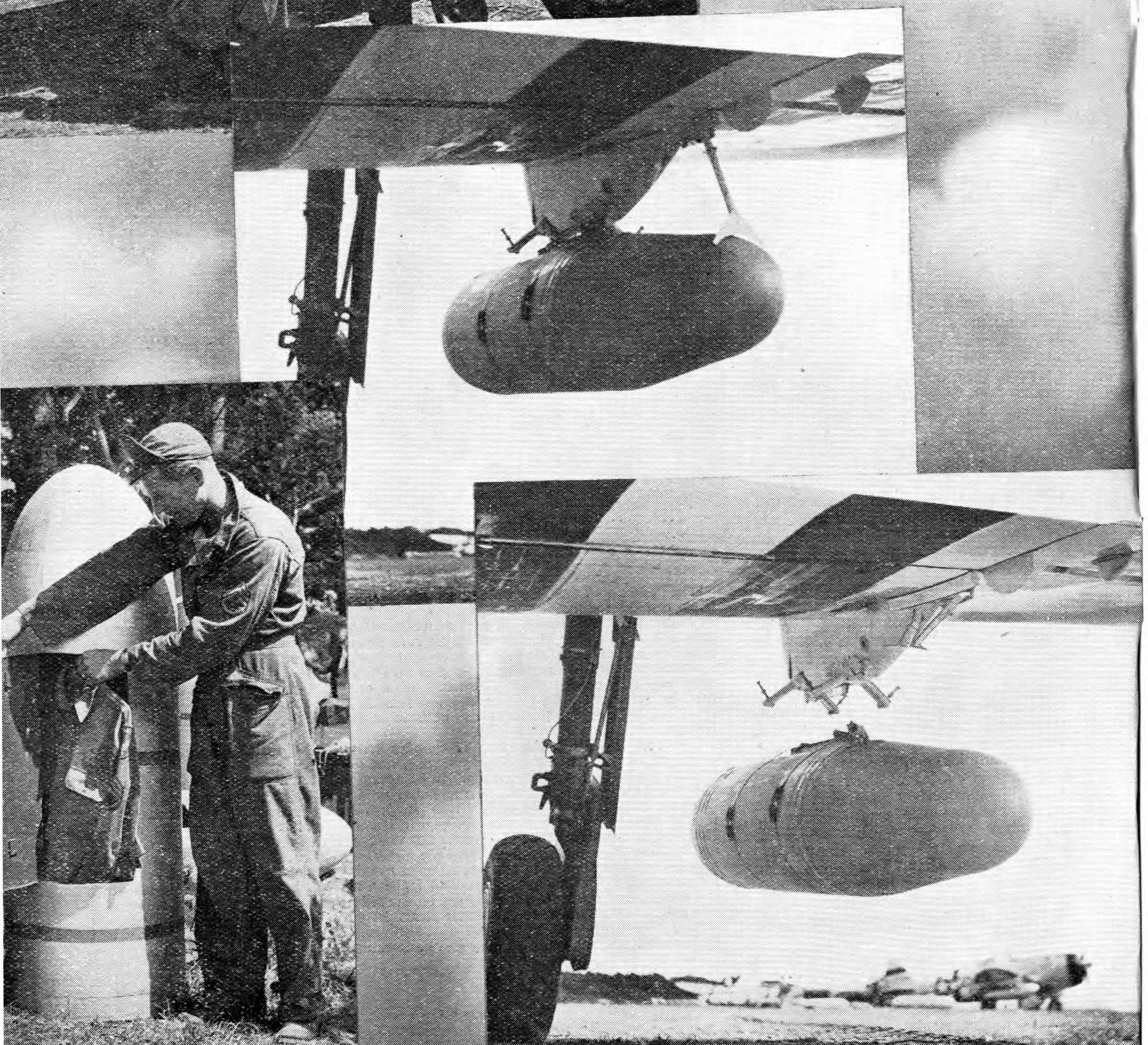
And the opposite moral effect on our pilots, who know that no show has been wasted when they have bombed, when they have seen results and know that they have helped our Army even if in a relatively small way, that fillip to their morale cannot be over-rated.

SPITFIRE XIV

The F. Mk. XIV Spitfire, which may be described as "the fastest Spitfire in service," has a new Griffon motor, the 65, with two-stage two-speed supercharger and intercooler, as on the Merlin 61 series. It uses a five-bladed propeller. It has been found that the propeller with an odd number of blades runs smoother than one with an even number, as no two blades are in line with the wing at the same moment.

Excellent performance is maintained at all altitudes, from sea level to 40,000 ft. The armament may consist of four 20-mm. cannon or two 20-mm. cannon and two .5-inch machine guns. or two 20-mm. cannon and four .303 machine guns. A bomb-carrier for either a 250-lb. or 500-lb. bomb can be fixed underneath the fuselage in the drop tank fittings.

The Griffon 65 has the same 12-cylinder arrangement and dimensions as the 'R' type Rolls-Royce Schneider Trophy engine, and develops over 2,000 h.p. The weight/power ratio is less than 1 lb. per h.p. An important achievement is that the very adequate and well-balanced proportions of the power-producing units have been provided in a compact, accessible engine of relatively small overall dimensions. This feature is of fundamental importance in the design of fighter aircraft, and furthers the original Rolls-Royce adoption of the 12-cylinder 60° Vee type liquid-cooled engine. The camshaft and ignition drives are arranged from the airscrew wheel at the front of the crankshaft to provide a smooth drive and to reduce the length of the engine. Dual ignition in one magneto unit achieves a clean layout of ignition wiring. Electric or cartridge starting is optional, and the starter is mounted on the reduction gear casing, with a robust and efficient transmission to the reduction gear. A drive for remote gearbox for aircraft service units is provided at the rear of the engine. Interconnected engine, airscrew and ignition controls are fitted for easy and uniform operation.



LONG RANGE TANKS

Fitting and dropping the Thunderbolt's 108-gallon long-range tanks. They can be used for a variety of other purposes as indicated in the photograph on the left.

Flying through an Electrical Storm

by W. J. Roberts

A freak electrical storm can be a most terrifying experience, as will be seen from this account of such an occurrence in the vicinity of a West-Country airport when the writer was test-flying in a rebuilt twin-engined trainer.

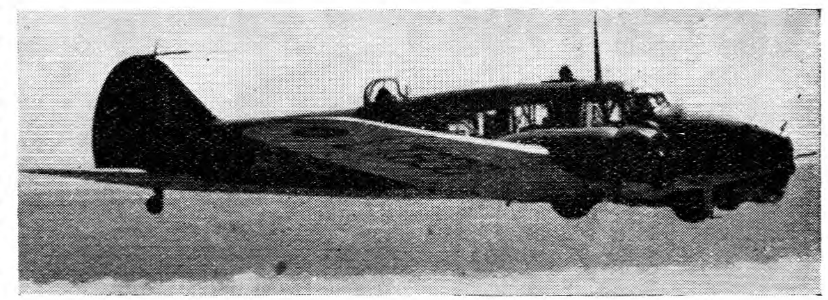
THE day was December 24th, 1941, Christmas Eve, and the machine, an Avro-Anson, which had been giving trouble due to faulty boost controls. A replacement boost unit had been fitted and it was decided that there would just be sufficient time to carry out an hour's test trip before dusk; the writer, as technical representative of the production staff, decided to accompany the test pilot and make a personal check-up. Incidentally the firm was holding a Christmas party in the airport mess that evening.

During the day the weather had been dull with sunny intervals, the sky had been clear with cirro-stratus clouds and later alto-stratus, but no signs of a bad patch were apparent and the met. report did not indicate anything which would deter us from a normal test flight. Accordingly, at about 15.45 we floated off the grass and headed north towards the Bristol Channel.

It appeared that the boost trouble had been cured, for both engines droned steadily and the rev. counters indicated correct speed for the throttle and boost lever positions. We climbed hard to about 6,000 feet and as the steady half-pound boost indicated all was well, we settled back to enjoy a quiet circular tour over the Bristol Channel and the quiet West-Country landscape which drifted lazily backwards below us. We had turned slowly through a wide circle and were heading inland about 15 miles from our landing field, I was gazing idly out of the starboard window, watching the smoke from a train, when I felt the pilot tap my arm.

He shouted something (there is no intercomm. and no R/T on a machine which is in for repair), and I saw his finger pointing to our P6 compass. It was gyrating wildly; as I watched, the altimeter also started to run wild. The hand oscillated back and forth rapidly and, almost at once, we sensed something strange and "heavy" about the whole machine. This feeling had barely become apparent when our real troubles started. The port wing rose almost to the vertical and sank as quickly, then the tail. Two bags of ballast we carried at the rear of the cabin slid forward. The nose rose, almost to the stalling angle, and fell as quickly. Clambering up the pitching cabin, holding on to any support available, I managed to drag the ballast bags back into place. As I clawed my way forward again I looked out of the port side; the whole wing tip was bathed in an intense glow, similar to the light of a blue neon tube. This light appeared to run back and forth along the leading edge and the wing-tip bend. For the first time I fully realised the reasons for the scrupulous care taken to ensure electrical continuity throughout the machine by "bonding."

By the time I had reached my seat again the whole aircraft was bucking and pitching in an alarming manner. The pilot was fighting the stick and rudder madly in a frantic endeavour to hold her in some sort of control. I tried to see what was happening outside; we appeared to be stationary over the same spot of ground, but with the motion it was impossible to see properly. Another surprising feature was the fact that small fat sparks kept



The Avro Anson.

crackling and jumping from the various odd metal fittings fixed to the wooden sections of the cabin floor and the main spar which passed through the cabin. I was fascinated by these, in spite of the risk of fire, which we were helpless to prevent.

My pilot was a veteran civil-airline man with many hundreds of flying hours in his log book and I marvelled at the way he played the controls against the effects of the disturbed air. After what seemed to be an hour, but must have been actually only a couple of minutes, I could see he had abandoned hope, for, holding the stick with one hand, he reached for the 'chute pack in its stowage beside his seat, motioning me to follow suit.

Clipping up my pack to its hooks on my harness I started off down the cabin again towards the door at the rear of the starboard corner. Holding on to the door strap I took a last look forward, the pilot was preparing to leave the cockpit. Almost 4,000 feet below I saw the same smoke and the same train; it could not have been more than three or four minutes since I first saw it. The thoughts raced through my mind; it was a long way down; I'd never done this before; I might become charged with static electricity and be burned up as I touched the earth; fantastic thoughts, one does not stop to reason at moments like this.

As I hesitated I suddenly realised that the pitching had ceased, the blue haze round the wing-tip had disappeared, the Anson was on an even keel and was droning steadily on. The pilot slid back into his seat; I crawled forward up the cabin again. Back in my seat I looked across at my pilot; his face was sickly white, I felt my own stomach protesting and realised that reaction had set in. I am not ashamed, I was very sick for the first time in many hours of flying.

We turned slowly and in the distance behind us we could see a distinct dark patch in the still air; we had run right through it. We drifted in, I wound down the undercart, pumped down the flaps, we lost speed and sank slowly, the road rushed below, the hedge, then the grass, we bumped, bumped again and rolled up to the apron in front of the hangar. A small group of men met us, we climbed slowly down and the ground felt unsteady, I sat on a wheel chock. They told us that as we touched down large sparks jumped from our undercarriage legs to earth; I could quite believe it.

Back in the test pilot's office a few minutes later we had subsided into two chairs and were discussing the phenomena. The 'phone bell trilled out, he picked it up, a minute later he replaced it and turned to me. "They want to know if we are going to the party, the electrician has rigged up the mess with coloured lights, and the tea is being served up." I smiled grimly, the thought of eating made me shudder, and coloured lights—well, I'd seen enough to last for an average lifetime in the last hour. *Coloured lights* . . . I ask you!

Ground staff rearming a Spitfire just returned from a fighter sweep. Immediately after landing, the machine is examined for damage, serviced and made ready again for instant take-off.

KEEPING THEM Going

by 'STRINGBAG'

I WAS at a naval air station the other day talking to the man who is known as Commander "E." It is he who is responsible for producing up to nearly 100 serviceable aircraft at any given moment for the use of the squadrons and their multifarious duties at that aerodrome. It is he who (if it were ordered) could line up wing tip to wing tip a row of fighters 1,000 yards long, with their engines ticking over, their guns loaded, wireless working and everything else on the top line, and repeat this day after day, and between each day carry out a minimum of 10,000 group inspections. It is he, in fact, who is the titular head of a central maintenance system which shells out aircraft about as fast as a housewife shelling peas. I asked him how he did it, and the answer was a set of facts and figures which ought to interest every pilot. They give a picture of big business and inspire new and wholesome respect for the tribe of men who labour under the name of "plumbers."

Two WAAFS work on the Merlin engine of a Spitfire as part of their fitters' (engines) course with Technical Training Command.

155 Inspections a Day

The best way of approaching this "big business" is to look first of all at a single aeroplane and see what it needs to keep it in order. I have taken a Seafire for my example, for there are many of them at this particular station, and the figures were handy. If, of course, I had been at a bomber station with four-engined aircraft the figures would have been more impressive, but the following are perhaps good enough to be going on with.

First of all one comes up against the figure 155, which is the number of inspections to be made each day before a Seafire is allowed to fly. They are divided between five men in the following proportions:

47 airframe group inspections (rigger's job);
46 engine group inspections (fitter's job);
30 instrument and electric inspections (electrician's job);
13 radio inspections (radio mechanic's job);
19 armament group inspections (armourer's job).

If each of these 155 items is on the top line Form 700 may be produced and signed up in its appropriate columns, thereby officially rendering the aircraft "serviceable."

Now, all this is very trifling. It is the bread-and-butter business done by the "branch shops" out at the dispersal points. The branches are officially called "servicing units," and from the pilot's point of view they are staffed by the "chaps" who wave the "seven hundred" at you to sign in the morning. They are also the chaps who refuel the aircraft when you bring it down, and take your complaints about it, and generally present themselves as targets for your disapproval or approbation. For every 16 Seafires out there one can usually find 16 riggers and fitters and a couple of petty officers, to say nothing of electricians and armourers, most of them sweating more than somewhat.

How Repairs are Organised

Back at "head office," or, to be correct, at the maintenance unit headquarters, there is an aurora of civilisation, with hangars and workshops and offices. The Seafire which we have been talking about is towed down there by a tractor at frequent intervals in its flying life, where it is figuratively and literally leapt upon by five men, who put in 120 man-hours on the aircraft in three days, and in total sum make more than 1,000 individual inspections. It is only then released for another period of flying. (I have not, of course, included such trifles as compass swinging and gun alignment in this inspection.)

Major Inspection

Now, even this is a bagatelle to Commander "E' 'and his men. It is when things go wrong, and the 120 hours' work is stretched to 150 hours for a dozen or more aircraft all at once that the pinch is felt, or when 20 or 30 Seafires come in for an inspection all on the same day. And then one has to remember that the life of a fighter engine is only 240 hours, so that every now and then an inspection means a complete engine change, while the old engine goes back to the makers for renovating. Finally, there comes a time for the biggest inspection of all, which is a "major," and entails pulling everything apart, including the airframe, in a big way.

After this one is inclined to the opinion that things like aeroplanes are "hardly worth the bother." It would seem that they are very frail things, the heirs to more diseases than a newborn babe. Yet it may be remembered that in a few hours a Seafire may cover many thousands of miles, and that one would probably give a humble motor-car equal attention once in only 2,000 miles. Then, if 240 hours seems a short life for an engine, it is (on a mileage basis) better than that of the average car. It may not be a fair comparison, but then a motor-car and a service fighter are hardly the same thing. There are about 10,000 more vulnerable parts in the aeroplane. What is more, it is a good thing to remember that the strain on the working parts of the modern aircraft are greater than ever they have been before, and that the strain for this particular type, since it started out its life as the prototype Spitfire, has increased commensurate with the following published facts:

(*a*)	Power increase from basically the same engine	100 per cent
(*b*)	Speed increase	35 per cent
(*c*)	Weight increase	40 per cent
(*d*)	Climb increase	80 per cent

In other words, the safety factors are smaller and the need for careful inspection proportionately greater.

Long Life

In theory, at least, the increased strains should have cut the life of a fighter aircraft in half. In practice, of course, the accident rate under Service conditions is all against aeroplanes reaching a ripe old age. At a guess, I should imagine that the life of a Service type is round about 150 hours under school conditions, and perhaps 100 hours under operational conditions. Major overhauls in the ordinary course of business are, therefore, not as common as they would be in a more perfect world. In extenuation of this crashery rate it should, of course, be understood that the aircraft are not write-offs. They are damaged to the extent of being withdrawn for an appreciable period from the general pool of day-to-day serviceable machines.

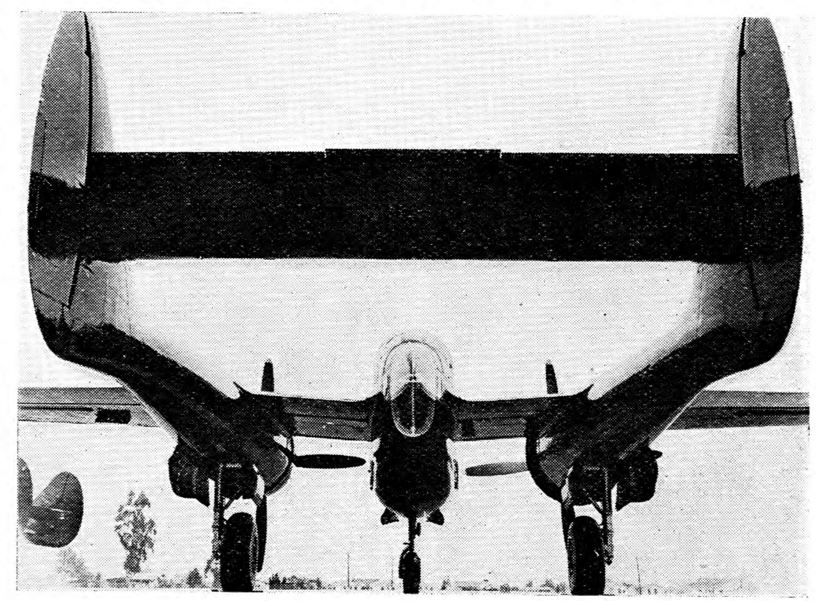
Daily Output

Lastly, let us look at the "plumber's" problem when he has definite commitment to fulfil. Supposing he has a total of 100 aircraft on his books. How many ought he to be able to supply daily to, say, the pupils of a fighter school? Well, in the first place, he will give thanks for an average quota of non-flying weather, and will begin to work out his programme on something like a 24-day month. On this basis he will probably find that he can put into the air each day about 45 aircraft, but being a wise man he probably restricts his offering to the fighter school to round about 38 aircraft, reserving the extra machines for spares in the event of last-minute troubles.

Now, of the 55 aircraft remaining on the ground, there would probably be 15 undergoing minor inspections and perhaps 7 on majors. This leaves 33 in various other states of unserviceability. In practice, probably 20 of them could be got into the air after a straightforward daily inspection. The last 13 would be in the repair shops, some because the young gentlemen had forgotten to lower their undercarriages when landing, others because of some mechanical defect, and a few, let it be admitted, just awaiting spares that mysteriously fail to arrive.

Yes—there is more in the plumber's job than meets the eye. This has often been said before, but it is not at all a bad thing to say it again—and again.

Incorporating the experience and information gathered by the R.A.F. in night-fighting technique, the Northrop P-61 Black Widow is claimed to be the first night-fighter to be designed as such. It is now flying operationally with the U.S.A.A.F. Equipment includes full wireless and night-flying devices, with heavy offensive armament.



AIR CHIEF MARSHAL SIR FREDERICK BOWHILL
G.B.E., K.C.B., C.M.G., D.S.O.
on TRANSPORT COMMAND

TRANSPORT Command is the logical development of many services that have long been rendered by the Royal Air Force.

For some time there have been Transport squadrons, which did magnificent work in the Near and Far East, in the Battle of France, and in the evacuation of our forces when France was overrun; they did equally magnificent work in carrying supplies to Malta during its siege.

When the Battle of the Atlantic was at its height the Canadian Pacific Railway, ATFERO (Atlantic Ferry Organisation) and later Ferry Command, delivered to the United Kingdom aircraft that had been built in the United States. Subsequently, to co-ordinate all these services, and to inaugurate new services, Transport Command was formed in 1943, the late Ferry Command forming part of the larger organisation as a group.

Today Transport Command has grown into a great undertaking, with regular services that stretch from North America to beyond India. Aircraft are being delivered from the United Kingdom and from North and South America to all operational theatres. Ferrying and freight services cover more than a hundred thousand miles.

The Atlantic

Flying the Atlantic today appears to be only a matter of routine, but we must not lose sight of the fact that every flight undertaken is an individual problem to the crews, as it necessitates, on every occasion, careful study of the flight plan, having regard to the different weather conditions to be met.

In conjunction with the British Overseas Airways Corporation many thousands of Atlantic crossings have been made. There is no rivalry or competition between Transport Command and B.O.A.C.; the magnificent work the Corporation has done in all theatres of operations is perhaps not fully realised. Its members have shared war risks with personnel of the R.A.F., and they have carried out their duties in a highly efficient manner.

Another organisation which is playing a great part in ferrying aircraft in this country is the Air Transport Auxiliary, whose pilots ferry to Transport Command stations most of the aircraft which have been ferried by Transport Command from America. These men and women pilots fly any type of aircraft; they may arrive in a Spitfire or Hurricane and depart in a four-engined bomber. Their ability is outstanding, and their success is largely due to the careful organisation and example set by Commodore d'Erlanger and Commandant Pauline Gower.

Transport Command aircraft fly roughly a million miles a month over the Atlantic, and total three million miles a month on scheduled services and ferrying. This does not include special flights.

Strategic routes now cover nearly all the Mediterranean area, cross Egypt, Palestine, Iraq and the Persian Gulf and form a network in India. They traverse Africa from the west coast to Cairo, and thence on to Calcutta. More routes are envisaged, for as the war develops in the East Transport Command will have much to do.

Operational Work

Transport Command is an operational command, and has fully earned its status. During the campaigns in the Middle East and Italy, as well as in India, its aircraft have been flown up to the front line, with urgent stores, key personnel, ammunition and medical supplies. Over 30,000 casualties have been evacuated from operational areas to base hospitals.

On the Burma front Transport Command squadrons delivered food, ammunition and stores to the "boxed in" divisions and evacuated casualties on the homeward journey. They also supplied forward units with all their needs, including even 25-pounder guns.

On the beachheads in Italy they flew in under our own barrage to deliver their cargoes.

Since operations in France began, in addition to maintaining all the regular trunk services according to schedule, Transport Command has flown in supplies to all fronts.

In Burma the group of Transport Command responsible has operated the supply service to forward troops and evacuated casualties on the homeward journey. The same is happening in Italy, and now in France.

The Invasion

Prior to invasion the aircraft of a Transport Command Group based in the United Kingdom dropped leaflets in the area chosen for attack, and just before the invasion began carried some thousands of paratroops and glider-borne troops to their objectives in the Caen area. Stores needed for their immediate needs were dropped at the same time, including jeeps, trailers, handcarts, bicycles and motor-cycles, six-pounder guns, medical supplies and ammunition.

Aircraft of the group also dropped a large number of anti-personnel bombs on the night of the invasion.

After the first attacking force had been delivered Transport Command aircraft continued with air supply and maintenance, transferring to Normandy the personnel and kit of several R.A.F. Wings, which meant a lift of some 2,000 people.

Equipment and supplies delivered included a large number of 500-lb. bombs, more jeeps, wireless equipment, propellers and spare parts, mines and high explosives. Medical stores included consignments of penicillin, blood plasma, whole blood and ether. As much as a ton of blood plasma has been carried in one day.

On the return journey, as soon as a landing-strip has been completed, Transport Command commenced the air evacuation of casualties. In one day Transport Command aircraft have brought home nearly 700 people.

The first aircraft to land and take off from a prepared landing-strip in Normandy was a Transport Command Hurricane on Air Despatch Letter Service.

Highly Trained Personnel

These activities, coupled with the transportation of very important personages and the vast amount of freight that is regularly carried by air, requires a close organisation throughout the Command, and that organisation demands keen and highly trained personnel. We have such people, and we shall have more, for Transport Command will expand still further as the days go by, requiring increases in crews, maintenance personnel, etc.

In the future, both before and after the end of the war, Transport Command will be able to offer great assistance to all the fighting services and civil departments. It exists to serve all: the Navy, the Army, the Royal Air Force and all branches of the Government. It carries vital stores which could not be delivered in time by surface transport, it speeds communications, and, just as the Royal Air Force has added a new dimension to operations, so Transport Command introduces a new factor in organisation.

The people who make up the Command have come from many sources. Some of our older pilots—for they are not all young men by any means—were famous in civil aviation, and without them in the early days we should have been badly handicapped. Other pilots, navigators, wireless operators, mechanics and ground crews have come from other operational Commands. They are scattered throughout the world, from the ice-bound shores of Canada in winter to the blazing heat of desert stations and airfield strips cut out of the jungle.

The pilots, navigators and wireless operators have all received additional training in Transport Command methods. They came to the Command already highly skilled in their work, but they pass through new courses of training which, added to their existing knowledge, makes them experts in their own branches and good all-round airmen. They have gained in addition a wide knowledge of the world, for they may be flying on trunk routes one day, and shortly afterwards be rushing urgent stores and supplies to a newly opened front. They have acquired a new airmanship, learning to avoid danger, yet accepting all that comes when the job has to be done. Their service differs in many respects from, say, that of a Bomber or Coastal pilot, who may be flying similar aircraft. Like the masters of ships, they understand the loading of aircraft, the formalities to be gone through in various countries, the care and treatment of passengers, and many other things that do not enter into normal operational activities.

With our own people fly representatives of almost every Allied nation; the United States, the Dominions and the Colonies, France, Belgium, Holland, Poland, Czechoslovakia and Norway all working together in perfect harmony, doing an essential job of work in war-time and preparing for as essential a service when peace comes.

By orders of the President of the United States, the U.S. Air Transport Command deliver aircraft from the factories in the U.S.A. to various airfields under the control of Transport Command, and also deliver flying-boats to their own base at Elizabeth City. Their help in this respect has been invaluable.

Transport Command's Future

Transport Command must remain for the sake of the fighting services, but it will, I am sure, also play a part in the development of aviation in the years to come. It will explore and plan new routes, shorten our lines of communication, and also help to pave the way for better future understanding between nations. There is a great future for Transport Command, and a great future in it for the right type of people.

The single-fin transport version of the Liberator. The lady in the foreground is Queen Wilhelmina of Holland.

Metal Aircraft CONSTRUCTION

by C. A. H. Pollitt

A Review of Modern Practice: Some Typical Methods of Construction

TWO of the first all-metal aircraft to go into large-scale production in this country were the Bristol Mk. I Blenheim and the Fairey Battle. Both were outstanding aircraft of their day, and were characterised by unique features of design that contributed in no small way to the ease and facility with which they lent themselves to quantity production.

The fundamental principle of construction of these machines has now become the generally accepted method for all types of modern front-line air-

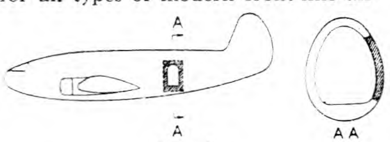


Fig. 1

craft, from heavy four-engined bombers at one end of the scale to single-engined, single-seat fighters at the other. The advantages are threefold, and result in a very roomy interior of the fuselage, due to the absence of bracing-wires, etc. Also, the need to periodically re-align, or rig, the fuselage is entirely eliminated, and, being of stressed-skin construction, the fuselage is at once easily rendered suitable for high-altitude flying in the sub-stratosphere.

What is Monocoque?

Monocoque is a term loosely applied to metal fuselage shells, although strictly speaking the term is only applicable to such shells when they are devoid of any reinforcement whatsoever. The conventional metal fuselage is, in fact, a semi-monocoque, and comprises a metal skin attached to transverse formers and reinforced longitudinal stringers. By this means, and depending on the size and type of aircraft, the average area of unsupported skin is approximately no more than nine or ten inches square.

Apertures necessitated by entrance doors and hatches have, of course, to be suitably reinforced, and common practice is to incorporate an inner skin immediately adjacent to the opening, as shown in Fig. 1.

Hinged or Detachable Panels?

To facilitate maintenance and servicing, many parts of the fuselage skin are made detachable, either in the form of loose panels or as small hinged doors. Their purpose is to give access to control cables and pulleys and to any equipment contained within the fuselage requiring frequent inspection. However, there are so few perfectly flat surfaces on the majority of aircraft that, due to the difficulty of arranging a hinge on a curved surface, the hinged type of inspection door is not so common as the detachable type, and for anything over the size of four or five inches square detachable panelling is preferable.

There are all manner of means for reinforcing panelling or cowling skin, and Fig. 2 shows a few of the many different sections used for stiffeners. These can be either riveted or welded to a panel, and are manufactured to standard sizes from 20 S.W.G. and 22 S.W.G. sheet steel and dural. Sections A and C would be suitable for reinforcing the edges of a detachable panel, while sections B, D, E, F and G would be used for longitudinal stiffening.

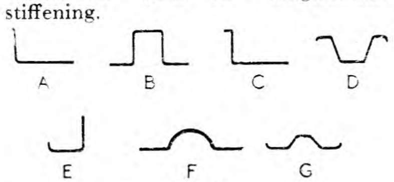


Fig. 2

From Fig. 3 an impression can be gained of the effectiveness of this arrangement. It will be observed that although rigidity is ensured in every direction, an approximately flat surface is preserved along all four edges, thus allowing the panel to bed down firmly on the frame surrounding the aperture.

On Welding

Within recent years great strides have been made in the application of welding to aircraft structures, and in some places welding now takes the place of riveting.

There are four methods of welding, of which oxy-acetylene is perhaps the most commonly known. This method is particularly suited to the welding of light sheet metals, though for materials of more than three-sixteenths of an inch thickness there is some difficulty in getting the necessary penetration, and it becomes more of a craftsman's process.

For the heavier gauges of material, metallic arc welding is preferable, and is actually considerably faster than gas welding. An American aircraft firm recently claimed a fifty-per-cent saving in time on welding up an engine mounting by the metallic arc process.

With parts that are not highly stressed, spot welding is becoming increasingly popular, and has been used extensively on the Lockheed Lightning for attaching edge stiffeners to detachable cowling panels. This method is really a form of intermittent welding, inasmuch as there is no continuous line of weld as with the other methods; instead, the weld is made by placing the materials concerned between two electrodes, thus fusing the metals at one point. The strength of a spot weld is approximately equal to that of a similar size rivet.

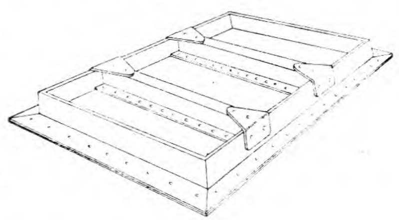
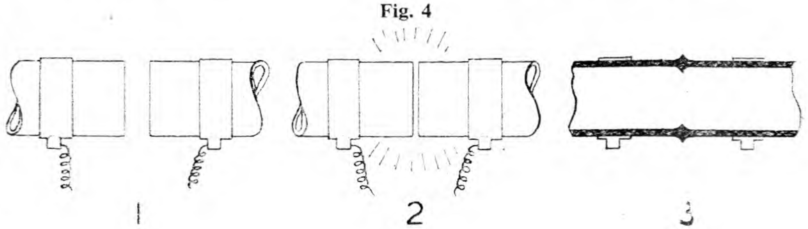


Fig. 3

Flash Welding

By far the most recent development is flash welding. This is an entirely automatic process, and has the best mechanical properties of any welded joint. Fig. 4 is a diagrammatic illustration of the flash welding of two circular tubes of similar size and materials. The tubes are placed in the flash-welding machine and their ends brought close together; an electric current inducted through the two grips fixed to the tubes creates a short-circuit across the small gap between them, which in turn produces a molten film on the surfaces to be joined. When these surfaces are finally brought together under pressure, a joint is produced that is to all intents and purposes analogous with a welded joint.

Fig. 4



LEAFLETS from HEAVEN

Key on page 24

Flying in INDIA

TO one accustomed to flying in the British Isles, India comes as rather a shock; its vastness, its climatic conditions, its comparative scarcity of navigational aids, all tend to induce in the newcomer the realisation that it is mainly by his own efforts that a flight from one place to another can be successfully completed. There are certain aids, but they are mainly reserved for the operational areas. Pilots must therefore get to know all about such aids that are available and use them intelligently.

Airfields in India are good. A large construction programme was commenced when Japan came into the war. Today there are many airfields dotted about the country, but in most cases they are great distances apart, and therefore no liberties can be taken with navigation or engine handling. The first requisite of the would-be navigator is to be an absolutely efficient map-reader. Landmarks are few and far between, but for this very reason they are easy to identify when found. But one has to be careful of rivers which are shown on the maps heavily marked in blue, because during the dry season they often dry up. They can, however, still be fairly easily identified by their beds. During the monsoon the opposite happens. Rivers frequently overrun their banks and occasionally change their course.

Canals and Railways

It is as well to pay little attention to the canals in the plains of India, as these are so numerous as to be more of a handicap than a help to map-reading. Railways, on the other hand, are fewer and offer an excellent means of checking position. Care has to be taken, however, not to confuse railways with canals, as from a height with a bright sun pouring down it is possible to mistake them. Heat-haze and dust-storms are also additional worries, because they cut down visibility considerably. Violent dust-storms are usually of short duration and normally can be avoided.

Engine handling from the point of view of petrol consumption is of paramount importance, particularly in a single-engine aircraft, as should one's navigation be at fault the little extra petrol saved by careful handling of the engine controls may mean the difference between a safe landing at an airfield and a "belly flop" in some particularly unpleasant piece of country. Pre-flight plans must, therefore, allow a sufficient margin of petrol to allow for searching for the airfield in the event of navigation not being up to standard.

It is also very desirable to have some knowledge of the type of country over which you will be flying, as vast tracts of land are entirely unsuitable for forced landings, particularly in forest areas. One should always try to avoid force-landing in forests, but if this is unavoidable and there is any bamboo about, it is always advisable to make for it, as it is more likely to give you a cushioning effect on landing than any other type of forest.

Contrasts in Weather

India is a country of great contrasts, and in nothing is this shown more clearly than in the meteorological conditions. Within its vast area are places with as low a rainfall as five inches, whereas in other places rainfall figures rise to the impressive total of 450 inches. The temperatures also show a similar contrast. Whereas on the Malabar Coast the average temperature is 80° F., with very small variations, throughout the year, on the plains of North-West India temperatures soar to 120° F., or above, in summer, and come down to freezing-point in the winter.

The monsoon is more or less common to the whole of India, and sets in in Malabar and Bengal early in June, and extends over the rest of the country by the end of the month, lasting until the end of September or early October. With the withdrawal of the monsoon from Northern India, good weather prevails in October and November, except in the south-east of India, where the main rainy period occurs during these two months.

Flying during the monsoon season is by no means impossible as long as due consideration is given to the met. reports and adequate pre-flight planning is undertaken. Its main characteristics are south-westerly winds, heavy rain and low clouds, and at times nil visibility. Thunderstorms are very violent at the beginning of the monsoon period, and it is advisable to avoid flying into these storms whenever possible. These storms are so turbulent as to make it impossible in some cases to retain control of the aircraft. It is therefore wise to fly around the storms, and this makes map-reading and dead reckoning of increasing importance.

In bad weather it is as well not to forget that India is hilly country, with hills that really are hills; flying at 10,000 feet is no guarantee that the highest peaks have been safely cleared.

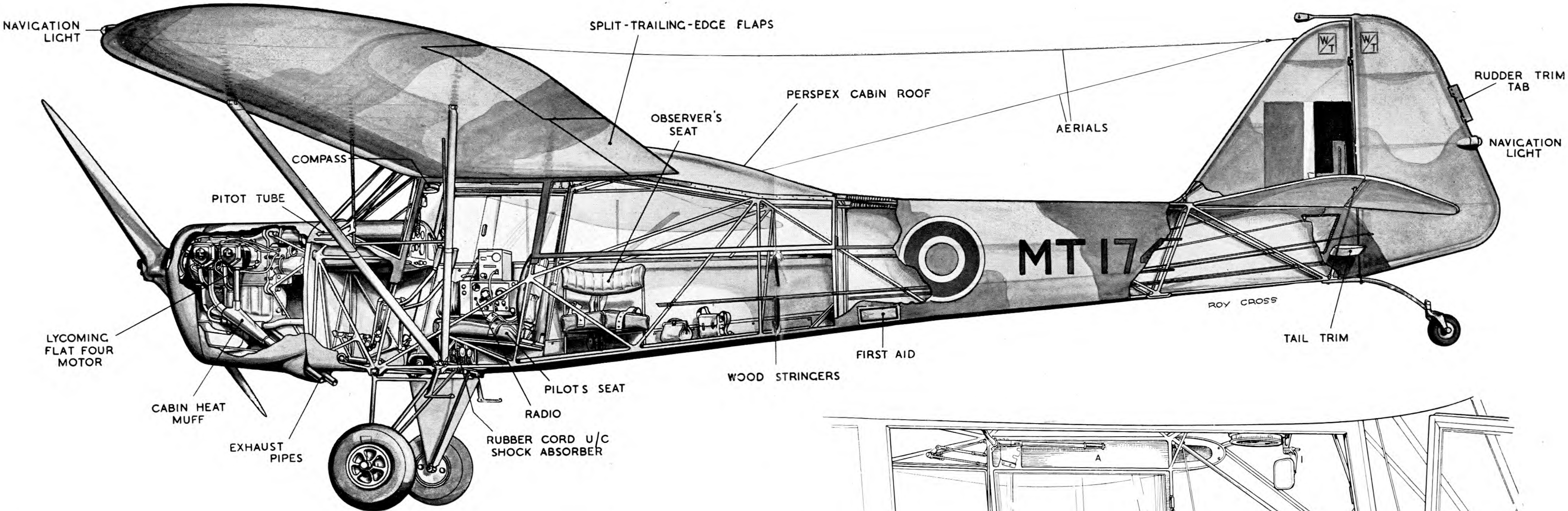
One other characteristic of India, and of all hot countries, is the fact that the performance of the aircraft is not as efficient as when flown in temperate climates. Engines simply do not deliver the power that they would in cooler air, and less lift is obtained from the atmosphere owing to the thinness of the air caused by the intense heat radiated from the ground. Take-off runs are longer and landings have to be made at slightly higher speeds than in England.

Flying in India, then, calls for a little more care in some respects than in England, but as long as due regard is paid to the climatic phenomena it is very rarely impossible. As the weather is seasonal, it is easy to forecast.

Indian pupils bombing up a Vultee Vengeance with 500-pounders.

Rocket-firing Beaufighters of R.A.F. Coastal Command led by Wing-Commander A. Gadd, D.F.C., of Bexhill-on-Sea, Sussex, carry out a devastating dusk attack on a Sans Souci escort vessel in the harbour of Les Sables D'Olonne on the French Biscay Coast, leaving the ship on fire.

Below — A Russian military mission inspecting rocket-firing Typhoons.



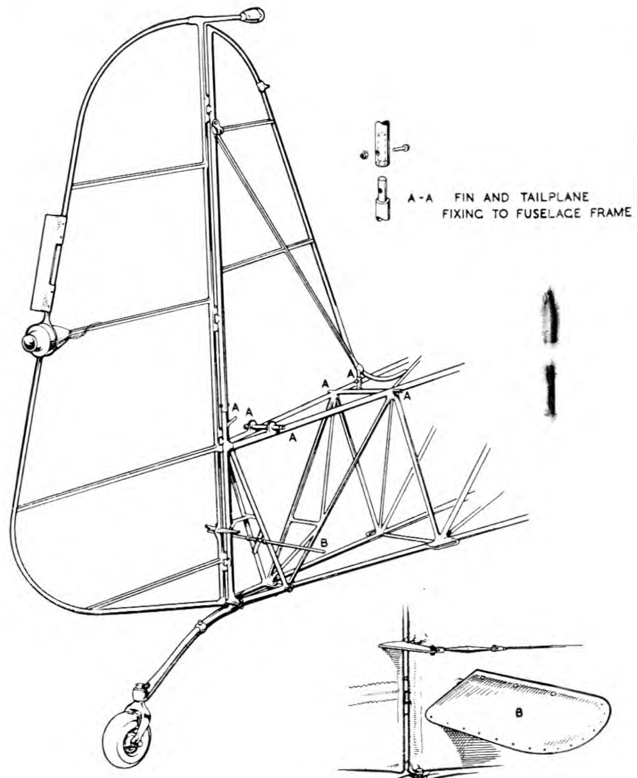
The Auster IV

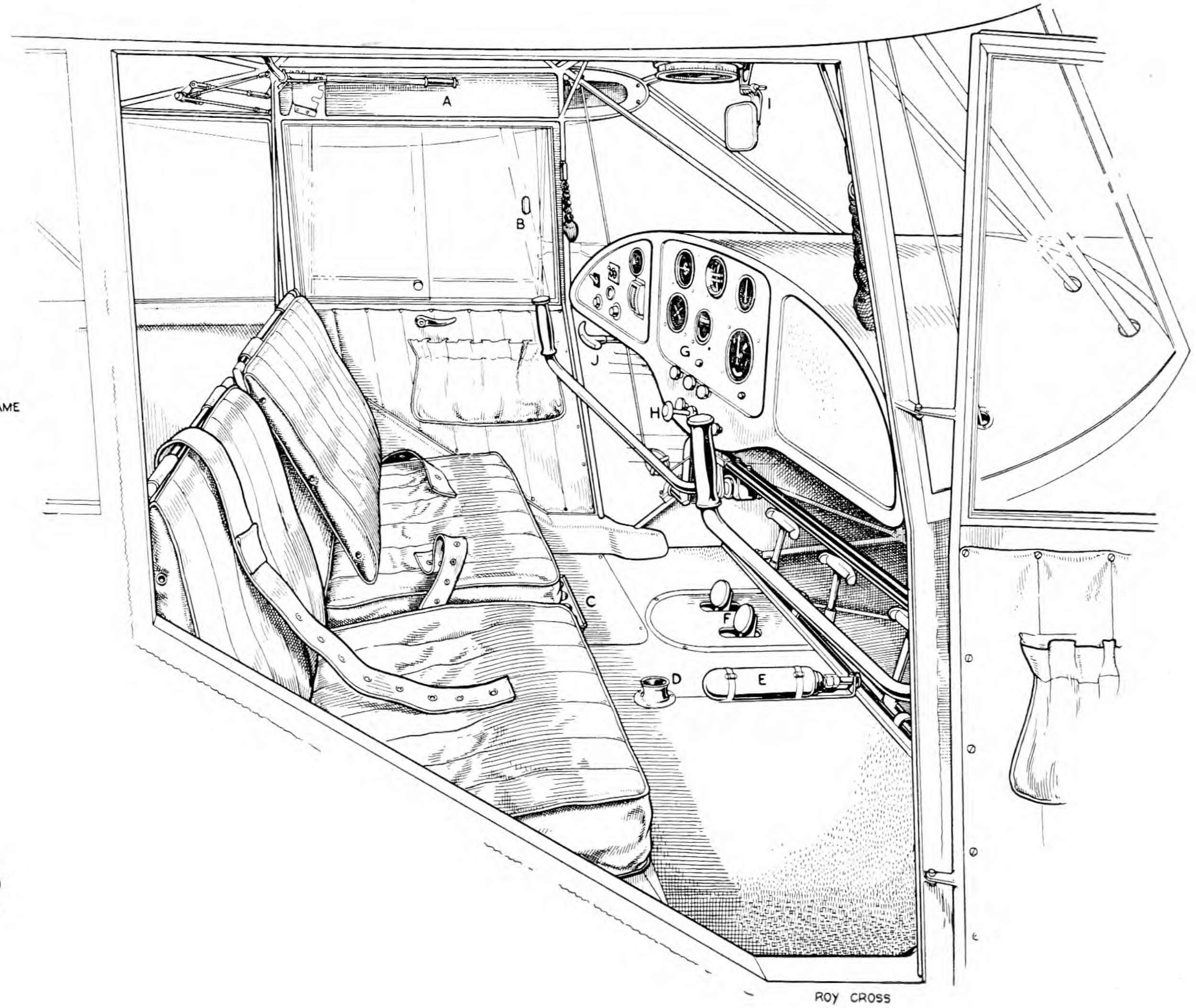
Latest product of Taylorcraft Aeroplanes (England) Limited is the Lycoming-powered Auster IV Air Observation Post (A.O.P.) or communications aeroplane, developed from the Auster I and III with 90 h.p. Cirrus and 130 h.p. Gipsy Major engines respectively. The main alterations on the new type are the change from the inverted four-cylinder motors to the horizontally-opposed Lycoming 0-290 motor of 130 h.p., and the re-arrangement of cabin accommodation. As well as the two front seats there is now a third seat facing to port in the rear part of the cabin. Wireless may be fitted in place of the front starboard seat as shown in the main cut-away drawing, which also illustrates dual control. Normally when wireless is installed the dual controls would be disconnected. A really fine view may be had from any of the seats and this, plus the excellent performance, reliability, ease of maintenance and general ability to take rough handling, makes the type an ideal choice for its duties with the Army.

Data for the Auster IV is: Span, 36 ft.; length, 22 ft. 5 ins.; wing area, 185 sq. ft.; empty weight, 1,070 lb.; loaded weight, 1,820 lb. Performance at sea level: Maximum speed, 130 m.p.h.; landing speed with flaps down, 29 m.p.h.; rate-of-climb, 900 ft. per min.

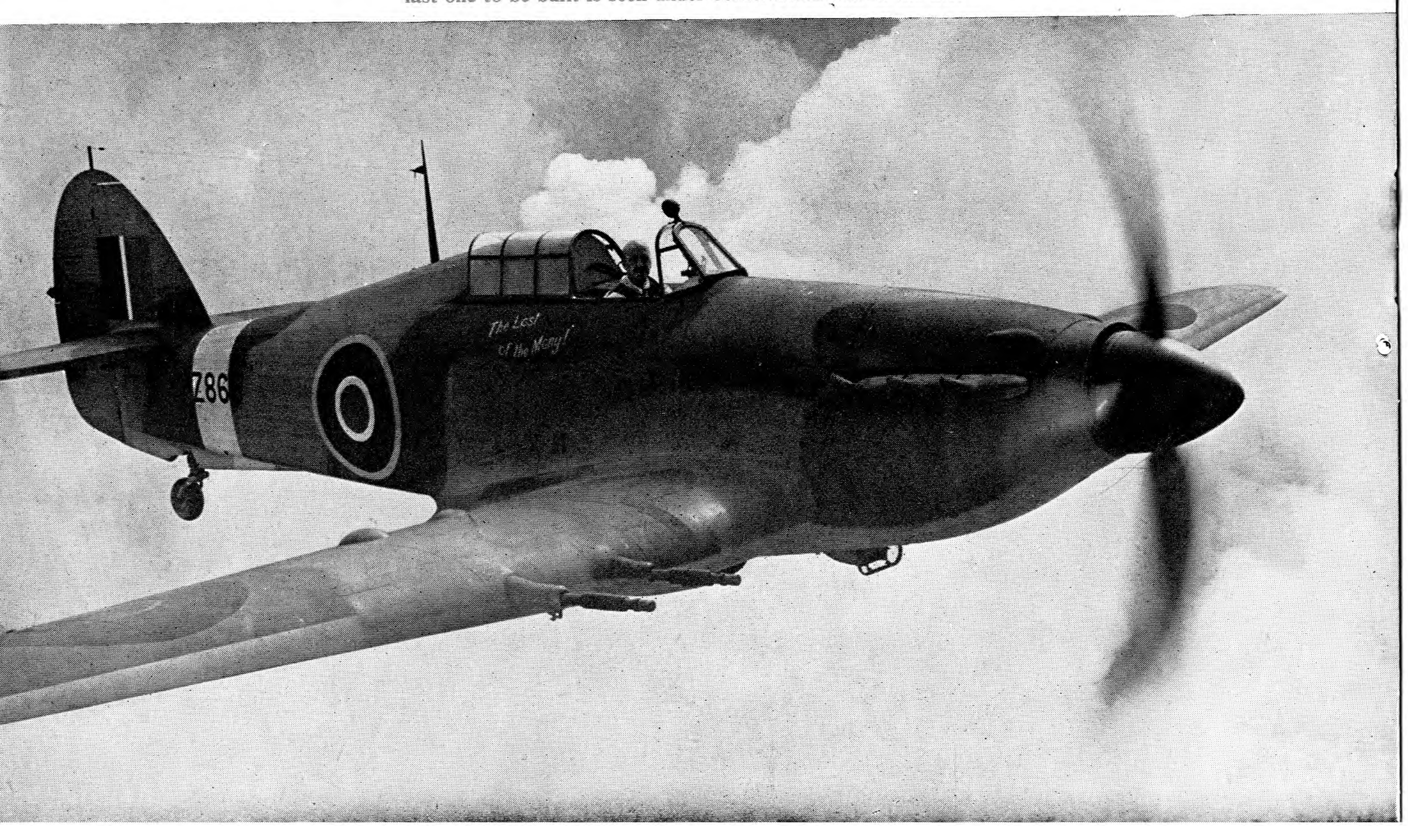
The sketches on the near right show the rear fuselage, fin and rudder with attachment points for fin and tailplane (A), the tail trimming surface and spindle (B), and the tail wheel which replaces the leaf-spring skid formerly fitted. Stripping of the fabric from the structure shows the light but extremely strong frame.

The cockpit layout is shown on the extreme right. The pilot has armour plate protection below and at the back of the seat; both seat-backs fold forward car-fashion to permit access to the rear of the cabin. The flap lever (A) permits manual control over a range of flap positions. Clear vision and variation in cabin temperature may be obtained by sliding back window panels (B) at either side. Other equipment is: C, Verey cartridge rack; D, Verey pistol socket; E, fire extinguisher bottle; F, brake pedals; G, blind flying panel (A.S.I., artificial horizon, R.P.M., altimeter, directional gyro, turn and bank), H, throttle; I, compass and reflector; J. parking brake.





THE LAST OF THE MANY. After five years of war the Hurricane has gone out of production, though it is still in wide use. First used in the first Battle of France, the Hurricane was the most numerous fighter in the Battle of Britain, and underwent many modifications as the war developed before finally giving way to the Typhoon and the Tempest. Here the last one to be built is seen under construction and in the air.



The Fairchild 24 Forwarder

by **Roy Cross**

BEHIND the Allied air assault on the Axis flies a smaller air force, whose job is every bit as important as the fighting wings, groups and squadrons. This force combines the Air Transport Commands of the Royal Air Force and the U.S. Army Air Forces, and employs not only heavy multi-engined cargo and transport 'planes, but a multitude of smaller types to be used for the carrying of light loads, for communications and liaison duties and for the rapid movement of personnel. Prominent among these smaller "utility" types is the Fairchild 24, a former civil three- or four-seater cabin monoplane now extensively used by the Americans as the Forwarder and by the R.A.F. as the Argus I. The latest deliveries to the A.A.F. are of the type UC-61A and UC-86. The prefix UC (Utility Cargo) denotes that the aircraft is a transport seating less than eight persons and carrying no more than 1,400 lb. of cargo. The Argus Is in this country are used chiefly as air taxis for picking up stranded ferry pilots who have completed their delivery flights and wish to return to the Pool.

Model UC-61A Forwarder

The fuselage of the Forwarder has a welded steel-tube frame faired with spruce stringers, fabric-covered. The four-seater cabin has an entrance door on either side with quick-release hinges, so that each door may be knocked out should a hurried emergency exit become necessary. Dual controls are standard, but the starboard set may be disconnected and stowed. Seat cushions are removable to accommodate seat-type parachutes, and a generous luggage-space is behind the cabin. The wing, in two halves, attaches direct to the top fuselage longeron and is strut-braced to the bottom one. Frise ailerons and split flaps are fitted, the last-named enabling the UC-61A to land and take off from small fields at 54 m.p.h. with a loaded weight of 2,801 lb.

Fairchild UC-61A

Motor: Warner Super-Scarab of 165 rated horse-power at sea level.

Span	36 ft. 4 in.
Length	23 ft. 10 ins.
Height	7 ft. 7½ ins.
Wing area	193.3 sq. t.
Weight, empty	1,732 lbs.
Weight, gross	2,801 lbs.
Wing loading	14.5 lbs. per sq. ft.
Power loading	17 lbs. per h.p.
Performance:	
High speed	110 m.p.h.
Cruising speed	104 m.p.h.
Stalling speed (with flaps)	54 m.p.h.
Service ceiling	11,400 ft.
Normal range	555 miles

Photo and specifications by courtesy of Fairchild Aircraft Division, U.S.A.

The Warner Super-Scarab seven-cylinder radial motor drives a two-bladed wooden Sensenich airscrew of 7 ft. 2 in. diameter. A fuel tank of 30 U.S. gallons capacity is contained in each wing root, giving the machine a normal range of roughly 555 miles. The Warner motor develops 175 h.p. for take-off at 2,250 r.p.m., and is rated by the U.S. Aeronautical Chamber of Commerce at 165 h.p. at 2,100 r.p.m. Overall diameter of the motor is 37¼ in., and the dry weight, minus hub and starter, is 332 lb.

Radio equipment includes a powerful Bendix transmitter-receiver with power unit.

The original Fairchild 24 was designed in 1933, and appeared the following year as a three-place sporting monoplane suitable for private owners. This early model, the 24 C-8-C, had spats covering the wheels, a "blistered" N.A.C.A. engine cowling, less head-room in the cabin, and was available either in standard or de luxe form. Later developments included facilities for installing additional seating space in the rear cabin, making the machine a four-seater, and the replacing of the Warner radial by a Ranger in-line motor on certain models. In early 1942 the R.A.F. received the first few Argus Is (Fairchild 24W-41), with 145-h.p. Warner radials.

Other types, with Ranger engines, are in service with the U.S.A.A.F. as the UC-86 (24K) and in the U.S. Navy as GK-1 and GK-2.

DESIGNING TWINS

by **R. H. Warring**

THE design layout of a twin-engined aeroplane is not simply a matter of sticking two engines on the wings and then arranging a neat cowling around them. Apart from structural considerations, such as the strength of the wings at the engine attachment points, strength of the centre-section beam, and so on, there are several aerodynamic features of great importance.

Obviously a symmetrical layout will be the most efficient—that is, the engines must be arranged equidistant from the centre line of the aeroplane (Fig. 1) and the thrust line of each should be as nearly coincident as possible with the centre of resistance of the whole machine. If there is any great vertical difference between the thrust line and the centre of resistance as in some marine aircraft, where the engines are mounted on the wings to keep the airscrews clear of spray—there is a considerable difference in trim between engine-on and engine-off performance, unless compensated by other means.

A twin-engined aeroplane must also be directionally stable with one engine stopped. With the starboard engine stopped, for example (Fig. 2), the port engine will be tending to turn the aeroplane to the right, due to the fact that the thrust line is distant from the "pivot point" or C. of G. This turning moment is aggravated by the fact that the one engine must now be set at full throttle (or nearly so).

To counteract this the rudder power must be sufficient to hold the aeroplane in straight flight (Fig. 3). Actually, the rudder power should be strong enough to give a wide circle to the *left*, i.e., *against* the engine, this being somewhat safer and less likely to precipitate a spin than a turn with the engine.

The airscrew of the useless engine acts as a brake, whether it is freewheeling or stationary. If freewheeling it is also turning the engine over, which may well result in further damage to the moving parts. This braking effect is helping the undesirable turning moment and can be reduced to a minimum by feathering the blades, i.e., altering the pitch of the blades until they are edge-on to the airflow and thus offer the minimum of resistance. This also stops the airscrew from freewheeling.

Another way of reducing the turning moment is to toe out the thrust lines, as in Fig. 4. The turning moment with one engine stopped depends on the thrust itself and the distance of the thrust line from the C. of G. This latter factor is obviously reduced slightly by toeing out the engines, as can be seen from the diagram.

The thrust line should also be as near to the centre line of the fuselage as possible, i.e., the engines should be set close in to the fuselage. This also gives a more economical wing structure. But against this are several other factors. The engines must not be so located that the airscrew disc overlaps the projected front elevation of the fuselage (Fig. 5). On a four-engined aeroplane individual airscrew discs should not overlap (Fig. 6).

Overlapping is apt to cause vibration and buffeting. This means that the airflow passing downstream towards the tail may be very turbulent, causing high drag and battering the tail surfaces, with consequent loss of control and added strain to the structure. In extremely bad cases the tailplane may break up during flight.

Close spacing of the nacelles may also cause jamming of the airflow between the nacelles and the fuselage sides, with similar results (Fig. 7). Turbulence or disturbed airflow over the wings is very bad, leading to poor control and loss of performance.

Finally, the disposition of the nacelles. It is generally agreed that the majority volume of the nacelle enclosing the engine should be below the wings. Put in another way, the area of the *upper* surface of the wings covered by the nacelles should be reduced to a minimum Fig. 8. At normal flight attitudes the majority of lift is derived from the upper surface of the wings, and the airflow over this surface is more critical. Hence protuberances on the upper surface should be avoided, or, if essential, kept to a very minimum, consistent with good streamlining.

The nacelle should also project well beyond the leading edge of the wing, so that the airscrew disc is located at least one third of its diameter in front of the leading edge of the wing, again minimising interference Fig. 9. The nacelle *shape* is best decided by wind tunnel tests on a scale model and confirmed by flight tests. On several aeroplanes the nacelle shape has had to be modified after flight testing, and in extremely bad cases it is not unknown for a small slat to be fitted around the mid-section of the nacelle nacelles projecting beyond the trailing to smooth out the airflow (Fig. 10). Other instances have led to extended edge, and the fitting of "smoothing plates" to the trailing edge immediately behind the nacelles.

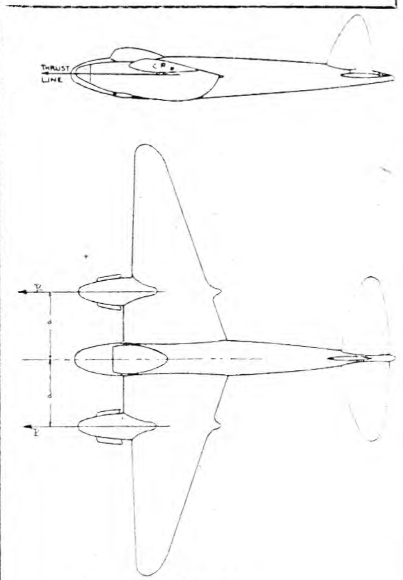


Fig. 1

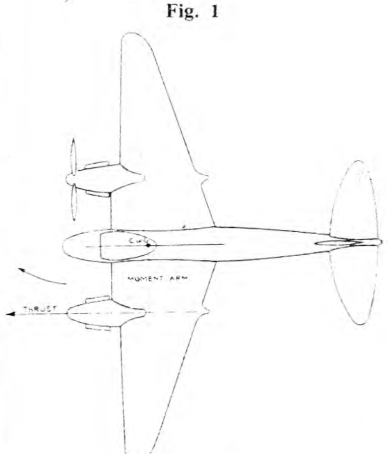


Fig. 2

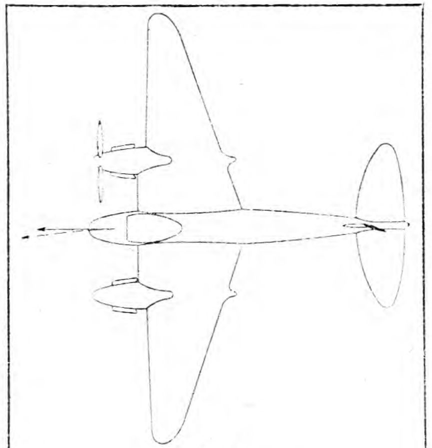


Fig. 3

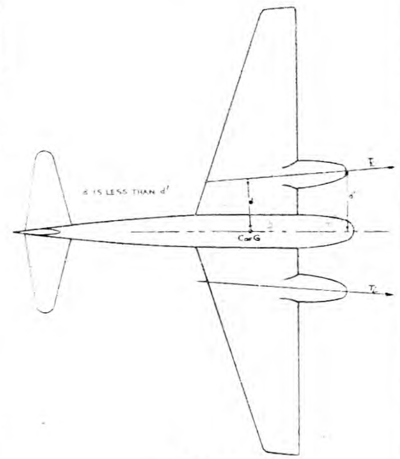


Fig. 4

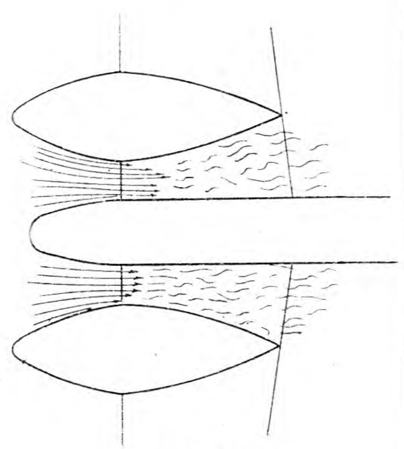


Fig. 5

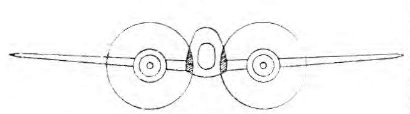


Fig. 6

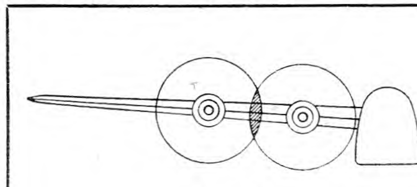


Fig. 7

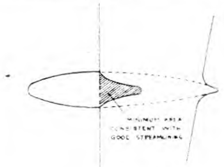


Fig. 8

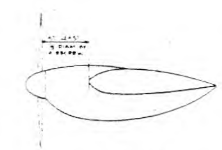


Fig. 9

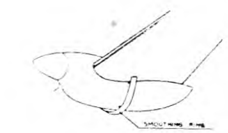
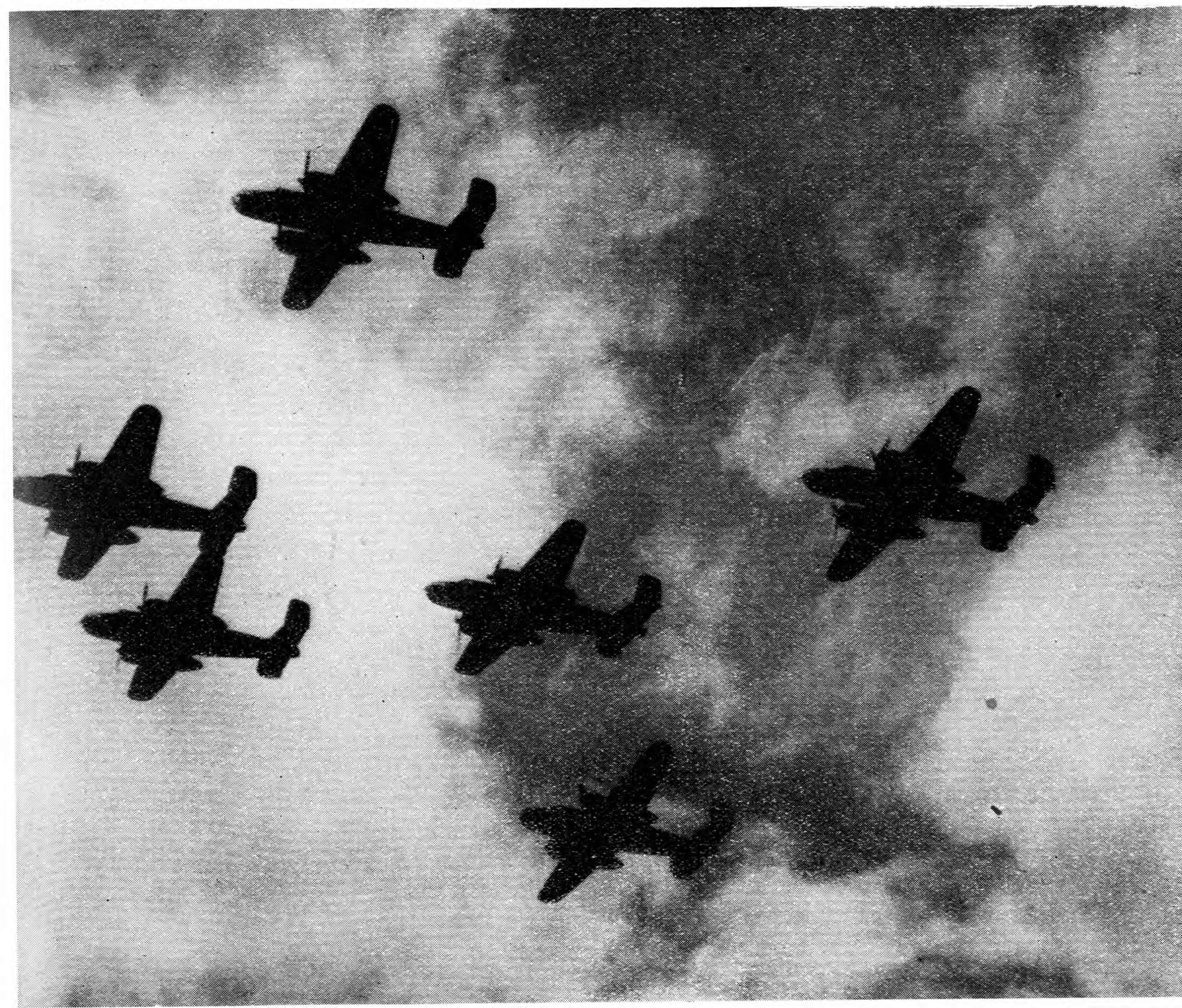


Fig. 10

R.A.F. Mitchell bombers flying over the liberated territories. This aircraft is one of the most successful U.S. twin-engined types in service.



HIGH-ALTITUDE PHOTOGRAPHIC RECONNAISSANCE

SQUADRON LEADER W. R. ACOTT — D.F.C.

FAST, high-flying, photographic reconnaissance aircraft provide valuable information about the enemy. Within a few hours of the aircraft being over the German cities photographs are available for expert interpretation which tell completely what are his dispositions in ships, rolling-stock and aircraft and what has been undertaken in the way of new construction of roads, buildings, airfields and hangars. New fortifications, movements of troops and convoys and the disposal of forces and reserves in the field cannot escape the ubiquitous eye of the P.R. aircraft.

This method of obtaining information has great advantages. It may be available at short notice. It is always accurate. Experts may study the photographs who would in no other way be afforded the opportunity of studying enemy-occupied territory from such an advantageous position. Varying phases of interpretation are done, from a rapid check of shipping movement, on which the striking aircraft are ordered off, to a long and detailed study of every feature. From the later phases the complete picture of the enemy war-machine unfolds.

The aircraft which take the photographs penetrate deep into enemy territory, some of the flights involving distances of nearly 2,000 miles, every mile of which may bring an enemy fighter up to intercept. To reduce this risk it is essential that the P.R. aircraft flies as high as possible. The greater the altitude the longer it takes the enemy fighter to climb up and the longer the time taken over the interception. Warning in plenty of time is necessary for high-altitude interception. Another advantage to flying high is the high speed which may be obtained at cruising power owing to the reduced density of the air. A high speed also adds to the difficulties of the intercepting aircraft.

Aircraft used for P.R. duties are Spitfires and Mosquitoes, both types being modified to carry extra petrol. Armament is sacrificed to make room for the long-range fuel tanks, the pilot relying on speed and height to avoid the enemy fighters. Crews are carefully selected and rigorously trained.

Mosquitoes carry an observer, who works the wireless and navigates, leaving the pilot free to fly and keep a careful watch for fighters. The Spitfire pilot, however, must fly, navigate, and search the sky. Flying to Berlin under such conditions requires the greatest mental and physical fitness.

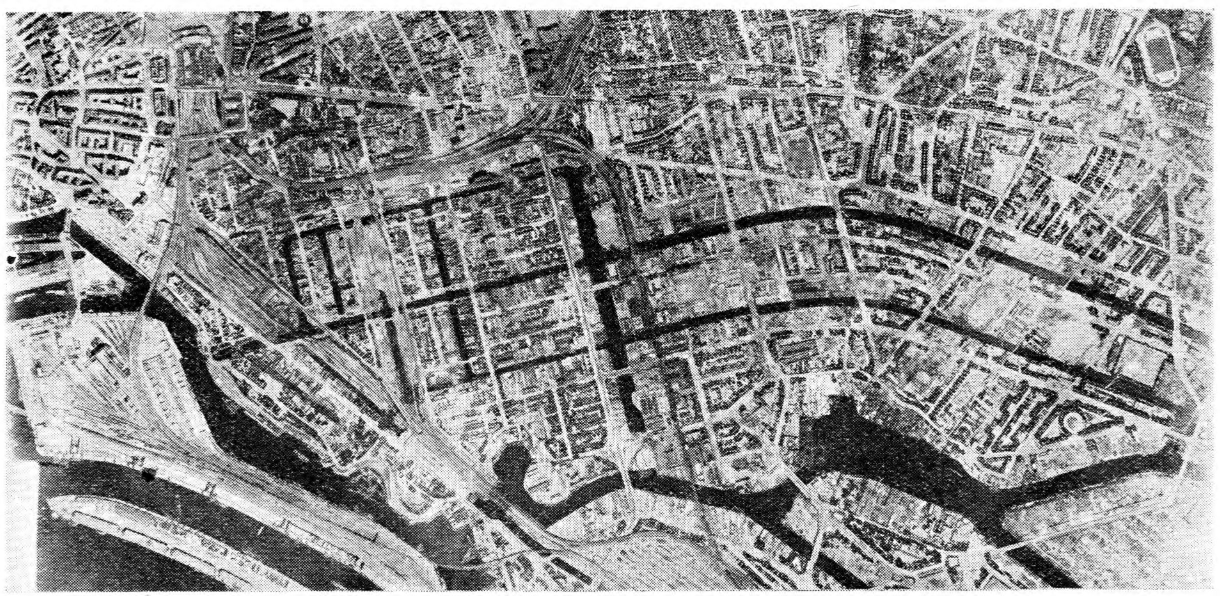
When the weather is good, navigation is not difficult, as visibility from these heights is sometimes as much as 200 miles. The countryside is spread out below like a large-scale map on which rivers, towns and forests stand out clearly. In bad weather, when the pilot is flying over or in cloud most of the way, he must rely on the winds forecast by the meteorologist, using his wireless to check his position.

Arriving in the target area, the pilot manœuvres for a position to take the best photographic run. He has been briefed on the cover required, the position of the factories, docks and marshalling yards, and the flight across the target is made with the object of securing maximum coverage with the minimum number of runs.

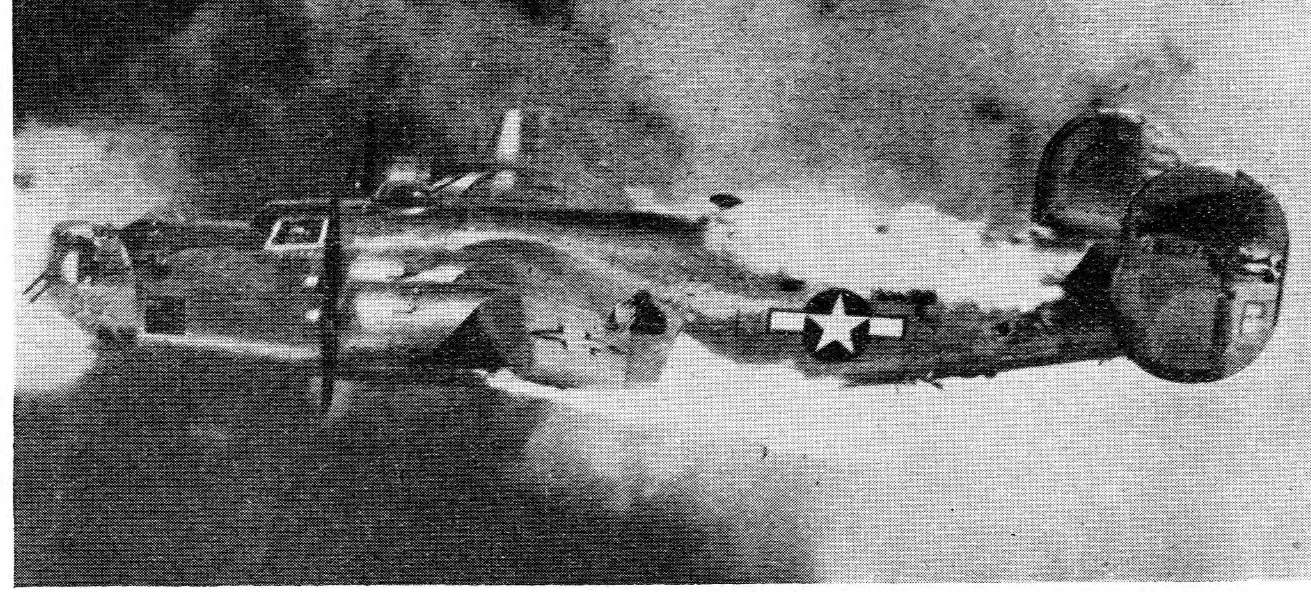
A large number of targets may be covered by a single aircraft. Having covered the targets for which he was briefed, the pilot may decide that he has plenty of petrol and may proceed to other targets to use up any film he has left. Generally this additional cover of targets takes the form of deviations on the homeward track to targets of minor importance.

The photographs are taken automatically by a control which operates the shutter at a predetermined interval, decided by the aircraft's height and airspeed. When the exposure is made the film is wound over and the shutter reset. A red light on the dashboard warns the pilot when the rewinding cycle is complete.

All targets covered, the pilot sets course for base. Now he must be doubly alert, for on the outward journey the enemy was in some doubt as to his ultimate objective. On the return flight there can be no doubt. His track back can be estimated fairly accurately and aircraft put up along this track to intercept.



Reconnaissance photographs, taken after R.A.F. raids on Hamburg, show a panorama of widespread devastation in the dockyard areas. Extensive damage has been caused to shipbuilding yards, power plants, marshalling yards, warehouses, industrial and dockside installations. This mosaic, a composite picture built up from several photographs to cover a wide area, shows the panorama of damage extending over approximately four miles of the Hamburg waterfront. Immense devastation can be seen over the whole of this area.



LIBERATOR LOSS. A Liberator bomber of the 15th Air Force is hit by fighter shells over Austria. Although the plane is afire the pilot has not left his aircraft.

Dodging the Ditch

J. A. Kyd discusses the economics of fuel consumption

THIS article might just as well have been entitled "The Economics of Air Transport," for it deals with the subject of fuel economy and whether you are bringing a bomber, short of fuel, back home over the North Sea or piloting an air-liner over a long leg of one of the Empire services in bad weather, the fuel consumption of the engines is a critical factor. In the first instance, proper handling of the engines may make the difference between a cold night in a dinghy and a hot meal and bed at base, and, in the second instance, an air-line company is not amused by one of their pilots who consistently arrives at ports of call with only a small margin of fuel left—not only from the viewpoint of the danger involved, but also from the economical aspect.

The above conditions of flight call for one type of fuel economy—that which will give the greatest range. There is another type which at first glance would appear to call for exactly the same method of operating the engines, but in actual practice it does not. This is when the greatest endurance is required from the aircraft, whether it be a Coastal Command anti-U-boat patrol, or, subsequently, a security patrol over Occupied Germany. Both types of fuel economy call for different methods in the handling of the engine and aircraft, and it is the purpose of this article to show why this is so.

There is one common feature about the methods adopted to obtain the two separate forms of fuel economy: it is that neither the maximum range of the aircraft nor the maximum endurance can be obtained through flying the aircraft at the lowest possible speed, that is, just above stalling speed. This is due to the fact that the drag of an aircraft wing increases greatly just before the stalling point is reached, and less power is required from the engine, hence less fuel, to maintain level flight at a speed quite a lot higher than the lowest possible speed for level flight.

To obtain the lowest consumption of fuel per hour's flying (maximum endurance), a lower aircraft speed is required than that to obtain the lowest consumption of fuel per mile flown (maximum range). This is due to the fact that for maximum endurance speed is only of importance to maintain manœuvrability of the aircraft, but for maximum range it will be found that the speed of the aircraft can be increased quite considerably above the lowest possible flying speed before the amount of fuel used per mile increases out of proportion to the rise in speed. Without very prolonged flight tests, with flowmeters installed in the aircraft to check fuel consumption, it is not possible to determine accurately what the ideal airspeed is for maximum range, but the handling notes provided for each aircraft usually specify what is the best speed. As a general rule the airspeed for maximum endurance is usually about 15 or 20 per cent lower than that for maximum range.

Although altitude has practically no effect upon the speeds to be used for range or endurance, it will be obvious that variations in the load carried will make for variations in the ideal speeds to be used. For instance, a bomber with bombs loaded will require a higher speed to maintain the margin above the stalling speed, which, of course, rises with the load. With the bombs gone the speed can be reduced, since the stalling speed will have dropped with the lightening of the load. Similarly, during a long flight corrections can be made from time to time to take advantage of the gradually reducing fuel load, but it should be realised that there is no need to do this frequently, as the advantage to be gained through corrections even after several hours' flying is relatively small.

Wind strength, whether it be a head or tail wind, does not call for an alteration in the recommended aircraft speeds, except in the case of a very strong head wind, when the speed should be increased slightly, providing it is not necessary to run the engine with the mixture control in the "Rich" position. It will be obvious that although the indicated airspeed is not altered, generally speaking, for head or tail winds, both the range and endurance will be affected. It is worthy of note that on a return flight to an objective, with a head wind in one direction and a tail wind (the same wind, with the same strength) in the reverse, the deterioration in the range or endurance due to the head wind is not by any means counter-balanced by the tail wind on the return flight. Naturally the position will be somewhat improved if the tail wind is encountered on the outward journey when the load is greater.

It's a Carve-up

Show-down on page 24

BOOKS Unofficially Reviewed by the Editor

The Navy and the Y Scheme, a paper-covered book published by the Stationery Office at ninepence, is worth more than every penny of the price. Primarily intended for those seeking to enter the Navy, it will also be of interest to everyone who likes ships. Besides pictures of the Navy in action, there are cut-away drawings of a battleship, a cruiser and a submarine. The selection of the pictures is good, most of these being real action pictures. There are two pages of silhouettes of various types of ship and four pages showing badges of rank. There is, besides, lots of interesting, informative and well-written text.

No Bombs At All, by C. H. Ward-Jackson (Sylvan Press, 8/6), is a collection of short stories of the Royal Air Force. There is a dozen of them, brief, racy and true to life.

Aircraft Recognition Without Tears will cost you 7/6. It is published by Pitman's, written by Squadron Leader J. C. Gent and illustrated by Linda Bramley. Squadron Leader Gent has taught at the R.A.F. Central School of Aircraft Recognition and in other important places, and can therefore be relied upon to expound the best methods and to give the right information.

Lynx V.C. Flies Again is an adventure story of a veteran of the last war who is given special intelligence work to do in this one. Somehow he lands in France, gets taken on the German S.S. and has many exciting adventures before finishing his job and getting home again. It is written by Vigilant and published by John Crowther.

Aeroplane Flight is an introduction to aerodynamics, written by H. F. Browne and published by Longmans Green at 7/6. It differs from the older books in that a two-seat advanced trainer, instead of the old biplane, is used as the "dummy" for illustrating principles, and it generally has a note of refreshing modernity. Clearly written, clearly printed, with 180 diagrams, it is a useful book for more than beginners.

Warfare Today is a co-operative inter-service book by three joint authors —Admiral Sir Reginald Bacon, Major-General J. F. C. Fuller and Air Marshal Sir Patrick Playfair. These distinguished and well-informed officers give as much information as may be given on the united work of the three Services. The book is well illustrated.

Radio Waves and the Ionosphere, by T. W. Bennington, explains in simple language how short radio waves travel such long distances. Although it is written for the technician, Sir Edward Appleton in a foreword recommends it as a guide to anyone interested in long-distance radio communication. It is published by Iliffe at 6/-.

Direction Finding by the Stars, by J. B. Sidgwick, will be easy meat for those training in navigation, but others may find it of general interest. It is published by Faber & Faber, and costs 5/-.

Burton's Four-Figure Navigational Tables (George Philip, 11/6) and **Gravity Die-Casting Technique** (Hutchinson's, 9/6) are both very technical in different ways, but no doubt some of our readers will be glad to have them brought to their notice.

Finally, one for the drum-major— **The Premier Drum Corps Guide,** published by the Premier Drum Co., London, W.1, at 4/6. It is full of information about bands—how to form them and how to run them, and how to get them to play tunefully, which is not quite the same thing as merely getting them to play.

Leaflets from Heaven

(SEE PAGE 11)

1, Lockheed Constellation; 2, Bv 222; 3, Svenska B.18; 4, Budd Conestoga; 5, Blackburn Botha; 6, Grumman Hellcat; 7, Hawker Hurricane; 8, Fairey Fulmar; 9, Pe 2s; 10, VS. 43; 11, Fairey Albacore; 12, D.H. Tiger Moth; 13, Auster; 14, Hawker Typhoons; 15, Heinkel 111; 16, Bristol Beaufighter; 17, Brewster Buffalo; 18, Handley Page Halifax; 19, Douglas Devastator; 20, Airspeed Oxford; 21, North American Mustang; 22, Martin Mariner; 23, Miles Martinet; 24, Hawker Typhoon; 25, Douglas Skymaster.

It's a Carve-up

(SEE PAGE 22)

1, SB-2; 2, Republic Thunderbolt; 3, Curtiss AT-9 Jeep; 4, Boeing Sea Ranger; 5, Northrop N-3PB; 6, Fieseler Storch; 7, de Havilland Mosquito; 8, North American Mitchell; 9, Douglas Dauntless; 10, Fw 200k Kurier; 11, Mitsubishi S-00 (Zeke); 12, Westland Whirlwind; 13, Douglas C-47 Dakota; 14, Grumman Avenger; 15, IL-2 Stormovik; 16, Vickers-Armstrongs Warwick; 17, Northrop Black Widow (P-61); 18, Budd RB-1 Conestoga; 19, Bell Airacobra Trainer; 20, North American Mustang; 21, Martin Baltimore; 22, Douglas B-19; 23, Martin Mars; 24, Messerschmitt Me 109F.

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Evening outing. A 9th Air Force Marauder makes a striking picture as she heads for home after a bombing mission. Below is an overhead view of one of the U.S.N.'s Coronados flying over the sun-dried scenery of San Diego, California. Wing span, 115 ft.; top speed, 220; weight, loaded 30 tons.