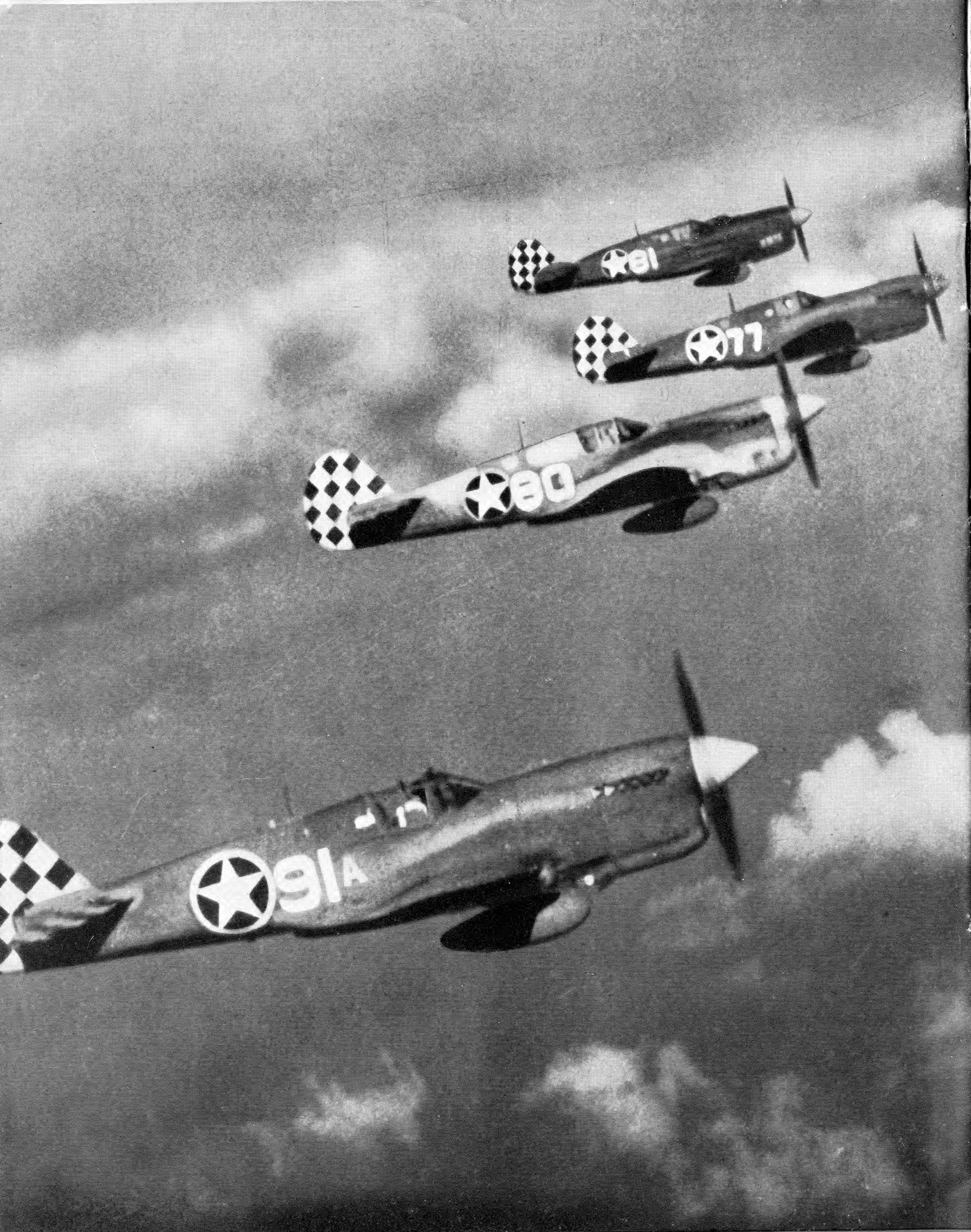
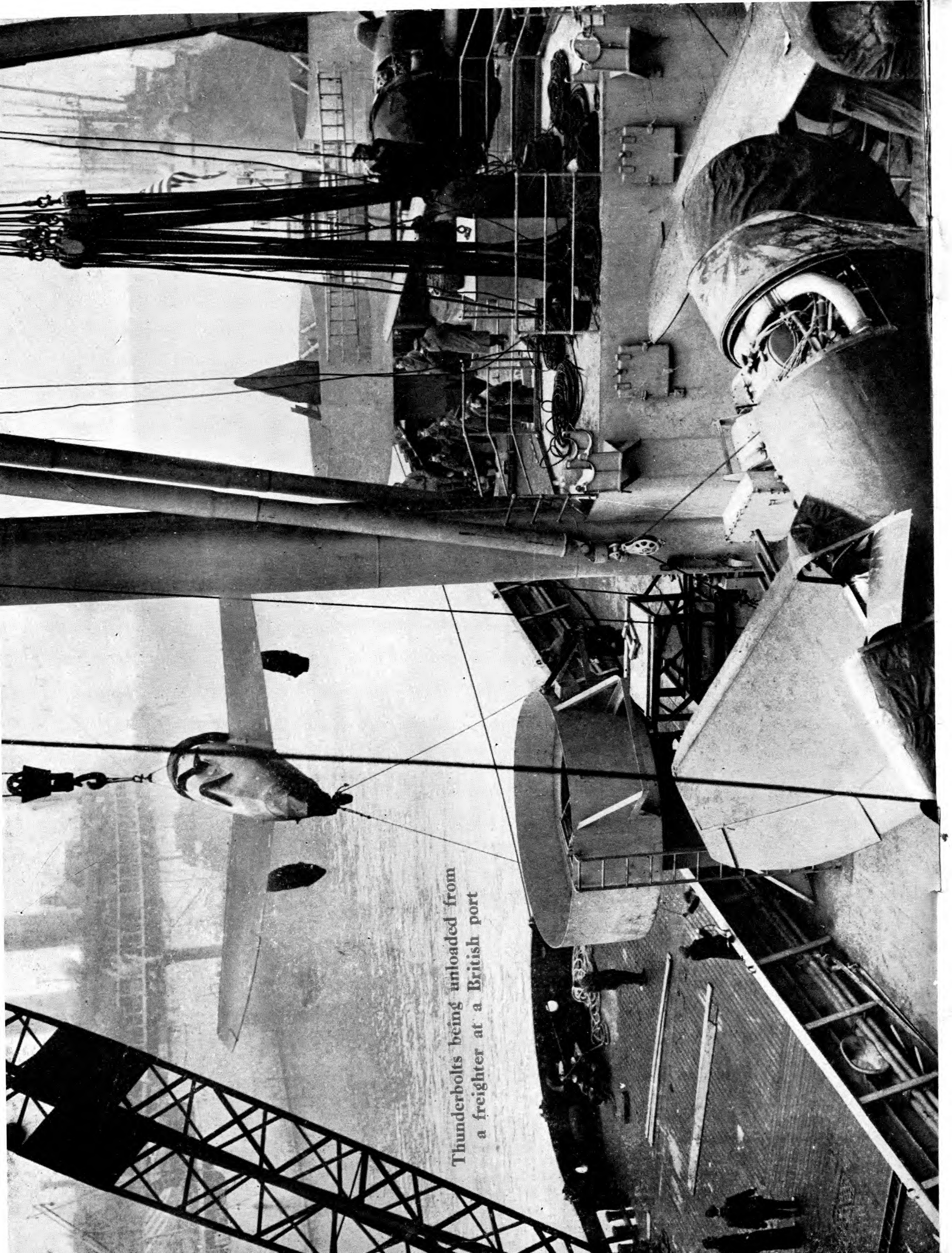


A good, though rather old, picture of a formation of P-40 Warhawks

AIR TRAINING CORPS GAZETTE

Vol. IV No. 4 APRIL 1944 6d.

THE DOUGLAS DAUNTLESS DIVE BOMBER



Thunderbolts being unloaded from a freighter at a British port

AIR TRAINING CORPS GAZETTE

PUBLISHED FOR THE AIR LEAGUE OF THE BRITISH EMPIRE, 1A, PALL MALL EAST, S.W.1 (TELEPHONE ABBEY 5041), BY THE ROLLS HOUSE PUBLISHING CO., LTD., ROLLS HOUSE, BREAMS BUILDINGS, LONDON, E.C.4.

VOL. IV NO. 4 *Edited by Leonard Taylor* APRIL 1944

Your Annual Training

WITHIN the next few weeks many of you will be going on your annual training with the Royal Air Force or at a Royal Naval Air Station, and for some it will be the first time you have had this privilege. I call it a privilege, because, after all, not every young man can have the opportunity of living and working with the air and ground crews which together are doing so much to bring us victory in the air.

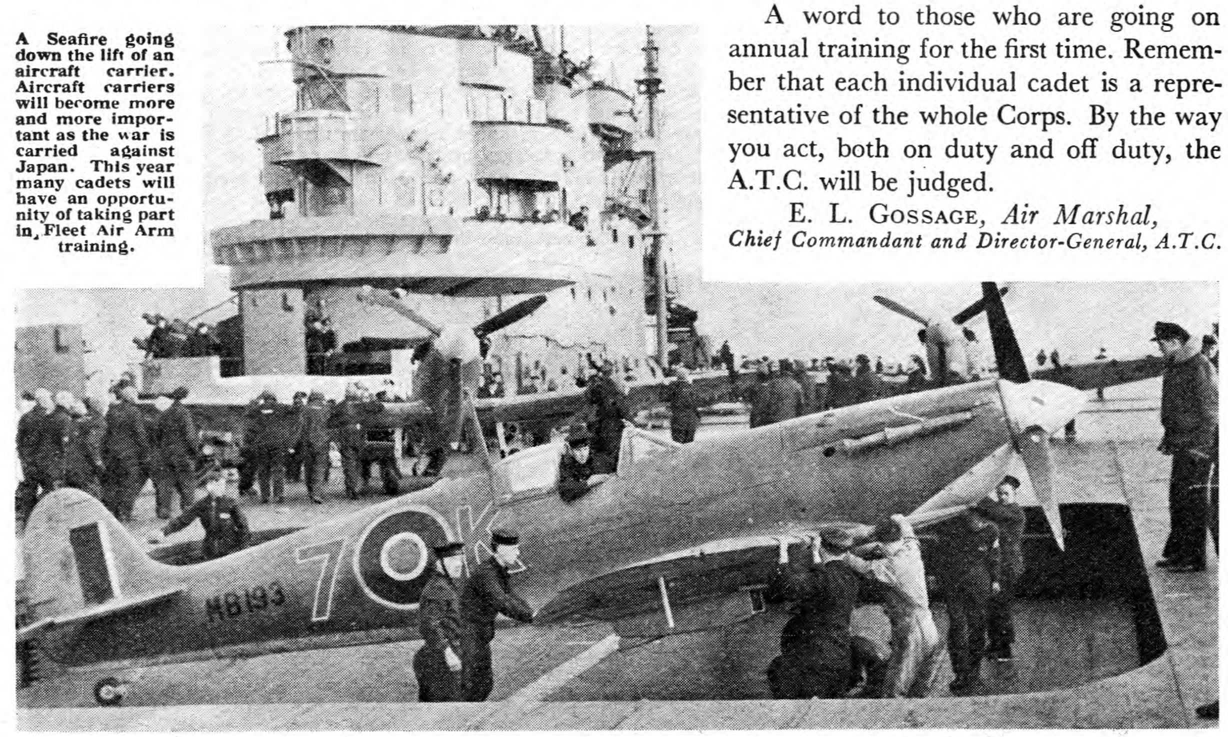
Annual training—we no longer call it "camp," because that sounds rather like a holiday—is the highlight of all Corps activity. It is the crown of a year's hard work in the squadron. There you can put into practical effect much of the theoretical instruction you have been getting in your classroom; and you will have the first taste of real Service life, for which your A.T.C. training is fitting you.

You will get flying whenever possible, also gliding at certain stations. Gliding is not merely something of a thrill, but is valuable air experience, in which a cadet has charge of an airborne aircraft, generally for the first time in his life.

This year some squadrons will not be able to go to the stations they have previously visited. They will, however, have the advantage of seeing different and probably more interesting aspects of R.A.F. or Fleet Air Arm life, and will benefit accordingly. Change of this sort is always of value.

A word to those who are going on annual training for the first time. Remember that each individual cadet is a representative of the whole Corps. By the way you act, both on duty and off duty, the A.T.C. will be judged.

E. L. GOSSAGE, *Air Marshal,*
Chief Commandant and Director-General, A.T.C.



A Seafire going down the lift of an aircraft carrier. Aircraft carriers will become more and more important as the war is carried against Japan. This year many cadets will have an opportunity of taking part in Fleet Air Arm training.

The Aeronautical GROUND ENGINEER

by Aero Spee

THERE have been many misconceptions about what a ground engineer really is and what his duties are. Although many attempts were made in the early days to get the training and ultimate duties of ground engineers on a proper footing the vague policy for civil aviation was not helpful to success. The ground engineer found himself forced to do two separate jobs, each of which was sufficient to occupy one man and neither of which should have been allowed to interfere with the other. Not only had the ground engineer to work as the mechanic on the job and maintain the aircraft fit for flight, but he had to certify, as an inspector, that he himself had passed the aircraft as being airworthy for one day, irrespective of the amount of flying that it might have to do.

The original idea of a licensed ground engineer was that he should be solely an inspector of the mechanic's work and be capable of giving advice to the mechanic on the maintenance of aircraft. Unfortunately there were not sufficient trained men for both these duties (nor sufficient money on many aerodromes to pay for them), with the result that ground engineers found themselves forced to work on the aircraft and then to inspect and certify their own work. This was obviously most undesirable, for no man, however brilliant at his job, can be expected to be totally foolproof.

There are signs that this state of affairs will cease when civil aviation comes into its own again, and this absorbingly interesting profession may have much to offer young men in years to come.

Firstly, let us have a word about what the job really is, or rather what it will be after the war.

Aircraft must leave the ground in perfect condition and remain so for the duration of the flight, however long it may be. The ground engineer must be competent not only to instruct the mechanic in what work requires to be done, but also to inspect every component in the aircraft with a view to anticipating defects. Naturally he cannot inspect the inside of the engine and its accessories, but he has to give the engine a thorough routine check during the run-up. Only with extensive experience can a ground engineer do this job properly. Every aircraft has to be certified fit for flight in this way each day. When the aircraft has done a certain number of hours' flying, more detailed inspections have to be made, and at the end of long periods of flying the airframe and engine have to be overhauled.

The salary offered by airline firms and private-hire firms to fully qualified ground engineers should be good. Prospects of advancement to senior posts are excellent, for in no other form of transport does so much depend upon the maintenance organisation.

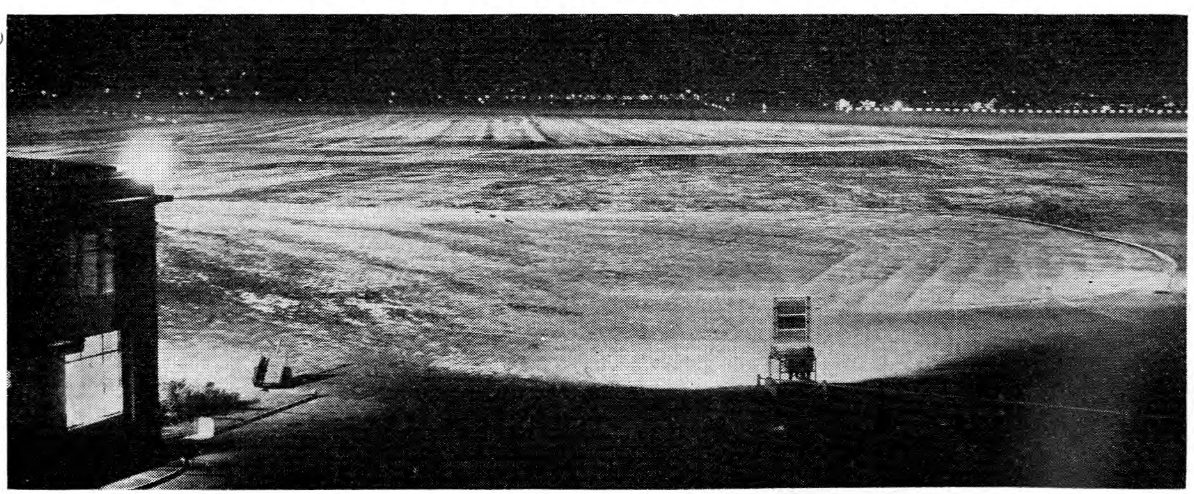
How does one set about becoming a licensed ground engineer?

There is no easy road to success. The training can be likened to that of a doctor, in which accepted principles have to be absorbed by the student, but these are useless to him unless he is able to appreciate the practical problems which arise. There is only one way of supplementing the academic experience, and unless this is done, textbook work will never make the student into a proper ground engineer. He must work as a mechanic for several years under a licensed ground engineer and on a wide variety of aircraft and engine types. Then, when he has had perhaps five years of work, partly as a student at a technical school (day or night) and partly as a mechanic, he will be ready to sit for the Air Ministry's Ground Engineer's Licence. This licence has several different categories, which are divided according to whether the ground engineer wants to look after airframes or engines, or both, and depending upon the extent of work which he is capable of certifying.

The knowledge to be acquired on the academic side will include such things as the testing of materials, aerodynamics, mathematics, the testing of aero-engines and the theory of flight. There are technical schools which will take the student right through the training over a number of years, but, provided one is keen and interested and not afraid of hard work, a fine training can be acquired, with little financial outlay, by being apprenticed to a firm of aeronautical engineers where opportunities exist for the maintenance of aircraft. The latter training, coupled with night-school work, will provide the potential ground engineer with as good a training as it is possible to acquire anywhere.

The experience gained in technical subjects in the A.T.C. would be valuable to the man who decided to make this his profession, and it would shorten the training period to a great extent. The cadet who upon entering the R.A.F. finds himself for one reason or another unsuited to aircrew work is indeed fortunate if he is put on to aircraft servicing, for in the post-war years the ex-R.A.F. servicing engineer will have the pick of some very good jobs on the technical side of Civil Aviation.

When the lights come on again all over. . . . Croydon aerodrome floodlit during a pre-war night.



Douglas 'DAUNTLESS'

The Douglas Dauntless dive bomber (also shown on our front cover this month) has done good work with the U.S. Navy in the Pacific. It is also used by the R.A.F. The perforated flaps are a noticeable feature. Wing span is 41 ft. 6 in. Top speed with 950-h.p. Wright Cyclone engine, 295 m.p.h.

Differences in AMERICAN AIRCRAFT

by P. W. Blandford

TO anyone accustomed to flying or working on British types of aircraft, American machines present a number of interesting differences. These differences are not so great that a new technique has to be mastered to operate them, but there are several national preferences which characterise the aircraft of the two countries. As the interchange of British and American ideas continues, some of the good points peculiar to American aircraft are being introduced into British aircraft, and vice versa.

Instruments

The first thing that you notice about the instrument panel is that the familiar central group of six blind-flying instruments is missing. Blind-flying instruments are provided, but they are mixed with the other instruments.

Control Column

The control column in a single-seater fighter may be of the plain stick type instead of the spade grip favoured by British designers. The only British machines with plain sticks are the light aircraft, such as the Tiger Moth.

Brakes

While hand-operated wheel brakes are used on nearly all British aircraft, most U.S. machines have foot-operated brakes. In the British system the hand lever on the control column controls the pressure through a pneumatic or hydraulic system, and movement of the rudder pedals automatically provides a differential action when turning. In the American system the brakes are hydraulic and are operated by extensions on the rudder pedals which are pressed by the toes. Differential action is provided by varying the pressure on each pedal.

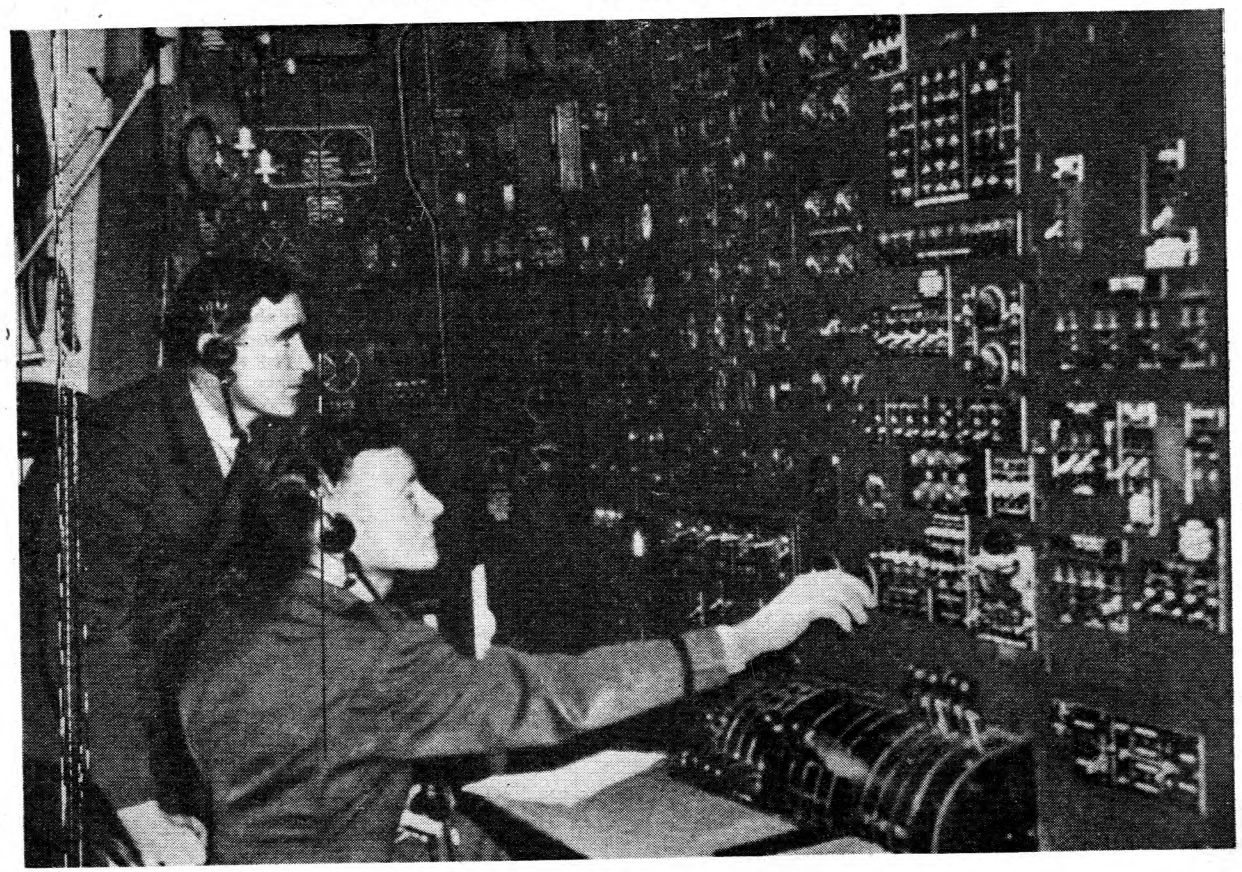
In the British system, although the degree of pressure is regulated by the hand lever, the pressure is actually provided by a reserve of compressed air (if a pneumatic system is used), or by a hydraulic accumulator (if a hydraulic system is used). In the U.S. system a hydraulic accumulator is fitted on large aircraft, but on smaller machines the pressure is provided directly by the pilot's toes.

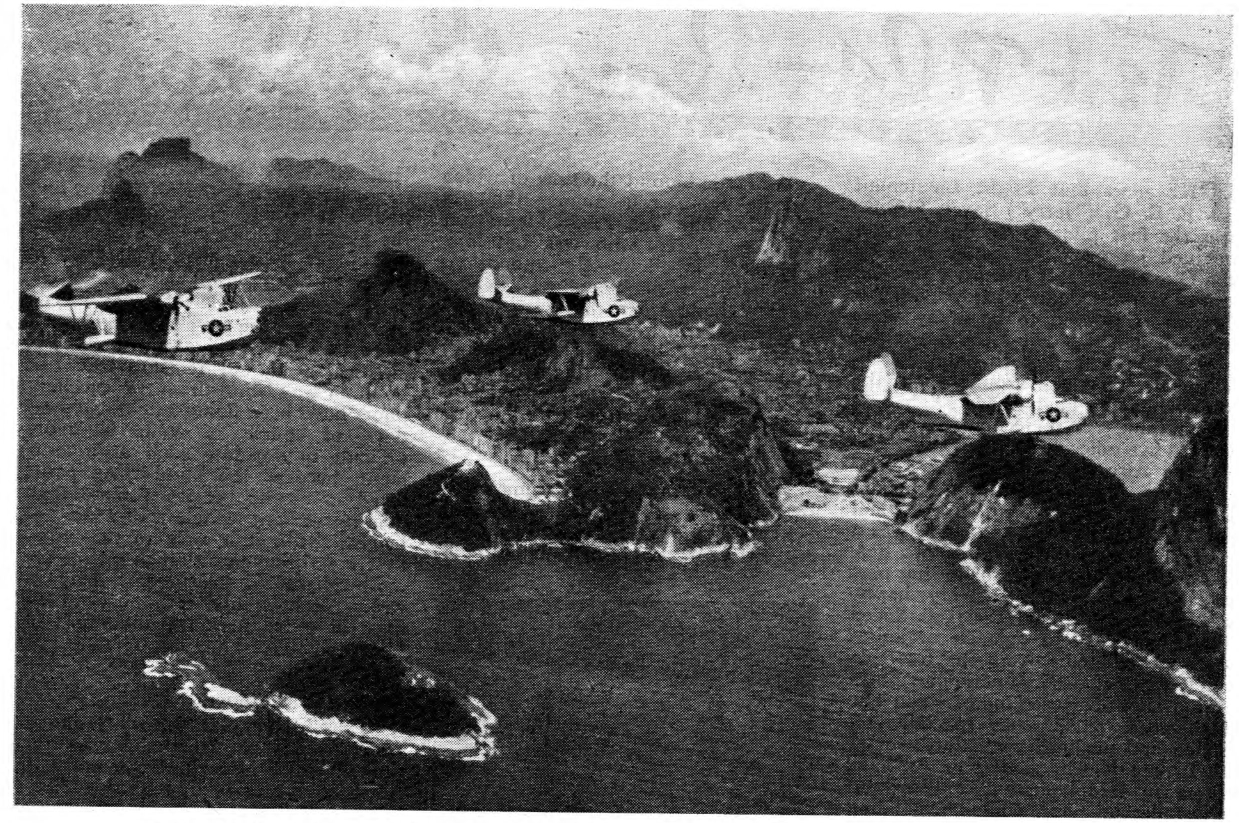
Fuel Control

Although there is a large variety of fuel-system layouts in use on both sides of the Atlantic, there is a general preference here for a number of single-acting cocks, while the American designers favour only one or two multi-position cocks. In a British machine there is usually one cock for each tank and, probably, a master cock in the supply pipe to each engine. In an American machine the supply from all tanks is taken to one cock, controlled by a rotary selector handle, which directs the fuel to the engine.

Most of the engine controls are very similar in the aircraft of both countries, except that the mixture lever and ignition switches look strange to British eyes.

The flight engineer's panel on the Martin Mars flying-boat.





A flight of U.S. Navy Martin Mariner patrol bombers over the harbour of Rio de Janeiro, capital city of Brazil.

Carburation

In nearly all British machines the engine has a float-type carburettor, similar in principle to that on a car engine. This may be "automatic," in which the mixture is automatically adjusted to either of the two ranges—Weak or Rich—which may be selected by the pilot, or "fully automatic," which, as its name implies, does not have any pilot-operated controls.

Most U.S. engines are fitted with injection carburettors, which have a special type of control, the mixture quadrant in the cockpit being marked with three or four positions, the end one being the cut-off point for shutting off the supply to the carburettor. In the few American aircraft which have float-type carburettors the control is entirely manual, i.e. instead of the choice of two automatic positions, as in the British arrangement, the pilot varies the mixture strength to suit conditions by intermediate movement of the mixture lever.

Ignition Switches

The ignition switches on a British aircraft are similar in action to ordinary electric-light switches, but with the "off" position downwards. One switch is provided for each magneto (two per engine).

American ignition switches are generally rotary in action and mounted on a circular base. There is one switch for each engine and, on multi-engined aircraft, a master switch for all ignition systems. Each engine switch has four positions, "Off," "L," "R," "Both," the "L" and "R" positions being provided for separately testing the left and right magnetos respectively.

Fire Extinguishers

One item missing from the American cockpit is the familiar red safety cover over buttons for manually operating the automatic engine fire extinguisher. There are no automatic fire extinguishers on American aircraft, but usually a single fire extinguisher can be directed to a fire in either engine by operating a cock, which on dual-control machines is usually beneath a cover in the floor between the two pilots' seats.

Switches and Circuit Breakers

Another thing that strikes you in many American cockpits is the large number of identically shaped electric switches, all grouped together and neatly arranged in rows. There are probably as many switches in a British cockpit, but they are not all similar and they are fitted in different parts of the cockpit. Near the block of switches in some U.S. aircraft there are rows of red buttons. These are electric circuit breakers, which take the place of fuses. If a circuit becomes overloaded its circuit breaker springs out, switching off the current and indicating the faulty circuit. It can be reset simply by pushing it in.

Starters

Of the various methods of engine starting, that most favoured in this country is direct electric and in America, inertia.

A direct electric starter consists of an electric motor coupled through gearing to the engine, in much the same way as a self-starter of a car. It starts to turn the engine as soon as the starter button is pressed.

In an inertia starter the electric motor is used to spin a flywheel. When this has been worked up to a sufficiently high speed a clutch is engaged and the energy stored up in the flywheel causes it to turn the engine. The usual control for this type of starter is a three-position switch, which is "Off" when central, and is pressed one way to "Energise" (spin the flywheel) and the other way to "Engage" (connect flywheel with engine). The flywheel can also be energised by turning with a hand crank if necessary.

Test Pilots leave their Mark

BY CAPTAIN NORMAN MACMILLAN M.C. A.F.C.

THE news that Flight Lieutenant P. E. G. ("Jerry") Sayer, O.B.E., was the first pilot to fly the Whittle-engined jet-propelled fighter built by the Gloster Aircraft Company recalled to my memory Martlesham Heath Air Station as it used to be many years ago, when it was called the Aeroplane and Armament Experimental Establishment. That was around about the time when the High-Speed Flight was in training at Felixstowe seaplane station five miles away (then called the Marine Aircraft Experimental Establishment) under Squadron Leader Leonard Slatter (now Air Vice-Marshal Sir Leonard Slatter), and there was a mutual tie-up between these two Service test stations which made that part of the country into a very happy R.A.F. home, although the High-Speed Flight was really a separate organisation housed apart from the test side of Felixstowe and functioning in a rather Silent-Service kind of way. The high-speed pilots were specially selected and medically examined, for at that time it was something to have flown an aeroplane that could exceed 200 miles an hour, while the landing of a float-seaplane at 80-90 or even 100 miles an hour was regarded as a feat of conjuring rather than of pilotage. Among the high-speed pilots were Norman Webster ("Webbie"), who won the Schneider Trophy race at Venice in 1927 at a speed of 281 m.p.h. Others in the original flight were Worsley (later killed in a motor-car crash), Rex Stocken, and Schofield, who flew the Short-Bristol monoplane at Venice and turned turtle, and when the machine was fished up from the sand next day the magnesium alloy crankcase had all fizzed away through the action of the saline water. Most of these pilots were landplane pilots who had had little or no experience of seaplane flying. Which just shows how easy it is to train good pilots to handle any type of aircraft.

The Germans Never Won

The pilots who flew in Fighter Command in the Battle of Britain were, in a way, the direct R.A.F. inheritors of the pilots of the High-Speed Flight; not only because they handled fast machines superbly, but because it was through the High-Speed Flight and the R.A.F. participation in the Schneider Trophy contests that the type of aircraft which sired the Spitfire came into being. It is of interest to recall that no German aircraft ever won a Schneider Trophy contest. Of the eleven contests for the trophy Britain and Italy each won four, U.S.A. two and France one—the first, at a mere 45¾ m.p.h.

At Martlesham at the time of which I write there was among the test pilots that fine flier, Flight Lieutenant Norman Jenkins, who was not long afterwards killed in the mountains of Tunisia with Squadron Leader Jones-Williams when they were essaying the flight for the world-record nonstop in a straight line. The cause of their fatal crash into the mountains south of Tunis is worth knowing, for it bears a lesson for every embryo pilot.

Altimeter Jammed

They left Cranwell aerodrome to fly direct towards the Cape. Everything went well and the Napier engine in the Fairey monoplane ran perfectly across France and the Mediterranean. They were flying by then at a steady height, high enough to pass safely over the mountains that lie behind the littoral of the southern Mediterranean. Their speed logged in faster than they expected, and they are believed to have credited this to the benefit of a tail wind. In fact, their altimeter had jammed at five thousand feet and ceased to record changes in height. They were in a gentle glide and did not know it. They passed lower than the topmost height of the mountains they had to cross.

The late F/Lt. P. E. G. Sayer, O.B.E.

There was a thunderstorm over Tunis, and the evening visibility was poor. Apparently they saw the mountains rise above them at the last moment. They pulled their aircraft up, and skimmed the peak, for they actually crashed on the reverse slope of the hill. Evidently they just stalled over the crest, and were probably caught in a down-draught with insufficient speed to make a recovery, for they hit in a kind of belly crash-landing. They might have been better off if they had had a retractable undercarriage, but the aircraft they flew was a high-wing monoplane with a fixed undercarriage anchored one leg to each wing.

The tale I have told was pieced together from the wreckage, the instruments and the navigator's log. It is circumstantial, but it rings true. In no other way could those two excellent pilots have been flying too low. Nowadays, of course, it would be more difficult to get into such a predicament, because the blind-flying panel fitted in aircraft possesses more than one instrument which shows loss of height. Still, it is wise to remember that the altimeter, although one of the most reliable of instruments, may go wrong. I have had it happen to me once or twice in many thousands of hours' flying.

Sayer and Summers

"Jerry" Sayer and "Mutt" Summers were friends at Martlesham at the time of which I speak. Sayer was tall, fair-haired, blue-eyed; Summers dark-haired, brown-eyed, and what the Spaniards call *gordo,* which means burly of figure. They both left the R.A.F. not very long afterwards to become test pilots in the British aircraft industry.

Sayer went to Hawkers to join "George" Bulman in 1930. He was transferred to Glosters in 1934, as chief test pilot, after that company came into the Hawker group. He dealt with the Gladiator, last of the biplane fighters, which did well in Norway and in the Western Desert, and was the first fighter to defend Malta. He began flying the jet-propelled fighter in 1941. He received his O.B.E. in the New Year Honours list of 1942, in recognition of his test work. On October 22nd of the same year he was killed in a flying accident, and the aircraft industry lost a fine test pilot and the world a grand fellow.

Mutt Summers went to Vickers at about the same time, and became a test pilot later. He is a pilot who is at home in any kind of aeroplane. Those who attended the Royal Aeronautical Society's garden parties before the war recall his masterly handling of the early Wellington. He is the only pilot I have ever seen loop a Wellington. He was first to fly the first Spitfire. Here are two aircraft that are still in first-line service after four years of war. There are few aircraft test pilots who can say that both fighter and bomber that they flew on test before the war began have been on service ever since.

LEVERED SUSPENSION

DAVID VINE on

LEVERED suspension or, to give it a more technical name, articulated shock absorption, is an attempt to solve a difficult problem. The ordinary undercarriage, as shown at Fig. 1, cannot always be subjected to compression or vertical loads during landing or taxying. When an aircraft touches down at speed or meets an obstruction while running along the ground, the load will be more in line with S, Fig. 1, namely, a horizontal drag loading, than with C, Fig. 1, which is an upward or compressive force. As all modern aircraft shock absorbers are of the telescoping type, designed to damp out a compressive load, which is almost vertical, or at least no worse than C, Fig. 1, they are liable to behave badly if the load becomes a horizontal force.

The Typhoon's Undercarriage

If the horizontal force is severe the telescopic portion of the strut will jam in the glands at A. The shock absorber will be rendered useless and structural damage will ensue. To overcome this defect, common to all compression-damping telescopic shock absorbers, the undercarriage can be raked forward, as it is on the Typhoon. For main landing-wheels this forward rake generally solves the problem sufficiently to avoid the use of the greatly increased weight of the levered type of undercarriage. But, for tail wheels the articulated or levered strut (Fig. 2) is a great advantage. It is rarely possible to rake a tail wheel forward, but with a lever hinged as shown in Fig. 2 at A, all the shock forces both horizontal parallel to S and vertical about C are carried around the hinge or pivot A and translated into a vertical or compressive loading which can be adequately dealt with by the shock absorber. The dotted lines show this in Fig. 2.

By this form of suspension the friction loading on the glands is removed and placed on the smoothly hinged pivot capable of translating, with a minimum of friction, the forces of landing to the shock absorber. Use of the lever eliminates the leg jamming and snapping off, as so often happens to the unlevered strut after a heavy landing, or on a grass airfield where horizontal loads are heavy during taxying. The use of runways has to a certain extent remedied the danger of horizontal loads during taxying, but they are still a problem during landing.

Damping Out Shimmy

Another advantage which has arisen out of the adoption of levered suspension for tail wheels is the fact that the lever shown in Fig. 2 tends to damp out shimmy. This is an important advantage of the levered strut. Controversy rages over the relative merits and disadvantages of the levered undercarriage, and though it has undoubted advantages, it also has disadvantages, chiefly due to the increased weight of the levers, links, pivots, etc.

But, like many technical controversies, it may be solved by something which supersedes both the telescopic and the articulated undercarriages. This will be the new track landing-gear (shown in last October's *A.T.C. Gazette*) which is coming along both in Britain and the U.S.A., and which, it is said, may supplant the ordinary undercarriage. But at the moment the compromise between the two arguments for and against levered suspension can be seen by studying the side view of the Typhoon, which, it will be noticed, has its main landing struts raked well forward and an articulated tail wheel.

Another difficulty which has arisen recently owing to greatly increased engine power is the bigger propeller diameters found to be necessary to translate the extra engine power. This has made for taller undercarriages and increases the problem of translating all the landing forces into a compression load capable of being dealt with by the compression strut.

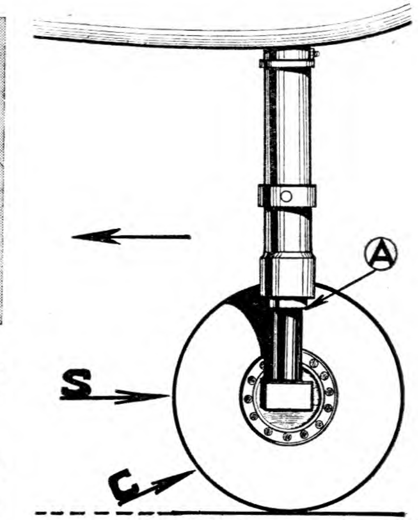


Fig. 1.

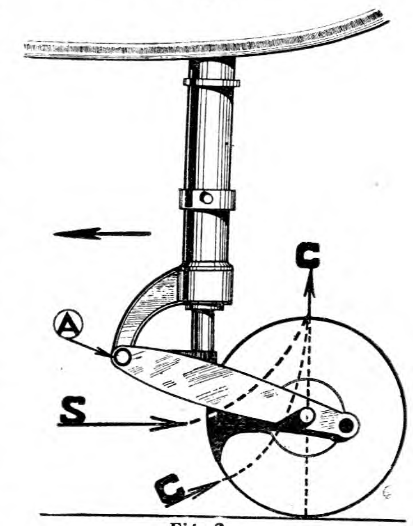
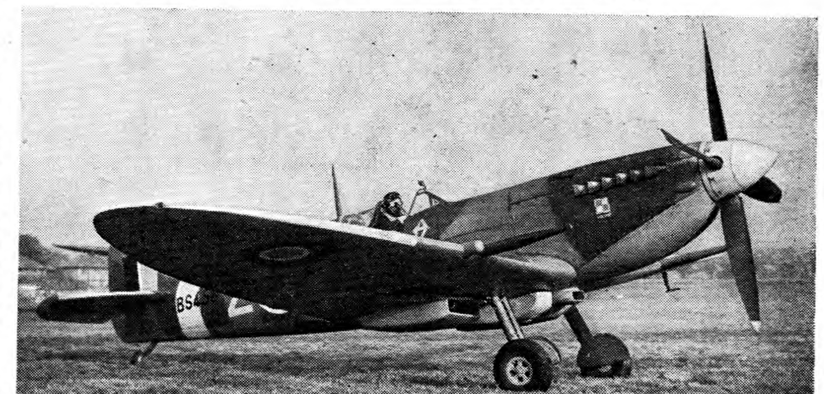


Fig. 2.

The Spitfire's undercarriage is well raked forward.



Flying Damaged Aircraft

by C. H. SHAW, A.F.R.Ae.S.

MANY a bomber pilot after meeting the enemy's defences finds himself with a badly shot-up aircraft to begin his long journey home over hostile territory.

A situation such as this demands all the resourcefulness of the crew to nurse the weakened machine. If aircrews have a knowledge of the function of the parts of the airframe structure they will know the best treatment to use when their machine suffers extensive damage.

The criterion by which any damaged member is measured is whether up to every manœuvre it is likely to experience in actual flight, and the loads on the airframe of a heavy bomber can be as high as six times the actual all-up weight of the aircraft.

The airframe is built up almost entirely of cantilevers. Consider first the fuselage: the front section is a cantilever attached to the front spar, the rear section is a cantilever bending about the rear spar, and between the spars is the centre section, which is a comparatively rigid box section.

The loads tending to bend the rear section are turrets, guns and ammuni-

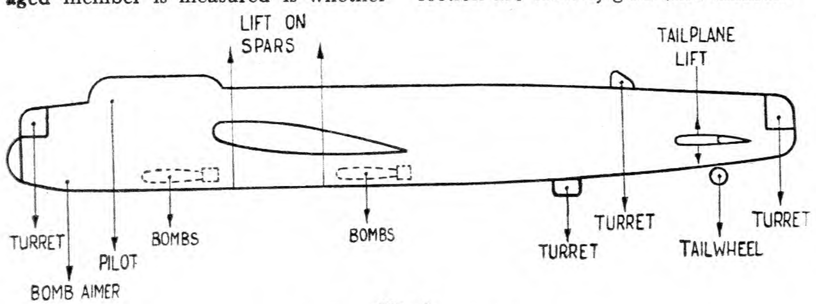


Fig. 1.
Loads acting on fuselage.

it is "highly stressed." In other words, is the load in the member near to the maximum which the member will safely stand? Here we come upon the first difficulty: only the designers know the stresses in each member, and similar members in different types of machines may have different stresses

Load Distribution

The best way to understand the aircraft structure is to understand the load distribution and the way the airframe is designed to accommodate it.

An aeroplane is designed to stand tion, gunners, bombs and equipment, all of which act downwards, and the tailplane, which can act either up or down depending on the tail setting and the relative position of the elevators (Fig. 1).

If the lift on the tailplane is acting down, then the fuselage is said to be "hogging" (Fig. 2), for all the loads are bending it downwards. This means that the top skin is in tension and the bottom skin is in compression. If the tailplane is lifting up, the fuselage is "sagging" (Fig. 3), and the tension and compression are reversed.

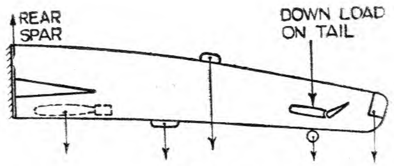


Fig. 2.
Fuselage "Hogging."

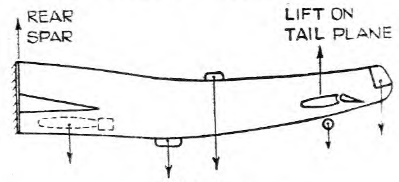


Fig. 3.
Fuselage "Sagging."

Damage to Fuselage

Consider what will happen if a hole is blown in the underside of the fuselage. When the fuselage "hogs" the underside compresses, and if the stringers have been severed there will be no resistance. The hole will tend to close up, throwing all the load on the surrounding metal, which may not be strong enough to carry it, thus resulting in buckling of the skin around the hole.

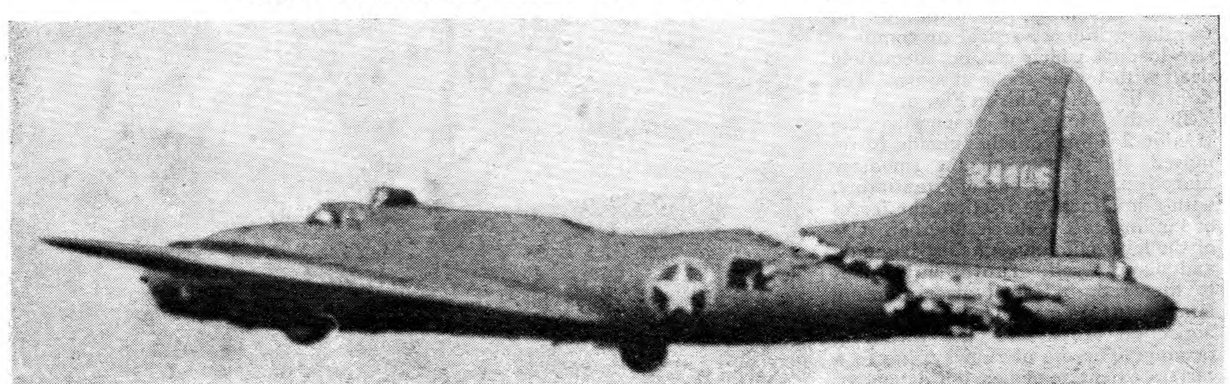
When the fuselage "sags" the hole opens out, owing to the tension, throwing increased load on the compression side.

If the aircraft is made to undergo manœuvres or changes of attitude by quick movements of the elevators the fuselage will be subject to alternating conditions of "sagging" and "hogging" and the top and bottom skins will be constantly changing from tension to compression, and vice versa. This is called "reversal of stresses," and quickly leads to failure by aggravating the existing damage.

Wings

Each main wing is built as a cantilever bending about the fuselage. The bending is mainly resisted by the two spars—rigid members which form the backbone of the wing—around which

A German fighter crashed into this Fortress and the fuselage at the rear was cut in two. The tail gunner stuck to his post until they were clear of enemy fighters, and the pilot made a successful landing half an hour later.

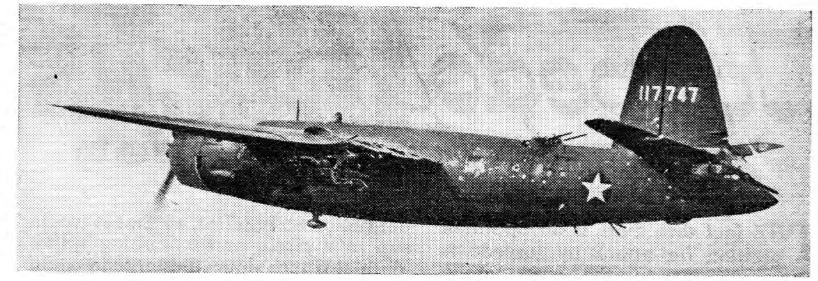


are built the ribs, stringers and skin, which combine to resist the twist of the wing.

The wing is bent upwards due to the lift, but there are also loads acting down which relieve the upwards bending. These loads can be summarised as engines, airscrews, fuel, undercarriage and the weight of the wing itself.

The top of the wing, then, is in compression and the underside is in tension, as in the fuselage "sagging" condition.

Approximately seventy per cent. of the lift comes on the top of the wing, so that damage to this surface is likely to have a worse effect than damage to the underside. Not only does a torn panel on the surface break up the streamline flow and reduce the lift, but the weakened panels tend to tear away, due to the suction and compression.



This battered Marauder flew home to safe belly landing after all this damage.

Damage to the tailplane surfaces, though not so important as damage to the elevator (loss of lift can be compensated for by a bigger elevator angle), can become serious if the damage is aggravated by clumsy use of the elevator.

The most general action which will help to prevent an extension of damage and maintain the aircraft airborne is to fly steadily at a uniform speed wherever possible. Steeply banked turns should be avoided, and change of altitude should be accomplished slowly without sudden movement of the controls.

'Bird-Proof' Glass

by Michael Lorant

A "BIRD-PROOF" windshield glass has been tested in Westinghouse's high-power laboratory.

The tests, **carried out with the aid of a 20-foot-long compressed-air cannon**, resulted in a "club-sandwich" design of strong glass and resilient plastic capable of withstanding the impact of a 15-pound bird at a speed of 200 or more miles an hour. The older type broke under impact at 100 miles an hour or less.

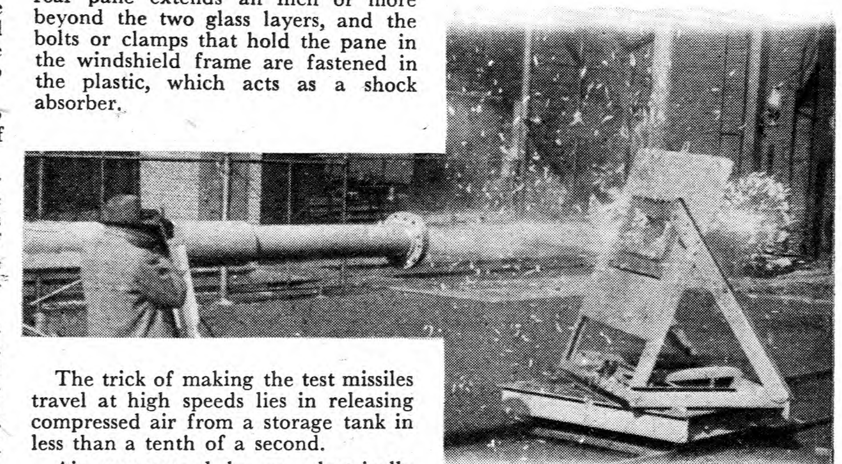
A medium-sized bird smashing into a windshield can cause a lot of damage.

One bird broke through the windshield of an aircraft, punched a hole in the metal bulkhead of the pilot's compartment, travelled the length of the aircraft, and burst through the rear wall into the baggage compartment.

Westinghouse engineers devised a "cannon" that would shoot birds at a windshield panel. The gun was fitted with interchangeable barrels for different-sized test missiles, which in some cases consisted of bodies of chickens and turkeys, then fired by compressed air at the glass panels being tested.

Using the cannon, experts developed new windshields consisting of a single layer of full-tempered glass on the outside, an air space, then an inside panel made of two sheets of glass separated by a thick filling of plastic. Air, heated by the engine exhaust, circulates in the enclosed space to de-ice the windshield.

The full-tempered glass is heat-treated to make it seven times as strong as ordinary glass. The plastic in the rear pane extends an inch or more beyond the two glass layers, and the bolts or clamps that hold the pane in the windshield frame are fastened in the plastic, which acts as a shock absorber.



The trick of making the test missiles travel at high speeds lies in releasing compressed air from a storage tank in less than a tenth of a second.

Air compressed by an electrically driven pump is stored in a bathtub-sized tank underneath the barrels. Pressures required for the experiments ranged from 100 to 200 pounds..

Stories are often heard of Midwest cyclones driving fragile straws through the walls of wooden buildings, so the researchers decided to test the authenticity of such tales with the cannon.

The cannon pushed straws into a three-quarter-inch thick pine board mounted a foot in front of the muzzle. The board looked like a porcupine after the shot. With greater pressures it had made the straws go all the way through the wood.

Nails mixed in the straw were hammered through the board as neatly as any carpenter could do it.

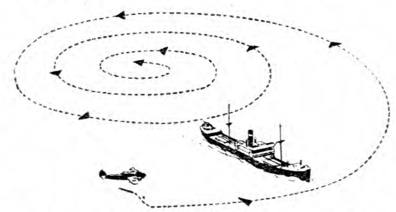
Torpedo Attacks

by B. J. Hurren

THE fact that there is an optimum position for attack by torpedo is soon apparent to the keen young aviator and never forgotten by the captain of the ship being attacked. Interesting problems arise for the pilot. We can consider those first—turning aside for a moment to make a quiet gibe at the Hun. For, as must be evident, since it takes courage, initiative and, above all, a period of sound training to teach a pilot how to manœuvre to the correct aiming position, and since the Hun saw himself short-suited in all three qualities, he decided on what he thought was a wonderful new idea.

Going Round in Circles

Briefly, he said that all the problems involved in the triangle of attack hinge upon the straight path of the running torpedo. Remove the straight run, and the triangle does not arise. To effect this collapse of the triangular problem he decided to have the torpedo's rudder deliberately offset, so that it would run in a circle or diminishing spiral. With this technique the torpedo could in theory be dropped at any point forward of the beam of the ship being attacked, and then, running in a helical track, would eventually find a hit.



A helical track proves extraordinarily wasteful in torpedoes.

These methods semed to him excellent for attacking a convoy, and on some of the North Russian trips his Heinkels launched broadsides of three torpedoes, some running helically, some running straight. This "browning" attack proved extraordinarily wasteful in torpedoes—as he might have learned had he been able to be present in the ward room of the old *Courageous*, where this idea was thrashed out at least two decades ago.

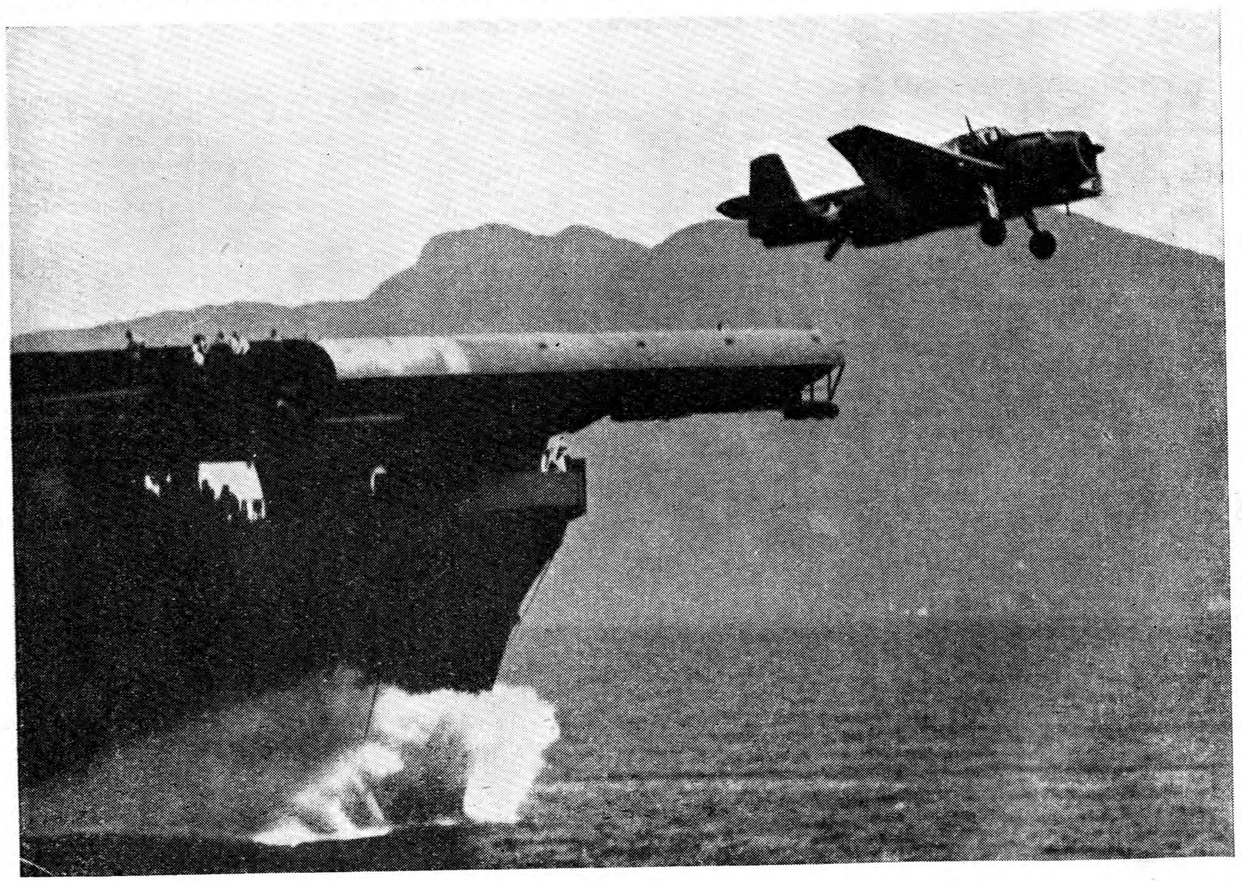
Course Always Changing

To return to the standard methods of torpedo attack. It is important to bear in mind that whether the ship continues on a steady course or alters course, to pilots in formation she must always be on a changing course. The only exception is dead ahead or astern, and as explained later there are good reasons against those positions.

Presuming the optimum point to be on a bearing 45 degrees from the ship's course (i.e. ahead and on the bow), you could have a succession or wave attack planned. In this, one after the other, at short intervals, pilots would arrive at the chosen spot, which for simplification in explanation we will call point D (for dropping).

Beating the Defence

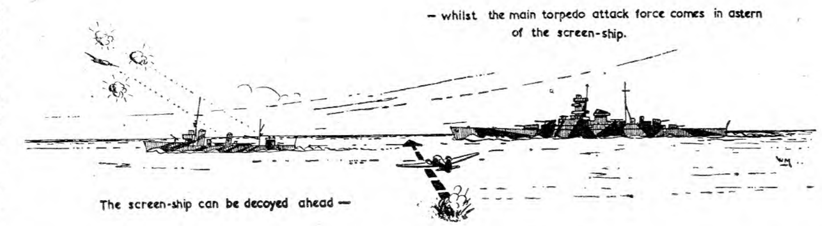
But if the ship being attacked has a screen of any sort—and certainly it will have if it is a capital ship—then D is exactly the spot where the defending destroyer will be sited, with the deliberate intention of baulking aircraft-launched torpedo aim. In this event the pilot is forced either



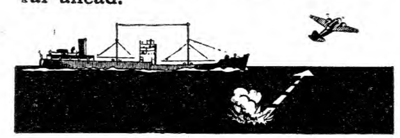
to come right in close to the target and almost certainly be shot down by A.A. multiple guns, or else to drop outside effective torpedo range.

One method of countering this is to attack in formation. In flight of three (whether V, echelon, abreast or in line astern is immaterial) the cover provided by the screen destroyer can be avoided, since at worst the flank aircraft can skirt the baulking ship. Skilful positioning will also result in the defending destroyer being in line of fire from the target ship, which cannot shoot at the low-flying torpedo aircraft without shooting through its own screen ship.

Alternatively, by using a small force to engage the attention of the destroyer—and destroyers have been known to sacrifice themselves deliberately on running torpedoes in order to save the main unit from a hit—the screen ship can be decoyed ahead whilst the main torpedo attack force comes in astern of the screen ship.



In this event far more attention must be paid to deflection aim. To approach a ship on the beam is to place before a pilot an almost irresistible temptation to aim directly at that ship, whereas the only way to get a hit is to aim far ahead.



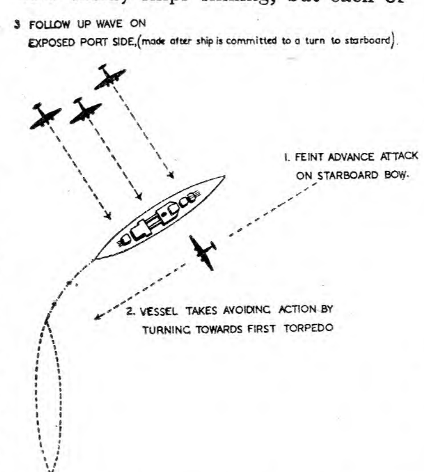
The only way to get a hit is to aim ahead.

Kidding the Captain

In addition to the tactics for drawing off the screen ships, there exists also the feint attack for committing a major target to a turn from which it cannot recover in time for avoidance of the next wave attack.

If two or more torpedoes are running towards a ship, and to its captain they appear to have been dropped in position D or thereabouts, his best chance of avoiding a hit is to turn *towards* the torpedoes.

But a big ship is not to be turned like a motor-car. It takes an appreciable time for the helm to be answered, and, once answered, as the stern begins to swing port or starboard in response to the rudder action, then it takes a considerable time to check that turn and a much longer time to alter to the opposite course.



Thus a captain may be trapped by a feint advance attack on, say, the starboard bow into committing himself to a turn to starboard; and then the follow-up wave finds him committed to a line of action which he cannot alter in time to avoid torpedoes launched on his exposed port quarter.

Work it out for Yourself

It may sound a primitive method of instruction, but many of these problems can be worked out with match-sticks and match-box. Make a model aeroplane by crossing and glueing together two match-sticks, and you can readily simulate the whole fascinating problem of torpedo attacks.

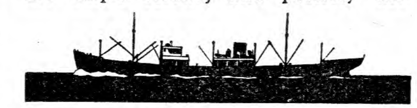
One thing is sure: in no other form of military flying, except perhaps the massed flights of big bombers and long-range fighters on day raids, is so much individuality required of each pilot and so concerted a teamwork demanded of the attack force as a whole. The selfish pilot who jockeys always for the plum position and never takes on the more awkward shots is likely to throw out of balance the whole scale of an attack.

Moreover, in no other form of flying do surprise and novelty pay such dividends. It is not expedient here to disclose some of the stunts which have left enemy ships sinking, but each of them shows to advantage that brilliant quality of extemporisation and improvisation which is a peculiar characteristic of British pilots.

Don't Forget the Superstructure

In working out possible lines of attack, bear in mind two important but often overlooked factors. Every ship under way has a bow wave. The exact degree of compressibility of the water immediately ahead of a ship is dependent on bow shape and ship speed, and is not fully understood by scientists.

It is, however, a fact that it is quite difficult to hit something directly ahead of the ship's bow, as the wave there tends to carry the object away from the stem to one side or the other. Thus a torpedo approaching absolutely dead ahead is likely to be deflected by the bow wave. Conversely, the torpedo approaching directly, or nearly directly, from astern is liable to be upset in its running by the water disturbances caused by the churning of the ship's screws, and possibly the

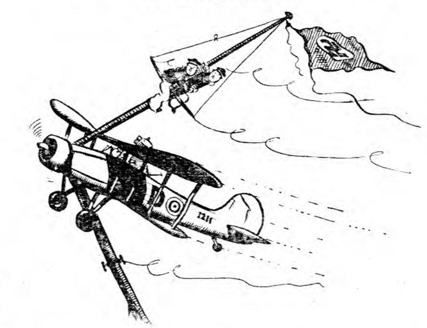


The bow wave is dependent on the bow shape and the ship's speed.

violent disturbance to water flow caused by rudder application as the ship is turned to another course.

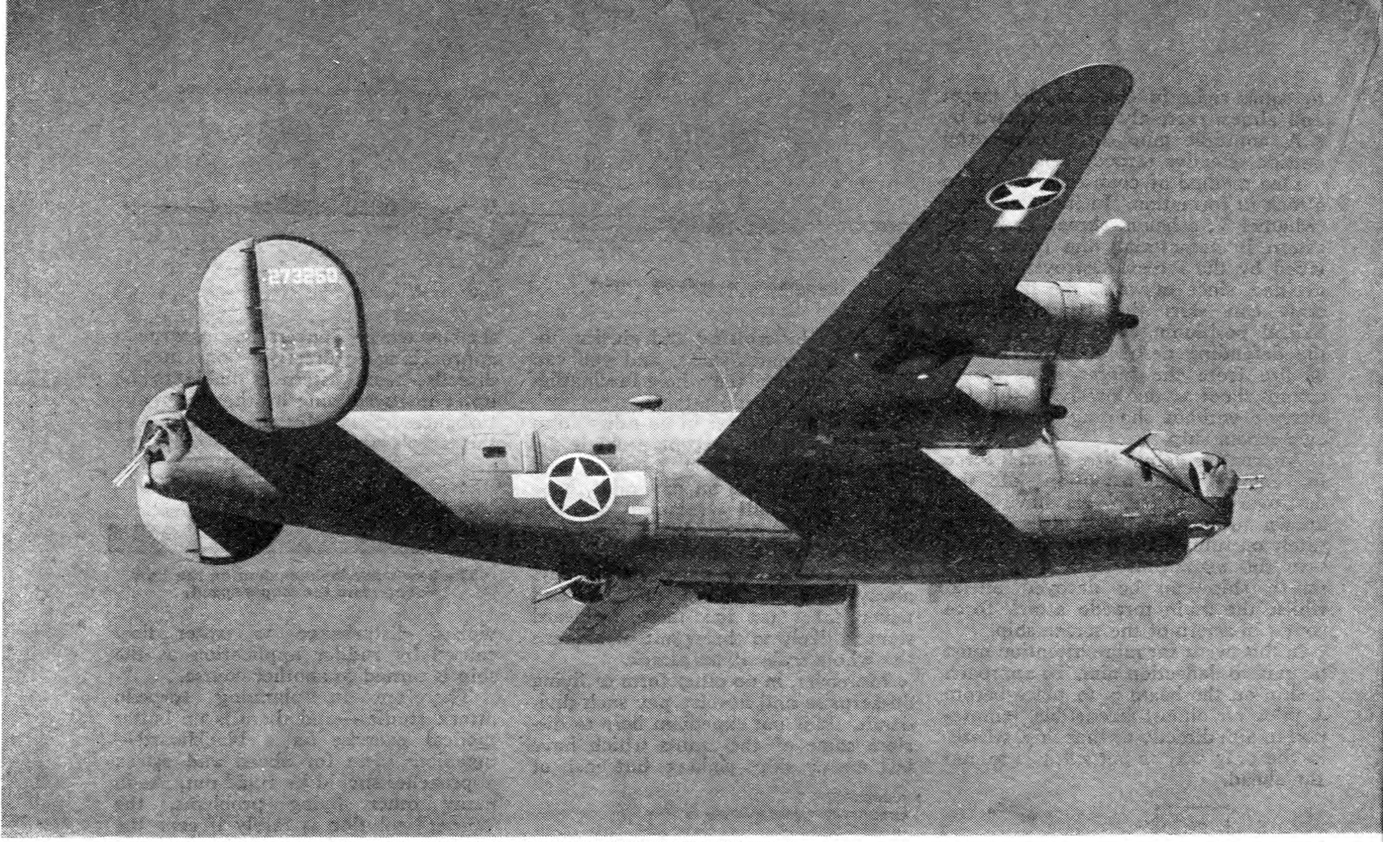
Therefore in planning torpedo attack studies—and there is no better tactical exercise on a blackboard—ingenious ideas for ahead and astern approaches should be ruled out. As in many other flying problems, the "clever" solution is rarely if ever the most sound or effective. One word of warning to the "umpire" and over-zealous solvers—a ship has superstructure and masts which, if they are not to be flown into, must be avoided.

Masts, if they are not to be flown into, must be avoided.



Though the statistics show that the accident rate is declining, we are not satisfied. Every accident represents a lamentable waste of labour and materials, and perhaps a precious life and skill. It is our duty to see that each member of a crew whose lives depend on any one of its members is as skilled as practice and as swift in thought and action as training can make him.

—Sir Archibald Sinclair, in the House of Commons.



Consolidated LIBERATOR

RECENT releases by the U.S. Office of War Information have officially disclosed the existence of the Consolidated B-24 H and J heavy day-bombers. The modifications to these models are concerned chiefly with increasing the defensive fire-power and rearranging the armament to eliminate blind-spots which were present on earlier B-24s. The B-24J now has a new nose incorporating a redesigned bomb-aimer's prone position affording a much-improved all-round view and clear vision for bombing through a large optically-flat glass panel. Above this is a revolving power-operated nose turret mounting two 0.5-in. machine-guns, built and designed by the Emerson Electric Co. This installation replaces and improves upon the former nose armament of three 0.5-in. free guns on universal ball mounting. A Consolidated front turret is substituted on some B-24s owing to a one-time shortage of Emerson turrets.

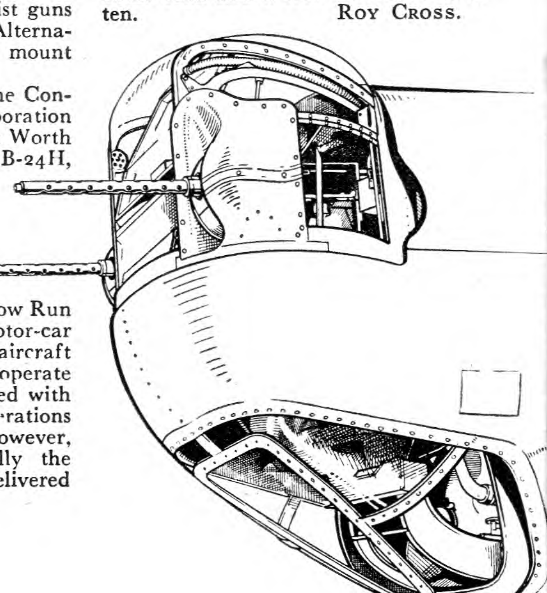
Another addition is a Sperry-designed belly turret mounting two 0.5-in. guns built by Briggs and the Emerson Electric Co. It is similar to the Sperry ball turret of the B-17G Fortress, except that the Liberator turret retracts into the fuselage. The remaining armament is as follows: a Martin powered top turret behind the pilots' compartment and a Consolidated tail turret, both with two 0.5-in. Browning guns; two 0.5-in. waist guns firing through beam windows. Alternatively, the waist positions may mount four guns.

The B-24J is being built by the Consolidated Vultee Aircraft Corporation at both its San Diego and Fort Worth plants. A similar version, the B-24H, is produced by the Ford factory at Willow Run, whose output for the last quarter of 1943 was five times that for the first quarter of the year. Some trouble was experienced at Willow Run owing to the introduction of motor-car assembly-line methods to the aircraft production lines, which did not operate with advantage when confronted with the frequent introduction of alterations and changes to aircraft. Now, however, Fords are swelling substantially the large numbers of B-24s being delivered to the U.S.A.A.F.

The heading photo is of a B-24H produced at Willow Run, with what looks to be a Consolidated nose turret. The sketch shows the more usual Emerson front turret and bombardier's prone position.

The motors are four 1,200-h.p. Pratt & Whitney Twin Wasp R-1830-S4C4-G with turbo-superchargers, giving a service ceiling of 36,000 ft. Empty weight is 34,933 lb. and loaded weight is over 56,000 lb., including a 3½-ton bomb load and a crew of from five to ten.

ROY CROSS.



MORE OF THE BEST

1. F/S Eric Moore, R.A.F.V.R., D.F.M.
2. F/O Granville Wilson, D.S.O., D.F.C., D.F.M.
3. W/O N. F. Williams, C.G.M., D.F.M. and bar.
4. W/C R. H. Harries, D.S.O., D.F.C. and two bars.
5. W/C D. E. Gillam, D.S.O., D.F.C. and bar, A.F.C.
6. G/C J. A. Searby, D.S.O., D.F.C.
7. F/Lt. J. A. Broadley, D.S.O., D.F.C., D.F.M.
8. S/L W. C. E. Craig, D.F.C. and bar.
9. S/L Lewis David Leicester, D.F.C.
10. F/O A. F. Bircher, D.F.M.

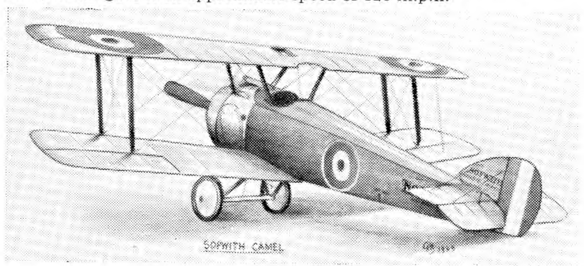
The Vought-Sikorsky Corsair fighter is fitted with a 2000-h.p. Pratt and Whitney Double Wasp engine. Span 40 ft. $11\frac{1}{2}$ in.

THE LAST WORD—THEN

SOPWITH CAMEL

One of the most successful single seat fighters produced during the 1914-18 War. A product of the Sopwith Aviation Company, Kingston-on-Thames, this small (and for those days) highly efficient aircraft played a great part in the winning of the war in the air. Armed with two Vickers guns, and possessing exceptional powers of manœuvre, the Camel earned an excellent reputation as a fighter. It was no novice's friend, for it took patience and careful handling to master some of its vices. Owing to the small span the effect of the gyrating rotary engine produced great engine torque, and it was vicious and sometimes dangerous in a turn. Its sensitivity was attributed also to a pronounced dihedral on the lower plane and none at all on the top plane.

In the latter stages of its development it was usually fitted with a 200-h.p. Bentley Rotary—the most powerful engine of its kind at that time, which gave it an approximate speed of 120 m.p.h.



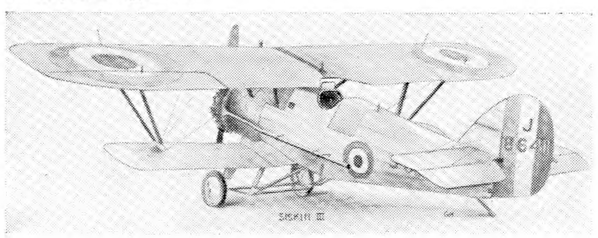
SOPWITH CAMEL

ARMSTRONG WHITWORTH SISKIN

For several years the Armstrong Whitworth Siskin contributed at least 60 per cent. of the total fighter strength of the R.A.F. First appearing in 1924, it underwent a series of modifications (chiefly concerning the type of Jaguar engine fitted), and it was eventually the Mark IIIA. with which most of the squadrons were equipped.

Of unconventional design, and technically known as a sesquiplane, the Siskin had a good performance and was very manœuvrable. A noteworthy feature, discernible in the drawing, was the deep chord of the top plane, uniform throughout its length except for slightly tapered tips. It was virtually a high wing monoplane, for the lower wing was small in area and could really only be classified as an "additional lifting surface" and as a platform for the wide Vee struts.

The Siskin was invariably fitted with a 14-cyl. Armstrong Siddeley Jaguar radial engine, originally of 385 h.p., but later models, fully supercharged, yielded more power, giving it a top speed of around 100 m.p.h. at 15,000 ft.



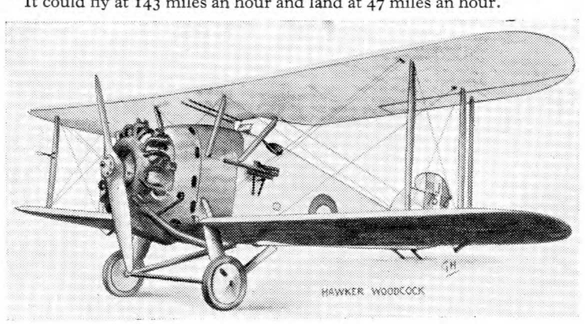
SISKIN III

HAWKER WOODCOCK

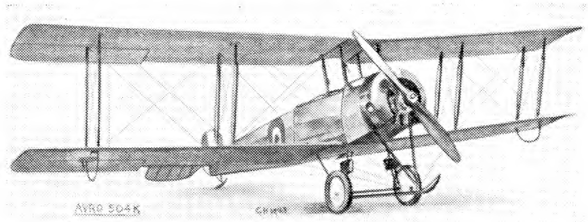
Appearing in 1925, the Hawker Woodcock was probably the last machine to retain features peculiar to nearly all Sopwith aircraft—notably the shape of the fin and rudder. Centre section and several constructional details.

The Woodcock became the standard night fighter of the Royal Air Force, and survived until 1929. It was originally powered with a Bristol Jupiter IV air-cooled radial engine of 380 h.p. and possessed a wide speed range and was thus particularly suitable for night operations.

It could fly at 143 miles an hour and land at 47 miles an hour.



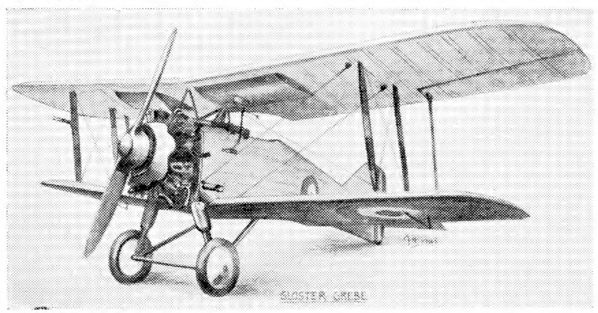
HAWKER WOODCOCK



AVRO 504K

AVRO 504

One of the most outstanding aeroplanes ever designed and most certainly the finest training aircraft of its time. The original Avro was produced just before 1914, and with modifications it survived until 1930. Powered with one of the many types of rotary engines, the two most widely used being the 100-h.p. Monosoupape and the 80-h.p. Le Rhone, it was the safest training aircraft in the world. A top speed of between 75-100 m.p.h., a low stalling speed, exceptional stability, and a reputation of "landing itself," this trainer was more popular than any type in existence.

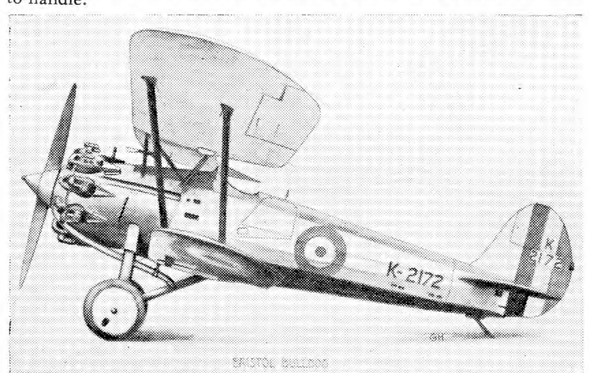


GLOSTER GREBE

GLOSTER GREBE

A single seater fighter of 1925 used extensively by the Royal Air Force, the Gloster Grebe was one of several successful aeroplanes designed by Mr. Folland, who was responsible for that remarkable aeroplane—the S.E.5. Several features of the S.E.5 were to be found in nearly all the aircraft designed by him for Glosters.

The Grebe was a single bay biplane with wings of unequal span, and was powered with an Armstrong-Siddeley Jaguar of 325 h.p.—one of the early series of this type with open exhausts. It could fly at about 130 miles an hour at 10,000 ft., was manœuvrable, and a pleasant machine to handle.



BRISTOL BULLDOG

BRISTOL BULLDOG

First appeared in 1928. Replaced the Siskin and Gamecock as a first line fighter. It underwent numerous modifications, and the Mark IIA of 1932 is depicted in the drawing.

The Bulldog had an excellent reputation as a fighting aircraft. It was reputed to be delightful to handle, manœuvrable and safe. It was constructed of steel and was thus of great strength. All surfaces except the fuselage forward of the cockpit were fabric covered. The Bristol Jupiter VIIF.P. of 490 h.p. was neatly housed, the rear of each cylinder being faired with a small "V" piece fillet. Later models had Townend rings which decreased drag.

The armament was two fixed Vickers 0.303 guns firing forward and housed in channels each side of the engine cowling. The belt boxes contained 1,200 rounds of ammunition. Four 20-lb. bombs in racks below the lower plane could be carried. GODFREY HOWARD.

Carburettors Reconsidered

by a Naval Engineer Officer

EXPERIENCE has shown that carburettors in which the supply of fuel is governed by a float are not entirely suitable for combative aircraft, since high-speed aerobatics disturb their smooth working. The reason for this is that the float is not rigidly attached to the body of the carburettor but is free to move up and down.

When an aircraft is thrown into a dive it is subjected to negative G. The effect on the fuel in the float chamber of the carburettor and on the float itself is as though gravity were acting upwards instead of downwards. Petrol is forced to the top of the float chamber, and the float moves towards the bottom, thereby opening the needle wider as more petrol flows in. Thus, as the float chamber becomes full of petrol, an excess quantity passes to the jets, and the engine cuts. This is known as a rich-mixture cut. When pulling sharply out of a dive the state of affairs is reversed, and the engine may cut with a weak-mixture cut.

Other aerobatics also are liable to produce rich-mixture or weak-mixture cuts in engines fitted with float-type carburettors. Carburettors of the injection or diaphragm type are quite free from this liability. For this reason an increasing number of them are now being fitted in Fleet Air Arm aircraft. Unlike the other types, they are not developments of simple carburettors; they work on quite different principles. It will help towards an easy understanding if, before considering how they work, we obtain first of all a clear picture of what the carburettor of a combative aircraft has to do and then study how each different type does it.

Metering

The primary duty of an aircraft carburettor is to meter the fuel in proportion to the weight of air passing to the engine. This function of metering or measuring is often lost sight of. To make a good explosive mixture only just over one ounce of fuel should be mixed with one pound of air. Petrol will burn in a cylinder if mixed with anything between eight and eighteen times its weight of air, but for reasonably efficient running and smooth working of the engine, the practical proportion will be rather less, namely, an air/fuel ratio of between 9 and 14½.

Rich Mixture Required

The easiest way to picture the variations required in the mixture strength is to consider an aircraft making a flight. When the engine is first started up it must tick over at a slow rate until it is thoroughly warmed up. Further slow running on the ground occurs when it is waiting to take off. While the engine is slow-running the stream of air flows slowly to the engine. This may cause the evaporation of the fuel to be comparatively poor: some fuel may be deposited on the walls of the supercharger and induction manifold, and finally the exhaust gases left behind in the cylinder dilute appreciably the comparatively small charge drawn in. Hence an aircraft carburettor requires special arrangements to give a rather rich mixture for slow running.

Weak Mixture Required

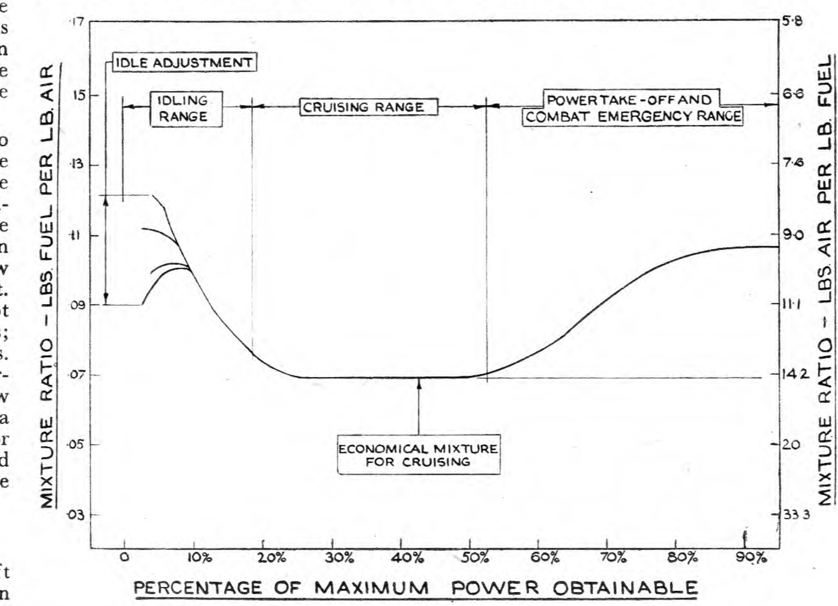
When the signal to take off is given the pilot advances his throttle lever. The suction of the engine causes a rush of air. There is a slight time-lag before the petrol flow speeds up to the changed conditions. The mixture momentarily tends to be too weak for combustion and causes the engine to cough or even cut completely. Some device is required to maintain the correct mixture strength while the sudden change is taking place.

Rich Mixture Again

A loaded aircraft requires maximum power to become airborne in the least possible time. An aircraft loaded with full crew and torpedo must be airborne in less than 300 yards when taking off from the deck of an aircraft carrier. To achieve this the engine has to develop considerable overload for about a minute. If the normal mixture were supplied there would be a risk of detonation, with disastrous results to the engine and to the aircraft. If a rich mixture can be arranged it reduces the risk of detonation, partly because of its cooling effect, more particularly because a rich mixture burns rather more slowly. Similar conditions apply when the engine is driven to its utmost during combat. Thus, when the throttle is "beyond the gate" the carburettor must automatically give a rich mixture.

Cruising Mixture

When well clear and at the proper height the aircraft will travel at cruising speed until it reaches the target area. The mixture supplied to the engine over its range of cruising speeds should be as economical as possible. In some cases two mixtures are available for cruising speeds—a weak mixture to give maximum economy and a rich cruising mixture to give reasonable economy while keeping the engine cooler and allowing it greater flexibility if sudden manœuvres are likely.



The tendency in modern British aircraft is to have one mixture only in the cruising range.

Constant Mixture

As the aircraft climbs, the atmosphere becomes thinner. At 18,000 ft. the weight of air in a given space is only half that at ground level. Unless some special device were fitted to the carburettor the mixture would become increasingly rich as the aircraft climbs. In order to relieve the pilot of the necessity of making frequent adjustments an automatic device must be incorporated in the carburettor to maintain the mixture constant at all heights.

Figure 1 is a graph showing typical

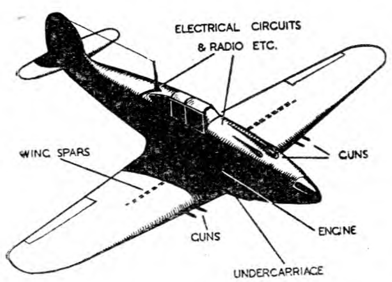
CONTINUED ON PAGE 18

A. M. COLBRIDGE on *Distant Reading* COMPASSES

THE normal type of aircraft compass fitted on or near the instrument panel is surrounded by magnetic materials and electric circuits. Thus in order to prevent distortion of the reading it is necessary to adopt elaborate screening and other corrections. All iron or steel parts in the neighbourhood of the compass are liable to affect its accuracy. The effect of the undercarriage alone is different when it is extended from that when it is retracted.

Where the Master Compass Goes

To obviate this difficulty the distant reading compass has been produced. Briefly, this consists of a master compass — which may be conveniently located away from source of disturbance—coupled to a repeater compass or an indicator in the pilot's cockpit, usually on the instrument panel. The master compass is generally located in the rear of the fuselage, or even in the fin of the aircraft, where it is comparatively free from the disturbing influence of the metallic parts of the



structure, such as engines, wing spars, guns, etc., and also well clear of the electrical circuits closely linked with the instrument panel.

Many Varieties

Distant reading compasses are known to have been produced in many of the leading aeronautical nations, but little or no information is available of British types. Details of two German units are known, however, and both operate on different principles.

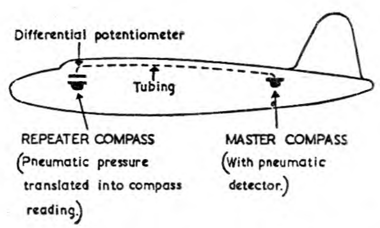
Each system must consist essentially of a master compass, i.e. a true magnetic compass, and a repeater compass or indicator, generally found in the instrument panel, and some method of transmitting the reading from the master compass to the repeater.

The Askania

The first system to be described is the Askania distant reading compass, in which the operating link is pneumatic.

The master compass consists of a double pivoted magnetic compass with a liquid-filled bowl to dampen oscillations. The overall dimensions are 9

ASKANIA SYSTEM



in. high with a diameter of $9\frac{1}{2}$ in. This is located in the fuselage just in front of the tail unit on a Dornier Do 17P. The weight of the master compass is $5\frac{1}{2}$ lb.

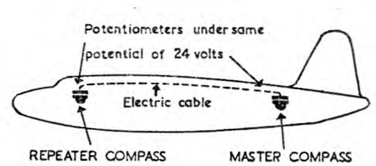
Pneumatic System

To the top of the compass, and directly connected to the magnets, is a pneumatic detector. The position of the compass needle gives a certain set to the detector, corresponding to a known pressure in the pneumatic system. The detector is directly connected, by suitable tubing, to an indicator mounted on the pilot's instrument panel. This indicator consists of a diaphragm-type differential manometer, and the pressure in the pneumatic system is translated, on the indicator dial, into a reading corresponding to that of the master compass.

Electrical System

The second system is the Patin and Siemens distant reading compass. Again the master compass is similar in construction and is mounted in the rear of the aircraft. The main difference is the use of electrical energy to transmit the reading to the repeater compass. The base of the pivoted part of the master compass is in effect a circular potentiometer with a potential difference applied of 24 volts. Any variation in position of the compass needle carries a corresponding difference in resistance in the electrical circuit.

PATIN & SIEMENS SYSTEM



The potentiometer is connected by electrical cable to a similar potentiometer on the repeater compass or indicator on the instrument panel, also under the same potential of 24 volts. The whole master compass unit of the Patin and Siemens type is $7\frac{1}{2}$ in. high, $20\frac{1}{2}$ in. long and 12 in. wide; the weight is $9\frac{1}{4}$ lb.

The repeater compass is somewhat larger than the Askania type, having a $4\frac{1}{2}$-in. diameter dial. On the aircraft in question, a Heinkel He 111, it was positioned and closely linked with the directional gyroscope. The servo motor used to drive the compass repeater also serves to drive the directional gyroscope, the potentiometer being so arranged that the indicator hunts until in such a position that the circuit is in symmetry with that of the master compass, i.e. the readings are identical. The total weight of the indicator is $2\frac{3}{4}$ lb.

Carburettors Reconsidered

CONTINUED FROM PAGE 17

mixture strengths required for different powers of the engine.

If an aircraft climbs to a height where the temperature is low, or into certain atmospheric conditions, ice will form in the air passages of the carburettor and reduce to a dangerous extent the power that the engine can develop. A special requirement of an aircraft carburettor, therefore, is that it should be free from any liability to freeze up: it must continue to operate correctly in icing conditions of flight.

Reference has been made to the effect of high-speed aerobatics on the performance of the carburettor. It is essential that carburettors fitted to cambative aircraft be designed to work normally under such conditions.

To sum up, then, the requirements of an aircraft carburettor are:

(i) To meter the fuel in proportion to the weight of air passing through it.
(ii) To provide a slightly rich mixture when the engine is slow-running.
(iii) To maintain a correct mixture while the throttle is advanced.
(iv) To provide an increasingly rich mixture for overload conditions.
(v) To supply weak mixture at cruising speeds, for economy of fuel.
(vi) To maintain automatically a correct mixture at all altitudes.
(vii) To continue to work smoothly during aerobatics.
(viii) To operate correctly in icing conditions of flight.

A question of COLOUR

by JOHN SINCLAIR

LITTLE imagination is required to understand the wisdom of the R.A.F. in insisting that pilots, navigators and bomb-aimers shall possess a high standard of colour vision, but the average cadet, training to become, say, a wireless-operator/air-gunner or a wireless mechanic, may perhaps have wondered why he, too, must possess exceptionally good colour vision.

It is not the purpose of this article to discuss the reasons for, or degrees of, colour blindness, but rather to indicate why cadets must be free from this defect.

In simple words, colour blindness is a defect of vision which prevents a person from accurately defining or recognising colours or shades of colour. Many people are colour blind without knowing it, and unless their vision is checked by means of one of the recognised tests they will go through life in blissful ignorance of the fact. A person wl.o is colour blind may have no difficulty in recognising the difference between, say, red and green, but when confronted with green and blue he will be unable to define them accurately.

We shall now see why the accurate definition of colours is essential to men in the signals trades, and to air-crew wireless-operators and mechanics.

Aldis Lamp Signals

The ordinary Aldis lamp is generally operated with a plain glass lens, but frequently coloured screens — red, green and amber — are substituted. Imagine, if you can, the confusion that would arise if an aircrew operator failed to recognise instantly the colour of the lens being used from, say, the control tower.

Aldis-lamp signalling, useful as it is for normal ground-to-air and air-to-air purposes, assumes an even greater value when used by aircraft of Coastal Command. The correct reading of a flickering signal from a tanker may mean the difference between life or death to the crew. No chance can be taken with the eyes of the man aloft whose task it is to translate the hidden meaning behind the message sent through a red or green lens.

Electrical and Radio Equipment of Aircraft

Let us turn now to an even more important reason for requiring a high colour-vision standard from wireless mechanics—air and ground.

Have you ever examined the internal wiring system of a modern bomber? If not, then make a special point of doing so during your next visit to an R.A.F. operational station. Unless you are electrically minded the chances are that you will say to yourself: "It looks pretty complicated, but I imagine it isn't, really." You would be wrong, for it *is* a most complicated job of work. But for those "in the know" the maze of wires becomes "an open book." The key to the maze is contained in the word "colour." By adopting a recognised "colour code" of wiring the trained mechanic can trace quickly every connection.

It is for this reason that a high standard of colour vision is required from ground wireless mechanics. The air operator, too, must be able to trace the wiring of his electrical and

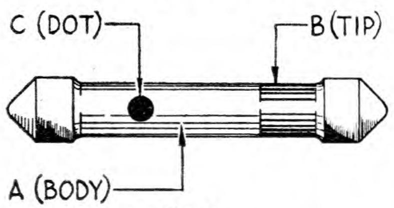


Fig. 1.
Shows how to identify resistors by means of the colour code.

wireless equipment and be ready to effect a temporary repair whilst air-borne.

The Colour Code for Aircraft Circuits

It would be quite impossible in the space of a short article to describe all the circuits encountered in modern aircraft, but the following list of major circuits and the colours used to identify them will serve to show the need for good eyesight.

Red—Radio circuits.
Yellow—General aircraft wiring.
Blue—Ignition circuits.
Green—Intercom. circuits.
White—Bomb-release circuits.
Grey — Retractable undercarriage circuits.

Bearing in mind that the electrical equipment in a modern bomber contains upward of a dozen different circuits, the task of an air operator would become a nightmare unless he can recognise the distinctive colour marking used for each circuit.

The following is an abridged list of some of the more commonly known circuits used in a "Wimpey":

(1) Lighting (about 50 points), (2) heating, (3) bomb release, (4) fuel, (5) undercarriage, (6) flap indicator, (7) electrical starting, (8) rev. indicator, (9) battery charging, (10) reflector gun-sights, (11) automatic gunsights, (12) flotation gear for dinghy, (13) fire extinguishers, (14) de-icing.

And remember, this is only the *electrical equipment.*

Consider now the problem of the wireless sets themselves. Look inside your own broadcast set and note the maze of connections. Then if opportunity presents itself take a peep inside one of the new G.P. sets installed in a modern bomber. You will appreciate instantly the need for good colour vision, for the set is, to the uninitiated, a jumble of multi-coloured wires that appear to lead nowhere and come from anywhere!

The trained mechanic, however, can tell at a glance where every lead begins and terminates. He can say without hesitation: "That green wire is the grid bias lead to the frequency changer"; "That blue lead is the H.T. negative feed to the detector." Unless he possessed extremely good colour vision he might easily confuse the blue and green wires—and with what dire results only the wireless engineer can appreciate!

Recognising Components

The need for a simple colour code to identify resistances and condensers was recognised by component manufacturers as soon as wireless equipment passed from the crystal-set stage. The modern wireless receiver employs upwards of 40 resistances of varying values and nearly as many small fixed condensers. In the early days of wireless it was the custom to stamp the value on the condenser case or along the body of the resistance, but as designs became more complicated and space more limited, a more satisfactory method had to be evolved.

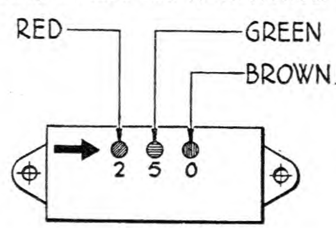
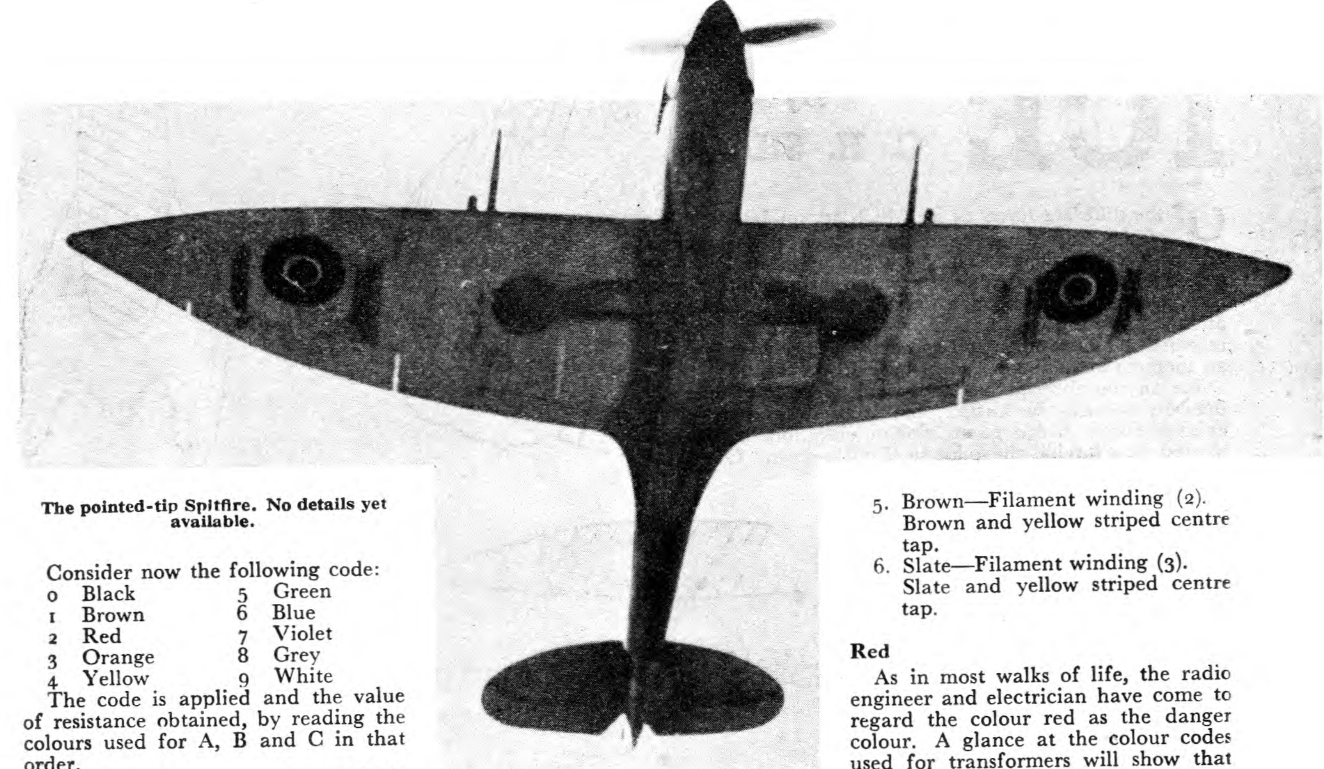


Fig. 2.
Small fixed condensers are often identified by means of small dots arranged in accordance with the colour code.

The resistance colour code is very simple to apply, provided the would-be mechanic will spend a little time committing to memory the order of the colours used.

The diagram Fig. 1 depicts a standard type of resistance. The *body* is marked A and the *tip* B, whilst a *dot* is given the letter C.



The pointed-tip Spitfire. No details yet available.

Consider now the following code:

0	Black	5	Green
1	Brown	6	Blue
2	Red	7	Violet
3	Orange	8	Grey
4	Yellow	9	White

The code is applied and the value of resistance obtained, by reading the colours used for A, B and C in that order.

For example, suppose we wish to find the value of a resistor which has a blue body (A), green top cap (B) and an orange spot (C). We consult the colour-code table and see that *blue* represents 6, *green* 5 and *orange* 3. This last figure represents the *number of noughts that follow the first two figures,* thus the value of the resistor under consideration is 65,000 ohms.

If we had a resistance with red body, yellow cap and black dot, its value would be 24 ohms. The black dot means that no nought follows the first two figures.

What is the value of a resistance which has a violet body, white tip and orange dot? What colours would be used to identify a 25,000-ohms resistor?

It will be noticed that the colours used to represent the figures 2, 3, 4, 5 and 6 follow the spectrum arrangement, viz. red, orange, yellow, green and blue.

Good eyesight is absolutely essential if a wireless mechanic is to earn a reputation for diagnosing faults quickly, for without that faculty it will be impossible for him to check wiring and resistor values.

In the case of small fixed condensers a similar type of colour code is employed. The condensers are marked with three coloured dots, with an arrow or other symbol indicating the sequence of colours. Readings are in *micro-micro farads* ($\mu\mu$F). Thus a 250-$\mu\mu$F condenser would be marked red (2), green (5), brown (1 nought). (See Fig. 2.)

Coloured wires are often used to identify the connections of transformers.

The following are the recognised colours and their identities:

Audio-Frequency Transformers

1. Blue—Plate or anode lead of primary (finish of winding).
2. Red—H.T.+ lead (this applies whether the primary is plain or centre-tapped).
3. Brown—Plate lead on centre-tapped primaries (start of winding).
   Blue may be used for this lead if polarity is not important.
4. Green—Grid lead to secondary (finish of winding).
5. Black—Grid return (this applies whether the secondary is plain or centre-tapped).
6. Yellow—Grid lead on centre-tapped secondaries (start of winding).
   Green may be used for this lead if polarity is not important.

Intermediate Frequency Transformers

1. Blue—Plate or anode lead.
2. Red—H.T.+ lead.
3. Green—Grid or diode lead.
4. Black—Grid or diode return.

Power Transformers

1. Black—Primary leads.
   If tapped: Black—Common.
   Black and yellow striped—Tap.
   Black and red striped—Finish.
2. Red—High-voltage plate or anode winding.
   Red and yellow striped centre tap.
3. Yellow—Rectifier filament winding.
   Yellow and blue striped centre tap.
4. Green—Filament winding (1).
   Green and yellow striped centre tap.
5. Brown—Filament winding (2).
   Brown and yellow striped centre tap.
6. Slate—Filament winding (3).
   Slate and yellow striped centre tap.

Red

As in most walks of life, the radio engineer and electrician have come to regard the colour red as the danger colour. A glance at the colour codes used for transformers will show that the high-voltage end of a winding is always identified with a red wire. This colour is also used in aircraft to identify the radio circuits, as it is these circuits that invariably carry the highest currents and voltages.

Conclusions

Enough has been written on this occasion to show the importance of good colour vision for those whose duty it is, or will be, to operate or maintain electrical or radio equipment in aircraft or on the ground. In a future article some hints and tips will be given which will perhaps prove of use to wireless mechanics. In the meantime the writer will be pleased to hear from any reader who has a problem to discuss. Topics for consideration in future wireless articles will also receive every consideration from the Editor.

KINETIC ENERGY

WITH reference to the article, "Variation of Trail Angle," in the February *Gazette*, the author, Squadron Leader Acott, writes:

"Several correspondents have written pointing out that the kinetic energy of a body is $\frac{1}{2}$ mv^2, where m is the mass of the body and v its velocity, and not the product of its weight and speed, as I stated in paragraph 2. It is the momentum of the bomb which is the product of its mass and velocity. Similarly, I should have said later in the article that 'the momentum of bomb "A" is twice that of bomb "B",' instead of 'the kinetic energy of bomb "A",' etc. This does not affect the conclusions reached."

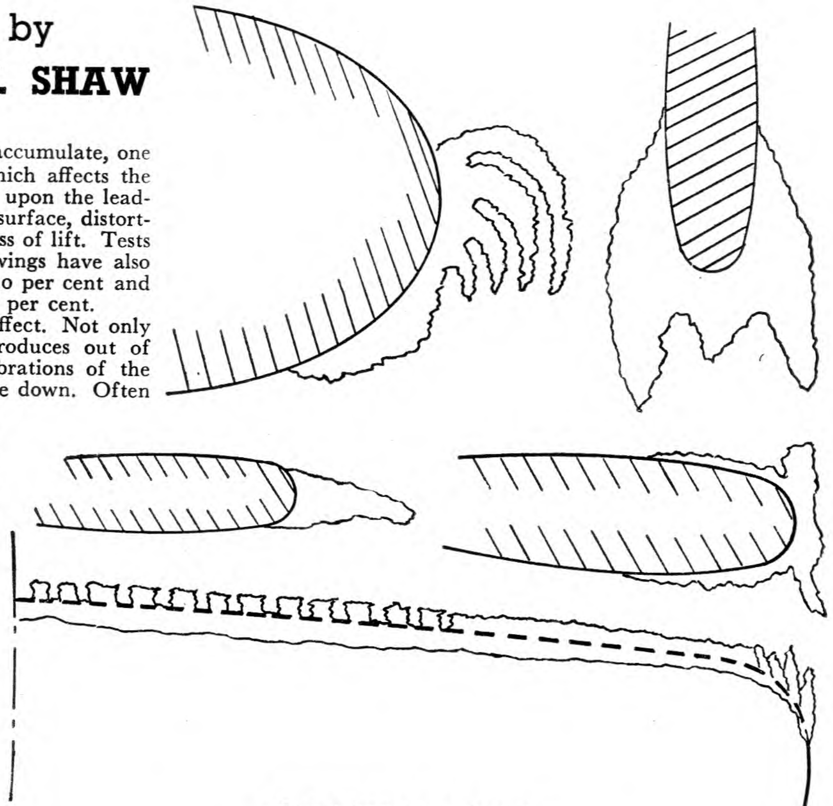
ICE by C. H. SHAW

Of the different forms of ice which accumulate, one of the most dangerous is that which affects the airflow over the wings. The ice builds upon the leading edge, and also spreads out over the surface, distorting the aerofoil contour and causing loss of lift. Tests on this type of ice accretion on the wings have also revealed a reduction in top speed by 30 per cent and an increase in stalling speed of over 12 per cent.

Ice on the airscrew has a twofold effect. Not only does its disturb the airflow, but it produces out of balance forces which cause violent vibrations of the blades, thus forcing the pilot to throttle down. Often the ice breaks away, due to the high tip speeds, and can cause injury to flying personnel and fabric coverings.

The engines can be directly affected by icing conditions because of the natural tendency of the air intake on the carburettor to ice up and become blocked. This difficulty has been a great source of trouble and has caused many fatal accidents in the past.

Other units such as windows, windscreens and bomb-aimers' panels are all liable to become obscured by frost coverings in certain atmospheric conditions.



Typical forms of Ice Accretion.

The Different Forms of Ice

The accumulation of ice can take up various formations dependent upon the atmospheric conditions through which an aircraft is flying. Drops of water in clouds or mist can retain their liquid state even at a temperature well below freezing-point, but little inducement is needed to bring about a change to the solid state—ice. This inducement is provided by contact with the surfaces of aircraft.

The most general classification of ice formation is as follows:

(1) Clear, transparent, glass-like ice.
(2) White, opaque, granular ice (usually called rime).
(3) Frost.

Clear Ice

A light form of transparent ice is possible in light rain or mist containing large drops of water at 0 degrees C. When these drops make contact with the leading edge of the wing they do not congeal immediately, but spread out, forming a thin, glassy surface. This type does not distort the wing profile to any marked extent, and although it adds to the weight of the aircraft it is not considered dangerous.

A more dangerous form of clear ice occurs when flying through supercooled heavy rain or sleet. The surface of the resulting ice becomes very rough and, in the case of sleet, long conical fingers appear at the leading edges. This has the effect of extending the chord and altering the aerodynamic characteristics of the wing, resulting in a loss of lift and an increase in drag.

In heavy rain the drops spread out over the wing surface, often to the trailing edge, where icicles may form. Under these conditions there is a great danger of freezing the clearance gap between the wing and the ailerons.

Rime

The white, opaque type of ice (rime) is formed when an aeroplane whose outside surface is at zero temperature enters a cloud containing very small drops of water well below freezing-point. The drops, being so minute, solidify instantly on contact with the wings, thus preserving their spherical shape and causing the wing to assume an extremely rough contour.

A layer of this ice along the leading edge can reach a great thickness. Accumulation at the rate of one inch per minute has been recorded when flying at 200 m.p.h. through cloud and rain.

Rime also forms into long jagged fingers and claws pointing forward into the airstream from the leading edges.

Frost

Frost is the least dangerous of all types of icing. Like a fine layer of snow it clings to windows and panels, and, at its worst, only restricts visibility. It is caused when a damp surface is cooled to freezing-point.

Modern aircraft are invariably fitted with some form of de-icing apparatus, and our ability to carry the war to the enemy in every kind of weather is due in no small measure to the pioneers in this important branch of aircraft development.

Are You Certain?

(SEE PAGE 19)

1, Bristol Beaufort; 2, Vickers-Armstrongs Wellington; 3, De Havilland Mosquito; 4, Consolidated Catalina; 5, Northrop N3p-B; 6, Handley Page Halifax; 7, Fairey Fulmar; 8, Taylorcraft Auster; 9, Grumman J2-F1; 10, North American Mustang; 11, Boeing Fortress II; 12, Curtiss Seagull; 13, Grumman Avenger; 14, Lockheed Vega Ventura; 15, Hawker Typhoon; 16, Fairchild M-62 Cornell; 17, Douglas DC3 Dakotas; 18, Supermarine Spitfire; 19, North American Harvard; 20, Airspeed Horsa; 21, Fairey Albacore; 22, Lockheed Hudson; 23, Douglas Bostons; 24, Bristol Beaufighter; 25, De Havilland Dominie; 26, Cessna Crane; 27, Supermarine Walrus; 28, Avro Anson; 29, Boeing Clipper; 30, Douglas 8A-5.

BOOKS

Reviewed by Laurence Fletcher

The Model Aeroplane Manual

By I. H. Sparey and C. A. Rippon. 236 pages. $7\frac{1}{4}'' \times 4\frac{3}{4}''$. Percival Marshal & Co. 7/6.

The third edition of this well-known manual has been eagerly awaited by many aeromodellers. Consisting of a comprehensive tutor on the design and construction of flying model aircraft, its latest form, with its attractive blue binding and striking cover jacket, is a distinct improvement on the earlier editions.

The material has been thoroughly revised, and includes the designs of several world-famous models, such as the G.B. 3, world's duration-record holder, and others.

Practical Aircraft Rigging

By P. W. Blandford. Hutchinson's Scientific and Technical Publications. 80 pages. $6\frac{1}{2}'' \times 4\frac{1}{8}''$. Paper covers. 2/6.

Includes chapters on Hydraulics, Pneumatics, Plastics, Aircraft Inspection, Repairs, etc. Some taken from articles in the *A.T.C. Gazette*. The treatment is brief, but the author keeps well to the point, and gets a quart into a pint pot.

Many useful sketches are included which should have a wide appeal to air cadets.

Reviewed by Engineer Rear Admiral J. E. G. Cunningham

1,000 Questions and Answers for Practical Engineers

By P. W. Blandford. Hutchinson's Scientific and Technical Publications. 88 pages. 2/-.

This paper-covered booklet will be of help to aircraft mechanics, but its value doesn't end there because any person will find terse and accurate answers to many questions which continually crop up in the conversations, events of the day and in the course of work. For example, What is friction? What is a calorie? What is the difference between mild and high speed steel? A valuable book to any reader.

Find, Fix and Strike

By Lieutenant-Commander Terence Horsley, R.N.V.R. Eyre & Spottiswoode. 143 pages. 14 full-page illustrations.

Confessedly written to foster a closer bond between the public and the Fleet Air Arm, this book cannot fail to attain its object. The excellent illustrations attract the more-than-usual attention of the casual reader, and as the print is exceptionally good he is tempted to read on and on. And well is he repaid, for he learns of incidents and intense experiences which he has never before heard of. The chapter, "Exit 'Bismarck,'" will hold the attention of the most indifferent because it is dramatic without being too wordy, and aptly illustrates the co-operation between the Fleet and its aircraft and the success attained as a result thereof.

Every branch of Fleet Air Arm work is described by giving details of actual occurences, some failures, and some successes, but all intensely interesting and described in attractive language. The book brings out the fact that whatever work the aircraft of Fleet Air Arm had to undertake the successes obtained were the result of team work together with the individual excellence of the personnel.

Reviewed by the Editor

Flying Crusader

By Isaac Don Levine. 310 pages. $7\frac{1}{4}'' \times 5''$. Peter Davies. 15/-.

The son of a U.S. Senator, brought up with horses and guns, General Mitchell enlisted as a private in the U.S. Army at 18, was commissioned in the Signal Corps, served in the Philippines and Alaska, and became interested in aviation. He pranged his machine on his first solo flight, but learnt some lessons from it, and took command of the 1st

CONTINUED ON PAGE 24

Air Marshal Gossage at a South-West Gliding School.

BOOKS — CONTINUED FROM PAGE 23 Army Corps in France. After the last war he did what he could to build up the American Air Services, but finding himself obstructed he became too outspoken and was deprived of his rank and command by sentence of court-martial in 1925. He died in 1936, but in 1942 Congress posthumously promoted him to full general. This book tells the full story. It is a good story and well told.

Triumph Over Tunisia

By T. H. Wisdom. 202 pages. $7\frac{1}{4}'' \times 4\frac{1}{2}''$. George Allen & Unwin. 8/6.

A Press officer here tells the story of the Tunisia campaign, from the landing on November 8th, 1942, until the victory in May 1943. The writing is a little careless and hurried, but the author has kept to his subject rather better than in his previous book, and has produced a series of reports which, though they do not cover the whole of the campaign in the textbook manner, give vivid impressions of the air fighting.

War Eagles

By James Saxon Childers. 261 pages. $7\frac{1}{4}'' \times 5''$. William Heinemann Ltd. 10/6.

A colonel of the American Army Air Force here tells how a number of adventurous but slightly undisciplined American youths were trained as the Eagle (No. 71) Squadron of the Royal Air Force in 1940 and 1941. The Eagles have now changed into the khaki of the American Air Forces. Their official list of victories is 45 destroyed, $15\frac{1}{2}$ probably destroyed and $24\frac{1}{2}$ damaged, and in addition, of course, there were many victories against ground targets.

Ground Staff

By A. J. Brown. 183 pages. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. Eyre & Spottiswoode. 10/6.

An intelligence officer in a rather discoursive book writes of the R.A.F. as seen from the ground. It has little to do with actual flying, though containing much of interest in other activities.

Published for the Proprietors, The Air League of the British Empire, Kinnaird House, 1a Pall Mall East, London, S.W.1, by the Rolls House Publishing Co., Ltd., Rolls House, Breams Buildings, London, E.C.4, and printed by the Stanhope Press Ltd., Rochester, Kent.

A good example of precision bombing. Fortresses attacking an aerodrome near Amiens.