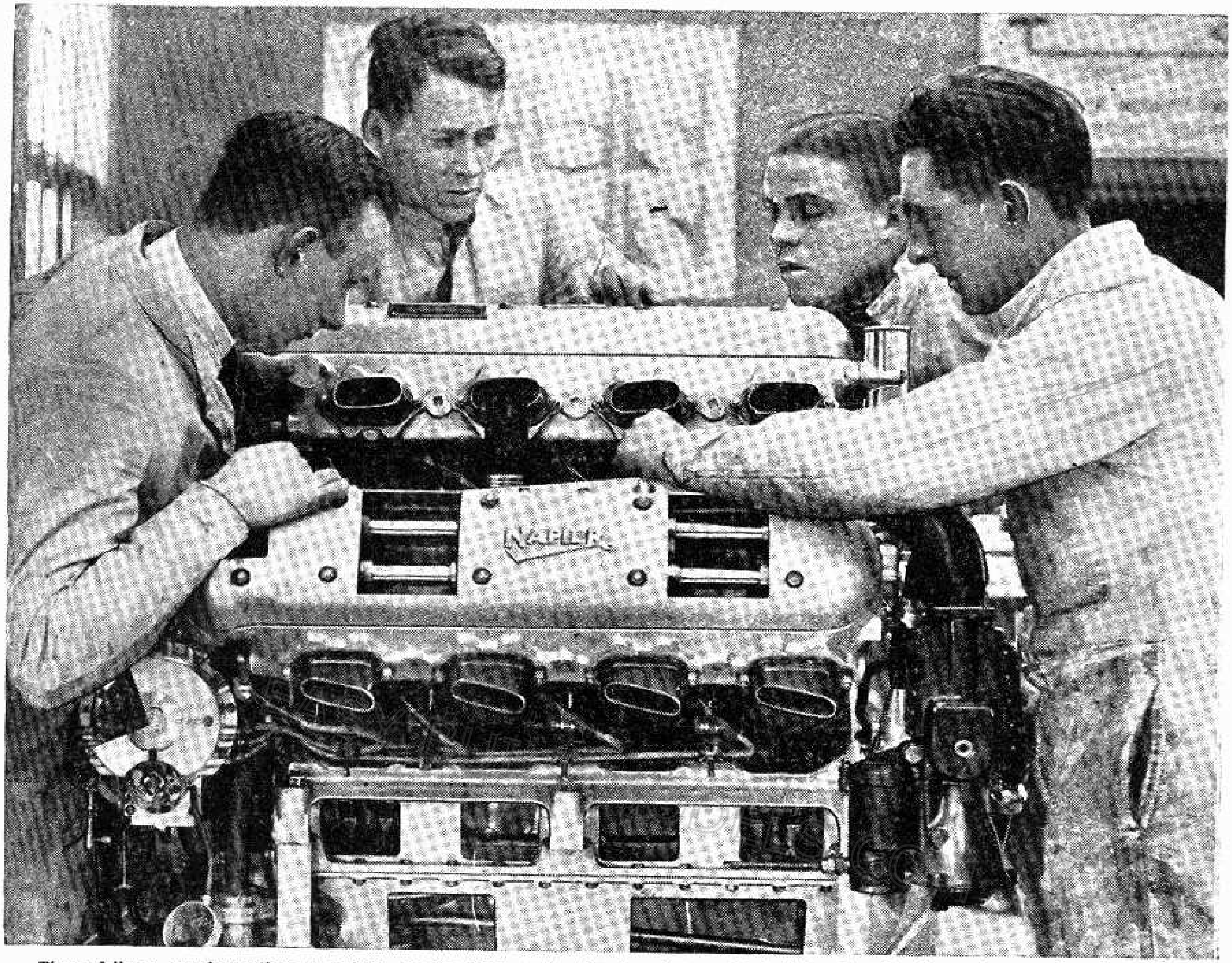


These fellows are inspecting a British Napier Lion unit—the type from which Schneider Trophy racing seaplanes' engines have been evolved.

How an Aeroplane Works

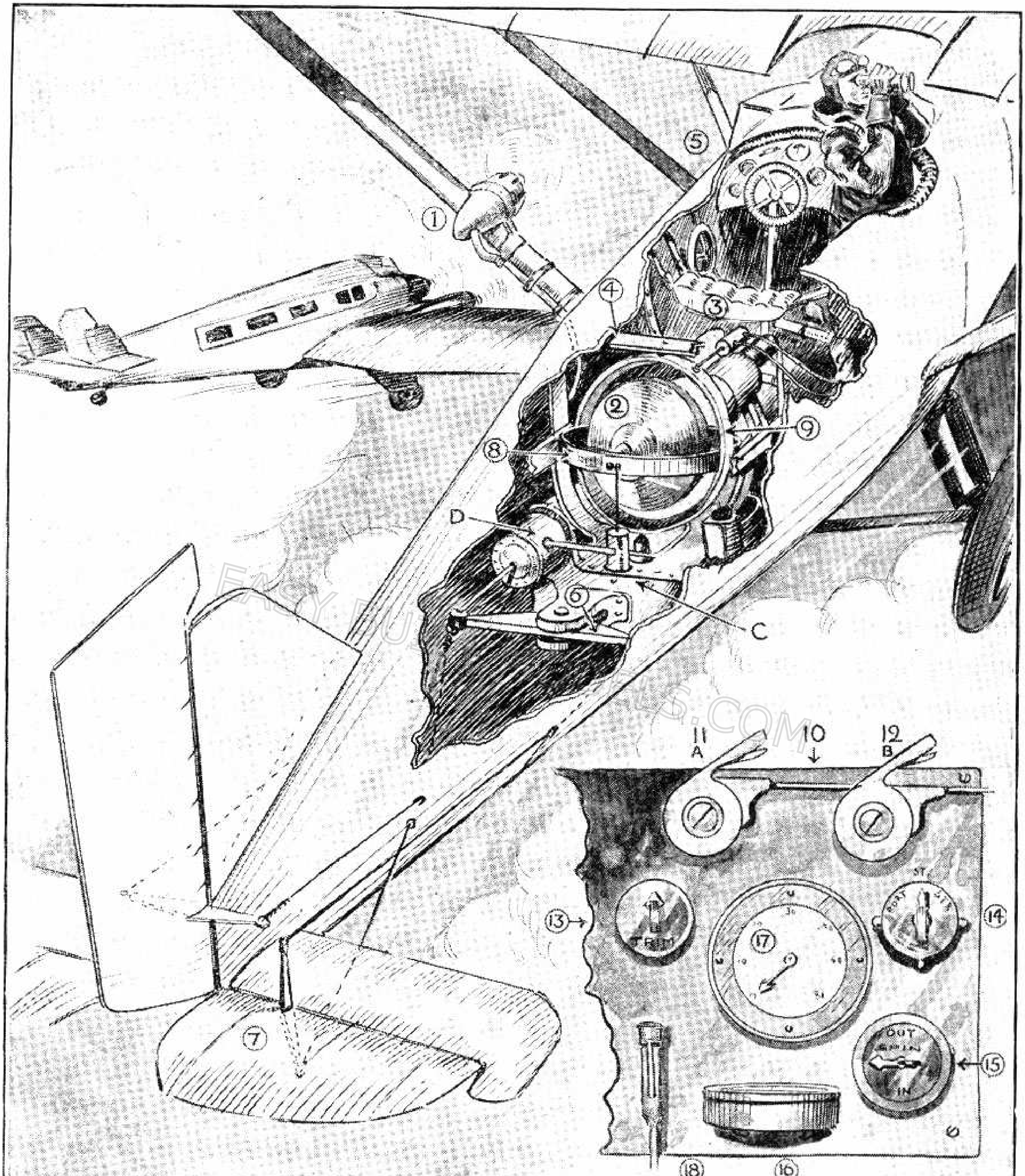
All about the why and wherefore of an aeroplane's power of flight

NATURALLY most non-flyers think that it is very mysterious and wonderful that an aeroplane should fly at all, and still more wonderful that it can be flown and controlled with perfect safety after a few lessons. Yet, really, when one understands the intricacies of flying, it is all very simple.

The most used aeroplane of to-day is undoubtedly the Moth—the machine in which so many remarkable flights have been made. It is used by all flying clubs and schools, so that practically every pilot has found his "air legs" on a Moth plane. This machine is all-British, and is used all over the world, both for flying training and by private pilots.

You will notice that the aeroplane consists of a narrow fish-shaped body from which, on either side, project the broad, flat wings. The narrow body is called the fuselage, and the two separate compartments in which the pilot and passenger sit are called cockpits.

Where the fuselage tapers towards a point there are various flat surfaces, set upright and horizontally, which are known collectively as the tail unit. First, we have a big vertical surface shaped almost like a butterfly's wing. If you look



THE MECHANICAL PILOT.—A British device called the Pilot's Assister, which controls an aeroplane's flight automatically, is shown here. If an aeroplane fitted with the device is forced suddenly earthwards by a gust of wind, automatically the gyroscope (2)—which is the source of the stabilising powers of the apparatus and is driven by air compressed by the wind-driven pump (1)—by remaining horizontal forces the piston of the valve (C) open, admitting compressed air to the cylinder (D). Inside this cylinder is a piston which, moved by the power of the compressed air, operates the elevators (7) and so causes the machine to climb again until it is on a level keel. The gyroscope and controls then return to their normal positions. Rudder control is worked in the same way, the mechanism operating both controls. In this sketch, where the mechanism is shown much enlarged to make details clear, (3) is the pilot's seat ; (4) part of the fuselage framework ; (5) the steering-wheel-like control column ; (6) the gyroscope frame and elevator arm ; (7) the elevator ; (8) the inner gymbal ring ; (9) the outer gymbal ring ; (10) the gyro control board ; (11a) the emergency release for the rudder ; (12a) the emergency release for the elevator ; (13) the trim control for the elevators ; (14) the course-changing tap ; (15) the gyro control proper ; (16) the oil-pressure indicator ; (17) the air-pressure indicator ; and (18) the air valve.

at it closely you will see that it is really two surfaces. One shaped like a triangle with the top cut off is fixed, and is known as the fin. The other, known as the rudder, is hinged to it and can be moved from side to side.

Set horizontally at right angles to the fin, and lying on either side of it, there is another flat surface like the tail of a fish. This surface is also divided. One part of it is fixed, and is known as the tail plane. The other can be moved up and down, and is known as the elevator—or, rather, since it is divided into two by the rudder, which works between the two halves, as the elevators.

There is nothing mysterious about these surfaces. You all know how an arrow with four feathers in the end will keep a true course. The weight concentrated in the arrow head is held steady by the air pressure on the feathers behind.

Just the same way all the aeroplane's weight is forward, where are the engine and passengers, and the fin and tail plane, acting in a similar manner to the feathers of the arrow, keep the aircraft flying in a straight line.

Streamlined Engine

As for the rudder, it steers the aeroplane just like the boat's rudder steers the vessel to which it is attached. Unlike a ship, however, an aeroplane when in the air can also climb and dive, so we have the elevator, which is really the same as the rudder, but which moves the aircraft up and down instead of from side to side.

The engine is set in the other end of the fuselage (generally called the nose) and is usually covered with a smooth surfaced cowling to make for better streamlining, although occasionally this is omitted and it is then possible to see the projecting cylinders.

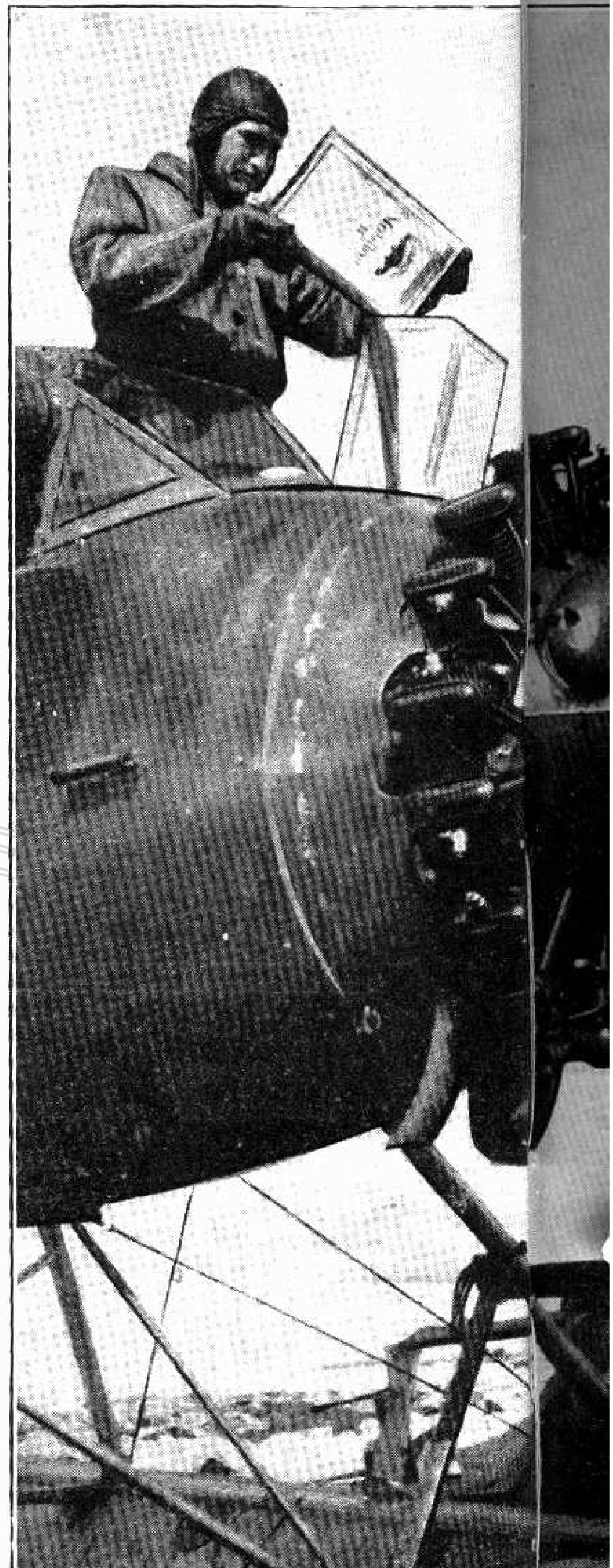
In front of the engine is the propeller, or air-screw, which pulls the aircraft forward by screwing into the air. The centre of the propeller is called the hub, and on either side are the blades. The Moth, like most aircraft, has a two-bladed propeller, but some planes have three or even four blades.

When on the ground the whole aircraft rests on the undercarriage, which consists of two wheels, carefully sprung to minimise the shock of bumping over uneven surfaces. The tail rests on a tail-skid, a single piece of metal which drags over the ground.

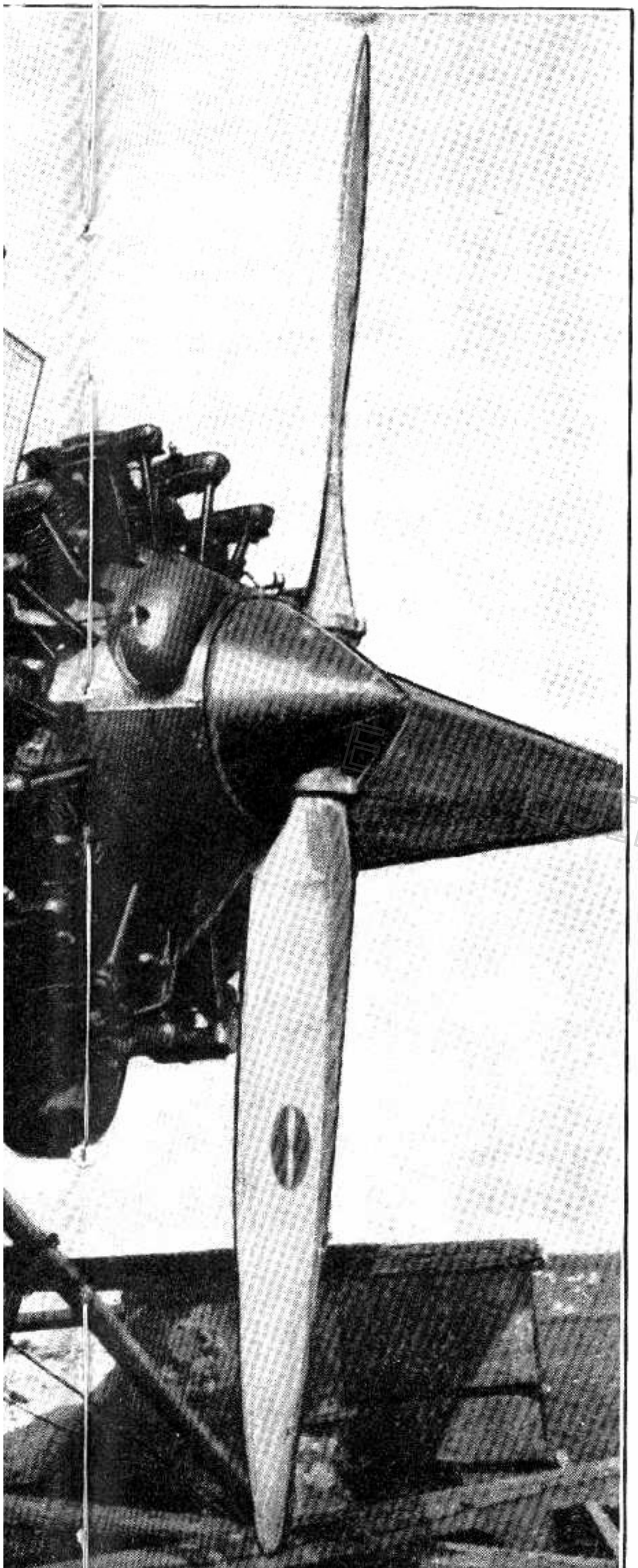
When in the air the aeroplane is supported by the wings in a manner similar to that in which a kite is supported by the wind blowing on to its flat surfaces, but with the difference that in this case the wind is caused by the aeroplane moving forward, either pulled by the engine or by gravity as it glides earthwards.

The Moth has two wings on either side of the fuselage, and is therefore termed a biplane. Monoplanes, with one wing on each side, are common, but triplanes, which have three wings each side, are now obsolete.

The wings of a biplane are strengthened by vertical rods, known as struts, and by wires.



The plane seen here was used by Sir Hubert Wilkins on his expedition into the South Polar regions, the pilot being Lieut. Carl Ben Eielson, whom you see replenishing the oil-tank of his machine.



At the tip of each lower wing there is a long, narrow movable flap. These flaps are called ailerons, and they have the very important task of tilting the aircraft from side to side or (as it is called) banking or rolling it. They are so connected that when one goes up the other goes down—in other words they work opposite ways.

Now, if one flap is lifted one side the air running along the wing is obstructed by the flap and so pushes the wing down. On the opposite side the flap is, of course, pulled down, and the air underneath the wing pushes under this flap and so pushes that wing up.

Starting-Up

Between them they make the aircraft tilt in the direction of the flap which is lifted. Either aileron can be lifted and either can be pushed down, but the action that depresses one must inevitably elevate the other.

Now we will see how the aircraft works in the air. Let us imagine that you are in the pilot's seat. First of all, you look at the petrol gauge, and if this shows that your tank is nearly empty, you have it filled.

The petrol tank in the Moth is really part of the top wing (the centre part, or centre section, as it is called), and is filled either from petrol tins or from an ordinary petrol pump.

In some aircraft the oil is carried in a tank like the petrol, but in the Moth it is all kept in a compartment at the bottom of the crankcase of the engine, and the level is tested by dipping a rod into it.

Having satisfied yourself on these points, you have your engine started up, which is done by swinging the propeller round till the engine fires.

The speed of the engine is controlled by a lever called the throttle, which is placed conveniently to the left hand, and on which, during flight, that hand should always rest. Before starting, the engine is allowed to "rev." at full power several times for testing purposes, while the machine is held back by mechanics, or by two triangular pieces of wood, called chocks, placed under the wheels.

Projecting from the floor between your legs you will find a vertical stick on which you place your right hand. This is the "joystick," or control column. If you swing it backwards and forwards it works the elevators. This is simple to remember, because if you push the stick forward the nose is depressed, and if you pull it back the nose goes up.

The ailerons are worked in the same way by swinging the joystick from side to side, and it is just as easy to remember, because if you swing it to the right the aircraft tilts *to* the right, and, similarly, if you swing it to the left, the aircraft tilts to the left.

Finally, if you stretch your feet, you will find a bar with foot-rests, hinged in the middle. This is the rudder-bar. If the bar is swung so that the right foot comes forward, the aircraft swings to the right, and if you swing it to the left the aircraft swings to the left.

Although the cockpit is not big, it is quite comfortable and cosy, while a small windscreen in front protects you from draughts.

To take off, you give your engine full power and push the nose down so that it runs across the aerodrome with the tail-skid off the ground. An aeroplane is always taken off and landed with its head straight into the wind.

Soon the plane gathers speed, while at the same time you pull the stick back gently until at about 50 m.p.h. the aircraft will take-off and slowly climb. All the time, of course, you must prevent the aircraft from going off its course to right or left, or " rolling," by application of rudder and ailerons to counteract external influences.

Once at a good height you throttle down so that your engine turns over more slowly and keep your aircraft on a straight course.

Should you turn, you will have to remember certain points of piloting. If you simply apply the rudder, the aircraft will make a " flat turn " and skid outwards. So, just as you would tilt a bicycle when you corner, so you must bank or tilt the aircraft inwards. It follows that the sharper the turn, the steeper the bank, until with an acute turn the wings are vertical, instead of horizontal.

Once you are in the turn your inner wing will continue to drop unless you keep it lifted by an application of your ailerons. Apart from this, there is no difficulty in a turn.

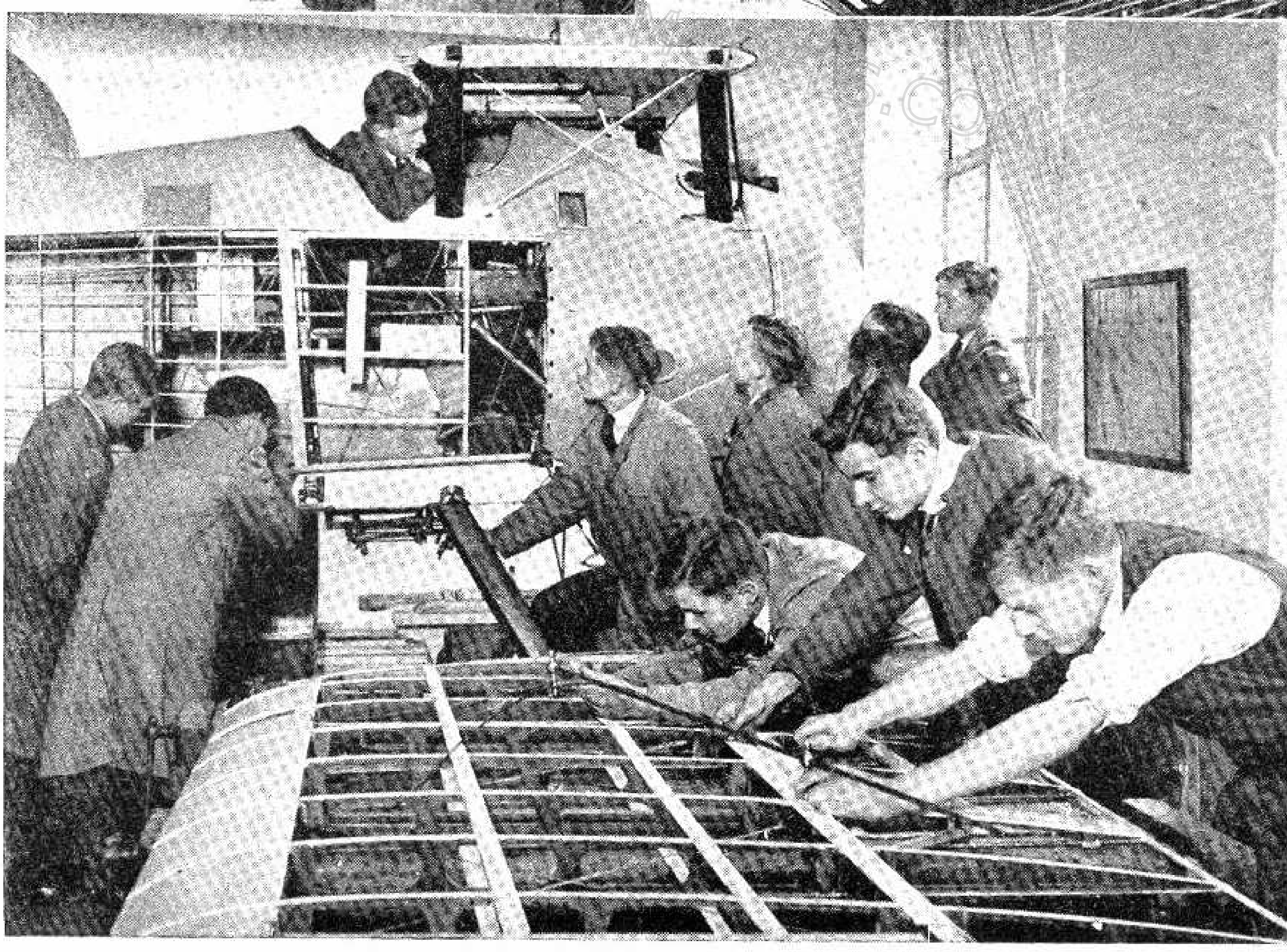
To land, you shut off your engine and start to glide earthwards at a steady 55 m.p.h., carefully timing matters so that at the finish of your glide you are just over the edge of the aerodrome and heading into the wind. As you near the ground you make your glide more and more flat, at the same time losing speed.

Then, just as you are about to touch the ground, you pull the joystick right back, and the plane drops out of the air, touching the ground with wheels and tail-skid simultaneously. This is known

Starting up an aeroplane's engine by swinging the propeller is not so easy as it looks !

Lucky fellows, these members of Highgate School, London. Special lessons on aviation are part of their ordinary school work, and here a class is being shown the working of the controls of a two-seater plane.

(Below) —Another photo of the Highgate School aviation class at work. The fellows in the foreground are getting to know how an aeroplane wing is built. Those at the back of the picture are learning the secrets of fuselage construction.



as a three-point landing, and every good landing should be made in this way.

There is really nothing difficult about all this, and if you can do the above solo (and you should be able to after a few hours' instruction with an experienced pilot), you can gain your official pilot's certificate—a licence which permits you to fly all over the world.

Later, if you wish, you can learn stunt flying—spins, loops, rolls, and so forth—but you can be a good pilot without knowing any of these tricks.

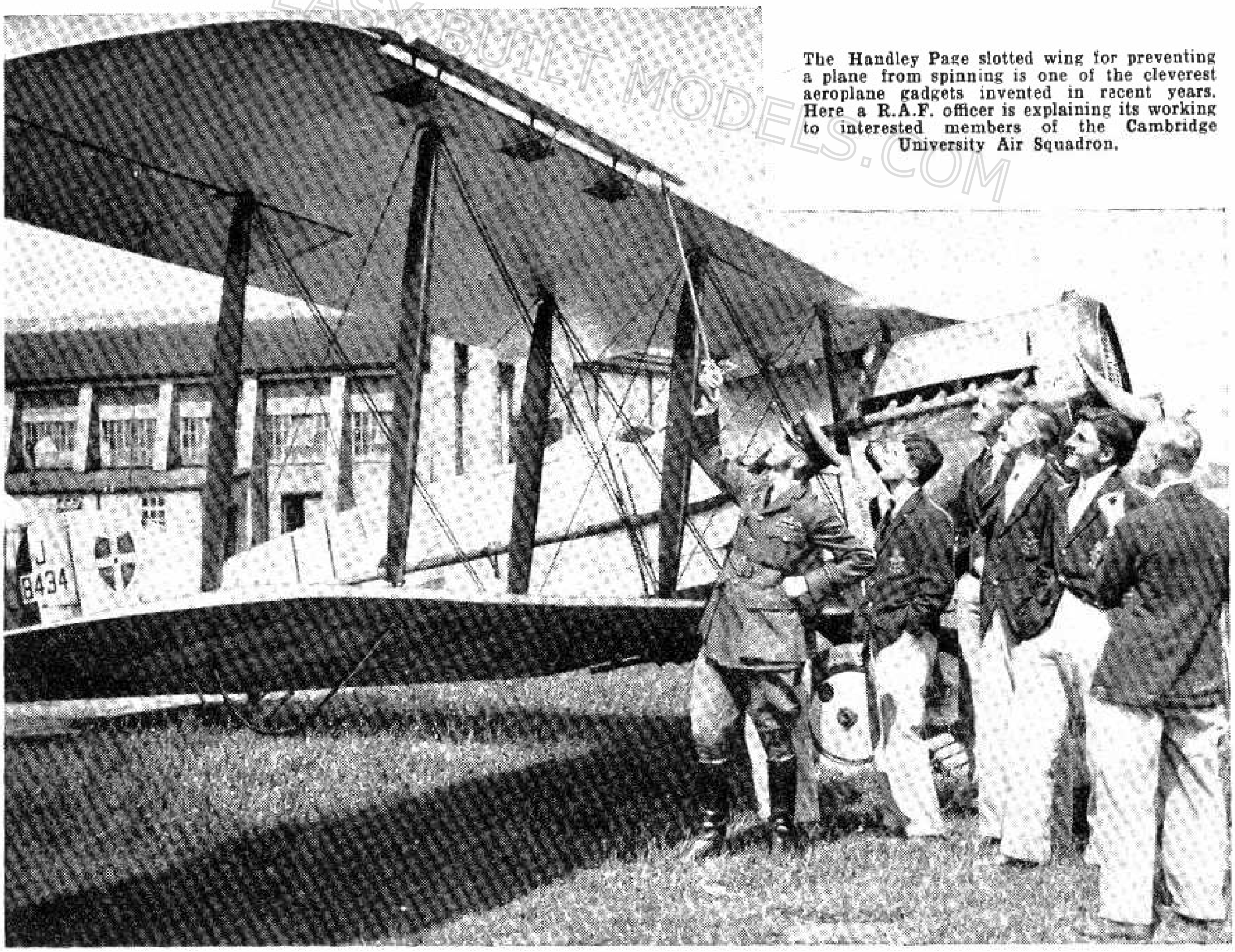
One of the most puzzling gadgets about a modern aeroplane is the "slotted" wing. An invention which few people understand. Here is a simple explanation.

If you move an aeroplane wing forward keeping it absolutely horizontal, there is only a little upward lift. If you tilt it slightly it will lift a good deal more. Further tilting will still further increase the lift.

This is important, because the lift of a wing also decreases the slower it moves through the air. So that if you are going to make your aeroplane move slowly there will not be enough lift to hold it in the air unless you tilt the wings by slightly raising the nose, to increase their lift. Unfortunately there is a limit to this tilting. Beyond a certain point, instead of the tilting increasing the lift, it actually decreases it. In this case the aircraft is what is called "stalled." It will start to fall earthward.

Now when it is in this stalled condition one wing may drop. The pilot puts over the joystick in the opposite direction, so pulling down the aileron flap on that wing. Instead of raising it, however, because it still further increases the tilt of that wing, the aileron reduces the lift, and makes the wing drop lower. Then it will at once spin, becoming uncontrollable.

Handley Page discovered that the loss of lift when the wing was tilted past a certain point was due to the air suddenly eddying behind the wing, instead of flowing smoothing over it. So he arranged a little strip in front of the ailerons which, when the air started to eddy, automatically rose and formed a slot. The air, following through the slot, was smoothed out and stopped eddying. Thus, even if the pilot holds his machine in a stall, it will only sink earthwards on a level keel.



The Handley Page slotted wing for preventing a plane from spinning is one of the cleverest aeroplane gadgets invented in recent years. Here a R.A.F. officer is explaining its working to interested members of the Cambridge University Air Squadron.