

THE INTER



SERVICES

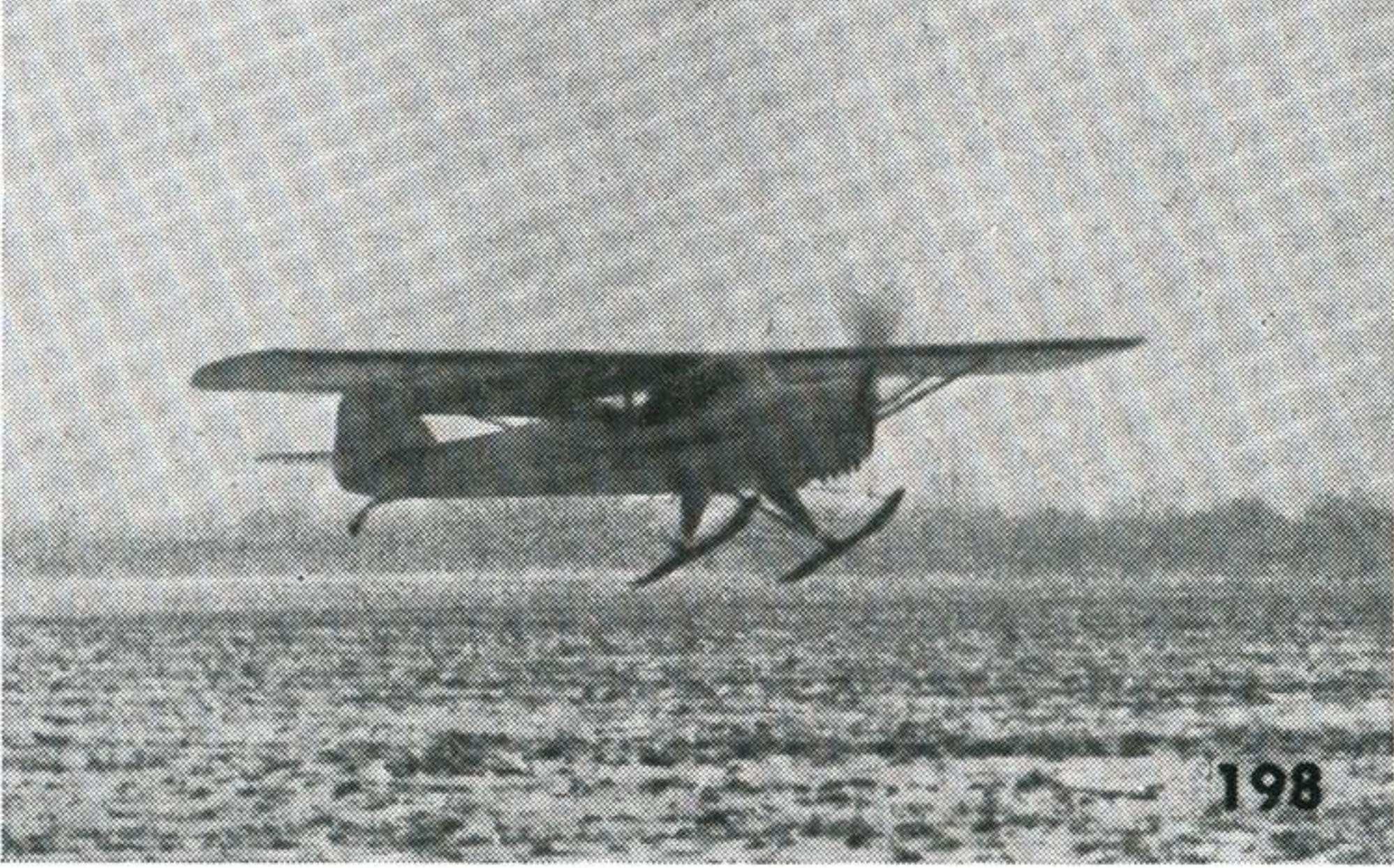
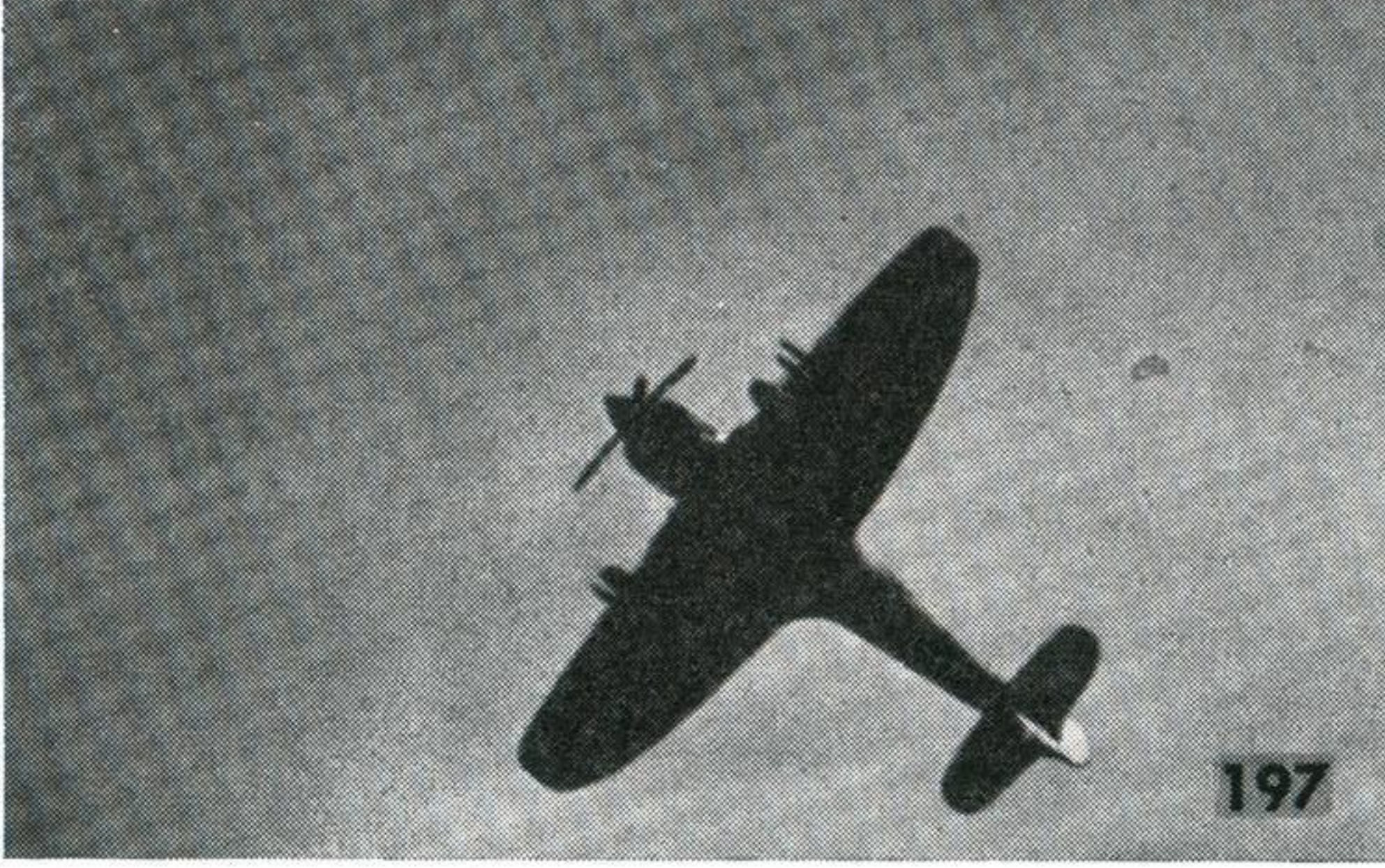
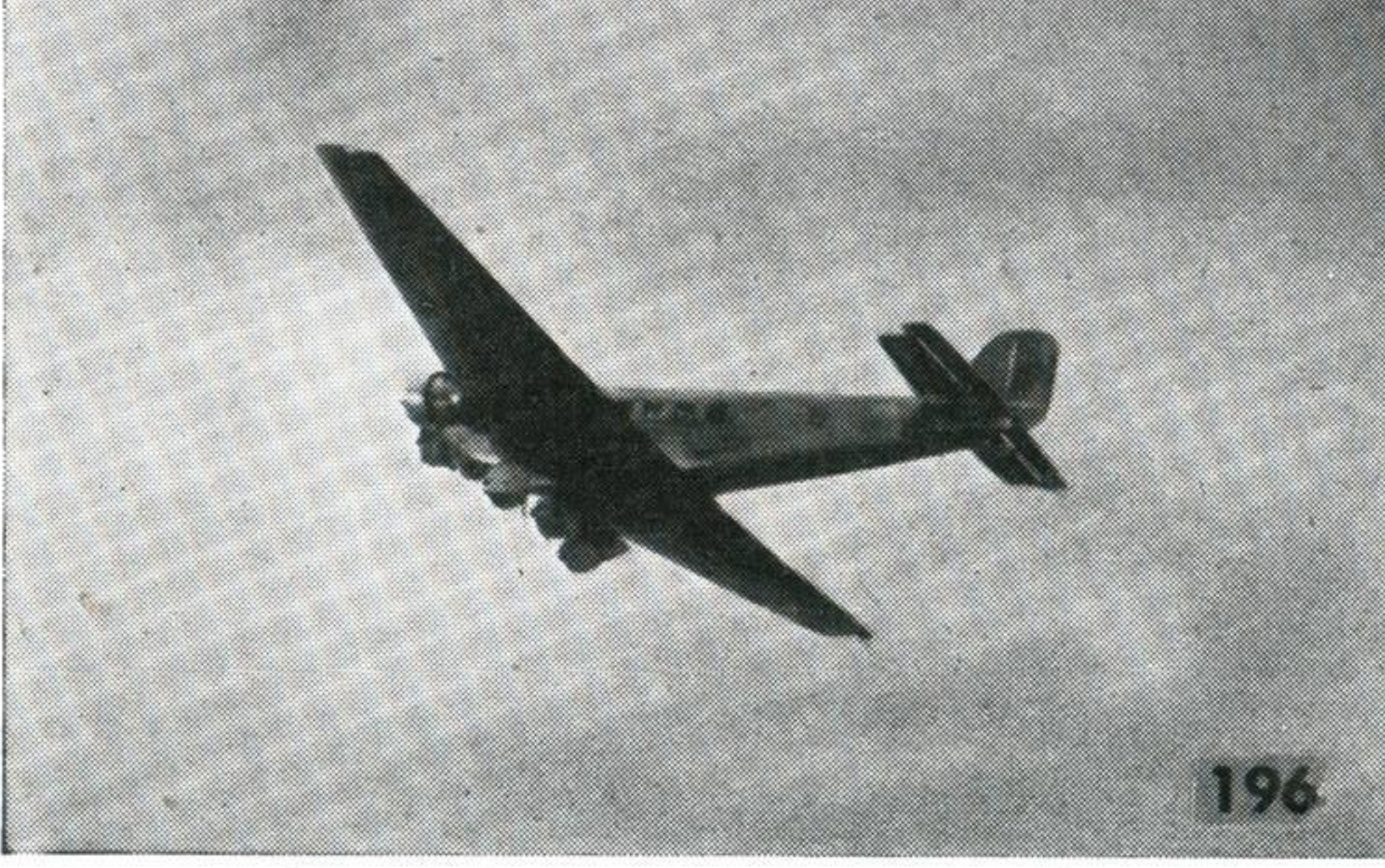
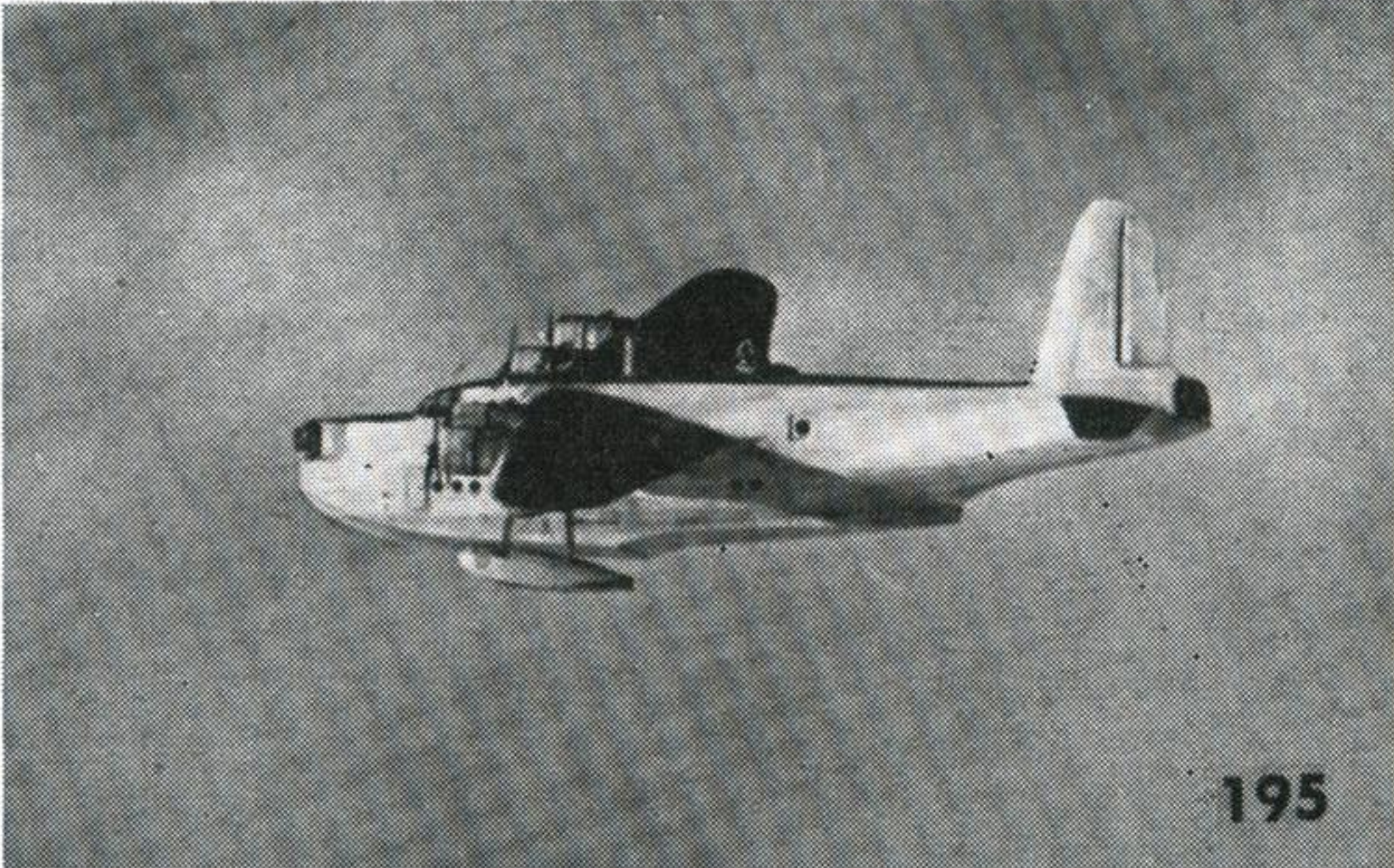
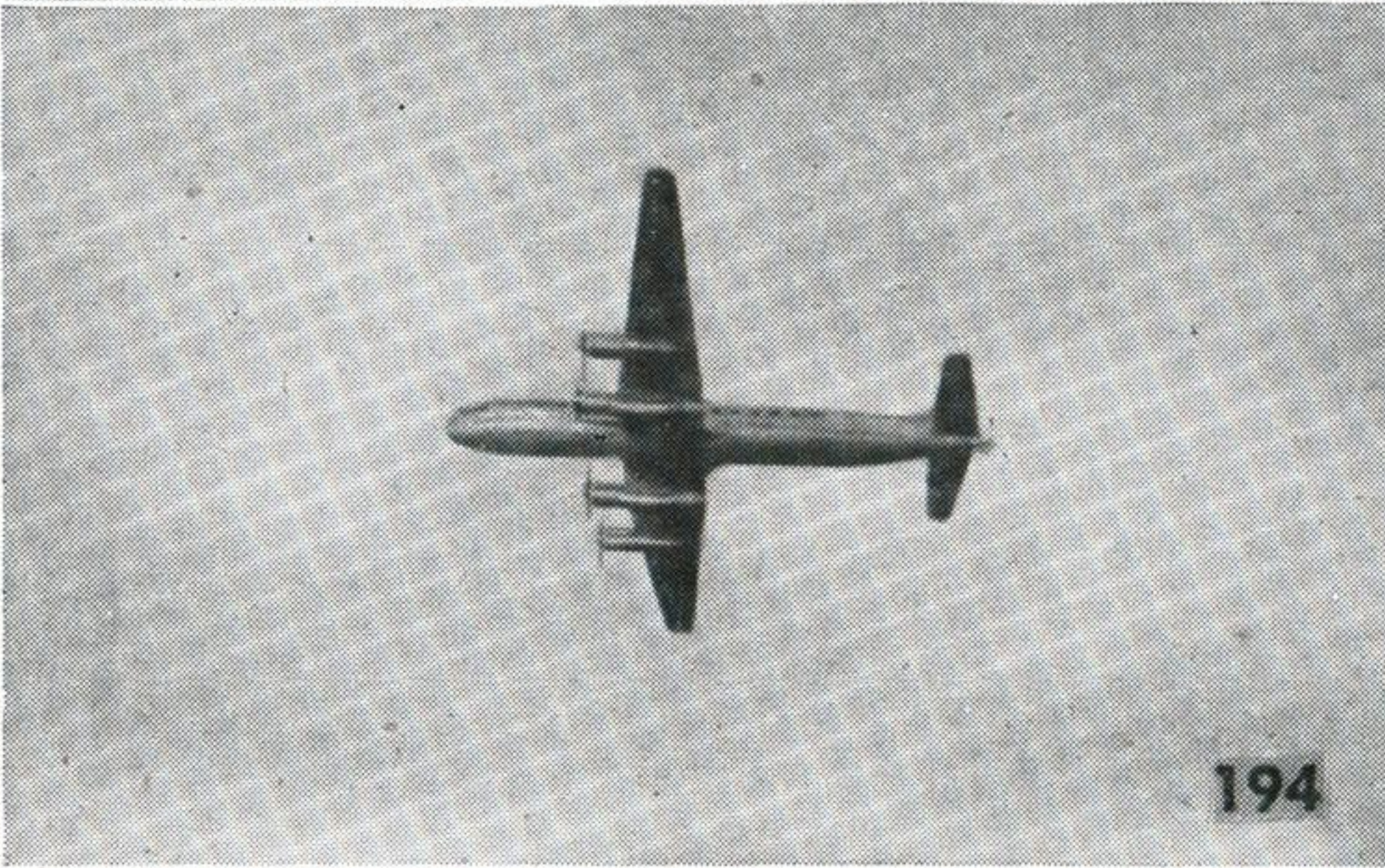
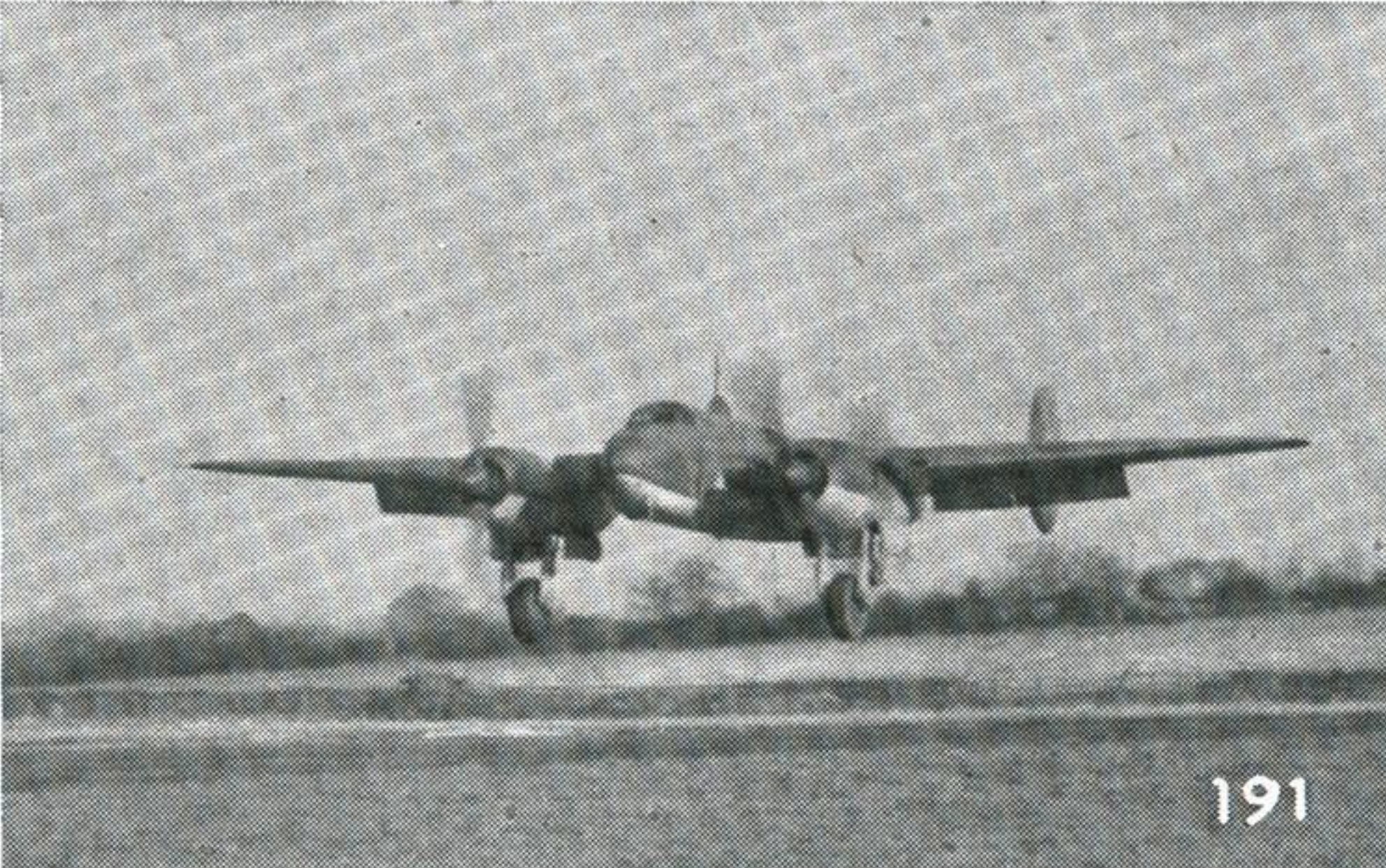
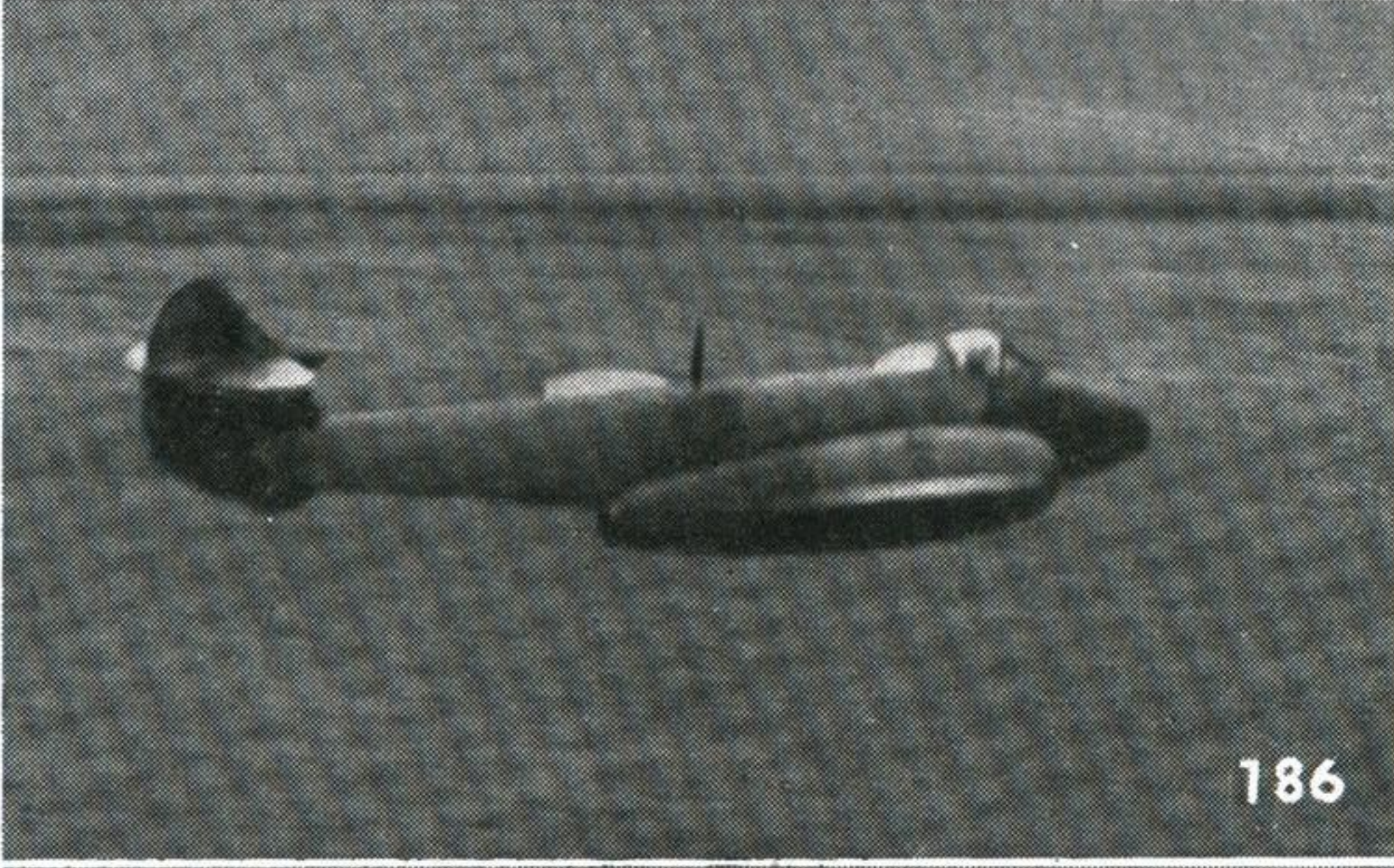
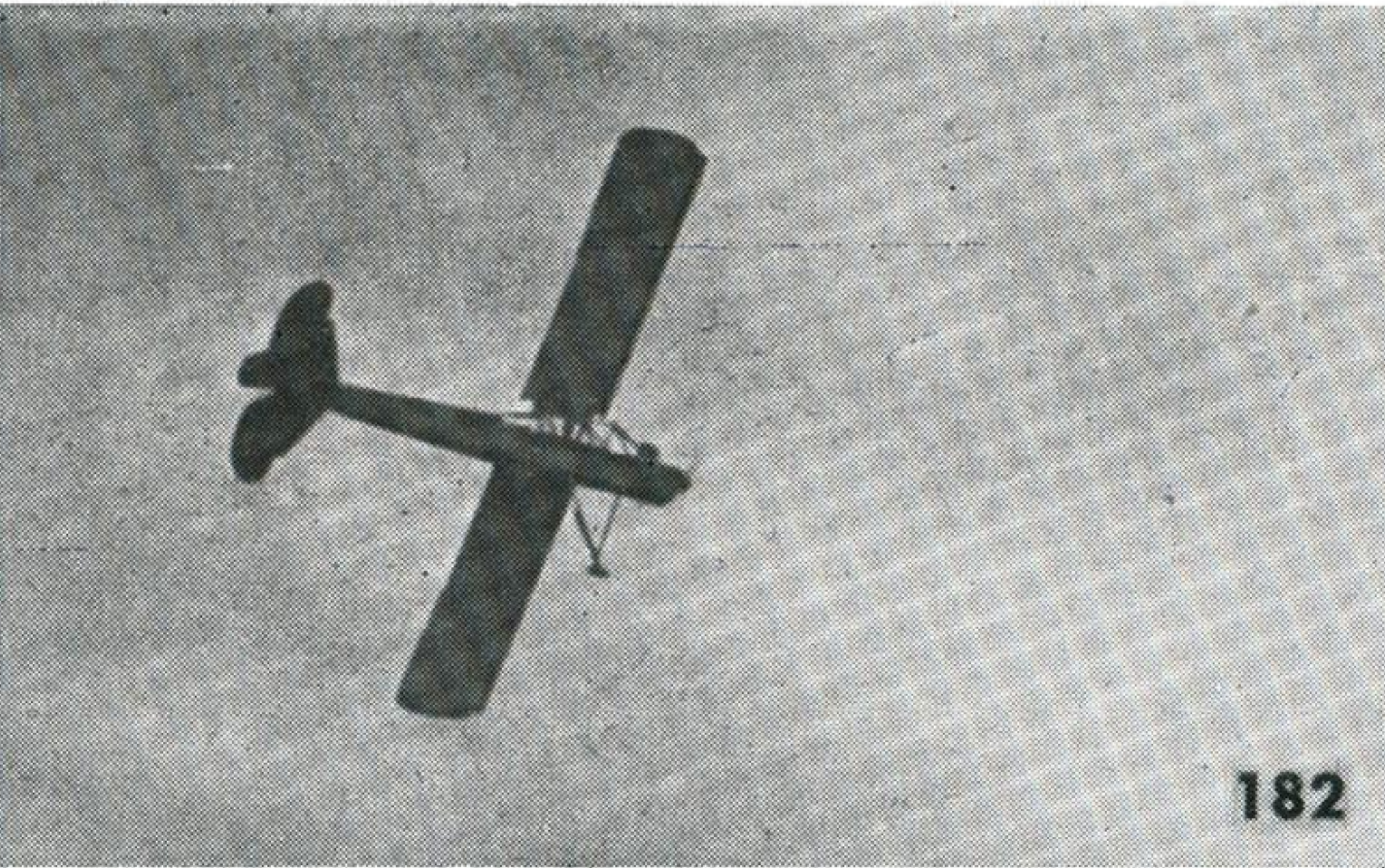
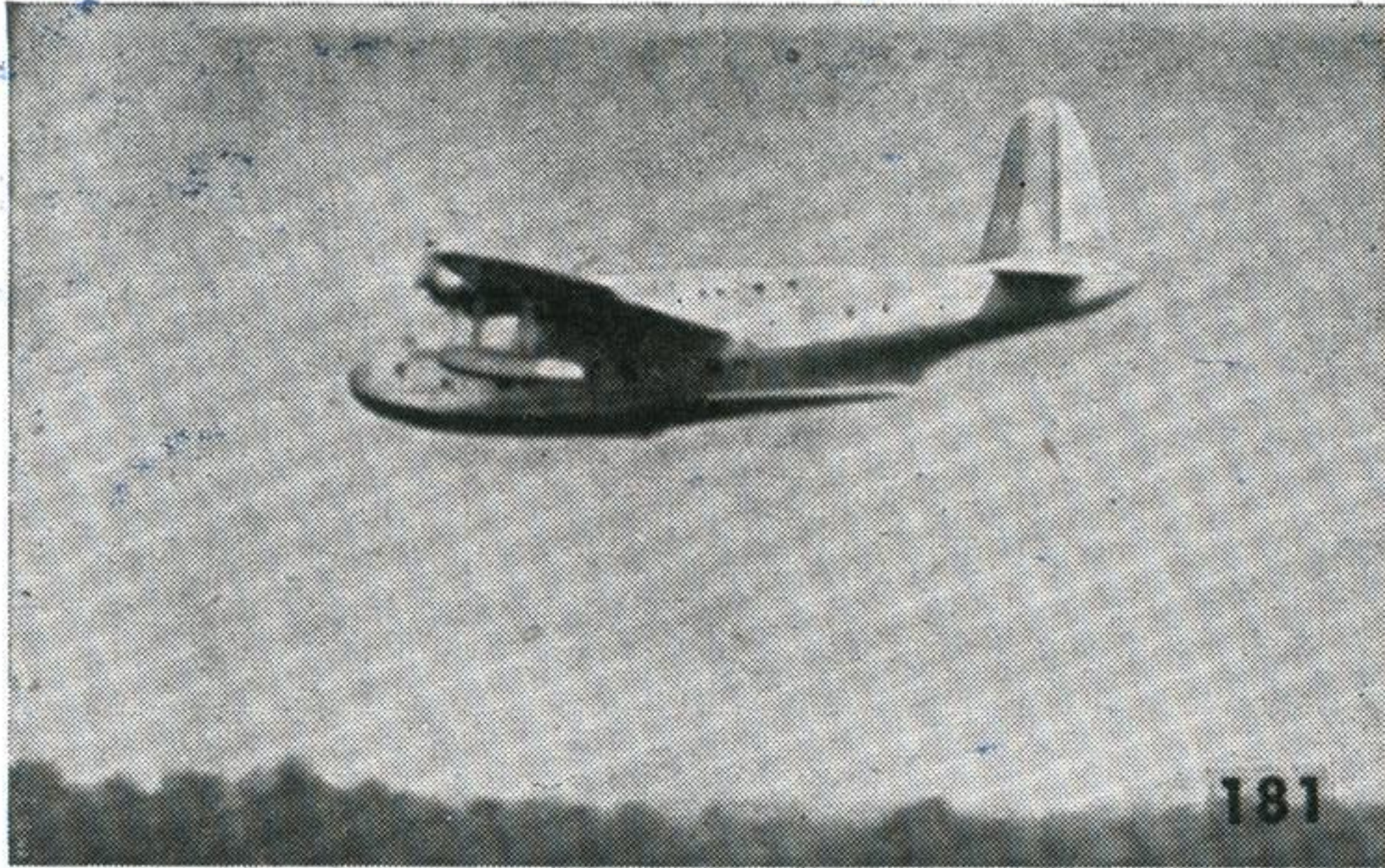
AIRCRAFT RECOGNITION *Journal*



New Series

MAY 1947

Volume I. No. II



THE INTER



SERVICES

AIRCRAFT RECOGNITION JOURNAL

(NEW SERIES)

... read all about it

BACKGROUND KNOWLEDGE is the essence of Aircraft Recognition work. For this reason, we are publishing an article on re-action propulsion or, as it is more commonly called, jet propulsion. There have been persistent requests from all the Services for an article which reduces the more technical aspects of the subject to something reasonably simple. This, we feel, we have achieved. We have managed to dodge the triangles of velocities hurled at us by the technicians as well as foot/pounds and the single-sided impellers, and we make no apology for dealing somewhat ruthlessly with their "baby" in order to achieve simplicity. Our aim, of course, is to reach the not-so-technical types. A spotter will take much more interest in a Meteor, or a Vampire, or a P-80 if he knows what makes it tick—or scream.

Generally speaking, ideas on the principles of jet propulsion seem to be none too clear. We recently heard someone, who ought to know better, broadcast the explanation that, in order to effect forward movement, the hot gases from the jet engine "impinge upon the atmosphere." In our article, we hope we have killed that idea stone dead.

In a few months' time, when this article has been well digested, we shall publish another one going a little deeper into the subject.

¶ We wish to draw the attention of Royal Air Force and Naval Aviation readers to the May and June issues of *Air Clues* which are carrying an article entitled *What are the Americans doing?* This provides a fairly comprehensive survey of the current American aviation scene. It is well illustrated and should be useful to all Recognition students and instructors.

SKYSCRAPINGS

QUITE a large variety of developments of the Tudor are being undertaken by Avros. The most interesting is the **Tudor VIII** which is a Tudor I airframe fitted with four Rolls-Royce Nene jet engines. It is an experimental type. The normal **Tudor I** with the short fuselage and the longer **Tudor II** have been flying on test. The **Tudor III** is a V.V.I.P. version of the Tudor I. The **Tudor IV** is a Tudor I with a six-feet longer nose and is destined for B.S.A.A. The **Tudor V** is a Tudor II and, externally, is indistinguishable from the other II's, but has different internal furnishings. The **Tudor VI** is a II modified for Argentine Airways, and the **Tudor VII** is a Tudor II airframe with Bristol Hercules engines. It is quite likely that the Tudor II standard type will be built in Canada as a transport for the R.C.A.F. Australia is tooling up to produce Tudor II transports for the R.A.A.F.

Many ex-Bomber Command **Handley Page Halifaxes** are making regular South Atlantic crossings from Bordeaux to Rio de Janeiro by way of Rabat and Dakar.

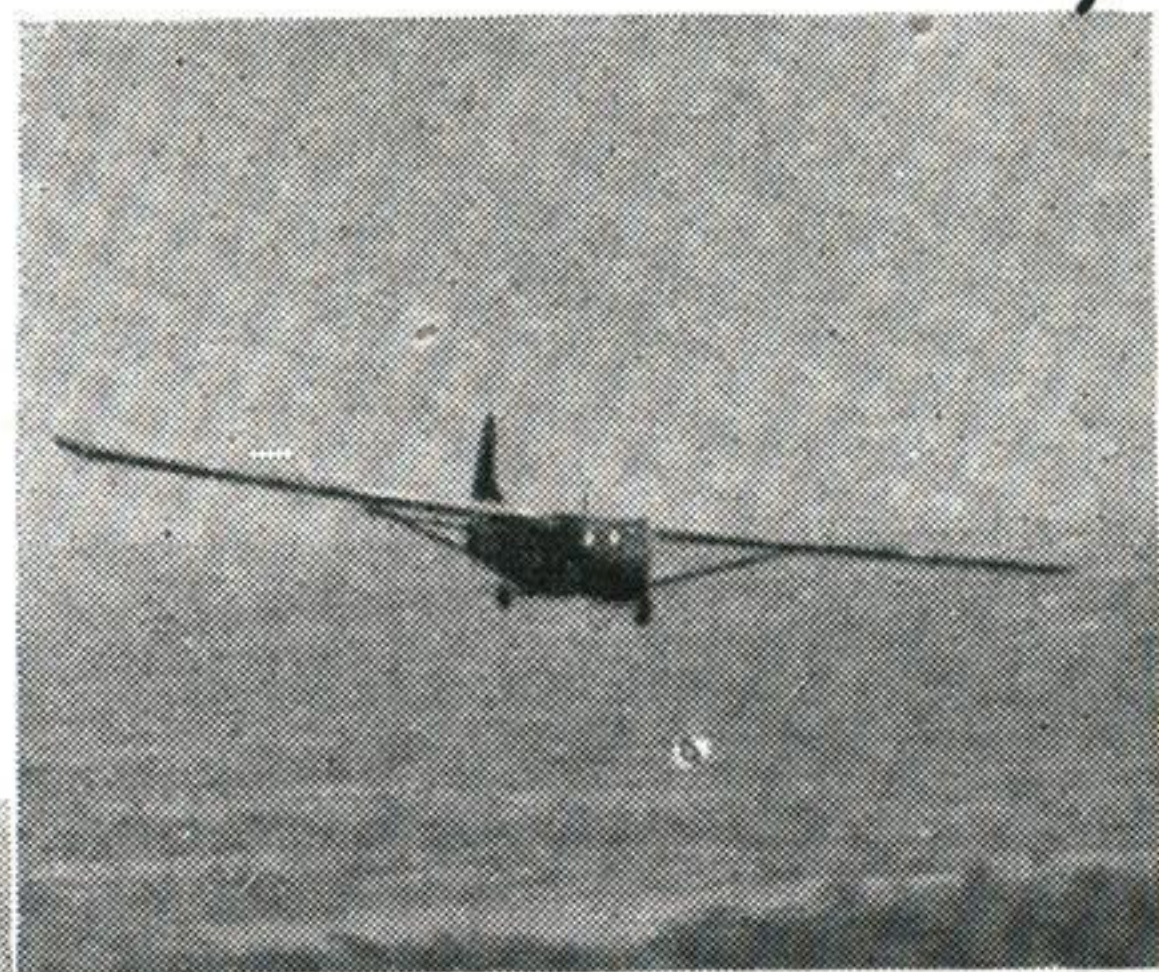
De Havilland Aircraft of Canada are fitting **Doves** with skis. They have also produced, so far, ten **Chipmunks**, one of which is in this country. More are probable.

De Havilland's present production in this country consists of **Mosquitoes** and **Hornets**, **Sea Mosquitoes** and **Sea Hornets**, **Doves** and **Vampires**.

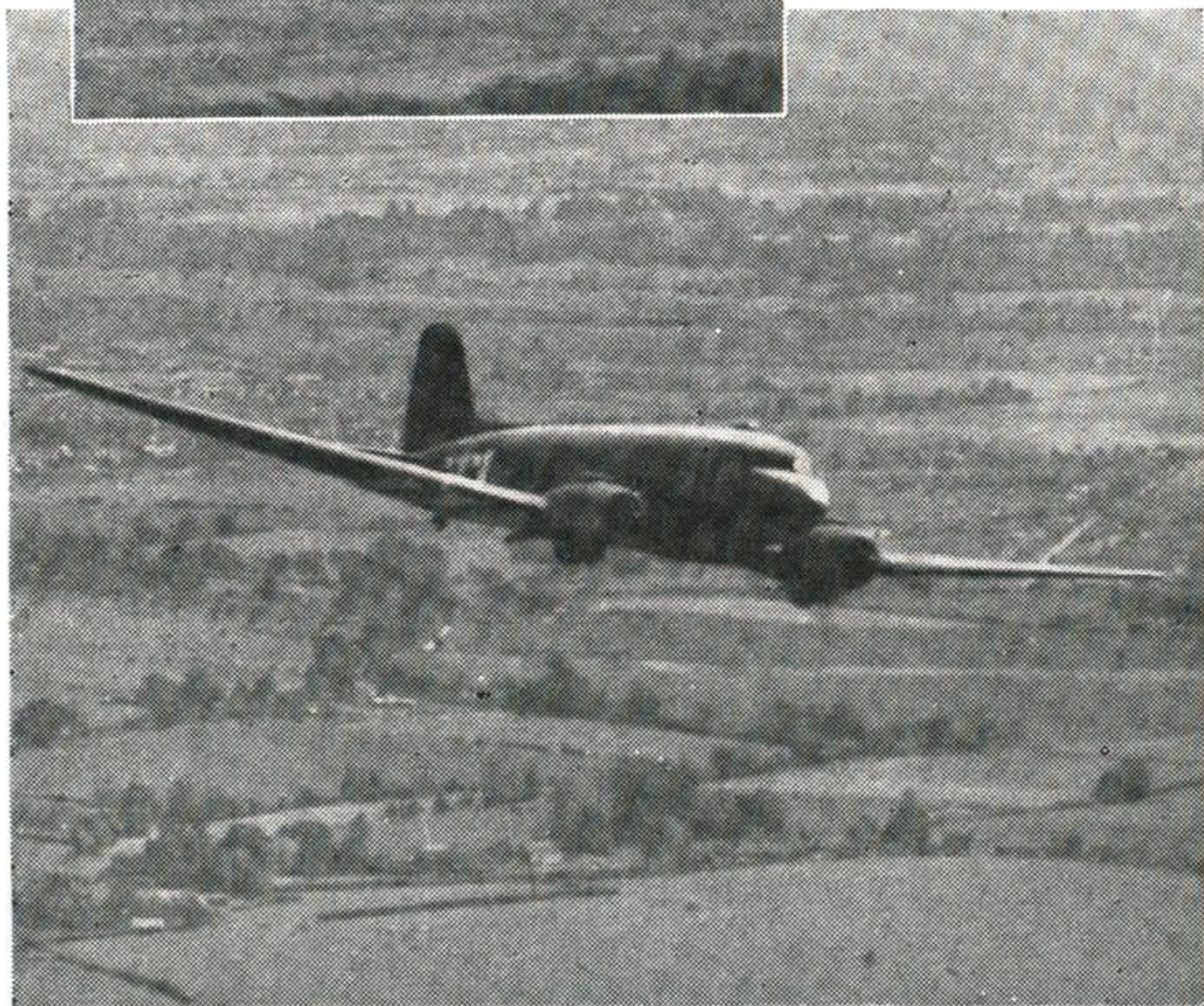
Percival Aircraft announce that they are producing a new twin engine all-metal medium transport, powered by two 505 h.p. **Alvis Leonides** radials. The firm's type number is P.50. It has been named the "**Prince**." It can be fitted with wheels, floats or skis.



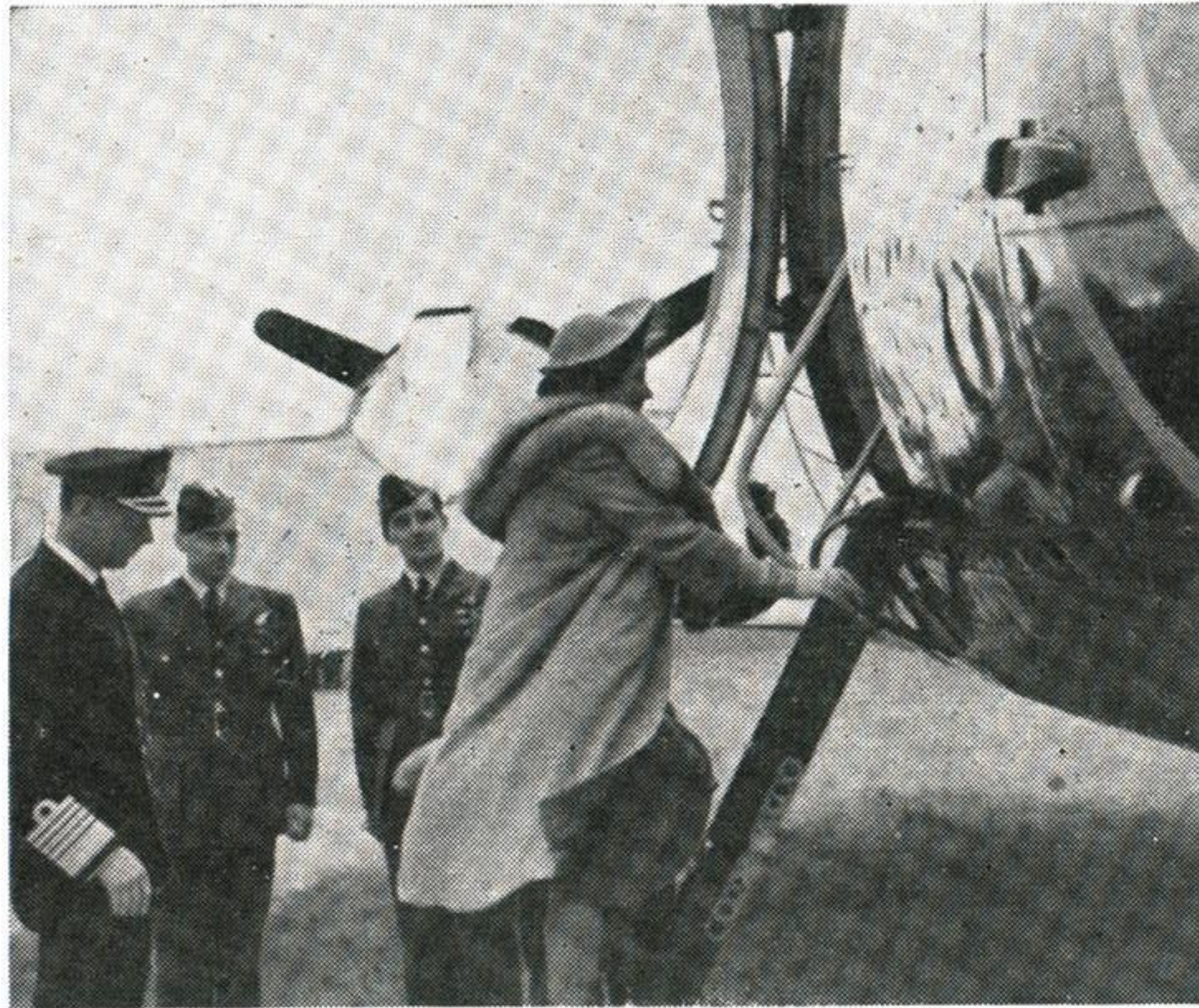
Spotters to Note. Production **De Havilland Sea Hornets**, keeping abreast of fashion, have now been modified by quite a large fin fairing extending halfway up the fuselage. There are no prizes offered for recognizing the aircraft in the background of these pictures.



The DAK



During the war the Dakota was in service as a glider-tug.

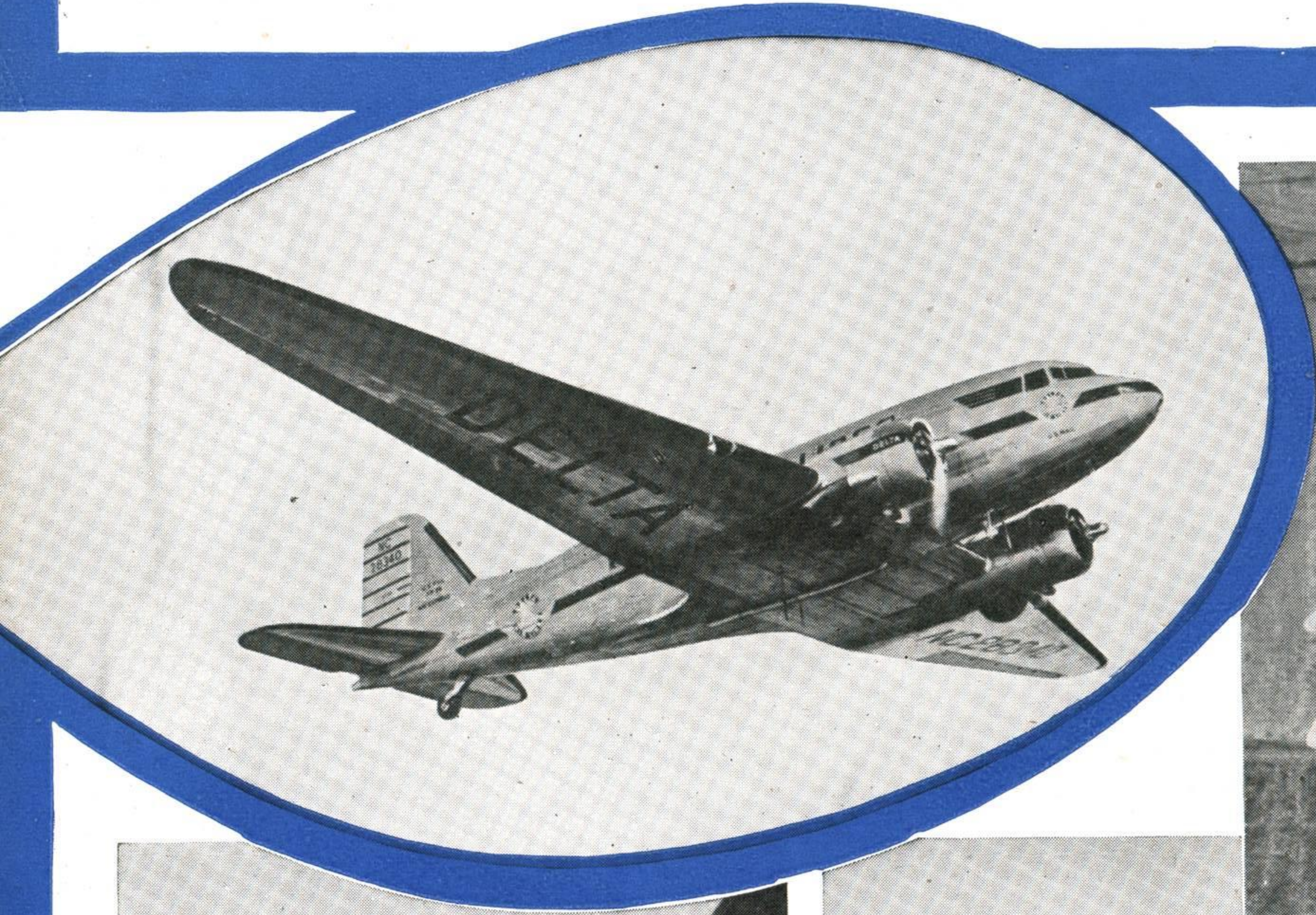


Their Majesties the King and Queen visited the Channel Islands in June, 1945. They flew in a Dakota of Transport Command.

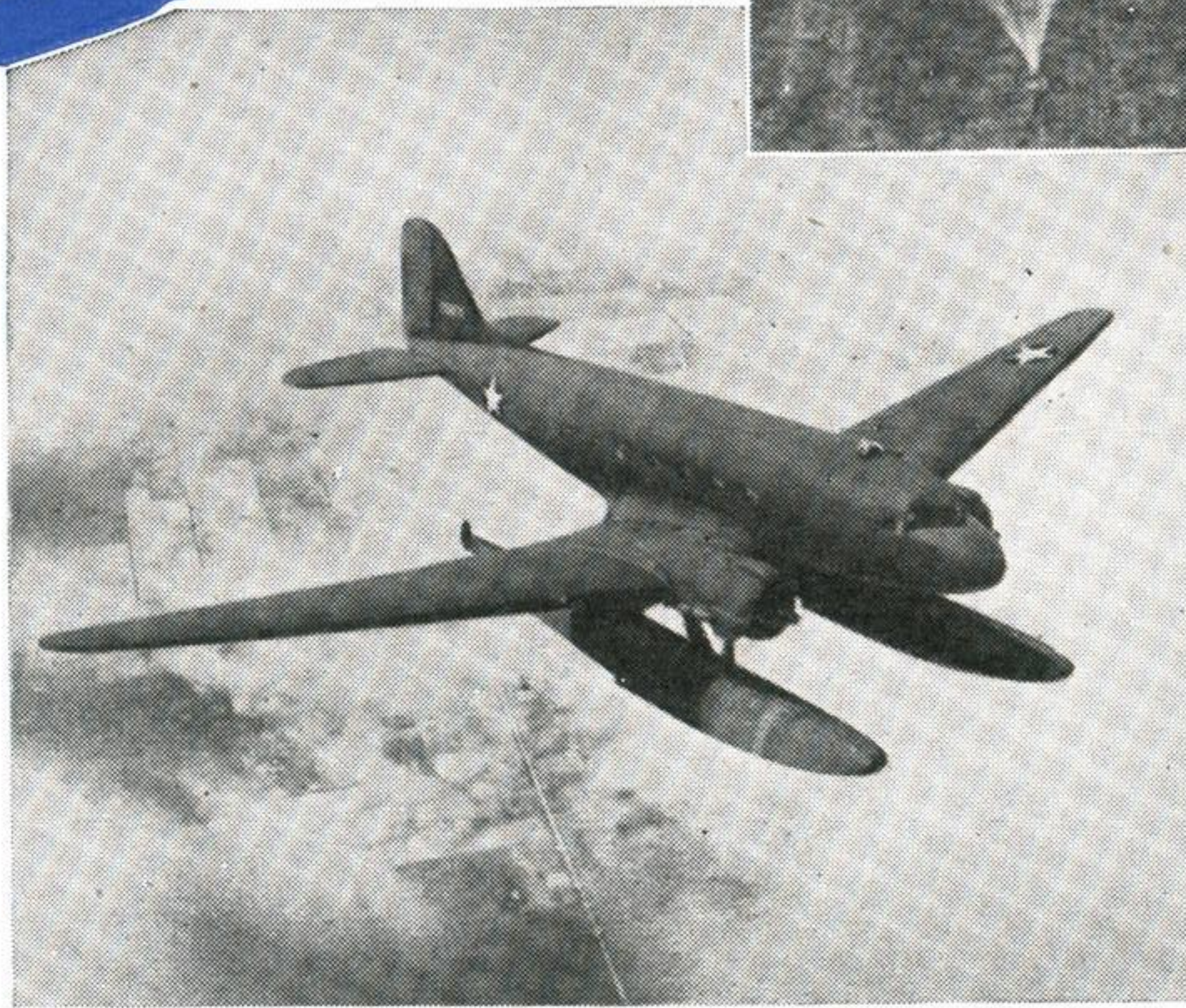


The Russians have many Dakotas. They call them LI-2s.

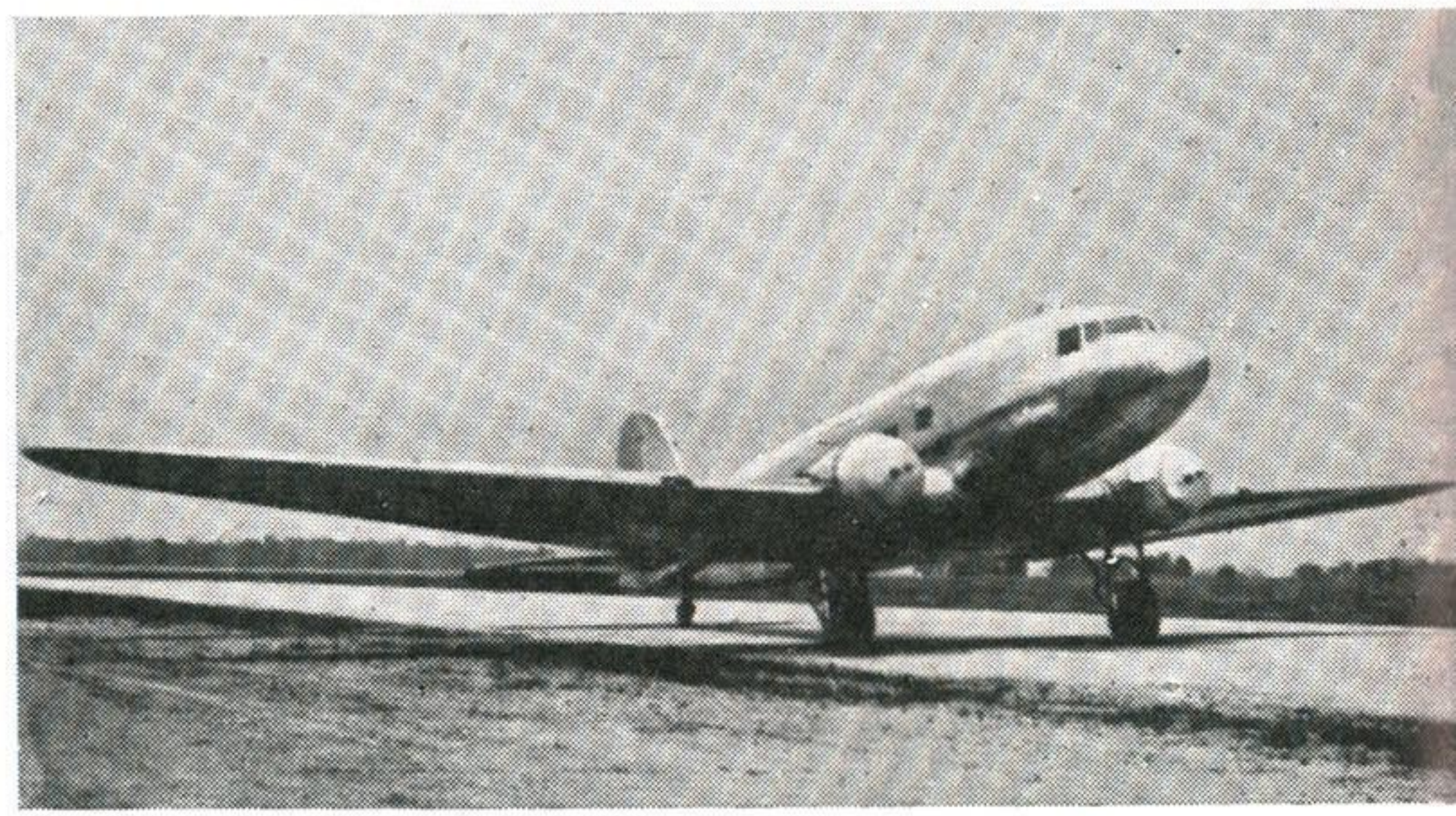
The **Douglas DC-3 Dakota** has had some rough handling in the press lately. It has already had a rough time during the war and we illustrate some of the many different kinds of operations it has done, and is still doing. It is a good aeroplane, and will probably be with us for another ten years. On the opposite page is a family tree showing its development from the Douglas DC-1.



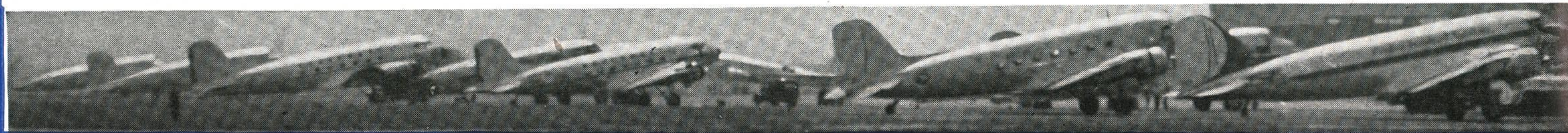
(Encircled) In its designed job, airline operating. (Lower) As an ambulance during the war it saved many lives.

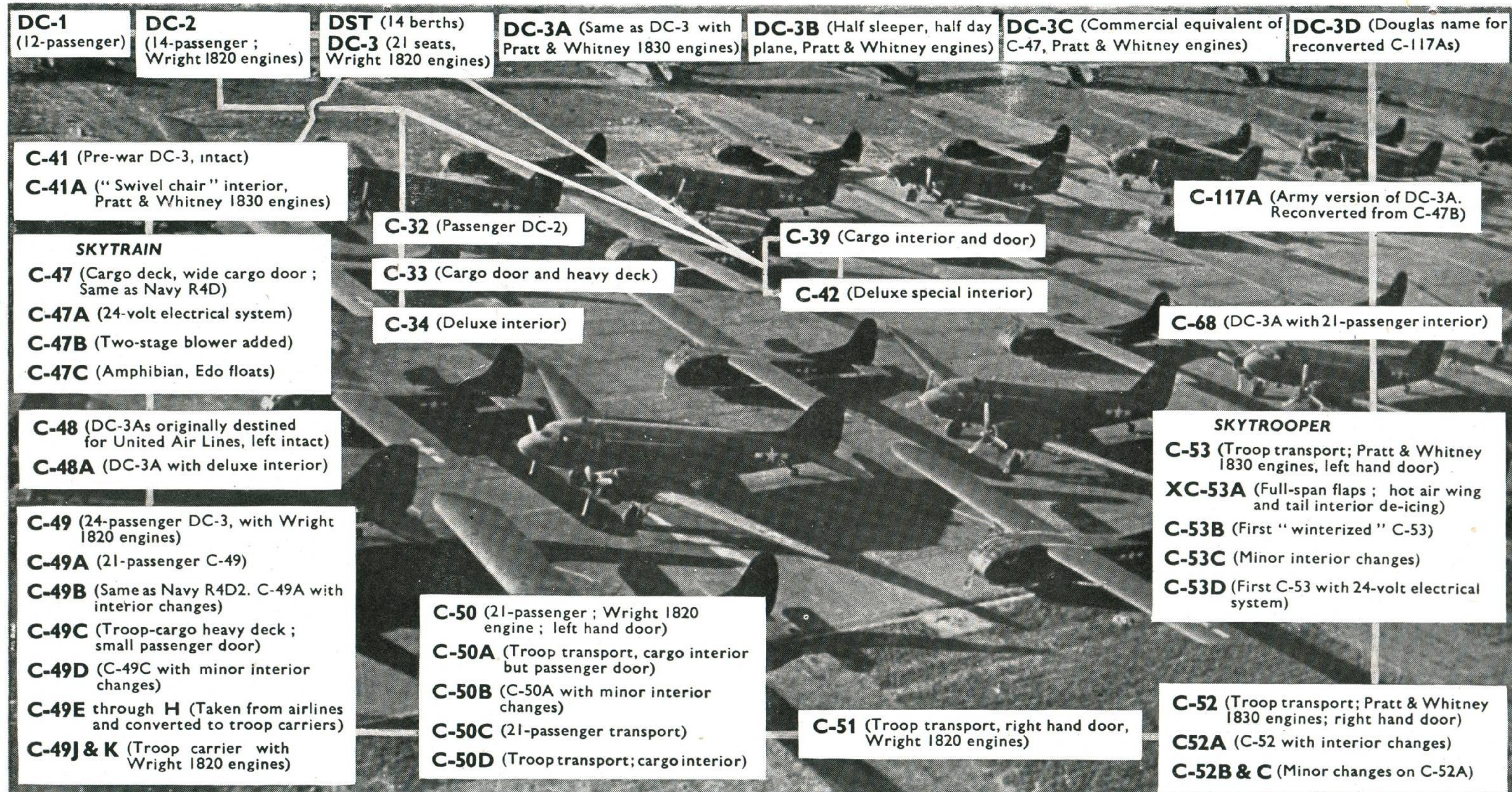


A few of them were fitted with floats and worked in Canada and the U.S.A.



(Upper) Front line work—dropping paratroops. (Lower) With engines removed, it flew quite well on the other end of the tow-rope.



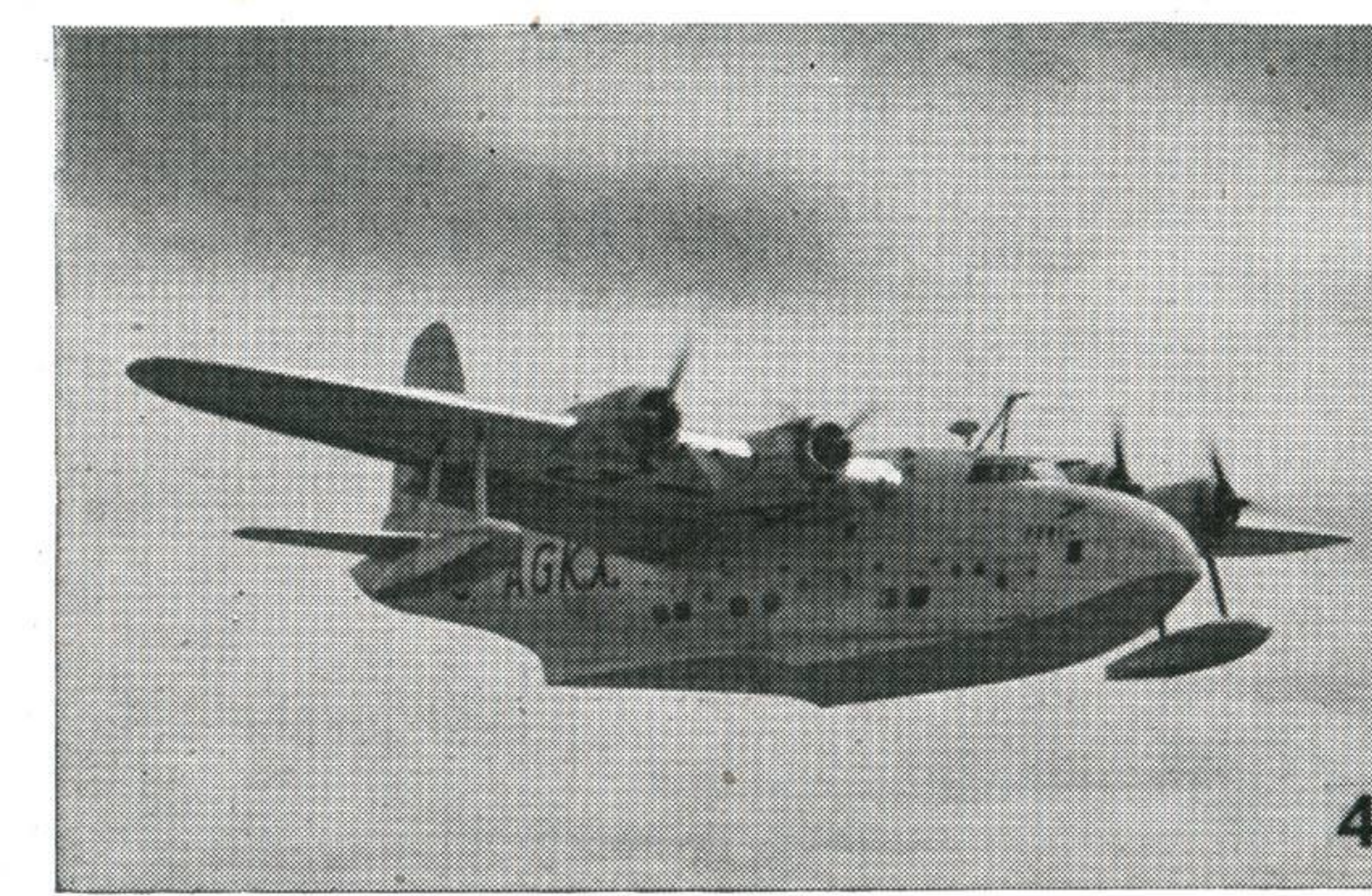
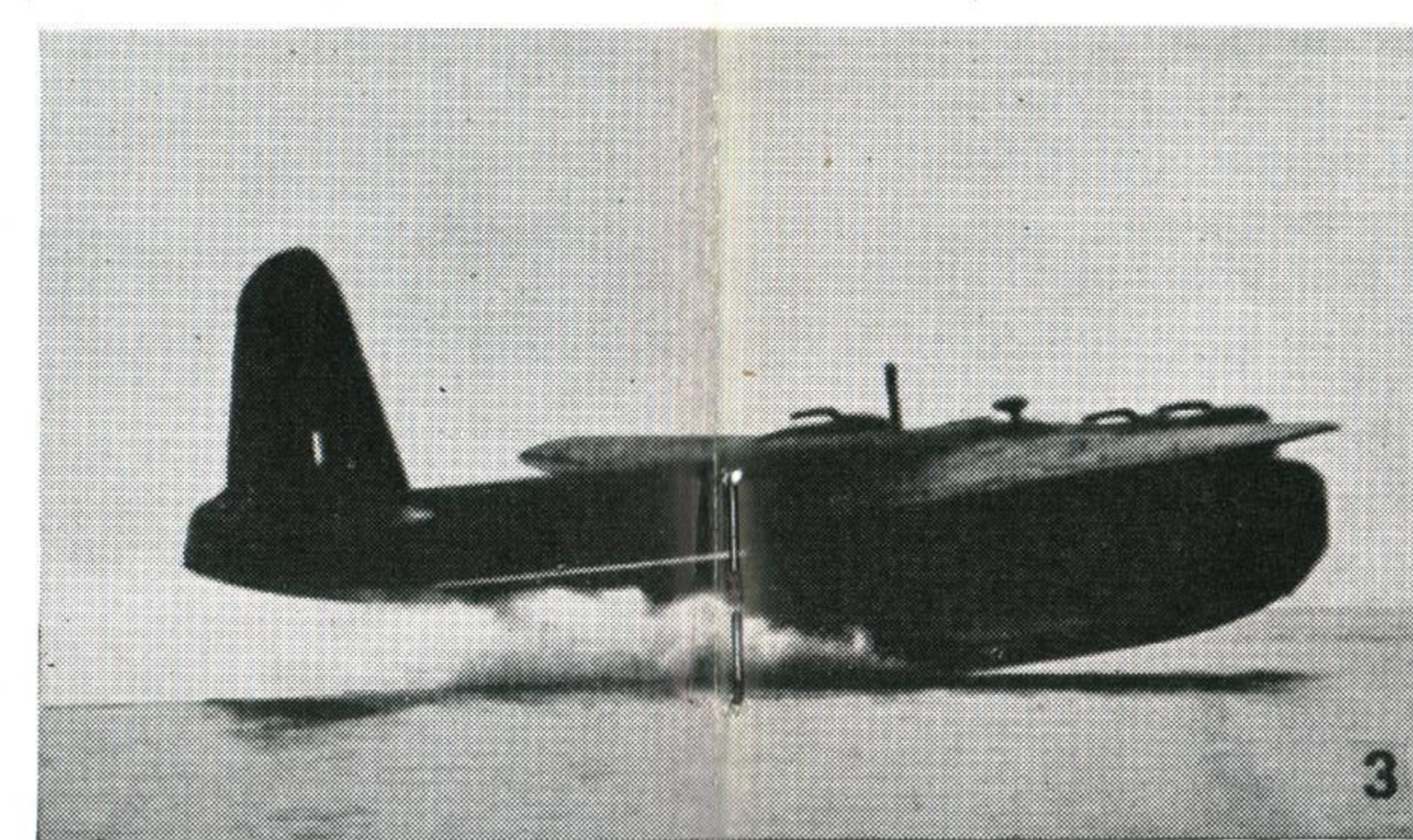
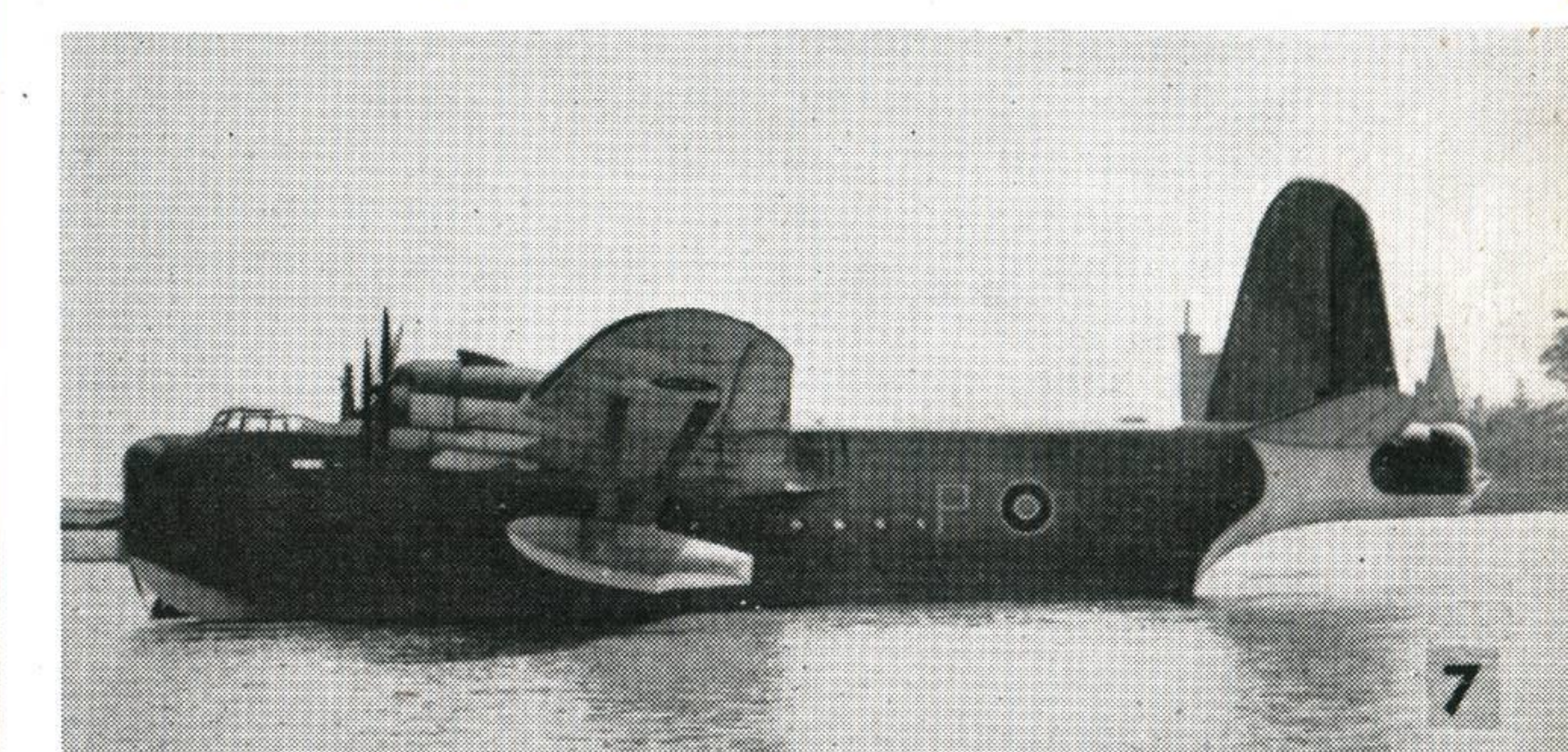
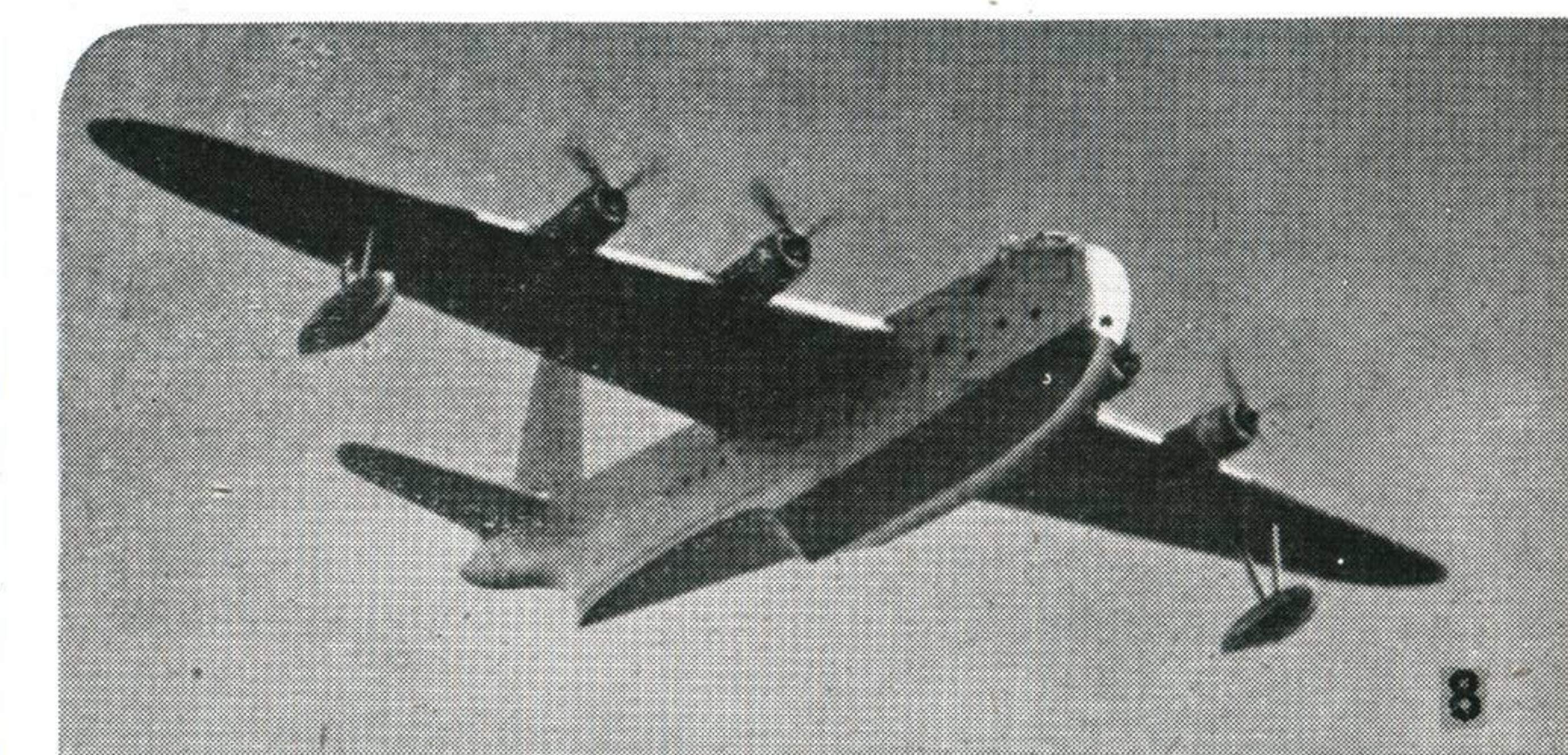
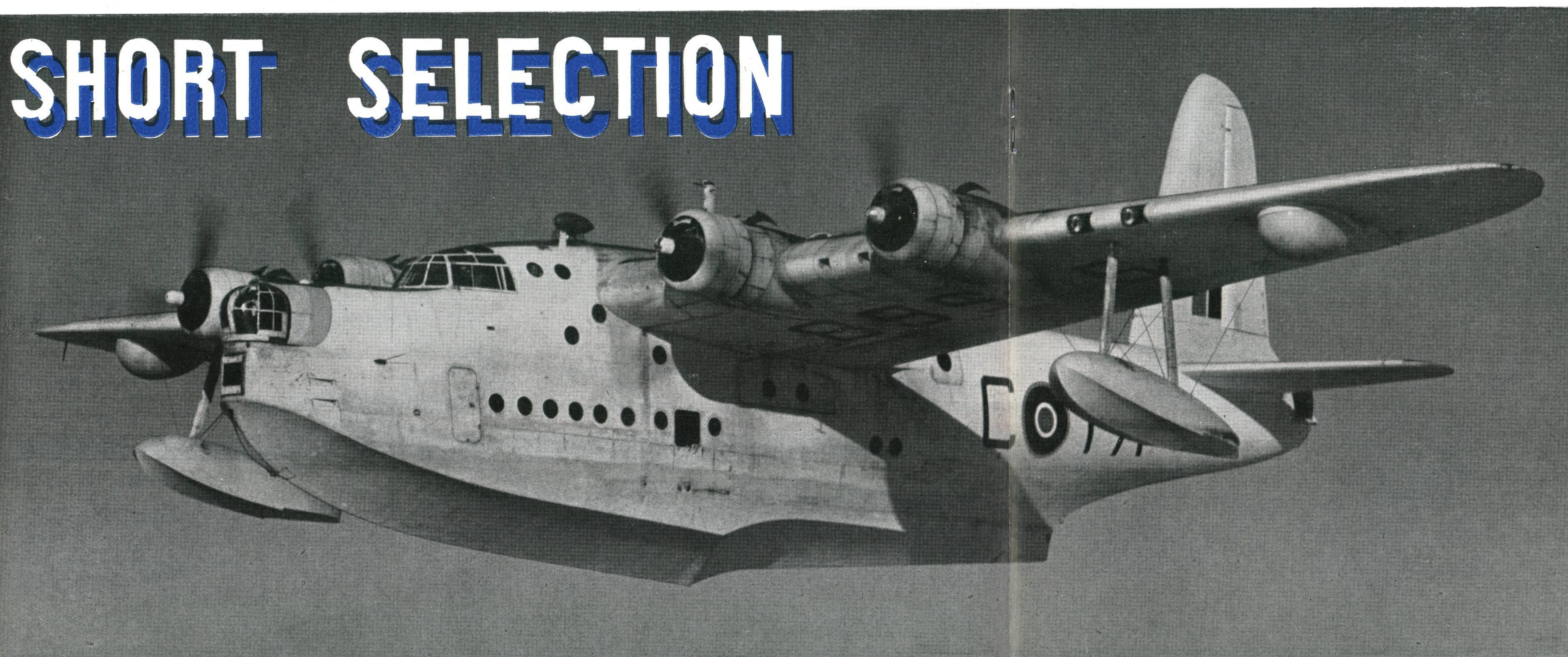


ADVANCED SPOTTING

Recognition Test No. 35



SHORT SELECTION



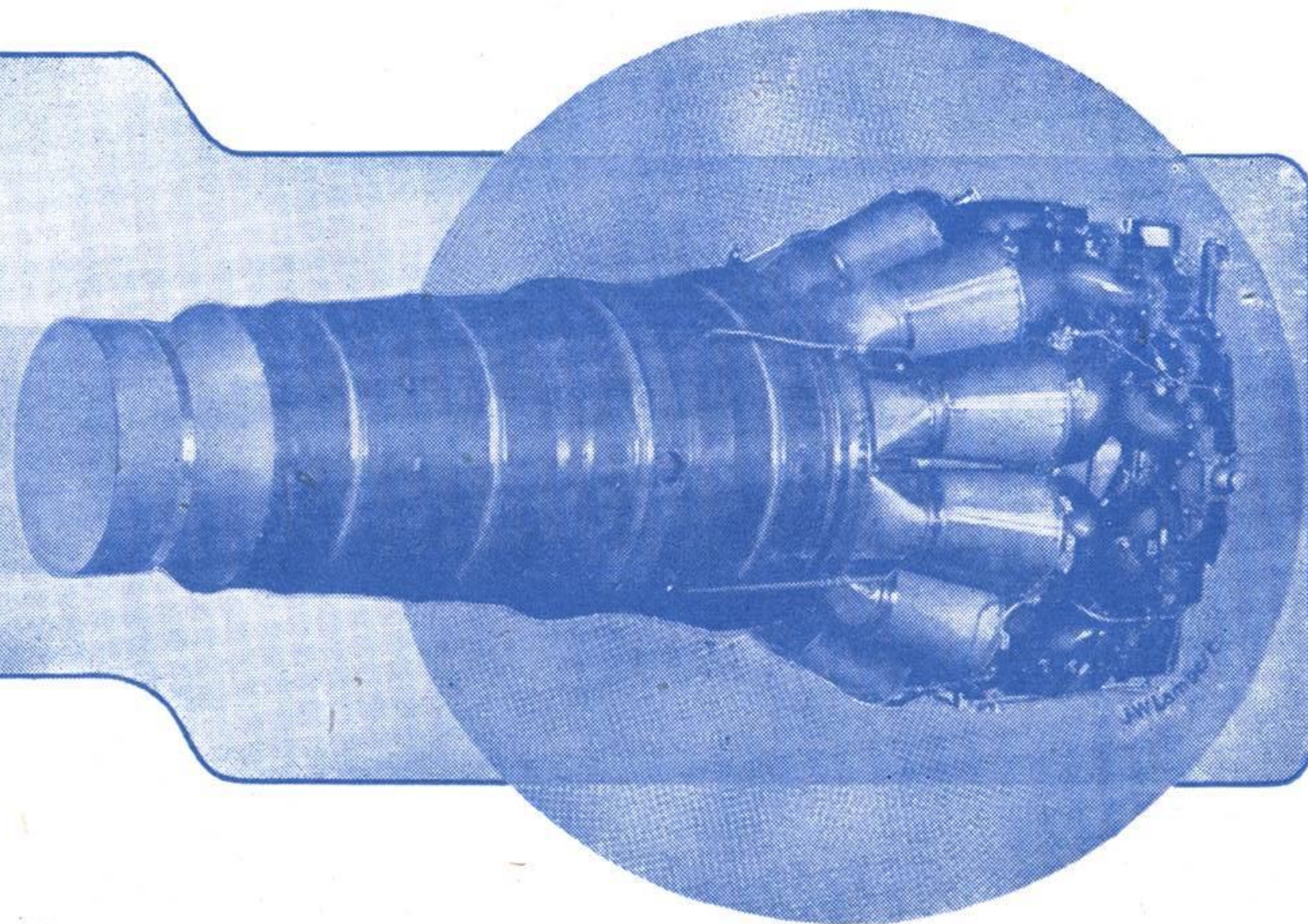
The Short Sunderland Mk. V, seen in the large illustration above, is the latest Short military flying-boat to go into service. Developed from the Mk. III, to which it bears close resemblance, it is fitted with four Pratt and Whitney R-1830 Twin Wasp radial motors, the cowlings and spinners of which are slightly different from the Bristol radials of the earlier Sunderlands, as are the exhaust tail-pipes.

There are a number of other types of Short flying-boats with which there is a tendency to confuse the Sunderlands and together they provide a fruitful field of faulty recognition. A special study of their differences is called for, and, with this in view, we have reproduced pictures of the most important ones now flying. Most of the differences between them are in the hull form with some modifications to fins and rudders.

We have therefore included, along the top and bottom, a line-up of side-view silhouettes. These are in the same numerical order as the small pictures, reading left to right.

If you can identify them all correctly first time you are just the type we like to meet. And so that you will get the maximum value out of this lesson, we have put the answers on the back page.

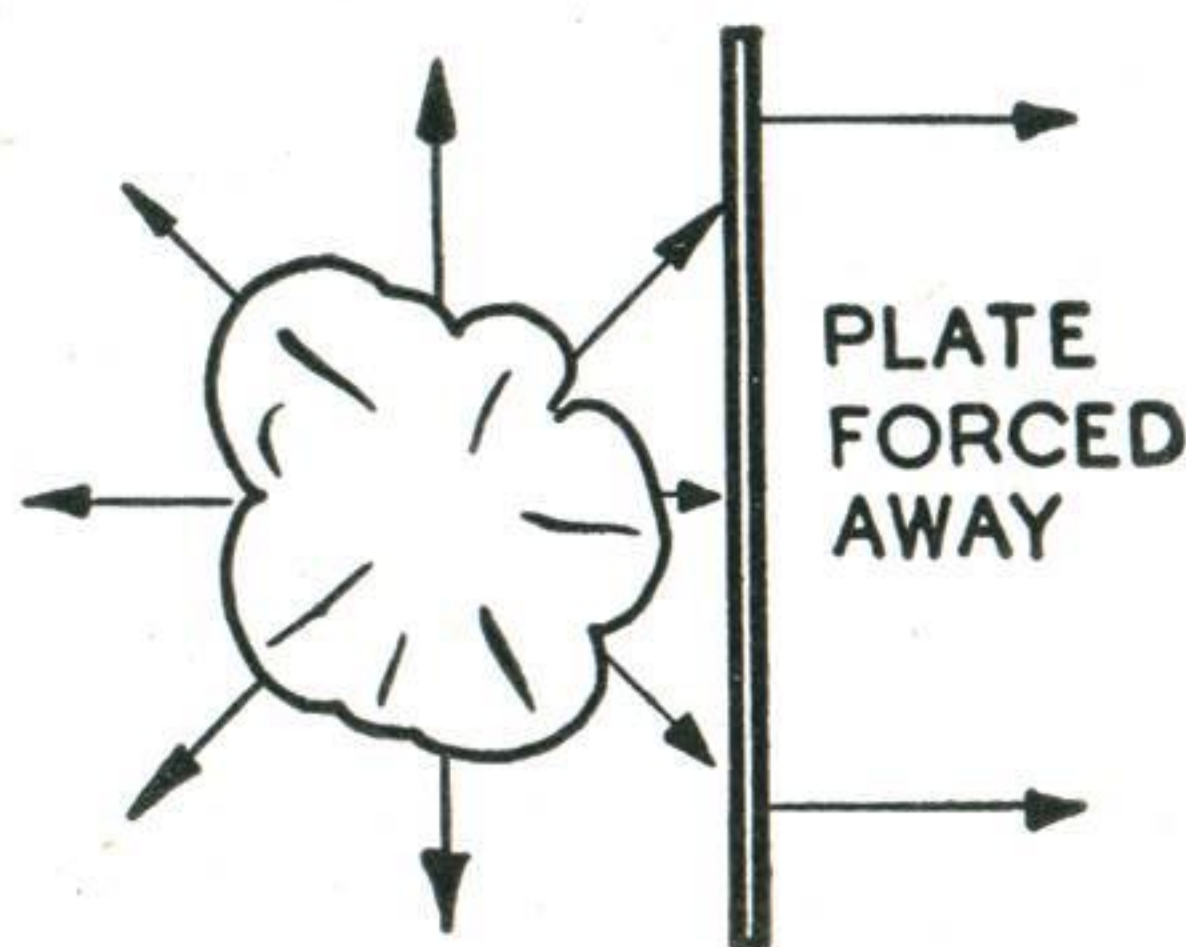
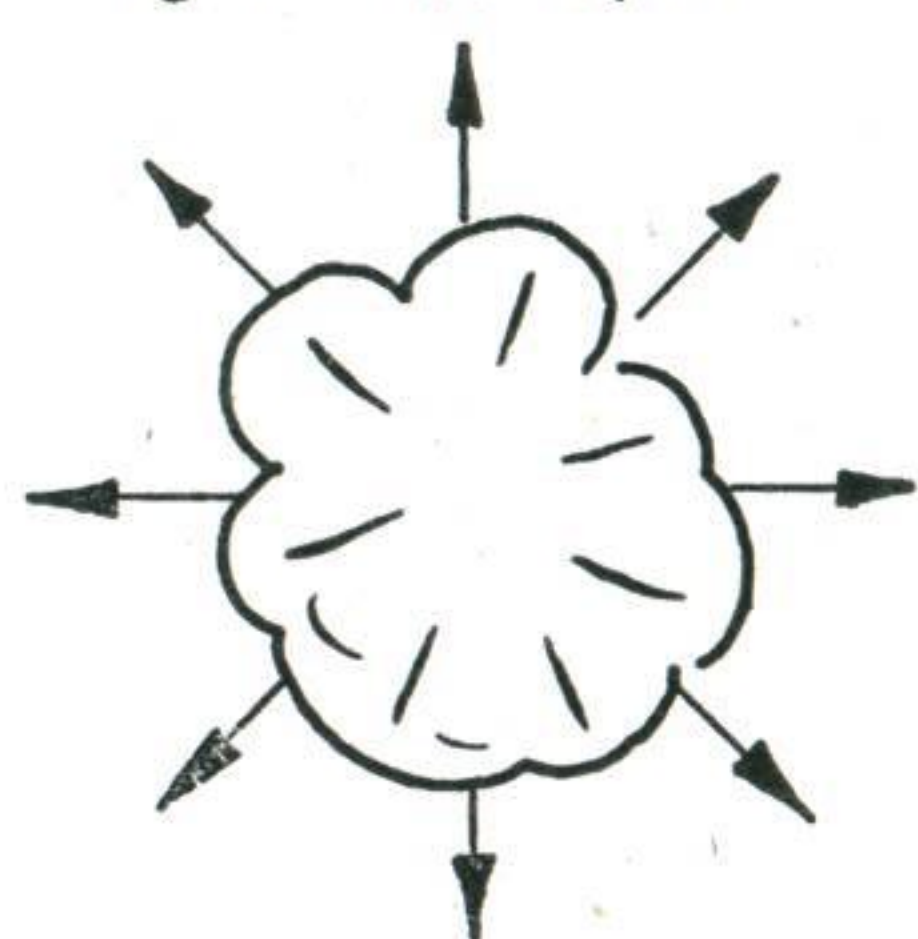
Principles of JET PROPULSION



IF you make an explosion in mid-air, the force of the explosion disperses in all directions. Suppose you hold a piece of cardboard to one side of such an explosion; it will be pushed away by its force (Fig. 1). By confining the explosion further, for example producing it within a tube which has one end sealed, you will find the tube propelled one way, the expanding gases from explosion the other (Fig. 2). This is the reaction-propulsion principle. You get exactly the same idea if you blow up a rubber balloon and suddenly release it from your hand, the resultant jet-reaction drives it through the air.

By contriving to get continuous thrust from the tube by means of a series of explosions producing a continuous reaction, and, at the same time by means of wings and stabilising surfaces, controlling the flight of the tube, you will have in effect a jet-propelled aeroplane (Fig. 3). That, in a nut-shell, is the jet

Fig. 1. The explosion



aeroplane principle. It is the continuous reaction upon the tube, or combustion "can" or chamber, of the jet engine that produces motion in the opposite direction. It has nothing whatever to do with the jet pushing against the atmosphere which it meets in its rearward rush out of the jet-pipe.

The Fuel

Jet aeroplanes do not use an explosive charge to get their reactions, they usually use paraffin and air, which are burned together. You stick scoops on your aeroplane to collect the air as it goes along. To increase the power of the jet, you can have several combustion tubes arranged in a bank with their

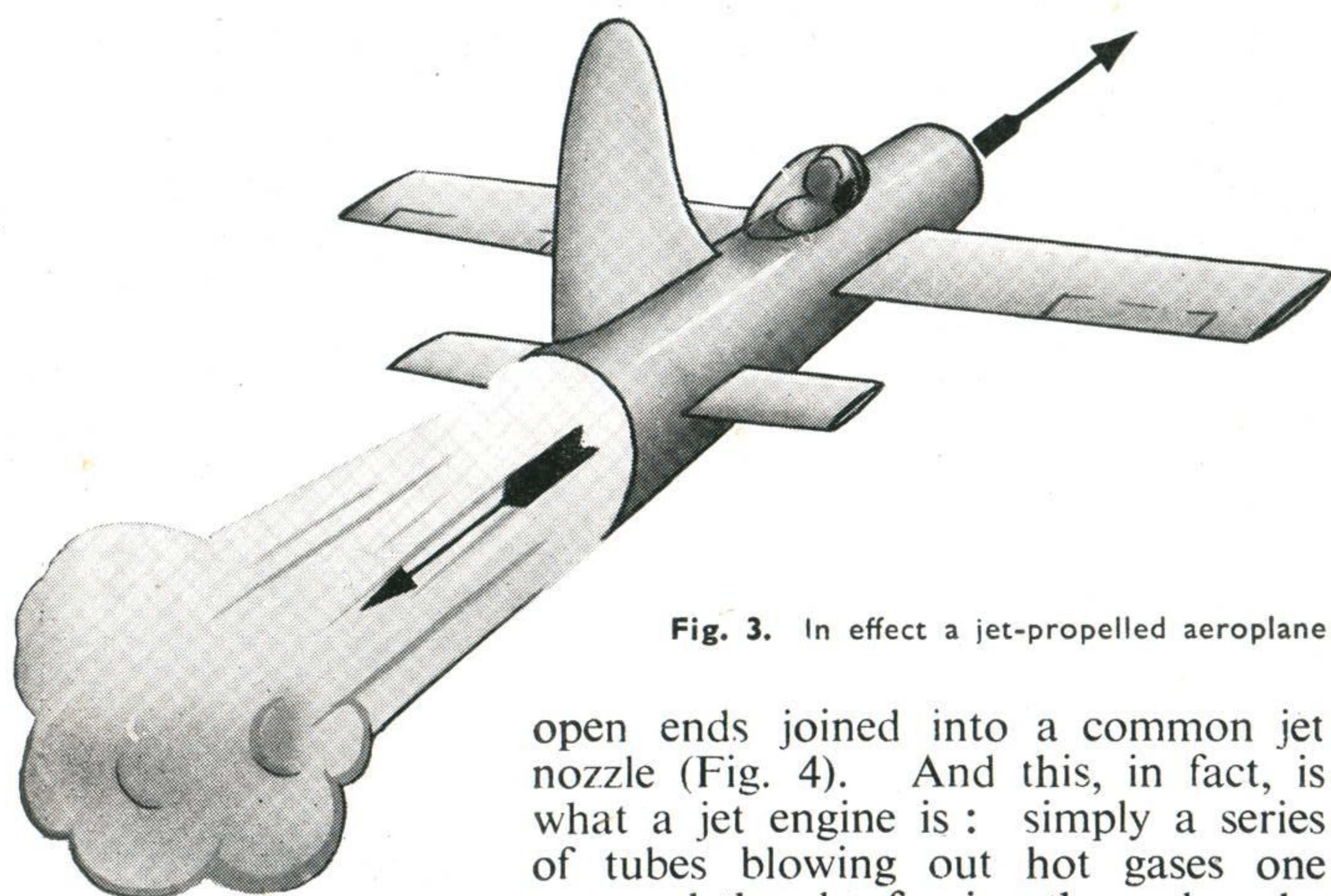
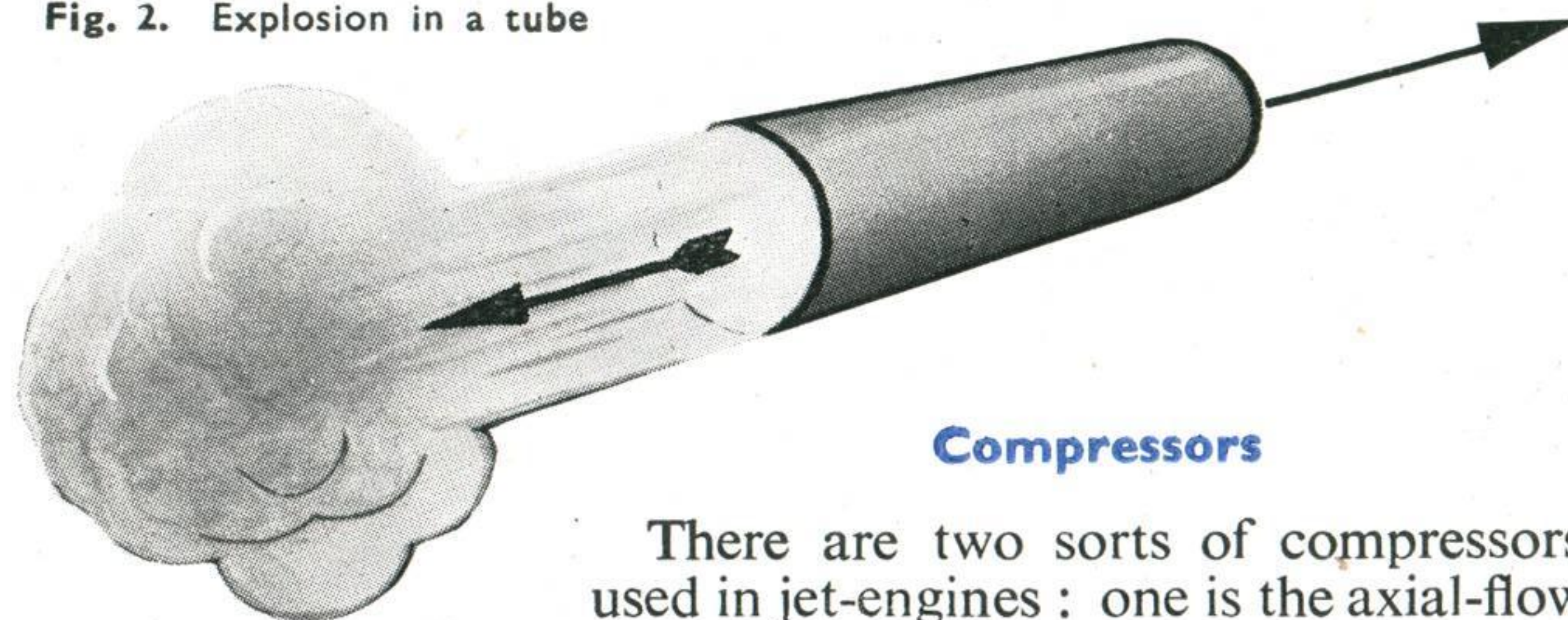


Fig. 3. In effect a jet-propelled aeroplane

open ends joined into a common jet nozzle (Fig. 4). And this, in fact, is what a jet engine is: simply a series of tubes blowing out hot gases one way and thereby forcing themselves by reaction in the opposite direction.

If you wish further to increase the thrust by giving up some of the power already generated and using it to force more air into the combustion chamber, you can do so by putting a turbine wheel (it's just a fan) into the jet stream before it leaves the nozzle (Figs. 5, 7 and 10). By connecting it with a shaft to a compressor (which is just another sort of fan) you can compress the air which comes in at the intakes and feed it into the combustion chambers, together with more paraffin, at a much higher pressure and so increase your previous thrust.

Fig. 2. Explosion in a tube



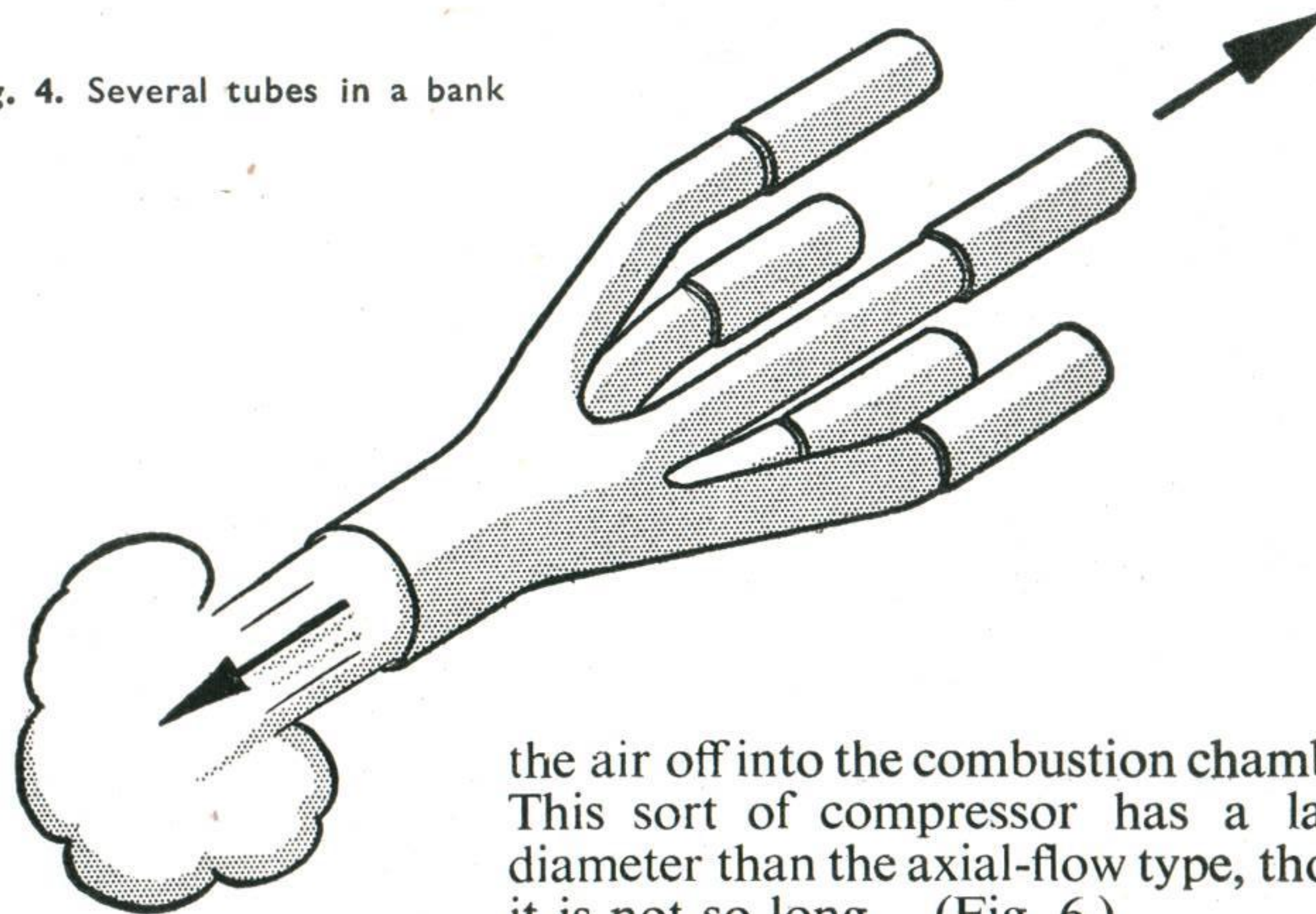
Compressors

There are two sorts of compressors used in jet-engines: one is the axial-flow type, and the other the centrifugal type. In our diagram we show an axial-flow compressor simplified into a row of fans of different sizes (Fig. 5) in an ever narrowing tunnel. They are all going at a very high speed and driving the air down towards the narrow end, where it gets very "depressed" indeed. The air, coming in at the big end is going very fast, but when it gets to the other end its speed is much less, but its pressure is much greater. It is being compressed into a very small space. This high pressure air then suddenly expands into the combustion chambers, mixes with the atomized fuel and burns. We shall discuss ignition means later.

The beauty of the axial-flow compressor is that it provides a very slim overall body form, and, as you know, aeroplanes want slim overall forms.

The centrifugal compressor is another sort of fan, but in this case its function is to fling the air, with great force, outwards against the side of its casing, rather like one would be flung off a giant wheel at the fair, if it went fast enough. Round the casing there are a number of pipes, or volutes as they are called, leading

Fig. 4. Several tubes in a bank

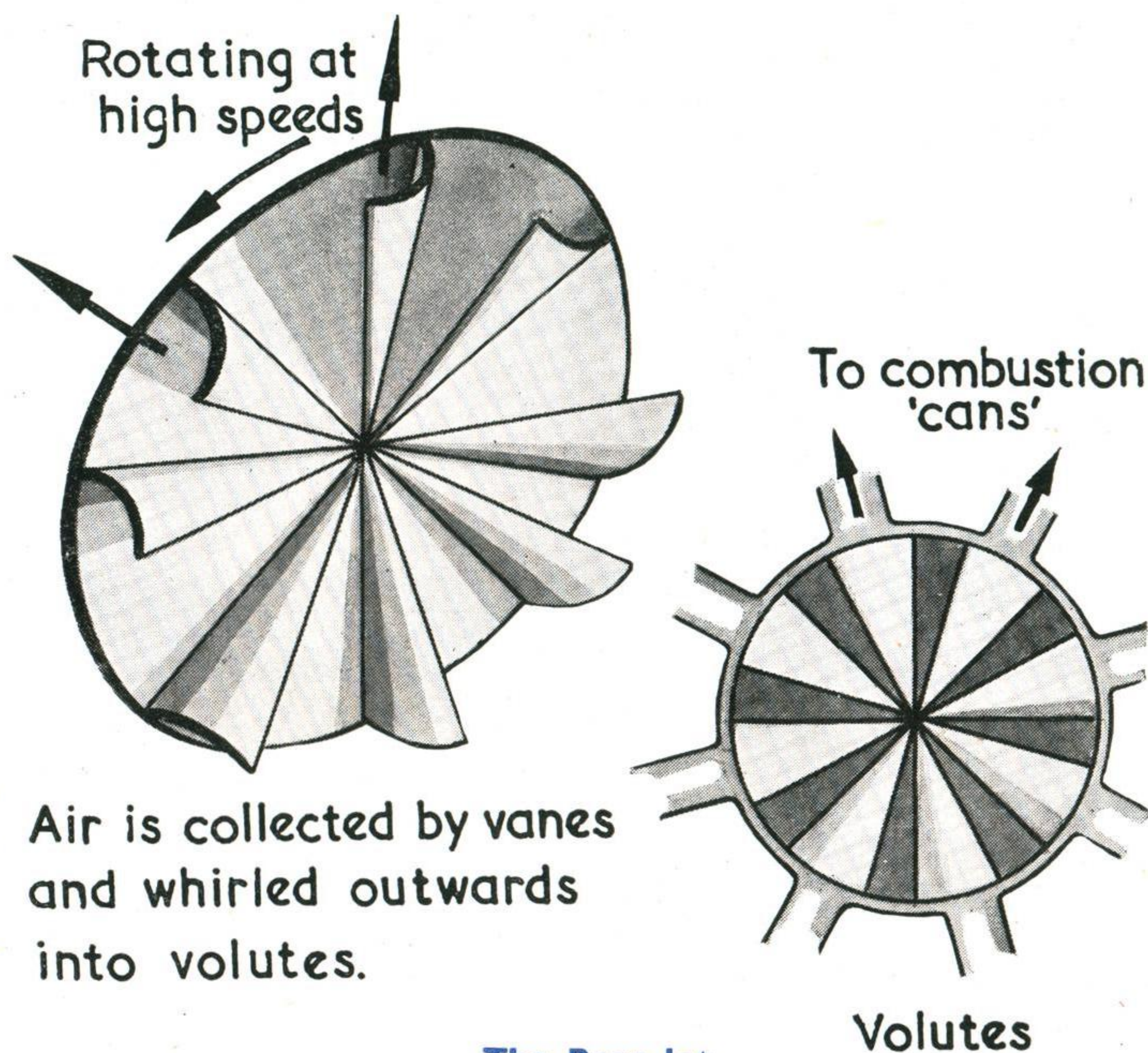


the air off into the combustion chambers. This sort of compressor has a larger diameter than the axial-flow type, though it is not so long. (Fig. 6.)

Combustion Chambers

When the air and fuel, at high pressure, meet in the combustion chamber they burn together very fiercely and continuously, producing large quantities of very hot, rapidly expanding, gases and thus build up even greater pressure. Since there is only one way out of this "torture" chamber, the gases in their haste to escape, take a hearty kick at the combustion chamber, thus pushing it away from them as they force a way down the tube through the turbine wheel to the jet orifice and out into the open air. The gases go one way, the engine goes the other. Most of the work of propelling the aircraft is done in the combustion chamber by the hot expanding gases. This must be clearly understood. The jet of gases leaving the jet orifice has already done its work and it is, regrettably, of no further use to man nor beast once it reaches the open air, except, perhaps, to clear snow drifts.

Fig. 6. The centrifugal compressor (principles)



The Prop-Jet

There is an enormous waste of energy by the "slip" of the jet efflux at low forward speeds of aircraft, and it is this fact that makes the jet-engine so inefficient. Its maximum efficiency is reached at high altitudes where rarified air provides little resistance and permits high speed passage of the aeroplane, and, at the same time, enables the jet-engine to gather sufficient weight of air to keep itself going.

At a low altitude the jet engine is wasteful, for there is more than enough air for it to swallow, and the speed of the aeroplane is held back by the relative thickness of the air, that is by drag. This results in a high speed jet for a low forward speed to the aircraft. Generally speaking the jet-engine is most efficient when the aircraft's forward speed is half the speed of the jet stream. Say, 500 m.p.h. air speed for a 1,000 m.p.h. jet stream.

Fig. 7. The prop-jet

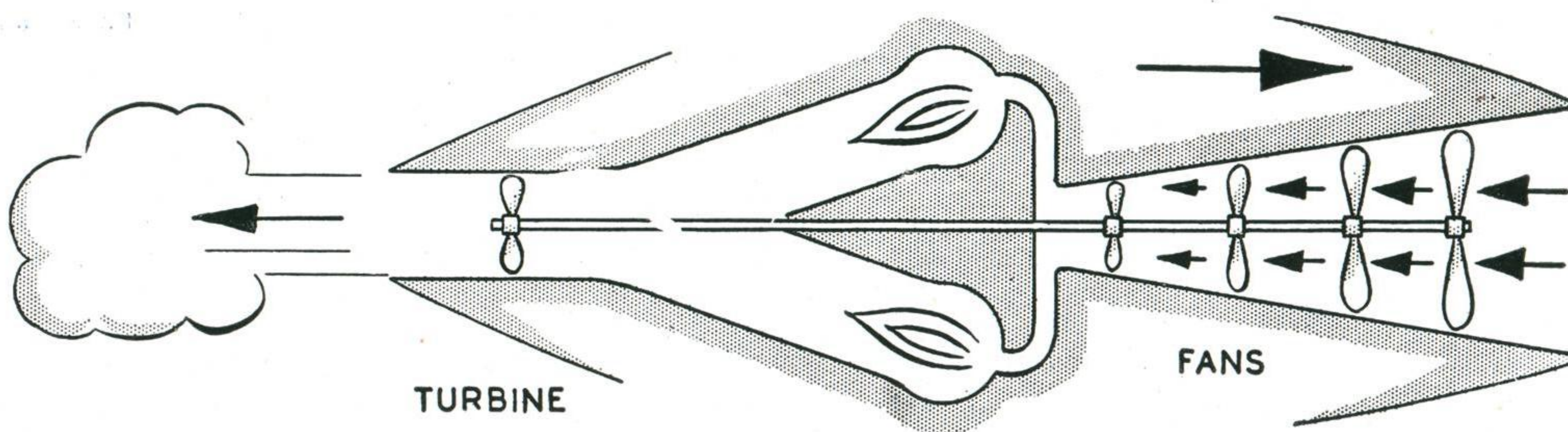
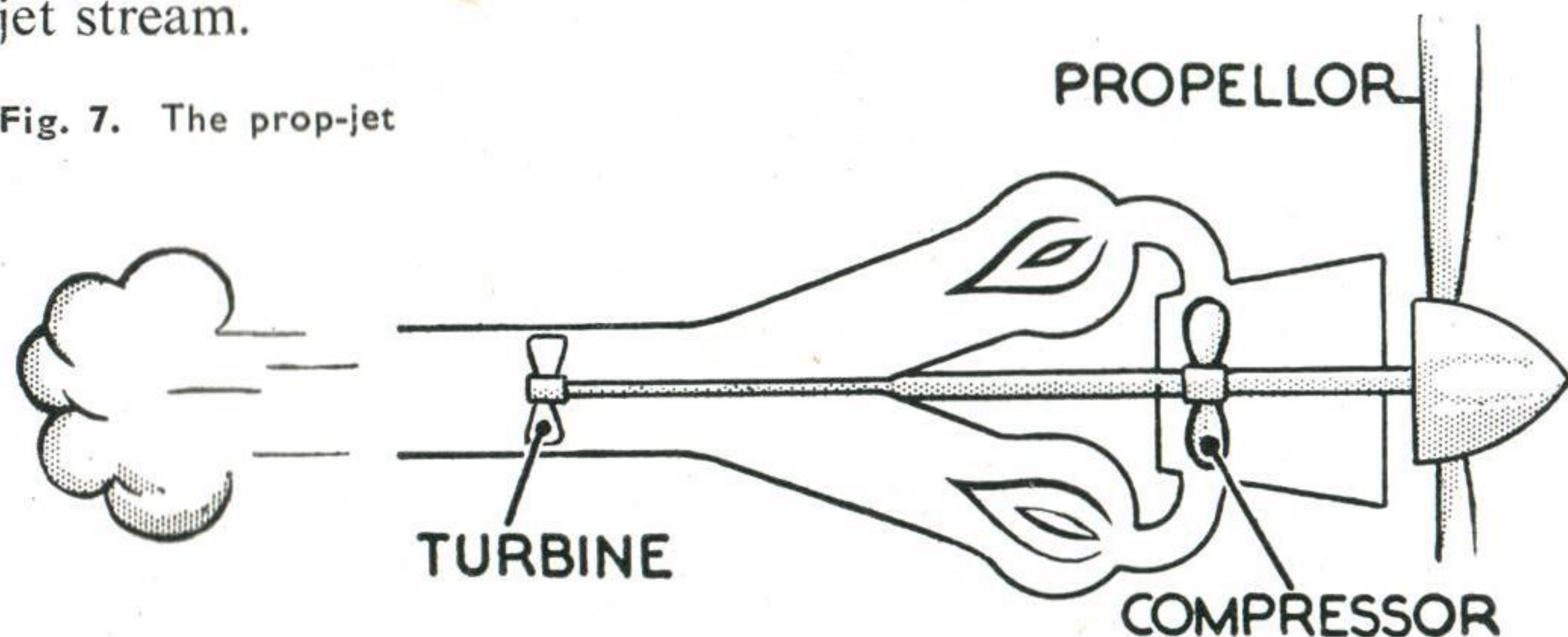


Fig. 5. The axial-flow compressor (principles)

The propeller, on the other hand, works best in the relatively thick atmosphere of low altitude. The higher the propeller is taken the less efficient it becomes, until at extreme altitudes there is not enough air on which it can grip and the engine turns over at high speed, uses a lot of fuel and gets nowhere.

Thus, with propeller efficiency greatest at low altitudes, jet efficiency greatest at high altitudes, to get the best of both worlds the prop-jet, at least for the present, is the more efficient (Fig. 7). The propeller is mounted on the same shaft as the turbine.

Rockets and Things

An off-shoot, and an important one, of this jet business, is the development of rocket-propulsion. This is another form of reaction propulsion, and the only difference between this form and the jet we have been talking about, is that the rocket does not rely upon the surrounding atmosphere for its oxygen, but carries its own with it. If you can compress your oxygen and fuel together into a solid form, put it inside a tube with one end sealed, fit it with a stabiliser, get it to burn continuously, you have a rocket. The November 5th rocket has a stick as a stabilizer (Fig. 8). The principle of this form of propulsion is exactly the same as for jet-engines. The thrust of the burning rocket fuel reacts upon the combustion chamber and forces it into motion. Since it is not relying upon the atmosphere for its oxygen it can travel through a vacuum. In other words inter-planetary travel is just round the corner, provided the rockets are big enough and the passengers brave enough.

Yet a further extension of the reaction-propulsion principle is seen in the athodyd or ram-jet. The athodyd is really a jet engine without a mechanical compressor (Fig. 9). It consists of a specially shaped tube which has a large opening at the front, and an ever-narrowing tunnel leading to a small aperture, which opens suddenly, into a fairly large combustion chamber. In the combustion chamber is a burner, giving off atomized fuel, and a spark-plug or igniter, as it is called, to start the burning. The combustion chamber extends into a normal jet-tail pipe. To function at all the athodyd must travel very fast so that a tremendous pressure of air can be built up in the intake tube. In fact it won't work much below the speed of sound. Whilst being compressed, the air has generated great heat and, on reaching the combustion chamber, finding itself able to expand, does so. At the same time it mixes with the atomized fuel, is ignited, and burns fiercely, turning into hot, violently expanding, gas. There being no alternative way out, it departs rapidly down

Fig. 9. The athodyd or ram-jet

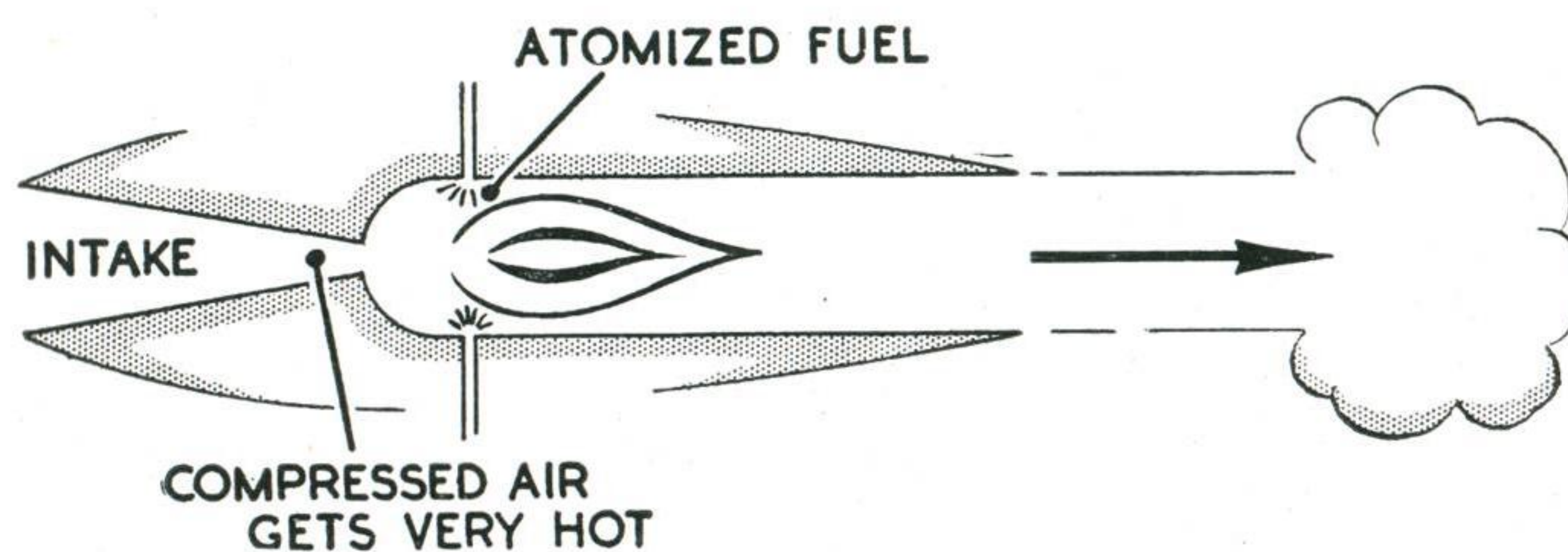


Fig. 8. The rocket

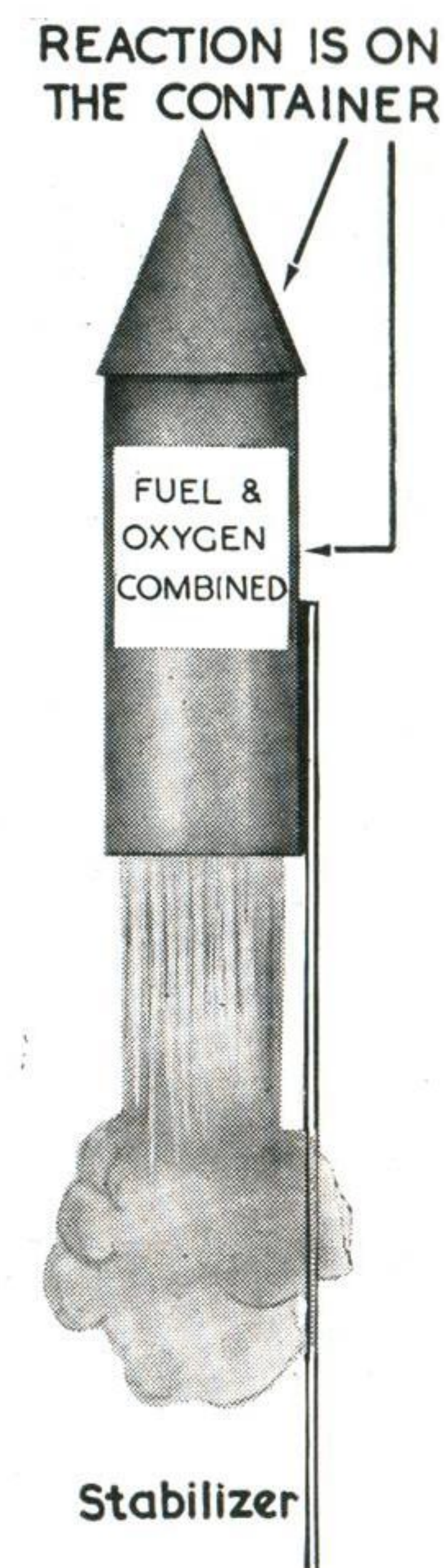
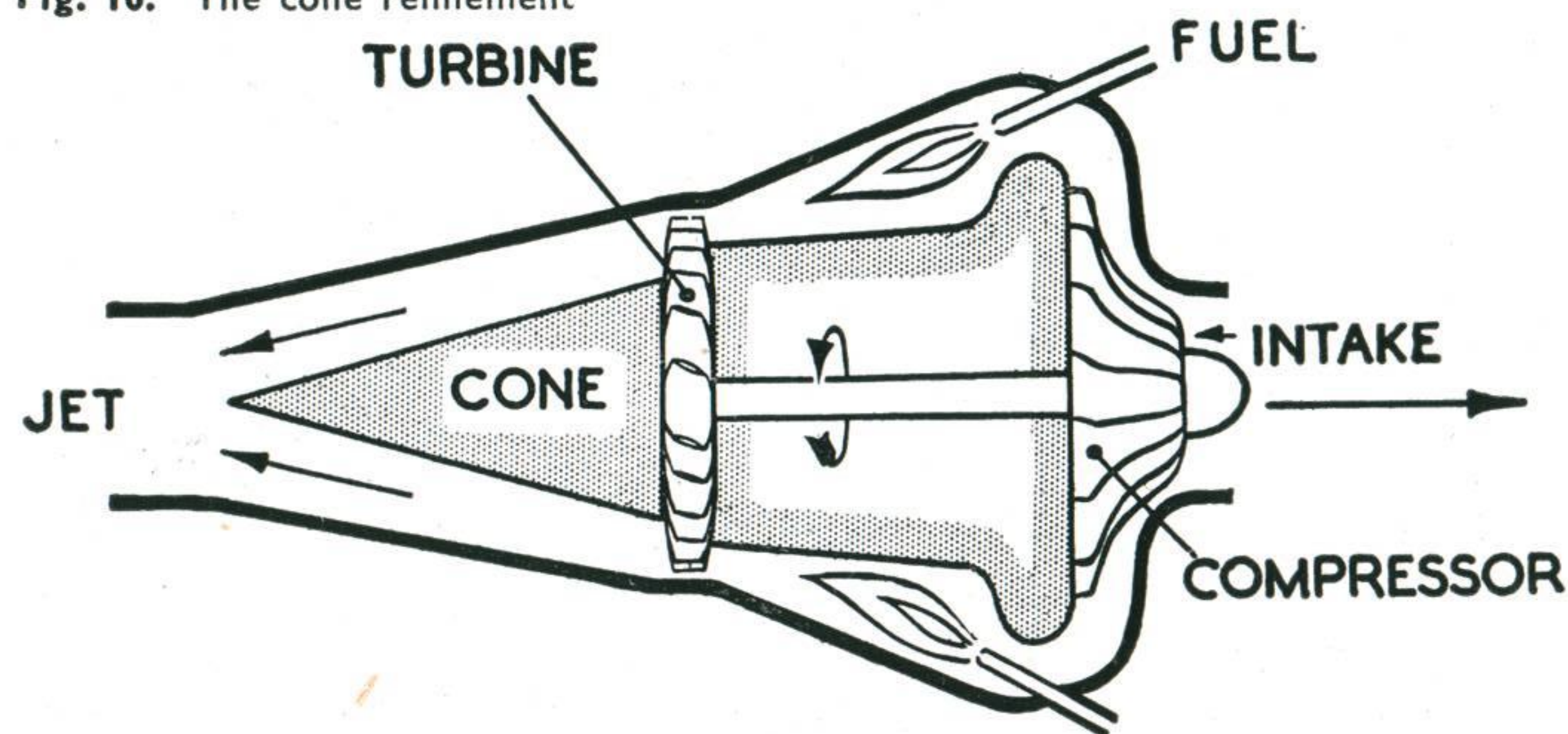


Fig. 10. The cone refinement

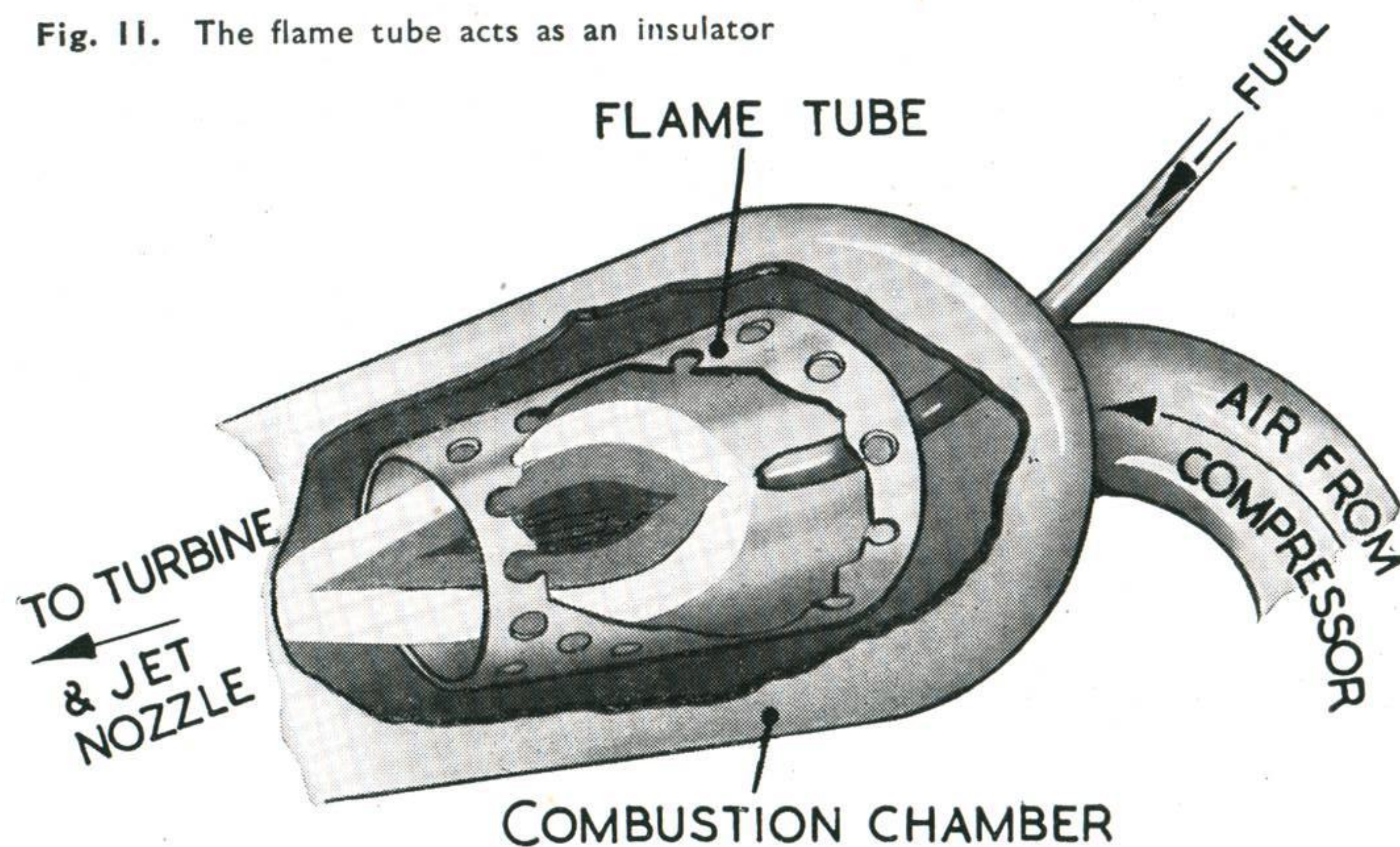


the tube, giving a vicious parting kick at the combustion chamber thus hurling the athodyd in the opposite direction to which it is, itself, racing. Exactly like the released rubber balloon we mentioned. One small point—once the athodyd has reached working speed and has been ignited, it keeps itself burning without the igniter, and so long as the fuel lasts will keep on, keeping on.

Some Technicalities

So far we have discussed the jet principles only. The modern jet engine, however, has a few refinements to improve its efficiency. If you look at (Fig. 10) you will see inside the rear part of the engine, there is a large cone. It is called the tail cone. Having passed the turbine wheel, the hot, racing gases still have great force, and the faster they can be made to go in this part of the jet engine the bigger the departing kick they give. The tail cone is designed to speed up the flow here and also to take this kick. Eject an orange pip from between your thumb and forefinger and you have some idea of what the jet stream does to the tail cone. It can be said, in fact, that the

Fig. 11. The flame tube acts as an insulator



whole of the inside of the jet engine from the combustion chambers to tail pipe takes the strain of the reaction to the racing gases and contributes, its quota, to the forward movement of the engine. The forces imparted are carried by the component structures to a very solid frame between the compressor and the combustion chamber, which frame is rigidly attached to the aeroplane's structure, usually the main spar of the wing.

Ignition

Once the jet engine has been started, that is, once the gases have been ignited, the ignition system is of no further use. There are only two igniters on a De Havilland Goblin engine and these are necessary only to light up. The combustion cans being interconnected the flame spreads to all of them instantly, and when things are well alight the igniters are made to switch themselves off. Inside a combustion can there is a flame-tube, which, as its name implies completely surrounds the flame. The idea is to prevent temperatures from getting too high. The air between the tube and the combustion chamber wall acts as an insulator (See Fig. 11). Even so gas temperatures run very high.

Facts and Figures

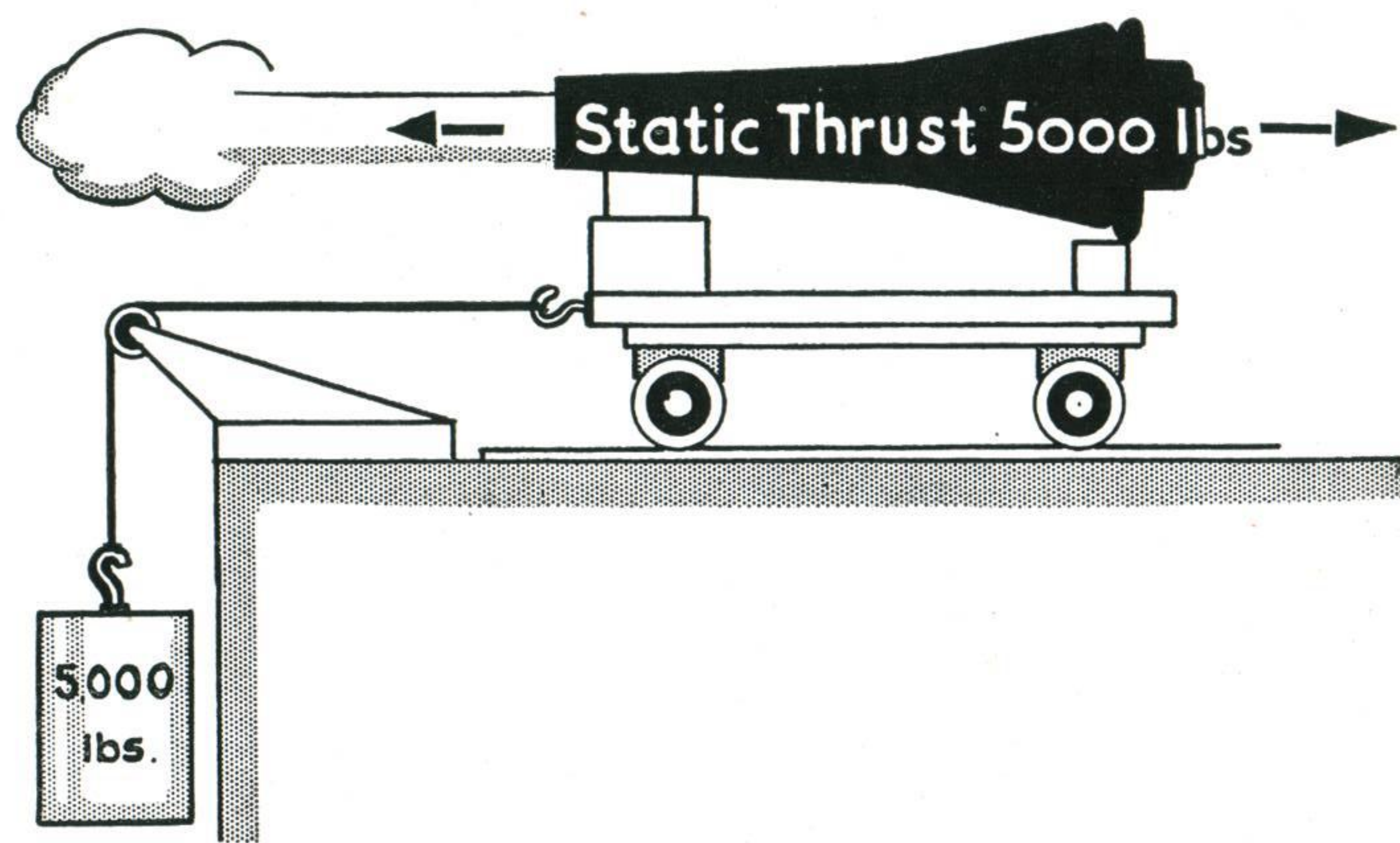
The power of jet-engines is measured in pounds of static thrust. In a broad sense this means that a jet engine of 5,000 lbs. static thrust could support that weight, suspended in a well, and attached to it, by means of a pulley and wheel (Fig. 12).

Very high speeds are reached by turbines and compressors, and 17,000 revolutions per minute are common. At these terrific, almost inconceivable, speeds the tensile stresses on the blades of a turbine reach something like 10 tons per square inch, and blade tips often travel at over 1,000 m.p.h. The turbine of the De Havilland Ghost generates 9,000 shaft h.p.

Jet stream velocities reach speeds of over 1,000 m.p.h., and in athodyds speeds of 3,000 to 4,000 m.p.h. are possible.

Turbine blades have not only to withstand these high speeds, but also very high gas temperatures, which can reach very nearly 1,000 degrees centigrade. For this reason they have to be made very tough and are always very short. The tail cone also serves the purpose of preventing turbulence behind the turbine, in fact, it protects the turbine wheel.

Fig. 12. A broad idea of measuring static thrust

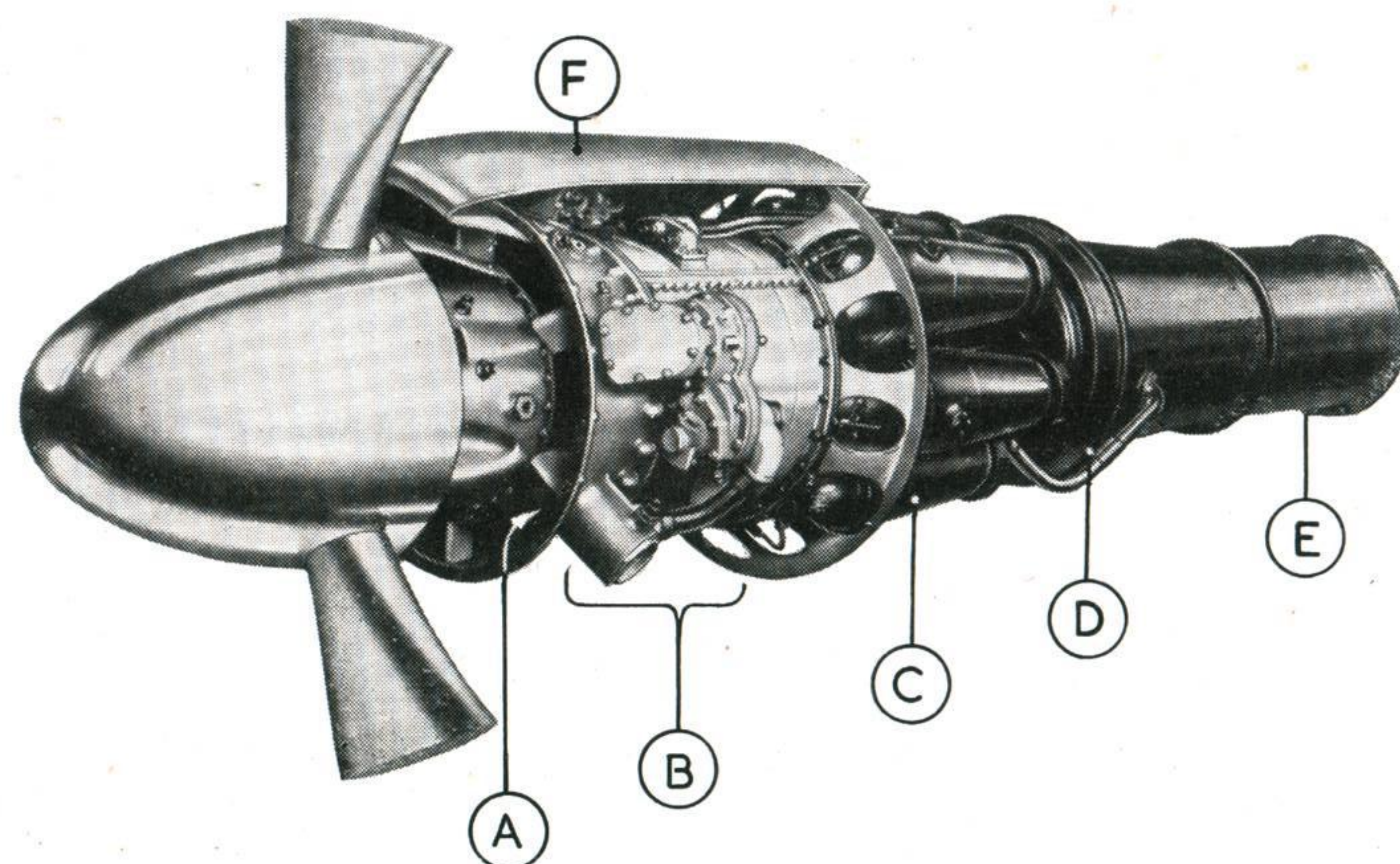


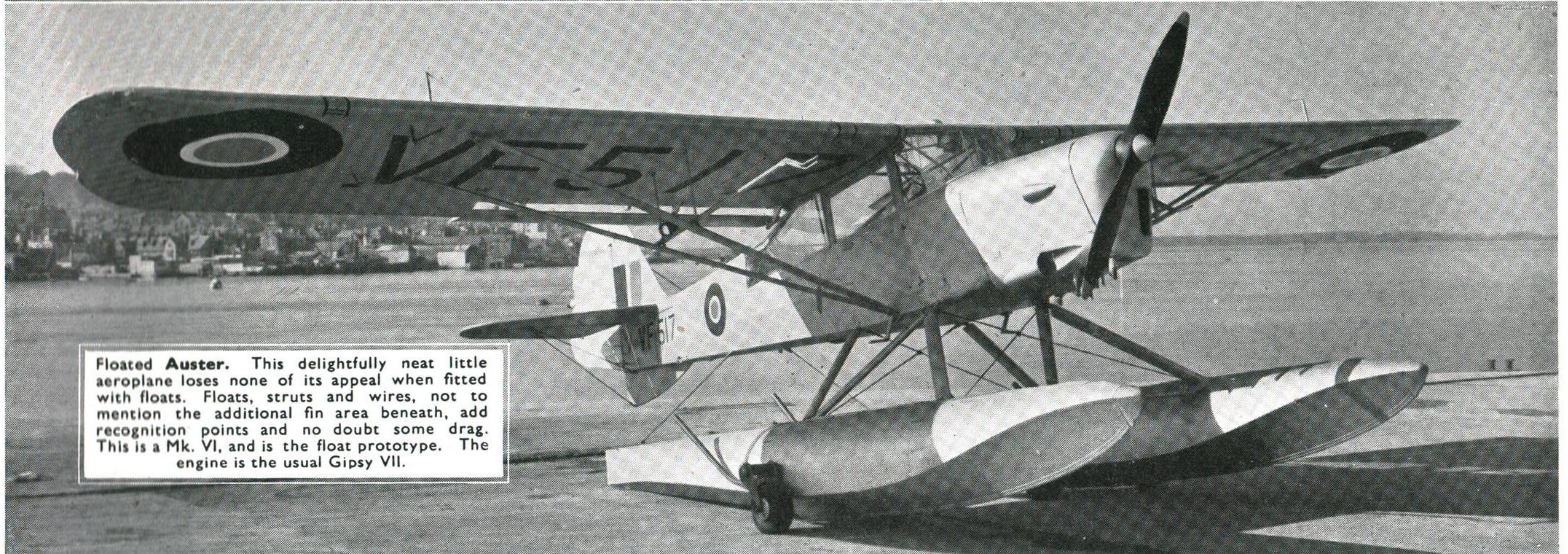
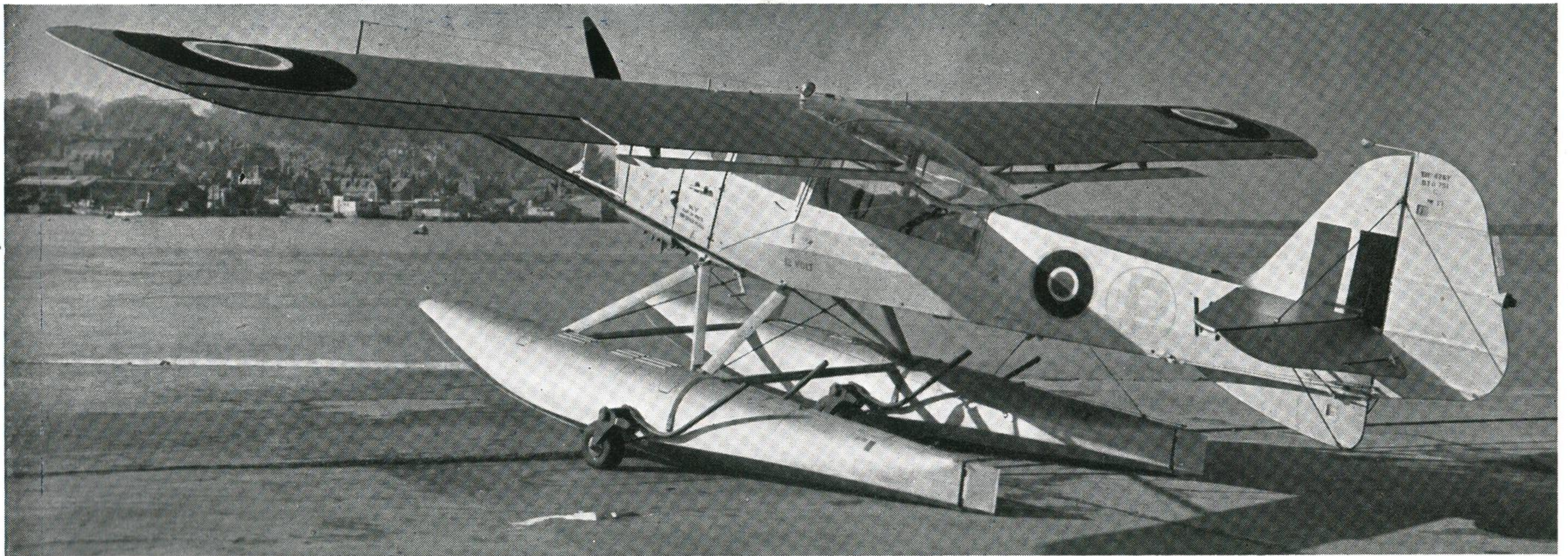
The De Havilland Ghost jet-engine swallows 140 tons of air per hour.

And that very roughly speaking, covers this jet business. Remember, contrary to popular belief, the jet stream does NOT, repeat NOT, produce motion by impinging upon the atmosphere. If this were so, there would have been no V-2's, because the V-2 was able to travel quite well in the rarified atmosphere 70 miles up.

If you were to strap a large lighted, blowlamp to your back, put on a pair of roller skates, and stand in the road say, at Marble Arch, you should, in theory, be able to make some jet-propelled progress up the Edgware road. At least until lead gently but firmly away by a kindly policeman.—C.E.S.

The Prop-Jet. The Armstrong Siddely Mamba Prop-Jet power unit, partly uncovered. A intake. B axial flow compressor. C combustion chambers. D turbine. E jet-pipe. F cowl.

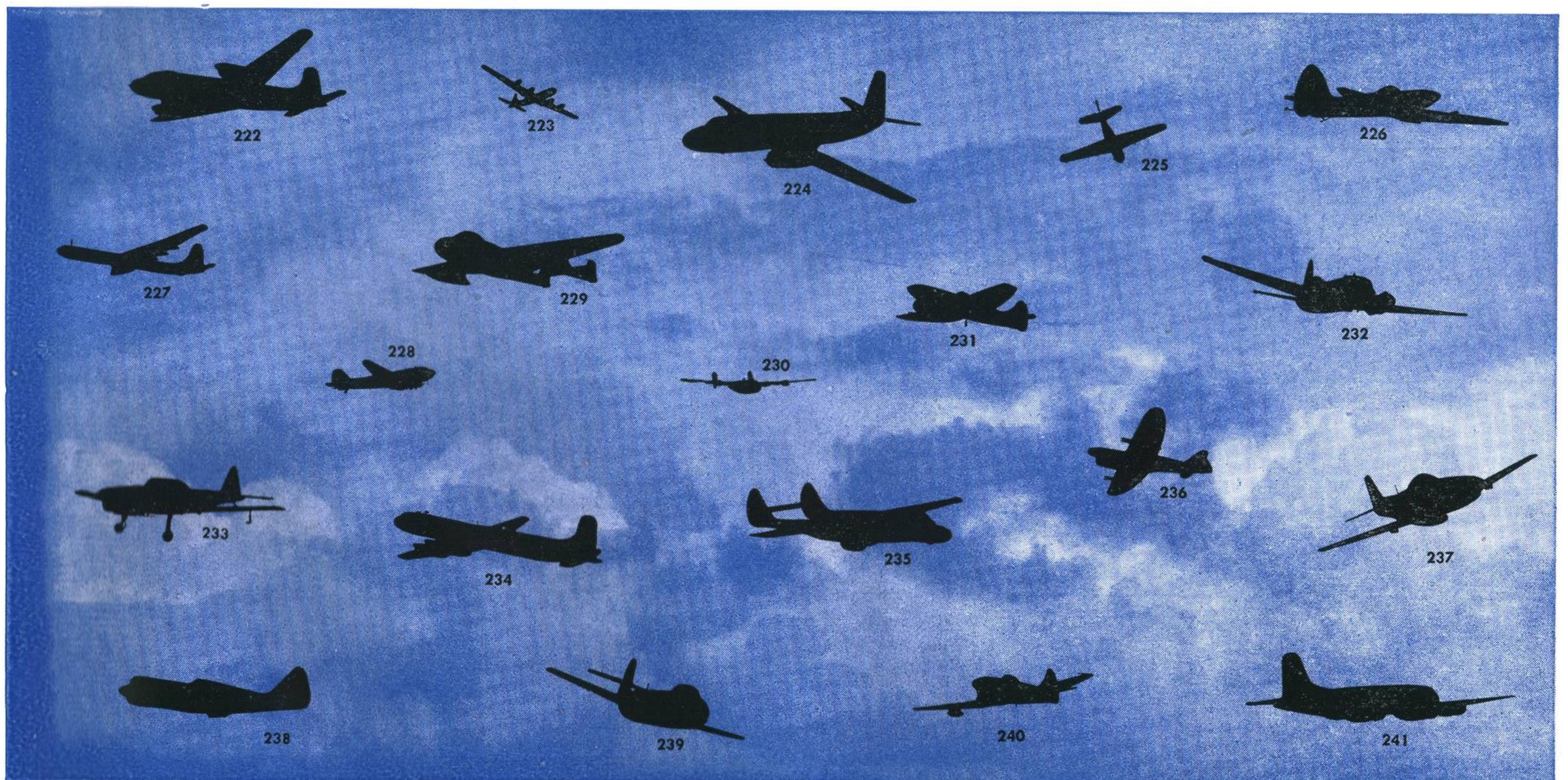




Floated Auster. This delightfully neat little aeroplane loses none of its appeal when fitted with floats. Floats, struts and wires, not to mention the additional fin area beneath, add recognition points and no doubt some drag. This is a Mk. VI, and is the float prototype. The engine is the usual Gipsy VII.

SILLOGRAPHS

Recognition Test No. 36

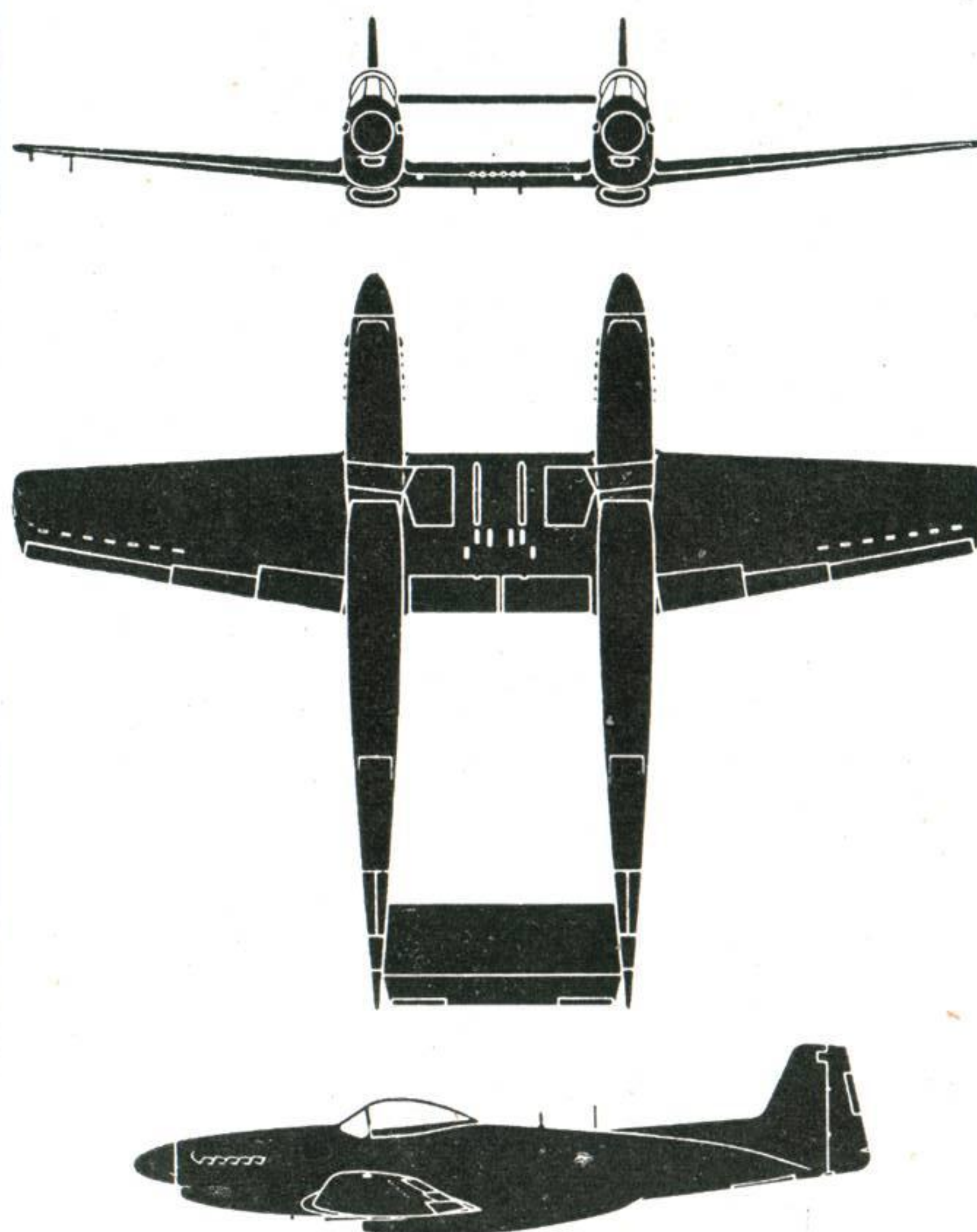


CONSOLIDATED XB-36



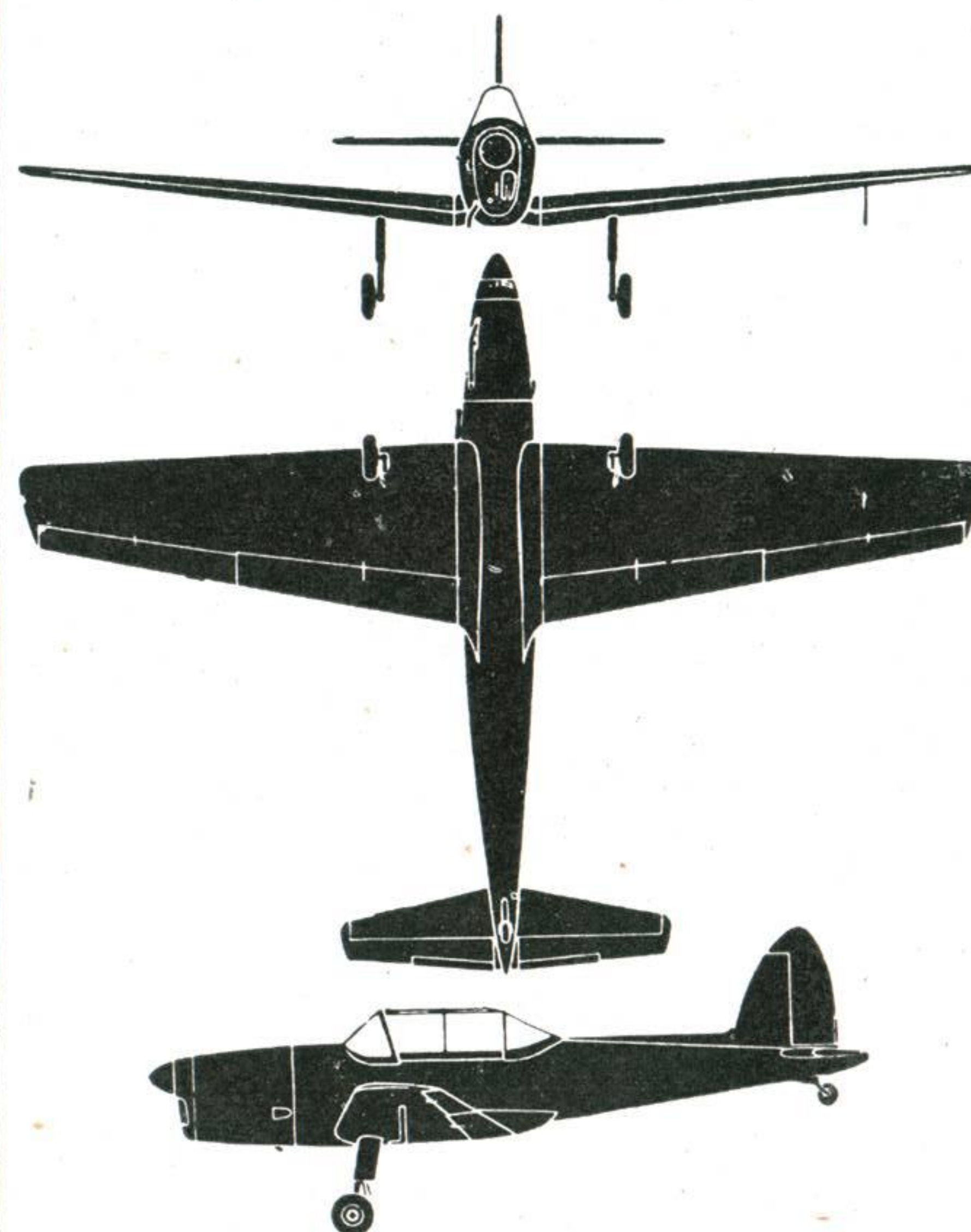
American Heavy Bomber
6 Wasp Major Radials Span 230 ft. 0 ins.
New Silhouette

NORTH AMERICAN P-82 TWIN MUSTANG



American Fighter
2 Packard Merlins Span 51 ft. 3 ins.
New Silhouette

DE HAVILLAND CHIPMUNK



British Trainer
1 Gipsy Major Span 34 ft. 4 ins.
New Silhouette

SOLUTIONS TO RECOGNITION TESTS IN THIS ISSUE :

FRONT COVER : Sea Fury X

No. 34 (ELEMENTARY SPOTTING)

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|----------------------|--------------------|
| 181. Sandringham | 190. LA-5 |
| 182. Storch (Fi 156) | 191. Buckmaster |
| 183. Tempest II | 192. Lancaster VII |
| 184. Avro XIX | 193. Lancastrian |
| 185. Lincoln I | 194. Tudor II |
| 186. Meteor III | 195. Sunderland V |
| 187. Lancaster VII | 196. Junkers Ju 52 |
| 188. Tempest VI | 197. Tempest V |
| 189. Auster VI | 198. Autocrat |

No. 35 (ADVANCED SPOTTING)

- | | |
|---------------------------|-------------------------|
| 222. Catalina | 235. Meteor IV |
| 223. Firefly I | 236. Wellington |
| 224. Halifax and Hamilcar | 237. Mariner PBM-5 |
| 225. Beaufighter X | 238. Junkers Ju 52 |
| 226. Mosquito VI | 239. Consolidated XB-36 |
| 227. Firebrand IV | 240. Lancastrian |
| 228. Fireball FR-I | 241. Sunderland V |
| 229. Expeditor | 242. Harvard II |
| 230. Dakota | 243. TU-2 |
| 231. Argus | 244. Seafire 47 |
| 232. Sea Fury X | 245. Hythe |
| 233. Anson | 246. AD-1 Skyraider |
| 234. Wayfarer | |

No. 36 (SILLOGRAPHS)

- | | |
|----------------------|--------------------|
| 222. DC-4M | 232. Viking |
| 223. B-29 Superfort | 233. Chipmunk |
| 224. Martin 202 | 234. Tudor II |
| 225. Helldiver | 235. F-15 Reporter |
| 226. Seafire 47 | 236. Firefly I |
| 227. XB-36 | 237. P-51H |
| 228. Dakota | 238. LA-7 |
| 229. Vampire | 239. XF6U-I |
| 230. Liberator | 240. Tempest VI |
| 231. Tempest V or VI | 241. Hastings |

SHORT SELECTION (centre-spread).

1 "C" class of Empire boat. 2 "G" class. 3 "Hythe."
4 "Sandringham." 5 Seaford I. 6 Solent. 7 Shet-
land I (military). 8 Shetland II (civil).

RECCABSURDITY

De Havilland Sea Hornet

No. 2

